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Convincing Conversations: Using a Computer-Based Dialogue System to Promote a Plant-Based Diet

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Abstract

In this study, we tested the effectiveness of a computer-based persuasive dialogue system designed to promote a plant-based diet. The production and consumption of meat and dairy has been shown to be a major cause of climate change and a threat to public health, bio-diversity, animal rights and human rights. A system promoting plant-based diets was developed, comprising conversational, motivational and argumentational elements. 280 participants were randomly assigned to one of four conditions, each representing a particular combination of motivational and argumentational modules. Male participants showed higher intention scores in the motivational conditions compared to the argumentation-only or control condition. Female participants scored higher overall, unaffected by condition. These results suggest that men and women are differentially sensitive to persuasive strategies regarding the adoption of a plant-based diet. It seems to be particularly worthwhile to use motivational - as opposed to merely argumentational - elements in a persuasive conversation.

Keywords: human-machine interaction; dialogue system; persuasive communication; cognitive dissonance; motivational interviewing.

Introduction

When individuals experience a mismatch between their beliefs and their actual behavior, the phenomenon of cognitive dissonance (Festinger, 1957) kicks in: "an aversive state which motivates cognitive or behavioural actions to lower itself" (Dijkstra, 2009, p.792). For instance, most people do have a desire to behave ethically, but this desire is often not reflected in their actual behavior. People are often 'wilfully ignorant' when it comes to their ethical beliefs, actively ignoring or discarding relevant information

about those beliefs (Zane, Irwin & Reczek, 2013). There are two ways in which you can deal with and/or solve cognitive dissonance. The first one is to change your cognitions in line with your current behavior. For example, you could change your belief: "behaving ethically is not so important for me (anymore)." The second way is to change your behavior in line with their current beliefs: actually acting in an ethical manner (Dijkstra, 2009; Hewstone, Jonas & Stroebe; 2012).

The latter way of solving cognitive dissonance is often an ultimate goal of – for instance - health and sustainability communication professionals: they want people to change their behaviour, like: exercise more often (Riet et al., 2010); quit smoking (Ballast & Dijkstra, 2011); reduce fat-intake (Wright, Velicer & Prochaska, 2008); behave environmentally friendly (Bolderdijk et al., 2012) etc. However, people often change their cognitions instead of their actual behavior. Therefore, persuaders often start by trying to change people's cognitions. In order to achieve this, one has to address the most focal cognitions that people hold about a particular behaviour (Fishbein & Yzer, 2003).

One problem area that is often associated with cognitive dissonance, is the consumption of meat and other animal products. Meat eaters are assumed to experience cognitive dissonance resulting for instance from the perceived aversive consequences of their diet ("I eat meat but eating meat hurts animals") (Cooper & Fazio, 1984); or because it threatens their self-integrity ("ethical people don't eat meat, but I do") (Aronson, 1968). Most people believe it is wrong to hurt animals, while at the same time around 95% of the consumers in the U.S. eat meat. Researchers have referred to this phenomenon as the 'meat-paradox', and claim that

cognitive dissonance lies at the heart of this phenomenon (Bastian, Loughnan, Haslam & Radke 2012; Rothgerber, 2014).

Besides solving the unpleasant feeling of cognitive dissonance that consumers may experience due to eating meat, there are several other important reasons to address meat consumption. First, the livestock industry is one of the largest polluters worldwide. In order to meet stringent climate change targets, the consumption of animal products should be reduced at least by half (Donham et al., 2007; Hedenus, Wirsenius & Johansson, 2014; Hertwich et al., 2010; Steinfeld et al., 2006). Second, the production of animal products is threatening rights and wellbeing of both humans and animals due to poor working conditions for the first, and poor living conditions for the latter (Pew Commission, 2008). Third, individual and public health is negatively affected by meat and dairy consumption. For instance, the growing consumption animal products is associated with an increase of diseases like obesity, type II diabetes (Cooney, 2014; Montonen et al., 2013), heart and vascular diseases (Yokoyama et al., (2014) and a variety of cancers, like colorectal, lung and bladder cancer (Lippi, Mattiuzzi & Cervellin, 2016). Thus, a successful promotion of plant-based diets - diets without meat, dairy and eggs – could have a great many positive outcomes for animals, humans, and the environment.

