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Positive emotions explain increased intention to consume five types of alternative proteins

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A B S T R A C T

Transitions in consumer diets towards a more 'meat-less' diet are stated to result in various health and environmental benefits. Consumption of alternative proteins provides one of the alternatives towards more meat-less diets. Alternative proteins receive a lot of attention, however it is unclear whether consumer acceptance is changing over time. Moreover, changing consumers' dietary habits is harsh. The current study explores with a longitudinally study whether trends are visible in consumer acceptance of alternative proteins, and which drivers are relevant to understand acceptance of alternative proteins over time.

An online survey was conducted in the Netherlands resulting in two types of samples: a longitudinal sample (500 respondents) that answered the same survey in 2015 and 2019, and cross-sectional samples that answered the survey in 2015 (2,461 respondents) or in 2019 (2,000 respondents). The survey addressed a range of possible drivers, including personal norms, food innovation traits (i.e. food neophobia and domain-specific innovativeness), food-choice motives and positive and negative emotions. Respondents were randomly divided into five groups and presented with specific questions on: fish, seaweed, insects, legumes and cultured meat.

The results reveal an increase in the intention to consume seaweed, legumes, and cultured meat over time, though self-reported consumption remains stable indicating an intention-behaviour gap. Positive emotions appear to be the most relevant driver for intention (beyond all other included variables), and intentions in turn are the most relevant driver of consumption. Thus indicating the relevance of positive emotions as joy, content and pride. Implicating that interventions, promotions and communications should not only focus on cognitive added values as environmental impact though also include affective communication messages, e.g., consumption of alternative proteins feels good.

1. Introduction

Research conducted in recent decades has clearly shown that replacing diets rich in animal-based foods—particularly red and processed meat products—with dietary patterns that are higher in plant-based foods could yield substantial benefits in terms of human health and environmental sustainability (e.g. Carlsson-Kanyama & González, 2009; Godfray et al., 2018; McMichael, Powles, Butler, & Uauy, 2007; Tukker et al., 2011; Westhoek et al., 2014; Willett et al., 2019). Despite a large body of evidence and the existence of clear health and environmental concerns, such knowledge is currently not enough to motivate a broad range of consumers to choose exclusively low-meat diets. Studies show that many food consumers are deeply attached to meat and unwilling to change their meat-consumption behaviour (e.g. Dagevos & Voordouw, 2013; Graça, Calheiros, & Oliveira, 2015; Harguess, Crespo, & Hong, 2020; Hartmann & Siegrist, 2020; Lentz, Connelly, Mirosa, & Jowett, 2018; Macdiarmid, Douglas, & Campbell, 2016; Schösler, Boer, & Boersema, 2012). In order to support transitions towards a 'meat-less' diet there is a need to understand the drivers of acceptance of meat alternatives (e.g., Hartmann & Siegrist, 2020; Onwezen, Bouwman, Reinders, & Dagevos, 2021).

The 'protein transition' entails reducing total protein intake and changing the ratio between animal-based and plant-based proteins in favour of plant-based proteins (Aiking & de Boer, 2020; de Boer & Aiking, 2019). The current study focusses specifically on the acceptance of alternative proteins. The shift towards food-consumption patterns involving less meat can take a variety of forms. Consumers can adopt 'flexitarian' or vegetarian diets, or they can adjust their dietary habits only slightly by occasionally including dishes that do not centre on traditional meat products in their diets (Dagevos & Voordouw, 2013). Meat reduction could potentially be facilitated by the availability of alternatives to meat, but this depends largely on the acceptability and attractiveness of such alternatives to consumers (van der Weele, Feindt, van der Goot, van Mierlo, & van Boekel, 2019). In principle, a broad range of protein sources could be regarded as meat alternatives. Meat alternatives range from plant-based meat substitutes, legumes, mushrooms, quinoa, lupines, tofu, nuts, algae and seaweed to animal-based alternatives including fish, eggs or cheese, and even insects and 'animal-free' cultured (*in-vitro*) meat (Hartmann & Siegrist, 2020; Michel, Hartmann, & Siegrist, 2021). Some alternative proteins (e.g. legumes)

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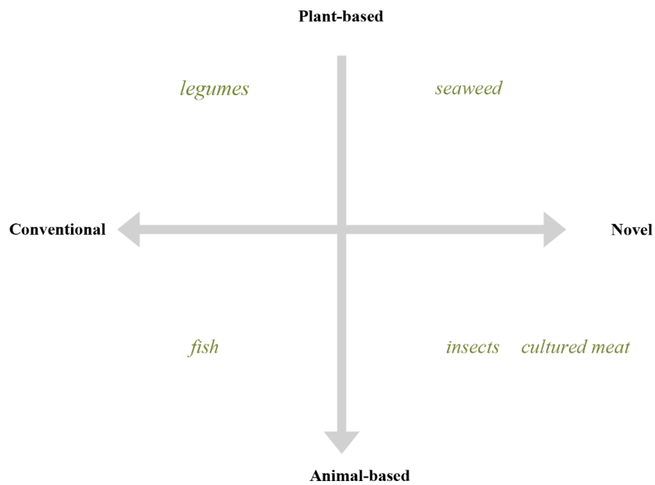

Fig. 1. Two-dimensional framework of selected alternative proteins.

have a long history in human consumption, others are relatively new (e.g. cultured meat) or unfamiliar in the Western diet (e.g. insects) (Onwezen, Van den Puttelaar, Verain, & Veldkamp, 2019; Onwezen et al., 2021). The current study includes multiple alternative proteins, as the diversity in different types of alternative proteins results in the need to understand how consumer acceptance varies across alternative proteins.

Although not all of the aforementioned alternative proteins are widely accepted by contemporary consumers (Onwezen et al., 2021), and despite the difficulty of changing habitual meat-consumption behaviours, several trends suggest that interest in alternative proteins is growing. At this point, we mention three examples. First, growing consumer interest in more plant-rich flexitarian and vegetarian diets (e.g., Bryant, 2019) indicates the existence of support for meat-reducing strategies and the gradual integration of alternative proteins into Western diets. Second, although not all categories of alternative proteins are currently widely available, supermarkets and restaurants are increasingly offering alternatives to traditional meat products or dishes (Innova 2018). In particular, plant-based meat alternatives and hybrid products (e.g. burgers or sausages made of ground meat mixed with nuts, fungi, legumes or soy) have become more widely available and are attracting consumer attention as substitutes for conventional meat products. Although market shares have thus far been low, they appear to be on the rise, for example the purchase of meat substitutes is shown to be doubled from 2015 to 2020 (e.g., Distrifood; Sustainable, 2020). Third, in addition to cautious changes at the individual and market levels, a dietary shift towards meat moderation has been recognised as an issue that should be on the policy agenda at the European level. In its recent *Farm to Fork Strategy*, the European Commission clearly states:

> *Current food consumption patterns are unsustainable from both health and environmental points of view. (…) Moving to a more plant-based diet with less red and processed meat and with more fruits and vegetables will reduce not only risks of life threatening diseases, but also the environmental impact of the food system.* (European Commission, 2020)

To date it is however unclear whether consumer acceptance indeed increased over the years.

The current study adds to the body of research on the acceptance of alternative proteins in three ways. First, it provides insight into how the level of acceptance for a number of alternative proteins changed between 2015 and 2019. To date, there are up until our knowledge no studies that explore the shift in consumer acceptance of alternative proteins across years. We included a longitudinal sample answering the same survey in 2015 and 2019 ($N = 500$) to explore whether consumer intentions and consumption of alternative proteins changes across the past years. Second, the current study proposes explanations for such changes. Previous cross-sectional studies have provided indications of relevant drivers of acceptance. For example, health and environmental considerations have been identified as playing a particularly important role in the shift towards plant-based diets and foods (Aschemann-Witzel & Peschel, 2019; Banovic et al., 2018; Peschel, Kazemi, Liebichová, Sarraf, & Aschemann-Witzel, 2019), while potential barriers include scepticism towards these products in terms of taste, satiety, nutritional value and other aspects (Reipurth et al., 2019). We add to the literature by testing a conceptual model including a wide range of explanatory variables for consumer acceptance of alternative proteins, and exploring whether these drivers remain significant across years. Third, most previous studies have focused on specific alternative proteins, and comparisons across proteins are needed in order to investigate differences in consumer acceptance for multiple alternative proteins. The current study adds to the literature by including various alternative proteins, namely fish, legumes, seaweed, insects and cultured meat. The current study thus aims to provide an indication of whether consumers became more accepting of a range of alternative proteins over time (RQ1), in addition to identifying drivers that could explain variations over time (RQ2).

