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Appetite, 98, 19-27

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**Post-print, accepted by Appetite, December 1, 2015**

# Help the climate, change your diet: A cross-sectional study on how to involve consumers in a transition to a low-carbon society

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To cite this article:

de Boer, J., de Witt, A., & Aiking, H. (2016). Help the climate, change your diet: A cross-sectional study on how to involve consumers in a transition to a low-carbon society. *Appetite, 98,* 19-27.

doi: 10.1016/j.appet.2015.12.001.

To link to this article:

http://dx.doi.org/10.1016/j.appet.2015.12.001

Abstract

This paper explores how the transition to a low-carbon society to mitigate climate change can be better supported by a diet change. As climate mitigation is not the focal goal of consumers who are buying or consuming food, the study highlighted the role of motivational and cognitive background factors, including possible spillover effects. Consumer samples in the Netherlands (n = 527) and the United States (n = 556) were asked to evaluate food-related and energy-related mitigation options in a design that included three food-related options with very different mitigation potentials (i.e. eating less meat, buying local and seasonal food, and buying organic food). They rated each option's effectiveness and their willingness to adopt it. The outstanding effectiveness of the less meat option (as established by climate experts) was recognized by merely 12% of the Dutch and 6% of the American sample. Many more participants gave fairly positive effectiveness ratings and this was correlated with belief in human causation of climate change, personal importance of climate change, and being a moderate meat eater. Willingness to adopt the less meat option increased with its perceived effectiveness and, controlling for that, it was significantly related to various motivationally relevant factors. The local food option appealed to consumer segments with overlapping but partly different motivational orientations. It was concluded that a transition to a low carbon society can significantly benefit from a special focus on the food-related options to involve more consumers and to improve mitigation.

*Keywords*

Climate change, mitigation, consumers, meat eating, local and seasonal food

Highlights

- Cross-sectional study on consumers' interest in adopting climate-friendly food
- Focused on three food-related options with very different mitigation potentials
- Consumers rated each option's effectiveness and their willingness to adopt it
- Outstanding effectiveness of eating less meat was recognized by few consumers only
- Eating less meat and buying local food appealed to partly different consumer segments

## Introduction

Experts and policy-makers increasingly agree that in order to mitigate climate change a transition is required to achieve a low-carbon society, with patterns of consumption that are consistent with low levels of greenhouse gas (GHG) emissions, and that extremely valuable results can be achieved through changes in the Western diet (see Carlsson-Kanyama & González, 2011; Hedenus, Wirsenius, & Johansson, 2014; Hoolohan, Berners-Lee, McKinstry-West, & Hewitt, 2013; Popp, Lotze-Campen, & Bodirsky, 2011; Stehfest et al., 2009; Westhoek et al., 2014). For instance, Stehfest et al. (2009) estimate that a global transition toward low-meat diets may reduce the costs of climate change mitigation by as much as 50% in 2050. This may be challenging news for countries whose per capita meat consumption was almost twice (the Netherlands, 73 kg) or three times (the United States, 118 kg) the global average (42 kg) in the year 2011 (FAO, 2015)— if a diet change has such a large mitigation effect, there is a world to be won. However, research has shown that consumers often underestimate the impacts of meat consumption on the environment, in general (Lea & Worsley, 2008; Tobler, Visschers, & Siegrist, 2011), and on climate change, in particular (Bostrom et al., 2012; Skamp, Boyes, & Stanisstreet, 2013; Truelove & Parks, 2012; Vanhonacker, Van Loo, Gellynck, & Verbeke, 2013). Hence, an important question is whether the transition to a low-carbon society requires a special focus on food-related options for consumers, such as eating less meat and more seasonal food, as compared to energy-related options, such as using energy saving light bulbs. The present paper aims to address this question by presenting an empirical study of how consumers evaluate different food-related and energy-related mitigation options, their willingness to adopt the most effective options, and the

relationship between willingness and strategically relevant factors. The study is based on nation-wide consumer surveys in the Netherlands (NL) and the United States (US), two countries similar in some ways—they were the world's top exporters of food in 2011 (FAO, 2014, p. 10)—yet different enough to provide further insights into the generalizability of the results.

The comparison of food-related and energy-related mitigation options has several important strategic aspects. The first is that climate mitigation (or energy saving) is not the focal goal of consumers who are buying or consuming food. The notion that it is meaningful to distinguish between focal and background goals is a key theme of goal systems theory (Kruglanski et al., 2002; Kopetz, Kruglanski, Arens, Etkin, & Johnson, 2012). Consumers do not only have one or more activated focal goals (e.g. eating tasty), but also various background goals, often linked to broader themes, such as cost and time minimization, which affect their choices and actions (e.g. eating quick). In the same way, consumers may be sensitive to the background goal of reducing the impacts of their food choices on the natural environment, as revealed by preferences for organic products (Mondelaers, Verbeke, & Van Huylenbroeck, 2009; Hughner, McDonagh, Prothero, Shultz, & Stanton, 2007). A typical feature of goals related to the environment is that they are often associated with holistic representations and processes, based on a sense of connection with nature and all life forms (Davis, Green, & Reed, 2009; Hedlund-de Witt, de Boer, & Boersema, 2014). Importantly, the broad environmental theme may include various kinds of beliefs that appear to affect people’s judgment of climate mitigation effectiveness, such as general beliefs on environmental harm and carbon emissions-

specific beliefs (Bostrom et al., 2012). These motivational and cognitive background factors may work out differently for different mitigation options.

