Food Quality and Preference 126 (2025) 105431

Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Do you remember? Consumer reactions to health-related information on snacks in repeated exposure

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ARTICLE INFO

Keywords:
Nutrition claim
Repeated exposure
Product liking
Implicit reactions
Eye-tracking
EEG

ABSTRACT

Health-related information on pre-packed food products can enhance purchase intention and healthy choices. However, retained positive influence of health-related information on product liking is necessary to help consumers make informed decisions about a healthy diet in the long term. According to information-reduction theory, consumers reduce the amount of information that is processed in repeated exposure. Hence, increasing familiarity with a product could lead to increased levels of ignoring health-related information and an increasing reliance on product experience-based associations.

These effects were tested in a laboratory study, involving actual food tasting and repeated exposure across two sessions. Participants ($N = 154$) were invited to evaluate yoghurts with and without health-related information with a screen representation of the product packaging. Differences in product evaluations and attention paid to health-related information between the two sessions were recorded using both implicit and explicit methods.

Findings reveal that, despite a decrease in visual attention to health-related information, the perceived healthiness of the products remained stable. However, consumers reported lower perceived tastiness when health-related information was present. The findings underscore the importance of compelling taste experiences, as taste beliefs, in contrast to health beliefs, consistently influenced product liking. Finally, the findings emphasised the need for a comprehensive understanding of consumer reactions to healthier food products that considers both implicit and explicit responses.

1. Introduction

Adding health-related information to food products can lead to increased purchase intention and healthier choices (Ballco & Gracia, 2022; Giezenaar et al., 2024; Kaur et al., 2017; Meijer et al., 2022; Steinhauser & Hamm, 2018). Hence, health-related information serves as a communication tool on pre-packaged food products, potentially encouraging consumers to make healthy food choices (Cadario & Chandon, 2019, 2020; Vecchio & Cavallo, 2019).

Retained attention to health-related information over repeated exposure would help consumers make informed decisions about their diet continuously. The information-reduction hypothesis (Haider & Frensch, 1996) proposes learned selectivity in information processing, implying that individuals allocate attentional resources only to task-relevant information during repeated exposure. This research argues that, in the context of healthy food products, consumers may exhibit a reduction in attention to health-related information over time, as they become more selective in processing information. Specifically, other factors such as the taste of the product might become more relevant for consumers in their food choice (Mai & Hoffmann, 2015; Tijssen et al., 2019; Zellner et al., 2018). Only a few studies have examined consumer reactions to health-related information in repeated exposure (Asbridge et al., 2021; De Wijk et al., 2019; Tijssen et al., 2019). The aim of this research was to examine the extent to which consumers reduce their attention to health-related information, remember the information without visually attending to it again, and incorporate the information into future product evaluations. A study was conducted where participants were exposed to a product and health information twice in consecutive weeks, and their reactions to product packaging as well as actual taste were analysed. A conceptual model can be found in Fig. 1.

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https://doi.org/10.1016/j.foodqual.2025.105431
Received 25 August 2024; Received in revised form 11 December 2024; Accepted 8 January 2025
Available online 11 January 2025

2. Conceptual background

2.1. Information-reduction hypothesis: The effect of selective attention to health-related information on food products in repeated exposure

The information-reduction hypothesis (Haider & Frensch, 1996) explains how consumers reduce the amount of information that is processed in repeated exposures. Specifically, the theory describes how individuals learn to distinguish task-relevant and –irrelevant information when repeating a task several times, increasing the speed and quality of performance and reducing cognitive load associated with irrelevant details. As a result, attentional resources are selectively allocated to focus on information that is essential for task execution, while non-essential information is processed to a lesser extent or ignored. Non-essential information, even if remembered from past exposures, experiences a reduction in attention because it is considered less critical or relevant to the current task or stimuli.

Analysing visual attention directed toward task-relevant information in their eye-tracking study, (Haider & Frensch, 1999) utilise the terms "perceptual level" and "conceptual level" to refer to different stages of information processing during the learning of a task. The perceptual level involves early pattern recognition processes, while the conceptual level involves higher-level cognitive understanding and interpretation of the task. Once individuals have recognised patterns at the perceptual level, they move on to interpreting and understanding the underlying concepts and principles of the task. This stage goes beyond simple recognition and involves forming a conceptual framework to guide task performance. Their results suggested that expertise is associated with a more efficient allocation of attention at both these levels during task performance.

This research proposes that information-reduction processes can occur in the context of food-related consumer behaviour. For example, choosing a food product based on previous experiences can be a way to reduce the amount of cognitive effort required for decision-making. Consumers might change their visual attention to elements of the package design in repeated exposure, focussing less on those they already know, reducing cognitive load by not processing them again while choosing a food product.

Thus, it is hypothesised that repeated exposure to a food product reduces visual attention to health-related information that is provided on the product package. This is attributed to the expectation that individuals, having remembered such information from previous exposures, view health-related information on food products as less task-relevant for evaluating their product liking during repeated exposures.

Hypothesis 1a. Visual attention to health-related information decreases in repeated exposure.

While the primary focus of the information-reduction theory (Haider & Frensch, 1996) is on improving performance by reducing the cognitive load associated with task-irrelevant details, it does not necessarily imply that task-irrelevant information will be forgotten. Instead, the emphasis is on minimising the impact of such information on cognitive load. Thus, health-related information could be remembered and influence product evaluations consistently without the need to pay attention to the information again (Haider & Frensch, 1996, 1999). Previous research in the food literature suggests that information on the product package has a lasting effect and influences product perceptions even after tasting (Cardello, 2007; Tijssen et al., 2019). Thus, it was hypothesised that:

Hypothesis 1b. Perceived healthiness of the food product remains stable, even if visual attention to health-related information decreases.

2.2. Inferences: The effect of inferences on consumer reactions toward health-related information on food products

The literature on food-related consumer behaviour has identified inferences between attributes mentioned on food labels, most notably healthiness and tastiness (Berry & Romero, 2021; Peschel et al., 2019; Stancu et al., 2017, 2021; Togawa et al., 2019). These inference effects between health and taste in food products can be both positive and

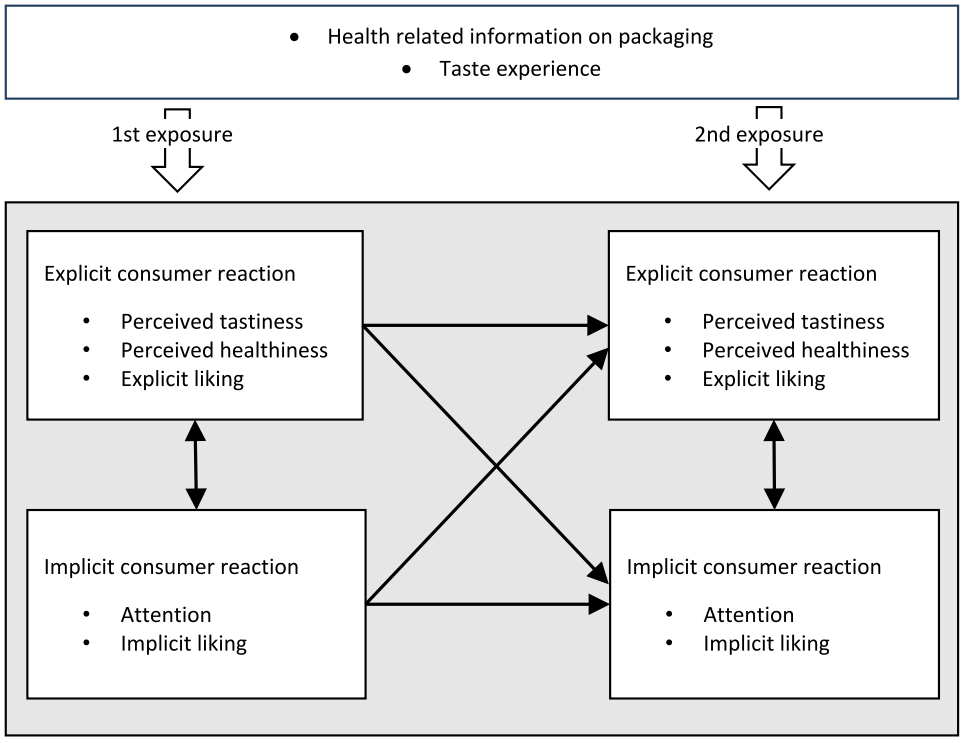

Fig. 1. Conceptual Model. The health-related information on the product packaging and the products' taste might influence both, implicit and explicit consumer reactions, and this can change over repeated exposure. Implicit and explicit consumer reactions might occur simultaneously and influence or conflict each other.

negative (Ballco & Gracia, 2022; Jo & Lusk, 2018; Kaur et al., 2017; Meijer et al., 2022; Temple, 2019) and have gained a lot of attention as "unhealthy = tasty intuition" (Raghunathan et al., 2006). The "unhealthy = tasty intuition" refers to a situation where people believe that foods that are less healthy have greater taste and vice versa. This intuition implies that foods high in fats, sugars, or salt, or with a higher caloric content, are often perceived as more delicious or enjoyable. Several factors contribute to the "unhealthy = tasty" intuition. For example, evolutionary pressures have shaped human preferences for certain tastes and flavours that are associated with energy-dense foods. In the past, when food scarcity was more prevalent, individuals who were drawn to calorie-rich foods had a survival advantage (Raghunathan et al., 2006). Nowadays, food marketing often emphasises the indulgent and pleasurable aspects of less healthy foods. Advertising campaigns frequently use images and messages that associate these foods with enjoyment, happiness, and reward. Meanwhile, advertisements for healthy foods tend to emphasise their nutritional benefits, appealing to cognitive reasoning for a healthy lifestyle. Nevertheless, in certain cultures, healthier foods are associated with greater taste, such as in France (Werle et al., 2013). Apart from that, unhealthy-tasty intuition's influence can vary depending on consumers' goals and the specific consumption context (Loebnitz & Grunert, 2018; Piqueras-Fiszman & Jaeger, 2015). Defining these nuances, however, was not the objective of this study.

