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Factors Affecting Young Adults' Willingness to Try Novel Health-Enhancing Nature-Based Products

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ABSTRACT

One of the megatrends that affects consumers' preferences is a growing interest in health, well-being and self-care. This study explores consumer perceptions of a health-enhancing nature-based substance. Based on a survey data ($N=944$) collected among national and international students in Finland, we examined factors that affect young adults' willingness to try products containing the substance. The results showed a relatively high willingness to try the products, particularly among female and non-Finnish respondents. Relationship to nature and beliefs related to the health benefits or risks of soil microbes influenced willingness to try products. The results highlight the importance of accounting for consumer perceptions in the innovation process.

KEYWORDS



Consumer behavior;
functional products; health;
nature-based solutions;
well-being

Introduction

A growing interest in health and well-being has been recognized as one of the megatrends that affects consumers' preferences and purchase decisions in industrial societies. Self-care has been identified as an emerging consumer trend (Angus and Westbrook 2019). There is a rising demand for products that have health benefits, such as functional foods and dietary supplements, as consumers are increasingly willing to invest in their well-being (Bigliardi and Galati 2013; Birch and Bonwick 2019). Part of this trend for health, well-being, and self-care is an interest in a more natural way of living (Kim and Seock 2009) which is often linked to perceived healthiness (Rozin et al. 2004). There has been an upsurge in research on the health and well-being effects of natural environments. The proximity of green areas in cities and outdoor activities in natural settings have been connected to various health benefits, such as stress alleviation, mental health, and self-rated well-being (e.g., Hartig et al. 2014). These health effects, however, typically require spending time in nature,

which is not possible for everyone. While some consumer products, such as vitamins, minerals, and botanicals, are perceived as natural, they are often associated with alternative or holistic approaches which do not attract all consumer groups (Thompson and Troester 2002; see Goetzke, Nitzko, and Spiller 2014).

This article presents an explorative consumer study on an innovative, nature-based substance that can be integrated in various types of consumer products (patent pending, application number 20165932 at Finnish Patent and Registration Office). The substance is composed of soil and plant microbes that aim to help consumers prevent the onset and alleviate symptoms of common allergies and autoimmune diseases, such as asthma, eczema, type 1 diabetes or celiac disease, which prevalence is rising. This idea is based on the biodiversity hypothesis which argues that human immune systems are strengthened from contact with environmental microbes and urbanization contributes to the declines in exposure to natural environments (Hanski et al. 2012; Haahtela 2019). Contact with microorganisms has been shown to

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increase one's immune system health by improving the microbiome. When the immune system lacks the exposure to a diverse array of microbes, the body struggles to differentiate between pathogenic and nonpathogenic microbes, leading to chronic immune-mediated diseases (Danzer and Mattner 2013; Belkaid and Hand 2014; Roslund et al. 2020). The nature-based substance presented in this study brings the health benefits of microbial exposure to consumers in a targeted manner. The substance is based on sound scientific evidence and currently undergoing clinical testing (Nurminen et al. 2018; Grönroos et al. 2019; Hui et al. 2019).

As the substance is a radical innovation, presenting opportunities for novel types of consumer products, there is little previous consumer research to rely on (Somervuori and Fredrikson 2016; Puhakka, Valve, and Sinkkonen 2018; Puhakka et al. 2019). Therefore, we draw throughout on previous studies on consumer awareness, preferences, attitudes, perceptions, and purchase intentions toward functional foods and dietary supplements that offer benefits for health, well-being, and performance (e.g., Anninou and Foxall 2017; Bimbo et al. 2017; Steinhauser and Hamm 2018). Of special interest among these products are probiotics which contain live microbial ingredients, such as bacteria, with potential health benefits (Saarela et al. 2002). However, in contrast to probiotics, other dietary supplements, and functional foods, the substance under study here is not meant to be digested but applied topically, for instance directly to the skin.

Integrating consumers in product development at an early phase is vital to ensure success, as consumers will need to be able to incorporate the product into their daily lives. Cultural differences in consumers' reactions toward new products must also be taken into account. Failure to account for consumer needs and perceptions in the innovation process may lead to market failures (see van Kleef, van Trijp, and Luning 2005; Siegrist 2008). Consumer acceptance is highlighted in the case of "radical" (or discontinuous, generational, or breakthrough) product innovations, which are by their very nature dissimilar to existing products, create disruptions in users' existing consumption patterns or require new ones (Dahlin and Behrens 2005). Hence,

consumer acceptance may be slower than for "incremental" new products (Bogue, Sorenson, and O'Keeffe 2009).

A previous survey-based marketing research (Somervuori and Fredrikson 2016; Puhakka et al. 2019) conducted in Finland, Germany, and the United Kingdom indicated the cultural differences in the interest toward products containing a substance that helps to prevent the onset and alleviate symptoms of allergies and autoimmune diseases. The study also showed that the youngest age-group (18 to 24 years) was significantly more interested than their older peers in such products, and the same was observed among students compared to people with other status. This directed our interest to this group of young adults, with the aim to study more thoroughly their perceptions and attitudes toward the novel nature-based, health-enhancing substance. We conducted a survey among university students, both national and international, at the University of Helsinki, Finland ($N=944$). In this article, we examine factors that affect young adults' willingness to try generic, topical products that contain the novel substance with potentially disruptive market effects. The study pays attention to differences between national and international students' perceptions of the novel substance and provides a perspective on growing health trends and young future consumers' interest toward a unique type of topically applied functional product.

Literature review

Previous research has suggested that personal, psychological, social, and cultural factors, and factors related to the product affect consumer behavior toward health-enhancing products such as functional foods and dietary supplements.

Culture plays a key role in determining how consumers react to, and accept a new product (Hofstede 2001; de Mooij and Hofstede 2011; see Daghfous, Petrof, and Pons 1999), including functional foods (Siró et al. 2008; Siegrist et al. 2015). Hofstede's (2001) widely accepted cultural dimensions theory has indicated that in cultures with a high tendency to avoid uncertainty (e.g., Finland), people search for truth, believe in experts, and show a strong resistance to change.

They tend to wait for their peers and try the product only after it reaches a certain level of penetration (Yaveroglu and Donthu 2002). Meanwhile, in low uncertainty avoidance cultures (e.g., Anglo-Saxon), people are more willing to take risks and open to innovations, new technologies, and experiences (Hofstede 2001; de Mooij and Hofstede 2011; see Singh 2006). Although Finnish consumers have been found to be relatively positive toward functional foods (Bech-Larsen and Grunert 2003) and dietary supplements (Flynn et al. 2009), our previous marketing research indicated that Finnish consumers were more critical toward the novel health innovation than German or British and highlighted the importance of scientific evidence (Somervuori and Fredrikson 2016; Puhakka et al. 2019).