2. Theoretical framework

2.1. Selection of five alternative protein sources.

The field of alternative proteins can be organised or divided in various ways (see Fischer, Onwezen, Meer, & van der, 2021). For example, Sexton, Garnett, and Lorimer (2019) distinguish between edible insects, cellular agriculture (cultured meat) and plant-based proteins. In contrast, Van der Weele colleagues (2019) use the classifications of cultured meat, legumes, plant-based meat alternatives, insects and algae, as also reported in a systematic review on the topic by Onwezen and colleagues (2020). In another review study, Hartmann and Siegrist (2017) refer to meat substitutes, cultured meat and insects. Our selection of five distinct alternative proteins was made as early as 2015. In retrospect, however, it largely anticipates the selection used in studies conducted in recent years. Our selection further allows the possibility of filling in the quadrants of a two-dimensional model (based on Dagevos, Tolonen, & Quist, 2019; Henchion, Hayes, Mullen, Fenelon, & Tiwari, 2017) that can be used to represent the field of alternative proteins (Fig. 1).

In addition to contrasting plant-based and animal-based alternative proteins, our selection allows a distinction between conventional and novel sources of protein (Onwezen et al., 2021). For example, while both legumes and seaweed are plant-based, legumes like beans are more accepted as meat alternative than seaweed or algae (Weinrich, 2018). Likewise, fish, insects and cultured meat are all animal-derived proteins, but fish is more accepted by Dutch consumers as meat alternative than insects (Weinrich, 2018). Cultured meat has not entered the Dutch market yet, and is therefore a future meat alternative.

2.2. Explanatory variables

To date, rational considerations alone have apparently had relatively little impact on consumers' decisions to change their eating habits to place less emphasis on meat (Onwezen et al., 2021). The present study therefore highlights a wide range of explanatory variables that extends far beyond health and environmental considerations. Both of these issues are nevertheless included in terms of *personal norms* (Fig. 2), which play a pivotal role in the norm-activation model, originally developed by Schwartz (1977) to explain altruistic behaviour. Personal norms (or personal beliefs) concern the extent to which specific individual behavioural actions are right or wrong, and they are commonly used to predict individual behaviour. It is therefore relevant to include personal norms in the current study on consumer acceptance of alternative

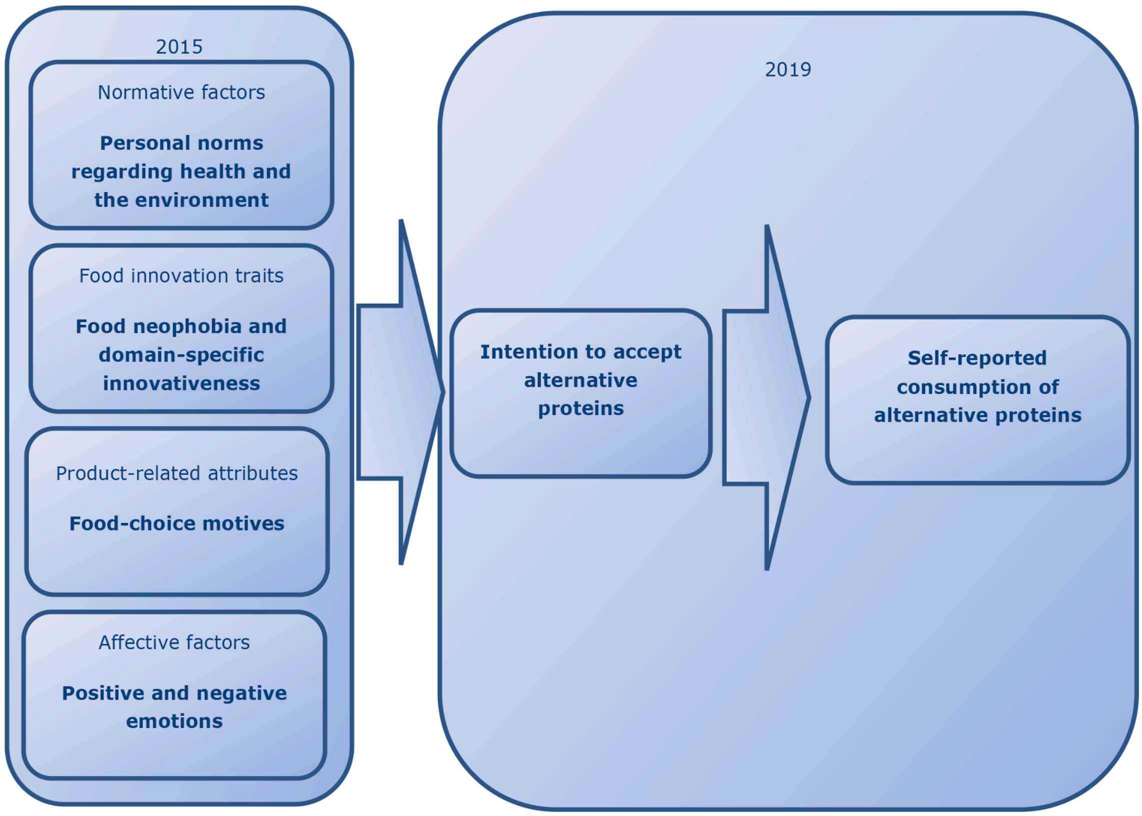

Fig. 2. Conceptual model to explain consumer intentions to accept alternative proteins over time.

proteins, particularly given that health and environmental considerations have been addressed in studies aimed at explaining the shift towards plant-based diets and foods (Aschemann-Witzel & Peschel, 2019; Banovic et al., 2018; Peschel et al., 2019) or consumer receptiveness to eating insects (Menozzi, Sogari, Veneziani, Simoni, & Mora, 2017; Schlup & Brunner, 2018; Sogari, Menozzi, & Mora, 2016; Vanhonacker, van Loo, Gellynck, & Verbeke, 2013; Verbeke, 2015). We propose that both higher levels of personal environmental norms and personal health norms are associated with higher levels of acceptance for alternative proteins.

The existing literature reflects personal variability (i.e., traits) in the extent to which consumers are willing to try novel foods. Key constructs relating to food innovation traits are the adoption of novel products include *food neophobia* (i.e. the aversion to trying novel foods; Pliner & Hobden, 1992) and *domain-specific innovativeness* (i.e. consumer innovativeness within a given domain; Goldsmith & Hofacker, 1991). Our conceptual model includes both of these constructs (Fig. 2). More specifically to the context of alternative proteins, various studies on edible insects have indicated that food neophobia is an important driver of consumer acceptance of insects (see Dagevos, 2021; Mancini, Moruzzo, Riccioli, & Paci, 2019; Sogari, Amato, Biasato, Chiesa, & Gasco, 2019 for current reviews), seaweed or cultured meat (see Onwezen et al., 2021 for an overview of relevant studies). We propose that higher levels of food neophobia are associated with lower intentions to consume alternative proteins.

In contrast to food neophobia, domain-specific innovativeness has been largely ignored in studies relating to alternative proteins. Domain specific innovativeness is shown to be relevant in acceptance of novel foods (e.g., Barrena & Sánchez, 2013), and as alternative proteins can be regarded as novel foods, we include this concept in this study. We propose that higher levels of domain-specific innovativeness are associated with higher intentions to consume alternative proteins.