Based on the literature reviewed, it was hypothesised that:

Hypothesis 2a. Health-related information on the product package is used to infer tastiness.

Hypothesis 2b. The effect of health-related information on tastiness is mediated by perceived healthiness.

Hypothesis 2c. The effect of health-related information on tastiness carries over to product liking.

2.3. The effect of inferences on selective attention to health-related information in repeated exposure

Based on the Information-Reduction Hypothesis (Haider & Frensch, 1996), it was hypothesised that visual attention to health-related information decreases, but consumers remember the information and perceived healthiness remains stable. This implies that the influence of perceived healthiness on product liking should also remain stable. Yet, previous research on consumer reactions to healthier food products suggests a dominant influence of taste-related beliefs on product evaluations after tasting, while the effect of perceived healthiness on product evaluations and purchase intentions decreases (Mai & Hoffmann, 2015; Tijssen et al., 2019; Zellner et al., 2018). For example, Mai and Hoffmann (2015), adding 'reduced sugar' and 'reduced fat' claims to yoghurt packages, found that the positive impact of perceived healthiness from the product package improved expectations, but this was counteracted by less favourable taste evaluations resulting in lower purchase intentions. Therefore:

Hypothesis 3a. In repeated exposure, the direct influence of perceived healthiness on product liking decreases.

In line with the Information-Reduction Hypothesis (Haider & Frensch, 1996), it was hypothesised that visual attention to health-related information decreases, but consumers remember the information, implying that consumers can keep on using healthiness as a cue to infer tastiness. Hence, it was hypothesised that:

Hypothesis 3b. In repeated exposure, the influence of perceived healthiness on tastiness remains.

2.4. The divergence of implicit and explicit product liking

Consumer associations related to a food product are updated with each encounter, a process that occurs, at least in part, on an implicit level (Clark, 2013; Piqueras-Fiszman & Spence, 2015; Tijssen et al., 2019). In fact, previous research found that effects of repeated exposure on product evaluations are reflected predominantly in implicit rather than explicit reactions (Asbridge et al., 2021; De Wijk et al., 2019; Tijssen et al., 2019). Those studies suggest that implicit measures capture different reactions to explicit measures (Asbridge et al., 2021), particularly faster and unconscious reactions versus more controlled and conscious reactions (Tijssen et al., 2019).

Implicit preferences are formed in the pre-frontal cortex of the brain and can be measured with an electroencephalogram (EEG). Specifically, neuroscientific research found that increased left frontal cortex activation indicates positive emotions and approach motivation, while increased right frontal cortex activation indicates negative emotions and avoidance motivation, and the difference between both, called 'frontal alpha asymmetry', indicates preference (André et al., 2019; Briesemeister et al., 2013; Davidson, 1979, 2004; Stasi et al., 2018). Within sensory and consumer science, previous research has used EEG to examine consumer emotional reactions to food products (Brouwer et al., 2017; Pennanen et al., 2020; Songsamoe et al., 2019) as well as overall food liking (Chen et al., 2020; Stickel et al., 2025), purchase intentions (Ravaja et al., 2013), and willingness to pay (Semenova et al., 2023). Within this study, EEG data was used to measure implicit preferences of the food products and called 'implicit liking', conceptualising a pendant to explicit liking which has been measured with a questionnaire.

Only a few studies have examined the effects of repeated exposure on product evaluations with implicit methods, making the results far from robust Nonetheless, it was hypothesised that effects of repeated exposure are reflected in implicit but not explicit liking for two reasons. First, in repeated exposure, taste-related beliefs tend to influence product evaluations stronger than health-related beliefs (Mai & Hoffmann, 2015; Tijssen et al., 2019; Zellner et al., 2018), as discussed in hypothesis 3. Since implicit liking is more likely to reflect taste-related preferences than explicit liking (Asbridge et al., 2021; Tijssen et al., 2019), an increase in implicit liking should be observed in repeated exposure, when consumers unconsciously remember the taste of the yoghurt. Second, health-related information, which is processed more consciously and would typically affect explicit liking, might receive less attention in repeated exposure due to effects related to the Information-Reduction Hypothesis (Haider & Frensch, 1999; Mai & Hoffmann, 2015; Tijssen et al., 2019; Zellner et al., 2018), as discussed in hypothesis 1. Consequently, explicit liking is less likely to show an increase, as it reflects reduced conscious engagement with health-related information over repeated exposure (Tijssen et al., 2019). In sum, it was hypothesised:

Hypothesis 4a. Effects of repeated exposure are reflected in implicit but not explicit liking.

Furthermore, this research proposed that changes in product perceptions in repeated exposure are mainly driven by changes in taste associations. This assumption builds on the "unhealthy = tasty intuition" literature (Haasova & Florack, 2019; Mai & Hoffmann, 2015; Raghunathan et al., 2006; Werle et al., 2013) and findings from previous research (Asbridge et al., 2021; De Wijk et al., 2019; Mai et al., 2015; Stroebe et al., 2008; Tijssen et al., 2019) suggesting that the short-term goal of indulgence is predominantly *(not exclusively)* working implicitly, in contrast to the predominantly *(not exclusively)* cognitively controlled interest of eating healthy. Thus, in repeated exposure, increases in implicit liking should be stronger in response to tasting rather than to the product package. Therefore, it was hypothesised that:

Hypothesis 4b. In repeated exposure, implicit liking changes predominantly in response to the taste experience.

The above-described effect of taste-associations on implicit liking in repeated exposure might be weaker for products that carry health-related information. As proposed in hypothesis 1b based on the Information-Reduction Hypothesis (Haider & Frensch, 1996),

consumers might remember health-related information in repeated exposure despite reduced visual attention to the information. Logically, this information could then still be used as a cue to infer taste and can, hence, also still influence implicit liking. According to the "Unhealthy = Tasty Intuition" (Raghunathan et al., 2006), this influence should be negative since individuals implicitly infer lower tastiness for healthy products, leading to a weaker increase in implicit liking in response to the taste experience.

Hypothesis 4c. The increase in implicit liking during tasting (hypothesis 4b) is weaker for products with a health message.

In repeated exposure, implicit liking might show encoding specificity effects. Encoding specificity, as proposed by Tulving (1972), refers to the phenomenon that retrieval of information is more effective when the conditions at the time of retrieval match those at the time of encoding. For example, in this context, when individuals are exposed to a product package with health-related information and taste the product, they should encode the taste in combination with the health-related information. At their next exposure to the product, seeing the same health-related information on the product package (matching conditions) should help them remember (retrieve) the taste of the product through the health-related information. The health-related information on the product package should serve as a retrieval cue, facilitating the recall of product attributes, specifically triggering the retrieval of information associated with the product's taste.

The theory (Tulving, 1972) as well as previous research (Franco-Arellano et al., 2020; Lee, 2002) and neuroscience literature (Jansson-Boyd & Bright, 2024) suggest that this memory encoding is an implicit process. Consequently, implicit liking should change during the second exposure to the product package especially when health-related information is present, facilitating encoding specificity effects.

The proposed hypothesis posits that individuals encode the taste experience along with the visual impression of the product package, leading to the recall of the product experience upon encountering the package again. Furthermore, the encoding effect is expected to be more robust for products featuring health-related information on the package, as it provides consumers with an additional cue for encoding their memory.

Hypothesis 4d. In repeated exposure, health-related information cues the retrieval of the taste experience, which affects implicit liking.

Implicit and explicit liking might diverge when health-related information is present on the product package. Previous research employing both explicit and implicit methods suggests that implicit processes interact with cognitive reasoning during preference formation, whereby the mainly cognitively controlled interest in eating healthily seems to conflict with the implicit temptation of eating something delicious (Ballco & Gracia, 2022; De Wijk et al., 2019; Jaeger et al., 2023; Mai et al., 2015; Meijer et al., 2022; Raghunathan et al., 2006; Stroebe et al., 2008; Tijssen et al., 2019). That implies that for products without health-related information, where no conflict exists, implicit and explicit reactions should align, while for products with health-related information, where the conflict exists, implicit and explicit reactions should diverge. This led to the final hypothesis:

Hypothesis 4e. Implicit and explicit consumer reactions to food products with health-related information diverge.

3. Methods

3.1. Study design

This study investigated consumer reactions to health-related information in repeated exposure. Participants were invited twice in consecutive weeks and were exposed to the same products in both weeks. The aim was to mimic real-life shopping and consumption cycles, as many consumers do not repurchase or revisit products immediately, ensuring ecological validity in the study design. In line with the above, the sessions were not held on the same day each week, participants could choose their session days (however, many participants chose the same days and it was all weekdays to keep consumption contexts similar). Each week, participants were exposed to the product package on screen and tasted the product, resulting in four stages of product evaluations (see Fig. 3). Participants were exposed to two yoghurt products, one plant-based and the other dairy-based. In addition, participants were divided into two groups, whereby one group was exposed to products with a nutrition claim on the package while the other group was exposed to the same products without the nutrition claim on the package.