It has been suggested that women are slightly more health oriented and aware of health issues than men because they feel heightened responsibility for the well-being of other family members and are often the main purchasers of foods in a household (Bech-Larsen and Scholderer 2007). Accordingly, women have often been reported to be more likely users of functional foods (Siró et al. 2008; Bimbo et al. 2017; Steinhauer and Hamm 2018; cf. Verbeke 2005; Peng, West, and Wang 2006) and dietary supplements (Skeie et al. 2009; Tetens et al. 2011; Dickinson and MacKay 2014). Women are also more likely users of herbal medicine and natural health products (Häkkinen and Alha 2006; Stjernberg, Berglund, and Halling 2006).

Previous results related to age are not as consistent as for gender. Many studies have concluded that middle-aged and older consumers are more health-oriented than younger ones, which positively influences their awareness of and intentions to buy functional foods (Siró et al. 2008; Bimbo et al. 2017; Steinhauer and Hamm 2018) or dietary supplements (Skeie et al. 2009; Tetens et al. 2011; Dickinson and MacKay 2014). Personal relevance has been identified as a strong factor in willingness to use health-enhancing products (Verbeke 2005; Landström et al. 2007; Dean et al. 2012; Goetzke, Nitzko, and Spiller 2014). Since middle-aged and older consumers are more likely to have health-related problems, or a family member with such problems, they

tend to be more aware of health issues and able to evaluate specific health claims and relate them to their personal situation (Bech-Larsen and Scholderer 2007).

Meanwhile, some studies have shown that younger consumers display a greater intention to purchase functional foods than older ones (Armstrong et al. 2005; see Kraus, Annunziata, and Vecchio 2017). This observation may be related to greater general openness toward innovations. Based on Rogers' Diffusion of Innovation Theory (2003), "innovators" or "early adopters" are typically younger in age and possess a high professional status, income, and educational level (see Daghfous, Petrof, and Pons 1999). Some studies have suggested that older and younger consumers have preferences toward different types of functional foods and benefits (e.g., Niva 2006). Furthermore, typical functional food and dietary supplement consumers have been shown to be well educated and have higher than average income (Siró et al. 2008; Annunziata and Vecchio 2013; Dickinson and MacKay 2014; cf. Steinhauer and Hamm 2018).

According to many studies, attitudes, knowledge, beliefs, and familiarity rather than demographics explain the consumption of health-enhancing products (Verbeke 2005; Landström et al. 2007; Verbeke, Scholderer, and Lähtenmäki 2009; Lähtenmäki 2013). Dimensions related to perceived reward (Urala and Lähtenmäki 2007; Anninou and Foxall 2017), belief in the health benefits of the products and perceived relevance (Verbeke 2005) were found to have the strongest effect on consumers' interest in functional foods (see Ronteltap et al. 2007). The likelihood of future purchase was increased by positive attitudes toward the product, strong beliefs in a benefit, and previous experience with the product category (Peng, West, and Wang 2006; Dean et al. 2012). In terms of nonedible health-enhancing products, our qualitative study (Puhakka, Valve, and Sinkkonen 2018) indicated that perceived need and beliefs in the health effect of the novel products promoted the willingness to try such products. Furthermore, higher health motivation or health-consciousness has been shown to lead to higher preferences or purchase intentions toward products with health

claims (Tetens et al. 2011; Dean et al. 2012; Steinhäuser and Hamm 2018).

Product-dependent differences also influence the perceptions of functional foods. Siegrist, Stampfli, and Kastenholz (2008) found a significant interaction between benefit claim and carrier (i.e., product type) for willingness to buy and suggested that consumers do not perceive health claims independently from the carrier (see Annunziata and Vecchio 2013). Hence, functional foods are not seen as one homogenous group of products, but consumers rather approach them as members of the general product categories (e.g., yogurt) (de Jong et al. 2003; Urala and Lähtenmäki 2007). This means that interest in one category of health-enhancing products does not necessarily translate to other categories (Peng, West, and Wang 2006; Puhakka, Valve, and Sinkkonen 2018). Health claims were found to be more likely accepted on product categories that already have a healthy image (Bech-Larsen and Grunert 2003; Lähtenmäki 2013).

Besides familiarity with the carrier, familiarity with the functional compound, the health benefit and health claims *per se* is important for consumers (Lähtenmäki 2013; Steinhäuser and Hamm 2018). Our qualitative study (Puhakka, Valve, and Sinkkonen 2018) indicated that consumers already familiar with and attracted by functional properties of foods were the most interested in novel products containing the health-enhancing substance. Based on previous research on functional foods (Bech-Larsen and Grunert 2003; Urala and Lähtenmäki 2007), consumers rather tend to accept functional ingredients with a well-established and broadly appealing health image than ingredients which are unfamiliar or appeal only to consumers with quite advanced medical or nutrition knowledge. Hence, consumers' acceptance of a specific functional ingredient was linked to their knowledge of the health benefits of ingredients (Siró et al. 2008). For example, Bruhn et al. (2002) observed that consumers aware of "friendly bacteria" in yogurt were more likely to accept the potential benefits of probiotic cultures than consumers unaware of beneficial bacteria. Furthermore, perceived carrier-ingredient fit was strongly related to purchase intentions of functional foods (Krutulyte et al. 2011).

According to Wilson's (1984) biophilia hypothesis, humans have an innate sense of attachment to natural things. In various domains, especially food, people tend to prefer natural entities to those which have been produced with human intervention. Consumers often consider naturalness as a positive product attribute and link it to perceived healthiness, although the understandings and relative importance of food naturalness vary across social groups and cultures. Natural options are preferred for ideational reasons rather than for any instrumental benefit (Rozin et al. 2004; see Kim and Seock 2009). However, while foods are perceived to be close to nature as such and consumers may consider added functional components as unnatural (Bech-Larsen and Grunert 2003; de Jong et al. 2003), our study focuses on manufactured products that incorporate the substance made of natural, soil- and plant-based materials. On the one hand, consumers' understanding of the connection between nature and health may make them more receptive to the usage of this novel innovation. On the other hand, unfamiliar way of using natural materials may also raise skepticism toward the products (Puhakka, Valve, and Sinkkonen 2018).

As the products studied in this article contain a substance composed of soil and plant microbes, consumers' understandings of bacteria and contagion are of special salience. Nemeroff and Rozin (1994) have studied the "magical" thinking involved in popular accounts of contagion and acts of purification, focusing on interpersonal sources, physical illness and disgust. This "contamination" of objects by contact can have a positive or negative effect on product evaluation, depending on the sources of contamination, product characteristics and consumer attitudes. For example, previous celebrity possession has a positive effect on product desirability (Newman, Diesendruck, and Bloom 2011), whereas contact with another object or person that is considered disgusting has a negative effect on product evaluation (Morales and Fitzsimons 2007). In their study on probiotics, Bruhn et al. (2002) observed that the concept of beneficial bacteria was not credible for consumers who were very sensitive to the risks of pathogenic bacteria or repelled by the thought of eating bacteria.

The notion of disgust points to the importance of the form and sensory qualities of an innovation for its acceptance (see Siró et al. 2008). Previous research has suggested that functional benefits cannot outweigh the sensory properties of products. Taste seems to be the most important sensory property of functional foods (Verbeke 2005; Urala and Lähteenmäki 2007; Anninou and Foxall 2017), but sensory appeal was also found to be important for nonedible health-enhancing products (Puhakka, Valve, and Sinkkonen 2018). Scientific evidence of the benefits and consumers' interest in maintaining good health are not enough to make a product successful in the market if new ingredients and modes of use – such as touching a soil- and plant-based material – raise feeling of disgust, for example.