It has been claimed that one of the most effective strategies to reach persuasion is through conversation and interaction (Helme et al., 2011; Noar, Carlyle & Cole, 2006). However, even if that were the case, face-to-face conversations are obviously very time consuming and costly (Southwell & Yzer, 2007). A fruitful solution for this could be the deployment of human-machine interaction systems. There is a huge benefit in using online dialogue systems as larger target groups can be reached at lower costs. In addition, automated dialogues can also easily be tailored, which lowers resistance to persuasion and makes messages individually more relevant (Dijkstra, 2008). An added benefit for experimental research is that manipulations can be held more constant, making it easier to measure the effect(s) of the strategy/strategies employed within the dialogue system separately - and/or combined.

The Dialogue System

We devised and tested a persuasive online dialogue system that promotes plant-based diets. Our system incorporates persuasive strategies aimed at reducing the consumption of animal products. First, an ‘argumentation’ module was designed to target cognitive dissonance by addressing focal beliefs about meat consumption. This module provides individually tailored arguments that address the individual’s so-called ‘disengagement’ beliefs: beliefs that may be true in themselves, but that are not valid arguments in the discussion at hand (e.g., “Our ancestors ate meat” is true, but it is not a valid reason why a present-day individual should still be eating meat).

In addition, a second module was designed to reduce the likelihood of experiencing negative affect and resistance to counter arguments and persuasion. In building this module, we borrowed heavily from the theoretical framework of Motivational Interviewing (MI). MI is "a collaborative conversation style for strengthening a person’s own motivation and commitment to change" (Miller & Rollnick, 2002). In this method, the receiver formulates its own goals, capacities and reasons regarding his/her behavior change towards the targeted behavior. Dialogue in MI is framed in such a way to emphasize one's autonomy and to avoid any direct confrontation with the target individual. Important elements of MI are: 1) an explicit consent question, asking whether an individual agrees with talking about a specific topic; 2) a ‘motivation ruler’, which consists of asking one to number or ‘grade’ their motivation to change and subsequent questioning and giving feedback on the number they choose (e.g., “You chose “2”, what would it take for you to get a higher level of motivation?”); and 3) a ‘confidence ruler’, which asks about a person’s confidence in his/her own capacity to change towards the target behavior. Digital applications of this conversational method have proved to be effective in achieving positive intentional and behavioral outcomes (Shingleton & Palfai, 2015).

To increase the ‘feel’ of an actual conversation, we include a picture (of a young female) to visualize the ‘person’ talking to the participant. We use personal pronouns like “I” and “you” in conversation; and talk is individually tailored by the system throughout the conversation based on responses of the - non-digital - conversational partner. In the future, we would like to develop a more sophisticated dialogue system, capable of reacting to natural language input. Previous research has shown that technological social agents - like robots - are able to induce behavior change by providing interactive feedback with regard to for instance sustainability-related behavior like energy conservation (Ham & Midden, 2014). However - to our knowledge - no research has yet looked into computerized agents that are active in the field of plant-based eating. We used survey-builder Qualtrics to design a straightforward, tree-based conversational system with feedback based on answers on - for the most part - multiple choice questions.

Table 1: Example of tree-based conversation with Eliza

"When are you planning to make changes to your diet?"	
Participant's answer	Eliza's answer
<ul style="list-style-type: none"> • Within a week 	"That's pretty soon, good to hear! Can I ask you more?"
<ul style="list-style-type: none"> • Within a month 	
<ul style="list-style-type: none"> • Within 3 months 	"You're taking your time, but that's OK! Are there any ways to potentially speed up this process for you?"
<ul style="list-style-type: none"> • Within a year 	

Method

Participants

Three-hundred-and-seventy-one Dutch participants took part in the research. Participants were recruited from social media, mailing lists and the researchers' personal networks. Data from participants who had a vegetarian or vegan diet - or failed to complete the questionnaire - were excluded from analysis. Two-hundred-and-eighty participants remained. Of this sample, 76% was female (N=212) and 24% male (N=68). Participants' mean age was 26 years (SD=9.9), ranging from 17 to 65. Male and female participants were dispersed evenly across four conditions (15-20 men and 55-60 women in each condition).

