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Motivations for Sustainable Consumption: The Case of Vegetables

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ABSTRACT

According to the World Health Organization a diet high in vegetables may reduce the risk of coronary heart diseases, stroke, and certain types of cancer. In addition, vegetables have lower carbon footprints than most other foods. The main objective in this paper is to find drivers behind vegetable consumption, with emphasis on health and environmental motivation. We used the theory of planned behavior together with direct acyclic graphs as a theoretical basis. The empirical analysis applied the graded response model and bounded beta regression with survey data from 2019. The main results show that health attitude is a stronger motivator for vegetable consumption than environmental attitudes.

***Keywords**: Vegetables; attitudes; personality; theory of planned behavior; beta regression; directed acyclic graphs; graded response model.*

1 Introduction

The food and agriculture organization of the United Nations defines a sustainable diet as: “those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.” (FAO, 2016). The consumption of most vegetables is connected to low greenhouse gas emission and use of land (Mertens et al, 2019; Rose et al, 2019). It means that from a sustainable point of view it is recommended that a large part of a sustainable diet is vegetables. In addition, according to the World Health Organization a diet high in vegetables may reduce the risk of coronary heart diseases, stroke, and certain types of cancer (WHO, 2019).

But what is the most important motivation to consume vegetables? Is it health or is it climate and the environment? The objective in this paper is to find drivers behind vegetable consumption, with emphasis on health and environmental motivation.

To find out more about the link between vegetable consumption and the drivers behind it, our point of departure is the theory of planned behavior (TPB). This is a psychologically theory proposed by Ajzen (1985) to link individual’s beliefs, attitudes, intentions to their actions. To find out how the different items in the TPB should be related in an empirical framework we applied the causal framework proposed by Pearl (1995). This taxonomy is based on a combination of Direct Acyclic Graphs (DAGs) and causal calculus. Using Pearls methods we will be able to identify confounding variables and variables blocking the effects of causal relations.

We assume that an individual’s personality may affect both environmental attitudes, health attitudes, and vegetable consumption. Including empirical measures of personality traits may therefore avoid confounding bias and give more precise effects of environmental and health attitudes on vegetable consumption.

We used the graded response model (GRM) to construct latent variables to represent measures of environment and health attitudes and personality traits. These latent variables are then included in models linking personality and attitudes with frequency of vegetable consumption. To account for differences between individuals who consume vegetables with low, medium and high frequency we constructed a bounded beta regression model together with attitude variables and other predictors as age, gender, income, place of living, social status, and education. We applied the model to test for differences in frequencies of vegetable consumption for individuals with little and high degree of environmental consciousness, and little and high degree of health consciousness.

In the next section the theory of planned behavior is presented. After that we present Pearl’s causal taxonomy described in Pearl et al (2016) which is based on DAGs and causal calculus. Next, we construct a model connecting the frequency of vegetable consumption and health and environmental attitudes on TPB and DAGs. Next, data from the Norwegian Monitor database is presented and the empirical methods are described. After that the model is estimated and the results are presented, statistical tests are performed and discussed, and finally the paper concludes.

2 The Theory of Planned Behavior

The theory of planned behavior (TPB) proposed by Ajzen (1985) is a psychological theory that is used to understand behavior based on intentions. Intentions are determined by three factors: Attitudes towards the behaviors, subjective norms, and perceived behavior controls. The attitudes reflect the positive and negative evaluation of a specific behavior by an individual. Subjective norms relate to the perceived social pressure about engaging in a certain behavior. Perceived behavioral control has to do with factors that may influence the ability to perform the behavior, as time, money, and abilities. Attitudes toward a behavior is related to the consequences of the behavior, or behavioral belief (Ajzen, 2005)with. Likewise, normative beliefs are related to subjective norms, or a person’s belief that certain persons or groups will approve or disapprove the behavior. Perceived behavior control is linked to the belief about in what way the presence or absence of factors that facilitate or impede the performance of the behavior. Figure 1 shows TPB as it is presented in Ajzen (2005).