Since health-related qualities of products are credence characteristics which consumers cannot experience directly (Grunert 2002), trust is one of the most important factors in the acceptance of health-enhancing products (Peng, West, and Wang 2006; Siegrist 2008). Credence goods are sometimes called post-experience goods because it is difficult for consumers to ascertain the quality even after they have consumed the goods, and professionals must confirm the benefits (Darby and Karni 1973). Health effects may also be quite abstract, such as the decreased risk of diseases, and consumers do not usually possess the requisite knowledge for assessing the possible risks of products. Trust in industry, authorities and institutions is culturally bound (Dolgoplova, Teuber, and Bruschi 2015; Puhakka et al. 2019). Likewise, trust has an impact on both perceived benefit and risk of using new products (Ronteltap et al. 2007; Siegrist, Stampfli, and Kastenholz 2008). Our previous survey (Puhakka et al. 2019) showed in general that institutional sources of information, such as science and physicians, would convince consumers to try the novel health-enhancing products rather than reasons related to industry or fellow consumers' recommendations. Based on their study on probiotics, Bruhn et al. (2002) suggested that information is regarded more credible when it is consistent with existing beliefs and endorsed by recognized health experts.

Hence, consumer attitudes toward functional products are also influenced by suspicious attitudes and perceived risks (Bruhn et al. 2002; Annunziata and Vecchio 2013; Puhakka, Valve, and Sinkkonen 2018). For example, perceiving functional foods as a marketing scam was found to decrease intention to use such products (Verbeke, Scholderer, and Lähteenmäki 2009). Other recognized barriers for using functional products are the lack of interest, the lack of perceived need or knowledge, high cost, and reluctance to change habits (Bruhn et al. 2002; Niva 2006; Urala and Lähteenmäki 2007). In this study, we aim to identify factors that affect young adults' perceptions of, and attitudes toward, a topical health innovation that has not been widely studied before.

Materials and methods

To examine factors that affect young adults' willingness to try products containing the novel nature-based substance that prevents the onset or alleviates symptoms of immune-mediated diseases, we conducted a survey among national and international students at the University of Helsinki, Finland. The questionnaire was developed in English and translated into Finnish. The questionnaire was parallel translated between a native English and native Finnish speakers: differences were discussed and the most appropriate words were used to back translate. Both versions of the questionnaire were delivered through SurveyMonkey Inc (San Mateo, California, USA; www.surveymonkey.com) online survey tool from December 10, 2019 to January 10, 2020. The questionnaire was distributed through 18 student email lists encompassing bachelors, masters, and doctoral students at all 11 faculties of the university with over 30,000 students in total.

Responses to the questionnaire were voluntary, and no personal information was collected. A total of 1,058 respondents returned the questionnaire with a completion rate of 89% ($N = 944$), incomplete responses were excluded. Table 1 shows the key demographic characteristics of participants. The mean age of respondents was 28 years (median of 25 years), ranging from 18 to 75 years.

Table 1. Demographics of respondents.

Variable	Group	Frequency	% (N=944)
Gender	Female	716	75.8%
	Male	193	20.4%
	Other	14	1.5%
	Prefer not to say	21	2.2%
Age (years)	18 to 20	125	13.2%
	21 to 25	373	39.5%
	26 to 30	226	23.9%
	>30	220	23.3%
Level of study	Bachelors	492	52.1%
	Masters	368	39.0%
	Doctoral	85	9.0%
Field of study	Humanities and social sciences	410	43.4%
	Natural sciences	397	42.1%
	Applied sciences	122	12.9%
	Other	15	1.5%
Region of origin	Finland	818	86.7%
	Europe (excl. Finland)	88	9.3%
	Asia	16	1.7%
	North America	13	1.4%
	Africa	3	0.3%
	Australia South America	3 3	0.3% 0.3%

In the questionnaire, background demographics were collected on age, gender, region of origin, level of study, field of study, presence of an immune-related disease, and the use of other products with health claims (i.e., prebiotics and probiotics, functional foods, vitamins and minerals, or botanicals) within the last year. To examine respondents' relationship to nature, their frequency of nature visits was asked, followed by nine statements (e.g., "I like to spend time outdoors even when the weather is bad"; "My relationship with nature is an important part of who I am"; see Nisbet, Zelenski, and Murphy 2009; Kaikkonen et al. 2014). As the novel products of interest contain environmental microbes, participants' perceptions of microbes were assessed with 12 statements (e.g., "Having my hands in soil and 'getting dirty' is important for my physical health," "Contact with soil exposes me to microbes that may make me sick").

As no products containing the novel nature-based substance were on the market at the time of the survey, we relied on generic products in three categories applied in everyday life to study participants' willingness to try such products (cosmetics, textiles, and cleaning supplies; 11 products in total). We provided similar stimuli of replacing each product with a similar product containing the nature-based substance. In the questionnaire, we asked "How interested would you be in trying the following products

containing a soil- and plant-based substance, as described above?" The novel substance was defined as:

A new consumer product incorporates a substance made of soil- and plant-based materials. It contains environmental microbes that help consumers to prevent the onset and alleviate symptoms of common allergies and autoimmune diseases, such as asthma, eczema, type 1 diabetes or celiac disease. These soil- and plant-based integrated products are used in a similar way as their counterparts. The new product is based on scientific evidence and currently undergoing scientific testing. According to the biodiversity hypothesis, urbanization has diminished exposure to natural microbial diversity, which has led to an increase in allergies and autoimmune diseases.

To find out consumers' beliefs influencing the willingness to try the above defined products with the nature-based substance, respondents were requested to answer ten statements related to the products (e.g., "I believe I can influence the onset of allergies and autoimmune diseases with the product," "I do not feel such product is necessary for me"). Lastly, credibility factors were examined by requesting respondents to answer 11 statements related to the important issues when deciding to try these novel health products containing the nature-based substance (e.g., "The product has been tested in clinical studies," "The product is recommended by users").

Respondents' willingness to try novel soil- and plant-based products was assessed using a four-point scale ("I would not be interested," "I would be somewhat interested," "I would be very interested," and an "I don't know" option). A five-point Likert scale (from *strongly disagree* to *strongly agree*) was used to assess statements relating to relationship to nature, perception of microbes (including an "I don't know" option) and beliefs influencing the willingness to try the novel health-enhancing products. A five-point scale (from "not at all important" to "very important") was also used to assess credibility factors.

