



How consumers of meat-based and plant-based diets attend to scientific and commercial information sources: Eating motives, the need for cognition and ability to evaluate information

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ABSTRACT

This study explores how consumers' eating motives, need for cognition, and subjective ability to evaluate information were associated with the perceived influence of scientific and commercial information sources, and how these were associated with a self-reported consumption of red meat and plant-based alternatives. An online survey of a nationally representative sample of the 18- to 65-year-old adult population living in Finland (N = 1279) was analysed with structural equation modelling. The perceived influence of commercial sources was negatively associated, and the perceived influence of scientific sources positively associated with a plant-based diet. The health motive and subjective ability to evaluate information were positively associated with the perceived influence of scientific information sources and negatively associated with the perceived influence of commercial sources. The environmental motive was positively associated with commercial sources. The findings can be used for tailoring food-related communication to suit the motivations and information assessment capacities of different consumers. In particular, public authorities need to respond to the information needs of environmentally conscious consumers, increase public awareness of the environmental impacts of red meat, and train consumers to assess information quality.

1. Introduction

There is abundant scientific evidence of the negative impacts of diets based on red meat, and the positive impacts of plant-based diets on health and the environment (Cross et al., 2007; Rizkalla, Bellisle, & Slama, 2002; Steffen et al., 2015; Stehfest et al., 2009; World Cancer Research Fund, 2013). Consumers' awareness of environmental and health risks associated with red meat and willingness to reduce meat consumption has increased (Niva, Mäkelä, Kahma, & Kjærnes, 2014), but is not borne out in corresponding reductions in the consumption of red meat. At the EU level, the consumption of beef has been decreasing by about 1 kg/per capita/year since 2007, whereas the consumption of pork has been stable (EC, 2018), but the situation varies across countries and types of meat. For example, in Finland the consumption of beef has been slightly increasing and pork decreasing (Natural Resources Institute Finland, 2018).

Multiple strategies have been used to influence consumers' eating habits, such as policies, prices, information provision and attractive meat substitutes (Niva, Vainio, & Jallinoja, 2017). Among these

strategies, information provision is important because knowledge is a necessary albeit insufficient requirement for making healthy and sustainable food choices (Peschel, Grebitus, Steiner, & Veeman, 2016; Verbeke, 2008). The challenge is that scientific evidence about the risks of excessive red meat consumption and the benefits of plant-based diets does not appear to convince some regular meat eaters. While some groups have adopted plant-based diets, others do not demonstrate willingness to reduce their consumption of red meat (Jallinoja, Niva, & Latvala, 2016; Vainio, Niva, Jallinoja, & Latvala, 2016; Verain, Dagevos, & Antonides, 2015).

Information can have an impact on consumers' behaviour only if they are exposed to it. Consumers' motives and needs regulate their exposure to new information (Knobloch-Westerwick, Johnson, & Westerwick, 2013; Turner, Skubisz, Pandya, Silverman, & Austin, 2014; Verbeke, 2008), as well as their food choices (Mullee et al., 2017; Tobler, Visschers, & Siegrist, 2011; Vainio et al., 2016). Moreover, information can exert an impact on consumers' choices only if they are sufficiently motivated to search for and process the information, and have sufficient ability to assess its relevance and quality (Hung,

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Grunert, Hoefkens, Hieke, & Verbeke, 2017; Miller, Gibson, & Applegate, 2010). The aim of this study is to explore why consumers of meat-based diets are not convinced by scientific evidence, and to examine whether consumers of meat-based and plant-based diets attend to information in different ways. More specifically, the study tests the assumption that individuals are likely to attend to scientific evidence about food if they are motivated to make healthy and environmentally sustainable food choices, and have sufficient motivation and ability to assess the quality of information about healthy and environmentally sustainable eating.