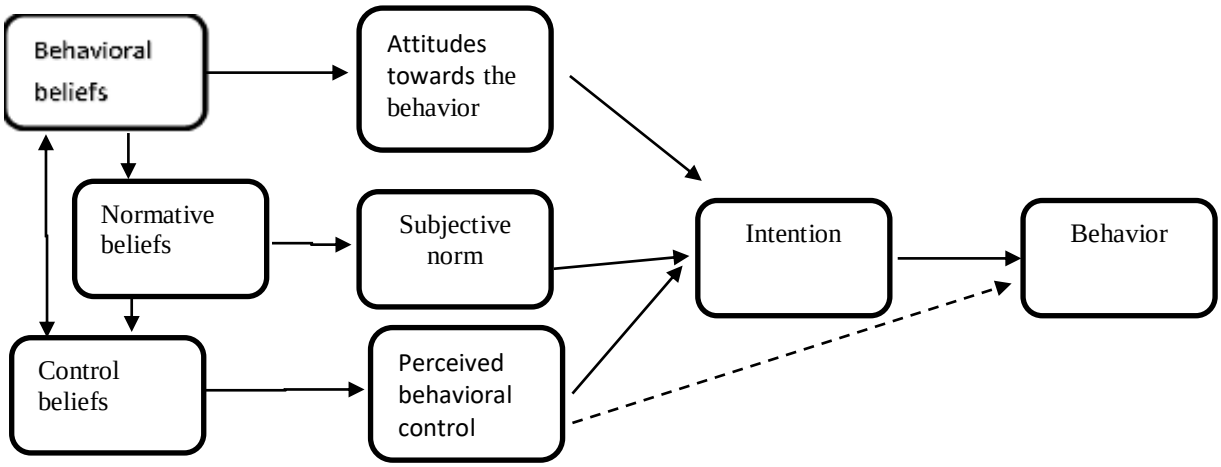

Figure 1. The theory of planned behavior. Source: Ajzen (2005).

3 Graphical causal models and observational data

Pearl (1995) developed methods to use directed acyclic graphs (DAGs) to provide causal inference in observational data. These methods are described in Pearl et al. (2016) and Pearl and Mackenzie (2018). A good introduction to these methods in psychology is described in Rohrer (2018). A DAG consists of two basic building blocks: nodes and edges with arrows. The nodes can be transferred into variables and the relation between two nodes are described by an edge with an arrow pointing in one direction. Various paths can be traced by travelling along arrows, from node to node. These paths can be broken down to three basic structures: Chains, forks, and colliders, each consisting of three nodes and two edges. Chains have the structure A→B→C, i.e. A affects B, and B affects C. Relating to figure 1, that means that subjective norms affects intentions which affects behavior. Intention is a mediator between subjective norms and behavior. The second basic structure is Fork: A←B→C, i.e., B affects A and B affects C. Relating to figure 1, we see that perceived behavioral control affects both intentions and behavior. The last basic structure is collider: A→B←C, i.e, B is affected by both A and C. In figure 1, intention is affected by attitudes towards the behavior and subjective norm (and perceived behavioral control). The path attitudes towards the behavior→intention←subjective norm is therefore a collider.

Pearl (2016) used these structures together with causal calculus on DAGs to construct his causal framework. With observational data this translates to how to take account of confounding. This is done by the back-door criterion which states which variables to take account of and which to be excluded. All the backdoors between the variables of interests and the outcome should be closed. Translated to statistical modelling this says that the model should include forks between our main variables of interests and the outcome variables. These forks act as confounders and bias the effects of our variables of interest on the outcome. The back-door criterion also implies that we should not include colliders or mediators (in a chain) in the path going from our variable of interest to the outcome variable. Including such variables will block the path from the variables of interest to the outcome, and thereby bias the effects. In addition, including variables that affect our variables of interest but are not part of a back-door path should be ignored. Related to figure 1, that means that the belief variables which affect our variables of interest: Attitudes toward the behavior, subjective norms, and perceived behavioral control, should not be included in a statistical model. More about bad and good controls in statistical models is found in Cinelly, Forney and Pearl (2019).