Data gathered through the questionnaire were analyzed using R software (R version 3.6.2, R Core Team 2019 and RStudio version 1.2.5019, RStudio Team 2019). First, principal coordinate analysis (PCoA) was used to summarize 11

individual questions that measured willingness to try novel products containing the nature-based substance. Prior to PCoA, “I don’t know” – responses were turned to NA and for each question a binomial “I don’t know” – variable was added (e.g., willing to try a lip balm: TRUE/FALSE). Second, Gower distance (package *StatMatch*, D’Orazio 2019; Gower 1971) was calculated for all the pairs of respondents and log-transformed to prevent negative eigenvalues in the consecutive PCoA. Finally, the first PCoA-axis scores were extracted and used as an index of general willingness to try these products. PCoA1-axis scores correlated reasonably well with the original answers (Spearman correlation ρ 0.63 – 0.8, p always $< .0001$), and thus, large PCoA1 scores indicated greater willingness to try the products.

Differences in general willingness to try (i.e., PCoA1-axis) were then explained with several explanatory variables. For those explanatory variables with two factors, either Wilcoxon rank sum test (when variances equal based on Fligner–Killeen median test) or Welch’s t test with bootstrap (when unequal variances, package *MKinfer*) (Kohl 2019) were used. These tests were used because the response variable (i.e., PCoA1-axis scores) was not normally distributed for any of the explanatory variables (Shapiro–Wilk test within each group always $p < .02$).

Explanatory variables with more than two groups and ordinal scale (e.g., level of study, questions with Likert scale) were analyzed using Spearman’s rank-order correlation and Kruskal–Wallis test. Because of the high number of statistical tests, these p values were also calculated using Benjamini–Hochberg correction (i.e., false discovery rate). Only two of the significant tests turned to nonsignificant, and these cases will be mentioned in the results. For each of the 12 statements regarding respondents’ perceptions of microbes, “I don’t know” – responses were removed before calculating the correlations, which led to the removal of two to 66 observations depending on the statement. Age was categorized into four groups (see Table 1). Field of study was categorized into humanities and social sciences (arts, theology, educational sciences, law, and social sciences), natural sciences (agriculture

and forestry, mathematical and natural sciences, and biological and environmental sciences), and applied sciences (medicine, veterinary medicine, and pharmacy), and tested using Kruskal–Wallis test (15 “Other”-responses were removed for this variable). Nine statements measuring relationship to nature were summarized by counting a mean value for each respondent (see Nisbet, Zelenski, and Murphy 2009; Kaikkonen et al. 2014). This value was correlated with general willingness to try the products using Spearman’s rank-order correlation because the variables were not normally distributed.

Results

Willingness to try products containing the nature-based substance

Eleven health-enhancing products containing the nature-based substance were presented in the questionnaire (Figure 1). Nearly 80% of the respondents were very or somewhat interested in trying cleaning supplies, i.e., surface cleaners and laundry detergents, as well cosmetic products, i.e., shampoo and lotion. More than half of the respondents were interested in trying other cosmetic products – deodorant, lip balm, and face mask – and textiles, i.e., clothes and linens. Almost half of the participants were interested in trying fabric softener and curtains. In total 5% of the participants were not interested in trying any of the products.

In general, females showed a higher willingness to try the novel products compared to males (Table 2). Respondents not from Finland showed a higher general willingness to try the products compared to respondents from Finland. There were no differences between age groups (Kruskal–Wallis, $df = 3$, statistic = 2.11, $p = .55$).

The respondents’ level of study (bachelors, masters, or doctoral degree) or field of study (humanities and social sciences, natural sciences or applied sciences) had no effect on general willingness to try health-enhancing products containing the nature-based substance (Kruskal–Wallis, $p = .33$, $p = .055$, respectively). Neither were there any significant differences between participants who had either worked or studied in biological and environmental fields, or health and

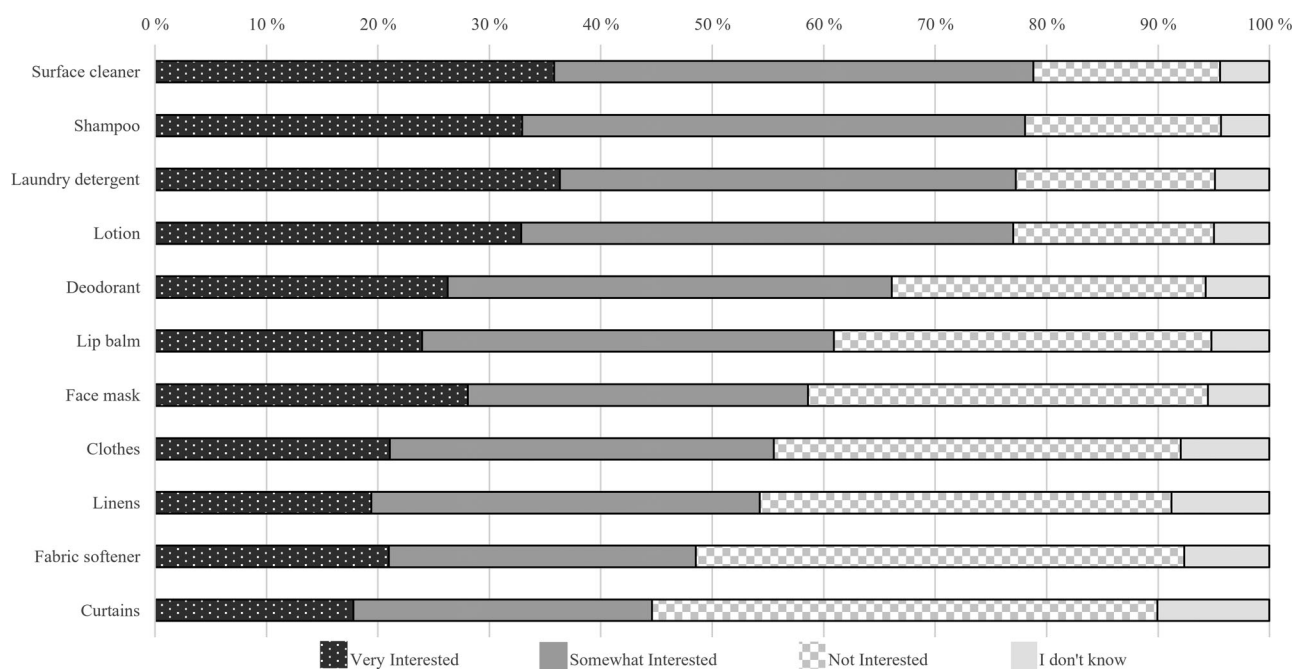


Figure 1. Respondents' willingness to try health-enhancing products containing the nature-based substance ($N = 944$).

Table 2. Characteristics affecting general willingness to try health-enhancing products with the nature-based substance.

		Mean PCoA1 score	Median PCoA1 score	Fligner test, p value	Test	Test statistic	p value
Gender	Female	0.03	-0.01	.075	Welch's t test	84,610	<.001
	Male	-0.08	-0.10				
From Finland	No	0.07	0.03	.20	Welch's t test	61,571	<.001
	Yes	-0.01	-0.04				
Work or study in biological/ environmental field	No	0.00	-0.03	.45	Welch's t test	82,834	.447
	Yes	0.01	-0.01				
Work or study in health/nutrition field	No	0.00	-0.03	.43	Welch's t test	88,608	.930
	Yes	0.00	-0.01				
Allergy or autoimmune disease	No	-0.01	-0.02	.81	Welch's t test	107,582	.590
	Yes	0.01	-0.02				
Use of health products	No	-0.10	-0.10	.21	Welch's t test	28,540	.001
	Yes	0.01	-0.02				
Use of pre/probiotics or functional foods	No	-0.02	-0.02	.034	Wilcoxon rank sum test	-2.7	.008
	Yes	0.02	-0.03				
Use of botanicals	No	-0.03	-0.05	.031	Wilcoxon rank sum test	-5.9	<.001
	Yes	0.09	0.06				

General willingness is represented by PCoA1-axis scores summarizing willingness to try 11 individual products; large PCoA1-axis scores indicate higher willingness.