1.1. Information sources and food choices

Consumers are surrounded by multiple and contradictory messages about food choices: for example, scientific evidence about the healthiness and environmental sustainability of food may sometimes be in conflict with the information delivered by commercial communicators that aim at selling food products through consumer satisfaction (Fitzgibbon et al., 2007). This study focuses on the perceived influence of commercial and scientific information sources because they have been identified as important sources of food-related information in European countries (Holgado et al., 2000), and previous research has found an association between consumers' use of commercial sources and unhealthy food choices, and the use of scientific sources and healthy food choices. For example, commercial mass media advertising has been accused of increasing obesity in society (Chandon & Wansink, 2012), and obtaining information about new foods from television cooking programmes was associated with a high Body Mass Index in the US (Pope, Latimer, & Wansink, 2015). The use of science-based sources was associated with healthy food choices (Barreiro-Hurlé, Gracia, & de-Magistris, 2010; Hieke, Pieniak, & Verbeke, 2018), and self-reported exposure to nutrition information was positively associated, while exposure to commercials was negatively associated with fruit and vegetable consumption among Austrian adolescents (Freisling, Haas, & Elmadfa, 2010). Moreover, a reluctance to reduce meat consumption was associated with scepticism about scientific evidence for the climate effects of meat in Scotland (Macdiarmid, Douglas, & Campbell, 2016). Based on these studies, the following hypotheses about the association between information sources and food choices were tested:

H1. The perceived influence of commercial sources should be negatively associated with a plant-based diet (Freisling et al., 2010).

H2. The perceived influence of scientific sources should be positively associated with a plant-based diet (Barreiro-Hurlé et al., 2010; Hieke et al., 2018; Macdiarmid et al., 2016).

H3. Further, scientific and commercial sources are related: for example, science-based claims about health and nutrition are used as marketing tools in commercials (Van Buul & Brouns, 2015). Therefore, the perceived influence of scientific and commercial information sources should be interrelated.

1.2. The need for cognition and ability to evaluate information

Consumers' motivation and ability to assess the quality of information are the main concepts used for explaining individuals' comprehension and use of information in the Motivation-Ability-Opportunity model (Andrews, 1988) and the Elaboration-Likelihood model (Petty & Cacioppo, 1986). The motivation, or the *need for cognition*, facilitates a greater acquisition of information, whereas ability facilitates the comprehension of information (Greenwald & Leavitt, 1984; Moorman, 1990). First, the need for cognition has been associated with a tendency to assess the quality of information (Petty, Cacioppo, Strathman, & Priester, 2005). In addition, the need for cognition has been associated with a tendency to attend to multiple different viewpoints, which may reduce cognitive biases (Tsfati &

Cappella, 2005; Winter & Krämer, 2012), and increase an interest in science (Feist, 2012).

The need for cognition is necessary for information to have an impact on consumer behaviour. For example, in a study by Van Dillen, Hiddink, Koelen, de Graaf, and van Woerkum (2004) most research participants were not motivated to acquire more information about dietary guidelines even though they considered the guidelines highly relevant, and in another study by Yoon and George (2012), individuals' need for cognition significantly increased their use of nutrition information about healthier choices in restaurants.

The ability to evaluate the relevance and quality of information is important for understanding science-based information (Bromme & Goldman, 2014), such as the comprehension of nutrition labels (Miller, 2014; Rothman et al., 2006). The ability to direct attention to relevant information and ignore marketing features has been found to promote information comprehension (Miller & Cassady, 2015).

Further, the need for cognition and the ability to evaluate information quality appear to be interrelated (Miller et al., 2010). Moreover, the need for cognition was more important than ability in determining consumers' use of health claims in food packages (Hung et al., 2017). However, we do not yet know how the need for cognition and ability are associated with the selection of information sources in the context of food. Three hypotheses about the need for cognition and ability were tested:

H4. The need for cognition should be positively associated with the ability to evaluate information quality (Greenwald & Leavitt, 1984; Miller et al., 2010; Moorman, 1990).

H5. As the need for cognition is associated with the use of multiple and different information sources, the need for cognition should be positively associated with the perceived influence of both scientific and commercial information sources (Tsfati & Cappella, 2005; Winter & Krämer, 2012).

H6. The ability to evaluate information quality directs attention to relevant information and facilitates the ignoring of marketing features (Miller & Cassady, 2015), and therefore ability should be positively associated with the perceived influence of scientific information sources and negatively with commercial sources.

1.3. Eating motives

Food choices are regulated by multiple eating motives (Renner, Sproesser, Strohbach, & Schupp, 2012). The motives related to health and environmental sustainability have been strongly associated with the consumption of plant-based diets (Lazzarini, Zimmermann, Visschers, & Siegrist, 2016; Mullee et al., 2017; Vainio et al., 2016). For example, in a Swiss study environmental motives were associated with consumers' willingness to eat fruit and vegetables, and health motives were associated with the intention to reduce the consumption of meat (Tobler et al., 2011). Health and environmental motives have also been found to be positively interrelated (Cavaliere, Ricci, Solesin, & Banterle, 2014).