4 Personality

An individual's personality defines how he or she relates to other individuals and to the surroundings. The personality traits are thought to be relatively stable from the age of 30 (McCrae and Costa, 2003). The Big Five taxonomy assumes that personality may be described by five broad traits: Extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience. Extraversion is the

tendency to be talkative and sociable, agreeableness is associated with compassion and trust, conscientiousness is the tendency to be organized and working hard to achieve goals, emotional stability is about psychological stress, and openness to experience is about creativity, curiosity and preference for variety. These traits are latent but may be revealed by a questionnaire and statistical modelling. The big five personality model has been linked to both attitudes and food consumption. Hirsh (2010) and Hirsh (2014) found that higher levels of agreeableness and higher level of openness to experience were linked to higher levels of environmental concern. Milfont and Sibley (2012) found that agreeableness, conscientiousness, and openness top experience were linked to environmental engagement. Mendolia and Walker (2014) found noncognive traits as locus of control, self-esteem and work ethics have effects of health behavior. Regarding food consumption, Gustavsen and Hegnes (2020[a]) revealed that openness to experience were positively related and extraversion was negatively related to the consumption of organic foods in Norway. In addition, individuals high in conscientiousness have lower willingness to pay for organic foods. Openness to experience was also one of the most important predictors for consumption of local food specialties in Gustavsen and Hegnes (2020[b]). Pfeiler and Egloff (2018) analyzed the differences between German vegetarians and meat eaters and found that individuals high in openness to experience have a higher probability to be vegetarian, while individuals high in conscientiousness have a higher probability to be a meat eater.

5 Modelling the effects of attitudes on vegetable consumption

Our main interest is to find out how vegetable consumption is connected to environmental and health attitudes. To do that we focus on the TPB while taking Pearls theory of causal DAGs into account. Related to figure 1, the belief boxes on left side should not be included in the model. They are just parents to attitudes towards the behavior, subjective norm, and perceived behavior control and not connected to any back-door path. As attitudes towards the behavior we create variables for environmental attitudes, environmental worries, and environmental actions. In addition, we create a variable for health attitudes. Subjective norm refers to how friends and family and other important persons approve or disapprove the behavior. Our data sample doesn't contain any direct measure of this attitude but as a proxy we include a variable referring to the individual's relation to family and friends. Perceived behavior control is included in the model as household income, education, and social status. In addition, we also include other covariates that potentially have effects on vegetable consumption as age, gender, and a variable indicating if the individual is living in one of Norway's four biggest cities. In addition, a variable indicating if taste is important for the food choice is included in the model. The box named intention in figure 1 is a mediator between the different attitudes and the behavior, and according to Pearl (2016) this mediator variable should be excluded. If included, it will make the different attitudes and behavior independent, and hence block the path between them. Our behavior variable is the frequency of vegetable consumption. To take account of possible confounding between attitudes and vegetable consumption, and to block the backdoor between these variables we include variables for the Big Five personality traits. Our model is presented in figure 2.

