Appetite 200 (2024) 107501

Contents lists available at ScienceDirect

Appetite

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

Psychological factors influencing consumer intentions to consume cultured meat, fish and dairy

L. Engel [a,*], K. Vilhelmsen [b], I. Richter [b], J. Moritz [c], T. Ryynänen [c], J.F. Young [d], R.J.F. Burton [e], U. Kidmose [d], C.A. Klöckner [b]

[a] Faculty of Psychology, University of Basel, Switzerland
[b] Department of Psychology, Faculty for Social and Educational Sciences, Norwegian University of Science and Technology, Trondheim, Norway
[c] Ruralia Institute, Faculty of Agriculture and Forestry, University of Helsinki, Mikkeli, Finland
[d] Department of Food Science, Aarhus University, Aarhus, Denmark
[e] Ruralis: Institute for Rural and Regional Research, Trondheim, Norway

A R T I C L E I N F O

Original content: PROTEIN 2.0 survey data (Original data)

Keywords:
Cellular agriculture
Cultured protein
Nordic countries
SEM
Meat consumption

A B S T R A C T

This study investigates the structure of factors that influence consumer intentions to both try and to consume cultured proteins, and their intentions to substitute vegan, vegetarian and omnivore diets with these alternative protein sources. Comprehensive survey data ($N = 3862$) was collected from three Nordic countries (Denmark, Finland, and Norway) and analysed using confirmatory factor analysis and structural equation modelling. Theoretically, this article draws from behavioural models of environmental psychology, identity theory, and attitude theory. Results indicate that beliefs about the necessity of an industry producing cultured proteins and impacts of cultured proteins on the global economy are significant predictors of consumer intentions. Moreover, participants who exhibited high levels of general and food innovativeness were more likely to express positive intentions to consume cultured proteins. Social norms influenced consumer intentions: Individuals surrounded by positive attitudes and intentions toward cultured proteins within their social networks were more inclined to want to consume these products. The predictor variables in the final model accounted for between 39% and 66% of the variance in the different cultured proteins related intentions. Understanding consumer intentions better can inform targeted communication strategies aimed at promoting the advantages of cultured proteins and facilitating its adoption.

1. Introduction

Livestock agriculture is facing a variety of issues including meeting the needs of a growing global population, biodiversity loss, the effect of climate change on production levels, legislative requirements to reduce GHG emissions, declining aquifers, and soil degradation to name a few. In addition, concern is emerging for the animal welfare implications of industrial livestock production (Linzey, 2009; McClements, 2023) and the human health implications of the overuse of antibiotics and the potential emergence of drug-resistant microbes (Padma, 2022). Alternatives are limited. Substituting fish for meat in the diet may lead to other adverse externalities as more than 90% of world's fish stocks are fully exploited, overexploited, or have collapsed (Kituyi & Thomson, 2018). Commercial fishing, as it is today, does not provide a reliable solution for the future (Pitcher & Cheung, 2013) while aquaculture comes with its own environmental problems (Ahmad et al., 2022). Even plant-based protein alternatives – long touted as the solution – have been recently subject to critique (Banach et al., 2023).

With a lack of viable alternatives, the solution to this issue is often the promotion of low-meat (or no-meat) diets. However, despite widespread knowledge of the impact of animal agriculture on the environment, willingness to reduce currently high levels of meat, fish and dairy consumption remains relatively low (Gillison et al., 2021).

Recently a potential solution has emerged in the form of cultured proteins. Originating from technologies developed in the medical/pharmaceutical sector (tissue engineering and precision fermentation) producing cultured proteins for food involves either growing stem or satellite cells of live animals in a bioreactor (Post, 2012) or genetically

* Corresponding author. Faculty of Psychology (Psychology of Sustainability and Behavior Change), University of Basel, Missionsstrasse 62a, 4055, Basel, Switzerland.
E-mail address: lukas.engel@unibas.ch (L. Engel).

https://doi.org/10.1016/j.appet.2024.107501
Received 14 March 2024; Received in revised form 10 May 2024; Accepted 15 May 2024
Available online 17 May 2024

engineering micro-organisms to produce animal proteins such as whey, casein or egg white. Producing animal proteins and fats in vitro in this fashion creates a product that is not only a functional substitute for agricultural meat/dairy proteins (e.g. tofu, vegetable meat-substitutes), but retains taste and smell characteristics, may behave the same way when cooked, and may even hold similar cultural connotations (e.g. religious acceptance – Burhanuddin et al., 2022).

Producing cultured proteins has a variety of potential benefits. Besides boosting food supply and avoiding future pandemics (both highlighted by the recent Coronavirus outbreak), according to recent life cycle assessment (LCA) analyses, cultured protein production could reduce agricultural land use and acidification, water consumption, fine particulate matter, and greenhouse gas emissions (Sinke & Odegard, 2021; Kim et al., 2022; Sinke et al., 2023; Supermeat, 2024). In addition, antibiotics are not required for cultured animal proteins production as the environment is sterile while welfare implications are negligible as it involves sampling a small number of cells from live animals or simply copying DNA sequences from gene databases (for precision fermentation). It has also been suggested that cultured proteins have a better environmental profile than plant-based proteins in some areas (Collett et al., 2021).

However, it also presents an array of challenges. In particular, besides our current inability to produce bioreactors at a scale necessary to contribute meaningful quantities of proteins to the global food system (Humbird, 2021), bioreactors require massive amounts of energy to retain the growing cells at the required temperature. As the source of energy-related emissions needs to be taken into account when calculating the environmental impact of cultured proteins (Collett et al., 2021) the development of a sustainable cultured proteins sector must occur alongside a major transition to renewable energy (Mattick, 2018). Other concerns have also been raised including potential damage to rural communities and semi-natural habitats (Helliwell & Burton, 2021), and food health and safety issues (Giles, 2023).

The cultured proteins sector is still in a very early stage of development. Precision-fermented protein products have taken the lead with Perfect Day's whey powder now used in a wide number of products and by a variety of companies (see https://perfectday.com/our-consumer-brands/). On the other hand, the only cultured meat product that can even tentatively claim to have reached the market is Good Meat's chicken nuggets which it sells in a few restaurants in Singapore. However, the nuggets are being sold at less than the cost of production (McCormick, 2021) while, at the same time, the company lacks the manufacturing capacity to make it more widely available (Yu, 2023). As yet, production costs of cultured meat remain significantly higher than the consumer price of conventional meat (Hubalek et al., 2022).

As well as the state of the technological development, other factors complicate the transition potential. In particular, the legislative and regulative frameworks for the introduction of cultured proteins have yet to be widely established, but are believed to be a key determinant in the success (or otherwise) of the sector (Rubio et al., 2020; Stephens et al., 2018). Only Singapore, the US and Israel have so far authorised cultured meat while, in the EU, there has not been a single application for cultured proteins under the required Novel Food Regulation (2015) yet (Apelblat, 2024). How retailers respond is another issue. Studies analysing potential position of retail sector towards cultured proteins are scarce. However, results from a political stakeholder analysis suggest that the retail sector may have a significant role in hindering or advancing market entry of cultured proteins (Moritz et al., 2022).

The lack of material development, uncertainty over what qualities the products will have, regulative and market issues, and debates concerning whether the impact of the sector will be positive or negative and for whom currently create a confusing situation for potential consumers. As a result, disentangling factors that are likely to influence consumer willingness to incorporate cultured proteins into their diets is a difficult but important task. Success or failure of the technology will depend on whether consumers are willing to purchase and eat cultured animal proteins.

This study explores this issue. Following this brief introduction we review existing literature on motivational, socio-demographic, and cultural drivers that impact consumer intentions towards cultured proteins. The methodology is divided into two sections: firstly, we present the rationale behind the study design and the psychological theories drawn on and, secondly, we outline the processes used for data gathering and analysis. The result section presents findings from three Nordic countries (Norway, Denmark and Finland). Here we analyse national differences in perceptions of cultured proteins as a dietary staple, investigate the effects of socio-demographics, dietary habits, and psychological factors on intentions to consume cultured proteins, and explore the influence of familiarity and perceptions of naturalness on these intentions. The overall goal is to propose and test a comprehensive framework of possible determinants of behavioural intentions towards cultured proteins. Because this, to our knowledge, is the first integration of determinants into a framework for this specific food domain, our approach is exploratory and synthesizes the determinants from previous studies into one large-scale empirical assessment.

2. Literature review – what leads to intention to consume cultured proteins?

A recent rapid increase in the number of research articles on cultured protein consumption has led to the establishment of a set of predictive factors (Bryant & Barnett, 2018, 2020; Pakseresht et al., 2022). These include public awareness, perceived naturalness, food-related risk perception and food neophobia, ethical and environmental concerns, and doubts associated with food safety and human health (Bryant & Sanctorum, 2021; Klöckner et al., 2022; Pakseresht et al., 2022; Siegrist & Hartmann, 2020). Willingness to try cell-cultured meat, as measured by various studies, ranges from 19% to 66.4% (Spurgeon et al., 2020). However, willingness to regularly purchase cell-cultured meat or use it as a replacement for conventional meat is generally lower. As public familiarity with the product remains very low we need to interpret the willingness to try and consume it with caution. In addition, potential consumer adoption of cultured proteins is often contrasted with the adoption of alternatives such as plant-based meat substitutes (e.g., Bryant & Sanctorum, 2021; Dean et al., 2023; Onwezen et al., 2021; Slade, 2018).

Consumer response to cultured meat varies between countries, with similarities and differences between countries related to common factors such as food cultures (Boereboom et al., 2022) or level of economic development. For example, studies of cultured protein acceptance in comparison with other forms of alternative protein (e.g. pulses, algae, insects, and plant-based meat alternatives) have shown that consumers in the Netherlands, Italy, Germany, the US, Switzerland, Belgium, the UK, Spain, Brazil, Finland, and the Dominican Republic, show a preference for plant-based alternatives compared to cultured meat (Ahmad et al., 2023; Bryant & Dillard, 2019; Bryant & Sanctorum, 2021; de Koning et al., 2020; Escribano et al., 2021; Franceković et al., 2021; Gómez-Luciano et al., 2019). Consumers in economically developed countries tend to be more receptive to meat alternatives than those in less economically developed countries (Gómez-Luciano et al., 2019). A study comparing China and India with the US (Bryant et al., 2019) found higher levels of acceptance in China and India, while French consumers showed lower levels of acceptance than consumers in other European countries as they believed cultured meat to be unnatural and disgusting (Siegrist & Hartmann, 2020). In Nordic countries cultured proteins are generally viewed favourably with Finns having the most positive perceptions (Klöckner et al., 2022).

In addition to the country/culture differences, preference can also vary according to socio-demographic characteristics. Studies have shown that young, higher educated individuals, males, left-leaning voters, and meat-eaters tend to show high levels of acceptance (Bryant et al., 2019; Klöckner et al., 2022; Mancini & Antonioli, 2019; Slade, 2018; Wilks & Phillips, 2017). The question of how dietary preference affects consumption appears somewhat more complex. There is some evidence that meat eaters are more willing to try cultured meat (Franceković et al., 2021) and those who do not wish to reduce meat consumption have been found to be more willing to consume it (Dupont et al., 2022). Appiani et al. (2023) suggest that this preference may be attributable to challenges regarding texture, flavour and appearance. In the Nordic context, Klöckner et al. (2022) found that while vegetarians and vegans had a more positive attitude towards cultured proteins, they did not exhibit a higher willingness to taste or consume cultured proteins compared to omnivores. This led to the conclusion that vegetarians and vegans valued the environmental and animal welfare benefits of cultured proteins for wider society rather than wanting to eat ethical meat themselves.

Psychological factors impact willingness to consume cultured proteins through a variety of means: a general distrust of new foods and food sciences alongside conservative inclinations decreases likelihood of consumption (Wilks et al., 2021), innovativeness in experimenting with new foods and recipes increases likelihood (Brunsø et al., 2021), and a desire to follow social norms results in the selection of a normative preference (Arango, Septiano, & Pontes, 2023). Social norms may be particularly important for cultured proteins because ambiguity in behavioural expectations has been found to enhance the role of social norms in selecting eating choices (Higgs, 2015). Finally, beliefs can also influence behaviour. For cultured meat perceived health benefits and beliefs about the negative impacts of livestock production affects consumption choices and acceptance of cultured meat (Circus & Robison, 2019; Gómez-Luciano, et al., 2019; Slade, 2018; Verbeke et al., 2015).

Familiarity with the concept of cultured meat has also been widely found to influence its acceptance (e.g., Bryant & Dillard, 2019; Klöckner et al., 2022; Onwezen et al., 2021). For example, Franceković et al. (2021) investigated consumer perceptions of cultured meat in Croatia, Greece, and Spain and found that while almost half of the respondents had never heard of cultured meat, those who were familiar with it recognized its potential benefits in terms of environmental protection, animal welfare, and human health. Similarly, Zhang et al. (2020) and Mancini and Antonioli (2019) reported that providing information and hence increasing familiarity with cultured meat positively influenced consumers' willingness to taste and purchase the product.

Finally, a key issue for cultured proteins and, indeed, all artificial substitutes (see Burton, 2019) is the question of naturalness. Concern for the absence of naturalness proved to be one of the key factors in the failure of agricultural biotech in the 1990s as fear of "Frankenfoods" led to effective campaigns to ban GMOs from the food system (Schurman, 2004). The arrival of cultured meat is likely to open up similar discussions (Castle, 2022). Consumer studies indicate naturalness continues to play an important role in consumer response with individuals concerned for the naturalness of food less likely to accept cultured meat (Bryant et al., 2019; Siegrist & Hartmann, 2020; Siegrist & Sütterlin, 2017; Weinrich et al., 2020). Many consumers view cultured proteins with scepticism, deeming them unnatural (Verbeke, et al., 2015) – although what is perceived as "natural" or not is both strongly dependent on culture and changes over time (Rozin et al., 2012).

Concerns for naturalness can be moderated by other factors. For example, trust in the food industry is associated with acceptance, as research suggests participants with higher levels of trust in the producers of cultured meat perceive it as more natural (Siegrist & Hartmann, 2020). Similarly, familiarity and information about cultured proteins boosted consumer acceptance in a Dutch study (Rolland et al., 2020), while understanding the ethical and environmental benefits of cultured proteins has been found to foster a more positive reception (Valente et al., 2019; Verbeke et al., 2015). Valuing green consumption has also been found to increase perceptions of naturalness (Dupont et al., 2022). On the other hand, food neophobia may contribute strongly to the perception of cultured meat as unnatural (Franceković et al., 2021).

The potential for moderating concerns for naturalness suggests that strategies can be applied to increase perceptions of the naturalness of cultured meat. In a recent study, Arango, Chaudhury, and Septianto (2023) for example, found that amongst people who view human traits as changeable, a messaging strategy challenging the significance of naturalness was effective in increasing acceptance of cultured meat. In addition, research indicates that increased knowledge can enhance acceptance of cultured proteins (Aertsens et al., 2009), possibly because of the significant role beliefs concerning health benefits and negative externalities of conventional livestock production (as mentioned above) play in acceptance. Knowledge of industrial food production may also influence uptake. Over recent decades animal protein production has bifurcated into high quality production (e.g., organic meat) and "bottom line" production (e.g., mechanically reclaimed meat) where ultra-processing and intensive livestock systems have progressively lowered the bar for what can be considered "natural" (Burton, 2019).

Overall, this review identifies a complex series of factors contributing to the uptake of cultured animal proteins. Common to all factors is that, in this situation, the lack of a product on which to base opinions leads to perception (rather than experience) based responses. These can be based on a variety of factors including "factual" knowledge of the properties of cultured protein, the opinions of significant others, "trust" in information sources, extrapolation from experiences in the food system with similarly technological products, ethical issues associated with contemporary livestock production, psychological or "yuck" responses to non-natural products, or general dietary preferences (vegan/vegetarian/omnivore). With non-experience based factors key, responses to cultured proteins have been shown to vary on an individual, cultural, and national basis – where people living in similar knowledge environments and within similar cultural belief systems form common views. This understanding forms the framework for the study detailed below.

3. Methodology

3.1. Design of the current study – conceptual and theoretical origins

Reviewing different studies of cultured proteins acceptance reveals a variety of different responses to cultured proteins – suggesting that acceptance results from a complex mix of determinants. However, most of the reviewed studies neither go beyond testing the relevance of acceptance factors nor analyse potential interrelations of the factors to determine how they interact in terms of people's willingness to consume cultured proteins. In this study we move beyond simply analysing correlates of acceptance to, instead, develop three models drawing on different psychological traditions and common constructs that are expected to impact the intention to consume cultured proteins. In a last step, we integrate all three models into a comprehensive framework and exploratorily added inter-model paths (Fig. 1). There are five parts to this analysis as detailed below.

First, we extend the complexity of understandings of cultured protein acceptance by modelling three related but distinct types of intentions: (a) general intentions to consume, (b) intentions to substitute vegan food alternatives, and (c) intentions to substitute non-vegan food alternatives. Whereas the first general intention was often captured in previous studies, the second and third intention are specific for certain types of diet and contribute to assessing the potential for cultured proteins to improve the ecological footprint of protein consumption.