Italics highlight the significant p -values (<.05).

nutritional fields compared to those who had not worked or studied in such fields (Table 2).

The presence of an immune-mediated disease did not show significant effect on general willingness to try products containing the nature-based substance (Table 2). However, those who had used any product/supplement/food with health claims (e.g., prebiotics, probiotics, vitamins or minerals, functional foods, botanicals) in the past 12 months were more willing to try the products. Looking into more detail, respondents who indicated they had used prebiotics or probiotics or

functional foods showed a greater general willingness to try the products than those who had not used such supplements or foods. Even higher willingness to try the products was detected for those who had used botanicals compared to those who had not used botanicals (Table 2).

Furthermore, the closer their relationship to nature (Spearman $\rho = 0.18$, $p < .001$) and the more frequent visits in nature (Spearman $\rho = 0.065$, $p = .045$, corrected $p = .07$), the more willing participants were to try products containing the nature-based substance.

Table 3. Correlations between respondents' perceptions of microbes and their general willingness to try health-enhancing products containing the nature-based substance.

	Spearman rank correlation, rho	Spearman rank correlation, p value
I always wash my hands when I get home.	0.09	.007
Having my hands in soil and "getting dirty" is important for my physical health.	0.20	<.001
Cleaning my home regularly is important to me.	0.06	.054
All microbes are harmful.	0.05	.13
I believe there are many beneficial microbes in nature.	0.13	<.001
I do not like to pick up things from the ground because they are dirty.	-0.09	.004
Spending time in nature makes my body stronger to resist disease.	0.23	<.001
Contact with soil exposes me to microbes that may make me sick.	-0.17	<.001
Being in crowded spaces exposes me to microbes that may make me sick.	-0.04	.29
I like to use disinfectants when cleaning.	0.07	.027
I am comfortable touching pets.	0.10	.003
I am comfortable drinking from the same cup or water bottle as another person.	0.10	.003

Italics highlight the significant p-values (<.05).

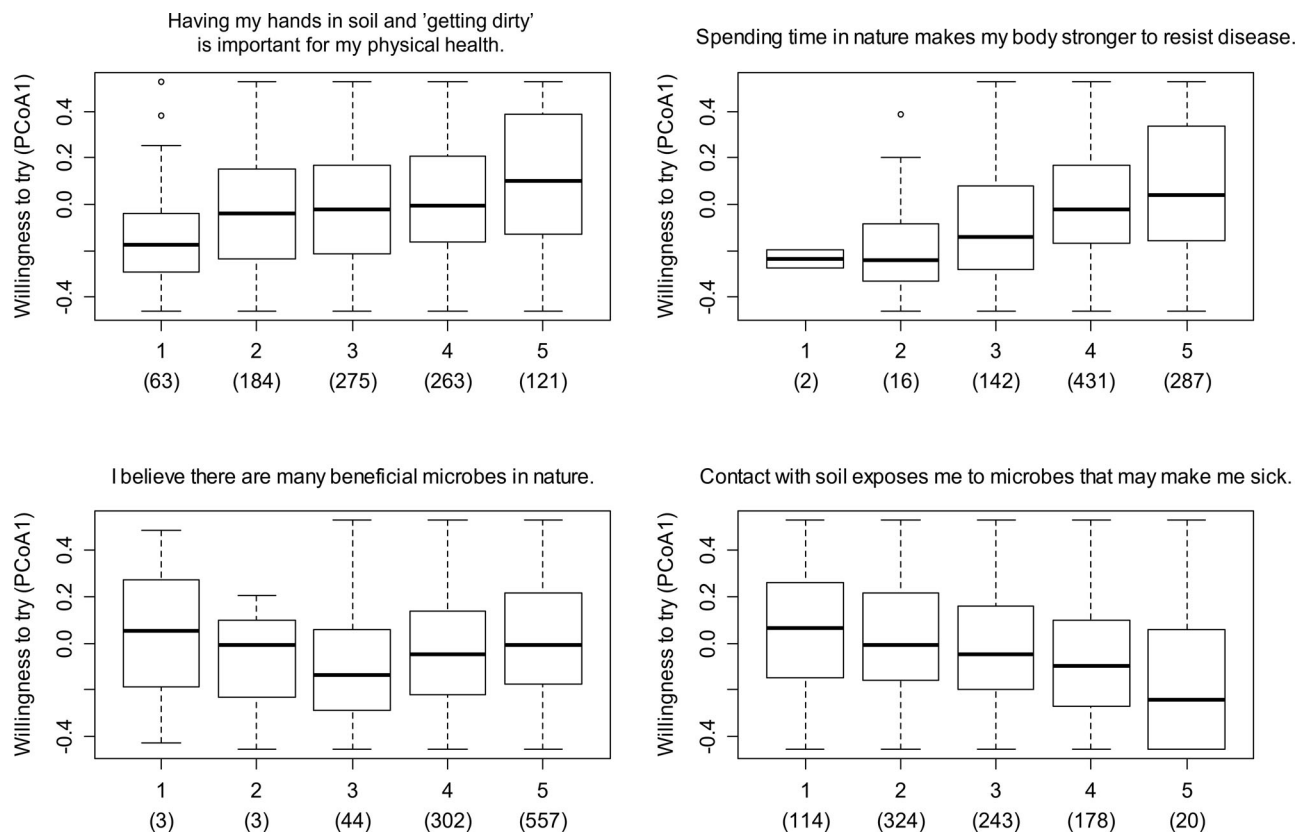


Figure 2. Selected relationships of respondents' perceptions of microbes relative to their general willingness to try health-enhancing products containing the nature-based substance (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Number of responses for each response is given in the parentheses.