Consumer evaluations of strategically chosen mitigation options can provide further insights into the role of effectiveness perceptions for a diet change. In determining the options, it is important to take into account that the size and composition of household carbon footprints differ substantially by location, income, and household size. Calculations for the US show that the composition of household carbon footprints varies considerably between different household types, with “food” comprising 10-30% , “housing” 15-30%; and “transportation” 20-40% of the household’s total emissions (Jones & Kammen, 2011). For this study, we focused on evaluations of broad-based, food-related options with very different mitigation potentials. The options chosen were (1) reduce meat consumption (hereafter called *the less meat option*), (2) avoid food transported by air-freight or hot-housed food and shift to seasonal fruits and vegetables in stead (*the local food option*), and (3) increase the content of organic products in a diet (*the organic food option*). The different mitigation potentials of these options have recently been demonstrated in the United Kingdom; it was calculated that eliminating meat from the diet reduces food-related GHG emissions by 35% and that avoiding hot-housed food or food air-freighted to the UK reduces emissions by 5% (Hoolohan et al., 2013). Judged purely in terms of mitigating climate change, the organic food option is not recommended (Heerwagen, Andersen, Christensen, & Sandøe, 2014). As noted by Saxe (2014), the organic food option can have climate-related advantages and disadvantages, depending on the products involved (e.g. organic bread has an advantage, organic

chicken has a disadvantage). A strategically important point to note is that the option may be attractive to "green" consumers.

Another point to take into account is that consumer evaluations of food-related and energy-related mitigation options may be based on different kinds of beliefs. As a result of the many energy-related campaigns in the past decades (Delmas, Fischlein, & Asensio, 2013), consumers will be more familiar with energy-related options and may find it easier to relate them to climate change. Although "carbon" is not a salient consideration in their everyday decision-making (see e.g. Whitmarsh, Seyfang, & O'Neill (2011) on the UK), consumers may tend to evaluate the effectiveness of energy-related options on the basis of carbon emissions-specific beliefs. To help track the impacts of these beliefs, for this study we chose three familiar energy-related options, called *drive less*, *save energy at home* (e.g., turning thermostat down, using energy saving light bulbs, air-drying laundry), and *install solar panels on one's house*. The evaluation of the food-related options may be affected more by non-specific "green" beliefs, although this may differ between the local food option and the organic food option. It may be relatively easy for consumers to recognize the energy-related dimensions of the local food option, due to the visible aspect of less transportation (Roininen, Arvola, & Lähteenmäki, 2006). This does not apply to the organic food option. Although organically produced food does not necessarily result in lower GHGs (a climate-specific goal), consumers may still perceive this option as effective as it is associated with less or even no use of pesticides, thus protecting the quality of the soil and groundwater (non-specific "green" goals).

The perceived mitigation effectiveness of the options may be affected by two consumer-related variables that should be controlled for. The first is the perception of climate change itself. It should be mentioned that beliefs about the seriousness of climate change have deteriorated during the last five to ten years both in the Netherlands and the United States (de Boer, Schösler, & Boersema, 2013; Scruggs & Benegal, 2012). Climate skeptics respond very negatively to anything they see as pressure by the supporters of climate change prevention (de Boer et al., 2013; Hart & Nisbet, 2012; Lewandowsky, Gignac, & Oberauer, 2013; Mäkiniemi & Vainio, 2014) and in particular to overly dire messages about climate change impacts (Feinberg & Willer, 2011). Although there are various kinds of skepticism, it is at least necessary to control for differences in the attribution of climate change to human factors and the personal importance of climate change (Leiserowitz, 2005; Whitmarsh & O'Neill, 2010). The second variable is the frequency of meat eating. The less meat option may have more impact on the structure of daily meals than the other options, because in Western countries meat is often the dominant part of the meal (Schösler, de Boer, & Boersema, 2012; Swatland, 2010). This option may thus more directly affect what is lying on consumers' dinner plates, thus hitting very close to home. As a result, regular meat eaters may be slower to recognize the effectiveness of the less meat option than other individuals.

A final aspect to consider is the relationship between perceived mitigation effectiveness and willingness to make a lifestyle change. Consumers will not choose an option that is not effective for a particular purpose, except when they see it as an obligation or a moral duty to do so (Higgins, 2012). However, a high level of perceived effectiveness is merely

one of the inputs that affect consumer decision making; their willingness to make changes can be weakened or strengthened by previously activated goals and behavior-specific external constraints (Kruglanski et al., 2002; Kopetz et al., 2012). In this context, it is important to consider whether and when interventions to promote the adoption of food-related options may benefit from positive spillover effects created by energy-related interventions in the last few decades. The literature shows that a behavioral intervention can have a positive spillover effect on other pro-environmental behaviors not initially targeted by the intervention, which may be accounted for by common motivational or cognitive causes of the behaviors, such as useful knowledge (Lanzini & Thøgersen, 2014; Thøgersen & Ölander, 2006; Truelove, Carrico, Weber, Raimi, & Vandenbergh, 2014). A key motivational aspect is whether those who are willing to change or have already changed their lifestyle have a commitment to an overarching environmental goal, such as the goal of "using fewer resources" or "doing things in a different way" and with a positive environmental impact (Clayton & Myers, 2009, p. 144), which may indirectly link a lifestyle choice in one area (e.g., energy) to a lifestyle choice in another area (e.g., food). Hence, the question is whether consumers who are willing to adopt energy-related mitigation options or who already changed their lifestyle also appear more willing to take up the less meat option and the local food option, after controlling for their beliefs about the effectiveness of these options.