Our model also includes *food-choice motives* (Fig. 2), which refer to a range of motivations for food-related choices (Steptoe, Pollard, & Wardle, 1995; Onwezen, Reinders, Verain, & Snoek, 2019). The original scale (Steptoe et al., 1995) includes nine motives: health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity and ethical concerns. In later studies, the ethical dimension has been subdivided into multiple motives (e.g. Lindeman & Väänänen, 2000; Sautron et al., 2015; Onwezen et al., 2019): animal welfare, environmental protection and fair trade. Studies on alternative proteins have consistently identified certain motives (e.g. health and taste) as relevant (Onwezen et al., 2021). Moreover, alternative proteins have consistently been associated with sustainable benefits (Hartmann & Siegrist, 2017; Onwezen et al., 2021). We therefore propose that health, taste and sustainable motives are relevant to the acceptance of alternative proteins.

Positive and negative emotions (Fig. 2) were also included in the conceptual model. Although emotions have been relatively under-researched within the context of food (see Evers, Dingemans, Junghans, & Boevé, 2018 for a *meta*-analysis), they play an important role in decision-making and guiding behavioural choices (Onwezen, Antonides, & Bartels, 2013), particularly for people with little to no knowledge or experience with particular choices or circumstances. This aspect supports the assumption that emotions could be relevant to understanding consumer acceptance of alternative proteins, many of which are new an unfamiliar to food consumers. It is this remarkable to note that consumer studies on alternative protein sources (as compared to conventional meat products) hardly ever address emotions. One notable exception relating to modern meat-consumption practices is a recent study by Sahakian, Godin, & Courtin, 2020. Other exceptions include consumer studies on edible insects, which reveal that emotions play a stronger role when alternative proteins are perceived as more innovative (Onwezen et al., 2019), as well as that eating insects (or the idea of eating them) can evoke strong negative emotions, including disgust or even fear (for further details, see Dagevos, 2021; Onwezen et al., 2021). With respect to positive and negative emotions, we therefore propose that higher levels of positive (or negative) emotions are associated with

Table 1
Means and reliability scores for all constructs across the various samples.

	Cross-sectional samples				Longitudinal sample			
	2015 (*N* = 2461)		2019 (*N* = 2000)		2015 (*N* = 500)		2019 (*N* = 500)	
	M	α	*M*	α	*M*	α	*M*	α
Personal norm: Health	5.02	0.90	5.05	0.85	4.86	0.91	4.94	0.89
Personal norm: Environment	4.90	0.92	5.01	0.91	4.94	0.93	5.11	0.90
Food neophobia	3.21	0.85	3.46	0.87	3.23	0.83	3.42	0.88
Domain-specific innovativeness	4.06	0.80	4.17	0.79	3.96	0.81	3.82	0.83
FCM Health	4.70	0.92	4.31	0.82	4.77	0.93	4.53	0.84
FCM Price	4.56	0.94	4.23	0.81	4.65	0.94	4.37	0.84
FCM Weight control	4.24	0.94	4.07	0.83	4.36	0.94	4.28	0.79
FCM Mood	3.54	0.95	3.80	0.89	3.59	0.95	4.00	0.92
FCM Familiarity	3.69	0.90	3.87	0.77	3.72	0.90	3.90	0.77
FCM Convenience	4.42	0.98	4.21	0.91	4.56	0.98	4.36	0.92
FCM Sensory appeal	4.69	0.95	4.32	0.85	4.72	0.96	4.51	0.86
FCM Naturalness	4.77	0.96	4.33	0.88	4.81	0.97	4.52	0.91
FCM Sustainability	4.50	0.96	4.19	0.88	4.50	0.97	4.46	0.89
Positive emotions	3.15	0.90	3.41	0.91	3.13	0.91	3.73	0.93
Negative emotions	2.11	0.89	2.33	0.90	2.10	0.88	2.23	0.90
Intention level	3.49	0.94	3.65	0.94	3.52	0.95	3.68	0.94

Note: FCM = Food-choice motives. M = mean, α = Cronbach's alpha; note that the Spearman Brown coefficient is reported for the measurement of two items for personal norms and intentions.

higher (or lower) intentions to consume alternative proteins.

Finally, the research design includes intentions and self-reported consumption to measure acceptance of alternative proteins. As stated in the literature intentions do not necessarily reflect behaviour. Consumer acceptance is often differentiated in intention and behaviour, as there is a gap between intentions and behaviour (Vermeir & Verbeke, 2006). Including both measures further increases the understanding of consumer acceptance. In accordance with the theory of planned behaviour (Ajzen, 1991), we propose that the effects of drivers on behaviour mainly occur via intentions. Previous studies have theorised extended drivers of the TPB, and revealed for the various included drivers in this study (emotions [Perugini & Bagozzi, 2001], food neophobia [Ting, de Run, Cheah, & Chuah, 2016], personal norms [Parker, Manstead, & Stradling, 1995], food choice motives [Wang & Scrimgeour, 2021]) that they associate with intentions. We therefore theorise and assume that the included drivers mainly affect intentions, and intentions in turn affect behavioural consumption (see Fig. 2).

Moreover, reviews indicated the need for more longitudinal studies to understand the drivers of acceptance in the transition towards decreased meat consumption and increased alternative protein consumption (Bryant & Barnett, 2018; Hartmann & Siegrist, 2017). We decided to include a longitudinal design to explore the robustness of the drivers across time. We followed the example of previous studies (LaBarbera & Mazursky, 1983; Tang, Guo, & Gopinath, 2016), such that independent variables are measured as baseline and the dependent variables (intentions and consumption) are measured later time. Including a longitudinal sample decreases common method bias, as dependent and independent variables are measured in different moments in time (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), increases understanding of causality of associations (Hartmann & Siegrist, 2017), and improves understanding of robustness of drivers over time (Harris, Gordon, MacKintosh, & Hastings, 2015; Muijs, 1997; Pace, D'Urso, & Zappulla, 2018).

In sum the current study aims to explore trends over time in consumer acceptance of alternative proteins (RQ1), and explore which drivers are relevant in explaining consumer acceptance over time (RQ2, see Fig. 2).

3. Method

3.1. Data sampling

Data was collected by a research agency in 2015 and 2019. Adult respondents were recruited online in the Netherlands. They were invited to join an online survey by email, and they received a small fee (e.g., gift points) in return. The research agency was asked to recruit balanced samples in terms of age and gender. Each respondent was randomly assigned to one of five conditions and presented with questions specific to one of the following five protein sources: fish, seaweed, legumes, insects and cultured meat (see Onwezen et al., 2019 for a short explanation of each alternative protein).[1]

In 2015 and in 2019 a research agency was asked to recruit respondents. Moreover they were asked to re-invite the respondents of 2015 in order to try to have a subsample of respondents that answered both surveys (assigned to the same condition as in 2015). Note that we did not set up a longitudinal survey beforehand, though decided on hindsight to explore the opportunity to invite the same respondents, though we managed to recruit 500 respondents that answered the same survey in both years (20%). We separated the total sample in two independent datasets to avoid mixing up respondents with or without prior knowledge of filling out the survey in 2015. The data collection thus resulted in two types of data samples: cross-sectional samples and a longitudinal sample.

The cross-sectional samples include all respondents that either answered the survey in 2015 (N = 2,461) *or* 2019 (N = 2,000). (Excluding the respondents that answered the survey in both years).

The longitudinal sample includes respondents that answered the survey in both 2015 *and* in 2019 (N = 500). The response rate of this specific sub-set was 60% indicating that 833 respondents were invited to participate. The low percentage of respondents that answered both

[1] The measurements used in this study were part of a larger survey. Other parts of the survey have been published in Onwezen et al. (2019) and Onwezen et al. (submitted). These studies have a different focus and use other parts of the data. More specific, the Onwezen et al. (2019) only uses data from 2015. This study also includes other datasets and shows the added value for affective variables in understanding acceptance of a range of insect products. The Onwezen et al. (submitted) paper focusses on a specific part of the data that has a focus on burger consumption. That study focussed on the theory of planned behaviour and the added value of ambivalence.