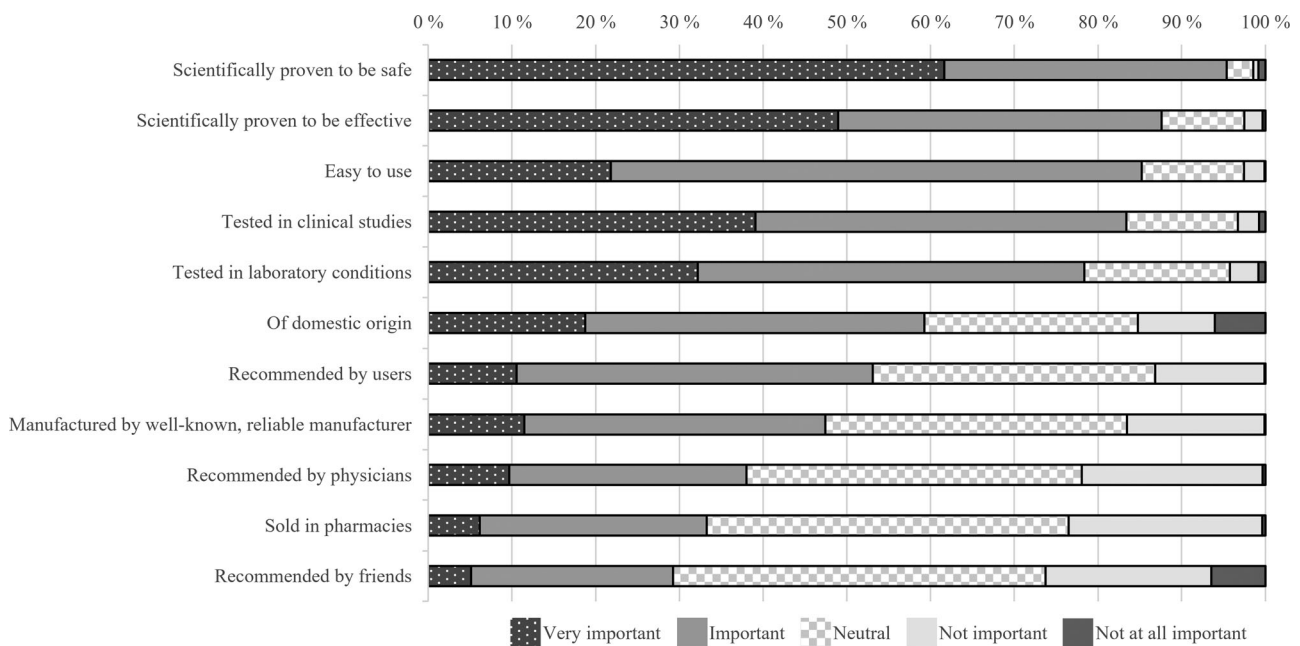
Participants' perceptions of microbes also affected their general willingness to try health-enhancing products containing the novel substance (Table 3). Those who strongly agreed that having hands in soil and "getting dirty" is important for their physical health or that spending time in nature makes their body stronger to resist disease, were more willing to try the products than those who did not agree with these

statements. Those who strongly agreed that there are many beneficial microbes in nature were also more willing to try the products. Only few respondents disagreed with this statement, and thus, the correlation was mainly driven by answers from neutral to strongly agree (Figure 2). Furthermore, participants who strongly agreed that contact with soil microbes can make them sick were less willing to try the novel products.

Table 4. Correlations between respondents' product-related beliefs and their general willingness to try health-enhancing products containing the nature-based substance.

	Spearman rank correlation, rho	Spearman rank correlation, p value
I believe I can influence the onset of allergies and autoimmune diseases with the product.	0.34	<.001
I believe being in close contact with nature is the best way to prevent allergies and autoimmune diseases.	0.18	<.001
I do not feel such product is necessary for me.	-0.50	<.001
I am turned off by putting the product directly on my body.	-0.32	<.001
I believe exposing myself to this product could have negative effects.	-0.25	<.001
I believe the product would be effective.	0.38	<.001
I believe in using medication to alleviate symptoms of allergies or autoimmune diseases rather than using the product.	-0.25	<.001
I believe the product would be too costly for me.	<0.01	.99
I do not want to bring these kinds of foreign materials at my home.	-0.29	<.001
I believe that using these products would not be convenient.	-0.10	.001

Italics highlight the significant *p*-values (<.05).

**Figure 3.** Importance of different factors when deciding to try a health-enhancing product containing the nature-based substance.

Beliefs influencing willingness to try the novel products

We looked at several product-related beliefs that could influence respondents' willingness to try the health-enhancing products containing the nature-based substance (Table 4). Participants who agreed they could influence symptoms of allergies and autoimmune diseases with the products or believed that the products would be effective, were more willing to try the novel

products than the others. Additionally, those respondents who agreed that being in close contact with nature is the best way to prevent allergies and autoimmune diseases were more willing to try the products. However, respondents who believed that exposing themselves to these products containing the nature-based substance could have negative effects, who agreed that they are turned off by putting a product containing the substance directly on their bodies or that they do

Table 5. Correlations between credibility factors related to trying products containing the nature-based substance and respondents' general willingness to try such products.

	Spearman rank correlation, rho	Spearman rank correlation, <i>p</i> value
The product has been tested in clinical studies.	-0.06	.048*
The product has been tested in laboratory conditions.	0.18	.098
The product has been scientifically proven to be effective.	-0.14	<.001
The product has been scientifically proven to be safe.	-0.08	.009
The product is recommended by specialist physicians.	-0.01	.684
The product is recommended by users.	0.18	<.001
The product is sold in pharmacies.	-0.03	.301
The product is manufactured by a well-known, reliable manufacturer.	-0.02	.557
The product is of domestic origin.	0.17	<.001
The product is easy to use.	0.10	.002
My friends and relatives have found the product useful.	0.13	<.001