In brief, the present study is new in that it compares consumer evaluations of food-related and energy-related options in a design that included three food-related options with very different mitigation potentials. This approach may reveal more of the role of motivational

and cognitive background factors, also clarifying potential spillover effects that would be relevant to a transition to a low carbon society. Specifically, the paper aims to assess (1) how consumers evaluate the mitigation effectiveness of the food-related and the energy-related options, and in particular whether they recognize the crucial differences between the less meat option, the local food option and the organic food option, respectively, (2) the impacts of belief in human causation of climate change, personal importance of climate change, and regular meat eating on their evaluations, (3) the indirect role of involvement with “green” goals in their evaluations, as indicated by their response to the organic food option, (4) their willingness to make effective lifestyle changes by adopting the less meat option or the local food option, and (5) the relationship between the willingness to take up these options and the adoption of the energy-related mitigation options. The design included a comparison between Dutch and American participants to gain insight into the generalizability of the results.

## Method

### Participants and procedure

The study surveyed consumers in the age of 18 to 65 years from the Netherlands ($n$ = 527) and the United States ($n$ = 556) who were sourced through national online panels, organized by the Motivaction research agency. The data were collected between April 15th and May 7th 2014. To obtain representative samples from the panels, a two-step approach was applied. First, a "quota" approach was used, which specified the numbers of participants that had to be recruited in each category of the stratified sampling scheme. This approach included the purposeful oversampling of potential participants in categories known to respond slowly to invitations, which means that traditional response metrics, such as response rates, cannot be applied meaningfully. The panel members were invited via email, but the topic of the questionnaire was not mentioned to prevent response bias. In the second step of the approach, weighting variables were applied to adjust the data to reference data. From a statistical perspective, it should be noted that weighting reduces the number of effectively independent observations (the effective sample size) in comparison with the achieved sample size. In the Netherlands, the weighting variables were gender, age, level of education, region, and a value-related test score (i.e. "mentality-environment"), developed and standardly applied by Motivaction research agency (efficiency of the weighting 89%, effective sample size 478); in the United States, the weighting variables were gender, age, and level of education (efficiency of the weighting 90%, effective sample size 500). Table 1 shows the characteristics of the two (weighted) samples. It may seem that the two samples differ in level of education, but the percentages of participants with a high level of education are

difficult to compare due to dissimilarities between the Dutch and the American educational systems in degree types (e.g. university and college) and quality differences within degree type. The variables gender, age, and level of education were used as control variables in the analyses.

TABLE 1

Measures

The questionnaire included modules with structured questions about various topics, as the study was part of a broader project that also explored opinions about biotechnology and worldviews (not reported here). One of the modules dealt with issues related to food, energy, and climate change.

Regular meat eating

Following other studies (e.g. Hedlund-de Witt et al., 2014), the frequency of meat eating was measured by the item “How many days a week do you eat meat (including chicken) with your main meal, on average?”

Climate

The perceived relevance of mitigation was measured by two items, both adapted from the Yale Project on Climate Change Communication (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Howe, 2013). Unlike the Yale project, the words “climate change” were used instead of “global warming”. The items referred to the attribution of climate change

to either natural or human factors, and the personal importance of climate change. The first item was “Assuming climate change is happening, do you think it is (  ) caused mostly by human activities (recoded to 5), caused about equally by human activities and natural changes (recoded to 4), caused mostly by natural changes in the environment (recoded to 2), none of the above because climate change isn’t happening” (recoded to 1)? "Don't know" responses were recoded to the middle category (3). The second item was “How important is the issue of climate change to you personally?” The answer categories were “not at all important” (1), “not very important” (2), “somewhat important” (4), “very important” (5), and “don’t know” (3).

Effectiveness ratings

The three food-related and the three energy-related options were presented in terms of lifestyle changes. The participants were asked: “For each of the following lifestyle-changes, please let us know whether you think this is an effective way of combatting climate change”. The options, which were presented in randomized order, were: “Eat less meat”, “Buy local, seasonal, unprocessed foods (e.g., by going to farmer’s markets)”, “Buy (more) organic foods”, “Drive less”, “Save energy at home (e.g., turning thermostat down, using saving bulbs, air-drying laundry)”, and “Install solar panels on my house”. The answer categories were “Not effective at all” (1), “Not very effective” (2), “Effective” (4), “Highly effective” (5), and “Don’t know” (recoded to 3).

Willingness to change

The same options were presented a second time with the question “For each of the following lifestyle-changes, please let us know whether you are willing to personally make that lifestyle-change (if you are already doing it, you are willing).” The answer categories were “Certainly not willing” (1), “Likely not willing” (2), “Likely willing” (4), “Certainly willing” (5), and “Don’t know” (recoded to 3).

## Analysis

Research questions 1 (How do consumers evaluate the mitigation effectiveness of the food-related and the energy-related options, and in particular the differences between the less meat option, the local food option and the organic food option, respectively?), and 2 (What are the impacts of belief in human causation of climate change, personal importance of climate change, and regular meat eating on their evaluations?) were addressed together. To assess how the participants evaluated the mitigation options, profile analysis (i.e. the repeated measures extension of MANOVA, see Tabachnick & Fidell, 2007) was used with the effectiveness ratings of the six options as dependent measures, and country, regular meat eating, belief in human causation and personal relevance of climate change as between-subjects factors. The analysis determined whether the mean ratings differed across the options (within-subjects factor) and whether subgroups of participants differed in mean ratings across the options (profile magnitude) and in the shape of the profile of the mean ratings (profile shape). To reduce the number of profiles that had to be evaluated, the participants were divided into lower- and higher-scoring subgroups based on a median split for the variables regular meat eating, belief in human causation and personal importance of climate change. The interpretation of