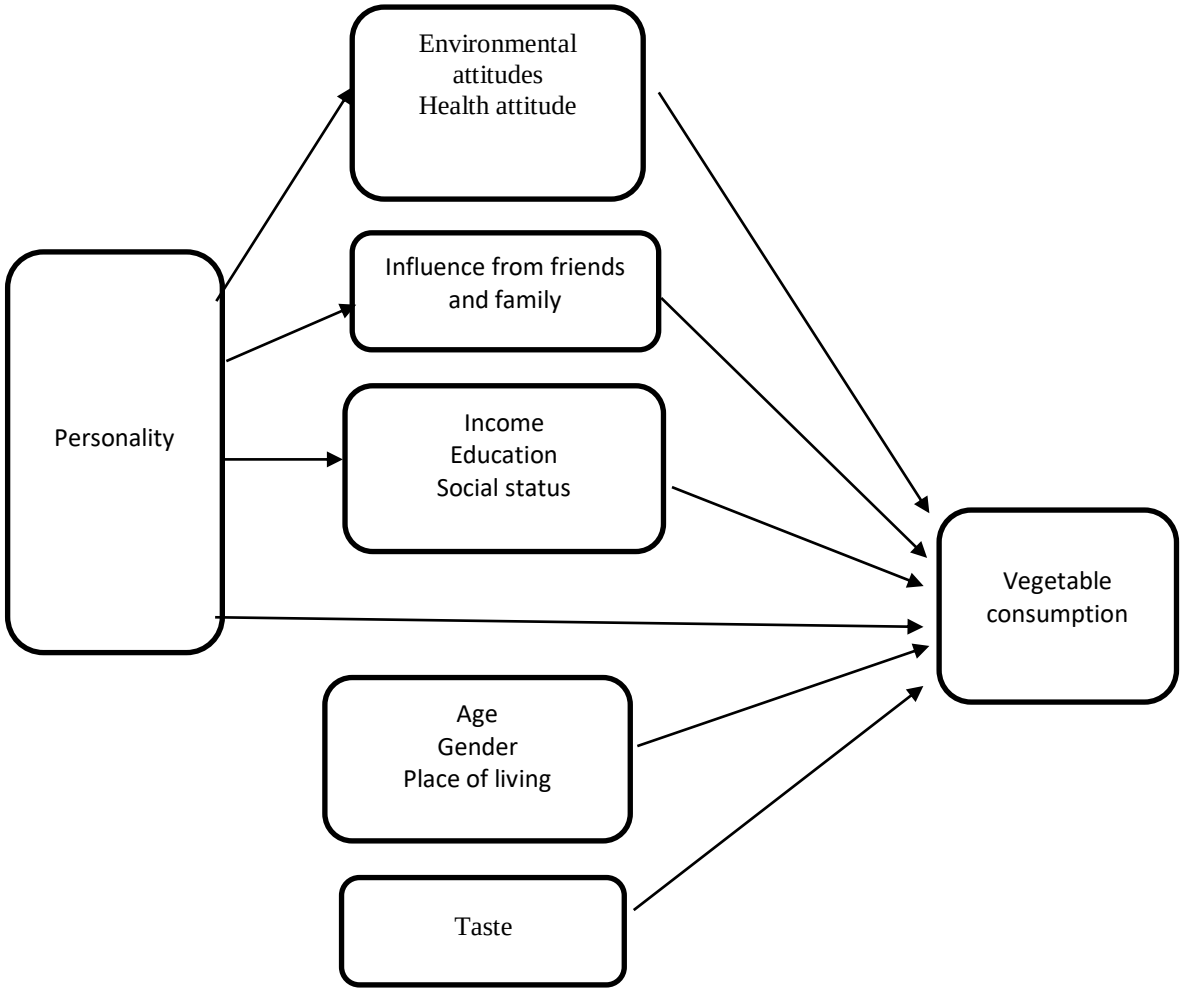

Figure 2. The model for vegetable consumption

Figure 2 is the basis for our empirical model. Vegetable prices affect vegetable consumption. But our model is based on a survey at one point in time (October 2020) where prices are approximately constant. So vegetable prices are redundant.

6 Data

We analyzed the frequency of consumption of vegetables using the Norwegian Monitor (NM) survey. This survey is a nationally representative cross-sectional survey of adults that has been repeated every second year since 1985. In each survey, 3,000-4,000 respondents answer questions about food consumption, health, time use, and preferences. Our data is from 2019.

Our basis for the outcome variable is survey participants answer to one question: (i) How often do you eat vegetables? The respondents checked one of the following responses: 4 times a day, 3 times a day, 2 times a day, 1 time per day, 5-6 times a week, 3-4 times a week, 1-2 times per week, 2-3 times per month, less than once a month or never. Table 1 shows the frequency and the relative frequency of vegetable eating in the NM database in 2019. Table 1 shows that 1768 individuals, or about 50 % of the sample eat vegetables at least once a day. About 2 percent eat vegetables less than once a week.