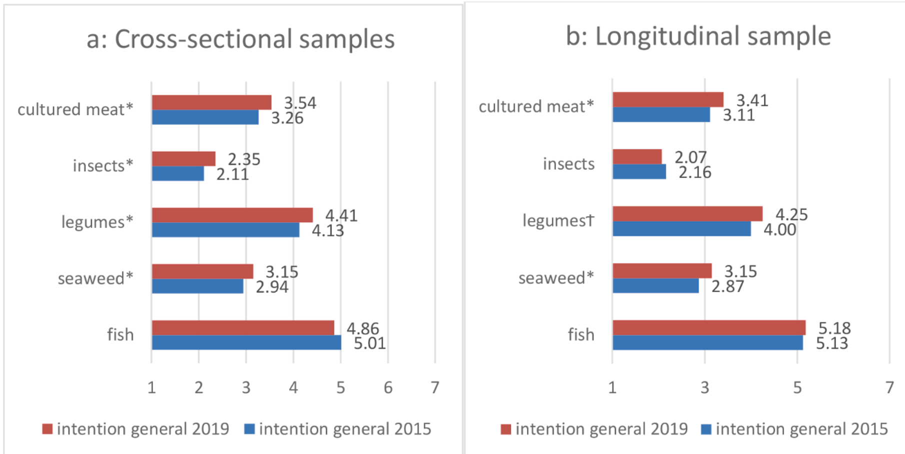

Fig. 3. Intention to consume five categories of alternative proteins. Note: * indicates significant differences across 2015 and 2019 at $p < 0.05$; † indicates a marginally significant difference at $p \leq 1$.

surveys across years depends on high dropout rates of the professional panels, these respondents could not be reached anymore. Subsequently a selection bias might have occurred.

3.2. Participants

The cross-sectional sample in 2015 consisted of 2,461 respondents (male: 58.9%), with a mean age of 46.0 years ($SD = 15.8$), and the cross-sectional 2019 sample comprised 2,000 respondents (male: 50.6%), with a mean age of 43.08 ($SD = 15.8$). The longitudinal sample of 500 respondents (approximately 100 for each of the five conditions) answered the online questionnaire in both 2015 and 2019. This subset of 500 respondents (male: 47.4%) had a mean age of 56.93 ($SD = 12.6$).

3.3. Measurements

All of the Cronbach's alpha values and Spearman Brown coefficients (for personal norms and intentions) indicated reliability (Table 1).

Personal norms. The following items were selected to measure personal norms, based on previous research (Gärling, Fujii, Gärling, & Jakobsson, 2003; Onwezen et al., 2013): 'I feel that I should protect the environment/my health', and 'Because of my own values/principles, I feel an obligation to behave in an environmentally friendly/healthy way'. Response options ranged from 1 (completely disagree) to 7 (completely agree).

Food neophobia. The construct of food neophobia was measured using five items from the scale developed by Pliner and Hobden (1992). The original 10-item scale included reverse-coded items. We included only the five negative items. Response options ranged from 1 (completely disagree,) to 7 (completely agree).

Domain-specific innovativeness. The construct of DSI was measured using three items from the scale developed by Goldsmith and Hofacker (1991). The original six-item scale included reverse-coded items. We included only the three positive items. Response options ranged from 1 (completely disagree) to 7 (completely agree).

Food-choice motives. Food choice motives were measured with an updated, more robust version of the original scale (Steptoe et al., 1995), developed by Fotopoulos, Krystallis, Vassallo, and Pagiaslis (2009). The updated version has additional variables, including environmental friendliness and social justice (e.g. 'is produced in an environmentally-friendly way'; Lindeman & Väänänen, 2000). Exploratory factor analyses revealed that the sustainability items formed one dimension, as all items loaded on the same underlying dimension, which is in accordance with a recent study on sustainable food choice motives (Verain, Snoek, Onwezen, Reinders, & Bouwman, 2021). In the current manuscript, these motives are therefore combined to form a single sustainability dimension. Animal welfare is excluded, as it is not relevant to all product categories (e.g. seaweed and legumes). The participants were asked to respond to the following statement 'It is important to me that the [one of the five protein-based categories] …' for 33 items, using a seven-point scale ranging from 1(not important at all) to 7 (very important).

Emotions. Positive and negative emotions were measured following the example of Bagozzi and Pieters (1998). Three items measured positive emotions (happy, satisfied, proud), and three items measured negative emotions (angry, sad, guilty). The participants were asked to respond to the statement 'When I think of eating [one of the five protein-based categories], I feel…' (ranging from 1 (not at all) to 7 (very much).

Intention. Intention was measured with two items: 'I intend to eat [name category] this week' and 'I believe it is likely that I will eat [name category] this week'. Response options ranged from 1 (completely disagree) to 7 (completely agree) on a seven-point Likert scale.

Self-reported consumption. Self-reported consumption was measured following the example of previous studies (e.g., Onwezen, Bartels, & Antonides, 2014). Respondents were asked to indicate how often they had eaten several proteins, including meat, during the previous week, using a 10-point scale ranging from 0 (never) and 1 (0 days a week, although I do occasionally eat this product) to 9 (every day of the week).

3.4. Use of samples for the analyses

RQ1 trends in time. The current study aims to explore trends over time in consumer acceptance of alternative proteins. We use both datasets, the longitudinal sample and the cross-sectional samples, to explore trends over time. The longitudinal sample has the added value of having the same respondents therefore allowing to explore changes over time within individuals. The cross-sectional samples have the added value of having large sets of respondents allowing to explore changes over time across representative groups of individuals.

RQ2 drivers to explain consumer acceptance. The current study aims to explore which drivers are relevant in explaining consumer acceptance over time. We focus on the longitudinal sample to explore which drivers measured in 2015 are relevant in explaining consumer intentions and self-reported consumption of 2019. Longitudinal research designs are not often used in the specific context of alternative proteins. In related areas longitudinal datasets are more often used. In line with previous studies in the context of academic achievement (Muijs, 1997), negative eating attitudes and behaviour (Pace et al., 2018), and alcohol consumption (Harris et al., 2015) we used the independent variables on 2015 (wave 1) to predict intentions and behaviour in 2019 (wave 2).

The statistical software of Gpower was used to calculate the post hoc

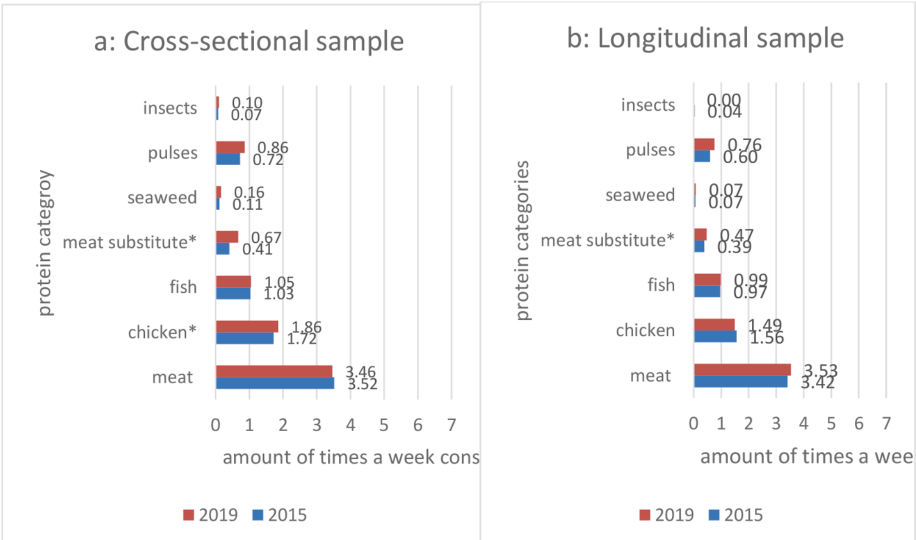

Fig. 4. Self-reported consumption of meat and novel proteins in 2015 and 2019. Note: * indicates significant differences across 2015 and 2019 at p < 0.05 (the scale was recoded such that 'never' and '0 times a week' both correspond to 0 and all other numbers corresponding to the number of days on which a category was consumed). Note that the number of respondents reporting having consumed the alternative proteins once a week or more was low for some alternative proteins. The results should therefore be interpreted with caution, especially for insects and seaweed as these variables show small variation in answering, for example from the longitudinal sample only 7 consumers indicated to have consumed insects and 9 consumers indicated to have consumed seaweed.