Second, we draw from common psychological behaviour theories, the Value-Belief-Norm theory (VBN; Stern, 2000) and the Theory of Planned Behaviour (TPB; Ajzen, 1991), to structure the factors depicted under Predictor set 1 (Fig. 1). Both theories address different processes underlying behaviour (Kaiser et al., 2005). While the TPB models rational decision-making in which people evaluate different behavioural aspects based on their importance and likelihood of occurring, the central behavioural determinant in the VBN is personal norms that relate to moral considerations in decision-making (Kaiser et al., 2005). When it

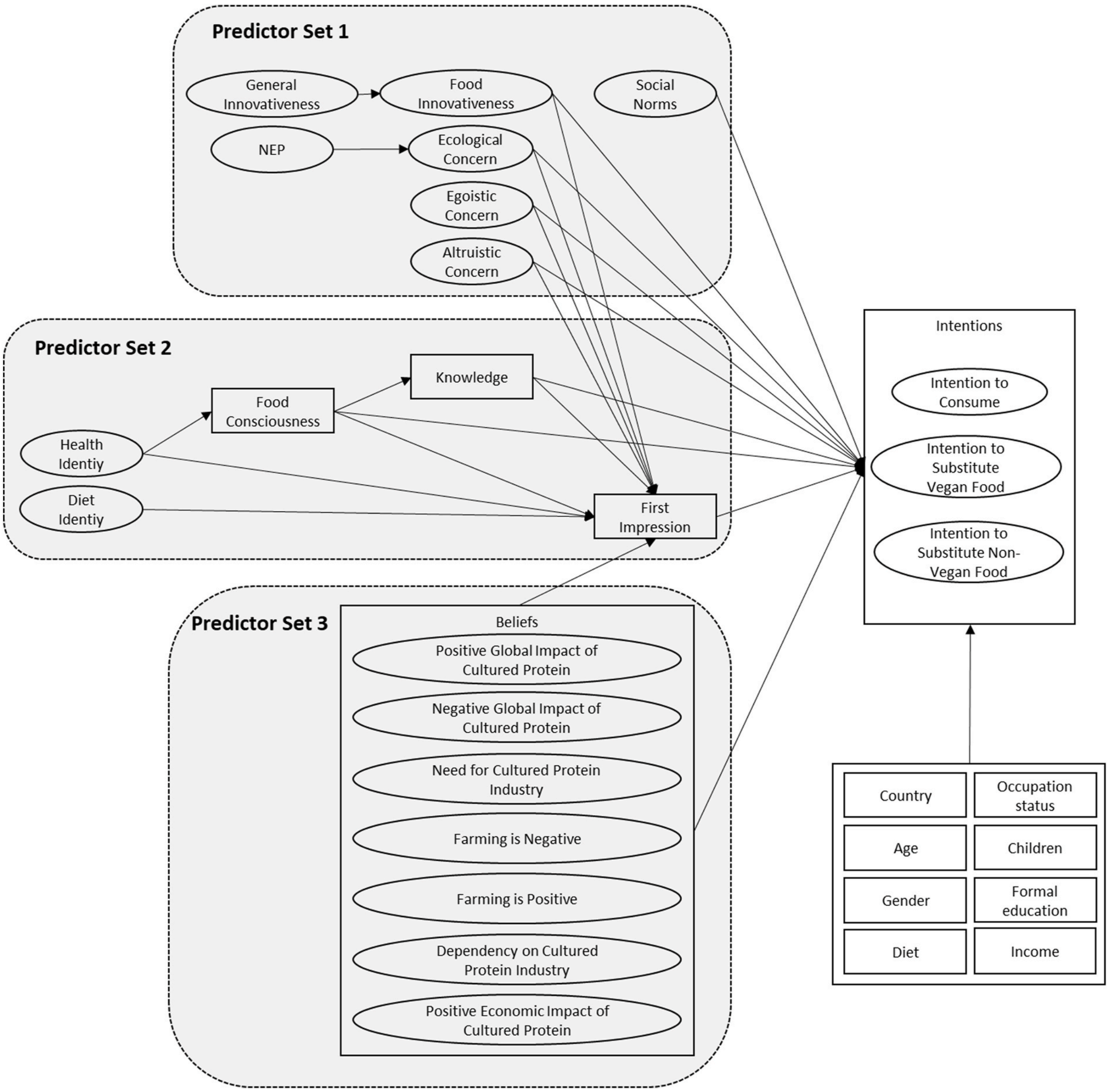

Fig. 1. Path model including three predictor sets for the intention to consume cultured proteins, to substitute vegan food and to substitute non-vegan food.

comes to novel technologies and related behaviours such as cultured proteins consumption it can be argued that people base their decision on both rational and moral considerations. This is also reflected in previous findings on the determinants of cultured proteins related behavioural intentions (e.g., Dupont et al., 2022; Wilks et al., 2024; for an overview see Bryant & Barnett, 2018, 2020). Hence, aspects of both theories were taken into account for the framework development.

The VBN assumes that three different value orientations may impact decisions for or against environmental behaviours, namely; ecological values (e.g., protecting the environment or animal welfare), egoistic values (e.g., getting the best result for oneself), and altruistic values (e.g., helping other people). We focused on general more behaviour-proximal concerns that are founded in those values. We assume that these concerns independently influence the three intentions we modelled. Furthermore, in line with the VBN, we assume that a general pro-environmental world view as captured in the New Environmental Paradigm (NEP; Dunlap et al., 2000) plays an important role in the cascade of psychological variables influencing behaviour and behavioural intentions. We assume that having a high expression on the NEP activates ecological concerns which combine the role of the value orientations and the awareness of consequences (i.e., being aware that specific actions, e.g., factory farming, has a negative impact on a valued object, e.g., the environment) from the VBN (Stern, 2000).

Parallel to value-based concerns, we assume that social norms (the expectations of significant others regarding behaviour) influence intentions to consume cultured proteins in line with the TPB (Ajzen, 1991). Finally, we build on innovation diffusion theory (Rogers, 2003), which assumes that in addition to innovation related factors and cultural factors, the innovativeness of people impacts how early they tend to adopt new practices or technologies. One can differentiate between general innovativeness (Vandecasteele & Geuens, 2010) and food specific neophobia (Pliner & Hobden, 1992), which is the opposite of food innovativeness. We assumed that higher levels of general innovativeness would also lead to more food-specific innovativeness (understood as a reverse-coded food neophobia), which would predict intentions to consume cultured proteins.

Third and drawing from a different theoretical tradition, we explore the impact of identity processes on intentions to consume cultured proteins. Identity consists of general assumptions about who we are, what defines us, and what social groups we associate with. Identity can be divided into self-identity and social identity (Fischler, 1988; Tajfel, 2010), where the former captures the self-concept (what defines me) and the latter captures the social belongingness as part of the identity (who do I have things in common with). It has been shown that food is a central part of self-identity and social identity (Fischler, 1988). Both types of identity can have many facets. We focus on health identity ("It is an important part of me to be healthy and eat healthy food") and diet identity ("It is an important part of me to eat meat/vegetarian/vegan"). We further assume that a strong health identity would manifest itself in greater food consumption consciousness.

We assume that most of the influence of identity on intentions to consume cultured proteins was mediated by a spontaneously formed first impression. This first impression forms a first general attitude towards cultured proteins (i.e., a first evaluation of cultured proteins) which is commonly investigated as a predictor of pro-environmental behaviours (Ajzen, 1991, 2012). Cultured proteins are such a novel food product that most people have not heard about or formed a sophisticated opinion about it. We therefore described briefly the production processes of cultured proteins and asked participants how positive or negative their first impression was.

Fourth, in the last predictor set, we draw from general attitude theory (Ajzen, 2012), which assumes that general attitudes are composed of different salient beliefs about advantages and disadvantages of specific behaviour. We therefore constructed a set of potential beliefs associated with cultured proteins and used exploratory factor analytical methods to group the beliefs into six distinct components. These six belief components are assumed to predict intentions both directly and mediated through the first impression. Even though this predictor set overlaps with the attitude component of the TPB (Ajzen, 1991), we separated them into two predictor sets to reduce complexity in the initial models.

Fifth, based on the results on the effects of socio-demographic variables discussed above, we also included the country, age, gender, diet (omnivore, vegetarian, vegan), occupational status, number of children, formal education, and income as predictors.

3.2. Data and analysis

A survey was conducted in Denmark, Finland and Norway in February and March of 2021.[1] Even though all three are Nordic countries differences exist. Denmark and Norway share cultural similarities (including similar northern-Germanic languages), while Finland is culturally distinct and belongs to the Finno-Ugric language group. The survey instrument – created in English and then translated to Norwegian, Danish, and Finnish – was developed based on a literature review. Translations and interpretability of items were validated by native speakers. Cultured proteins were referred to in the survey as "cultured/synthetic[2] meat, fish, and dairy products" (for naming effects see Bryant & Barnett, 2019; Bryant & Dillard, 2019).

Participants were recruited from national online survey panels and were remunerated for participating by the panel reward systems. This paper received an exemption to the ethical guidelines from the Ethical Committee at the Norwegian University of Science and Technology (NTNU, Ref. 2024/001). Survey companies guaranteed that GDPR and data protection regulations were followed and had a clearance for the operation of their panels.

3.2.1. Participants

The participants were representative for each country's adult population (between 17 and 85 years old) with respect to their age, gender, education, and income (Statistics Denmark, 2024; Statistics Finland, 2024; Statistics Norway, 2024). An estimated sample size of 1067 participants per country was required for a confidence level of 95% and < 3% error margin according to pre-survey power analyses. A total of 3862 participants were included in this study, and of them 1203 (610 female) were from Denmark, 1452 (727 female) were from Finland, and 1207 (587 female) were from Norway.

3.2.2. Measures

The survey was structured in the following way: First, after recording central socio-demographics (country of residence, gender, income, formal education, age, number of children in the household, and occupation status) preferred diets were explored. In this section we also asked participants how conscious they were about their food consumption. Next, questions about more general person-related variables were asked. In line with the VBN, we assessed general environmental concern with the commonly used NEP[3] (Dunlap et al., 2000; Dunlap & Van Liere, 1978), and more specific concerns such as altruistic, egoistic, and biospheric concerns (adopted from Slade, 2018) founded in the value component of the VBN (Stern, 2000). To assess the psychological component of the innovation diffusion theory (Rogers, 2003) we measured the general level of innovativeness with the adapted Motivated Consumer Innovativeness Scale (Vandecasteele & Geuens, 2010) and food related innovativeness with an adapted Food Neophobia Scale (Pliner & Hobden, 1992).

This section also contained the evaluation of identity constructs: the importance of (not) eating meat and of healthy food for one's self-identity (inspired by typical items from identity research; Cameron, 2004; van der Werff et al., 2014). After that, the concept of cultured proteins was introduced (a short text described what cultured proteins are and how they are produced) to the participants, and familiarity with the concept, the first impression, willingness to try it, willingness to eat it regularly, and willingness to replace farmed meat/fish/dairy or plant-based alternatives with cultured proteins were measured which were specifically designed for this study. For full question wording see the Tables in Appendix A.

The final sections of the questionnaire measured variables specific to participants' perceptions of cultured proteins, including social norms (adapted TPB questions from Ajzen, 1991) and beliefs about cultured proteins, agriculture, and the food industry in general (these items were specifically formulated for this study). Responses were measured on a five-point Likert scale (1 = *Strongly agree* to 5 = *Strongly disagree*; except for the assessment of intentions with 1 = *Yes, definitely* to 5 = *No, definitely not* for the willingness to try and to eat regularly and 1 = *Much less* to 5 = *Much more* for the willingness to substitute conventional products).

3.2.3. Statistical analyses

The following analyses were conducted using R version 4.2.2 (R Core Team, 2022) and commands from the lavaan package (Rosseel, 2012). Before inspecting the measurement structure, descriptive analyses of the items were conducted. By focusing on the distribution of the responses to the items, we assessed univariate normality to determine which estimation algorithm to use (Royston, 1983; Shapiro & Wilk, 1965). Bivariate correlations were computed to get an overview of the relations between the different psychological variables.

The main statistical analyses were conducted in several steps. First, the assumed internal structures of the measurement instruments were

[1] The dataset is available online https://zenodo.org/record/6326869.

[2] "Synthetic" was a term used more widely in the earlier stages of technological development, but has now largely been repalced by "cultured" and, even more recently, "cultivated" as the start-up industry has attempted to control the labelling discourse. Given the lack of any single or widely "known" term to define the product at the time, we consider it unlikely that this labelling caused comprehension issues – particularly as a definition was provided to participants.

[3] The NEP contains negatively phrased items, which for methodological reasons load additionally on a method factor. This factor is not supposed to be related to the other variables modelled.

assessed with confirmatory factor analyses (CFAs). For item blocks where the structure was less defined, exploratory factor analyses (EFAs) with preceding parallel analyses (both, based on principle component and principle axis analyses) were conducted (Horn, 1965). We used a Maximum Likelihood (ML) algorithm to estimate the model parameters in the EFAs and computed separate EFAs for each newly developed instrument. An oblique promax rotation was used to account for the possible intercorrelations of the factors.

Structures emerging from the analysis were subsequently tested using CFA. For all instrument-specific CFAs, the model estimation was based on a robust ML (MLR) algorithm with Huber-White corrected standard errors and a Yuan-Bentler equivalent test statistic (Buchholz & Hartig, 2020). The robustness of this estimation refers to low sensitivity to non-normal item distributions. The algorithm we applied can be further described as Full Information ML (FIML) as it used all available information regardless of the existence of missing values (Enders & Bandalos, 2001). To ensure the identification of the models, the unstandardized factor loading of the first item per factor was restricted to 1 and the variance of the latent factors was set to 1. For factors on which only one item loaded, an unstandardized error variance of 0.10 was defined to account for the assumption that one item cannot perfectly reflect a latent psychological construct. The error variance of 0.10 equals an assumed reliability of the single-item measures of 0.90 (Petrescu, 2013).

The appropriateness of the models was assessed through common fit indices and corresponding cut-offs. Because of the sensitivity of the χ^2-tests to large samples (e.g., Bentler & Bonett, 1980) the focus was placed on the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). In line with Hu and Bentler (1999), we interpreted CFI $>$ .90, RMSEA $<$ .08, and SRMR $<$ .08 as indicative of an appropriate model fit, and CFI $\geq$ .95, RMSEA $\leq$ .05, and SRMR $\leq$ .05 as a very good model fit (the usage of the robust test statistics allows the evaluation of the robust CFI and robust RMSEA; the cut-offs are the same). In a subsequent step, we computed a CFA with all assessed instruments to test the overall adequacy of our measurement models.

As an intermediate step, all established measurement structures were confirmed in multigroup CFAs (MG-CFA) testing for measurement invariance (MI). The assumption of MI pertains to the idea that the estimated parameters of a measurement model are comparable across different subgroups: gender, age, formal education, income, country of residence, and diet. If this assumption holds, the instrument measures the same latent construct across different sub-populations for which equal understanding of the items is a prerequisite (Chen, 2008; Sternberg, 2004). If differences in the measurement of the constructs exist but are overlooked, interpretations of statistical findings can be heavily biased (Milfont & Fischer, 2010).

We grouped some of the measurement models together for the MG-CFA and did not compute MG-CFA for all instruments in one model to minimize computation time (measurement models of the following constructs grouped together: NEP; concerns and social norms; innovativeness, identity and intentions; beliefs). Four levels of MI can be differentiated based on the restriction of different model parameters to equality across subgroups (Cieciuch & Davidov, 2015; Vandenberg & Lance, 2000). The levels in order of least restrictive to most restrictive are: configural MI (equal item-factor configuration), metric MI (equal unstandardized factor loadings), scalar MI (equal unstandardized item intercepts), and residual MI (equal unstandardized item residual variances; (Cheung & Lau, 2011). To evaluate which MI level applies to a measurement model, the fit indices of models testing subsequent MI levels are compared. By doing so, the amount of model fit loss is related to the increase in model parsimony. The cut-offs for the acceptance[4] of the MI levels are: ΔCFI $\leq$ .01; ΔRMSEA $\leq$ .015; ΔSRMR $\leq$ .03 or $\leq$ .01 for metric or scalar MI, respectively (Chen, 2008). We also applied the Bayesian Information Criterion (BIC; lower values indicate a better model-fit-to-parsimony ratio; Byrne, 2016).

As we were interested in the relation between the different psychological constructs and as those relations can be investigated using latent factors in Structural Equation Models (SEM), the achievement of (partial) metric MI was sufficient for our analyses (Cheung & Lau, 2011). To ensure model identification, we restricted the variance and mean of the latent factors to 1 and 0, respectively (in the configural MI model; in the metric MI model the mean was still restricted in all groups, but the variance was only restricted to 1 in one group and freely estimated in the others). The following subgroups were compared through the MG-CFA: Norway, Denmark, and Finland; male and female; 17–39 years old, 40–59 years old, and 60–85 years old; being vegetarian, vegan, and omnivore; no high school degree, high school degree, and university degree; income of under 50,000 of the country's currency, between 50, 000 and 90,000 of the country's currency, and over 90,000 of the country's currency.