Eating motives give rise to specific information needs (Verbeke, 2008). Health-related motives have been associated with increased information needs about the effects of food on human health (Geeroms, Verbeke, & Van Kenhove, 2008; Verbeke, 2008; Verbeke & Vackier, 2004), and increased attention given to nutrition information on food packages (Visschers, Hess, & Siegrist, 2010). Similarly, individuals with high environmental concerns have a tendency to search for new information that is congruent with their environmental values (Stern, Dietz, & Guagnano, 1995). Environmentally concerned consumers in the US perceive the increased informational utility of, and increased need for cognition towards environmental sustainability claims in food advertisements (Matthes & Wonneberger, 2014). Based on these findings, three hypotheses were developed:

H7. Health and environmental sustainability motives should be positively associated with each other (Cavaliere et al., 2014).

H8. Health and environmental sustainability motives should be associated with a plant-based diet (Lazzarini et al., 2016; Mullee et al., 2017; Vainio et al., 2016).

H9. The findings related to the health motive (Geeroms et al., 2008; Verbeke, 2008; Verbeke & Vackier, 2004), and environmental concern and green consumerism (Matthes & Wonneberger, 2014) suggest that both eating motives should be associated with an increased need for cognition.

H10. There is evidence that a significant proportion of food advertising focuses on less healthy products (Henderson & Kelly, 2005) and that individuals with an increased health motivation are likely to show an increased willingness to attend to information that can help them to make healthy choices (Geeroms et al., 2008; Verbeke, 2008; Verbeke & Vackier, 2004). Therefore, health-conscious individuals should attend to science-based information sources and avoid commercials that would expose them to unhealthy choices.

H11. There is evidence that environmentally concerned consumers attend to information that can help them make green choices (Stern et al., 1995), and it can be both scientific as well as commercial (Matthes & Wonneberger, 2014). Therefore, the environment motive should be positively associated with both the perceived influence of scientific and commercial information sources.

2. Materials and methods

2.1. Research participants

The data were collected with an online questionnaire administered to the consumer panel of a commercial marketing research company, representative of 18- to 65-year-old internet users living in Finland (N = 1279). The survey included a wide range of questions related to food choices and attitudes towards food and food-related information. The survey was distributed in August–November 2016. Compared to the adult population of the same age range living in Finland, the participants were more likely to be women, to be slightly older, to have a higher level of education, and to live in the Helsinki-Uusimaa region (Table 1).

Table 1
Age, gender distribution, highest education level, and living area in the Finnish population (Statistics Finland, 2015) and in the data sample.

	Finnish population (%)	Data sample (%)
Gender		
women	50.8	55.7
men	49.2	44.3
Age groups between 20–64 years		
20 – 34	32.6	26.1
35 – 49	32.1	33.7
50 – 64	35.3	40.2
Highest education		
basic level	16.9	6.3
upper secondary level	47.8	42.1
lowest level tertiary	10.6	9.0
lower-degree level tertiary	12.9	18.5
higher-degree level tertiary	10.8	21.2
doctorate or equivalent	1.0	2.8
Region		
Helsinki-Uusimaa	29.7	40.7
Southern Finland	21.3	22.9
Western Finland	25.2	25.9
Northern and Eastern Finland	23.8	10.6

2.2. Measures

The items were part of a longer questionnaire that measured eating motives, self-reported eating habits, and the self-reported use of information sources/channels related to food. The descriptive statistics of the variables (means, bivariate correlations and Cronbach alphas) are shown in Table 2. All of the items used for constructing the variables are reported in Table 3.

Perceived influence of information sources/channels for food information. The participants were requested to evaluate the extent to which seven information sources/channels influenced their choices related to food and eating, using a five-point scale (“not at all” – “extremely”). Three items measured scientific information sources/channels: (1) public authorities’ official dietary guidelines, (2) health professionals, and (3) scientific studies. Four items measured commercial information sources/channels: (4) advertisements, (5) information available in grocery stores, (6) food companies and (7) information available in restaurants. The exploratory factor analysis (Maximum Likelihood, Varimax Rotation) indicated that the items loaded into two factors, the factor loadings were above 0.50 on the main factor and each item loaded strongly into only one factor.

Two food choice motives were included in the study: Health and Environment. The items for health were taken from the Eating Motivation Survey (TEMS) (Renner et al., 2012). As TEMS does not include environmental sustainability, three items for measuring this motive were developed for the current study. A seven-point scale was used (“never applies” – “always applies”).