significant results was supported by profile plots and pairwise post hoc comparisons, with Bonferroni correction for multiple comparisons. All tests were two-tailed ($p < .05$). Huynh-Feldt corrections were used when assumptions of sphericity were violated. To explore the role of gender, age, and level of education in profile differences, we repeated the MANOVA with these three variables as a covariate. For research question 3 (What is the indirect role of involvement with "green" goals in the evaluations, as indicated by the responses to the organic food option?), a principal component analysis was done to examine the relationships among the food-related and the energy-related effectivity ratings. As the ratings of the options may be based on both general beliefs on environmental harm and carbon emissions-specific beliefs, it is important to identify cross-loadings. For research question 4 (What is the willingness to make effective lifestyle changes by adopting the less meat option or the local food option?), the ratings of effectiveness and willingness to change were examined for each option, using comparison of means and bivariate correlation analysis. For research question 5 (What is the relationship between the willingness to take up the less meat option or the local food option and the adoption of the energy-related mitigation options?), two-step multiple regression analyses were run separately for each country to predict willingness to take up the less meat option. The predictors were the option's effectiveness rating (step 1), the willingness to change (WTC) ratings for the other options, belief in human causation, personal importance of climate change, regular meat eating, gender, age, and level of education (step 2). Similar analyses were done for the local food option. Both ordinal regression and linear regression were utilized. As the results were highly comparable only the latter is reported. All analyses were conducted with SPSS 21 for Windows.

## Results

### Preliminary analysis

The preliminary analysis revealed that the Dutch and American participants had somewhat different opinions on climate change. The Dutch believed more strongly ($M$ = 4.26, $SD$ = 1.06) than the Americans ($M$ = 3.98, $SD$ = 1.21) that climate change—if it is happening—is caused mostly by human activities ($t(1081) = 5.28$, $p < .001$). In contrast, the Americans reported more strongly ($M$ = 3.93, $SD$ = 1.13) than the Dutch ($M$ = 3.68, $SD$ = 1.06) that the issue of climate change is important to them personally ($t(1081) = 3.80$, $p < .001$). As to meat consumption, the Americans reported more often (27%) than the Dutch (16%) to eat meat every day of the week, but the mean ($M$ = 4.7) and the median (5) number of days did not differ. In other words, the answers to this question differed ($Chi^2$ (7, $N$=1082) = 55.64, $p < .001$) but the measure of central tendency did not (($t(1081) < 1$).

### Perceived mitigation effectiveness

The 2 x 2 x 2 x 2 (Country [NL, US] x Regular Meat Eating [low, high] x Belief In Human Causation [low, high] x Personal Importance Of Climate Change [low, high]) MANOVA (with Huynh-Feldt correction to correct for non-sphericity) revealed that the participants assigned different effectivity ratings to the six mitigation options ($F(4.56, 5325.48) = 121.11$, $p < .001$, $\eta_p^2 = .094$), indicating that it is meaningful to rank the means, either for the whole group or per country. Country had no effect on the mean ratings across the options ($F(1, 1168) = 3.58$, $p > .05$), but it did affect the shape of the profile of the mean ratings (two-way interaction, $F(4.56, 5325.48) = 8.59$, $p < .001$, $\eta_p^2 =$

.007). The profile plot of the mean ratings in the two countries and the post hoc comparisons, with Bonferroni correction, in each country separately revealed that the rankings of the mitigation options from high to low perceived effectiveness were almost the same in both samples, except for the positions of the less meat option and the organic food option (see Table 2). In both samples, “save energy at home” scored the highest, the energy-related options scored higher than the food-related options, the local food option scored higher than the less meat and the organic food option, and “eating less meat” was the least effective (US) or the least effective but one (NL) option in the eyes of the participants. For descriptive purposes, we also calculated the percentages of the participants who assigned higher ratings to the less meat option than to the local food option and the organic food option. This revealed that 12% of the Dutch and 6% of the American sample recognized the outstanding effectiveness of the less meat option in the eyes of climate experts. Much larger groups of participants responded positively to the option’s effectiveness (NL 46% and US 30%), but they were less distinctive in their effectiveness ratings as the groups referred to above.

TABLE 2

The MANOVA also showed that the subgroups of moderate and regular meat eaters assigned, on average, slightly different ratings to the options ($F(1, 1168) = 5.16$, $p < .05$), but that the profiles of the mean ratings differed significantly in shape (two-way interaction, $F(4.56, 5325.48) = 4.57$, $p < .01$, $\eta_p^2 = .004$). The profile plot revealed that regular meat eaters assigned lower effectiveness ratings to the less meat and the organic

food option, but not to the other options. The subgroups formed by the median split on belief in human causation and personal importance of climate change differed significantly in mean ratings across the options. Belief in human causation ($F(1, 1168) = 25.51$, $p < .001$, $\eta_p^2 = .021$) and personal importance ($F(1, 1168) = 50.42$, $p < .001$, $\eta_p^2 = .041$) were associated with assigning higher effectiveness ratings to all the options. The profiles of the mean ratings differed slightly in shape, depending on belief in human causation (two-way interaction, $F(4.56, 5325.48) = 2.91$, $p < .05$, $\eta_p^2 = .002$), but not on personal importance (two-way interaction, $F(4.56, 5325.48) < 1$).

