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Increasing public support for food-industry related, obesity prevention policies: The role of a taste-engineering frame and contextualized values

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ABSTRACT

Background: Support for policies to combat obesity is often undermined by a public sense that obesity is largely a matter of personal responsibility. Industry rhetoric is a major contributor to this perception, as the soda/fast food/big food companies emphasize choice and individual agency in their efforts to neutralize policies that are burdensome. Yet obesity experts recognize that environmental forces play a major role in obesity. We investigate whether exposure to a taste-engineering frame increases support for food and beverage policies that address obesity. A taste-engineering frame details strategies used by the food industry to engineer preferences and increase the over-consumption of processed foods and sugary beverages. We also examine the effects of exposure to two contextualized values that have recently been promoted in expert discourse—consumer knowledge and consumer safety — on public support of policies. Our research shows how causal frames and contextualized values may effectively produce support for new obesity policies.
Methods: We use an online survey experiment to test the effects of exposure to a taste-engineering frame (TEF), the value of consumer knowledge (CK), or the value of consumer safety (CS), on level of support for a range of policies. A random sample of adults, age 18 + living in the United States was included in the study ($N = 2580$). Ordered logistic regression was used to measure the effects of treatment exposure.
The primary outcome was level-of-support for four (4) food-industry related, obesity prevention policies (aka food and beverage policies): 1) require food-manufacturers to disclose the amount of additives in food products on food packaging; 2) require food-manufacturers to advertise food products in accordance with their actual nutritional value; 3) prohibit all high-fat, high-sugar food advertising on television programming watched primarily by children; and 4) increase healthy food availability in work sites, schools, and hospitals.
Findings: These data suggest that a taste-engineering frame and contextualized values significantly increase public support for many of the food and beverage policies tested.
Conclusions: Applying a taste-engineering frame and/or contextualized values to address obesity advances a population-based policy agenda to counteract the effects of food-industry strategies.

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1. Introduction

Throughout the media, as well as in political discourse, obesity is often framed as either an issue of personal responsibility or as a societal concern (Kersh, 2009; Klein and Dietz, 2010), with the most dominant of the two being personal-responsibility (Brownell et al., 2010). The personal-responsibility frame, which emphasizes the individual's responsibility for his or her obesity status, typifies an episodic frame, contextualizing social concerns solely within the realm of the individual by focusing on discrete events happening to specific people in particular places and at particular times (Iyengar, 1991). The personal-responsibility frame is a powerful tool used to limit governmental intervention exclusively to the provision of health information (Azétsop and Joy, 2011).

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Experts in obesity research do not see it this way. While recognizing a role for personal responsibility, obesity experts overwhelmingly stress the role of the food environment in creating the conditions that have led to our current epidemic of overeating (Institute of Medicine, 2012). In contrast to the personal-responsibility frame, the environmental frame assigns both obesity causality and responsibility to numerous agents, including the government, business, and larger social forces (Lawrence, 2004). Where the personal-responsibility frame is episodic, the environmental frame is thematic, contextualizing social concerns within the realm of the environment, policies, and systems (Iyengar, 1991). But the environmental frame faces a problem. Because it strongly emphasizes the complex causal pathways leading to obesity, and because the public tend to disbelieve complex explanations (Heath and Heath, 2007; Kahneman, 2011), the environmental frame often faces deep public and political resistance.

For different reasons, therefore, both the personal-responsibility frame and environmental frame impede systematic progress against obesity-related morbidity and costs. The task of public health scientists now is to communicate evidence-based theories of obesity in a way that is memorable and actionable for the general public. Alternative frames of discourse must be developed that would be more appealing and evidence-driven than either the personal-responsibility frame or the broad environmental frame.

The approach taken here is to disentangle the environmental frame to allow the public to see players and population-based solutions within the environmental frame as easily as they see individuals and individual willpower in the personal-responsibility frame. This approach simplifies the environmental frame to make it stick, while remaining faithful to the empirical support for it. This study examines the effectiveness of a *taste-engineering* frame, a sub-frame within an environmental frame of obesity causation that highlights the techniques used by the food industry to increase the availability and over-consumption of processed foods and sugary beverages (Ortiz et al., 2015). This study also investigates the effectiveness of two contextualized values, consumer knowledge and consumer safety, that obesity experts increasingly use to articulate an ideal of consumption based not on personal responsibility, but on valuation of the food industry environment.