The subjective ability to evaluate information was evaluated with three items focusing on the perceived personal skills needed to assess the validity of food-related information and identify reliable information sources using a five-point scale (“fully disagree” – “fully agree”).

In order to measure the *need for cognition*, a short version of the Need for Cognition Scale (NCS) developed by Cacioppo and Petty (1982) was used. Hevey, Thomas, Pertl, Maher, and Chuinneagain (2012) found a significant method effect associated with positively and negatively worded items, and therefore the scale was shortened further by selecting the nine positively worded items. The respondents evaluated the items using a five-point scale (“extremely uncharacteristic of me” – “extremely characteristic of me”).

Self-reported consumption of red meat and plant-based alternatives. Questions measuring the consumption of red meat and plant-based alternatives were adapted from the Food Frequency Questionnaire (FFQ) that investigates the average use frequencies during the previous 12 months. Short versions of the FFQ have been shown to be valid instruments in previous studies (Andersen, Johansson, & Solvoll, 2002; De Boer & Aiking, 2017). Seven food items were included in the analysis. The meat of (1) ruminants (beef or lamb), (2) pork, and (3) processed meat products were used to measure the consumption of red meat. The consumption of (4) vegetables, (5) beans, lentils and products based on them (e.g., tofu), (6) nuts and seeds, and (7) wholegrain cereal products were used to measure the consumption of plant-based alternatives. There were nine response categories, ranging from “less than once a month or never” to “at least six times a day”.

3. Analysis

The hypotheses were tested with structural equation modelling (SEM) using AMOS version 25.0 (Arbuckle, 2017). SEM is a form of confirmatory factor analysis that is useful for simultaneous testing of multiple sets of associations between variables. The model consists of a measurement model (the associations of the indicators with their designated latent variables) and a structural model (the associations between latent variables). The hypothetical structural model was tested with SEM using the Maximum Likelihood Method because all variables were normally distributed (skewness and kurtosis were between –2 and +2, see George & Mallery, 2010) (Fig. 1). There were no missing

Table 2

The correlation coefficients, means, standard deviations and reliabilities of the main variables (mean scores), and socio-demographic variables.

	Food choices		Information sources		5. Subj. ability to evaluate information	6. Need for cognition	Eating motives	
	1. Red meat	2. Plant-based alternatives	3. Scientific	4. Commer- cial			7. Health	8. Environ- ment
2. Plant-based alternatives	-.26***							
3. Scientific sources	-.08**	.30***						
4. Commercial sources	.04	.08**	.40***					
5. Subj. ability to evaluate information	-.18***	.23***	.18***	-.03				
6. Need for cognition	-.04	.19***	.14***	.08**	.21***			
7. Health	-.22***	.48***	.37***	.14***	.21***	.15***		
8. Environment	-.29**	.34***	.24***	.17***	.21***	.12***	.48***	
9. Gender (female)	-.24***	-.17***	.10***	.11***	.03	-.14***	.17***	.15***
10. Age	.12***	-.03	.05	.02	-.19***	-.04	.02	.01
11. Education: basic	.06*	-.10***	-.05	-.01	-.08**	-.14***	-.09**	-.03
12. Education: vocational	.06*	-.15***	-.12***	-.04	-.15***	-.12***	-.07**	-.03
13. Education: academic	-.10***	.22***	.16***	.05	.21***	.20***	.13***	.05
Range	1–9	1–9	1–5	1–5	1–5	1–5	1–7	1–7
M	3.31	4.33	2.67	2.40	3.11	3.35	4.65	3.92
S.D.	1.24	1.09	.78	.64	.78	.76	1.05	1.18
α	.69	.60	.71	.76	.77	.90	.85	.77

*p < .05; **p < .01; ***p < .001.

data. One of the regression weights for each latent variable was set to 1 (Table 3). The fully independent variables (subjective ability to evaluate information, need for cognition, health motive, environment motive) were allowed to correlate.

The first step in SEM analysis is to look at the goodness-of-fit indices for the measurement model in order to evaluate the discrepancy between observed values and expected values. For continuous data, the RMSEA < .06, TLI > 0.95, CFI > 0.95, and SRMR < 0.08 have been suggested as cut-offs for a good fit (Hu & Bentler, 1999). Indices based on χ^2 were interpreted with caution because with large samples, even small failures in the model may be significant.