Lastly, each section of the model in Fig. 1 was tested separately, before all three were merged for a final comprehensive assessment. In line with the CFAs, single-item measures in the SEMs were assigned a reliability of .90 by setting the unstandardized item error variance to .10. Furthermore, we applied the same estimation algorithm as for the previously described models. As a SEM is the combination of a measurement model and a path model, the standardized path coefficients from the SEM can be interpreted as standardized regression coefficients (Ullman & Bentler, 2012). We tested the assumed mediating effect of food innovativeness and ecological concern on the relation between general innovativeness and the NEP with the intentions through indirect regression coefficients. The indirect regression coefficient represents the product of the regression coefficient of the predictor (in our case general Innovativeness or NEP) on the mediator (food Innovativeness and ecological concern) and the regression coefficient of the mediator on the criterion (the intentions) when controlling for the direct effect of the predictor on the criterion. We interpreted significant indirect regression coefficients as indicative of existing mediation effects. We also reported the total effects of the predictors which equal the sum of the indirect and direct regression coefficient of the predictor, but refrained from interpreting them (Zhao et al., 2010).

4. Results

The inspection of univariate normality of the items with the Shapiro-Wilk and the Shapiro-Francia test indicated that all items deviated from normality (Royston, 1983; Shapiro & Wilk, 1965; see Tables A1 to A8 in Appendix A for the statistics of univariate normality).

4.1. Establishing the Measurement Models

For the NEP, a CFA including a factor on which all items loaded and a method factor on which only the reversely formulated items loaded, showed acceptable fit when applying Hu and Bentler (1999) cut-off criteria (robust CFI = .952, robust RMSEA = .096, SRMR = .028). The standardized factor loadings on the NEP factor ranged from 0.32 to 0.66. The correlation between both factors was restricted to zero. The main scale was sufficiently reliable (ω = .73).

For innovativeness we excluded four items from the analyses (three

[4] If a measurement model fails a certain MI level, partial MI can be tested by freeing restricted parameters based on expected model fit gains (indicated by fit indices). If a model fails to achieve metric MI, partial metric MI can be tested by freeing the restriction associated with one factor loading. If the model fit is still inadequate more factor loadings can be freed (Borsboom, 2006).

reversely formulated items and “If an innovation functions better than what I have, then I buy it.“) because of their low factor loadings in the EFAs ($\lambda < 0.30$). After the addition of one error covariance (between “I love to use innovations that impress others.” And “I like to own an innovative product that distinguishes me from others who do not own this product.“) the CFA combining both concepts, the food and the general innovativeness, as separate but correlated factors yielded appropriate fit statistics (robust CFI = .962, robust RMSEA = .084, SRMR = .036) and sufficiently high standardized factor loadings ($0.33 \leq \lambda \leq 0.79$). While general innovativeness showed high reliability (ω = .88), the reliability of food related innovativeness was rather low (ω = .69).

We measured different concerns with seven items adopted from Slade (2018): “How concerned are you about (1) climate change caused by human activity, (2) animal welfare, (3) extinction of animals/plants (loss of biodiversity), (4) hunger in the world, (5) security of access to food, (6) food safety, and (7) economic prosperity”. After computing parallel analyses and EFAs and comparing different item-factor configurations by means of CFA, a three-factor solution was most appropriate with items (1), (2), and (3) loading on the *ecological concern* factor, items (5), (6), and (7) loading on the *egoistic concern* factor, and item (4) constituting the *altruistic concern* factor. This model structure showed good model fit (robust CFI = .976, robust RMSEA = .079, SRMR = .026) and sufficient standardized factor loadings ($0.51 \leq \lambda \leq 0.85$). The two factors reflected by three items showed an appropriately high reliability ($\omega_{\text{ecological concern}} = .84$ $\omega_{\text{egoistic concern}} = .78$).

The CFA combining both food related identities yielded appropriate fit statistics (robust CFI = .975, robust RMSEA = .061, SRMR = .034) and sufficiently high standardized factor loadings ($0.45 \leq \lambda \leq 0.83$). Furthermore, both scales showed appropriate reliability ($\omega_{\text{diet identity}} = .83$; $\omega_{\text{health identity}} = .81$).

The newly developed belief items necessitated an exploratory approach for establishing a measurement structure. First, we split the items into two parts – farming related items and cultured proteins related items – and analysed them separately. Two farming related items (“Traditional animal farming has a positive impact on biodiversity because certain animals and plants need the cultural landscapes.“; “Synthetic fish production would be a big economic problem for Norwegian salmon farmers.“) were excluded due to a high content overlap with other items and subsequent model estimation problems (the items constituted their own factor which was highly correlated to other factors which resulted in high multicollinearity in the SEMs). The EFAs suggested the extraction of three or four agriculture related factors and four or five cultured proteins related belief factors. The fit indices extracted from the corresponding CFA models supported the three factor and four factor solutions. When combining all items in one model, the CFA yielded sufficient fit indices (robust CFI = .907, robust RMSEA = .059, SRMR = .074) and appropriate standardized factor loadings ($0.44 \leq \lambda \leq 0.96$). The reliability of the factors on which more than two items loaded ranged from .75 to .89 and was therefore sufficient.

For intentions to consume cultured proteins, we again followed parallel analyses and EFAs. The items constituted three factors, the intention to eat cultured proteins (combining the items for tasting and for eating regularly), the intention to substitute animal plant proteins, and the intention to substitute plant-based proteins. The final CFA with error covariances between the corresponding “taste” and “eat regularly” items showed good model fit except the robust RMSEA (robust CFI = .934, robust RMSEA = .130, SRMR = .034). Furthermore, the standardized factor loadings were high ($0.85 \leq \lambda \leq 0.92$) and all factors showed high reliability ($\omega_{\text{intention to eat}} = .95$; $\omega_{\text{intention to substitute animal based protein}} = .93$; $\omega_{\text{intention to substitute plant-based protein}} = .93$).

4.2. Combined measurement model and test of measurement invariance

The CFA model combining all constructs and allowing the factors to correlate yielded good model fit indices (n = 3859, robust CFI = .910, robust RMSEA = .040, SRMR = .050, scaled χ^2 (2521) = 13,730.8 with p < .001). The corresponding standardized factor loadings can be found in Tables A1 to A8 in Appendix A.

In the next step, we tested the MI across different grouping variables for groups of instruments at the same time. We allowed the correlations between the latent factors as well as pre-defined error covariances to differ across the different groups. Tables A9 to A12 in Appendix A give an overview of all relevant fit indices. Starting with the assessment of MI for the NEP, at least partial metric MI was achieved across all grouping variables. As the constraints of the factor loading pertaining to the first and the fifth items introduced an inacceptable amount of misfit for some grouping variables these constraints were lifted. Across gender and diet full metric MI was achieved. For the MG-CFA with concerns and social norms, metric MI was achieved across all grouping variables except for age. In that case, the factor loading of the item constituting altruistic concern had to be freed to achieve sufficiently high fit indices. The same applied to the MG-CFA with the innovativeness, identity, and intention measures, for which metric MI held across gender, diet, income, and formal education groups. In the country and age-group models the restriction on one factor loading had to be lifted to achieve partial metric MI. Lastly, the belief instrument was metrically invariant across all grouping variables except countries. That was the only measurement instrument-grouping variable combination for which neither metric nor partial metric MI held.

To sum up, the MG-CFA suggested that the instruments used in this study achieved the necessary level of MI – (partial) metric MI – required to conduct the planned analyses. Only the belief scale posed some larger MI problems across the countries – an aspect that needs to be considered when interpreting the findings.

4.3. Descriptive and bivariate statistics

To get a sense of the data, we estimated the mean, median, standard deviation, skewness, and kurtosis of all manifest factor scores (based on the mean factoring over the items). The corresponding statistics can be found in Tables A1 to A8 in Appendix A. The mean general intention to consume cultured proteins is close to the scale midpoint while the means of intention to substitute plant-based and conventional products with cultured protein are below the scale midpoint with low values – indicating a low willingness to substitute.

Table 1 gives an overview of the correlations between all constructs. The correlations were computed between latent factors based on the combined CFA model including all psychological constructs. The Pearson correlation indicates important correlates of intention to consume cultured proteins. The most relevant ones ($|r| \geq .50$) in descending order are first impression (r = .73), social norms (r = .71), the belief that cultured proteins will have a positive impact on the economy (r = .61), the belief that the participants' country needs a cultured proteins industry (r = .60), the belief that cultured proteins have a positive global impact (r = .57), and the belief that farming practices have negative consequences (r = .52). A similar correlation pattern emerged for the willingness to substitute non-vegan products, while the correlates of the willingness to substitute vegan products were less clear.

As might be expected, the NEP scale and ecological concern, and general innovativeness and food related innovativeness were highly correlated (r = .83 and r = .92 respectively). The highest correlates of the first impression of cultured proteins were with the beliefs that cultured proteins would have a positive economic impact, a cultured protein industry was needed, the global impact will be positive, and that farming has negative consequences (all $r > 0.50$ and positive).

4.4. Predictive model of cultured proteins consumption

The models that separately tested the three predictor sets can be found in Appendix B. Here we focus on the model combining all three predictors sets and exploring the relationships between them. The

Table 1
Pearson correlation coefficients based on latent factors in measurement model.

	Concerns			SN	Innovativeness		Identity		Food consciousness	Knowledge	1st Impression	Beliefs							Intention		
	Ecological	Egoistic	Altruistic		general	Food-related	diet	health				Global pos. impact	Global neg. impact	Pos. economic impact	Increased dependency	Farming is pos.	Farming is neg.	Need for cultured protein industry	Consume	Substitute vegan	Substitute non-vegan
NEP	.83***	.36***	.42***	.28***	.05*	.03	-.27***	.16***	.29***	.14***	.19***	.49***	-.14***	.44***	-.03	.09**	.49***	.31***	.21***	.04	.17***
Eco. Con.		.64***	.67***	.26***	-.03	-.02	-.19***	.17***	.34***	.09***	.22***	.46***	-.12***	.43***	-.05	-.06*	.52***	.28***	.23***	.06**	.23***
Ego. Con.			.66***	.08**	-.01	.04	.06*	.23***	.28***	-.01	.07**	.19***	.16***	.20***	.12***	-.004	.24***	.09***	.08***	-.02	.05**
Alt. Con.				.14***	-.06**	-.06*	-.10***	.19***	.27***	-.02	.09***	.27***	.03	.25***	-.01	-.002	.31***	.12***	.11***	-.02	.10***
SN					.25***	.20***	-.17***	-.05*	.03	.25***	.70***	.66***	-.35***	.69***	-.12***	-.19***	.64***	.66***	.71***	.47***	.58***
Gen. Inno.						.92***	-.07**	.05*	-.07**	.23***	.18***	.15***	.03	.12***	.09***	.10***	.07**	.14***	.12***	.04	.09***
Food Inno.							-.001	.09***	-.04	.17***	.16***	.13***	.09**	.09***	.14***	.06**	.06*	.08***	.14***	.06**	.05*
Diet Ident.								.27***	-.01	-.08***	-.16***	-.19***	.30***	-.15***	.18***	.11***	-.15***	-.16***	-.18***	-.07**	-.19***
Health Ident.									.44***	.02	-.13***	.04	.18***	.07**	.11***	.22***	-.02	-.03	-.09***	-.12***	-.15***
Food Consc.										.01	.06**	.14***	.02	.15***	.02	-.05*	.19***	.07***	.04	-.07**	.06**
Knowledge											.29***	.21***	-.15***	.20***	.02	.002	.15***	.21***	.23***	.19***	.22***
1st Impress.												.56***	-.39***	.58***	-.16***	-.27***	.55***	.57***	.73***	.52***	.64***
Glob. Pos. Impact Bel.													-.22***	.84***	-.09**	-.10***	.82***	.65***	.57***	.32***	.47***
Glob. Neg. Impact Bel.														-.30***	.61***	.45***	-.32***	-.33***	-.31***	-.29***	-.47***
Pos. Econ. Impact Bel.															-.05	-.12***	.78***	.70***	.61***	.35***	.48***
Dependency Bel.																.40***	-.16***	-.08**	-.07**	-.09***	-.25***
Farming is pos. Belief																	-.36***	-.08***	-.18***	-.20***	-.43***
Farming is neg. Belief																		.63***	.52***	.27***	.52***
Need for industry Bel.																			.60***	.40***	.48***
Consume Intent.																				.59***	.64***
Sub. Vegan Intent.																					.64***

Note. $N = 3859$. Substitution intentions and knowledge about cultured proteins were recoded to match their scale to the other constructs. *$p < 0.05$, **$p < 0.01$, ***$p < 001$.

corresponding path coefficients can be found in Table 2. Based on data from $n = 3242$ participants the model was able to explain 66% of the variance of the general intention to consume cultured protein, 54% of the variance of the intention to substitute non-vegan products, and 39% of the variance of the intention to substitute vegan options. Food innovativeness significantly mediated the relationship between the general innovativeness and the general intention (indirect $\beta = .13$) indicating general innovativeness is positively related to the general intention through the association with food innovativeness. None of the other indirect regression coefficients were significant.

The two most relevant predictors for all three intentions were perceived social norms ($0.18 \leq \beta \leq .34$) and first impression ($0.33 \leq \beta \leq .46$). Perceived social norms positively influenced the intention to consume cultured protein, the intention to substitute vegan alternatives with cultured protein, and the intention to substitute non-vegan alternatives with cultured protein. First impression of cultured protein follows a similar pattern: the better the first impression the higher were all three intentions. The other psychological variable that was significantly and positively associated with all intentions was belief in the need for a cultured proteins industry ($0.09 \leq \beta \leq .13$; the stronger the belief the higher the intentions).

General intention to consume was also strongly predicted by the general innovativeness ($\beta = -0.19$) and food innovativeness ($\beta = .15$). Stronger general intention was associated with lower general innovativeness and higher food innovativeness. In terms of intention to substitute vegan products, the strongest predictors were negative beliefs about farming ($\beta = -0.32$), general innovativeness ($\beta = -0.16$), and the belief that cultured proteins will have a positive global impact ($\beta = .16$). Hence, holding a negative view of farming and stronger general innovativeness were associated with lower intentions to substitute vegan products with cultured protein, whereas believing that cultured proteins will have a positive global impact has the opposite effect. The intention to substitute non-vegan options furthermore significantly decreased with increasing positive beliefs about farming ($\beta = -0.24$) and an increasing belief that cultured proteins will have a negative global impact ($\beta = -0.14$).

Associations with socio-demographic variables differed across the three intentions. Being vegan ($0.07 \leq \beta \leq .08$) and being vegetarian ($0.10 \leq \beta \leq .10$) were positively related to general intention to consume cultured proteins as well as intention to substitute vegan options, but negatively associated with intention to substitute non-vegan products. Positive predictors of intention to consume and intention to substitute vegan options included residing in Finland ($0.05 \leq \beta \leq .10$) and being female ($0.03 \leq \beta \leq .07$) while having a higher formal education was associated with lower intentions ($-0.05 \leq \beta \leq -0.05$). In contrast, a higher intention to substitute non-vegan products with their cultured counterpart was positively associated with age ($\beta = .09$) and income ($\beta = .04$), but negatively associated with Norwegian residency ($\beta = -0.04$).

5. Discussion

A critical factor in the introduction of cultured proteins will be whether consumers accept it or whether, as occurred with GMOs in the 1990s, the technology is rejected as a desirable source of protein. Although previous studies have examined this issue to some extent these have been relatively simple analyses – whereas the drivers of consumption behaviour are known to be complex. This is particularly true in our case as the product has yet to appear on the market in most

Table 2
Path coefficients of the structural equation model representing the combined model (standardized regression coefficients).