Table 1.
Frequencies and percentages of vegetable consumption

	4 day	3 day	2 day	1 Day	5-6 week	3-4 week	1-2 week	2-3 month	1 month	Seldom/ never	N
#	45	135	497	1091	793	670	237	50	21	10	3622
%	1.3	3.8	14.0	30.7	22.3	18.9	6.7	1.4	0.6	0.3	

Our personality variables are based the Big Five taxonomy. Included in the NM survey there are 20 questions regarding the personality factors extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience. These questions are the 20-item Norwegian version of the Big Five developed by Engvik and Clausen (2011) and they are described in Gustavsen and Hegnes (2020[a], 2020[b]).

We created indexes for three different environmental attitudes: The first index is named Environmental Attitude and is based on four questions. The individuals tick one of the boxes totally agree, somewhat agree, somewhat disagree and totally disagree on the following statements: "It matters to me what I can do to protect the environment and the natural resources" ; "I support environmental organizations"; "I don't buy products from producers that pollute the environment"; "The climate changes are by and large man- made".

The second environmental index, which is called Environmental Worries, is based on 11 questions. The participants tick one of the boxes very worried, somewhat worried, a little worried, or not worried at all based on the questions: How worried are you about the following environmental problems: "Greenhouse effect and climate change"; "Decomposition of the ozone layer"; "Acid deposits"; "Development of waterways and mountain regions"; "Dismantling of farmland"; "Clogging of cultivated landscape"; "Extinction of animal and plant species"; "Loss of cultural monuments"; "Global warming"; "Environmental poison in products that you use"; "Air quality in cities and urban areas".

The third environmental index, called Environmental Actions, is based on the question: How often have you done the following because you wanted to take care of the environment? The participants tick one of the boxes often, now and then, seldom or never, and not relevant on each of the following: "Used public transportation even if you could have used car"; "Deliver special category waste or electronic waste to specialty waste storage"; "Reduced the consumption of electricity"; "Purchased commodities labelled "Good for the environment"; "Used a bike or walked instead of using car".

The health attitude index is created based on: Do you agree or disagree on the following assertions: "I am always concerned about living healthy and keeping in good physical shape"; "I am more concerned about the taste of the food than how healthy it is".

The frequency of respondence on each of these questions regarding environment and health can be found in Gustavsen (2020).

In addition, also included in the model, is a variable for taste/hedonism: "It is more important to me that the food tastes good than how healthy it is"; "I am more interested in the taste of the food than how it looks"; "I would rather use my money on things that give me long time pleasure than short time pleasure as vacation, eating at restaurants etc. ". The individuals tick one of the boxes totally agree, somewhat agree, somewhat disagree, totally disagree, and impossible to answer.

Table 2 shows the other variables in the model. The variable representing Influence from friends and family is a dummy variable based on the question: How satisfied are you with your relationship with your closest (friends and family). Used here is a 5-point scale from very happy to very unhappy. Our variable takes the value 1 if the respondent answered very happy, and 0 otherwise.

The average household income in the data is 569 000 NOK, 59% of the individuals have a university degree, 62% are married or cohabit, the mean age is 46.3 years old, 50% are women, and 22% live in one of Norway's 4 biggest cities. Before being used in the estimation, the continuous variables age and income are standardized, i.e., the mean is withdrawn, and the new variable is divided by the standard deviation.

Table 2.
The socioeconomic predictors used in the model

Predictor	Explication	Mean	sd
Friends and family	=1 if the individual thinks the relationship with friends and family is very good, 0 otherwise.	0.38	0.49
Income	= household income in 2015 (in 1000 NOK)	569	301
Education	=1 if 3 years or more of university education, 0 otherwise	0.59	0.49
Married	=1 if married or cohabit, 0 otherwise	0.62	0.49
Age	Age of the individual, in years	46.28	18.28
Woman	= 1 if woman, 0 otherwise	0.50	0.50
wm	= 1 if woman and married (interaction term)	0.31	0.46
BCity	=1 if place of living is one of the 4 largest cities in Norway: Oslo, Bergen, Trondheim, Stavanger	0.22	0.42