The model specified in Fig. 1 was tested. The RMSEA and SRMR indicated that the model exhibited a good fit with the data sample ($\chi^2 = 1534.540$; $df = 441$; $p < .001$; $CFI = 0.929$; $TLI = 0.920$; $RMSEA = 0.044$; $SRMR = 0.051$). The CFI and TLI indices were slightly below the recommended level but above the level 0.90, which Hu and Bentler (1999) regard as acceptable.

4. Results

4.1. Perceived influence of information sources and food choices

The hypothesized associations between the variables were analysed (Fig. 2). The perceived influence of commercial sources was positively associated with the consumption of red meat and negatively with plant-based alternatives. Conversely, the perceived influence of scientific sources was negatively associated with the consumption of red meat and positively with plant-based alternatives. In other words, commercial sources were associated with a meat-based diet (H1) and scientific sources with a plant-based diet (H2) as expected. In addition, scientific and commercial information sources were interrelated as expected (H3).

4.2. The need for cognition and subjective ability to evaluate the quality of information

The need for cognition was positively associated with the subjective ability to evaluate information quality as expected (H4). The need for cognition was not associated with the information sources and therefore Hypothesis 5 was rejected. The subjective ability to evaluate information was positively associated with the perceived influence of

scientific information sources and negatively with the perceived influence of commercial sources as expected (H6).

4.3. Eating motives

The Health and Environment motives were positively associated with each other (H7) as expected. The Environment motive was negatively associated with the consumption of red meat and positively with the consumption of plant-based alternatives as expected (H8). On the other hand, the Health motive was positively associated with the consumption of plant-based alternatives but not with the consumption of red meat, and therefore Hypothesis 8 was only partially confirmed. Moreover, both eating motives were positively associated with the need for cognition as expected (H9).

The Health motive was positively associated with the perceived influence of scientific information sources and negatively with the commercial sources (H10) as expected. In addition, the Environment motive was positively associated with commercial information sources, but was not associated with scientific information sources, and therefore Hypothesis 11 was only partially confirmed.

5. Discussion

The aim of this study was to explore whether consumers of meat-based and plant-based diets attend to scientific and commercial information sources in different ways. The findings suggest that they do: the consumption of red meat was associated with commercial sources, and plant-based alternatives with scientific sources. Similar findings have also been reported in previous studies (Barreiro-Hurlé et al., 2010; Chandon & Wansink, 2012; Hieke et al., 2018; Pope et al., 2015).

Further, the aim was to explore whether attending to scientific information sources was more likely among respondents who had a high need for cognition and a high perceived ability to assess the quality of information about healthy and environmentally sustainable eating. Respondents' subjective ability was positively associated with the perceived influence of scientific sources and negatively with commercial sources, which is also in line with previous findings (Bromme & Goldman, 2014; Miller, 2014; Rothman et al., 2006). The need for cognition was not directly associated with information sources, which was surprising because in previous studies the need for cognition has been associated with an increased use of information (Tsftati & Cappella,

Table 3

The measured variables in the structural equation model, standardized regression coefficients (β) (all coefficients are statistically significant at $p < .001$).

Items	β
<i>Need for cognition</i>	
I would prefer complex to simple problems.	.79
I like to have the responsibility of handling a situation that requires a lot of thinking.*	.80
I find satisfaction in deliberating hard and for long hours.	.74
The idea of relying on thought to make my way to the top appeals to me.	.60
I really enjoy a task that involves coming up with new solutions to problems.	.77
I prefer my life to be filled with puzzles that I must solve.	.66
The notion of thinking abstractly is appealing to me.	.70
I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.	.76
I usually end up deliberating about issues even when they do not affect me personally.	.45
<i>Subjective ability to evaluate information</i>	
It is easy for me to distinguish between valid and invalid information about the healthiness of food choices.	.75
It is easy for me to distinguish between valid and invalid information about the climate impacts of food choices.	.78
It is easy for me to identify reliable and unreliable information sources related to the healthiness and climate-friendliness of food.*	.81
<i>Food choice motive: Environment</i>	
I eat what I eat because I aim to reduce food waste.	.47
I eat what I eat because it has been produced in a way that does not disrupt the balance of nature.	.88
I eat what I eat because it has small climate impacts.	.86
<i>Food choice motive: Health</i>	
I eat what I eat because it keeps me in shape. *	.83
I eat what I eat because it is healthy.	.81
I eat what I eat to maintain a balanced diet.	.81
<i>Scientific sources</i>	
Public authorities' official dietary guidelines *	.79
Scientific studies	.64
Health professionals	.57
<i>Commercial sources</i>	
Information available in restaurants and cafeterias	.61
Information available in grocery stores *	.72
Food companies	.61
Advertisements	.61
<i>Self-reported food choices: red meat</i>	
Beef or lamb	.59
Pork *	.77
Processed meat products	.66
<i>Self-reported food choices: plant-based alternatives</i>	
Vegetables *	.65
Beans, lentils and products based on them (e.g., tofu)	.50
Nuts and seeds	.60
Wholegrain cereal products	.38

Note. * For these items the factor loading has been fixed to 1.