3.2. Participants

A total of 154 participants were recruited from the participant pool of the Feast sensory lab at Massey University, New Zealand, where the study was conducted. This study received ethical approval by Massey's Human Ethics Committee (application ID: OM1 23/22). Participants were aged between 19 and 65, 37 years old on average, with 30 % of participants identifying as men and 70 % as women. Each participant received remuneration amounting to 40 NZD and gave informed written consent to participate.

3.3. Stimuli

Two types of health-related information were examined. Firstly, two products were used, a dairy yoghurt and a plant-based yoghurt. From a health standpoint, plant-based products have the potential to be a perceived healthier alternative to animal-based products, (Ferrari et al., 2022). However, some plant-based products undergo significant processing and may contain additives, contributing to concerns about their overall healthiness (Curtain & Grafenauer, 2019). The fictitious package designs for the two products are detailed in Table 1.

Each of the products was either presented with or without a nutrition claim. In this study, a nutrition claim stating "reduced sugar" was added in half of the product exposures, because sugar is generally perceived as unhealthy (Belkova et al., 2017). Package designs with/without a nutrition claim are shown in Table 1.

For tasting, the study utilised two commercially available yoghurts from the brand 'the collective' with boysenberry flavour, which is a popular flavour in New Zealand. One of these yoghurts was plant-based, while the other was dairy-based. The products naturally differed in their ingredients, such as their sugar content, but were the most alike products available in the market.

3.4. Measures

The study employed a comprehensive approach measuring both implicit and explicit reactions. For implicit reactions, electroencephalogram (EEG) data, specifically frontal alpha asymmetry (FAA), served as an implicit measure of liking. Prior research demonstrated correlations between activations of the pre-frontal cortex of the brain, which can be measured as FAA, and approach- or withdrawal-related motivation (for reviews, see Briesemeister et al., 2013; Stasi et al., 2018; for a detailed discussion about FAA, see Section 2.4). For example, Ravaja et al. (2013) varied brand and price of 14 different grocery products, and found that higher perceived need for a product were associated with greater relative left frontal activation, indicating approach-related motivation. EEG signals were recorded with the Neuroelectrics Enobio 8 EEG (Neuroelectrics, Spain) at 500 Hz using disposable snap electrodes of the type H124SG (latex-free and pre-gelled; Kendall TM, USA) for the CMS/DRL electrodes (electrical referencing on the mastoid behind the ear) and SIGNAGEL® saline gel (Parker Laboratories Inc., USA) for electrode placements F7 and F8 on the prefrontal cortex. Eye-tracking data served as an implicit measure of participant attention to health-

Table 1
The fictitious product packages with and without health-related information. The areas of interest (AOIs) are marked with a blue box, but were not visible to participants during data collection.

	Without Nutrition Claim	With Nutrition Claim
Dairy Yoghurt		
Plant-based Yoghurt		

related information, specifically dwell count, revisit count, and dwell time. Smart-Eye's Aurora eye-tracker (Smart-Eye, Sweden) recorded participants eye-movements at a sampling rate of 250 Hz after a 9-point calibration.

A questionnaire captured explicit reactions on 7-point scales. Tastiness ("This yoghurt is tasty."), a sensory measure, was measured with the endpoints "strongly disagree"/ "strongly agree". Perceived healthiness of the snack was measured on a 7-point Likert scale with the endpoints "strongly disagree"/ "strongly agree" with the statement "the yoghurt…" and four items (Cronbach's alpha = 0.86), namely "contains a lot of vitamins and minerals", "keeps me healthy", "is nutritious", and "provides enough energy" (Pula et al., 2014). Explicit liking ("How much do you like this yoghurt?"), an attitude measure, was measured with the endpoints "dislike extremely" to "like extremely" (Jaeger et al., 2019) and reflects the overall product experience, including tastiness and healthiness.

3.5. Procedure

The sessions took 35 min including the setup of equipment for measuring participant implicit reactions, exposure to the products (package and tasting), completion of the questionnaires, and removal of the equipment. The procedure is depicted in Fig. 2. Participant allocation to the condition with or without health-related information was random, as was the product presentation order. The study involved two sessions across consecutive weeks (Fig. 3), whereby the above procedure was the same in both sessions.

The yoghurt samples were served in small white porcelain dishes, each containing one tablespoon of yoghurt. To ensure consistency, the two samples — one dairy-based and one plant-based — were prepared in the laboratory kitchen and discreetly placed on the desk in the laboratory room with a metal teaspoon just before participants entered the room. To minimize bias and preserve blinding, the dishes were covered with cardboard coffee cups, which remained in place until participants were instructed to remove them and taste the yoghurts during the session. All instructions were provided on-screen as part of the iMotions slideshow, ensuring consistency across participants. A glass of water was provided as palate-cleanser. Participants were setup with the EEG equipment and eye-tracker calibration on arrival. Next, participants watched a 4 min nature video that had nothing to do with the purpose of this study, serving as a baseline for EEG data. To ensure that the video did not systematically influence the results, the same video was shown

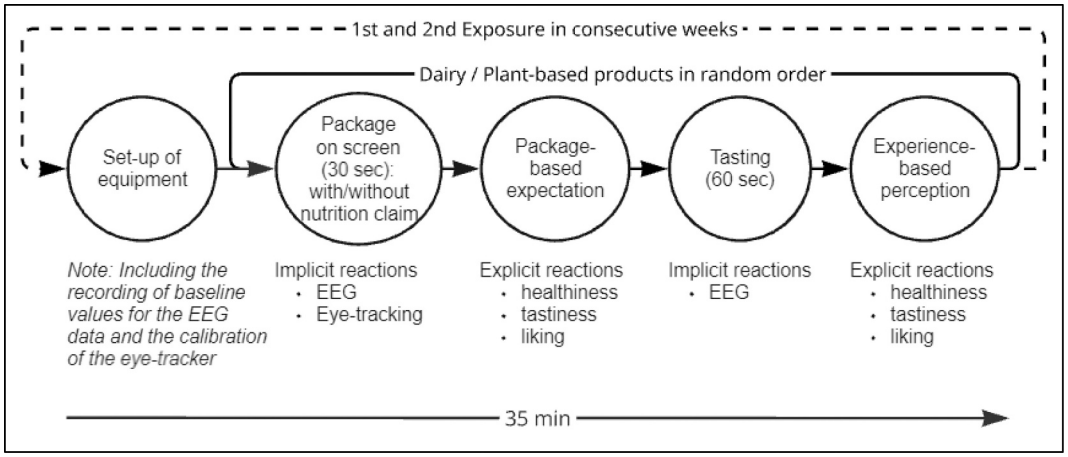

Fig. 2. Experimental procedure.

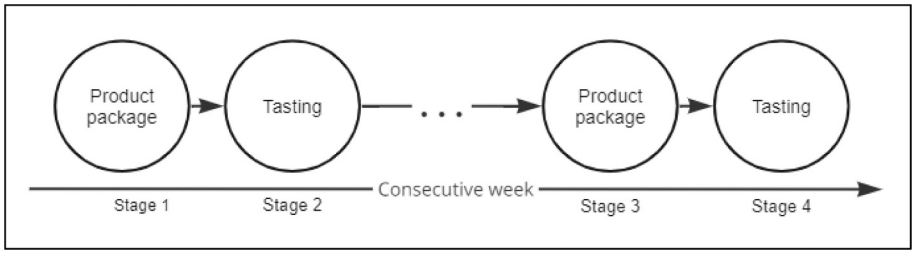

Fig. 3. Experimental procedure, illustrating the repeated exposure in four stages.

to all experimental groups during each session. This approach guaranteed that any observed variance could be attributed solely to the experimental manipulation. The use of a video, rather than a blank screen, was intended to minimize participants' tendency to drift into their own thoughts, which could vary widely — some focusing on positive and others on negative reflections. Package-based expectations were measured by showing participants the product package for 30 s on a computer screen, ensuring that participants had enough time to engage with the pack design and see the health-related information. Meanwhile EEG and eye-tracking data were recorded. Afterwards, participants filled in a questionnaire indicating their product expectations. To measure experience-based perceptions, participants tasted the product. Meanwhile, EEG data were recorded. Afterwards, participants filled out a questionnaire indicating their product experience. After a 30 s break, the above steps were repeated for the second product.

3.6. Data analysis

Implicit data were prepared for further analysis with iMotions' open-source R-notebooks (iMotions A/S, 2023), following standard procedures in the literature (Allen et al., 2004; Benedek & Kaernbach, 2010; Briesemeister et al., 2013). Specifically, EEG data were pre-processed with bandpass filtering, notch filtering, artefact rejection, and power band computation. Power Spectral Density (PSD) was averaged across alpha frequencies (8–12 Hz), whereby PSD was computed using Fast Fourier Transform (FFT) and has frequencies in the range of [0, 250]. Frontal alpha asymmetry scores were calculated as "FAA = ln (Alpha (F8)) – ln (Alpha (F7))". For eye-tracking data, areas of interest (AOIs) were drawn on the product package, and subsequently eye-tracking metrics were calculated to later indicate participant attention to the health-related information. Eye-tracking data from participants whose calibration was rated "poor" by the iMotions software in the beginning of a session were removed from the dataset, affecting eleven participants in one of their sessions and four participants in both sessions.