The sample consists of individuals from 15-96 years of age. *n*=3981

7 Methods

To construct latent variables for the individuals' personality, attitudes toward the environment, environmental worries, environmental action, health attitudes, and taste we make use of the graded response model (GRM). The latent variables are then incorporated into a bounded beta regression model together with other predictors. But the beta distribution is a continuous probability distribution and our variables are frequencies registered in intervals. To solve this, for each individual, we draw from the uniform distribution within the relevant interval. The beta regression model is then estimated 500 times in bootstrap repetitions with new draws within the relevant frequency interval each time.

7.1 The graded response model

The graded response model was suggested by Samejima (1969). It is defined as:

$$P(y_i = k \mid \theta) = P(y_i \geq k \mid \theta) - P(y_i \geq k+1 \mid \theta) = \frac{\exp(\alpha_i(\theta - \beta_{ik})}{1+\exp(\alpha_i(\theta - \beta_{ik})} - \frac{\exp(\alpha_i(\theta - \beta_{i,k+1})}{1+\exp(\alpha_i(\theta - \beta_{i,k+1})}, \quad k = 1,2,.,K, \qquad (1)$$

which for question i is the probability to choose the response *k* from *K* possible choices, where *K* = 7 when constructing variables for each of the personality traits (7-point Likert scale), *K*=4 for environmental attitude, environmental worries, health attitude, and taste. *K*=3 for environmental action. Our aim is to find θ for each individual. θ is the latent variable that describes the position of the individual on the scale from the lowest to highest. These latent variables are then included in the bounded beta regression model. In addition to the latent variables, the predictors in Table 2 are included in the models.

7.2 The bounded beta regression model

The beta distribution for a continuous variable *q* is a two- parameter distribution within the range of (0,1). We can think of this as a relative frequency of vegetable eating. Assuming that the frequency of vegetable consumption, *q*, is beta distributed, i.e.

$$f(q|a,b) = \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)} q^{a-1}(1-q)^{b-1}, 0 < q < 1 \qquad (2)$$

where $\Gamma(\ )$ is the gamma function, and a and b are parameters.

To be able to include covariates the beta distribution is reparametrized as in Ferrari and Cribari-Neto (2004). But we also must include individuals who eat vegetables at the censoring point, i.e., the individuals bounded at q=1, which in our case means 4 times per day. This is done by including the

probabilities of eating vegetables 4 times per day in the likelihood function. Assuming the same covariates in the three parts, the whole conditional distribution then becomes:

$$f(q|x) = \begin{cases} P_1(x) & if \quad q = 1 \\ f(x) & if \quad 0 < q < 1 \end{cases} \tag{3}$$

where $f(x)$ in our case is the Beta distribution. The likelihood function will then be based on

$$\big(1 - P_1(q = 1|x)\big) f(q|x) \tag{4}$$

8 Estimation results

First, we used the GRM to construct the latent variables for environmental attitudes, environmental worries, environmental action, health attitudes, taste, and personality. The command grm is included in the ltm package (Rizopoulos, 2006) of the statistical software, R. The constructed latent variables have a shape close to the normal with the midpoint at approximately 0 and with most of the probability mass between -2 and 2. These variables are included in the beta regression model together with the predictors in table 2 to estimate the frequency of vegetable consumption.

To construct the dependent variable, monthly frequency of vegetable consumption, we started out with the data shown in table 1. The alternative "4 times a day" was set to 120, "3 times a day" is set to the interval (75, 119.999), twice a day is set to the interval (45, 75), and so on. The variables below 4 times a day are set to the interval containing the midpoint between the variable above and the variable below. The variable seldom/never is set to (0.0001, 0.5). Then, within each interval and for each respondent, we drew the frequency from a uniform distribution with the limits of the intervals used as the limits of each distribution. Dividing all these frequencies by 120, we obtained the beta distribution, bounded in 1.