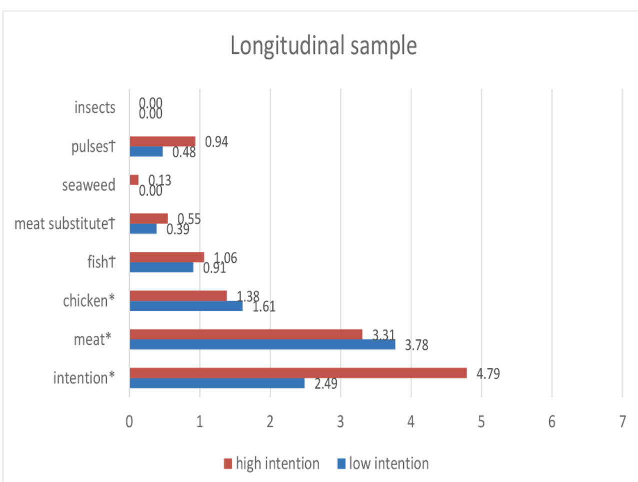

Fig. 5. Self-reported consumption of meat and novel proteins in 2019 differentiated by median splits for intention to consume alternative proteins in 2015. Note: * indicates significant at p < 0.05; † indicates marginally significant differences at p<=.1, (the scale was recoded such that 'never' and '0 times a week' both correspond to 0 and all other numbers corresponding to the number of days on which a category was consumed).

power of the regression analyses. All regression analyses show a power above 0.90 indicating good power. The only exceptions refer to the longitudinal sample with the specific regression analyses of cultured meat with intention as dependent variable (power = 0.74) and the specific regression analyses of insects with consumption as dependent variable (power = 0.52), these findings therefore should be interpreted with care. The cross-sectional samples show higher power than the longitudinal sample (due to larger sample sizes), though all analyses reveal good power.

4. Results

4.1. Changes in intentions and the consumption of alternative proteins (RQ1).

Figure 3a and b reveal the intention to consume various alternative proteins. In general conventional proteins (e.g. fish and legumes) received the highest scores for intention to consume, and they were the only protein sources with scores above the scale midpoint (i.e. indicating a positive intention to consume these proteins in the coming week). Insects received the lowest scores.

Differences in intention across years for cross-sectional samples. Separate samples T-tests were performed for each category of alternative protein with regard to intention to consume. Intention was included as a dependent variable and year as an independent variable. The results (see Fig. 3a) reveal that respondents were more willing to eat seaweed, legumes, insects and cultured meat ($T^{seaweed}(1, 885)4.343$; $p = 0.055$: marginally significant); $T^{legumes}(1, 888)5.831$; $p < 0.05$, $\eta^2 = 0.007$); $T^{insects}(1, 904)16.068$; $p < 0.05$, $\eta^2 = 0.007$); $T^{culturedmeat}(1, 893)0.99$; $p < 0.05$, $\eta^2 = 0.007$) in 2019 than they had been 2015.

Differences in intention across years for longitudinal sample. Paired samples T-tests were performed for each category of alternative protein with intention to consume as dependent variable and year as grouping variable. The results (see Fig. 3b) reveal that respondents were more willing to eat seaweed, legumes, and cultured meat ($T^{seaweed}(1, 106)$ 1.961; $p = 0.05$); $T^{legumes}(1, 101)1.528$; $p = .1$); $T^{culturedmeat}(1, 99)1.930$; $p. < 05$) in 2019 than they had been 2015.

Differences in consumption across years for cross-sectional samples. Separate samples T-tests with self-reported consumption[2] as a dependent variable and year as an independent variable revealed a significant increase from 2015 to 2019 in the consumption of chicken and meat substitutes, referring to plant-based processed meat alternatives ($T^{chicken}(1, 4461)7.611$; $p < 0.01$, $\eta^2 = 0.002$; $T^{meatsubstitutes}(1, 4461)$ 46.675; $p < 0.001$, $\eta^2 = 0.010$). None of the other self-reported consumption categories differed significantly between the two years. These findings indicate that, although intentions to consume seaweed, legumes and insects have increased, this shift has yet to be reflected in self-reported consumption.

Differences in consumption across years for longitudinal sample. Paired samples T-tests were performed for each category of alternative protein. The results (see Fig. 4b) reveal a similar pattern, with a significant increase in self-reported consumption of meat substitutes ($T^{meatsubstitutes}(1,$ $497)2.113$; $p < 0.05$, $\eta^2 = 0.010$). The significance levels of these results were lower, probably due to the smaller sample size. These findings again indicate that, although intentions to consume seaweed and legumes have increased, this shift has yet to be reflected in self-reported consumption.

Differences in acceptance of alternative proteins in 2019 for individuals

[2] Self-reported consumption of cultured meat was not included in the survey, as cultured meat is not yet available on the market.

Table 2
Hierarchical regression analyses exploring associations between explanatory drivers from 2015 and the intention to consume alternative proteins in 2019.

	Fish		Seaweed		Legumes		Insects		Cultured meat	
	β	t-	β	t-	β	t-	β	t-	β	t-
Personal norm: Health	−0.14	−1.35	0.07	0.69	0.11	0.89	−0.07	−0.49	−0.17	−1.12
Personal norm: Environment	0.10	0.87	0.13	1.23	−0.06	−0.44	−0.01	−0.06	0.17	1.08
Food neophobia	0.06	0.61	−0.08	−0.78	0.00	0.02	−0.08	−0.68	0.04	0.35
DSI	0.17	1.55	0.10	1.01	0.04	0.35	0.05	0.47	0.12	1.03
FCM Health	0.36**	2.78	0.12	0.76	0.25	1.23	−0.17	−0.73	0.04	0.23
FCM Price	0.16	1.43	0.02	0.11	−0.04	−0.22	0.03	0.11	0.30	1.34
FCM Weight	0.03	0.31	−0.28	−1.64	0.03	0.16	0.23	0.91	−0.08	−0.38
FCM Mood	−0.15	−1.18	0.18	1.26	−0.03	−0.21	0.08	0.43	0.07	0.33
FCM Familiarity	−0.11	−0.88	−0.05	−0.44	0.03	0.16	−0.26	−1.32	−0.19	−0.87
FCM Convenience	0.15	1.14	−0.13	−0.84	−0.11	−0.53	−0.05	−0.15	−0.03	−0.10
FCM Sensory	−0.14	−1.05	0.10	0.74	0.00	−0.01	0.44	1.02	−0.09	−0.28
FCM Naturalness	0.01	0.08	0.19	1.03	0.21	0.96	0.03	0.09	0.31	1.10
FCM Sustainability	−0.31	−1.77	−0.06	−0.33	−0.12	−0.60	−0.29	−1.11	−0.26	−0.99
Positive emotions	**0.46*** **	**4.27**	**0.42***	**3.82**	**0.26***	**1.95**	**0.53*** **	**4.70**	**0.31***	**2.59**
Negative emotions	−0.08	−0.77	0.08	0.92	0.01	0.07	0.10	0.82	0.06	0.50
Model 1F=(df1, df2); R^2	F=(15, 106)3.669***; R^2 = 0.377		F=(15, 106)4.597***; R^2 = 0.431		F=(15, 101)1.941*; R^2 = 0.253		F=(15, 81)2.983***; R^2 = 0.404		F=(15, 99)1.349; R^2 = 0.194	

Note: DSI = Domain-specific innovativeness; FCM = Food-choice motives; * $p < 0.05$; ** $p < 0.01$; ***$p < 0.001$.