IBM SPSS Statistics software (IBM SPSS Statistics for Windows, Version 29 (29.0), 2023) was used to perform univariate ANOVAs analysing effects of categorical predictor variables on participant reactions. For EEG data, the baseline interval was included as a covariate in the analyses to reduce the amount of variance in the residual error term (Alday, 2019). Hayes' (Hayes, 2017) PROCESS Model 1 was used to perform moderation analyses, specifically in hypothesis 4e to test if Implicit and explicit consumer reactions to food products with health-related information diverge. Model 4 was used for mediation analyses, specifically in hypothesis 2b to test if perceived healthiness mediated the effect of health-related information on tastiness. Finally, Model 59 was used for mediated moderation analyses, specifically in hypothesis 2c to test if the effect of health-related information on tastiness carries over to product liking. All PROCESS analyses were performed using 500 bootstrap samples.

SmartPLS 4 (Ringle et al., 2022) software was used to analyse relationships between variables representing product evaluations. Partial least squares structural equation models (PLS-SEM) were estimated with 5000 bootstrapping resamples.

4. Results

The results section evaluates each of the proposed hypotheses, one by one, in four sub-sections. One participant was exposed to the incorrect stimuli during the second exposure. Consequently, the data associated with this participant's second exposure were excluded from the dataset. Two participants also had incomplete data in the explicit variables in the first session, so their datapoints were removed.

4.1. Hypothesis 1: Selective attention to health-related information

Hypothesis 1a. Visual attention to health-related information decreases in repeated exposure.

A univariate ANOVA (Table 2) conducted on participant visual attention to health-related information, both the nutrition claim and the plant-based claim, showed that participants looked at the information significantly fewer times in the second exposure *(dwell count)* and looked back and fixated at the information significantly less *(revisit count)*, while the total time respondents looked at the information did not change significantly *(dwell time)*.

The results show that individuals reduce their attention to health-related information on food products in repeated exposure, with fewer and less repetitive visits to the health-related information, confirming hypothesis 1a.

Hypothesis 1b. Perceived healthiness of the food product remains stable, even if visual attention to health-related information decreases.

A univariate ANOVA conducted on perceived healthiness of the two yoghurts showed that healthiness remained constant throughout the four stages ($F(3,1216) = 0.598$, $\eta 2 = 0.001$, $p = .617$; for means and standard deviations see Table 3), supporting hypothesis 1b. Even if visual attention to health-related information decreased, perceived healthiness remained stable.

4.2. Hypothesis 2: Inferences from health-related information on food products

Hypothesis 2a. Health-related information on the product package is used to infer tastiness.

A univariate ANOVA conducted on perceived tastiness showed that those in the condition with a nutrition claim believed the yoghurts to be less tasty than those in the condition without a nutrition claim (M_with = 5.19 vs. M_without = 5.47, $p < .001$, $\eta 2 = 0.010$), supporting hypothesis 2a. The analysis conducted on perceived tastiness of the plant-based versus dairy product showed that they also believed the plant-based yoghurt to be less tasty than the dairy yoghurt (M_plant-based = 5.13 vs. M_dairy = 5.41, $p < .001$, $\eta 2 = 0.011$). Together, these two analyses confirmed hypothesis 2a.

Hypothesis 2b. The effect of health-related information on tastiness is mediated by perceived healthiness.

Perceived healthiness mediated the effect of health-related

Table 2
Visual attention to health-related information. Results of a Univariate ANOVA using the eye-tracking metric as dependent variable and the exposures as fixed factor.

Eye-tracking Metric	Description	Mean		Df	F-value	p-value	η2
		Exposure 1 (stage 1)	Exposure 2 (stage 3)				
Dwell count	Count of how often the respondent's gaze entered the AOI (i.e., how often the AOI was visited).	6.35	5.85	1	3.942	0.048	0.007
Revisit count (fixation dwells)	Count of how often the respondent looked back and fixated at the AOI after the first dwell.	4.65	4.16	1	5.702	0.017	0.010
Dwell time (gaze, ms)	Total time during which the respondent's gaze was recorded inside the AOI.	2381.67	2244.67	1	1.005	0.316	0.002

Table 3
Mean values of "perceived healthiness" of the yoghurts across the four stages.

	Stage									
	1 (1st exposure to the product package)		2 (1st exposure to the taste)		3 (2nd exposure to the product package)		4 (2nd exposure to the taste)		Total	
	M	SD	M	SD	M	SD	M	SD	M	SD
Dairy yoghurt	4.99	1.05	4.94	1.10	5.08	0.95	4.98	0.99	5.00	1.03
Plant-based yoghurt	4.84	1.04	4.91	1.12	4.95	1.07	4.88	1.15	4.89	1.09
Total										

Note: M = Mean, SD = Standard deviation.

information on tastiness. The moderated mediation analysis was significant (Index = 0.160, SE = 0.071, 95 % CI = [0.025, 0.302]), partially confirming hypothesis 2b because the mediation was product-dependent. Specifically, the effect of the nutrition claim on perceived healthiness was product-dependent (B = 0.305, SE = 0.132, 95 % CI = [0.046, 0.565]), showing tendencies of decreasing perceived healthiness for the dairy yoghurt but increasing perceived healthiness for the plant-based yoghurt. Further, perceived healthiness increased tastiness (B =

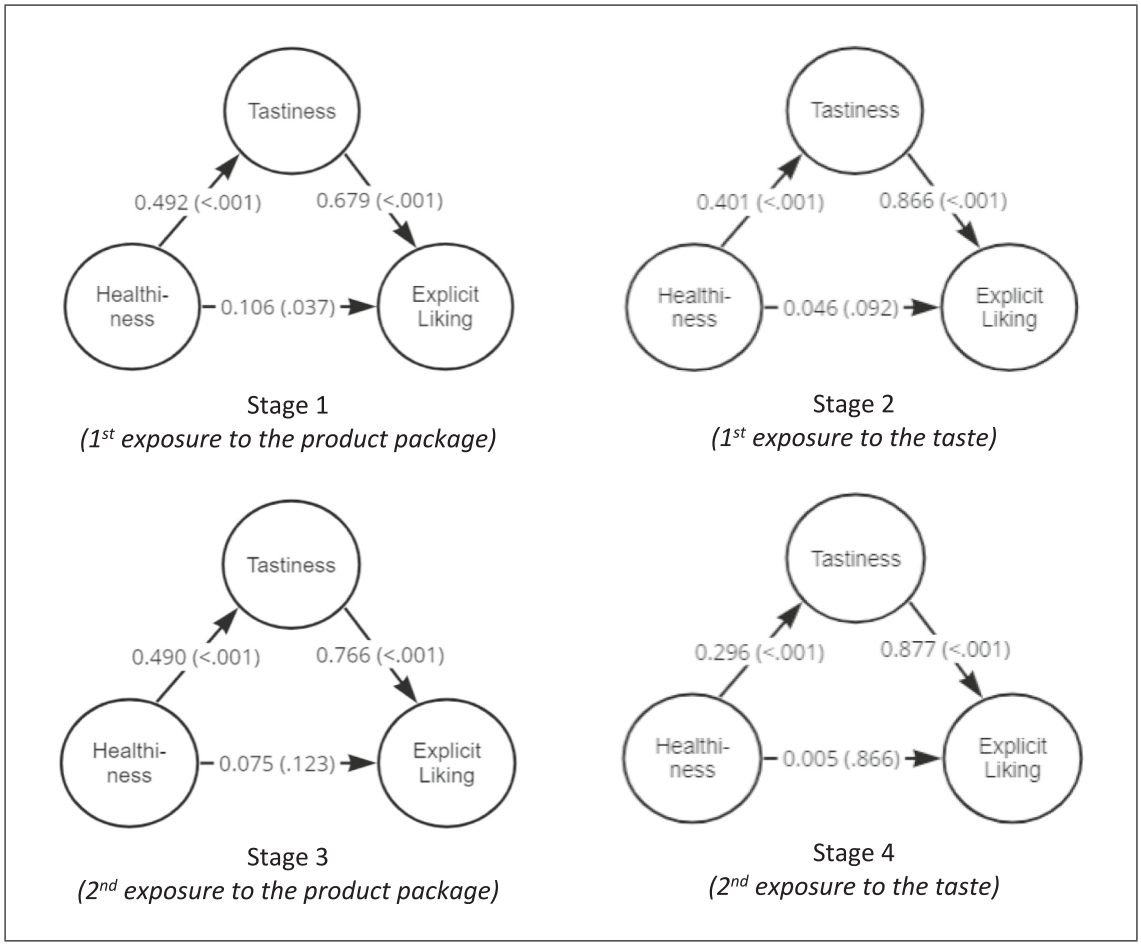

Fig. 4. Graphical representation of the structural equation model with standardised regression coefficients and the related *p*-value in brackets, illustrating the influence of health and taste associations on explicit liking throughout the four experimental stages.

0.447, SE = 0.048, 95 % CI = [0.353, 0.542]), while the nutrition claim decreased tastiness (B = −0.277, SE = 0.108, 95 % CI = [−0.488, −0.065]). The effect of perceived healthiness on tastiness was product-dependent as well (B = 0.136, SE = 2.046, 95 % CI = [0.006, 0.266]), with perceived healthiness influencing tastiness significantly more in the plantbased (B = 0.583, SE = 0.45, 95 % CI = [0.494, 0.672]) than the dairy product (B = 0.447, SE = 0.48, 95 % CI = [0.353, 0.542]).

Hypothesis 2c. The effect of health-related information on tastiness carries over to product liking.

The results showed a significant indirect effect of the nutrition claim on liking through tastiness (B = −0.176, SE = 0.051, 95 % CI = [−0.276, −0.077]). The same analysis conducted with the product (plant-based vs. dairy) as independent variable also showed a significant indirect effect of the nutrition claim on liking through tastiness (B = −0.172, SE = 0.047, 95 % CI = [−0.264, −0.080]), confirming hypothesis 2c.