Predictors	Criteria							
	FI	EC	Know.	Consc.	1st Impress.	Intention (Consume)	Intention (Sub. Veg.)	Intention (Sub. Non-Veg.)
Psychological								
General Innovativeness	0.90*** [0.64; 0.72]					−0.19** [-0.31; −0.09]	−0.16* [-0.34; −0.03]	0.05 [-0.08; 0.17]
Food Innovativeness					0.10*** [0.09; 0.20]	0.15** [0.05; 0.34]	0.11 [-0.04; 0.36]	−0.09 [-0.29; 0.03]
NEP		0.97*** [1.55; 1.77]				−0.02 [-0.56; 0.49]	−0.23 [-1.16; 0.34]	0.01 [-0.59; 0.61]
Ecological Concern					−0.15** [-0.25; −0.07]	0.03 [-0.25; 0.32]	0.22 [-0.18; 0.64]	0.03 [-0.30; 0.36]
Egoistic Concern					0.06 [-0.00; 0.14]	−0.01 [-0.06; 0.04]	0.01 [-0.06; 0.07]	−0.01 [-0.07; 0.04]
Altruistic Concern					0.04 [-0.01; 0.08]	0.01 [-0.02; 0.05]	−0.03 [-0.07; 0.03]	0.03 [-0.01; 0.06]
Social Norms						0.34*** [0.30; 0.45]	0.24*** [0.18; 0.38]	0.18*** [0.12; 0.27]
Health Identity				0.44*** [0.40; 0.50]	−0.11*** [-0.22; −0.09]			
Diet Identity					0.02 [-0.04; 0.09]			
Knowledge					0.15*** [0.15; 0.25]	0.004 [-0.03; 0.04]	0.05* [0.01; 0.11]	0.02 [-0.02; 0.06]
Food Conscious.			0.03 [-0.01; 0.08]		0.05* [0.01; 0.12]	−0.02 [-0.06; 0.02]	−0.07*** [-0.15; −0.04]	0.02 [-0.02; 0.06]
1st Impression						0.46*** [0.39; 0.47]	0.35*** [0.29; 0.41]	0.33*** [0.26; 0.35]
Glob. Pos. Impact Bel.					0.18 [-0.02; 0.53]	0.09 [-0.00; 0.23]	0.16** [0.07; 0.39]	0.13* [0.04; 0.30]
Glob. Neg. Impact Bel.					−0.20*** [-0.39; −0.16]	−0.002 [-0.08; 0.07]	−0.09* [-0.23; −0.02]	−0.14*** [-0.26; −0.09]
Pos. Econ. Impact Bel.					0.18** [0.07; 0.42]	0.08* [0.00; 0.20]	0.01 [-0.13; 0.14]	−0.01 [-0.12; 0.09]
Dependency Bel.					0.05 [-0.02; 0.17]	0.05* [0.00; 0.12]	0.09** [0.04; 0.20]	0.03 [-0.03; 0.10]
Farming is pos. Belief					−0.13* [-0.36; −0.03]	−0.01 [-0.09; 0.06	−11*** [-0.27; −0.08]	−0.24*** [-0.43; −0.26]
Farming is neg. Belief					0.07 [-0.35; 0.57]	−0.12* [-0.36; −0.00]	−0.32*** [-0.74; −0.27]	−0.09 [-0.33; 0.06]
Need for industry Bel.					0.21*** [0.15; 0.29]	0.09*** [0.04; 0.13]	0.13*** [0.07; 0.20]	0.09*** [0.04; 0.13]
Socio-Demographic								
Country (Norway)						−0.002 [-0.07; 0.06]	0.01 [-0.07; 0.11]	−0.04* [-0.17; −0.02]
Country (Finland)						0.05* [0.02; 0.19]	0.10*** [0.11; 0.34]	−0.04 [-0.17; 0.02]
Age (younger)						0.003 [-0.07; 0.08]	0.05* [0.02; 0.20]	0.03 [-0.02; 0.14]
Age (older)						0.02 [-0.02; 0.12]	0.05* [0.02; 0.22]	0.09*** [0.11; 0.27]
Gender (female)						0.03* [0.01; 0.12]	0.07*** [0.08; 0.23]	0.02 [-0.02; 0.10]
Diet (vegan)						0.08*** [0.31; 0.72]	0.07*** [0.20; 0.70]	−0.07*** [-0.66; −0.22]
Diet (vegetarian)						0.10*** [0.32; 0.58]	0.10*** [0.32; 0.65]	−0.04* [-0.35; −0.02]
Occupation Status (in education)						−0.03 [-0.21; 0.01]	−0.03 [-0.25; 0.05]	−0.02 [-0.19; 0.06]
Occupation Status (employed)						−0.01 [-0.09; 0.04]	0.002 [-0.09; 0.10]	0.03 [-0.02; 0.13]
Children (vs. none)						−0.01 [-0.08; 0.05]	−0.02 [-0.13; 0.04]	0.01 [-0.04; 0.09]
Formal Education (at least high school)						−0.02 [-0.11; 0.03]	−0.03 [-0.17; 0.04]	−0.02 [-0.11; 0.05]
Formal Education (at least university)						−0.05** [-0.17; −0.02]	−0.05* [-0.22; −0.02]	−0.03 [-0.15; 0.01]
Income (lower)						0.02 [-0.02; 0.09]	−0.01 [-0.10; 0.06]	−0.01 [-0.09; 0.04]
Income (higher)						0.00 [-0.08; 0.08]	0.02 [-0.04; 0.19]	0.04* [0.02; 0.22]
R^2	0.81	0.93	0.001	0.19	0.50	0.66	0.39	0.54
Test of the mediations								

(*continued on next page*)

Table 2 (*continued*)

Predictors	Criteria							
	FI	EC	Know.	Consc.	1st Impress.	Intention (Consume)	Intention (Sub. Veg.)	Intention (Sub. Non-Veg.)
Indirect Effect (Gen. Innov. - > Food Innov. ->)						0.13** [0.04; 0.24]	0.10 [-0.03; 0.25]	−0.09 [-0.20; 0.02]
Total Effect (Gen. Innov. - > Food Innov. ->)						−0.06** [-0.10; −0.03]	−0.06** [-0.12; −0.02]	−0.04 [-0.08; 0.003]
Indirect Effect (NEP - > Ecological Concern ->)						0.03 [-0.42; 0.53]	0.22 [-0.31; 1.07]	0.03 [-0.49; 0.59]
Total Effect (NEP - > Ecological Concern ->)						0.01 [-0.09; 0.12]	−0.02 [-0.17; 0.11]	0.04 [-0.05; 0.17]

Note. $N = 3242$. Robust CFI = .851, Robust RMSEA = .044 [0.043; 0.045], SRMR = .066, scaled χ^2 (3619) = 20,865.9 with $p < 0.001$. The 95%-confidence intervals of the unstandardized regression coefficients are presented in the brackets. FI = food innovativeness, EC = ecological concern, Know(ledge), (food) consc(iousness), Glob. Pos. Impact Bel. = belief that cultured proteins will have a positive global impact, Glob. Neg. Impact Bel. = belief that cultured proteins will have a negative global impact, Pos. Econ. Impact Bel. = belief that cultured proteins will have a positive economic impact, Dependency Bel. = belief that cultured proteins will increase international dependencies, Farming is pos. Belief = belief that farming is positive, Farming is neg. Belief = belief that farming is negative, Need for industry Bel. = belief that a cultured proteins industry is needed in the home country. Both substitution intentions were recoded, so that their scale matches the scales of the other constructs. *$p < 0.05$, **$p < 0.01$, ***$p <$ 001.

countries meaning that the decision whether to try the product or change dietary behaviours as a result of it cannot be based on consumption experiences. To address this complexity, we developed and applied a psychological framework exploring the relationships between factors such as innovativeness, social norms, self-identity, the first impression, and beliefs and participants' intentions – and applied it to consumers in Norway, Denmark, and Finland. The findings indicate that social norms, beliefs, and innovativeness are significant predictors of participants' intentions to consume cultured proteins, while concerns did not have a substantial predictive power when controlling for the other factors in the model.

Overall, the picture is one of ambiguity. There seems to be neither overwhelming opposition to cultured proteins nor massive support. In line with previous research on preferences for plant-based options over cultured proteins, the mean willingness to substitute plant-based alternatives with cultured proteins is descriptively below the scale midpoint indicating a slight preference for plant-based options (e.g., Bryant & Dillard, 2019; Francekovié et al., 2021; Siddiqui, Alvi, et al., 2022). The mean willingness to substitute meat, fish, and dairy products is even lower indicating a preference for these conventional products over cultured proteins.

When it comes to the SEM, the results show a positive association between general innovativeness and food innovativeness supporting the assumed conceptual proximity. This might explain the direct negative association of the general innovativeness with the general intention to consume cultured proteins in the combined SEM as we controlled for food innovativeness in that model. However, the *indirect* relationship (mediated by food innovativeness) was positive. Additionally, higher food innovativeness was associated with a more favourable first impression and greater intention to consume cultured proteins in line with previous findings (e.g., Lewisch & Riefler, 2023). These results align with previous research demonstrating that individuals with high levels of innovativeness (which tends to predict purchasing intentions – Vandecasteele & Geuens, 2010) are inclined to explore novel food products and technologies (Li et al., 2021). A connection was also found between food innovativeness and a positive first impression, suggesting that individuals interested in trying new foods have a favourable initial perception of cultured proteins due to their novelty as a food product.

Various factors were included for measuring participants' levels of ecological, egoistic, and altruistic concerns. Interestingly, ecological concern, encompassing worries about animal welfare, food security, and safety, did not show any relationship with intentions to consume cultured proteins. Recently, Wilks et al. (2024) presented similar findings where the acceptance of cultured proteins was not significantly associated with the moral value of not imposing harm, but rather with the value of purity. Similarly, neither egoistic nor altruistic concerns had a direct impact on intentions. The explanation of cultured proteins for the participants of our survey did not touch upon its consequences on conventional farming and climate change but rather on its production. This together with the lack of significant association suggests that participants did not associate these general concerns with cultured proteins and did not perceive cultured proteins as addressing these specific concerns (compare Wilks et al., 2024; Pakseresht et al., 2022). In addition, the items measuring egoistic concern are broadly formulated and easily applicable to the societal level. This operationalization might have attenuated the relation with the intentions as food consumption is a highly personal topic (e.g., Fischler, 1988; Lowe et al., 2015). In contrast, previous research assessed concerns that were more proximal to the individual such as health (e.g., Siegrist & Sütterlin, 2017; Wilks et al., 2021), taste (e.g., Grasso et al., 2019; Wilks & Phillips, 2017), or price (e.g., Gómez-Luciano, et al., 2019; Wilks & Phillips, 2017). Alternatively, this finding could suggest that the aspects from the concerns that are essential for the formation of the intentions were captured by other psychological factors. For example, the facet of ecological concern on animal welfare overlaps with the negative beliefs about farming. In contrast to the concern, the beliefs are directly connected with the system around cultured proteins per our operationalization and hence, might function as a mediator of the more general concerns. Additionally, individuals with higher ecological concerns had less favourable first impressions of cultured proteins, indicating a perception of cultured proteins as unethical (e.g., Bryant & Dillard, 2019; Rabl & Basso, 2021), unnatural (e.g., Siegrist & Hartmann, 2020), or associated with conventional proteins (e.g., Kaiser & Byrka, 2015).

Participants with a positive first impression of cultured proteins were more inclined to consume them regularly. Positive first impressions were also associated with a higher likelihood of substituting meat-eating and non-meat-eating diets with cultured proteins which is in line with the review by Siddiqui, Khan, et al. (2022). Additionally, prior knowledge about cultured proteins was positively linked to first impressions, but it did not significantly affect intentions to consume cultured proteins directly. This might indicate that the overall confidence in one's own knowledge is relatively low and therefore, the knowledge is only relevant for less important and behaviour distant variables like a vague first impression, but not consolidated enough to affect more behavioural proximal constructs like intentions (e.g., Sundblad et al., 2009). In line with that, previous studies have shown that prior knowledge as well as familiarity improves attitudes towards organic food (Aertsens et al., 2009) and also cultured proteins (Mancini & Antonioli, 2019; Rolland et al., 2020; Siddiqui, Khan, et al., 2022). Talking to other people about cultured proteins can reduce resistance and so does receiving information about cultured proteins technology and sustainability-related aspects (Bekker et al., 2017; Valente et al., 2019; Verbeke et al., 2015).

The influence of the social environment on individuals' choices, including dietary decisions, has been well-established (Croker et al., 2009; Higgs, 2015; Higgs & Thomas, 2016; Ryynänen & Toivanen, 2023; White et al., 2009). The SEM shows that the presence of strong social norms, encompassing both injunctive and descriptive norms, was associated with increased intentions to consume cultured proteins, and a greater likelihood of substituting omnivorous, vegetarian and vegan diets. These findings align with previous research emphasizing the role of social norms in consumers' evaluation of alternative proteins (Jensen & Lieberoth, 2019; Onwezen et al., 2021) and cultured meat specifically (e.g., Arango, Septiano, & Pontes, 2023). Lack of experience with cultured proteins may lead individuals to rely on social norms for guidance (de Maya et al., 2011).

Higher scores on health identity were associated with increased food consciousness, indicating that individuals identifying as health-conscious tend to be more mindful of their food choices (Michaelidou & Hassan, 2008). Interestingly, participants with a stronger health identity had a less favourable first impression of cultured proteins, potentially indicating their perception of cultured proteins as less healthy (also see Gómez-Luciano et al., 2019). In online news commenting "the three U's" or unhealthiness, unnaturalness and unethicalness are often associated with cultured meat (Ryynänen & Toivanen, 2023). Food consciousness was also related to a decreased intention to substitute vegetarian or vegan diets, suggesting that individuals who are conscious of their food choices may not view cultured proteins as an appealing option compared to other alternative proteins.

Beliefs about cultured proteins and their impact on the global economy were significant predictors of intentions. Participants who believed in the positive global impact of a cultured proteins industry exhibited higher intentions to substitute omnivore, vegetarian or vegan diets. Conversely, those who believed in a negative impact had more negative first impressions. Taken together, beliefs representative of a positive attitude were positively associated with cultured proteins, whereas related intentions and beliefs indicative of a negative attitude had the inverse relation (similar to findings from the organic food domain – Zagata, 2012).

Beliefs about the farming industry also influenced intentions, but the predictor pattern is arbitrary. Participants holding negative views of farming had lower intentions to consume cultured proteins, and a decreased likelihood of substituting vegetarian or vegan diets. This might indicate that participants still associate cultured proteins with conventional farming or negative aspects of conventional farming (e.g., ethical concerns about animal welfare; Bryant & Dillard, 2019). This perceived conceptual overlap might function as a barrier of cultured protein adoption. Positive beliefs about farming included concerns for farmers and their livelihoods, suggesting that participants perceived a potential threat to traditional farming practices and fewer farming opportunities with the rise of cultured proteins. This explains, why a stronger positive view of farming also relates negatively to the intention to substitute both meat and plant-based proteins – a finding that corroborates the results from Slade (2018). Complementary to this perception, Finnish livestock farmers address similar concerns (Räty et al., 2023).

The results suggest that nationality, age, education, diet, and gender influenced intentions and the willingness to substitute diets. Participants from Finland had higher intentions to try, consume, and substitute vegetarian and vegan diets compared to the other participants, while participants from Norway were less likely to substitute omnivore diets. Higher education was associated with lower intentions and a lower likelihood of substituting vegetarian and vegan diets. Furthermore, vegetarians and vegans showed higher intentions and were more willing to substitute their diets compared to omnivores. These socio-demographic factors have been consistently linked to intentions to consume cultured proteins in previous studies (Bryant et al., 2019; Mancini & Antonioli, 2019; Slade, 2018; Wilks & Phillips, 2017), with young, higher-educated individuals, males, left-leaning voters, and meat-eaters displaying more positive attitudes towards cultured proteins. Our findings only partially replicate these findings with arbitrary results for the influence of age and opposite relations for gender, diet, and education. Although generally small, these associations might be indicative of a broader societal proliferation and confrontation compared to previous studies.

Building on previous research and our findings, comprehensive marketing strategies should emphasize cultured proteins' benefits and differentiate it from conventional products to effectively market cultured proteins and maximize its market success. These strategies include designing packaging that underscores cultured meat's quality attributes and using clear labelling to highlight its distinctiveness. It's crucial to utilize simple, non-technical language and engage in transparent dialogue about the product's production processes and consumer-related benefits such as sustainability, animal rights, and public health (Siddiqui, Alvi, et al., 2022). Additionally, addressing consumer concerns about factors like unnaturalness, health, texture, price, and safety is vital to enhance acceptability and purchasing power (Siddiqui, Bahmid, et al., 2022). Emphasizing positive organizational factors such as trustworthiness and corporate social responsibility can reduce consumer uncertainty and build trust. Promoting the environmental benefits of cultured meat can further boost consumer engagement and acceptance, positioning it as a sustainable alternative to traditional meat (Lin-Hi, Reimer, Schäfer, & Böttcher, 2023). These integrated marketing efforts aim to foster holistic acceptance among consumers by addressing both the intrinsic qualities of the product and the organizational ethos. Based on our findings marketing strategies could leverage psychological mechanisms like social norms, beliefs about farming, or innovativeness. Dependent on the characteristics of the target group, communication could either focus on the advantages of cultured proteins over products from conventional farming (for a group that is more concerned about the environment, animal welfare, and other related issues) or on its novelty fostering a perception of cultured protein as "high-tech food" (for a group that is open to new food alternatives and technological innovations in general). Corresponding strategies should take into account that communicating either characteristic could deter the other group underlying the complexity of psychological determinants of dietary decisions.

In contrast, emphasizing a general societal acceptance of cultured proteins could be a promising lever across different target groups given the important role of social norms in our findings. Here, it might be even more effective to communicate social expectations from more proximate groups or peers by, for example, leveraging social media networks (e.g., Cialdini & Jacobson, 2021). It is important to note that the effectiveness of interventions that communicate a norm can be undermined when they do not match the experiences of the individual (e.g., Cialdini & Jacobson, 2021). This highlights the importance of considering the socio-cultural context when designing marketing strategies. For example, strategies might be different in Finland compared to Norway or Denmark because of the extended media coverage of cultured proteins in Finland and the corresponding familiarity with the topic. In addition, different socio-demographic groups might be targeted differently based on their reality of life as our findings indicate that some groups are more open to cultured proteins than others.

Overall, our final model was able to account for a substantial amount of variance in the general consumption intention as well as the willingness to substitute currently available products. Psychological variables from all three predictor sets were significantly associated with the intentions indicating that multiple psychological processes (such as rational decision-making, moral considerations, or social influence) might underly the consumer adoption of cultured proteins. Even though previous literature reviews (e.g., Bryant & Barnett, 2018, 2020; Onwezen et al., 2021; Siddiqui, Khan, et al., 2022) shed light on the manifold drivers and barriers of cultured protein acceptance and related behavioural intentions, this study is among the first to assess the main psychological and socio-demographic determinants identified in the reviews in one comprehensive empirical investigation. This not only helps to indentify which drivers and barriers are the most promising levers to target with interventions, but it is also the first step towards understanding the interconnectedness of the underlying factors and the associated cognitive and affective mechanisms.