The pattern of profile results remained unchanged when gender, age, and level of education were entered as covariates. This analysis revealed that these variables had small effects on the effectivity ratings. Females gave slightly higher ratings than males, especially to the food-related options (profile magnitude of gender, $F(1, 1165) = 22.38$, $p < .001$, $\eta_p^2 = .019$, two-way interaction, $F(4.60, 5357.36) = 4.15$, $p < .01$, $\eta_p^2 = .004$). Older participants gave lower ratings to the organic option and higher ratings to the save energy at home option (profile magnitude of age, ($F(1, 1165) < 1$, two-way interaction, $F(4.60, 5357.36) = 11.43$, $p < .001$, $\eta_p^2 = .010$). And a higher level of education was associated with higher ratings of the energy-related options (profile magnitude of education, ($F(1, 1165) = 7.28$, $p < .01$ , $\eta_p^2 = .006$, two-way interaction, $F(4.60, 5357.36) = 2.48$, $p < .05$, $\eta_p^2 = .002$).

Relationships between effectiveness ratings

The relationships among the food-related and the energy-related effectiveness ratings were examined by principal component analysis. In both countries, a two component solution was appropriate, which means that the reasons the participants had to give high or low ratings to the energy-related options (e.g., carbon emissions-specific beliefs) were at least partly different from the reasons they had to give high or low ratings to the food-related options. Table 3 shows that the first component accounted for more than 40% of the variance, which indicates that there was also a general tendency to give high or low ratings to all the options. The pattern of the loadings of the ratings on the two rotated components suggests that, in particular, the American participants made a clear distinction between the energy-related (first component) and the food-related (second component) effectivity ratings. In the Dutch sample, the first rotated component had high loadings of the food-related options and a cross-loading above .40 of the drive less option. In both samples, the rating of the local food option had a cross-loading above .30 on the energy-related component. Also, in both countries, the ratings of the less meat option and the organic food option had high loadings (above .80) on the food-related component. These loadings indicate that involvement with “green” goals played a role in the evaluations of the options.

TABLE 3

Willingness to make effective lifestyle changes

The ratings of the mitigation options in terms of willingness to make lifestyle changes could be ranked from highest to lowest in the same way as the effectiveness ratings.

Table 4 shows the ratings of the willingness to change among the samples as a whole (upper part) as well as separately for those who considered the option either “effective” or “highly effective” (lower part). Overall, the willingness to change ratings of each option had at least a moderate positive correlation with the ratings of its perceived effectiveness (ranging from $r(556) = .39$ to $r(527) = .66$, all $p$s $< .001$). As a result, the rankings of the mitigation options in terms of the participant’s willingness to change were largely similar to those in terms of perceived effectiveness. Again, the option to save energy at home had the highest ranking in both countries ($M = 4.42$ (NL) and $M = 4.31$ (US)). Among the large groups of participants who considered the option effective, the willingness to save energy at home was relatively high in both countries ($M = 4.59$ (NL) and $M = 4.48$ (US)). Among the smaller groups of participants who considered the food-related options effective, the willingness to change rating was relatively high for the local food option ($M = 4.20$ (NL) and $M = 4.21$ (US)), and, in the Netherlands exclusively, the less meat option ($M = 4.26$ (NL) and $M = 3.88$ (US)).

TABLE 4

Predictions of lifestyle changes

In both countries, the results of the multiple regression analyses show that the willingness to eat less meat increased with the option’s perceived effectiveness and, in addition to that, with higher willingness to change ratings for the organic food option and the drive less option, not being a regular meat eater, and female gender (see Table 5 for the unstandardized regression coefficients, standard errors, and $R^2$ of the full models). Belief

in human causation and willingness to buy local food were significant predictors in the American sample only. In the Netherlands, $R^2$ increased from .43 for the model with perceived effectiveness as single predictor to .54 for the full model ($R^2$ change .11, $F(11,513) = 10.82$, $p < .001$). In the United States, $R^2$ increased from .27 to .44 ($R^2$ change .17, $F(11,542) = 14.97$, $p < .001$).

In both countries, the second set of analyses shows that the willingness to buy local food increased with the option's perceived effectiveness and, in addition to that, with higher willingness to change ratings for the organic food option and the saving energy at home option (see Table 5). Gender also had an impact, indicating that females were more willing to buy local food, but this was not significant in the Dutch sample. In the Netherlands, $R^2$ increased from .33 for the model with perceived effectiveness as single predictor to .47 for the full model ($R^2$ change .14, $F(11,513) = 12.24$, $p < .001$). In the United States, $R^2$ increased from .17 to .39 ($R^2$ change .22, $F(11,542) = 17.35$, $p < .001$).

TABLE 5

## Discussion

This study has provided valuable insights into the evaluation of food-related mitigation options by consumers in two different countries. First, the participants saw significant differences in the mitigation effectiveness of the six options, but most of them did not recognize the crucial differences between the three that were related to food. Second, belief in human causation of climate change and personal importance of climate change were positively associated with perceived effectiveness, but did not result in different profiles of the options. However, regular meat eating was specifically negatively associated with the perceived effectiveness of the less meat and the organic food option. Third, the pattern of correlations between the ratings suggested that the perceived effectiveness of the food-related options was not only based on carbon-emission-specific beliefs but also on involvement with more general "green" goals, as revealed by positive evaluations of the organic food option. Fourth, the willingness of the participants to adopt the less meat option or the local food option increased as their rating of its effectiveness increased and was, controlling for that, also related to other factors. Fifth, there were indications of different positive spillover effects. Participants who were willing to adopt energy-related mitigation options or who already changed their lifestyle appeared to a certain extent more willing to take up the less meat option or the local food option, after controlling for their beliefs about the effectiveness of these options.