The model may then be estimated with the R package GAMLSS (Stasinopoulos et al, 2015), where the probabilities are included as odds ratios with log link functions to include covariates in the likelihood function (Stasinopoulos et al., 2017). We bootstrap the model to find the beta regression parameters, the standard deviations and to construct tests for the differences in vegetable eating between individuals with different degrees of health and environmental attitudes. The estimated parameters are shown in table 3.

Table 3 shows the estimated parameters in the beta distribution part of the model, *BE*(0,1), and the part bounded in 1, O_1, (4 times a day). The bounded part is included as an odds ratio, the odds of eating vegetables 4 times a day. Looking at the beta part of the model, i.e., individuals that eat vegetables less than 4 times a day, the environmental attitude index, the environmental action index, and the health attitude index are all significantly different from 0, and the health attitude parameter is about twice the size of environmental indexes. But the index for environmental worries is not significantly different from 0. Further, higher income people eat vegetables more often than lower income people, university educated individuals eat vegetables more often than individuals without university education, married people eat vegetables more often than singles, *ceteris paribus*. Further, older individuals eat less often vegetables than younger individuals, and women eat vegetables more often than men. Individuals living in one of Norway's four biggest cities consume vegetables more often than individuals living in other parts of Norway. Except for conscientiousness, the personality traits do not have effects on vegetable consumption. This is not surprising. The attitude variables function as mediators between personality and vegetable consumption, and hence block these indirect effects. For the odds ratio part of the model, just the intercept, the health attitude and the personality trait extraversion are significantly different from 0. It means that the individuals high in health attitude have a higher probability of consuming vegetables 4 times a day than individuals with lower score on the health attitude index.

Table 3.
Estimated parameters in the Beta regression models for vegetables

		BE(0,1)		O_1	
Explanation	**Variable name**	**Coef**	**Sd**	**Coef**	**Sd**
Intercept	Int	–1.29*	0.04	–5.18*	0.86
Attitudes towards the behavior					
Environmental attitude	*Eatt*	0.09*	0.02	0.29	0.29
Environmental worries	*Ewor*	0.01	0.02	0.33	0.22
Environmental action	*Eact*	0.08*	0.02	0.26	0.30
Health attitude	*Hatt*	0.19*	0.02	0.69*	0.29
Subjective norms					
Relation to family and friends	*Rel*	0.05	0.03	-0.20	0.36
Perceived behavioral control					
Household income per consumer unit	*Inc*	0.04*	0.02	–0.20	0.18
University education	*Univ*	0.09*	0.03	- 0.25	0.37
Married	*M*	0.19*	0.04	0.15	0.88
Other covariates					
The age of the individual	*Age*	–0.04*	0.02	0.14	0.18
Woman	*W*	0.30*	0.05	0.34	0.89
Woman and Married	*W·M*	-0.10	0.06	0.06	0.99
Big City (Oslo, Bergen Trondheim, Stavanger)	*BCity*	0.11*	0.04	–0.11	0.43
Taste	*Taste*	-0.02	0.02	0.26	0.23
Personalities					
Extraversion	*Ex*	0.04	0.02	0.06*	0.02
Agreeableness	*Ag*	0.00	0.02	-0.47	0.26
Conscientiousness	*Con*	-0.04*	0.02	0.46	0.25
Emotional stability	*Es*	0.00	0.02	-0.19	0.19
Openness to experience	*Oe*	0.03	0.02	0.34	0.18

Note: Standard deviations in parentheses. The numbers marked with asterisk are significantly different from zero at 5% level.

9 What works best? Is it health attitude or environmental attitude?

To capture the quantitative connection between environmental attitude, environmental worries, environmental action, health attitudes and the frequency of vegetable eating we constructed expected frequencies and standard deviations from the bootstrap samples to perform tests for differences in the tails of the distributions. To find the expected consumption frequency first we calculated the conditional odds ratios from their link functions, then the conditional probabilities were found from the odds ratio. Finally, the conditional expected frequencies were found as

$$E(q|x) = ((1 - \hat{P}_1)\hat{\mu} + \hat{P}_1) \cdot 120 \tag{5}$$

where $\hat{P}_1$ is the predicted probability of eating vegetables 4 times (or more often) per day calculated from the conditional odds ratio, and $\hat{\mu}$ is the conditional predicted frequency in the (0,1) interval, given that the individual eats vegetables less than 4 times per day.