Does exposure to a taste-engineering frame and new consumption-relevant values significantly increase support for food and beverage policies? Our results show the effects of causal frames and contextualized values, as well as both together. Furthermore, because public resistance towards policy approaches that address the systemic causes of obesity is based within broader notions of individual responsibility (Lawrence, 2004; Niederdeppe, Shapiro and Porticella, 2011), we assess the effect of treatment exposure on public perceptions regarding the causes of obesity and responsible agents. Finally, we assess whether the effect of frames and contextualized values on level of support for food and beverage policies are moderated by two potentially salient factors identified in other research: political orientation and universal human value dimensions. Our results may enable public-health advocates to build communication strategies that increase public support of population-based obesity prevention policies.

1.1. Conceptual framework

A growing body of research has examined the use of alternative causal frames of obesity besides personal responsibility, such as social justice (Adler and Stewart, 2009), and the use of framing elements in driving support for obesity policies, including metaphors (Barry, Brescoll, Brownell and Schlesinger, 2009), personal

narratives (Lundell et al., 2013; Niederdeppe et al., 2014), thematic frames (Major, 2009), and exemplars (Hoeken and Hustinx, 2007), and causal chains (Gollust et al., 2013). However, there is a paucity of empirical evidence regarding the influence of messages that directly identifies the food industry as a primary causal agent of obesity. We make a special note of the recent study by Niederdeppe et al. (2015) who examined the impact of messages emphasizing soda industry marketing as part of an environmental frame.

As framing research in obesity has increased, so has renewed attention to values, particularly as a way to directly counteract the dominance of personal responsibility in public discourse. The use of values in messaging has been shown to help people assess the efficacy of public policies, leading to more productive thinking about health issues (Manuel and Gilliam, 2008). Given that public-health policies may sometimes be pursued because they have robust associations with particular values over others (FrameWorks Institute, 2005; Guttman, 2000), identifying and testing the influence of values on public support of policies is an essential part of public-health policy-making.

1.2. Taste-engineering frame

A taste-engineering frame is rooted in empirical evidence from behavioral economics that shows the effects of choice manipulation on food choice. It may be considered a component of the environmental frame that is present in expert obesity discourse (Ortiz et al., 2015), and brings together a large assemblage of public health research about the power of food corporations on food consumption, organizing this research into 3 core tenets:

1. **Engineering of the Food Environment.** The food industry shapes the conditions in which food choices are made so that cognitive biases favor overconsumption. Examples include junk-food vending machines in schools, bundling of high-calorie meals as in "value meals" or "all-you-can-eat" buffets, increased portion sizes, placement of candy near the checkout counters of non-food-businesses, and so on (Brescoll et al., 2008; Brownell et al., 2010; Just and Wansink, 2011; McKinnon et al., 2009).

2. **Cognitive Engineering.** The food industry inundates the public with a barrage of advertising to induce over-consumption. Examples include not only traditional advertising, but also food-company sponsorship of special events, product placement in film and TV shows, advergaming, and so on (Harris and Graff, 2012; Institute of Medicine, 2005; Zimmerman, 2011). The purpose of this advertising is to increase the salience of food products, which increases the frequency of consumption.

3. **Physiological Engineering.** The food industry develops food products to exploit the biological need for energy and nutrients to induce overconsumption (Brownell and Gold, 2012; Gearhardt et al., 2011). Examples include the addition of salt and sugar to foods such as bread or milk, the addition of caffeine to foods such as potato chips, and the formulation of new products to have high quantities of salt, sugar, and fat.

Taste-engineering strategies used by the food industry in food development, processing, and advertising transform the purpose of the food industry from providing a product to ensuring that individuals increase over-consumption of that product. By concretely representing food-industry related causes of obesity, a taste-engineering frame directly corresponds with those specific policies that would most successfully countervail food industry strategies. Therefore, we posit that (H_1) respondents exposed to a taste-engineering frame will have higher levels of support for food and beverage policies than respondents in the control group.