Table 3
Hierarchical regression analyses exploring drivers of self-reported consumption of alternative proteins in 2019.

	Fish		Seaweed		Legumes		Insects	
	β	t-	β	t-	β	t-	β	t-
Personal norm: Health	0.035	0.336	0.102	0.909	0.009	0.076	0.086	0.493
Personal norm: Environment	−0.083	−0.731	−0.115	−0.953	−0.059	−0.467	−0.237	−1.172
Food neophobia	**0.196***	2.074	**0.208†**	1.917	−0.006	−0.056	0.066	0.464
DSI	0.144	1.314	0.163	1.442	0.130	1.206	−0.115	−0.858
FCM Health	0.047	0.362	0.315	1.797	0.108	0.561	0.021	0.072
FCM Price	0.057	0.513	−0.275	−1.736	−0.093	−0.547	0.009	0.026
FCM Weight	−0.043	−0.398	−0.064	−0.322	−0.016	−0.093	0.157	0.522
FCM Mood	−0.150	−1.217	0.048	0.293	−0.074	−0.509	−0.328	−1.457
FCM Familiarity	−0.008	−0.060	−0.016	−0.114	0.174	0.924	0.273	1.128
FCM Convenience	−0.213	−1.718	0.026	0.148	0.046	0.234	0.017	0.044
FCM Sensory	0.166	1.256	−0.158	−0.993	−0.124	−0.595	−0.062	−0.119
FCM Naturalness	0.133	0.999	0.102	0.489	−0.042	−0.205	−0.104	−0.242
FCM Sustainability	−0.053	−0.312	0.013	0.067	−0.029	−0.164	−0.052	−0.164
Positive emotions	−0.102	−0.901	0.000	0.002	0.027	0.216	0.267	1.722
Negative emotions	0.123	1.292	0.077	0.751	−0.025	−0.237	−0.030	−0.201
Intention	**0.601*****	5.944	**0.320****	2.720	**0.550*****	5.528	0.158	1.075
Model 1F=(df1, df2); R^2	F=(16, 106)4.182***; R^2 = 0.426		F=(16, 106)2.288**; R^2 = 0.289		F=(16, 101)3.129***; R^2 = 0.371		F=(16, 81)0.777; R^2 = 0.161	

Note: DSI = Domain-specific innovativeness; FCM = Food-choice motives; * $p < 0.05$; ** $p < 0.01$; ***$p < 0.001$; † indicates marginally significant at $p \leq 0.1$.

Table A1
Hierarchical regression analyses exploring associations of explanatory drivers of intentions to consume alternative proteins on cross-sectional 2019 data sample.

	Fish		Seaweed		Legumes		Insects		Cultured meat	
	β	t-	β	t-	β	t-	β	t-	β	t-
Personal norm: Health	−0.01	−0.10	−0.03	−0.61	0.05	1.20	−0.04	−1.01	−0.03	−0.58
Personal norm: Environment	0.06	1.32	0.08	1.75	**0.12***	2.53	0.06	1.43	0.05	0.96
Food neophobia	−0.06	−1.24	−0.06	−1.48	−0.04	−0.93	−0.03	−0.63	−0.03	−0.73
DSI	0.07	1.41	**0.11***	2.30	**0.12***	2.83	0.08	1.89	**0.20*****	4.59
FCM Health	−0.05	−1.07	0.05	0.93	−0.07	−1.33	0.03	0.42	−0.05	−0.91
FCM Price	0.08	1.71	−0.02	−0.32	0.01	0.21	0.01	0.09	0.07	1.26
FCM Weight	0.00	0.07	−0.03	−0.57	−0.01	−0.23	−0.01	−0.14	−0.07	−1.35
FCM Mood	−0.08	−1.45	−0.04	−0.76	**−0.10***	−2.17	0.02	0.26	−0.07	−1.35
FCM Familiarity	0.04	0.80	0.03	0.57	**0.12***	2.53	0.00	0.08	0.02	0.30
FCM Convenience	−0.07	−1.28	0.00	−0.03	−0.03	−0.59	−0.01	−0.16	−0.04	−0.71
FCM Sensory	0.06	1.09	0.02	0.37	0.00	0.07	0.03	0.47	0.08	1.47
FCM Naturalness	0.07	1.17	0.02	0.39	**0.16***	2.94	0.06	0.96	0.11	1.92
FCM Sustainability	−0.02	−0.46	0.03	0.58	−0.06	−1.12	−0.04	−0.56	0.00	−0.07
Positive emotions	**0.48*****	10.87	**0.56*****	12.54	**0.53*****	12.32	**0.64*****	17.04	**0.57*****	13.89
Negative emotions	**−0.24*****	−5.25	−0.03	−0.65	**−0.17*****	−4.26	**−0.13****	−3.44	**−0.09***	−2.08
Model 1F=(df1, df2); R^2	F=(15, 392)14.079***; R^2 = 0.359		F=(15, 396)20.928***; R^2 = 0.452		F=(15, 889)44.904***; R^2 = 0.435		F=(15, 415)26.569***; R^2 = 0.499		F=(15, 399)19.268 ***; R^2 = 0.429	

Note: DSI = Domain-specific innovativeness; FCM = Food-choice motives; * $p < 0.05$; ** $p < 0.01$; ***$p < 0.001$.

Table A2
Hierarchical regression analyses exploring drivers of self-reported consumption of alternative proteins in 2019.

	Fish		Seaweed		Legumes		Insects	
	β	t-	β	t-	β	t-	β	t-
Personal norm: Health	0.017	0.380	−0.017	−0.339	0.026	0.553	0.076	1.452
Personal norm: Environment	−0.063	−1.384	−0.033	−0.683	−0.068	−1.430	−0.101	−1.922
Food neophobia	**0.119****	2.719	**0.231*****	5.075	0.078	1.720	**0.187*****	3.931
DSI	**0.103***	2.323	**0.230*****	4.794	0.023	0.493	**0.097***	2.019
FCM Health	0.042	0.902	0.022	0.373	0.041	0.747	−0.093	−1.291
FCM Price	0.049	1.063	−0.087	−1.569	0.045	0.864	−0.088	−1.203
FCM Weight	0.046	0.968	−0.007	−0.123	−0.056	−1.033	0.031	0.428
FCM Mood	−0.012	−0.246	−0.035	−0.605	−0.011	−0.213	**−0.137***	−2.017
FCM Familiarity	0.043	0.874	0.051	0.947	0.033	0.645	**0.145***	2.162
FCM Convenience	−0.011	−0.234	−0.012	−0.203	0.045	0.832	−0.001	−0.013
FCM Sensory	−0.059	−1.156	−0.003	−0.058	−0.014	−0.250	0.113	1.557
FCM Naturalness	−0.040	−0.807	−0.032	−0.512	−0.097	−1.692	0.043	0.557
FCM Sustainability	0.059	1.219	0.086	1.464	0.056	1.089	−0.039	−0.542
Positive emotions	**0.122***	2.546	**0.207*****	3.765	**0.189*****	3.587	0.102	1.798
Negative emotions	**0.178*****	4.110	−0.042	−0.952	0.040	0.948	0.074	1.679
Intention	**0.418*****	8.682	**0.150****	2.761	**0.367*****	7.043	**0.260*****	4.485
Model 1F=(df1, df2); R^2	F=(16, 499)12.089***; $R^2 = 0.286$		F=(16, 500)8.496***; $R^2 = 0.219$		F=(16, 499)10.647***; $R^2 = 0.261$		F=(16, 498)6.058***; $R^2 = 0.167$	

Note: DSI = Domain-specific innovativeness; FCM = Food-choice motives; * $p < 0.05$; ** $p < 0.01$; ***$p < 0.001$.

with high and low intentions in 2015. Finally we aimed to explore how intentions from 2015 associate with intentions and consumption in 2019 for the longitudinal sample. We performed median-splits for each condition to explore whether consumers with a high intention in 2015 are more prone to have higher intentions and consumption patterns of alternative proteins in 2019. Paired samples T-tests were performed for each category of alternative proteins. The results reveal that consumers with a high intention in 2015 are more prone to have high intentions to consume alternative proteins in 2019, and also show different self-reported eating patterns. The consumers with high intentions in 2015 show lower amounts of meat and chicken consumption (T^{meat} (1, 498) 7.201; $p < 0.01$; $T^{chicken}$ (1, 498)4.413; $p < 0.05$), and higher meat substitute consumption $T^{meatsubstitute}$ (1, 498)2.695; $p = .1$), fish T^{fish}(1, 498)3.427; $p = 0.065$), and pulses T^{pulses}(1, 101)3.767; $p = 0.06$. There were no significant differences for self-reported consumption of insects and seaweed. Finally, we checked for variations in self-reported consumption across years for each of these two groups separately. Both groups, individuals with initial high and initial low intentions in 2015, showed no significant variations in self-reported consumption across years (all t-tests reveal to be insignificant, $p > 0.1$) (Fig. 5).