Our study has limitations. We analysed cross-sectional data to compute the SEM and the mediation relations. Hence, our evidence on the causal direction of the relationships between the assessed variables is correlational and therefore, restricted. Future work should focus on corroborating the found associations by experimental or longitudinal data. We collected the data from three Nordic countries and hence analysed Western, Educated, Industrialized, Rich, and Democratic (WEIRD) samples. As most of the research on the psychological predictors of the consumption of cultured proteins has been done in WEIRD samples and the psychological mechanisms might differ across cultures, we caution against generalizing our findings to non-WEIRD contexts. Further, more psychometric limitations were the use of two country specific items to assess the beliefs about cultured proteins and agriculture in general (one of them was omitted before the main analyses). Even though this can be justified in our case by the different agricultural context in the countries the use of differing item contents might also alter the psychological meaning of the scale. The lack of metric MI for the corresponding scale already hints at that. Another limitation lies in the conceptual proximity of our general attitude factor (i.e., the first impression of cultured protein) and our criteria (i.e., the three intention measures). As some studies suggest a conceptual overlap of attitudes and behavioural intentions (e.g., Kaiser & Byrka, 2015) and we also find high correlations between them, including the first impression as a predictor might obscure the influence of other psychological constructs in our model. Lastly, the introduction of the concept of cultured proteins tends to influence the participants' evaluation. There are no indications whether this introduction was sufficient or whether it was understood similarly by participants. Differential understanding of the concept of cultured proteins would introduce random variance to our models.

Future psychological research on cultured proteins should focus on the perception of cultured proteins and its determinants in non-Western countries. Furthermore, it seems worthwhile to explore the complex role diet and corresponding identity aspects play in forming beliefs and consumption intentions of cultured protein. It would be beneficial to investigate whether targeted interventions based on the diet could more effectively alter the perception of cultured protein. Well-designed framings of cultured proteins prime participants neutrally and help prevent the formation of misconceptions and inaccurate assumptions. Other psychological variables that our findings suggest worth targeting are social norms and the familiarity with the concept of cultured protein. Communicating a high acceptance of cultured proteins in the population or peer group may increase the intention to consume cultured protein. Another research gap is the investigation of the effect of actual experiences with cultured proteins. Increasing availability of cultured proteins products in the future will allow real-world experimental research settings. Given the importance of the first impression in our findings, testing real cultured proteins would add another dimension to study the behavioural intentions.

6. Conclusion

This study analysed the consumer intentions to adopt cultured proteins and their willingness to substitute omnivore, vegetarian or vegan diets with these novel protein products in Norway, Denmark, and Finland. The findings highlighted the significant role of social norms, beliefs, and innovativeness in shaping consumers' intentions and indicate psychological mechanisms underlying the decisions related to cultured proteins consumption. Additionally, the design allowed us to analyse the differing predictor patterns underlying the general intention to consume cultured proteins as well as the willingness to substitute an omnivore or vegetarian and vegan diet. One of the most important predictors in our model was positive social norms or the influence of meaningful others which were associated with higher intentions to consume cultured proteins and a greater likelihood of dietary substitution. Positive first impressions of cultured proteins drive intentions and dietary substitution although familiarity and knowledge associated with cultured proteins are rather limited. Prior knowledge about cultured proteins and beliefs about their global and economic impacts also shaped participants' intentions. Furthermore, socio-demographic factors such as nationality, education, diet, and gender were associated with variations in intentions and dietary substitution. Overall, the final model was able to explain the intentions well with proportions of explained variance ranging between 0.39 and 0.66. These findings contribute to the understanding of the factors influencing consumer acceptance of cultured proteins and inform targeted marketing strategies to promote their adoption.

Funding statement

This study was financed with funding from the Norwegian Research Council (Grant No. 294777), EIT-FOOD (FUTUREPROTEIN ID-20186), the Kone Foundation (Grant No. 201802185), and the Foundation for Economic Education (Grant No. 190340).

Ethical statement

We declare that the manuscript "Psychological Factors Influencing Consumer Intentions to Consume Cultured Meat, Fish and Dairy" follows Appetites ethical requirements. This submission reflects and accurate account of the work, and the data has been represented accurately and has been made available. All sources have been acknowledged and is an original work. All authors have made a significant contribution to the conception, design, execution, or interpretation of the reported study. Every author that has made contributions have been listed and an author contribution statement is included in the manuscript. In addition, those who have made contributions are recognized in an acknowledgement section. No AI was used in any part of the writing of the manuscript. This manuscript as not been published previously in any publication or other form.

CRediT authorship contribution statement

L. Engel: Writing – review & editing, Writing – original draft, Methodology, Formal analysis. **K. Vilhelmsen:** Writing – review & editing, Writing – original draft. **I. Richter:** Writing – review & editing, Writing – original draft. **J. Moritz:** Writing – review & editing, Writing – original draft. **T. Ryynänen:** Writing – review & editing, Writing – original draft, Funding acquisition. **J.F. Young:** Writing – review & editing, Writing – original draft, Funding acquisition. **R.J.F. Burton:** Writing – review & editing, Writing – original draft, Funding acquisition. **U. Kidmose:** Writing – review & editing. **C.A. Klöckner:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

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.

Data availability

The dataset is available online https://zenodo.org/record/6326869 PROTEIN 2.0 survey data (Original data) (Zenodo)

Acknowledgements

We thank Rashid Maqbool for his contribution to the development of the survey, Fie Følbæk Gravgaard for the translation of the Danish version, Knut Weberg for the translation of the Norwegian version of the survey, and Hanna L. Tuomisto for commenting on the translation of the Finnish version of the survey.

Appendix A

Table A1
Test statistics for univariate and multivariate normality tests and factor loadings for the NEP

				W	λ
Item level					
The balance of nature is very delicate and easily upset by human activities. ($n = 3853$)				0.81	0.73
The earth is like a spaceship with only limited room and resources. ($n = 3850$)				0.83	0.55
Plants and animals do not exist primarily for human use. ($n = 3854$)				0.86	0.57
Modifying the environment for human use seldom causes serious problems. ($n = 3853$)				0.89	0.43
There are no limits to growth for nations like Norway. ($n = 3854$)				0.91	0.31
Mankind was created to rule over the rest of nature. ($n = 3855$)				0.88	0.40
	Median	*M*	*SD*	Kurtosis	Skewness
Scale level					
NEP ($n = 3833$)	2.33	2.26	0.73	−0.63	0.12

Note. W = Shapiro-Wilk test statistic (perfect normality = 1.00; all test statistics were the same when Shapiro-Francia test was applied), λ = standardized factor loadings from CFA combining all constructs (Robust Full Information Maximum Likelihood estimator). All $p < 0.001$.

Table A2
Test statistics for univariate and multivariate normality tests and factor loadings for the concerns

				W	λ
Item level					
Ecological Concern					
extinction of animals/plants (loss of biodiversity) ($n = 3852$)				0.86	0.83
animal welfare ($n = 3848$)				0.89	0.75
climate change caused by human activity ($n = 3855$)				0.86	0.81
Egoistic Concern					
food safety ($n = 3856$)				0.92	0.80
security of access to food ($n = 3858$)				0.93	0.83
economic prosperity ($n = 3853$)				0.93	53
Altruistic Concern					
hunger in the world ($n = 3850$)				0.89	0.97
	Median	*M*	*SD*	Kurtosis	Skewness
Scale level					
Ecological Concern ($n = 3841$)	2	2.38	1.11	0.19	0.80
Egoistic Concern ($n = 3852$)	3	3.04	1.07	−0.43	0.23
Altruistic Concern ($n = 3850$)	2	2.58	1.32	−0.16	0.68

Note. W = Shapiro-Wilk test statistic (perfect normality = 1.00; all test statistics were the same when Shapiro-Francia test was applied), λ = standardized factor loadings from CFA combining all constructs (Robust Full Information Maximum Likelihood estimator). All $p < 0.001$.

Table A3
Test statistics for univariate and multivariate normality tests and factor loadings for social norms

				W	λ
Item level					
I expect that most people, who are important to me, will consume synthetic/cultured meat, fish and dairy products when they become available. ($n = 3852$)				0.91	0.80
I expect that most people, who are important to me, would approve of me consuming synthetic/cultured meat, fish or dairy when they become available. ($n = 3851$)				0.88	0.78
	Median	*M*	*SD*	Kurtosis	Skewness
Scale level					
Social Norms ($n = 3849$)	3	2.79	1.05	−0.27	0.33

Note. W = Shapiro-Wilk test statistic (perfect normality = 1.00; all test statistics were the same when Shapiro-Francia test was applied), λ = standardized factor loadings from CFA combining all constructs (Robust Full Information Maximum Likelihood estimator). The unstandardized factor loadings of both items were fixed to equality. All $p < 0.001$.

Table A4
Test statistics for univariate and multivariate normality tests and factor loadings for innovativeness

				W	λ
Item level					
General Innovativeness					
I like to own an innovative product that distinguishes me from others who do not own this product. ($n = 3850$)				0.90	0.75
I love to use innovations that impress others. ($n = 3850$)				0.90	0.74
In general, I am among the first in my circle of friends to buy or try an innovative product when it appears. ($n = 3854$)				0.91	0.80
If an innovative product makes my life easier, then this product is a "must" for me. ($n = 3853$)				0.89	0.63
It gives me a good feeling to acquire innovative products. ($n = 3849$)				0.89	0.78
Innovations make my life exciting and stimulating. ($n = 3853$)				0.90	0.78
Food-related Innovativeness					
If I heard that an innovative food was available in the store, I would be interested enough to buy it. ($n = 3849$)				0.90	0.78
I am curious and will eat almost anything. ($n = 3855$)				0.92	0.34
I usually prefer innovative food and tastes over classic food. ($n = 3853$)				0.90	0.77
	Median	*M*	*SD*	Kurtosis	Skewness
Scale level					
General Innovativeness ($n = 3825$)	2.83	2.82	0.90	−0.30	0.15
Food-related Innovativeness ($n = 3843$)	3	2.89	0.80	0.16	0.05

Note. W = Shapiro-Wilk test statistic (perfect normality = 1.00; all test statistics were the same when Shapiro-Francia test was applied), λ = standardized factor loadings from CFA combining all constructs (Robust Full Information Maximum Likelihood estimator). Standardized error covariance between items 1 and 2: 0.44. All $p < 0.001$.

Table A5
Test statistics for univariate and multivariate normality tests and factor loadings for food identity

				W	λ
Item level					
Diet Identity					
I have a lot in common with other meat eaters. ($n = 3856$)				0.90	0.75
I feel strong ties to other meat eaters. ($n = 3852$)				0.89	0.83
Eating meat is an important part of who I am. ($n = 3854$)				0.91	0.75
I feel good when I think about myself as a meat eater. ($n = 3854$)				0.90	0.70
I often think about the fact that I am a meat eater. ($n = 3854$)				0.89	0.45
Health Identity					
Eating healthy food is an important part of who I am. ($n = 3853$)				0.88	0.81
Eating nutritious food is an important part of who I am. ($n = 3855$)				0.87	0.81
Eating high quality food is an important part of who I am. ($n = 3856$)				0.89	0.66
	Median	*M*	*SD*	Kurtosis	Skewness
Scale level					
Diet Identity ($n = 3840$)	3	3.11	0.92	−0.31	0.08
Health Identity ($n = 3848$)	2.33	2.35	0.83	0.53	0.56

Note. W = Shapiro-Wilk test statistic (perfect normality = 1.00; all test statistics were the same when Shapiro-Francia test was applied), λ = standardized factor loadings from CFA combining all constructs (Robust Full Information Maximum Likelihood estimator). All $p < 0.001$.

Table A6
Test statistics for univariate normality tests and factor loadings for the single-item measures

	Median	*M*	*SD*	Kurtosis	Skewness	*W* (*W'*)	λ
Food Consciousness ($n = 3857$)	2	2.42	0.91	1.20	0.68	0.87	0.94
Knowledge about Cultured proteins ($n = 3851$)	2	2.04	0.90	−0.83	0.36	0.85	0.94
First Impression of Cultured proteins ($n = 3856$)	3	2.95	1.15	−0.69	0.10	0.91 (0.92)	0.96

Note. W = Shapiro-Wilk test statistic (perfect normality = 1.00), W' = Shapiro-Francia test statistic (perfect normality = 1.00; W' in parentheses only if $W' \neq W$), λ = standardized factor loadings from CFA combining all constructs (Robust Full Information Maximum Likelihood estimator). All $p < 0.001$.

Table A7
Test statistics for univariate and multivariate normality tests and factor loadings for the beliefs

	W	λ
Item level		
Global Positive Impact		
will reduce the overfishing of the oceans ($n = 3849$)	0.89	0.78
will reduce the impact of global warming associated with farming ($n = 3853$)	0.89	0.80
will reduce the problem of food contamination (e.g., microplastic and mercury in wild caught fish) ($n = 3849$)	0.88	0.72
will reduce the danger of cross-species spread of diseases ($n = 3847$)	0.88	0.71
will improve animal welfare conditions ($n = 3848$)	0.90	0.69
will reduce the number of farmed animals on earth ($n = 3849$)	0.88	0.52
will be a viable alternative to farmed meat ($n = 3847$)	0.90	0.77

(*continued on next page*)

Table A7 (*continued*)

				W	λ
will be able to solve world famine problems (n = 3851)				0.89	0.66
Global Negative Impact					
is disrespectful to nature (n = 3849)				0.90	0.66
will reduce biodiversity on earth (n = 3852)				0.90	0.73
will endanger ecosystems that depend on grazing animals (n = 3850)				0.90	0.70
will have a negative impact on traditional farmers (n = 3852)				0.89	0.57
will change how cultural landscapes in Norway look like in the future (n = 3850)				0.89	0.41
Positive Economic Impact					
create new high-tech jobs in Norway (n = 3849)				0.89	0.82
lead the way to new technologies in Norway (n = 3850)				0.88	0.81
contribute to sustainable use of resources (n = 3852)				0.89	0.84
be available in the shops within the next 10 years (n = 3850)				0.88	0.63
make more of the countryside available for recreational purposes (n = 3849)				0.89	0.65
Increased Dependency					
make Norway more dependent on large food companies (n = 3853)				0.89	0.80
make food production less local (n = 3852)				0.89	0.63
make Norway more dependent on other countries (n = 3850)				0.89	0.70
Farming is Positive					
Traditional farms are typical for Norway (n = 3850)				0.82	0.78
Farming is an important activity for the Norwegian society (n = 3853)				0.81	0.81
Animal farming in Norway secures Norwegian access to food in times of crisis (n = 3850)				0.86	0.70
Cultural landscapes formed by animal farming are an important part of Norwegian landscape (n = 3849)				0.86	0.75
Farming is Negative					
Traditional animal farming makes a significant contribution to Norwegian greenhouse gas emissions (n = 3846)				0.91	0.65
Traditional animal farming has a negative impact on biodiversity because it reduces the area of "untouched" land (n = 3851)				0.91	0.68
Synthetic fish production would solve the environmental problems connected to salmon farming (n = 3852)				0.90	0.78
Need for Cultured proteins Industry					
Norway should develop its own cultured meat industry (n = 3848)				0.89	0.96
	Median	*M*	*SD*	Kurtosis	Skewness
Scale level					
Global Positive Impact (n = 3816)	2.63	2.57	0.75	0.51	0.25
Global Negative Impact (n = 3833)	3.20	3.20	0.73	0.45	0.04
Positive Economic Impact (n = 3837)	2.60	2.63	0.79	0.69	0.42
Increased Dependency (n = 3847)	3.33	3.33	0.79	0.45	0.003
Farming is Positive (n = 3840)	2	2.01	0.81	−0.35	0.53
Farming is Negative (n = 3843)	3	2.87	0.89	−0.0005	0.16
Need for Cultured proteins Industry (n = 3848)	3	2.57	1.11	−0.30	0.38

Note. W = Shapiro-Wilk test statistic (perfect normality = 1.00; all test statistics were the same when Shapiro-Francia test was applied), λ = standardized factor loadings from CFA combining all constructs (Robust Full Information Maximum Likelihood estimator). All $p < 0.001$.