The results confirm that yoghurt products carrying health-related information are associated with lower tastiness, mediated through perceived healthiness. Furthermore, it was shown that this negative effect of health-related information on tastiness carries over to product liking.

4.3. Hypothesis 3: The effect of inferences on selective attention to health-related information in repeated exposure

Hypothesis 3a. In repeated exposure, the direct influence of perceived healthiness on product liking decreases.

The partial least squares structural equation model (PLS-SEM) analysis conducted on the effect of health-related product associations (i.e., perceived healthiness) on product evaluations in repeated exposures (Fig. 4), showed that perceived healthiness only directly influenced explicit liking significantly in stage 1, i.e., first exposure to the product package. Thus, even though perceived healthiness remained stable in repeated exposure, it lost its (positive) direct effect on product liking after the first tasting and thereafter only influenced product liking indirectly through tastiness.

Hypothesis 3b. In repeated exposure, the influence of perceived healthiness on tastiness remains.

The above analysis also showed that perceived healthiness influenced tastiness in all four stages, confirming hypothesis 3b.

These results confirm hypotheses 3a-b, showing that taste associations have a stronger influence on yoghurt liking than health-related product associations and this influence lasted throughout the four stages of evaluation.

Following findings stressing the persistent importance of taste perceptions to yoghurt liking, the evolution of taste perception depending on the type of health-related information, plant-based/dairy and nutrition claim, was investigated throughout the four stages. The Univariate ANOVA conducted on perceived tastiness of the yoghurts showed a significant interaction effect between repeated exposure and the products ($F(3,1204) = 3.829$, $\eta 2 = 0.009$, $p = .010$), while the nutrition claim did not evoke a significant effect on the evolution of taste associations. Fig. 5 illustrates the initially (stage 1) diverging package-based taste associations of the plant-based and dairy product and the similar perceived taste in stage 2. A week later, participants seemed to remember their experience, as reflected in the more similar package-based taste associations in stage 3, compared to stage 1. Looking at the evolution of taste associations per product, a pairwise contrast analysis showed that only the difference between stages 1 and 2 for the plant-based product was statistically significant ($p = .002$), while the other differences were non-significant. Overall, the results indicate that the effect of health-related information on tastiness is stronger for claims participants are unfamiliar with (plant-based) and weaker in situations where participants knew what to expect (dairy product, nutrition claim, and higher familiarity with the products after repeated exposure (stages 2–4)) but further research is needed to confirm this hypothesis.

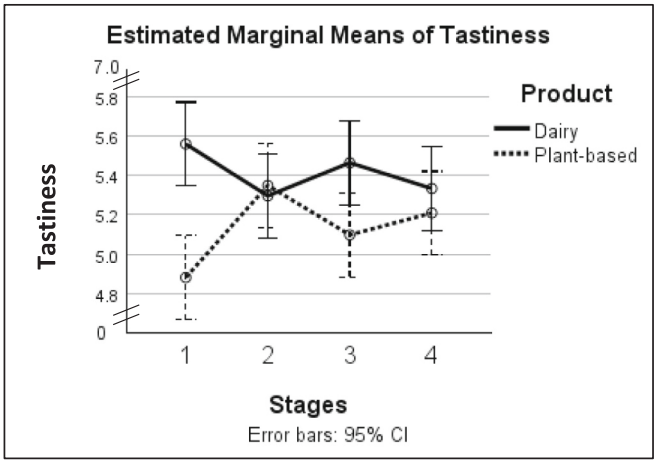

Fig. 5. Means (from a Univariate ANOVA) of the interaction effect of repeated exposure (stages 1–4) and product (dairy vs. plant-based) on tastiness (measured on a 7-point likert scale). Error bars at confidence interval 95 %. Stage 1: 1st exposure to the product package; stage 2: 1st exposure to the taste; stage 3: 2nd exposure to the product package, stage 4: 2nd exposure to the taste.

4.4. Hypothesis 4: The divergence of implicit and explicit reactions to health-related information

Hypothesis 4a. Effects of repeated exposure are reflected in implicit but not explicit liking.

To investigate if repeated exposure effects were evident in implicit and explicit liking, two Univariate ANOVAs were conducted, with repeated exposure as a fixed factor and either implicit or explicit liking as the dependent variable. Results revealed a significant main effect of repeated exposure for implicit ($F(3,1214) = 6.618$, $\eta 2 = 0.015$, $p < .001$) but not explicit ($F(3,1216) = 0.037$, $\eta 2 = 0.000$, $p = .991$) liking, confirming hypothesis 4a that effects of repeated exposure are reflected in implicit but not explicit liking. The direction of the effect is discussed under hypothesis 4b.

Hypothesis 4b. In repeated exposure, implicit liking increases predominantly in response to the taste experience.

A plot of the mean scores of implicit liking in repeated exposure (throughout the four experimental stages) from the analysis is presented in Fig. 6, specifically the solid black line called “total”. It illustrates that implicit liking is higher in response to the taste experience (stages 2 and 4) compared to exposures to the product packages (stages 1 and 3). Specifically, implicit liking increases from stage 1 (product package) to stage 2 (tasting), and in the following week from stage 3 (product package) to stage 4 (tasting). This confirms hypothesis 4b.

Hypothesis 4c. The increase in implicit liking during tasting (hypothesis 4b) is weaker for products with a health message.

A univariate ANOVA showed a non-significant tendency for an interaction effect between repeated exposure and the nutrition claim on implicit liking ($F(3,1214) = 2.355$, $\eta 2 = 0.006$, $p = .070$). Fig. 6 illustrates that products *without* nutrition claim may exhibit more pronounced shifts in implicit liking between package-based expectations (stages 1 and 3) and taste-based experiences (stages 2 and 4) than products *with* nutrition claim where the change in implicit liking is more subtle. Even though hypothesis 4c cannot be confirmed, there is a tendency for health-related information to dampen the increase of implicit liking during tasting and future research is warranted.

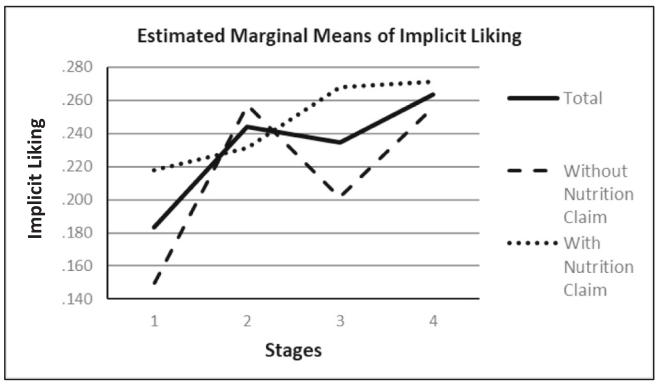

Fig. 6. Estimated marginal means (from a Univariate ANOVA) of implicit liking overall and for products with and without nutrition claim, over 4 experimental stages. Stage 1: product package in first exposure; stage 2: tasting in first exposure; stage 3: product package in second exposure, stage 4: tasting in second exposure.

Hypothesis 4d. In repeated exposure, health-related information cues the retrieval of the taste experience, which affects implicit liking.

The mean scores in Fig. 6 illustrate an increase in implicit liking from stage 2 to 3 for products with a nutrition claim on the product package, while implicit liking for products without nutrition claim decreased from stage 2 to 3, i.e. from tasting the product in the first week to the exposure to the product package in the consecutive week. A pairwise contrast analysis showed that only the difference between stages 1 and 2 for products without nutrition claim was statistically significant ($p < .001$), while the other differences were non-significant. Although the hypothesis 4d cannot be confirmed, the results indicate that having a nutrition claim on the product package may aid retrieval of the product experience from the previous exposure but this needs to be confirmed in future research.

Hypothesis 4e. Implicit and explicit consumer reactions to food products with health-related information diverge.

A regression analysis with implicit liking and nutrition claim as predictors and explicit liking as dependent variable showed a significant main effect of implicit liking on explicit liking (B = 0.812, SE = 0.303, $p = .007$, 95 % CI = [0.218, 1.407]) and a significant interaction effect of the two predictors (B = −1.055, SE = 0.318, $p = .001$, 95 % CI = [−1.678, −0.432]). As illustrated in Fig. 7, implicit and explicit liking diverge for products *with* the nutrition claim on their product packaging, while for products *without* the nutrition claim, implicit and explicit liking align.

Conducting the same analysis with implicit liking and the product as predictor (*dummy coding: 0 = dairy, 1 = plant-based*) also showed a significant interaction effect of the two predictors (B = −0.716, SE = 0.222, p = .001, 95 % CI = [−1.151, −0.280]). Again, implicit and explicit liking diverge for the plant-based product, while for the dairy product, implicit and explicit liking align.

These findings confirm hypothesis 4e, showing that implicit and explicit consumer reactions to food products with health-related information diverge. While explicit liking decreases in the existence of health-related information (see hypothesis 4a), implicit liking increased (see hypotheses 4b-d), leading to divergence as illustrated in Fig. 7.

5. Discussion

The present research examined consumer reactions to health-related information on pre-packaged food items in a repeated exposure paradigm. The results showed that while visual attention to the health-related information decreased when the same product was assessed a week after the first exposure, perceived healthiness of the products remained stable. However, perceived healthiness lost its (positive) effect on product liking after the first tasting. Perceived tastiness, in contrast, influenced product liking consistently in repeated exposure. This finding highlights the importance of also offering consumers a satisfying taste experience for products that focus on healthiness. In addition, this research confirmed the divergence between implicit and explicit consumer reactions in some conditions, emphasising the necessity of considering both types of reactions for a comprehensive understanding of consumer reactions toward healthier food products.