Measures

Disengagement Belief Strength The strength of the various disengagement beliefs was measured by asking participants about the extent they (1) *totally disapprove* - (7) *totally approve* of fourteen disengagement beliefs about eating meat (i.e. "Without meat you cannot be healthy"; "Lions eat meat too"). These fourteen disengagement beliefs were formulated based on a belief elicitation study in which twenty-three participants stated the most important reasons for them to keep eating meat. In the present study, participants were asked which three of these fourteen beliefs were the most important reasons for them to keep eating meat. Subsequently, they received tailored feedback based on the answers they provided. This feedback was framed as a short text in a *what-if* question format (i.e. "You state that meat is too tasty. That is hard to deny! But what if you find out that some meat substitutes are quite good and sometimes even as good as real meat. Would you then be open to change your current diet towards a more plant-based diet?"). When a participant answered "no", the dialogue system would give similar 'what-if' feedback for the second and/or third reason, until the participant either answered "yes" or all three reasons were addressed. Note that all responses of the dialogue system consisted of valid arguments, based on scientific findings.

MI module In the full MI version, participants were explicitly asked for their approval to talk about their dietary habits ("In this program, I will talk about the advantages of having a plant-based diet [...] Are you open to talk about your own eating habits and possible changes to it?"). When participants did not consent, there was a short feedback page after which the experiment ended. As we described above, motivation to change towards a plant-based diet was measured by asking one's motivation on scales ranging from (0) *No motivation at all* - (10) *very highly motivated*. (e.g. "It looks like reducing your meat consumption is not that high of a priority for you! Could you tell me why?") A similar procedure was used for measuring how much participants trusted their own capacity to perform the requested behavior (self-efficacy).

Attitude and Behavioral Intention Attitude was measured by evaluating the following statement on a semantic differential scale: "If I would change my current diet to a vegan diet, that would be...": i.e. *good-bad*; *foolish-wise*; *unnecessary-necessary*. In addition, participants evaluated several statements on a seven-point scale ranging from (1) *strongly disapprove* - (7) *strongly approve* (i.e. "A diet without animal product is more environmentally friendly."). Behavioral intention towards three kinds of behavior was measured: going completely or partially vegan; going completely or partially vegetarian; going completely or partially organic where meat was concerned. These intention measures were weighted and summed into one intention-score that indicated their willingness to change their diet towards a more - or less - plant-based diet (the higher, the more willing).

Evaluation questions At the end of the session, we asked 1) whether participants felt they were addressed in a nice manner, and 2) whether they liked to communicate with Eliza by means of evaluating statements on a Likert-type scale: (1) *completely disagree* - (7) *completely agree*.

Procedure and Design

When starting the dialogue system, participants saw a picture of a young girl who was introduced as "Eliza". She asked if they cared to join her in a conversation about their eating habits. Subsequently, participants were asked about their gender, age, education and actual eating habits. Next, participants received information about several benefits of a plant-based diet. In three of the four conditions the disengagement belief handling module ('DBH') was included to address the participant's most focal beliefs about eating meat. Two of the four versions also included a motivational interviewing module ('MI'), either a full (with an explicit consent question) or partial (without an explicit consent question) module. A fourth version did not include DBH and MI modules and served as - baseline - control condition. Table 2 shows how the modules were combined in the different versions of the system that were used in this study.

Table 2: Experimental conditions

	Full MI	Partial MI	DBH	Control
Consent	+	-	-	-
MI	+	+	-	-
DBH	+	+	+	-
INFO	+	+	+	+

Note. MI = Motivational Interviewing; DBH = Disengagement Belief Handling; Consent = consent question; INFO = information on plant-based diet.

Analysis

We used between-groups univariate Analysis of Variance to investigate the patterns of results for Attitude, Intention and Evaluation. Condition was one factor, with four levels (Full MI, Partial MI, DBH and Control), and Sex of Participant the other factor (male versus female). This latter factor has consistently been shown to influence behavioral outcomes concerning reduction of meat consumption (e.g. Cooney, 2014). In the analysis on Evaluation there were only three levels of Condition, as the Control condition did not feature a conversation with Eliza.