Table A8

Test statistics for univariate and multivariate normality tests and factor loadings for the intentions

				W	λ
Item level					
Intention to Consume Cultured Protein					
Would you be willing to taste synthetic/cultured fish? (n = 3853)				0.91	0.88
Would you be willing to taste synthetic/cultured meat? (n = 3854)				0.87	0.85
Would you be willing to taste synthetic/cultured dairy? (n = 3848)				0.88	0.86
Would you be willing to eat synthetic/cultured meat regularly? (n = 3851)				0.91	0.89
Would you be willing to eat synthetic/cultured fish regularly? (n = 3851)				0.89	0.86
Would you be willing to eat synthetic/cultured dairy regularly? (n = 3852)				0.91	0.88
Intention to Substitute Vegan Alternatives					
How willing would you be to eat synthetic/cultured fish as compared to plant-based fish substitutes (e.g. made from soy)? (n = 3854)				0.88	0.92
How willing would you be to eat synthetic/cultured meat as compared to plant-based meat substitutes (e.g. made from soy)? (n = 3852)				0.87	0.92
consume synthetic/cultured dairy as compared to plant-based dairy substitutes (e.g. made from soy)? (n = 3851)				0.88	0.89
Intention to Substitute Non-Vegan Alternatives					
How willing would you be to eat synthetic/cultured meat as compared to farmed meat? (n = 3851)				0.89	0.92
How willing would you be to eat synthetic/cultured fish as compared to conventional fish? (n = 3855)				0.89	0.91
How willing would you be to consume synthetic/cultured dairy as compared to farmed dairy? (n = 3849)				0.88	0.88
	Median	*M*	*SD*	Kurtosis	Skewness
Scale level					
Intention to Consume Cultured proteins (n = 3836)	2.67	2.84	1.09	−0.66	0.37
Intention to Substitute Vegan Alternatives (n = 3843)	2.67	2.51	1.10	−0.69	0.18
Intention to Substitute Non-Vegan Alternatives (n = 3844)	2	2.30	1.05	−0.56	0.39

Note. W = Shapiro-Wilk test statistic (perfect normality = 1.00; all test statistics were the same when Shapiro-Francia test was applied), λ = standardized factor loadings from CFA combining all constructs (Robust Full Information Maximum Likelihood estimator). Standardized error covariance between corresponding items of the Intention to consume factor: *r(meat-related items)* = −0.37, *r(fish-related items)* = −0.28, *r(dairy-related items)* = −0.50. All $p < 0.001$.

Table A9
Multiple-group confirmatory factor analysis models for the New Environmental Paradigm

Countries (n = 3858)				
	CFI	RMSEA	SRMR	BIC
Configural	0.942	0.107	0.034	65,412
Metric	0.838	0.130	0.142	65,772
Partial Metric (free factor loading of item 1)	0.890	0.112	0.076	65,556
Partial Metric (free factor loading of item 1 & 5)	0.915	0.104	0.058	65,465
Partial Metric (free factor loading of item 1, 2 & 5)	0.928	0.099	0.048	65,421
Gender (n = 3853)				
	CFI	RMSEA	SRMR	BIC
Configural	0.951	0.097	0.030	66,145
Metric	0.949	0.083	0.033	66,118
Age Groups (n = 3858)				
	CFI	RMSEA	SRMR	BIC
Configural	0.952	0.097	0.030	66,263
Metric	0.899	0.103	0.116	66,394
Partial Metric (free factor loading of item 1)	0.942	0.082	0.050	66,220
Diet (n = 3859)				
	CFI	RMSEA	SRMR	BIC
Configural	0.949	0.099	0.030	66,425
Metric	0.941	0.078	0.046	66,345
Income (n = 3297)				
	CFI	RMSEA	SRMR	BIC
Configural	0.948	0.100	0.031	57,073
Metric	0.908	0.097	0.080	57,115
Partial Metric (free factor loading of item 5)	0.925	0.092	0.069	57,071
Partial Metric (free factor loading of item 1 & 5)	0.944	0.083	0.036	57,017
Formal Education (n = 3858)				
	CFI	RMSEA	SRMR	BIC
Configural	0.950	0.098	0.030	66,465
Metric	0.868	0.116	0.121	66,720
Partial Metric (free factor loading of item 1)	0.920	0.095	0.053	66,509
Partial Metric (free factor loading of item 1 & 5)	0.948	0.081	0.035	66,406

Note. CFI = (Robust) Comparative Fit Index, RMSEA = (Robust) Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residual, BIC = Bayesian Information Criterion. Robust Maximum Likelihood estimation was applied. The item numbers refer to the order in Table A1.

Table A10
Multiple-group confirmatory factor analysis models for the concerns and social norms

Countries (n = 3858)				
	CFI	RMSEA	SRMR	BIC
Configural	0.965	0.073	0.049	100,134
Metric	0.959	0.075	0.052	100,156
Gender (n = 3853)				
	CFI	RMSEA	SRMR	BIC
Configural	0.965	0.073	0.044	100,828
Metric	0.957	0.076	0.053	100,889
Age Groups (n = 3858)				
	CFI	RMSEA	SRMR	BIC
Configural	0.963	0.064	0.053	100,993
Metric	0.947	0.085	0.065	101,154
Partial Metric (free factor loading of the item constituting the altruistic concern)	0.963	0.072	0.052	100,954
Diet (n = 3858)				
	CFI	RMSEA	SRMR	BIC
Configural	0.967	0.071	0.044	101,341
Metric	0.967	0.066	0.036	101,269
Income (n = 3297)				
	CFI	RMSEA	SRMR	BIC
Configural	0.964	0.074	0.043	87,144
Metric	0.964	0.069	0.039	87,080
Formal Education (n = 3858)				
	CFI	RMSEA	SRMR	BIC
Configural	0.965	0.073	0.044	101,436
Metric	0.952	0.080	0.059	101,550

Note. CFI = (Robust) Comparative Fit Index, RMSEA = (Robust) Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residual, BIC = Bayesian Information Criterion. Robust Maximum Likelihood estimation was applied. The item number refer to the order in Table A2.

Table A11
Multiple-group confirmatory factor analysis models for innovativeness, identity, and the intentions

Countries (n = 3859)				
	CFI	RMSEA	SRMR	BIC
Configural	0.921	0.064	0.053	296,256
Metric	0.907	0.067	0.103	296,997
Partial Metric (free factor loading of item 6 for general Innovativeness)	0.914	0.065	0.093	296,497
Gender (n = 3854)				
	CFI	RMSEA	SRMR	BIC
Configural	0.929	0.060	0.044	302,015
Metric	0.921	0.062	0.072	302,427
Age Groups (n = 3859)				
Configural	0.926	0.062	0.043	300,464
Metric	0.919	0.063	0.078	300,608
Partial Metric (free factor loading of item 1 for diet identity)	0.920	0.063	0.075	300,567
Diet (n = 3859)				
	CFI	RMSEA	SRMR	BIC
Configural	0.918	0.065	0.044	302,192
Metric	0.916	0.065	0.050	302,011
Income (n = 3297)				
Configural	0.920	0.064	0.046	261,518
Metric	0.917	0.064	0.059	261,397
Formal Education (n = 3859)				
	CFI	RMSEA	SRMR	BIC
Configural	0.921	0.063	0.045	304,277
Metric	0.913	0.065	0.069	304,489

Note. CFI = (Robust) Comparative Fit Index, RMSEA = (Robust) Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residual, BIC = Bayesian Information Criterion. Robust Maximum Likelihood estimation was applied. The item numbers refer to the order in Tables A.4 and A.5

Table A12
Multiple-group confirmatory factor analysis models for the beliefs

Countries (n = 3856)				
	CFI	RMSEA	SRMR	BIC
Configural	0.905	0.061	0.071	268,119
Metric	0.886	0.066	0.171	268,827
Partial Metric (free factor loading of item 6 for positive global impact belief)	0.887	0.066	0.169	268,775
Gender (n = 3852)				
	CFI	RMSEA	SRMR	BIC
Configural	0.910	0.059	0.075	270,711
Metric	0.895	0.063	0.195	271,314
Age Groups (n = 3856)				
	CFI	RMSEA	SRMR	BIC
Configural	0.905	0.060	0.078	270,092
Metric	0.891	0.063	0.139	270,473
Diet (n = 3856)				
	CFI	RMSEA	SRMR	BIC
Configural	0.905	0.060	0.077	271,059
Metric	0.902	0.060	0.085	270,853
Income (n = 3295)				
	CFI	RMSEA	SRMR	BIC
Configural	0.909	0.060	0.075	233,880
Metric	0.904	0.060	0.119	233,766
Formal Education (n = 3856)				
	CFI	RMSEA	SRMR	BIC
Configural	0.908	0.060	0.075	271,713
Metric	0.896	0.062	0.161	272,002

Note. CFI = (Robust) Comparative Fit Index, RMSEA = (Robust) Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residual, BIC = Bayesian Information Criterion. Robust Maximum Likelihood estimation was applied. The item number refer to the order in Table A.7.

Appendix B

B.1. SEM predictor set 1

The path coefficients pertaining to the first predictor set can be found in Table B1. The model estimation was based on the data from $n = 3241$ participants. We did not find any mediation effects of food innovativeness and ecological concern on the relation between general innovativeness and NEP with all intention factors. The lack of effect can be explained by the lack of significant relation between both mediators and the intentions in the model because both predictors and their respective mediators were strongly related. The amount of explained variance in the intentions was 0.55 for the general intention to consume cultured protein, 0.41 for the intention to substitute non-vegan options, and 0.29 for the intention to substitute vegan options.

Social norms (β =.70) and general innovativeness (β = −0.15) were the only significant psychological predictors of the general intention to consume cultured proteins. The stronger the expected social norm to consume cultured proteins was and the lower the general innovativeness was, the higher the intention to consume cultured protein. The only significant psychological predictor of the intention to substitute vegan options was social norms (β = .52). The intention to substitute non-vegan options was significantly predicted by social norms (β = .56) and egoistic concern (β = −0.07; stronger egoistic concern was associated with lower intention to substitute non-vegan options).

The most relevant socio-demographic predictors of the intentions were the diet, age, gender, and formal education. Being vegan or vegetarian was associated with higher intentions to generally consume cultured protein, higher intentions to substitute vegan products and lower intentions to substitute non-vegan options. Being older, female, and having a lower formal education than a university degree was positively associated with all intentions. Being from Finland was positively related to the general intention to consume cultured proteins and the intention to substitute vegan products.

Table B1
Path coefficients of the structural equation model representing the model pertaining to predictor set 1 (standardized regression coefficients)

Predictors	Criteria				
	FI	EC	Intention (Consume)	Intention (Sub. Veg.)	Intention (Sub. Non-Veg.)
Psychological					
General Innovativeness	0.90*** [0.64; 0.72]		−0.15* [-0.03; −0.15]	−0.12 [-0.30; 0.03]	0.03 [-0.11; 0.17]
Food Innovativeness			0.12 [0.00; 0.34]	0.08 [-0.10; 0.33]	−0.11 [-0.32; 0.04]
NEP		0.97*** [1.55; 1.79]	−0.07 [-0.75; 0.54]	−0.25 [-1.3; 0.39]	0.03 [-0.68; 0.78]
Ecological Concern			0.11 [-0.26; 0.47]	0.22 [-0.24; 0.69]	0.07 [-0.34; 0.47]
Egoistic Concern			−0.002 [-0.06; 0.05]	−0.01 [-0.08; 0.05]	−0.07* [-0.13; −0.01]
Altruistic Concern			0.01 [-0.04; 0.05]	−0.04 [-0.09; 0.02]	0.04 [-0.02; 0.08]
Social Norms			0.70*** [0.74; 0.85]	0.52*** [0.55; 0.67]	0.56*** [0.57; 0.68]
Socio-Demographic					
Country (Norway)			−0.01 [-0.11; 0.06]	−0.02 [-0.15; 0.04]	−0.03 [-0.16; 0.01]
Country (Finland)			0.05* [0.03; 0.20]	0.06* [0.02; 0.24]	0.02 [-0.07; 0.13]
Age (younger)			−0.07*** [-0.25; −0.08]	−0.01 [-0.13; 0.07]	−0.08*** [-0.26; −0.08]
Age (older)			0.05** [0.03; 0.20]	0.08** [0.08; 0.30]	0.12*** [0.18; 0.36]
Gender (female)			0.07*** [0.08; 0.20]	0.12*** [0.18; 0.33]	0.06*** [0.06; 0.20]
Diet (vegan)			0.09*** [0.36; 0.84]	0.07*** [0.25; 0.76]	−0.09*** [-0.85; −0.29]
Diet (vegetarian)			0.08*** [0.20; 0.50]	0.09*** [0.28; 0.62]	−0.08*** [-0.55; −0.16]
Occupation Status (in education)			−0.06** [-0.33; −0.08]	−0.05* [-0.34; −0.02]	−0.07** [-0.36; −0.06]
Occupation Status (employed)			0.01 [-0.05; 0.11]	0.02 [-0.05; 0.15]	0.03 [-0.03; 0.15]
Children (vs. none)			−0.02 [-0.11; 0.04]	−0.02 [-0.14; 0.05]	0.03 [-0.01; 0.15]
Formal Education (at least high school)			−0.004 [-0.10; 0.08]	−0.02 [-0.15; 0.07]	−0.02 [-0.13; 0.06]
Formal Education (at least university)			−0.06** [-0.21; −0.04]	−0.07** [-0.26; −0.04]	−0.07** [-0.23; −0.13]
Income (lower)			0.02 [-0.02; 0.12]	−0.01 [-0.12; 0.06]	−0.02 [-0.12; 0.03]
Income (higher)			−0.02 [-0.17; 0.04]	−0.004 [-0.14; 0.12]	0.01 [-0.08; 0.15]
R^2	0.80	0.93	0.55	0.29	0.41
Test of the mediations					
Indirect Effect (Gen. Innov. - > Food Innov. ->)			0.11 [-0.00; 0.23]	0.07 [-0.07; 0.23]	−0.09 [-0.22; 0.03]
Total Effect (Gen. Innov. - > Food Innov. ->)			−0.04 [-0.09; 0.00]	−0.05 [-0.11; 0.002]	−0.07* [-0.12; −0.02]
Indirect Effect (NEP - > Ecological Concern ->)			0.10 [-0.43; 0.78]	0.21 [-0.41; 1.16]	0.07 [-0.57; 0.79]
Total Effect (NEP - > Ecological Concern ->)			0.04 [-0.16; 0.03]	−0.04 [-0.19; 0.04]	0.10** [0.06; 0.26]

Note. $n = 3241$. Robust CFI = .862, Robust RMSEA = .059 [0.058; 0.060], SRMR = .064, scaled χ^2 (1011) = 9498.3 with $p < 0.001$. The 95%-confidence intervals of the unstandardized regression coefficients are presented in the brackets. FI = food innovativeness, EC = ecological concern. Both substitution intentions were recoded, so that their scale matches the scales of the other constructs. *$p < 0.05$, **$p < 0.01$, ***$p <$ 001.

B.2. SEM predictor set 2

The model estimation was based on the data from $n = 3178$ participants and all path coefficients pertaining to the second predictor set can be found in Table B2. The predictor set and the socio-demographic variables explained 58% of the variance in the general intention to consume cultured protein, 43% of the variance in the intention to substitute non-vegan options, and 22% of the variance in the intention to substitute vegan options. Across all intentions the most important predictor was the first impression of cultured proteins ($0.53 \leq \beta \leq .74$; the better the first impression the stronger the intentions). The intention to substitute vegan options was further significantly predicted by food consciousness (β = −0.09; higher consciousness was associated with weaker intentions). Both identities ($\beta_{\text{health identity}} = -0.17$; $\beta_{\text{diet identity}} = -0.10$) were negatively associated with the first impression in this model, while knowledge (β = .30) and food consciousness (β = .13) were positively related with it. Having a stronger diet-related and health-related identity was connected to a worse first impression, while being more familiar with cultured proteins and being more conscious about one's food were associated with a more favourable first impression.

Again, the most relevant socio-demographic predictors of the intentions were the diet, age, gender, and formal education. Being vegan or vegetarian was associated with higher intentions to generally consume cultured protein, higher intentions to substitute vegan products and lower intentions to substitute non-vegan options. Having a university degree was negatively associated with all intentions, and being older was positively associated with both substitution intentions. Being female was a significant positive predictor of the general intention to consume cultured proteins and the intention to substitute vegan options. Furthermore, being a Fin was positively related to the general intention to consume cultured proteins and the intention to substitute vegan products.

Table B2
Path coefficients of the structural equation model representing the model pertaining to predictor set 2 (standardized regression coefficients)

Predictors	Criteria					
	Know.	Consc.	1st Impress.	Intention (Consume)	Intention (Sub. Veg.)	Intention (Sub. Non-Veg.)
Psychological						
Health Identity		0.38*** [0.34; 0.43]	−0.17*** [-0.28; −0.17]			
Diet Identity			−0.10*** [-0.17; −0.07]			
Knowledge			0.30*** [0.34; 0.45]	0.01 [-0.03; 0.05]	0.04* [0.003; 0.11]	−0.01 [-0.05; 0.04]
Food Conscious.	0.03 [-0.01; 0.08]		0.13*** [0.11; 0.23]	0.004 [-0.03; 0.04]	−0.09*** [-0.17; −0.07]	0.02 [-0.02; 0.07]
1st Impression				0.74*** [0.67; 0.73]	0.53*** [0.49; 0.56]	0.63*** [0.54; 0.61]
Socio-Demographic						
Country (Norway)				0.04* [0.01; 0.15]	0.03 [-0.03; 0.15]	0.02 [-0.04; 0.12]
Country (Finland)				0.04* [0.01; 0.16]	0.08*** [0.09; 0.28]	0.01 [-0.07; 0.10]
Age (younger)				0.02 [-0.03; 0.13]	0.05* [0.03; 0.21]	0.003 [-0.08; 0.09]
Age (older)				0.01 [-0.05; 0.10]	0.05* [0.01; 0.22]	0.08*** [0.10; 0.27]
Gender (female)				0.03* [0.001; 0.12]	0.08*** [0.11; 0.26]	0.02 [-0.02; 0.11]
Diet (vegan)				0.08*** [0.33; 0.77]	0.07*** [0.25; 0.77]	−0.09*** [-0.91; −0.33]
Diet (vegetarian)				0.09*** [0.30; 0.57]	0.11*** [0.36; 0.71]	−0.07** [-0.49; −0.09]
Occupation Status (in education)				−0.04* [-0.25; −0.02]	−0.04 [-0.29; 0.01]	−0.05* [-0.30; −0.01]
Occupation Status (employed)				−0.03 [-0.13; 0.02]	0.01 [-0.13; 0.07]	0.001 [-0.08; 0.08]
Children (vs. none)				−0.002 [-0.07; 0.06]	−0.01 [-0.10; 0.08]	0.05** [0.03; 0.18]
Formal Education (at least high school)				−0.03 [-0.16; 0.01]	−0.04 [-0.20; 0.01]	−0.05* [-0.20; −0.02]
Formal Education (at least university)				−0.07** [-0.22; −0.06]	−0.07** [-0.26; −0.05]	−0.07** [-0.23; −0.06]
Income (lower)				0.03 [-0.01; 0.12]	0.003 [-0.08; 0.09]	−0.02 [-0.10; 0.04]
Income (higher)				0.01 [-0.07; 0.06]	0.02 [-0.06; 0.18]	0.03 [-0.01; 0.21]
R^2	0.001	0.15	0.13	0.58	0.33	0.43

Note. $n = 3178$. Fit indices could not be computed due to multicollinearity. The 95%-confidence intervals of the unstandardized regression coefficients are presented in the brackets. Know(ledge), (food) consc(iousness). Both substitution intentions were recoded, so that their scale matches the scales of the other constructs. *$p < 0.05$, **$p < 0.01$, ***$p <$ 001.