The conditional expected frequency evaluated at the 90th quantile and the conditional expected frequency evaluated at the 10th quantile of each of the latent attitude variables were used. When constructing the frequencies all the other attitude variables and other predictors were fixed at their means. From the bootstrapped differences in frequencies, we constructed the average differences and their respective *t*-statistics. The *t*-statistics could then be used to test the following hypotheses:

H1: There is no difference in expected frequency of vegetable consumption between individuals high in environmental attitude and individuals low in environmental attitude.

H2: There is no difference in expected frequency of vegetable consumption between individuals high in environmental worries and individuals low in environmental worries.

H3: There is no difference in expected frequency of vegetable consumption between individuals high in environmental action and individuals low in environmental action.

H4: There is no difference in expected frequency of vegetable consumption between individuals high in health attitude and individuals low in health attitude.

The significant effects at the 5% level when $|t| > 1.96$ are marked with an asterisk. The results are shown in Table 4.

Table 4.

The difference in expected frequency of monthly vegetable consumption between individuals high (90 quantile) and low (10 quantile) in attitudes toward environment and health

	90 quantile	10 quantile	Difference
Environmental Attitude	36.71*	31.48*	5.23*
	(0.88)	(0.75)	(1.39)
Environmental Worries	34.37*	33.39*	0.98
	(0.77)	(0.70)	(1.19)
Environmental Action	36.01*	31.73*	4.27*
	(0.77)	(0.71)	(1.22)
Health Attitude	38.57*	29.82*	8.75*
	(0.72)	(0.59)	(0.99)

[a] Standard deviation in parentheses. The numbers marked with asterisks are significantly different from zero at 5% level.

Table 4 shows the expected monthly frequencies of vegetable consumption evaluated at the 90 quantile and the 10 quantile of the attitudinal variables and their differences. All the frequencies are evaluated at the mean of all the other predictors. We see from table 4 that H1, H2, and H4 are rejected when *t*-tests are performed. Individuals high in environmental attitude have a higher frequency of vegetable consumption than individuals low in environmental attitude. Also, individuals high in environmental action have a higher frequency of vegetable consumption than individuals low in environmental action. Regarding health attitude, individuals more concerned about their health consume vegetables more often than individuals not concerned about their health. Finally, there is no difference between individuals high in environmental worries and individuals low in environmental worries. Evidently, the results in table 4 indicates that health attitude is a larger motivator, or driver for vegetable consumption than environmental attitudes or behavior.

10 Discussion and Conclusion

A sustainable diet is a diet which is good for the health and does not harm the environment. A lot of research recommends a diet high in vegetables both for health reasons and for environmental reasons. It means that both environmental concerns and health concerns are potential drivers for vegetable consumption.

In this paper a model for vegetable consumption based on TPB and causal DAGs is developed and estimated. Latent variables for personality traits are used to take account of possible confounding between attitudes and vegetable consumption. In addition, if there exist other confounders between for example health attitude and vegetable consumption, the personality variables may also block these other

backdoor paths. However, this is dependent upon the relation between the excluded confounders and the personality. If there is no relation between the excluded confounders and the individual's personality the excluded confounders will bias the results.

In this paper four different latent variables indicating environmental attitude, environmental worries, environmental action, and health attitudes are constructed and included in an econometric model for frequency of vegetable consumption. The model is estimated and tests concerning environment and vegetable consumption, and health and vegetable consumption are compared.

The tests indicate that health attitude is a stronger motivator for vegetable consumption than environmental attitude, environmental worries and environmental action. What is the implication of these findings? One of the implications is that to increase the frequency of vegetable consumption it is more efficient to emphasize health than to emphasize environment. Another implication is that if environmental information is used to increase vegetable consumption, environmental worries should not be highlighted.

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