Results

Table 3 shows the means for attitude towards adopting a plant-based diet, and the composite scores for intention to reduce meat consumption per condition.

Table 3: Means and Composite Scores (plus standard errors) of intention and attitude

Condition	Intention		Attitude	
	Men	Women	Men	Women
Full MI	95.45 (7.95)	99.67 (5.24)	5.56 (.21)	5.62 (.14)
Partial MI	95.67 (10.72)	106.80 (5.24)	5.21 (.28)	5.56 (.14)
DBH	80.65 (8.89)	101.72 (4.80)	4.74 (.23)	5.45 (.12)
Control	65.95 (7.76)	102.23 (4.41)	5.11 (.20)	5.77 (.11)

Note. MI = Motivational Interviewing; DBH = Disengagement Belief Handling

Effects of Condition and Sex on Attitude

A Univariate Analysis of Variance showed a significant main effect of Condition on Attitude towards adopting a more plant-based diet ($F(3,269)=2.67$, $p=.048$). Attitude scores of participants in the Control ($M=5.44$, $SE=.12$) and Full MI ($M=5.59$, $SE=.12$) condition were significantly higher than Attitude scores of participants in the DBH condition ($M=5.10$, $SE=.13$). In addition, there was a main effect of Sex on Attitude ($F(1,269)=11.54$, $p=.001$). Women ($M=5.60$, $SE=.06$) scored significantly higher on attitude measures than men ($M=5.16$, $SE=.06$) regardless of exposure to experimental condition. No interaction effect of Condition x Sex was found ($p\text{-value}>.23$).

Effects of Condition and Sex on Intention

A Univariate Analysis of Variance showed a marginally significant main effect of Condition on Intention to adopt a more plant-based diet ($F(3,272)=2.29$, $p=.078$). In addition, there was a main effect of Sex on Intention. Men ($M=84.44$, $SE=4.56$) scored significantly lower on intention to adopt a more plant-based diet than women ($M=102.61$, $SE=2.47$), $F(1,272) = 12.74$, $p=.000$. The interaction of Condition x

Sex was found to be marginally significant ($F(3,272) = 2.2$, $p=.09$).

Further exploration of these effects showed that intention scores were only significant between conditions for male participants ($F(3,64)=2.85$, $p=.044$) but not for female participants ($F(3,208)=.332$, $p=.80$). A post-hoc test showed that intention scores of men who were exposed to the Control condition ($M=66.0$, $SE=7.8$), were significantly lower than mean intention scores of men who were exposed to either the full MI condition ($M= 95.5$, $SE=8.0$), $p=.011$; or the partial MI condition ($M=95.67$, $SE=10.8$), $p=.030$. Intention scores between men in the DBH condition and the control condition did not differ.

Evaluation questions

Table 4 shows the mean scores about the participants' appreciation for the way they were addressed by Eliza and the extent they liked talking to her.

Table 4: Means (plus SE) of appreciation and liking

Condition	Appreciation		Liking	
	Men	Women	Men	Women
Full MI	5.26 (.32)	5.33 (.21)	4.42 (.32)	4.04 (.20)
Partial MI	4.91 (.43)	5.23 (.22)	4.46 (.42)	4.18 (.21)
DBH	5.53 (.36)	5.02 (.19)	4.73 (.36)	4.06 (.19)

Note. MI = Motivational Interviewing; DBH = Disengagement Belief Handling

In general, participants felt they were addressed in a nice manner: mean scores ranged from 4.9 to 5.5 (maximum 7). A 3 x 2 ANOVA was carried out - no evaluation questions about Eliza were asked in the control condition - which showed no significant main or interaction effects ($p\text{-values} > .37$). Participants also seemed to like to communicate with Eliza, though the marginally significant main effect of Sex of Participant ($F(1,182)=3.39$, $p=.067$) suggested that male participants enjoyed talking to Eliza a little bit more ($M=4.54$, $SE=.21$) than female participants ($M=4.09$, $SE=.12$). No other effects were significant ($p\text{-values} > .77$).