B.3. SEM predictor set 3

Lastly, the model estimation pertaining to predictor set 3 was based on the data from $n = 3137$ participants and the corresponding path coefficients can be found in Table B3. The predictor set and the socio-demographic variables explained 48% of the variance in the general intention to consume cultured proteins, 47% of the variance in the intention to substitute non-vegan options, and 27% of the variance in the intention to substitute vegan options. The predictor pattern of the belief factors was comparatively more complex than the previous models and there was no clear strongest psychological predictor. The following tendencies emerged: the beliefs that cultured proteins has a positive global effect, that it has a positive economic effect, and that there is a need for a cultured proteins industry were positively associated with all intentions. In contrast, the belief that cultured proteins has negative consequences, and that farming is something positive were negative predictors of all intentions.

The relations with the socio-demographic variables were similar to the previous models. A relevant deviation from the previous models was that being vegan and being vegetarian were negatively associated with the intention to substitute non-vegan options by cultured protein. Also not living in Norway or Finland seemed to be positively associated with the intention to substitute non-vegan products.

Table B3
Path coefficients of the structural equation model representing the model pertaining to predictor set 3 (standardized regression coefficients)

Predictors	Criteria		
	Intention (Consume)	Intention (Sub. Veg.)	Intention (Sub. Non-Veg.)
Psychological			
Glob. Pos. Impact Bel.	0.22*** [0.16; 0.43]	0.27*** [0.20; 0.55]	0.21*** [0.14; 0.42]
Glob. Neg. Impact Bel.	−0.10** [-0.21; −0.05]	−0.16*** [-0.33; −0.12]	−0.22*** [-0.37; −0.20]
Pos. Econ. Impact Bel.	0.25*** [0.20; 0.43]	0.14* [0.04; 0.33]	0.10* [0.01; 0.23]

(*continued on next page*)

Table B3 (*continued*)

Predictors	Criteria		
	Intention (Consume)	Intention (Sub. Veg.)	Intention (Sub. Non-Veg.)
Dependency Bel.	0.06* [0.01; 0.15]	0.10** [0.05; 0.23]	0.05 [-0.01; 0.13]
Farming is pos. Belief	−0.10*** [-0.21; −0.06]	−0.19*** [-0.38; −0.19]	−0.27*** [-0.47; −0.31]
Farming is neg. Belief	−0.09 [-0.29; 0.03]	−0.33*** [-0.73; −0.31]	−0.02 [-0.20; 0.14]
Need for industry Bel.	0.28*** [0.22; 0.33]	0.27*** [0.21; 0.34]	0.20*** [0.14; 0.23]
Socio-Demographic			
Country (Norway)	−0.05** [-0.19; −0.04]	−0.02 [-0.16; 0.04]	−0.08*** [-0.26; −0.10]
Country (Finland)	−0.02 [-0.12; 0.04]	0.03 [-0.03; 0.17]	−0.09*** [-0.26; −0.10]
Age (younger)	−0.07** [-0.23; −0.06]	−0.02 [-0.14; 0.06]	−0.02 [-0.14; 0.03]
Age (older)	0.05* [0.02; 0.18]	0.07** [0.07; 0.28]	0.09*** [0.12; 0.30]
Gender (female)	0.07*** [0.08; 0.20]	0.12*** [0.19; 0.34]	0.04* [0.02; 0.14]
Diet (vegan)	0.08*** [0.28; 0.81]	0.08*** [0.25; 0.82]	−0.07*** [-0.66; −0.24]
Diet (vegetarian)	0.08*** [0.20; 0.52]	0.10*** [0.30; 0.64]	−0.06** [-0.43; −0.11]
Occupation Status (in education)	−0.04 [-0.25; 0.004]	−0.03 [-0.27; 0.05]	−0.03 [-0.23; 0.04]
Occupation Status (employed)	−0.01 [-0.11; 0.05]	0.000 [-0.10; 0.10]	0.02 [-0.04; 0.13]
Children (vs. none)	−0.02 [-0.12; 0.02]	−0.03 [-0.16; 0.03]	0.01 [-0.05; 0.09]
Formal Education (at least high school)	−0.01 [-0.10; 0.07]	−0.02 [-0.15; 0.07]	−0.01 [-0.12; 0.06]
Formal Education (at least university)	−0.06** [-0.20; −0.04]	−0.06* [-0.24; −0.03]	−0.06** [-0.20; −0.03]
Income (lower)	0.02 [-0.03; 0.11]	−0.01 [-0.11; 0.06]	−0.02 [-0.11; 0.03]
Income (higher)	−0.02 [-0.17; 0.03]	−0.001 [-0.13; 0.12]	0.03 [-0.02; 0.18]
R^2	0.48	0.27	0.47

Note. $n = 3137$. Robust CFI = .890, Robust RMSEA = .050 [0.049; 0.051], SRMR = .066, scaled χ^2 (1264) = 8431.54 with $p < 0.001$. The 95%-confidence intervals of the unstandardized regression coefficients are presented in the brackets. Glob. Pos. Impact Bel. = belief that cultured proteins will have a positive global impact, Glob. Neg. Impact Bel. = belief that cultured proteins will have a negative global impact, Pos. Econ. Impact Bel. = belief that cultured proteins will have a positive economic impact, Dependency Bel. = belief that cultured proteins will increase international dependencies, Farming is pos. Belief = belief that farming is positive, Farming is neg. Belief = belief that farming is negative, Need for industry Bel. = belief that a cultured proteins industry is needed in the home country. Both substitution intentions were recoded, so that their scale matches the scales of the other constructs. *$p < 0.05$, **$p < 0.01$, ***$p < 001$.

References

Aertsens, J., Verbeke, W., Mondelaers, K., & Van Huylenbroeck, G. (2009). Personal determinants of organic food consumption: A review. *British Food Journal, 111*(10), 1140–1167. https://doi.org/10.1108/00070700910992961

Ahmad, N. A., Arshad, F., Nurul Azian Zakaria, S., & Ahmed, M. U. (2023). A review of cultured meat and its current public perception. *Current Nutrition & Food Science, 19*(9), 928–944. https://doi.org/10.2174/1573401319666230227115317

Ahmad, A. L., Chin, J. Y., Harun, M. H. Z. M., & Low, S. C. (2022). Environmental impacts and imperative technologies towards sustainable treatment of aquaculture wastewater: A review. *Journal of Water Process Engineering, 46*(102553). https://doi.org/10.1016/j.jwpe.2021.102553

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2012). Values, attitudes, and behavior. *Methods, theories, and empirical applications in the social sciences*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Apelblat, M. (2024). *Cultivated meat: Is EU falling behind in approving novel food and ensuring global food security?*. The Brussels Times. https://www.brusselstimes.com/929011/cultivated-meat-is-eu-falling-behind-in-approving-novel-food-and-ensuring-global-food-security. (Accessed 10 May 2024).

Appiani, M., Cattaneo, C., & Laureati, M. (2023). Sensory properties and consumer acceptance of plant-based meat, dairy, fish and eggs analogs: A systematic review. *Frontiers in Sustainable Food Systems, 7*, 1–23. https://doi.org/10.3389/fsufs.2023.1268068

Arango, L., Chaudhury, S. H., & Septianto, F. (2023). The role of demand-based scarcity appeals in promoting cultured meat. *Psychology and Marketing, 40*(8), 1501–1520. https://doi.org/10.1002/mar.21821

Arango, L., Septiano, F., & Pontes, N. (2023). Challenging cultured meat naturalness perceptions: The role of consumers' mindset. *Appetite, 190*, Article 107039. https://doi.org/10.1016/j.appet.2023.107039

Banach, J. L., Van Der Berg, J. P., Kleter, G., Van Bokhorst-van De Veen, H., Bastiaan-Net, S., Pouvreau, L., & Van Asselt, E. D. (2023). Alternative proteins for meat and dairy replacers: Food safety and future trends. *Critical Reviews in Food Science and Nutrition, 63*(32), 11063–11080. https://doi.org/10.1080/10408398.2022.2089625

Bekker, G. A., Fischer, A. R. H., Tobi, H., & van Trijp, H. C. M. (2017). Explicit and implicit attitude toward an emerging food technology: The case of cultured meat. *Appetite, 108*, 245–254. https://doi.org/10.1016/j.appet.2016.10.002

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*(3), 588. https://psycnet.apa.org/doi/10.1037/0033-2909.88.3.588.

Boereboom, A., Mongondry, P., de Aguiar, L. K., Urbano, B., Jiang, Z., de Koning, W., & Vriesekoop, F. (2022). Identifying consumer groups and their characteristics based on their willingness to engage with cultured meat: A comparison of four European countries. *Foods, 11*(2). https://doi.org/10.3390/foods11020197

Borsboom, D. (2006). When does measurement invariance matter? *Medical Care, 44*(11). https://doi.org/10.1097/01.mlr.0000245143.08679.cc

Brunsø, K., Birch, D., Memery, J., Temesi, Á., Lakner, Z., Lang, M., Dean, D., & Grunert, K. G. (2021). Core dimensions of food-related lifestyle: A new instrument for measuring food involvement, innovativeness and responsibility. *Food Quality and Preference, 91*(104192). https://doi.org/10.1016/j.foodqual.2021.104192

Bryant, C., & Barnett, J. (2018). Consumer acceptance of cultured meat: A systematic review. *Meat Science, 143*, 8–17. https://doi.org/10.1016/j.meatsci.2018.04.008

Bryant, C., & Barnett, J. (2019). What's in a name? Consumer perceptions of in vitro meat under different names. *Appetite, 137*, 104–113. https://doi.org/10.1016/j.appet.2019.02.021

Bryant, C., & Barnett, J. (2020). Consumer acceptance of cultured meat: An updated review (2018–2020). *Applied Sciences, 10(15), 5201*. https://doi.org/10.3390/app10155201

Bryant, C., & Dillard, C. (2019). The impact of framing on acceptance of cultured meat. *Frontiers in Nutrition, 6*. https://doi.org/10.3389/fnut.2019.00103

Bryant, C., & Sanctorum, H. (2021). Alternative proteins, evolving attitudes: Comparing consumer attitudes to plant-based and cultured meat in Belgium in two consecutive years. *Appetite, 161*(105161). https://doi.org/10.1016/j.appet.2021.105161

Bryant, C., Szejda, K., Parekh, N., Deshpande, V., & Tse, B. (2019). A survey of consumer perceptions of plant-based and clean meat in the USA, India, and China [original research]. *Frontiers in Sustainable Food Systems, 3*. https://doi.org/10.3389/fsufs.2019.00011

Buchholz, J. P. D., & Hartig, J. D. (2020). Measurement invariance testing in questionnaires: A comparison of three multigroup-CFA and IRT-based approaches. *Psychological Test and Assessment Modeling, 62*(1), 29–53. https://www.proquest.com/scholarly-journals/measurement-invariance-testing-questionnaires/docview/2385399412/se-2?accountid=12870.

Burhanuddin, I. H., Shukri, A. S. M., & Bakar, M. B. A. (2022). Cultured meat: An appraisal from the Fiqh and Sufi views of Muslim scholars. *Malaysian Journal of Syariah and Law, 11*(1), 14–30.

Burton, R. J. F. (2019). The potential impact of synthetic animal protein on livestock production: The new "war against agriculture"? *Journal of Rural Studies, 68*, 33–45.

Byrne, B. M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming* (3rd ed.). Routledge.

Cameron, J. E. (2004). A three-factor model of social identity. *Self and Identity, 3*(3), 239–262. https://doi.org/10.1080/13576500444000047

Castle, N. (2022). In vitro meat and science fiction contemporary narratives of cultured flesh in vitro meat and science fiction. *Extrapolation, 63*(2). https://doi.org/10.3828/extr.2022.11

Chen, F. F. (2008). What happens if we compare chopsticks with forks? The impact of making inappropriate comparisons in cross-cultural research. *Journal of Personality and Social Psychology, 95*(5), 1005–1018. https://doi.org/10.1037/a0013193

Cheung, G. W., & Lau, R. S. (2011). A direct comparison approach for testing measurement invariance. *Organizational Research Methods, 15*(2), 167–198. https://doi.org/10.1177/1094428111421987

Cialdini, R. B., & Jacobson, R. P. (2021). Influences of social norms on climate change-related behaviors. *Current Opinion in Behavioral Sciences, 42*, 1–8. https://doi.org/10.1016/j.cobeha.2021.01.005

Cieciuch, J. A. N., & Davidov, E. (2015). Establishing measurement invariance across online and offline samples. A tutorial with the software packages Amos and Mplus. *Studia Psychologica: Theoria and Praxis, 2*(15), 83–99. https://doi.org/10.21697/sp.2015.14.2.06

Circus, V. E., & Robison, R. (2019). Exploring perceptions of sustainable proteins and meat attachment. *British Food Journal, 121*(2), 533–545. https://doi.org/10.1108/BFJ-01-2018-0025

Collett, K., O'Callaghan, B., Mason, M., Godfray, C., & Hepburn, C. (2021). *The climate impact of alternative proteins*. Oxford Smith School of Enterprise and the Environment (Smith School Final 25% Series Paper) https://www.smithschool.ox.ac.uk/sites/default/files/2022-03/Climate_Impacts_of_Alternative_Proteins.pdf.

Croker, H., Whitaker, K. L., Cooke, L., & Wardle, J. (2009). Do social norms affect intended food choice? *Preventive Medicine, 49*(2), 190–193. https://doi.org/10.1016/j.ypmed.2009.07.006

de Koning, W., Dean, D., Vriesekoop, F., Aguiar, L. K., Anderson, M., Mongondry, P., Oppong-Gyamfi, M., Urbano, B., Luciano, C. A., Jiang, B., Hao, W., Eastwick, E., Jiang, Z., & Boereboom, A. (2020). Drivers and inhibitors in the acceptance of meat alternatives: The case of plant and insect-based proteins. *Foods, 9*(9). https://doi.org/10.3390/foods9091292

de Maya, S. R., López-López, I., & Munuera, J. L. (2011). Organic food consumption in Europe: International segmentation based on value system differences. *Ecological Economics, 70*(10), 1767–1775. https://doi.org/10.1016/j.ecolecon.2011.04.019

Dean, D., Rombach, M., Vriesekoop, F., de Koning, W., Aguiar, L. K., Anderson, M., Mongondry, P., Urbano, B., Gómez Luciano, C. A., & Jiang, B. (2023). Should I really pay a premium for this? Consumer perspectives on cultured muscle, plant-based and fungal-based protein as meat alternatives. *Journal of International Food & Agribusiness Marketing*, 1–25. https://doi.org/10.1080/08974438.2023.2169428

Dunlap, R. E., & Van Liere, K. D. (1978). The "new environmental paradigm". *The Journal of Environmental Education, 9*(4), 10–19. https://doi.org/10.1080/00958964.1978.10801875

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New trends in measuring environmental attitudes: Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425–442. https://doi.org/10.1111/0022-4537.00176

Dupont, J., Harms, T., & Fiebelkorn, F. (2022). Acceptance of cultured meat in Germany - application of an extended theory of planned behaviour. *Foods, 11(3), 424*. https://doi.org/10.3390/foods11030424

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information Maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal, 8*(3), 430–457. https://doi.org/10.1207/S15328007SEM0803_5

Escribano, A. J., Peña, M. B., Díaz-Caro, C., Elghannam, A., Crespo-Cebada, E., & Mesías, F. J. (2021). Stated preferences for plant-based and cultured meat: A choice experiment study of Spanish consumers. *Sustainability, 13*(15). https://doi.org/10.3390/su13158235.