2005; Winter & Krämer, 2012), and this need has been associated with consumers' use of science-based claims more strongly than ability (Hung et al., 2017). Thus the present study extends the current understanding, which is mostly based on studies of consumers' use of one information source, to consumers' use of multiple information sources. The findings suggest that in such a situation the associations between the need for cognition and information sources are indirect via the subjective ability to evaluate information, which appears to be critical in convincing consumers to attend to scientific instead of commercial sources. The implication of this finding for future studies is that if we want to understand how consumers use information to make food choices, it is important to consider multiple information sources at the same time.

The Health motive was positively associated with scientific sources and negatively with commercial sources, which is in line with previous findings about the association between consumers' health motivation and attention to nutrition information on food packages (Visschers et al., 2010). Further, environmental motivation was positively

associated with the perceived influence of commercial sources, which is in line with previous findings about green consumerism and an increased interest in environmental claims in advertisements (Matthes & Wonneberger, 2014). In Finland, the availability and variety of new plant-based alternatives has been increasing rapidly, which makes green advertising an important information source for those who want to adopt a plant-based diet. Environmental motivation was not associated with the perceived influence of scientific sources. One reason for this could be that the Finnish public authorities provide very little information about environmentally friendly food choices for consumers: for example, the national nutrition recommendations still focus exclusively on health promotion (Fischer & Garnett, 2016), so environmentally conscious consumers need to find food-related information from other sources. Moreover, both eating motives were positively associated with the need for cognition, which is similar to other studies that have found that increased information needs have been associated with health-related (Geeroms et al., 2008; Verbeke, 2008; Verbeke & Vackier, 2004) and environmental motives (Matthes & Wonneberger, 2014).

5.1. Limitations of the study

The data used self-reported measures that are often affected by social desirability bias, which is a tendency to respond in socially desirable ways (Chung & Monroe, 2003). For example, individuals with high health and environmental motives potentially underestimated their consumption of red meat and overestimated the consumption of plant-based alternatives. Moreover, the cross-sectional design and SEM enabled the analysis of complex interrelations between multiple variables, but it cannot verify the causal directions between the variables. For example, it could not verify whether eating motives influenced the need for cognition, or vice versa. In addition, scientific and commercial information sources overlap (Van Buul & Brouns, 2015; Aschemann-Witzel, Perez-Cueto, Niedzwiedzka, Verbeke, & Bech-Larsen, 2012) and therefore it was no surprise that the two information sources were strongly associated. However, despite the overlap, the two information sources can be distinguished based on their different aims: the public sector aims at promoting public objectives, while commercial actors aim at promoting products (Fitzgibbon et al., 2007). The association between scientific and commercial sources is likely to be bidirectional, but SEM allows only one-way associations between dependent variables, and hence only the effect of scientific sources on commercial sources was estimated. The model with the effect of commercial sources on scientific sources yielded practically the same results.

The study measured respondents' perceptions of their own ability to evaluate the quality of information, which may be different from their actual ability. Further research is needed to establish the relationship between subjective and objective ability to evaluate information in the context of food. Moreover, this study did not measure the specific information needs of the respondents, the type of influence of the information sources or the perceived content of the information delivered by different sources. More research is needed to address these issues. Finally, the study focused on two eating motives and it is highly likely that there are other relevant eating motives not included in the study. For example, plant-based and meat-based diets have also been associated with taste and animal welfare motives, as well as habits (De Boer, Schöslér, & Aiking, 2017). We do not yet know how these motives are associated with consumers' information needs and information search behaviours, which require further research.