5.1. Theoretical contributions

This research adds new insights to the Information-Reduction Hypothesis literature by identifying information-reduction effects in food-related consumer behaviour, particularly in repeated exposure to pre-packed food products with health-related information on the product package. Findings align with the Information Reduction Hypothesis (Haider & Frensch, 1996, 1999), showing reduced visual attention to health-related information on the product package in repeated exposure, with fewer and less repetitive visits to the information. Furthermore, health-related information was perceived less relevant in repeated exposures, consistent with a shift to taste-related associations influencing product liking post-tasting. Previous research has already indicated a dominance of taste-related product associations after tasting, while the effect of health-related information on product evaluations decreased (Mai & Hoffmann, 2015; Tijssen et al., 2019; Zellner et al.,

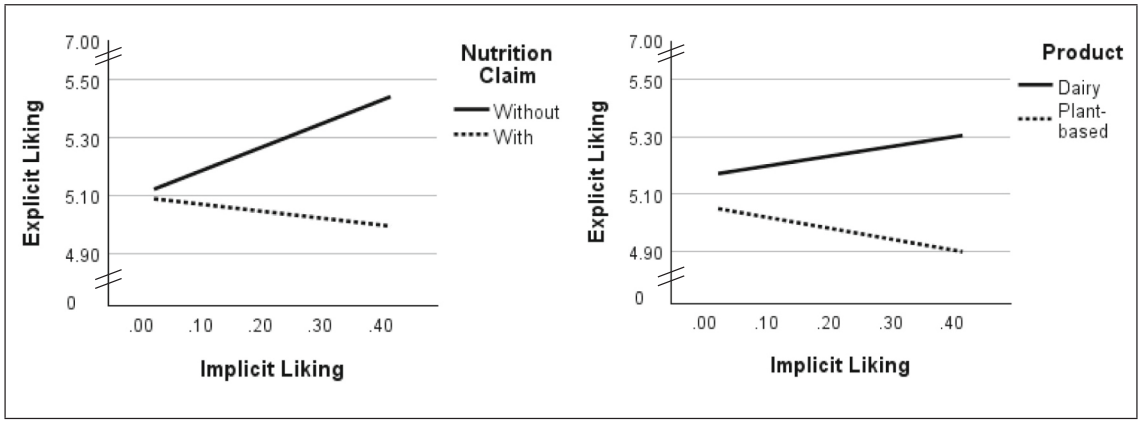

Fig. 7. Implicit versus explicit liking of yoghurts with health-related information on their product package. Results from a multiple regression analysis (Process Model 1) using implicit liking and health-related information as predictors. For implicit liking, the range represents the 16th, 50th, and 84th percentiles, as calculated by PROCESS Model 1, and interpolation lines were fitted to these values to illustrate the direction of the effect.

2018). For example, Mai and Hoffmann (2015), adding reduced sugar and reduced fat claims to yoghurt packages, found that the positive impact of perceived healthiness from the product package improved expectations, but this was counteracted by less favourable taste evaluations resulting in lower purchase intentions. Interestingly, if consumers taste the product, attention to nutrition and health claims slightly increases afterwards, compared to situations where consumers did not taste the product (Ballco et al., 2020), which could possibly be attributed to increased involvement.

Further, the findings of this research contribute to Encoding Specificity Theory (Tulving, 1972), showing enhanced encoding effects for products carrying health-related information. Encoding Specificity Theory (Tulving, 1972) proposes that the retrieval of information is more effective when the conditions at the time of retrieval match those at the time of encoding. This study tested whether consumers remember (retrieve) product attributes better if additional information is available on the product package in the form of a nutrition claim, serving as an additional informational cue and facilitating recall of product attributes. The results of this study suggest a confirmation of this hypothesis. Specifically, for products with a nutrition claim on the package, the results showed enhanced implicit liking when consumers were exposed to the product package one week after they first saw and tasted the product. Meanwhile, for products without this claim, implicit liking decreased during the second exposure. Potentially, the health-related information being present on the product package in both, encoding and retrieval, provides consumers with an additional cue for memory retrieval and hence facilitated the recall of product attributes.

This effect was visible in implicit but not explicit liking, confirming that encoding effects take place on the implicit level also in the context of health-related information on food products, as proposed by the theory itself (Tulving, 1972) and found in previous research (Franco-Arellano et al., 2020; Lee, 2002) and neuroscience literature (Jansson-Boyd & Bright, 2024).

5.2. Practical implications

This research suggests several important practical implications for retailers, manufacturers, and policy makers. According to previous research, adding health-related information to food products can enhance purchase intention and encourage healthier choices (Ballco & Gracia, 2022; Giezenaar et al., 2024; Kaur et al., 2017; Meijer et al., 2022; Steinhauser & Hamm, 2018). Consequently, health-related information serves as a potent communication tool on pre-packaged food products, guiding consumers toward healthier selections in the retail context (Cadario & Chandon, 2019, 2020; Vecchio & Cavallo, 2019). However, this research showed that perceived healthiness influences product liking primarily during the first exposure, while taste-related beliefs exert a lasting influence. This highlights the opportunity for retailers and manufacturers to leverage health-related communication for first-time purchases, with a focus on delivering a compelling taste for sustained product liking.

Furthermore, this research has an important implication for policy makers: This research shows that health associations influence product liking predominantly in first exposures, whereas a permanent influence would be beneficial to support consumers to make informed choices regarding healthy food continuously. Thus, policy makers should not rely entirely on consumers making healthy food choices but consider incentivising retailers and manufacturers providing food products that are healthy – and taste good.

Finally, retailers and manufacturers should consider assessing both implicit and explicit consumer reactions in new product development of products that could activate health associations and when desiring to follow the updating of consumer reactions over repeated exposure. Confirming the findings of previous research (Ballco & Gracia, 2022; De Wijk et al., 2019; Jaeger et al., 2023; Mai et al., 2015; Meijer et al., 2022; Raghunathan et al., 2006; Stickel et al., 2025; Stroebe et al., 2008; Tijssen et al., 2019), results of this study showed a divergence between implicit and explicit consumer reactions for products emphasising health-related information on their packaging, whereas consumer reactions to products emphasising taste-related information on their packaging were more aligned. The underlying reason for this divergence might be an unconscious conflict between the mainly cognitively controlled interest in eating healthily seems to conflict with the implicit temptation of eating something delicious when the product carries health-related information, as proposed by the "Unhealthy = Tasty Intuition" (Raghunathan et al., 2006). Hence, explicit liking, reflecting predominantly *(not exclusively)* the cognitively controlled interest in eating healthily, showed different results than implicit liking, reflecting predominantly *(not exclusively)* the implicit temptation of eating something delicious. These findings emphasise the added value of considering both types of consumer reactions, implicit and explicit, for a comprehensive understanding of consumer reactions. Apart from that, considering implicit reactions can provide additional insights when tracing consumer reactions in repeated exposure. Results of this study suggest that only implicit liking was sensitive enough to reliably reflect changes in consumer preferences. In previous research (Asbridge et al., 2021; De Wijk et al., 2019; Tijssen et al., 2019) it was hypothesised that implicit measures capture different reactions to explicit measures, particularly faster and unconscious reactions versus more controlled and conscious reactions. However, this research suggests that increases of liking over time occur in response to taste rather than cognitive stimuli *(see hypothesis 4b)*. Since taste stimuli activate the predominantly *(not exclusively)* implicitly controlled interest in indulgence, rather than the predominantly *(not exclusively)* cognitively controlled interest in eating healthily, it makes sense that methods capturing implicit consumer reactions are more sensitive to changes over time than methods capturing explicit consumer reactions. Hence, if retailers and manufacturers attempt to know how their consumers' perceptions of their products change over time, considering implicit methods is recommendable.

5.3. Limitations and future research

This research revealed new insights into the development of consumer reactions to health-related information over time that have not been investigated before. However, this research has limitations and would, for instance, be strengthened by testing the identified effects with other stimuli. Whereas stimuli used in this research were yoghurts, which are perceived healthy per se, future research should test the effects of health-related information in repeated exposure with products that were perceived unhealthy as default, such as healthier (e.g., sugar reduced or whole grain) cookies. Specifically, the perceived conflict between the mainly cognitively controlled interest of eating healthily and the implicit temptation of eating something delicious (Ballco & Gracia, 2022; De Wijk et al., 2019; Jaeger et al., 2023; Mai et al., 2015; Meijer et al., 2022; Raghunathan et al., 2006; Stroebe et al., 2008; Tijssen et al., 2019) should be bigger the more unhealthy the food product is perceived to be, due to the "unhealthy = tasty intuition" (Raghunathan et al., 2006). If the product has a compelling taste, health-related information could exert greater and longer-lasting influence on product liking. Of course, extending the examination period and following changes in consumer reactions over more than two weeks would then be interesting, to test whether these effects continue.

Moreover, attention reduction to health-related information might depend on the type of information. In the present research, attention reduction was stronger for the plant-based claim than for the nutrition claim. Apart from that, when having two types of health-related information on the package at the same time, these two seem to be in competition for attention. In the present study, the nutrition claim is receiving significantly less attention on the product with the plant-based claim ($F(1,346) = 7.09$, $p = .008$), and the plant-based claim is receiving significantly less attention on the product with the nutrition claim ($F(1,228) = 5.16$, $p = .024$).