4.2. Understanding the relevance of drivers in longitudinal data (RQ2)

Understanding the relevance of drivers on intention in longitudinal data. Using the longitudinal sample a hierarchical regression analysis was performed for each alternative protein. The intention to consume the alternative protein in 2019 was included as a dependent variable, and the explanatory factors of personal norms, domain-specific innovativeness, food neophobia, food-choice motives and positive and negative emotions in 2015 were included as independent variables.

The results (Table 2) clearly indicate that only positive emotions from 2015 remained as a relevant explanatory variable for the intention to consume alternative proteins in 2019. Explained variances ranged from 19.4% to 43.1%, indicating that positive emotions are quite strong in explaining future intentions to consume alternative proteins[3].

Understanding the relevance of intention on self-reported consumption in longitudinal data. Given that intentions do not always reflect behaviour, consumption was also included in our conceptual model (See Fig. 2). We proposed in accordance with the literature that intentions are the most relevant driver of consumption. We tested this assumption by including intentions and all other drivers (personal norms, domain-specific innovativeness, food neophobia, food-choice motives, positive and negative emotions) as independent variables, and self-reported consumption as dependent variable (Table 3). Separate hierarchical regression analyses were performed for self-reported consumption of each alternative protein on the longitudinal dataset. Note that cultured meat was not included, as this protein was not yet available on the market. Moreover, insect consumption shows a low mean and variation. The analyses for this protein should therefore be interpreted with caution.

Intention appears to be a significant predictor of consumption for all alternative proteins, with the exception of insect consumption. Food neophobia (marginally) significantly associates with consumption of fish and seaweed. This association is positive instead of the expected negative association, possibly occurs because fish and seaweed can be regarded as meat alternatives that are perceived as quite familiar. Note that the mean to consume insects was extremely low resulting in too little variation to explain (also visible in the power analysis). All other drivers showed no significant association with self-reported consumption[4].

5. General discussion

Despite many trends indicating an increase in the acceptance of novel proteins (e.g. availability of more products and increasing attention in policy and press), consumption rates for novel proteins remain low (Hartmann & Siegrist, 2017), and levels of meat consumption remain high and difficult to change (Sanchez-Sabate & Sabaté, 2019). This study was designed to explore possible shifts in consumer acceptance of alternative proteins (RQ1) and to generate insight into drivers of behaviour that could explain variations over time (RQ2). These insights could be used to understand societal shifts and develop interventions to support the protein transition.

[3] The same regression analyses as reported above were performed on the cross-sectional 2019 data (see appendix Tables A1 and A2).The findings indicate that cross-sectional data analyses reveal multiple associations of independent variables with the dependent variable (compared to analyses on the longitudinal data), though the strongest and most consistent association of positive emotions with intentions is comparable across both types of datasets.

[4] The same regression analyses as reported above were performed on the cross-sectional 2019 data (see appendix Table A1 and A2). The findings indicate that cross-sectional data reveals multiple associations of independent variables with the dependent variable (compared to the longitudinal data), though the strongest and most consistent association of intentions with self-reported consumption is comparable across both types of datasets.

5.1. Intention-behaviour gap (RQ1)

In general the results indicate a gap between intentions and consumption behaviour. The intention to consume seaweed, legumes and cultured meat has increased, these increased intentions have yet to be reflected in self-reported consumption. Self-reported consumption of fish, legumes, seaweed and insects has remained stable over the past five years. A more detailed look, however, reveals that this gap is much smaller for individuals that already formed intentions to consume alternative proteins in 2015. Individuals who already formed intentions in 2015 consumed less meat and chicken and more meat alternatives, fish and pulses in 2019 (than individuals with lower initial intentions). However, these motivated individuals also did not show a significant change in self-reported consumption patterns across years.

Consumers do not change their behaviour from one day to another. They first become more receptive towards the specific behaviour, and behaviour slowly follows (e.g. from pre-contemplation to action; Prochaska, 1994). Similar gaps between intention and behaviour have been observed within the context of several transitions in society, including the shift to sustainable (e.g. Grimmer & Miles, 2017) or healthy consumption (e.g., Mullan, Allom, Brogan, Kothe, & Todd, 2014). The current findings are promising in two manner. First, they reveal that initially formed intentions are associated with a different consumption pattern, showing smaller intention-behavior gaps. Second, our findings concerning increased intention to consume seaweed, legumes, and cultured meat are promising, suggesting that a transition might have started, as consumers have become more open to alternative proteins. However, the translation of intention into behaviour calls for attention. Interventions might help to support that intention will result in behaviour change (Michie, Van Stralen, & West, 2011). Previous literature has highlighted several ways of narrowing the gap between intention and behaviour, including by changing habits (de Bruijn et al., 2007; van 't Riet, Sijtsema, Dagevos, & De Bruijn, 2011) and activating personal norms (Godin, Conner, & Sheeran, 2005).

Our results indicate the relevance of focussing on different consumer groups. The intention behaviour gap shows to be different for consumers with different motivations. These consumer groups, or consumer segments (Onwezen, 2018), may need different (communication) strategies (Verain et al., 2012). For individuals with low intentions it seems most relevant to focus on interventions to increase motivations and intentions, for example by activating moral values (Hardy & Carlo, 2005) or increasing a sense of urgency (Koerth, Vafeidis, Hinkel, & Sterr, 2013). For individuals with high intentions it seems most relevant to focus on interventions that translate intentions in behaviour, for example making behaviour change easier by contextual triggers or increasing availability (Lehner, Mont, & Heiskanen, 2016).

Finally, our results indicate the relevance of finding ways to enhance understanding concerning self-reported consumption. Although we currently seem to have a good understanding of consumer intentions, including over time, additional research is needed in order to gain insight into actual consumption and identify drivers that can explain consumer choices. Future research should seek to enhance insight into barriers that must be overcome in order to introduce new products into the diets of consumers.

5.2. Conceptual model: Positive emotions are the strongest predictor of intentions (RQ2)

Despite the existence of many differences between alternative proteins and their acceptance, our results reveal substantial similarities in the acceptance of these alternative proteins (Onwezen et al., 2021). Various analyses across the five alternative proteins addressed reveal that positive emotions have the strongest explanatory value on intentions, both cross-sectionally and over time. This finding indicates that positive feelings and emotions that are experienced in relation to specific alternative proteins, such as joy, content and pride, are highly relevant to understanding why consumers do or do not accept those protein sources, even after five years. Previous studies have devoted considerable attention to motivations and negative affective variables (e.g. disgust, familiarity and attitudes), although positive affective variables have been under-researched (Onwezen et al., 2021). The current findings indicate that a positive affective approach is highly relevant. In accordance with lines of research that are increasingly underscoring the relevance of positive feelings (i.e. positive psychology, Gable & Haidt, 2005), we conclude that experiencing positive emotions is highly relevant to the acceptance of alternative proteins.