5.2. Implications

Despite these limitations, the findings are useful for those who communicate about the benefits of plant-based diets to diverse audiences. Consumers have different motives and abilities to evaluate information, and they need to be targeted with different messages. In

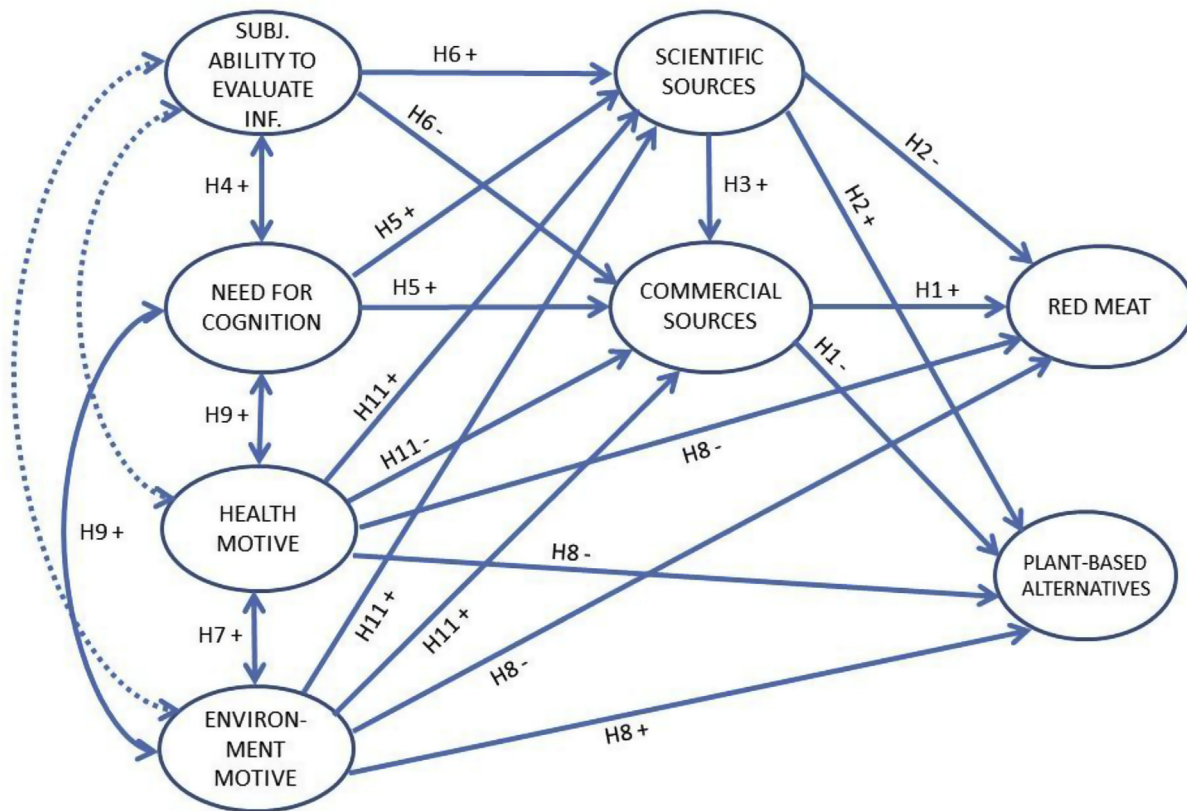


Fig. 1. The hypothetical model. The positive associations between variables are marked with + and the negative associations with -. Independent variables were allowed to correlate (dotted arrows).