Overall, these findings and their theoretical background clearly show that the transition to a low-carbon society requires a special focus on food-related options in order to make consumers more aware of the most effective options and to increase their motivation for

diet changes. This is a process that may start holistically (e.g. framing broad categories of options) and then may become increasingly analytic, focusing either on particular products or on certain types of meals. From this perspective, it is important to note that the outstanding effectiveness (in the eyes of climate experts) of the less meat option was recognized by merely 12% of the Dutch and 6% of the American sample, although many more participants gave the option fairly positive effectiveness ratings. This result can be partly explained by the complexity of the links between meat eating and climate change. Communicating information on these links appears to be a challenge for science education (Skamp et al., 2013), as it requires some understanding of the whole production process (e.g. the inefficient conversion of plant protein into meat protein, the impacts of fertilizer use and of methane produced by livestock (Aiking, 2014; Westhoek et al., 2014)). The low awareness of the option's effectiveness can also be explained by the fact that policy-makers in government, industry, and even environmental NGOs are often reluctant to inform consumers on this option, although the degree of and the reasons for this reluctance may vary between countries and organizations (Laestadius, Neff, Barry, & Frattaroli, 2014; Markham & van Koppen, 2014; Reynolds, Buckley, Weinstein, & Boland, 2014). Hence, recognizing the significance and effectiveness of the less meat option is not just a challenge for consumers but an important one for other stakeholders as well.

Some differences between the Dutch and the American sample suggest that it was relatively new for the American participants to link meat eating with climate mitigation. One of the explanations for this may be that meat consumption in the United States is

culturally more important and substantially higher than that in the Netherlands, although both countries are leading meat producers (FAO, 2014). This may be indicative of broader differences in worldviews, including the strength of motivation to justify and promote existing social and human-nature hierarchies. This particular motivation is related to both climate change denial (Jylhä & Akrami, 2015) and higher meat consumption (Dhont & Hodson, 2014; Hedlund-de Witt et al., 2014). Another relevant difference is that the Health Council of the Netherlands (2011) has published one of the first dietary guidelines in the world that discusses a healthy diet from an ecological perspective, pleading for a less animal-based and more plant-based diet. This publication could be indicative of a different "climate of opinion" in which the climate-meat connection is slightly more likely to be expressed. It should be noted, however, that the US Dietary Guidelines Advisory Committee (2015) in its recently published scientific report also provides dietary guidance that promotes both health and sustainability, with a focus on decreasing meat consumption.

Our research highlighted several features of consumers' motivation for a diet change, which should be well understood by climate experts and policy makers. A key point is whether belief in the human causation of climate change and personal relevance of climate change are sufficiently motivating to stimulate effective mitigation actions. Focusing on the low correlations of these variables with pro-environmental behavior in a UK sample, Whitmarsh and O'Neill (2010) concluded that there is a disparity between awareness and concern about climate change on the one hand, and action on the other hand. Our findings showed that belief in the human causation of climate change and

personal importance of climate change were associated with assigning higher effectivity ratings to all the options, which in turn were associated with ratings of the participant's willingness to change. These beliefs in the ability to positively influence climate mitigation were key components of motivation. After controlling for effectiveness, belief in the human causation of climate change and personal importance of climate change had no direct impact on the willingness to take up the food-related options, except for the less meat option in the US sample. Hence, in addition to the study of Whitmarsh and O'Neill (2010), it may be concluded that awareness and concern are required but not sufficient.

The motivation for a diet change was partly dependent on consumers' involvement with "green" background goals, as revealed by the fact that participants who were willing to adopt the organic food option were also more often willing to take up the less meat option or the local food option. This agrees with several studies showing that the three options may be appreciated by the same type of "green" consumers (Hedlund-de Witt et al., 2014; Whitmarsh & O'Neill, 2010). Although climate experts do not recommend the organic option as an effective mitigation option (Saxe, 2014), they should note that involvement with "green" goals may contribute to effective mitigation via a pattern of consumption in which the less meat and the local food option are embedded (see Heerwagen et al., 2014). The empirical relationship between these preferences has also been revealed by comparing purchases in the market place. In a longitudinal analysis of Danish household purchase data, Heerwagen and colleagues (2014) found a small but statistically significant correlation between increasing organic food budget shares and decreasing meat budget shares.

In the context of a transition to a low carbon society, the motivation for a diet change may benefit from positive spillover effects, depending on the extent to which consumers subscribe to overarching environmental goals that may indirectly link a lifestyle choice in one area (e.g., energy) to a lifestyle choice in another area (e.g., food). One of those overarching goals is the appeal of using fewer resources and the notion of "doing or using less," which is known to play a role in shaping many different behaviors (Clayton & Myers, 2009, p. 144). In both countries we found that the willingness to adopt the drive less option appeared to be a distinct predictor of the willingness to take up the less meat option. These options share the willingness to curtail one's consumption, which is intrinsically appealing to some people (Van der Werff, Steg, & Keizer, 2014; Verain, Dagevos, & Antonides, 2015). Another "green" theme may explain that, in both countries, the willingness to adopt the save energy at home option was a distinct predictor of the willingness to take up the local food option. These options share the appeal of small-scale solutions and the notion of "doing things in a different way," with a positive environmental impact (Clayton & Myers, 2009, p. 144). Hence, policies aimed at energy-related climate mitigation may have positive spillover effects on food-related climate mitigation, especially when it is taken into account that the less meat option and the local food option appeal to consumer segments with overlapping but partly different motivational backgrounds.