The findings on the other drivers in our conceptual model are less consistent, with generally little predictive value. *Personal norms* showed hardly any significant associations, indicating they are not a strong driver of either acceptance or behaviour. It is important to note that our measurement of personal norms (i.e. with regard to health and the environment) was on a different level compared to the other measurements. In order to include the aspect of morality personal norms were measured regarding the environment and ones' health instead of on the level of alternative proteins. This might have influenced the results, as existing literature emphasises the relevance of measuring all factors at the same level of specificity (e.g. van Raaij & Verhallen, 1994; van Trijp & Fischer, 2010). With regard to *food innovation traits*, food neophobia had no consistent association with intention, whereas domain-specific innovativeness was associated with intention to consume legumes, seaweed and cultured meat. These associations disappeared over time, indicating that emotions are a stronger predictor of intentions than of behaviour. Moreover, both food neophobia and domain-specific innovation were associated with self-reported consumption. These associations were visible only cross-sectionally and only for seaweed, insects and fish (not for legumes). These results nevertheless indicate that food innovation traits are relevant to explaining consumption behaviour. Future studies might further explore which variables are relevant under which circumstances. *Food-choice motives* revealed several cross-sectional associations with the acceptance of alternative proteins, but these effects disappeared over time. Moreover, the results did not confirm our hypotheses (relevance of taste, health and sustainability), nor did they reveal any consistencies across alternative proteins. Although food-choice motives have been shown to predict food choices in many domains, these cognitive deliberations are apparently not particularly relevant within the context of alternative proteins, or at least they are far less relevant than positive emotions are.

Finally, our results indicate that the selected drivers show a stronger association with the acceptance of novel alternative proteins (given the higher explained variance) compared to conventional proteins. Possibly due to the strong association between affective drivers and innovative and novel proteins (Onwezen et al., 2019). The explained variance for cultured meat was lowest, likely due to the fact that this protein source is not yet available.

5.3. Practical implications

- For all alternative protein sources, the results reveal the predictive power of positive emotions, suggesting the relevance of positive emotional framing in promoting the consumption of such proteins. It seems highly relevant to focus on communicating both cognitive benefits (e.g. in terms of health or the environment) and positive affective factors. This is in accordance with a study on insects, which highlights the relevance of framing a product affectively (instead of cognitively), especially for innovative products (Onwezen et al., 2019). One example of such framing could thus be to encourage consumers to *'feel good about themselves'*.
- Based on the differences in our results for the various types of protein, we strongly recommend distinguishing between alternative proteins in communications. Learning from related bodies of literature of success stories could also be highly effective, however, given the many similarities that were found.

- When comparing the acceptance scores across alternative proteins, the findings indicate that the acceptance of *insects* has a long way to go. Intention and self-reported consumption was low, and it did not increase over time. It will probably be a long time before insects are a prominent part of standard Dutch or Western diets. The intention to consume *cultured meat* was quite high for a product that is not yet on the market, and its increase over time is promising. In other words, cultured meat appears to be a promising avenue for development. The consumption of *legumes* is already relatively high, intention to consume is positive and increasing, and legumes are probably the best alternative in terms of both environmental impact (van der Weele et al., 2019) and current societal acceptance (Onwezen et al., 2021). It would seem promising to devote additional effort to increasing the acceptance and consumption of legumes. Given our findings that domain-specific innovativeness and positive emotions are significant predictors of the intention to consume *seaweed* and *legumes*, campaigns and interventions for example could benefit from targeting innovative consumers with novel products that highlight positive sustainable associations.

6. Limitations and future research

The current study has generated interesting findings for both science and practice. It is nevertheless subject to several limitations, which suggest directions for future research.

The current study included multiple comparisons (years, alternative proteins and explanatory variables), but not multiple countries. Although studies including multiple western countries show similar patterns (Knaapila, Hartmann, & Siegrist, 2021; Onwezen et al., 2021), we cannot guarantee that our findings can be extended to other Western and non-Western countries. Comparisons between countries in which alternative proteins are already part of cultural traditions and those where they are not would be particularly interesting. This could help to develop knowledge based on countries in which seaweed, insects or other alternative proteins are already part of the traditional diet.

The current study was part of a larger study that included some variables at a more concrete level: burgers made of alternative proteins (e.g. seaweed burgers) (parts of this study are already published (see Onwezen et al., 2019) or submitted (Onwezen et al., submitted, see footnote 1 for more details). In the larger study, only intentions were measured at both the categorical and the specific level. It would be quite interesting to measure multiple variables at both levels, thereby further disentangling the reasons underlying the ranking differences in consumer intentions to consume five alternative protein sources when measured at the categorical level as compared to the specific product level.

The sustainability gains from meat alternatives differ widely, highly dependent on the product ingredients and amount of processing (van der Weele et al., 2019). Our study did not address this level of variation. Future studies could include perceptions of environmental or sustainability impact, thereby controlling for differences in existing perceptions, or they could include an experimental design involving varying levels of environmental impact.

Our results based on two years provide an initial indication of the relevance of explanatory variables over time. Conclusions concerning causality would require multiple robust datapoints and experimental designs. Future research might include larger longitudinal samples with more datapoints in time to get more detailed insights in transitions and consumer behaviour over time. Moreover, in future research, it would be interesting to manipulate positive affect and explore whether increasing positive emotions does indeed increase behavioural choices for alternative proteins.

7. In conclusion

Although alternative proteins receive a lot of attention, the present study reveals self-reported consumption of alternative proteins remains low. We do see that intention to consume legumes, seaweed, and cultured meat increased over time, revealing that consumers become more open for these types of meat alternatives. Together these findings indicate an intention-behaviour gap. More specific, the results reveal variation in groups, as the intention-behaviour gap is smaller for individuals that already formed intentions years before. The current study provides strong evidence that positive emotions are highly relevant to measuring the intention to consume alternative proteins, which in turn associates with self-reported consumption of alternative proteins. These results span a wide range of alternative proteins, are shown beyond multiple other explanatory variables and remain present over time. Few previous studies have addressed positive emotions, we indicate the relevance of future research on alternative proteins to include positive emotions, like joy, pride and content. Moreover, it could be beneficial to incorporate positive emotions (e.g. through framing) into policies and efforts aimed at promoting alternative proteins, thereby stimulating the protein transition towards a healthier and more sustainable consumption pattern.

CRediT authorship contribution statement

Marleen C. Onwezen: Conceptualization, Formal analysis, Funding acquisition, Supervision, Writing-original draft, Writing-review & editing. **Muriel C.D. Verain:** Conceptualization, Formal analysis, Wiriting original draft. **Hans Dagevos:** Writing-original draft, Writing-review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Understanding relevance of drivers on intention to consume alternative proteins on cross-sectional 2019 data. Hierarchical regression analyses were performed separately for the intention to consume each alternative protein source in the coming week as a dependent variable and the explanatory factors of personal norms, domain-specific innovativeness, food neophobia, food-choice motives, and positive and negative emotions as independent variables.

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The results reveal that emotions were significantly and positively associated with all alternative proteins. Domain-specific innovativeness was also significantly and positively associated with intention to consume seaweed, legumes and cultured meat. Negative emotions were significantly and negatively associated with intention to consume fish, legumes, insects and cultured meat. Finally, environmental personal norms and the food-choice motives of mood, familiarity and naturalness were significantly and positively associated with intention to consume legumes.

Understanding relevance of intentions to self-reported consumption of alternative proteins on cross-sectional 2019 data. Separate hierarchical regression analyses were performed for self-reported consumption of each alternative protein on the 2019 dataset. Note that cultured meat was not included, as this protein was not yet available on the market. Moreover, insect consumption was so low that only 31 of the 499 respondents reported having consumed these proteins on a regular basis. The analyses for this protein should therefore be interpreted with caution.

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First, intention appears to be a significant predictor of consumption for all alternative proteins. Second, positive emotions (and, for fish, negative emotions) have a significant positive predictor of the consumption of fish, seaweed and legumes. Third, food neophobia and domain-specific innovativeness are significant predictors of consumption for fish, seaweed and insects (and not for legumes).

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