**p* value nonsignificant after Benjamini–Hochberg correction.
 Italics highlight the significant *p*-values (<.05).

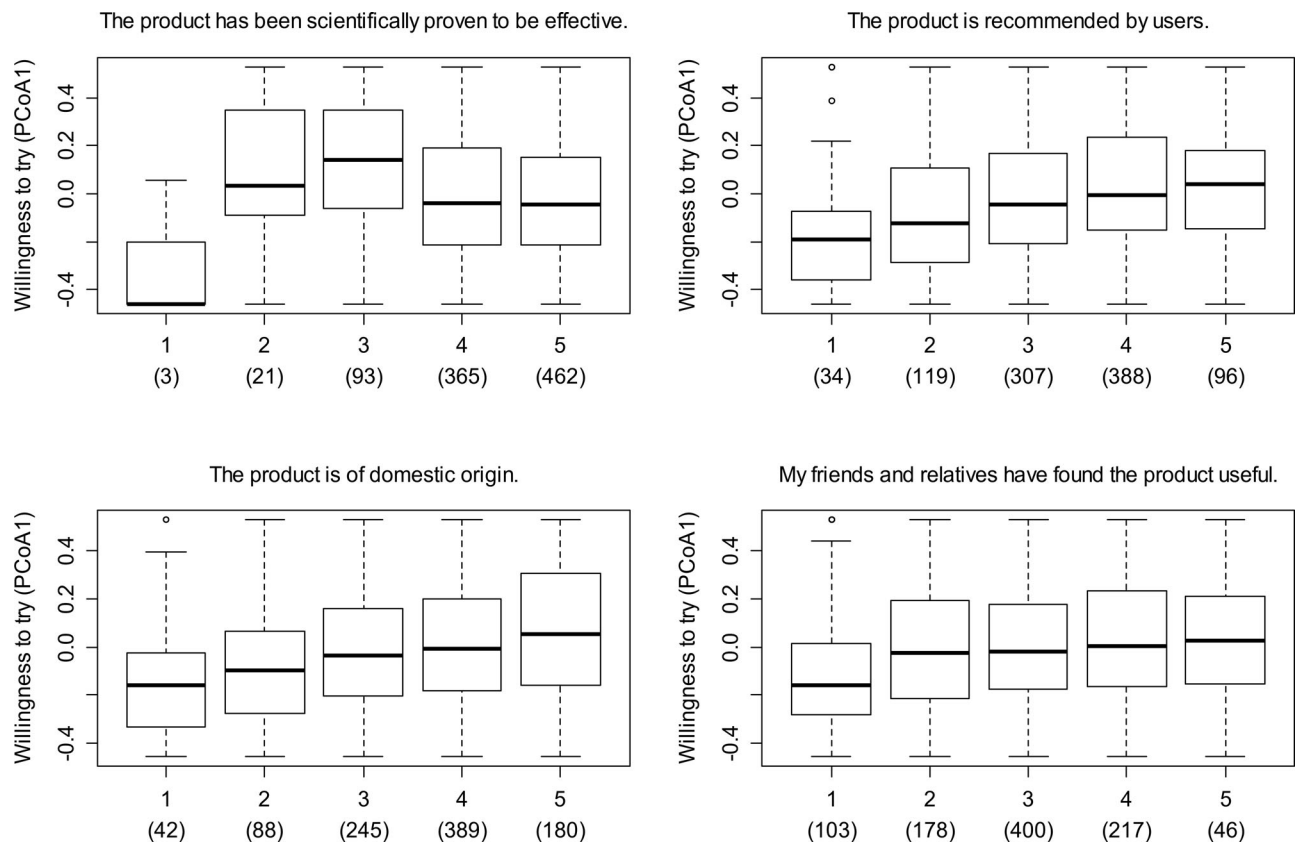


Figure 4. Selected relationships of credibility factors related to trying products containing the nature-based substance and respondents' general willingness to try such products (1 = not at all important, 2 = not important, 3 = neutral, 4 = important, 5 = very important). Number of responses for each answer is given in the parentheses.

not want to bring these kinds of foreign materials into their homes, were less willing to try the products. Moreover, respondents who believed that the products would be unnecessary for them, using medications was the preferred method for alleviating symptoms of allergies or autoimmune diseases or that using these products would be inconvenient, were less willing to try the products. Only few respondents took a strong opinion

regarding the cost of the products and most (47%) selected the “neutral” option, which explains the lack of correlation for this statement (Table 4).

Credibility factors

The most important issues when deciding to try a health-enhancing product containing the nature-based substance were that the product has been

scientifically proven to be both effective and safe to use (Figure 3). Other scientific evidence – that the product has been tested in clinical studies or in laboratory conditions – were also important for respondents as well as the product's ease of use.

Those who considered it important that the product is of domestic origin, it is recommended by users or friends and relatives have found it useful, were more willing to try the novel products than those who did not consider these factors important (Table 5; Figure 4). Those, rather few respondents, who either disagreed about the importance of scientifically proven effectiveness or were neutral, were more willing to try the products (Figure 4).

Discussion

In the present study, we have explored consumer perceptions of, and attitudes toward, hypothetical products containing a novel soil- and plant-based substance which contains microbes that aim to help consumers prevent the onset and alleviate symptoms of common allergies and autoimmune diseases. The results based on a survey data collected from the national and international university students in Helsinki, Finland showed a relatively high interest toward such products; only 5% of the respondents were not interested in trying any of 11 products included in the survey. Hence, our results suggest that young, well-educated adults are potential “early adopters” (Rogers 2003) of this kind of a novel health innovation (see Somervuori and Fredrikson 2016; cf. Bimbo et al. 2017; Steinhauser and Hamm 2018).

Based on the high interest toward products containing the novel substance, the innovation seems to be in a form that is easily acceptable for most consumers (see Siró et al. 2008; cf. Puhakka, Valve, and Sinkkonen 2018). Incorporating the nature-based substance to daily consumer goods allows consumers to adjust their consumption to obtain health benefits without significantly changing their habits. Respondents were particularly willing to try cleaning supplies and cosmetic products containing the novel substance. However, difference in the interest toward various products demonstrates that interest in one category of functional products does not necessarily translate to

other categories (see Peng, West, and Wang 2006). Hence, our study supports the results obtained in research on functional foods that novel health-enhancing products should not be treated homogeneously as consumer responses to them vary according to the carrier (see Bech-Larsen and Grunert 2003; Siegrist, Stampfli, and Kastenholz 2008) and the carrier-ingredient combination (Krutulyte et al. 2011). In the present study, the reason for the variation in interest may be related to the characteristics of different product types. While cleaning supplies or cosmetic products are already associated with producing effects on the home environment or the body (e.g., cleaning the home, cleaning the body, soothing/hydrating the skin), clothes or other textiles are not usually associated with such qualities, which may make it more difficult for consumers to see the benefits. Furthermore, people may easily understand that the soil- and plant-based substance can be mixed with liquids, powders, or wax, but in the case of textiles, the effect mechanisms may be harder to imagine.

However, our study indicates that consumer acceptance of nature-based innovations may vary in different cultures. Cultural differences are highlighted by our result showing that non-Finnish respondents were more willing to try health-enhancing products containing the nature-based substance than Finnish respondents. This finding supports cultural dimensions theory indicating that in cultures with high tendency to avoid uncertainty (e.g., Finland) people are less open to new innovations, believe in experts and wait for their peers before trying the product (Hofstede 2001; Yaveroglu and Donthu 2002; de Mooij and Hofstede 2011; see Somervuori and Fredrikson 2016). In the present study, however, Finnish respondents showed relatively high willingness to try health-enhancing products based on scientific evidence and testing, which might be related to high trust in science and authorities in Finland (Kiljunen 2019; see Puhakka et al. 2019). The generally high level of societal trust has been identified as one reason for optimistic views of functional foods in Finland (Niva and Mäkelä 2007). Moreover, the ideas of biodiversity hypothesis may already be familiar for many Finnish university students because the hypothesis has been widely studied by Finnish

researchers (e.g., Hanski et al. 2012; Haahtela 2019; Roslund et al. 2020), and it has been often discussed in the media.

Our study also indicated that women were more willing to try health-enhancing products containing the nature-based substance than men. This result is in line with the previous studies on functional foods, dietary supplements, and natural health products, which have shown female consumers' higher interest toward such products (e.g., Stjernberg, Berglund, and Halling 2006; Skeie et al. 2009; Steinhäuser and Hamm 2018; cf. Somervuori and Fredrikson 2016). Similar to functional foods (Bech-Larsen and Scholderer 2007), women may have a traditionally dominant responsibility in buying the household products or they may use some products included in our survey more often than men (e.g., face mask, lip balm).