In the context of a transition to a low carbon society, other positive spillover effects may be created by promoting useful knowledge about carbon emissions. An increase in

"carbon awareness" could make it feasible to design food-related policies that focus on particular products and provide consumers with information on product-specific carbon footprints. From an economic perspective, this information, for instance in the form of environmental footprint labels, may stimulate consumers (and producers) to switch from goods with a high carbon footprint to those with a low carbon footprint, which can decrease net carbon emissions (Shewmake, Okrent, Thabrew, & Vandenbergh, 2015). Obviously, this approach can only work if consumers recognize, understand and value carbon footprint information, and if they have meaningful opportunities to switch products (Shewmake et al., 2015; Spaargaren, van Koppen, Janssen, Hendriksen, & Kolfschoten, 2013). Our results on consumer evaluations of the effectiveness of mitigation options and other studies on this topic (Bostrom et al., 2012; Hartikainen, Roininen, Katajajuuri, & Pulkkinen, 2014; Whitmarsh et al., 2011) show that this carbon footprint approach is currently a bridge too far.

To further extend the motivational basis of a diet change, therefore, it is important to draw the attention of consumers to a broader focus on types of meals that can lead to a less animal-based and more plant-based diet, such as the "New Nordic Diet" (i.e. developed in the Nordic countries), which combines the less meat and the local food options (Mithril et al., 2012; van Dooren, Marinussen, Blonk, Aiking, & Vellinga, 2014). Choices for less animal-based diets may not just be motivated by "green" background goals, but also by health concerns, food quality and variety seeking, animal welfare concerns, saving money (Schösler, de Boer, & Boersema, 2014), or striving for a lean and muscular body (Cook, Russell, & Barker, 2014). The local food option also stands

for many motives, which may explain that this option was the most appreciated from the food-related options in our study. A recent literature review shows that, unlike organic food, local food is not perceived as expensive; yet consumers frequently seem willing to pay a premium price for the product's quality, freshness and taste, the local shopping experience, the benefits for the local economy, and the preservation of cultural heritage (Feldmann & Hamm, 2015). For policy-makers, this means that it may be easier to motivate consumers in the context of highly visible, culture-based lifestyle changes, such as the "New Nordic Diet" (Mithril et al., 2012; Saxe, 2014), than in their role as individual actors in the marketplace.

One of the limitations of the current study is that it is based on correlational evidence. Social desirability bias might play a role, but it cannot explain our overall results. An important point to take into account is that individuals and households are not inclined to change the course of their behavior too easily or too often, as real change often requires a change in the balance of forces that supports current habits and practices (Lewin, 1997). Hence, increasing the perceived effectiveness of the less meat option will not necessarily result in an increased willingness to eat less meat. The probability of actually making such a change depends on relatively brief windows of opportunity, which may be triggered by various conditions, including the implications of another change (e.g. a change in personal relations), the aftermath of events that function as interruptions (e.g. food scares, the market introduction of new, better products), or a threshold of gradually increased dissatisfaction with the perceived incompatibility of one's goals (e.g. violating one's own standards). Further work should be designed in such a way that it opens

windows of opportunity and allows consumers to make real changes. Another limitation is that the study did not provide more detailed information on the social, cultural, and economic context of meat consumption in the Netherlands and the United States and that not all the potentially relevant determinants of the willingness to eat less meat were included, such as product familiarity, preferred meal format, cooking skills (Schösler et al., 2012), as well as values and worldviews (Hedlund-de Witt et al., 2014). Despite these limitations, the present study yields important new findings on the appraisal of the food-related options and the way in which mitigation can be improved.

In conclusion, although climate mitigation (or energy saving) is not the focal goal of consumers who are buying or consuming food, they may have background goals that could help to motivate a diet change if they would be aware of the most effective options. However, consumers were largely unaware of the outstanding effectiveness of addressing climate change through eating less meat, while awareness of this effectiveness was positively associated with willingness to eat less meat and (already) being a moderate meat eater. Other factors, including potential spillover effects of energy-related campaigns, also played a motivating role. The results thus provide policy-makers with a justification for actively informing the public of this effectiveness, and insights into how to extend the motivational basis of a diet change. In this way, a transition to a low carbon society can greatly benefit from a special focus on food-related options.

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Table 1

Characteristics of the two samples.

| | Dutch sample | | American sample | |
|---|---|---|---|---|
| | No | % | No | % |
| Gender | | | | |
| Men | 266 | 50 | 280 | 50 |
| Women | 261 | 50 | 276 | 50 |
| Age | | | | |
| 18 – 24 year | 69 | 13% | 96 | 17% |
| 25 – 34 year | 97 | 18% | 114 | 21% |
| 35 – 44 year | 122 | 23% | 114 | 21% |
| 45 – 54 year | 121 | 23% | 124 | 22% |
| 55 – 65 year | 117 | 22% | 108 | 19% |
| Education | | | | |
| Low | 119 | 23% | 78 | 14% |
| Middle | 269 | 51% | 156 | 28% |
| High | 140 | 27% | 322 | 58% |

*Note:* It may seem that the two samples differ in level of education, but the percentages of participants with a high level of education are difficult to compare due to

dissimilarities between the Dutch and the American educational systems in degree types (e.g. university and college) and quality differences within degree type.