Discussion

The aim of this research was to find out 1) whether it would be effective to design a dialogue system to promote plant-based diets, and 2) which elements or modules contribute to the persuasive power of the system. To this end, four versions of a computer-based dialogue system were developed, which 'talked' about the benefits of plant-based diets and provided - individually tailored - conversations based on different persuasive strategies.

Most importantly, we saw positive effects of incorporating persuasive strategies in a dialogue system. This implicates the usefulness of using a dialogue system to

promote sustainable behavior concerning the promotion of adopting a (more) plant-based diet.

We discovered effects of the different versions on behavioral intention towards adopting a plant-based diet. These effects were only present for men. Women were in general more willing to change their diet, regardless of the condition they were assigned to. So contrary to expectations, men seemed to be most sensitive to persuasion in the area of moving towards a plant-based diet. Men who were exposed to the Full MI and the Partial MI conditions - which both contained a motivational interviewing module - showed higher intentions to adopt a more plant-based diet than men in the control condition. The DBH condition that only contained disengagement belief handling did not significantly differ from the control condition.

Apparently, if we restrict our persuasive attempt to mere argumentation, we will not get far, at least not with our male conversational partners. This conclusion is underscored by the findings regarding participants' attitudes. Incorporating an argumentational component even seems to negatively affect those: attitude scores were significantly lower in the argumentation-only (DBH) condition than in the Control condition for both men and women. Because a DBH module is included in all experimental conditions, it is still possible that DBH is effective, but only in combination with a motivational module. Future research including an 'only MI' condition could perhaps answer that question.

A second important finding concerns the effects of Sex of the Participant. Our results support the notion that men and women think differently about adopting a more plant-based diet and that they are persuaded by different means (e.g. Cooney, 2014). However, as we said, the outcome was not quite as we anticipated, as we expected that women would be more susceptible to persuasion in this area. What our results do suggest is that women are generally more likely to have or adopt a plant-based diet. While it is true that in this research only men were positively affected by two versions of the intervention, women showed more positive attitudes and higher intentions to adopt a more plant-based diet than men overall.

Of specific interest is that there was also a (trend towards a) main effect of Sex on the scores of one of the evaluation questions, when participants were asked whether they had enjoyed talking to Eliza. Men had enjoyed the conversation with Eliza more than women. Perhaps if we would use a picture of a young male, this 'Elisus' would work better with a majority of female participants. We will tackle this issue in a future version of the present experiment.

Future studies in our lab will focus on a number of issues. First of all, we will perform a replication of this study in a different participant group to gauge the extent to which we can generalize the specific findings of this study

Second, we measured intention immediately after participants were exposed to the intervention. It is very likely the case that interventions need much more time before they have a detectable effect. Especially with difficult behaviors like changing dietary habits, the

occurrence of what is sometimes called ' sleeper effects ' seems very plausible (Kumkale & Albarracín, 2004).

In addition, as in most studies, the present research measured *behavioral intention* and not actual behavior. While intention is thought to be a potent predictor of actual behavior (Fishbein & Ajzen, 2010), being able to measure and predict actual behavioral outcomes is the ultimate goal of persuasion research. We would like to use some form of longitudinal design, where we measure - self-reported - eating behavior over a longer period.

Finally, the present research measured the effects of a single intervention. In the real world, people are often exposed more than once to the same, or related persuasive information - they read advertisements in newspapers and magazines, see posters, look at commercials etc. Perhaps we need multiple exposures to create more persuasive results.

In conclusion, then, our research suggests that a dialogue system can induce behavior change in the field of a plant-based life-style. However, strategy-wise, only giving people *arguments* in trying to persuade them is not going to work. People, especially men, may want to feel their own autonomous motivation, which can be fueled by a supporting dialogue based on - for instance - elements from motivational interviewing. Future research should test designs that incorporate different combinations of persuasive strategies (and pictures/avatars); multiple exposures to/conversations with the system; over a longer time span; and should measure actual consumption behavior instead of intention as outcome.

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