Fischler, C. (1988). Food, self and identity. *Social Science Information, 27*(2), 275–292. https://doi.org/10.1177/053901888027002005

Francekovič, P., García-Torralba, L., Sakoulogeorga, E., Vučković, T., & Perez-Cueto, F. J. A. (2021). How do consumers perceive cultured meat in Croatia, Greece, and Spain? *Nutrients, 13*(4). https://doi.org/10.3390/nu13041284

Giles, R. (2023). Reduced zoonoses and improved nutritional profiles: Interrogating cultured meat and its alleged health benefits. *Journal of Global Health Reports, 7*, Article e2023039. https://doi.org/10.29392/001c.81235

Gillison, F., Lannon, G., Verplanken, B., Barnett, J., & Grey, E. (2021). A rapid review of the evidence on the factors underpinning the consumption of meat and dairy among the general public. https://doi.org/10.46756/sci.fsa.bmk523.

Gómez-Luciano, C. A., de Aguiar, L. K., Vriesekoop, F., & Urbano, B. (2019). Consumers' willingness to purchase three alternatives to meat proteins in the United Kingdom, Spain, Brazil and the Dominican Republic. *Food Quality and Preference, 78*(103732). https://doi.org/10.1016/j.foodqual.2019.103732

Grasso, A. C., Hung, Y., Olthof, M. R., Verbeke, W., & Brouwer, I. A. (2019). Older consumers' readiness to accept alternative, more sustainable protein sources in the European Union. *Nutrients, 11(8), 1904*. https://doi.org/10.3390/nu11081904

Helliwell, R., & Burton, R. J. (2021). The promised land? Exploring the future visions and narrative silences of cellular agriculture in news and industry media. *Journal of Rural Studies, 84*, 180–191. https://doi.org/10.1016/j.jrurstud.2021.04.002

Higgs, S. (2015). Social norms and their influence on eating behaviours. *Appetite, 86*, 38–44. https://doi.org/10.1016/j.appet.2014.10.021

Higgs, S., & Thomas, J. (2016). Social influences on eating. *Current Opinion in Behavioral Sciences, 9*, 1–6. https://doi.org/10.1016/j.cobeha.2015.10.005

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika, 30*(2), 179–185. https://doi.org/10.1007/BF02289447

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Hubalek, S., Post, M. J., & Moutsatsou, P. (2022). Towards resource-efficient and cost-efficient cultured meat. *Current Opinion in Food Science, 47*(100885). https://doi.org/10.1016/j.cofs.2022.100885

Humbird, D. (2021). Scale-up economics for cultured meat. *Biotechnology and Bioengineering, 118*, 3239–3250.

Jensen, N. H., & Lieberoth, A. (2019). We will eat disgusting foods together – evidence of the normative basis of Western entomophagy-disgust from an insect tasting. *Food Quality and Preference, 72*, 109–115. https://doi.org/10.1016/j.foodqual.2018.08.012

Kaiser, F. G., & Byrka, K. (2015). The Campbell paradigm as a conceptual alternative to the expectation of hypocrite in contemporary attitude research. *The Journal of Social Psychology, 155*(1), 12–29. https://doi.org/10.1080/00224545.2014.959884

Kaiser, F. G., Hübner, G., & Bogner, F. X. (2005). Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior 1. *Journal of Applied Social Psychology, 35*(10), 2150–2170. https://doi.org/10.1111/j.1559-1816.2005.tb02213.x

Kim, S., Beier, A., Schreyer, H. B., & Bakshi, B. R. (2022). Environmental life cycle assessment of a novel cultivated meat burger patty in the United States. *Sustainability, 14*, Article 16133.

Kituyi, M., & Thomson, P. (2018). 90% of fish stocks are used up–fisheries subsidies must stop emptying the ocean. In *World economic forum*. https://www.weforum.org/agenda/2018/07/fish-stocks-are-used-up-fisheries-subsidies-must-stop/.

Klöckner, C. A., Engel, L., Moritz, J., Burton, R. J., Young, J. F., Kidmose, U., & Ryynänen, T. (2022). Milk, meat, and fish from the petri dish—which attributes would make cultured proteins (Un)attractive and for whom? Results from a nordic survey [original research]. *Frontiers in Sustainable Food Systems, 6*. https://doi.org/10.3389/fsufs.2022.847931

Lewisch, L., & Riefler, P. (2023). Behavioural intentions towards cultured meat: The role of personal values, domain-specific innovativeness and distrust in scientists. *British Food Journal, 125*(5), 1769–1781. https://doi.org/10.1108/BFJ-03-2022-0270

Li, L., Wang, Z., Li, Y., & Liao, A. (2021). Consumer innovativeness and organic food adoption: The mediation effects of consumer knowledge and attitudes. *Sustainable Production and Consumption, 28*, 1465–1474. https://doi.org/10.1016/j.spc.2021.08.022

Lin-Hi, N., Reimer, M., Schäfer, K., & Böttcher, J. (2023). Consumer acceptance of cultured meat: An empirical analysis of the role of organizational factors. *Journal of Business Economics, 93*(4), 707–746. https://doi.org/10.1007/s11573-022-01127-3

Linzey, A. (2009). *Why animal suffering matters: Philosophy, theology, and practical ethics*. Oxford University Press.

Lowe, B., Fraser, I., & Souza-Monteiro, D. M. (2015). Changing food consumption behaviors. *Psychology and Marketing, 32*(5), 481–485. https://doi.org/10.1002/mar.20793

Mancini, M. C., & Antonioli, F. (2019). Exploring consumers' attitude towards cultured meat in Italy. *Meat Science, 150*, 101–110. https://doi.org/10.1016/j.meatsci.2018.12.014

Mattick, C. S. (2018). Cellular agriculture: The coming revolution in food production. *Bulletin of the Atomic Scientists, 74*(1), 32–35. https://doi.org/10.1080/00963402.2017.1413059

McClements, D. J. (2023). Plant-based meat: Building meat from plants. In *Meat less: The next food revolution*. Cham: Springer Nature Switzerland (pp. 113–147).

McCormick, E. (2021). Eat Just is racing to put 'no-kill meat' on your plate. Is it too good to be true? *The Guardian*. https://www.theguardian.com/food/2021/jun/16/eat-just-no-kill-meat-chicken-josh-tetrick. (Accessed 10 May 2024).

Michaelidou, N., & Hassan, L. M. (2008). The role of health consciousness, food safety concern and ethical identity on attitudes and intentions towards organic food. *International Journal of Consumer Studies, 32*, 163–170. https://doi.org/10.1111/j.1470-6431.2007.00619.x

Milfont, T., & Fischer, R. (2010). Testing measurement invariance across groups: Applications in cross-cultural research. *International Journal of Psychological Research, 3*(1), 111–130. https://doi.org/10.21500/20112084.857

Moritz, J., Tuomisto, H. L., & Ryynänen, T. (2022). The transformative innovation potential of cellular agriculture: Political and policy stakeholders' perceptions of cultured meat in Germany. *Journal of Rural Studies, 89*, 54–65. https://doi.org/10.1016/j.jrurstud.2021.11.018

Novel Food Regulation. (2015). *Regulation (EU) 2015/2283 of the European parliament and of the Council on novel foods*.

Onwezen, M. C., Bouwman, E. P., Reinders, M. J., & Dagevos, H. (2021). A systematic review on consumer acceptance of alternative proteins: Pulses, algae, insects, plant-based meat alternatives, and cultured meat. *Appetite, 159*, Article 105058. https://doi.org/10.1016/j.appet.2020.105058

Padma, K. (2022). Overuse and misuse of antibiotics. *Journal of Biomedical and Pharmaceutical Research, 11*(1). https://doi.org/10.32553/jbpr.v11i1.899

Pakseresht, A., Ahmadi Kaliji, S., & Canavari, M. (2022). Review of factors affecting consumer acceptance of cultured meat. *Appetite, 170*, Article 105829. https://doi.org/10.1016/j.appet.2021.105829

Petrescu, M. (2013). Marketing research using single-item indicators in structural equation models. *Journal of Marketing Analytics, 1*(2), 99–117. https://doi.org/10.1057/jma.2013.7

Pitcher, T. J., & Cheung, W. W. L. (2013). Fisheries: Hope or despair?. In *Marine pollution bulletin* (Vol. 74, pp. 506–516). https://doi.org/10.1016/j.marpolbul.2013.05.045

Pliner, P., & Hobden, K. (1992). Development of a scale to measure the trait of food neophobia in humans. *Appetite, 19*(2), 105–120. https://doi.org/10.1016/0195-6663(92)90014-W

Post, M. J. (2012). Cultured meat from stem cells: Challenges and prospects. *Meat Science, 92*(3), 297–301. https://doi.org/10.1016/j.meatsci.2012.04.008

R Core Team. (2022). R: A language and environment for statistical computing. https://www.R-project.org/.

Rabl, V. A., & Basso, F. (2021). When bad becomes worse: Unethical corporate behavior may hamper consumer acceptance of cultured meat. *Sustainability, 13*(12), 6770. https://doi.org/10.3390/su13126770

Räty, N., Tuomisto, H. L., & Ryynänen, T. (2023). On what basis is it agriculture?: A qualitative study of farmers' perceptions of cellular agriculture. *Technological Forecasting and Social Change, 196*, Article 122797. https://doi.org/10.1016/j.techfore.2023.122797

Rogers, E. M. (2003). *Diffusion of innovations*. Free Press.

Rolland, N. C. M., Markus, C. R., & Post, M. J. (2020). Correction: The effect of information content on acceptance of cultured meat in a tasting context. *PLoS One, 15*(10), Article e0240630. https://doi.org/10.1371/journal.pone.0240630

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02

Royston, J. P. (1983). A simple method for evaluating the shapiro-francia W'test of non-normality. *Journal of the Royal Statistical Society. Series D (The Statistician), 32*(3), 297–300. https://doi.org/10.2307/2987935
Rozin, P., Fischler, C., & Shields-Argelès, C. (2012). European and American perspectives on the meaning of natural. *Appetite, 59*, 448–455.
Rubio, N. R., Xiang, N., & Kaplan, D. L. (2020). Plant-based and cell-based approaches to meat production. *Nature Communications, 11*(6276). https://doi.org/10.1038/s41467-020-20061-y
Ryynänen, T., & Toivanen, A. (2023). Hocus-pocus tricks and moral progressions: The emerging meanings of cultured meat in online news comments. *Food, Culture and Society, 26*(3), 591–620. https://doi.org/10.1080/15528014.2022.2027688
Schurman, R. (2004). Fighting "frankenfoods": Industry opportunity structures and the efficacy of the anti-biotech movement in western Europe. *Social Problems, 51*(2), 243–268.
Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika, 52*(3/4), 591–611. https://doi.org/10.2307/2333709
Siddiqui, S. A., Alvi, T., Sameen, A., Khan, S., Blinov, A. V., Nagdalian, A. A., & Onwezen, M. (2022). Consumer acceptance of alternative proteins: A systematic review of current alternative protein sources and interventions adapted to increase their acceptability. *Sustainability, 14*(22), Article 15370. https://doi.org/10.3390/su142215370
Siddiqui, S. A., Bahmid, N. A., Karim, I., Mehany, T., Gvozdenko, A. A., Blinov, A. V., & Lorenzo, J. M. (2022). Cultured meat: Processing, packaging, shelf life, and consumer acceptance. *LWT, 172*(114192). https://doi.org/10.1016/j.lwt.2022.114192
Siddiqui, S. A., Khan, S., Farooqi, M. Q. U., Singh, P., Fernando, I., & Nagdalian, A. (2022). Consumer behavior towards cultured meat: A review since 2014. *Appetite, 179*(106314). https://doi.org/10.1016/j.appet.2022.106314
Siegrist, M., & Hartmann, C. (2020). Perceived naturalness, disgust, trust and food neophobia as predictors of cultured meat acceptance in ten countries. *Appetite, 155* (104814). https://doi.org/10.1016/j.appet.2020.104814
Siegrist, M., & Sütterlin, B. (2017). Importance of perceived naturalness for acceptance of food additives and cultured meat. *Appetite, 113*, 320–326. https://doi.org/10.1016/j.appet.2017.03.019
Sinke, P., & Odegard, I. (2021). *LCA of cultivated meat. Future projections for different scenarios*. CE Delft. Publication code: 21.190107.019.
Sinke, P., Swartz, E., Sanctorum, H., van der Giesen, C., & Odegard, I. (2023). Ex-ante life cycle assessment of commercial-scale cultivated meat production in 2030. *International Journal of Life Cycle Assessment, 28*, 234–254.
Slade, P. (2018). If you build it, will they eat it? Consumer preferences for plant-based and cultured meat burgers. *Appetite, 125*, 428–437. https://doi.org/10.1016/j.appet.2018.02.030
Spurgeon, J. P., Greg, K., & Mazhary, H. (2020). A systematic review of cell-cultured meat acceptance. Animal Charity Evaluators https://animalcharityevaluators.org/wp-content/uploads/2022/04/a-systematic-review-of-cell-cultured-meat-acceptance.pdf.
Statistics Denmark. (2024). StatBank Denmark. https://www.statbank.dk/.
Statistics Finland. (2024). StatFin database. https://stat.fi/en/data-base-tables.
Statistics Norway. (2024). StatBank Norway. https://www.ssb.no/en/statbank.
Stephens, N., di Silvio, L., Dunsford, I., Ellis, M., Glencross, A., & Sexton, A. (2018). Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in cellular agriculture. *Trends in Food Science and Technology, 78*, 155–166. https://doi.org/10.1016/j.tifs.2018.04.010
Stern, P. C. (2000). New environmental theories: Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175
Sternberg, R. J. (2004). Culture and intelligence. *American Psychologist, 59*(5), 325–338. https://doi.org/10.1037/0003-066X.59.5.325
Sundblad, E. L., Biel, A., & Gärling, T. (2009). Knowledge and confidence in knowledge about climate change among experts, journalists, politicians, and laypersons. *Environment and Behavior, 41*(2), 281–302. https://doi.org/10.1177/0013916508314998
Supermeat. (2024). Towards a sustainable future A forward-looking life-cycle-analysis of SuperMeat's cultivated chicken. https://supermeat.com/life-cycle-analysis/.
Tajfel, H. (2010). *Social identity and intergroup relations* (Vol. 7). Cambridge University Press.
Ullman, J. B., & Bentler, P. M. (2012). *Structural equation modeling*. Handbook of Psychology. https://doi.org/10.1002/9781118133880.hop202023. Second Edition.
Valente, J.d. P. S., Fiedler, R. A., Sucha Heidemann, M., & Molento, C. F. M. (2019). First glimpse on attitudes of highly educated consumers towards cell-based meat and related issues in Brazil. *PLoS One, 14*(8), Article e0221129. https://doi.org/10.1371/journal.pone.0221129
Van der Werff, E., Steg, L., & Keizer, K. (2014). I am what I am, by looking past the present: The influence of biospheric values and past behavior on environmental self-identity. *Environment and Behavior, 46*(5), 626–657. https://doi.org/10.1177/0013916512475209
Vandecasteele, B., & Geuens, M. (2010). Motivated consumer innovativeness: Concept, measurement, and validation. *International Journal of Research in Marketing, 27*(4), 308–318. https://doi.org/10.1016/j.ijresmar.2010.08.004
Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods, 3*(1), 4–70. https://doi.org/10.1177/109442810031002
Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D., & Barnett, J. (2015). 'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom. *Meat Science, 102*, 49–58. https://doi.org/10.1016/j.meatsci.2014.11.013
Weinrich, R., Strack, M., & Neugebauer, F. (2020). Consumer acceptance of cultured meat in Germany. *Meat Science, 162*, Article 107924. https://doi.org/10.1016/j.meatsci.2019.107924
White, K. M., Smith, J. R., Terry, D. J., Greenslade, J. H., & McKimmie, B. M. (2009). Social influence in the theory of planned behaviour: The role of descriptive, injunctive, and in-group norms. *British Journal of Social Psychology, 48*(Pt 1), 135–158. https://doi.org/10.1348/014466608x295207
Wilks, M., Crimston, C. R., & Hornsey, M. J. (2024). Meat and morality: The moral foundation of purity, but not harm, predicts attitudes toward cultured meat. *Appetite, 197*, Article 107297. https://doi.org/10.1016/j.appet.2024.107297
Wilks, M., Hornsey, M., & Bloom, P. (2021). What does it mean to say that cultured meat is unnatural? *Appetite, 156*, Article 104960. https://doi.org/10.1016/j.appet.2020.104960
Wilks, M., & Phillips, C. J. C. (2017). Attitudes to in vitro meat: A survey of potential consumers in the United States. *PLoS One, 12*(2), Article e0171904. https://doi.org/10.1371/journal.pone.0171904
Yu, D. (2023). Eat just to scale up cultured meat production on gaining new regulatory approval in Singapore. *Forbes*. https://www.forbes.com/sites/douglasyu/2023/01/18/eat-just-to-scale-up-cultured-meat-production-on-gaining-new-regulatory-approval-in-singapore/. (Accessed 10 May 2024).
Zagata, L. (2012). Consumers' beliefs and behavioural intentions towards organic food. Evidence from the Czech Republic. *Appetite, 59*(1), 81–89. https://doi.org/10.1016/j.appet.2012.03.023
Zhang, M., Li, L., & Bai, J. (2020). Consumer acceptance of cultured meat in urban areas of three cities in China. *Food Control, 118*, Article 107390. https://doi.org/10.1016/j.foodcont.2020.107390
Zhao, X., Lynch, J. G., Jr., & Chen, Q. (2010). Reconsidering baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research, 37*(2), 197–206. https://doi.org/10.1086/651257