Furthermore, future research should employ measures of behaviour, since the present study measured mainly attitudes which do not necessarily translate to behaviour (e.g., Sultan et al., 2020).

Finally, prior research suggests cultural differences in consumer reactions to health-related information (Werle et al., 2013) and to plant-based products (Giacalone & Jaeger, 2023). Due to the methodology requiring in-person assessment, participants of this study lived in proximity to the laboratory. Hence the findings cannot be extended to the general population or markets for healthy snacks in general. In countries where plant-based diets are more popular or where more plant-based products are on the market, consumers expectations of plant-based products will show different dynamics.

We recognise that a sample size of 154 participants can be considered small in comparison to consumer studies using online surveys to poll hundreds of participants. However, laboratory-based studies that utilise specialised equipment, trained personnel, and controlled settings yield high-quality, precise data, reducing noise and allowing robust findings even with fewer participants. Previous research on implicit reactions has typically involved participant numbers within a similar range. For example, as highlighted in Kreibig's (2010) review, sample sizes range from 6 to 160 participants. Drawing from these studies, approximately 80 participants per experimental condition (160 in total) was the target sample size to ensure sufficient statistical power and reliability in our findings.

6. Conclusion

This research examined consumer reactions to health-related information on pre-packaged food items in repeated exposure. It found that while visual attention to health-related information decreased over time, perceived healthiness remained stable. Yet, its positive effect on product liking diminished after the first tasting, while the effect of perceived tastiness on product liking remained stable. This indicates an opportunity for retailers and manufacturers to leverage health-related communication for first-time purchases, with a focus on delivering a compelling taste for sustained product liking. Furthermore, this research found divergences between implicit and explicit liking, emphasising the need for a comprehensive understanding of consumer reactions to healthier food products that considers both implicit and explicit responses. The findings contribute to theories like the Information Reduction Hypothesis and Encoding Specificity Theory and suggest practical implications for retailers, manufacturers, and policymakers in promoting healthier food choices.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to improve readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Ethical approval

The protocol was approved by Massey's Human Ethics Committee (application ID: OM1 23/22).

Informed consent

Informed consent was obtained from all individual participants of this study.

CRediT authorship contribution statement

Lisa Stickel: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Simone Poggesi:** Writing – review & editing, Software, Project administration, Investigation. **Klaus G. Grunert:** Writing – review & editing, Supervision, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Liisa Lähteenmäki:** Writing – review & editing, Supervision, Conceptualization. **Joanne Hort:** Writing – review & editing, Supervision, Resources, Methodology, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Lisa Stickel reports financial support was provided by Arla Foods amba. Lisa Stickel reports a relationship with Arla Foods amba that includes: funding grants. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

Alday, P. M. (2019). How much baseline correction do we need in ERP research? Extended GLM model can replace baseline correction while lifting its limits. *Psychophysiology, 56*(12), Article e13451. https://doi.org/10.1111/PSYP.13451

Allen, J. J. B., Coan, J. A., & Nazarian, M. (2004). Issues and assumptions on the road from raw signals to metrics of frontal EEG asymmetry in emotion. *Biological Psychology, 67*(1–2), 183–218. https://doi.org/10.1016/J.BIOPSYCHO.2004.03.007

André, Q., Chandon, P., & Haws, K. (2019). Healthy through presence or absence, nature or science?: A framework for understanding front-of-package food claims. *Journal of Public Policy & Marketing, 38*(2), 172–191. https://doi.org/10.1177/0743915618824332

Asbridge, S. C. M., Pechey, E., Marteau, T. M., & Hollands, G. J. (2021). Effects of pairing health warning labels with energy-dense snack foods on food choice and attitudes: Online experimental study. *Appetite, 160*, Article 105090. https://doi.org/10.1016/J.APPET.2020.105090

Ballco, P., Caputo, V., & de-Magistris, T.. (2020). Consumer valuation of European nutritional and health claims: Do taste and attention matter? *Food Quality and Preference, 79*, Article 103793. https://doi.org/10.1016/J.FOODQUAL.2019.103793

Ballco, P., & Gracia, A. (2022). Tackling nutritional and health claims to disentangle their effects on consumer food choices and behaviour: A systematic review. *Food Quality and Preference, 101*, Article 104634. https://doi.org/10.1016/j.foodqual.2022.104634

Belkova, J., Rozkot, M., Danek, P., Klein, P., Matonohova, J., & Podhorna, I. (2017). Sugar and nutritional extremism. *Critical Reviews in Food Science and Nutrition, 57*(5), 933–936. https://doi.org/10.1080/10408398.2014.940027

Benedek, M., & Kaernbach, C. (2010). A continuous measure of phasic electrodermal activity. *Journal of Neuroscience Methods, 190*(1), 80–91. https://doi.org/10.1016/J.JNEUMETH.2010.04.028

Berry, C., & Romero, M. (2021). The fair trade food labeling health halo: Effects of fair trade labeling on consumption and perceived healthfulness. *Food Quality and Preference, 94*, Article 104321. https://doi.org/10.1016/J.FOODQUAL.2021.104321

Briesemeister, B. B., Tamm, S., Heine, A., & Jacobs, A. M. (2013). Approach the good, withdraw from the bad—A review on frontal alpha asymmetry measures in applied psychological research. *Psychology, 04*(03), 261–267. https://doi.org/10.4236/PSYCH.2013.43A039

Brouwer, A. M., Hogervorst, M. A., Grootjen, M., van Erp, J. B. F., & Zandstra, E. H. (2017). Neurophysiological responses during cooking food associated with different emotions. *Food Quality and Preference, 62*, 307–316. https://doi.org/10.1016/J.FOODQUAL.2017.03.005

Cadario, R., & Chandon, P. (2019). Viewpoint: Effectiveness or consumer acceptance? Tradeoffs in selecting healthy eating nudges. *Food Policy, 85*, 1–6. https://doi.org/10.1016/J.FOODPOL.2019.04.002

Cadario, R., & Chandon, P. (2020). Which healthy eating nudges work best? A meta-analysis of field experiments. *Marketing Science, 39*(3), 465–486. https://doi.org/10.1287/MKSC.2018.1128/SUPPL_FILE/MKSC.2018.1128.SM1.PDF

Cardello, A. V. (2007). Measuring consumer expectations to improve food product development. *Consumer-Led Food Product Development*, 223–261.

Chen, Y., Huang, A. X., Faber, I., Makransky, G., & Perez-Cueto, F. J. A. (2020). Assessing the influence of visual-taste congruency on perceived sweetness and product liking in immersive VR. *Foods, 9*(4), 465. https://doi.org/10.3390/FOODS9040465

Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences, 36*(3), 181–204. https://doi.org/10.1017/S0140525X12000477

Curtain, F., & Grafenauer, S. (2019). Plant-based meat substitutes in the flexitarian age: An audit of products on supermarket shelves. *Nutrients, 11*(11), 2603. https://doi.org/10.3390/NU11112603