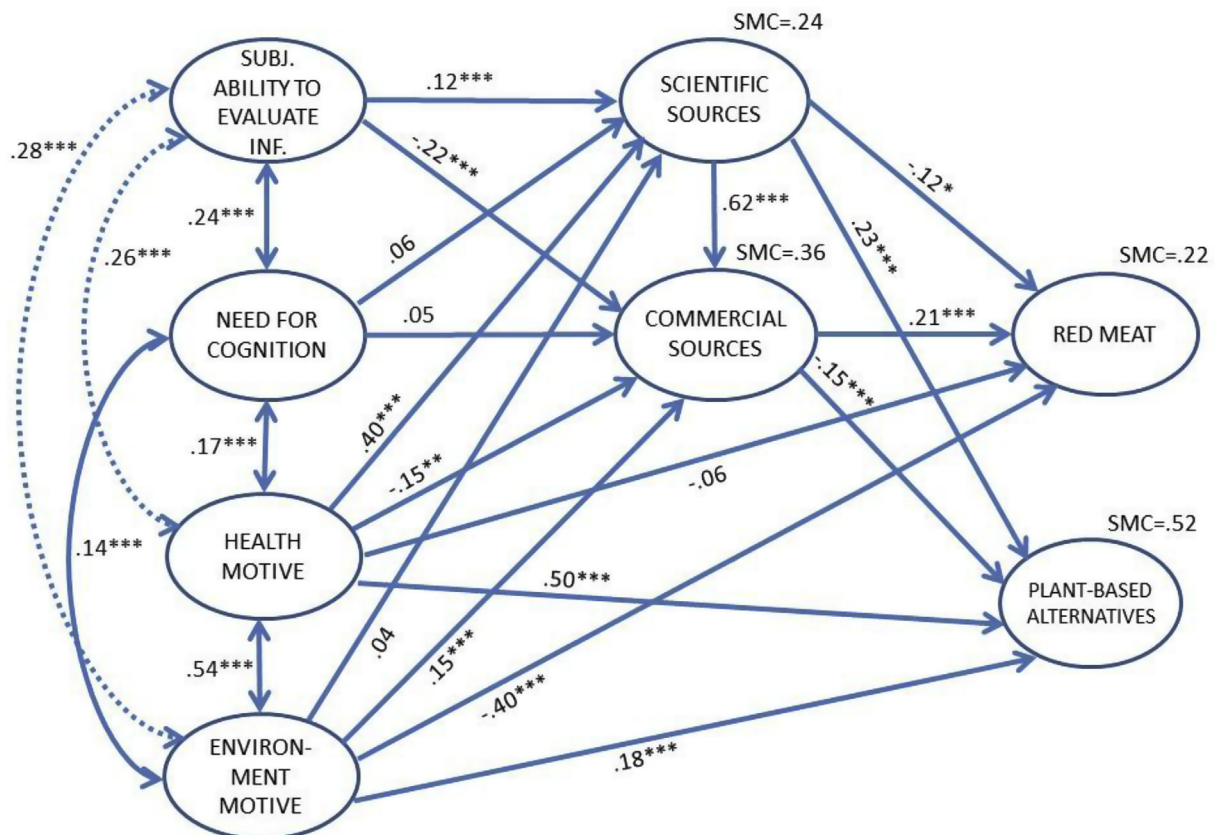


Fig. 2. The results of the structural equation model: Associations between latent variables. Standardized regression coefficients (one-way arrows), correlations (two-way arrows), and squared multiple correlations (SMCs). *p < .05; **p < .01; ***p < .001.

order to convince meat eaters, the messages that promote plant-based diets need to correspond to the eating motives that are important to this group, such as taste and habits (De Boer et al., 2017). At the same time, communicators can avoid references to the negative environmental and health impacts of red meat, which some meat eaters strongly disbelieve (Vainio, Irz, & Hartikainen, 2018). Moreover, the public sector can adopt methods that are successfully used in advertising. For example, individuals with a low need for cognition can be convinced using emotional appeals, well-known celebrities, and by creating a sense of community (Aschemann-Witzel et al., 2012). In addition, consumers' cognitive abilities to evaluate information are heterogeneous and the messages need to be sufficiently clear so that the target group will understand them.

Health-oriented individuals were likely to attend to scientific sources, suggesting that the information provided by the public sector reaches this group relatively well. Alternatively, environmentally concerned individuals' motives were not associated with scientific sources, suggesting that the Finnish public authorities do not sufficiently address the information needs of environmentally conscious consumers. As awareness of the environmental impacts of red meat is still relatively low in Western nations (Lenz, Connelly, Miroso, & Jowett, 2018; Macdiarmid et al., 2016), there is room for the public sector to increase their communication efforts about the environmental impacts of red meat and its more sustainable alternatives. In addition, the health motive was not associated with the consumption of red meat, suggesting that a significant part of the Finnish public is not aware of the negative health impacts of consuming considerable amounts of red meat, which is another message that the public authorities could promote more visibly in their campaigns.

Consumers attend to scientific sources if they have sufficient ability to evaluate the quality of information. Therefore, the public sector needs to train consumers to assess the quality of food-related information. A sceptical attitude towards scientific evidence among some consumers that follow meat-based diets may be explained in part by a low level of ability to evaluate information. In order to strengthen these skills, we need public campaigns that will improve consumers' skills to identify reliable information, separate facts from opinions, as well as demonstrate how science can be useful in their everyday lives, such as making food choices. In other words, in the current situation where there is a plethora of information, providing consumers with more information about the benefits of plant-based diets is not likely to be an effective strategy, but rather providing them with instructions on how to deal with existing information effectively.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2019.03.017>.

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