Table 2

Perceived levels of effectiveness of the mitigation options.

| Options | Dutch sample ($n$ = 527) | | American sample ($n$ = 556) | | t-test (1, 1081) |
|---|---|---|---|---|---|
| | M | SD | M | SD | |
| Save energy at home | 4.16 | .87 | 4.09 | 1.00 | 1.38 |
| Install solar panels on my house | 3.96 | 1.03 | 3.84 | 1.10 | 1.88 |
| Drive less | 3.93 | 1.02 | 3.69 | 1.18 | 3.52*** |
| Buy local, seasonal foods | 3.58 | 1.09 | 3.64 | 1.14 | -.84 |
| Eat less meat | 3.34 | 1.21 | 2.78 | 1.30 | 7.37*** |
| Buy (more) organic foods | 3.10 | 1.18 | 3.18 | 1.28 | -.96 |

*Note*: Ratings on a 1 (*not effective at all*) to 5 (*highly effective*) scale in response to the following question "For each of the following lifestyle-changes, please let us know whether you think this is an effective way of combatting climate change".

*** significant difference between the samples (t-test, $p < .001$).

Table 3

Principal component analysis of the effectiveness ratings of the mitigation options: Loadings after Varimax rotation.

| Options | Dutch sample (n= 527) | | American sample (n = 556) | |
|---|---|---|---|---|
| | Component | | Component | |
| | 1 | 2 | 1 | 2 |
| Save energy at home | .24 | .77 | .76 | .11 |
| Install solar panels on my house | .04 | .83 | .74 | .11 |
| Drive less | .46 | .54 | .76 | .13 |
| Buy local, seasonal foods | .63 | .36 | .32 | .68 |
| Eat less meat | .83 | .10 | -.02 | .80 |
| Buy (more) organic foods | .80 | .13 | .14 | .80 |
| Eigenvalue | 2.00 | 1.77 | 1.81 | 1.78 |
| % variance explained | 46 | 16 | 40 | 20 |

Table 4

Willingness to make a lifestyle change in each sample as a whole and in the subsample who rated the option as effective.

| Options | Dutch sample (n= 527) | | | American sample (n = 556) | | |
|---|---|---|---|---|---|---|
| | M | SD | N | M | SD | N |
| Save energy at home | 4.42 | .90 | 527 | 4.31 | .99 | 556 |
| Install solar panels on my house | 3.67 | 1.26 | 527 | 3.34 | 1.35 | 556 |
| Drive less | 3.62 | 1.31 | 527 | 3.47 | 1.35 | 556 |
| Buy local, seasonal foods | 3.75 | 1.20 | 527 | 3.88 | 1.20 | 556 |
| Eat less meat | 3.58 | 1.36 | 527 | 3.01 | 1.44 | 556 |
| Buy (more) organic foods | 3.38 | 1.28 | 527 | 3.45 | 1.27 | 556 |
| | | | | | | |
| Willingness if (highly) effective | | | | | | |
| Save energy at home | 4.59 | .70 | 465 | 4.48 | .85 | 461 |
| Install solar panels on my house | 3.91 | 1.16 | 422 | 3.59 | 1.30 | 412 |
| Drive less | 3.89 | 1.20 | 425 | 3.82 | 1.21 | 390 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Buy local, seasonal foods | 4.20 | .94 | 349 | 4.21 | 1.05 | 376 |
| Eat less meat | 4.26 | .94 | 305 | 3.88 | 1.19 | 195 |
| Buy (more) organic foods | 4.14 | .92 | 252 | 3.94 | 1.08 | 286 |

*Note*: Ratings on a 1 (*certainly not willing*) to 5 (*certainly willing*) scale in response to the following question “For each of the following lifestyle-changes, please let us know whether you are willing to personally make that lifestyle-change (if you are already doing it, you are willing)”.

9 Table 5

10 Predictors of the willingness to eat less meat and to buy local food.

| Predictors | Dutch sample (n= 527) | | | | American sample (n = 556) | | | |
|---|---|---|---|---|---|---|---|---|
| | Less meat | | Local food | | Less meat | | Local food | |
| | B | SE | B | SE | B | SE | B | SE |
| Constant | .04 | .37 | -.25 | .35 | -.46 | .41 | -.95*** | .34 |
| Effectiveness of the option (1 - 5) | .50*** | .04 | .42*** | .04 | .44*** | .04 | .26*** | .04 |
| WTC local food option (1 - 5) | .02 | .04 | | | .11* | .05 | | |
| WTC less meat option (1 - 5) | | | .04 | .04 | | | .03 | .03 |
| WTC organic food option (1 - 5) | .18*** | .04 | .28*** | .04 | .14** | .04 | .24*** | .04 |
| WTC driving less option (1 - 5) | .08* | .04 | .06 | .04 | .17*** | .04 | .01 | .03 |
| WTC saving energy at home option (1 - 5) | .09 | .05 | .15** | .05 | .03 | .05 | .23*** | .04 |
| WTC solar panels option (1 - 5) | -.02 | .04 | .00 | .03 | -.00 | .04 | .15*** | .03 |
| Belief in human causation (1 - 5) | -.02 | .04 | -.05 | .04 | .09* | .04 | .06 | .04 |
| Personal importance (1 - 5) | .05 | .04 | .08 | .04 | .09 | .05 | -.03 | .04 |
| Frequency of meat eating (0 - 7) | -.12*** | .02 | .04 | .02 | -.16*** | .02 | .04 | .02 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Gender (woman = 1, else 0) | .39*** | .09 | .16 | .08 | .25** | .10 | .27** | .08 |
| Age divided by 10 | .05 | .03 | .01 | .03 | .06 | .04 | .14*** | .03 |
| Level of education (1 - 3) | .10 | .06 | .00 | .06 | .04 | .07 | .10 | .06 |
| R square | .542 | | .472 | | .438 | | .385 | |

*Note*: Table entries are unstandardized regression coefficients and standard errors. All variables were coded from low to high. WTC is willingness to change.

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