Davidson, R. (1979). Frontal versus perietal EEG asymmetry during positive and negative affect. *Psychophysiology, 16*(2), 202–203.
Davidson, R. (2004). What does the prefrontal cortex "do" in affect: Perspectives on frontal EEG asymmetry research. *Biological Psychology, 67*(1–2), 219–234. https://doi.org/10.1016/J.BIOPSYCHO.2004.03.008
De Wijk, R. A., Kaneko, D., Dijksterhuis, G. B., van Zoggel, M., Schiona, I., Visalli, M., & Zandstra, E. H. (2019). Food perception and emotion measured over time in-lab and in-home. *Food Quality and Preference, 75*, 170–178. https://doi.org/10.1016/J.FOODQUAL.2019.02.019
Ferrari, L., Panaite, S. A., Bertazzo, A., & Visioli, F. (2022). Animal- and plant-based protein sources: A scoping review of human health outcomes and environmental impact. *Nutrients, 14*(23), 5115. https://doi.org/10.3390/NU14235115
Franco-Arellano, B., Vanderlee, L., Ahmed, M., Oh, A., & L'abbé, M. R. (2020). Consumers' implicit and explicit recall, understanding and perceptions of products with nutrition-related messages: An online survey. *International Journal of Environmental Research and Public Health, 17*(21), 8213. https://doi.org/10.3390/IJERPH17218213
Giacalone, D., & Jaeger, S. R. (2023). Consumer acceptance of novel sustainable food technologies: A multi-country survey. *Journal of Cleaner Production, 408*, Article 137119. https://doi.org/10.1016/J.JCLEPRO.2023.137119
Giezenaar, C., Jonathan, A., Foster, M., & Hort, J. (2024). Effects of intrinsic and extrinsic product characteristics related to protein source, health and environmental sustainability, on product choice and sensory evaluation of meatballs and plant-based alternatives. *Food Quality and Preference, 113*, Article 105070. https://doi.org/10.1016/J.FOODQUAL.2023.105070
Haasova, S., & Florack, A. (2019). Practicing the (un)healthy = tasty intuition: Toward an ecological view of the relationship between health and taste in consumer judgments. *Food Quality and Preference, 75*, 39–53. https://doi.org/10.1016/J.FOODQUAL.2019.01.024
Haider, H., & Frensch, P. A. (1996). The role of information reduction in skill acquisition. *Cognitive Psychology, 30*(3), 304–337. https://doi.org/10.1006/COGP.1996.0009
Haider, H., & Frensch, P. A. (1999). Eye movement during skill acquisition: More evidence for the information-reduction hypothesis. *Journal of Experimental Psychology. Learning, Memory, and Cognition, 25*(1), 172–190. https://doi.org/10.1037/0278-7393.25.1.172
Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications.
IBM SPSS Statistics for Windows, Version 29 (29.0). (2023). *IBM Corp*.
iMotions A/S. (2023). *iMotions (9.3)*.
Jaeger, S. R., Giacalone, D., Jin, D., Ryan, G. S., & Cardello, A. V. (2023). Information about health and environmental benefits has minimal impact on consumer responses to commercial plant-based yoghurts. *Food Quality and Preference, 106*. https://doi.org/10.1016/j.foodqual.2023.104820
Jaeger, S. R., Lee, P. Y., Xia, Y. X., Chheang, S. L., Roigard, C. M., & Ares, G. (2019). Using the emotion circumplex to uncover sensory drivers of emotional associations to products: Six case studies. *Food Quality and Preference, 77*, 89–101. https://doi.org/10.1016/J.FOODQUAL.2019.04.009
Jansson-Boyd, C. V., & Bright, P. (2024). Understanding emotions. *Consumer Neuroscience*, 141–164. https://doi.org/10.1016/B978-0-443-13581-1.00008-X
Jo, J., & Lusk, J. L. (2018). If it's healthy, it's tasty and expensive: Effects of nutritional labels on price and taste expectations. *Food Quality and Preference, 68*, 332–341. https://doi.org/10.1016/J.FOODQUAL.2018.04.002
Kaur, A., Scarborough, P., & Rayner, M. (2017). A systematic review, and meta-analyses, of the impact of health-related claims on dietary choices. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1), 1–17. https://doi.org/10.1186/S12966-017-0548-1/FIGURES/4
Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: A review. *Biological Psychology, 84*(3), 394–421.
Lee, A. Y. (2002). Effects of implicit memory on memory-based versus stimulus-based brand choice. *Journal of Marketing Research, 39*(4), 440–454. https://doi.org/10.1509/JMKR.39.4.440.19119/ASSET/IMAGES/LARGE/10.1509_JMKR.39.4.440.19119-FIG 3.JPEG
Loebnitz, N., & Grunert, K. G. (2018). Impact of self-health awareness and perceived product benefits on purchase intentions for hedonic and utilitarian foods with nutrition claims. *Food Quality and Preference, 64*, 221–231. https://doi.org/10.1016/J.FOODQUAL.2017.09.005
Mai, R., & Hoffmann, S. (2015). How to combat the unhealthy = tasty intuition: The influencing role of health consciousness. *Journal of Public Policy & Marketing, 34*(1), 63–83. https://doi.org/10.1509/JPPM.14.006/ASSET/IMAGES/LARGE/10.1509_JPPM.14.006-FIG 4.JPEG
Mai, R., Hoffmann, S., Hoppert, K., Schwarz, P., & Rohm, H. (2015). The spirit is willing, but the flesh is weak: The moderating effect of implicit associations on healthy eating behaviors. *Food Quality and Preference, 39*, 62–72. https://doi.org/10.1016/J.FOODQUAL.2014.06.014
Meijer, G. W., Lähteenmäki, L., & Stancu, V. (2022). Impact of health claims: What has been achieved and what is the future? *Critical Reviews in Food Science and Nutrition*. https://doi.org/10.1080/10408398.2022.2094339
Pennanen, K., Närväinen, J., Vanhatalo, S., Raisamo, R., & Sozer, N. (2020). Effect of virtual eating environment on consumers' evaluations of healthy and unhealthy snacks. *Food Quality and Preference, 82*, Article 103871. https://doi.org/10.1016/J.FOODQUAL.2020.103871
Peschel, A. O., Kazemi, S., Liebichová, M., Sarraf, S. C. M., & Aschemann-Witzel, J. (2019). Consumers' associative networks of plant-based food product communications. *Food Quality and Preference, 75*, 145–156. https://doi.org/10.1016/J.FOODQUAL.2019.02.015
Piqueras-Fiszman, B., & Jaeger, S. R. (2015). The effect of product–context appropriateness on emotion associations in evoked eating occasions. *Food Quality and Preference, 40*(PA), 49–60. https://doi.org/10.1016/J.FOODQUAL.2014.08.008
Piqueras-Fiszman, B., & Spence, C. (2015). Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Quality and Preference, 40*(PA), 165–179. https://doi.org/10.1016/J.FOODQUAL.2014.09.013
Pula, K., Parks, C. D., & Ross, C. F. (2014). Regulatory focus and food choice motives. Prevention orientation associated with mood, convenience, and familiarity. *Appetite, 78*, 15–22. https://doi.org/10.1016/J.APPET.2014.02.015
Raghunathan, R., Naylor, R. W., & Hoyer, W. D. (2006). The unhealthy = tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. *Journal of Marketing, 70*, 170–184. http://www.marketingpower.com/jmblog.
Ravaja, N., Somervuori, O., & Salminen, M. (2013). Predicting purchase decision: The role of hemispheric asymmetry over the frontal cortex. *Journal of Neuroscience, Psychology, and Economics, 6*(1), 1–13. https://doi.org/10.1037/A0029949
Ringle, C. M., Wende, S., & Becker, J.-M. (2022). *SmartPLS 4*. Oststeinbek: SmartPLS.
Semenova, D., Kulikova, S., Zaripova Shamgunova, Y., & Molodchik, M. (2023). Measuring effects of packaging on willingness-to-pay for chocolate: Evidence from an EEG experiment. *Food Quality and Preference, 107*, Article 104840. https://doi.org/10.1016/J.FOODQUAL.2023.104840
Songsamoe, S., Saengwong-ngam, R., Koomhin, P., & Matan, N. (2019). Understanding consumer physiological and emotional responses to food products using electroencephalography (EEG). *Trends in Food Science & Technology, 93*, 167–173. https://doi.org/10.1016/J.TIFS.2019.09.018
Stancu, V., Grunert, K. G., & Lähteenmäki, L. (2017). Consumer inferences from different versions of a beta-glucans health claim. *Food Quality and Preference, 60*, 81–95. https://doi.org/10.1016/j.foodqual.2017.03.001
Stancu, V., Lähteenmäki, L., & Grunert, K. G. (2021). The role of time constraints in consumer understanding of health claims. *Food Quality and Preference, 94*, Article 104261. https://doi.org/10.1016/J.FOODQUAL.2021.104261
Stasi, A., Songa, G., Mauri, M., Ciceri, A., Diotallevi, F., Nardone, G., & Russo, V. (2018). Neuromarketing empirical approaches and food choice: A systematic review. *Food Research International, 108*, 650–664. https://doi.org/10.1016/J.FOODRES.2017.11.049
Steinhauser, J., & Hamm, U. (2018). Consumer and product-specific characteristics influencing the effect of nutrition, health and risk reduction claims on preferences and purchase behavior – A systematic review. *Appetite, 127*, 303–323. https://doi.org/10.1016/J.APPET.2018.05.012
Stickel, L., Grunert, K. G., & Lähteenmäki, L. (2025). Implicit and explicit liking of a snack with health- versus taste-related information. *Food Quality and Preference, 122*, Article 105293. https://doi.org/10.1016/J.FOODQUAL.2024.105293
Stroebe, W., Mensink, W., Aarts, H., Schut, H., & Kruglanski, A. W. (2008). Why dieters fail: Testing the goal conflict model of eating. *Journal of Experimental Social Psychology, 44*(1), 26–36. https://doi.org/10.1016/J.JESP.2007.01.005
Sultan, P., Tarafder, T., Pearson, D., & Henryks, J. (2020). Intention-behaviour gap and perceived behavioural control-behaviour gap in theory of planned behaviour: Moderating roles of communication, satisfaction and trust in organic food consumption. *Food Quality and Preference, 81*, Article 103838. https://doi.org/10.1016/J.FOODQUAL.2019.103838
Temple, N. J. (2019). Front-of-package food labels: A narrative review. *Appetite, 144* (104485). https://doi.org/10.1016/j.appet.2019.104485
Tijssen, I., Zandstra, E. H., den Boer, A., & Jager, G. (2019). Taste matters most: Effects of package design on the dynamics of implicit and explicit product evaluations over repeated in-home consumption. *Food Quality and Preference, 72*, 126–135. https://doi.org/10.1016/J.FOODQUAL.2018.09.009
Togawa, T., Park, J., Ishii, H., & Deng, X. (2019). A packaging visual-gustatory correspondence effect: Using visual packaging design to influence flavor perception and healthy eating decisions. *Journal of Retailing, 95*(4), 204–218. https://doi.org/10.1016/J.JRETAI.2019.11.001
Tulving, E. (1972). Episodic and semantic memory. *Organization of Memory*, 381–403. http://alicekim.ca/EMSM72.pdf.
Vecchio, R., & Cavallo, C. (2019). Increasing healthy food choices through nudges: A systematic review. *Food Quality and Preference, 78*, Article 103714. https://doi.org/10.1016/J.FOODQUAL.2019.05.014
Werle, C. O. C., Trendel, O., & Ardito, G. (2013). Unhealthy food is not tastier for everybody: The "healthy = tasty" French intuition. *Food Quality and Preference, 28* (1), 116–121. https://doi.org/10.1016/J.FOODQUAL.2012.07.007
Zellner, D., Greene, N., Jimenez, M., Calderon, A., Diaz, Y., & Sheraton, M. (2018). The effect of wrapper color on candy flavor expectations and perceptions. *Food Quality and Preference, 98*(104). https://doi.org/10.1016/j.foodqual.2018.02.011