In contrast to studies on functional foods (Verbeke 2005; Landström et al. 2007; Dean et al. 2012; Goetzke, Nitzko, and Spiller 2014), the present study did not highlight the importance of personal relevance in willingness to use health-enhancing products. Those respondents who had an immune-mediated disease were not more willing to try novel products than those without a disease. Unlike, for example, in cholesterol lowering, where plant stanol ester food products are available, daily consumer goods are not usually associated with the treatment of allergies and autoimmune diseases. Furthermore, consumers may associate the main ideas of biodiversity hypothesis, e.g., that contact with soil can be healthy, to the prevention rather than treatment of diseases because the recent evidence on the biodiversity hypothesis and the corresponding public discussion has highlighted the prevention of diseases. Accordingly, it is possible that products containing the novel nature-based substance are particularly interesting for consumers who aim to prevent the onset of diseases. This may be related to young adults' relatively high interest toward our products; in contrast to functional foods (Bech-Larsen and Scholderer 2007), our health innovation does not only attract middle-aged or older consumers who already have health issues.

The present study supports the observation that factors such as attitudes, knowledge, beliefs and familiarity – rather than demographics – explain the consumption of health-enhancing products (Bech-Larsen and Grunert 2003; Landström et al. 2007; Verbeke, Scholderer, and Lähtenmäki 2009; Lähtenmäki 2013). Our results showed that respondents already familiar with functional foods, dietary supplements or botanicals were the most willing to try the novel products (see Puhakka, Valve, and Sinkkonen 2018). Moreover, those who had the closest relationship to nature and visited nature most often were more willing to try these nature-based products than the others. This may be explained not only by familiarity with natural materials but also by the knowledge about nature and beliefs in its positive effects on human health and well-being. Some respondents also wrote in the open responses of the survey that they would use the products if they were not tested on animals or if they were organic. This finding reflects young consumers' interest in more natural way of living (Kim and Seock 2009) which is often linked to perceived healthiness (Rozin et al. 2004).

Although the respondent's field or level of study or work experience in biological/environmental or health/nutritional fields did not have an impact on willingness to try products with the nature-based substance, we observed that more specific beliefs related to the health benefits or risks of soil microbes, and contact with nature in general, had an effect on willingness to try the products. As expected, naturalness and presence of microbes was not solely seen as a positive product attribute (see Bruhn et al. 2002). Belief in the health benefits of touching soil and being in close contact with nature correlated positively with willingness to try, whereas belief in the detrimental effects of such contact indicated low willingness. Positive perceptions of the health effects of natural microbial contact thus reinforced interest in the novel products. An opposite stance could also be possible, if the products tested in the study were framed as unnecessary substitutes to the effects of "real" nature, which are easy to obtain and abundantly available for all (see Puhakka, Valve, and Sinkkonen 2018).

This evidently was not the case among our respondents.

Similar to functional foods (Verbeke 2005; Peng, West, and Wang 2006; Dean et al. 2012), our results showed that belief in the health benefits and effectiveness of the novel products increased willingness to try products. Beliefs are related to trust (see Bruhn et al. 2002). The results confirmed that scientific evidence and communicating about it for consumers are important in order to convince consumers of the health benefits of the innovation based on credence characteristics (see Puhakka et al. 2019). However, those relatively few participants who were either neutral toward or downplayed the importance of scientific evidence were on average more interested in the products than those who valued scientific evidence. Moreover, recommendations from users or friends and relatives were important for those who were the most willing to try the novel products. It is possible that these consumers already believe in the health benefits of exposure to nature and navigate in the product world based on peer recommendations rather than scientific evidence. In line with the previous research on functional products (see Bruhn et al. 2002; Niva 2006; Urala and Lähteenmäki 2007; Annunziata and Vecchio 2013; Puhakka, Valve, and Sinkkonen 2018), major barriers for trying health-enhancing products containing the nature-based substance were disbelief in the benefits, perceived risks, disgust, and the lack of perceived need.

Limitations of this study are related to the data collection methods. Although almost 1,000 national and international students from the various faculties of the university completed the questionnaire, the response rate was low and likely the respondents were somewhat interested in the theme of the survey, indicating self-selection bias. The international respondents, who had moved to another country to study, might have been more open-minded than students on average. These factors may have affected the level of willingness to try products containing the novel substance. Taking into account the cultural differences in consumer acceptance of novel products, the results cannot necessarily be generalized to other cultural contexts. Therefore,

further comparative studies based on representative samples are needed to provide an accurate representation of cross-cultural viewpoints of willingness to try health-enhancing nature-based products.

Moreover, it was probably challenging for the respondents to imagine and give an opinion of products that they have never seen. Attitudes toward new products may not yet be strongly established in consumers' minds and their preferences might change by the time the products will be introduced in the market (see van Kleef, van Trijp, and Luning 2005; Puhakka, Valve, and Sinkkonen 2018). Hence, it is important to continue consumer research at subsequent stages of the product development process, particularly in the case of radical product innovations such as our example of the nature-based substance (see Dahlin and Behrens 2005). Research material could be collected, for example, in qualitative focus groups where consumers have the possibility to see the real products, test them and be informed about their properties. Further quantitative studies based on representative samples are needed to compare not only different cultural groups' but also other demographic groups' willingness to try various health-enhancing products with the nature-based substance.

Conclusion

In this study, we have examined factors that affect young adults' willingness to try health-enhancing products that contain the novel soil- and plant-based substance and aim to help prevent the onset and alleviate symptoms of common allergies and autoimmune diseases. The results based on a survey data collected from national and international university students in Finland showed a relatively high willingness to try such products, particularly among female and non-Finnish respondents, which reflects the present trend for health, well-being, and self-care. Accordingly, young adults' interest in health innovations should not be underestimated. However, differences between national and international students' interest toward health-enhancing nature-based products indicate the role of cultural dimensions in consumer acceptance of

product innovations. The study highlights the significance of several factors in explaining the willingness to try health-enhancing products. In particular, respondents' relationship to nature and beliefs related to the health benefits or risks of soil microbes influenced willingness to try products with the novel nature-based substance.

The study emphasizes the importance of accounting for consumer perceptions and attitudes in the innovation process, particularly when developing, launching and marketing radical innovations. As our results showed, functional products are not seen as a homogenous group; the potential of different products may vary according to the product category or carrier, and these differences should be identified before entering the market. As consumers showed interest in health-enhancing cosmetic products (see also Somervuori and Fredrikson 2016), the first products based on our innovation – launched after the survey – are cosmetic products including the nature-based substance (see <https://luonkos.fi/en>; <https://www.moiforest.com/en/home/>). Furthermore, different marketing strategies may be needed to create tailored messages for different consumer segments in different cultures and convince potential customers of the health benefits of the innovation based on credence characteristics. The websites of these cosmetic products address the health benefits and scientific credentials of the novel substance, but aspects of sustainability and naturalness – sensory connections to nature – are also strongly emphasized in the marketing. To attract larger consumer groups who may be more hesitant about natural products (see Puhakka, Valve, and Sinkkonen 2018), it could be important to highlight scientific evidence and make a clear difference to natural health products. Sources of trust may also vary in different cultures (Puhakka et al. 2019). To conclude, marketing of this kind of innovation must be based not only on scientific evidence of the health benefits but also on careful customer analyses of consumers' needs and perceptions of product attributes.

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Disclosure statement

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