1.3. Consumer knowledge and consumer safety

Values can be employed to influence public policymaking and public consideration of a social issue (FrameWorks Institute, 2011; Jennings, 1991). In contrast to what are variously termed foundational or universal values and which shape action indirectly (Hitlin and Piliavin, 2004; Rokeach, 1973; Swidler, 1986; Vaisey, 2009), the values used in public discourse and framing campaigns are often more directly tied to specific contexts. We term these "contextualized values," as they are articulations that are relevant to domain-specific contexts, such as health care, racism, or sexuality (Patterson, 2014). Contextualized values provide evaluative ideas, and thus can be deployed as resources in public discourse to shape new, socially-shared valuations (Abramson, 2012; Patterson, 2014). Patterson (2014) notes how social change in racism and sexism are partially due to some actors in racist or sexist communities articulating new values of racial or sex equality. A more recent example relevant to the policy process is the marriage movement, which attempts to increase marriage and decrease divorce by emphasizing marriage's contribution to financial independence and child development (Avishai et al., 2012).

Two contextualized values, consumer knowledge and consumer safety, are increasingly articulated by obesity experts as ideals with the potential to influence consumer-level behavior in relation to the issues of food and beverage consumption. These are part of an attempt by obesity experts to create discourse that articulates a new value configuration of "consumer sovereignty," which can then be a resource to evaluate the food environment in contrast to the well-known frame of personal responsibility (Ortiz et al., 2015). We posit that (H_2) respondents exposed to contextualized values of consumer knowledge and consumer safety will have increased support for food and beverage policies than respondents in the control group.

An important objective in obesity research is to identify how causal frames and values can work together in framing to inform the public about how their existing values are met by a particular policy (Simon, 2012). Causal frames show how to get to point A. Values remind the public that point A is a place they want to go. Brought together, they can orient opinion in a new direction (Andress, 2004). This comprehensive approach would articulate a value or set of values publicly held in high esteem within the context of the frame (Brewer and Gross, 2005). We posit that (H_3) respondents exposed to a taste-engineering frame and values *together* will have increased support than when exposed to these treatments alone.

1.4. Causal attributes & perceptions of responsibility

The theory of perceived responsibility proposes that public belief about who or what causes a health problem influences public belief about who or what is responsible to address the health problem, which is then significantly linked to public support of policies that address the health problem (Weiner, 1993, 2006). Once a health problem is discovered, assigning responsibility for both the cause and solution to the problem forms the basis of public discourse on the issue (Lawrence, 2004). Indeed, prior studies have demonstrated strong and positive correlations between societal solution attributions and support for public policies (Niederdeppe, Shapiro, et al., 2011). Causal chains, a communication tool that provides a clear explanation of the causes of and mechanisms by which problems are created, help the public become receptive to reform alterations to address a problem (Aubrun and Grady, 2005; Gilliam, 2012). A taste-engineering frame may serve as a causal chain linking food industry engineering practices and obesity. Therefore, we posit that (H_4) respondents exposed to a treatment will be more likely to agree that obesity is a problem in the U.S. because of societal factors. We also posit that (H_5) respondents exposed to a treatment will

attribute greater responsibility for addressing obesity to societal actors, than respondents in the control group.

1.5. Potential factors moderating level of policy support

1.5.1. Political orientation

Previous research demonstrates that public opinion regarding obesity causality and public support of policy solutions to address obesity is significantly influenced by political affiliation and ideology (Barry, Gollust and Niederdeppe, 2012; Gollust, 2013). For example, Niederdeppe et al. (2011) found that persuasive narratives on causal attributes of obesity along with supporting evidence are effective in changing solution attributions for obesity among politically-oriented liberal persons. This effect however, is not significant among conservatives (Niederdeppe, Shapiro, et al., 2011).We posit that (H_6) persons with a liberal political orientation exposed to a treatment will have increased support for food and beverage policies than liberals in the control group and that no statistically significant differences in levels of support will exist between politically-oriented conservatives exposed to a treatment and conservatives in the control group.

1.5.2. Human value dimensions

We consider whether the effect of treatment exposure is influenced by foundational value dimensions (Schwartz, 2012). Value dimensions are deeper, permanent, but usually unarticulated, ideals based on evaluations of what is ultimately meaningful (Patterson, 2014; Swidler, 1986; Vaisey, 2009). These are "inputs" (Abramson, 2012) that may shape opinion and action in a pre-discursive way (Vaisey, 2009), quite differently than contextualized values.

We use Schwartz's (2012) truncated value dimension scheme, but because of space limitations and a focus on value dimensions that may connect to contextualized values of consumer sovereignty and personality responsibility, we examine only three human value dimensions: *benevolence*, *universalism*, and *self-direction*. The benevolence dimension measures a voluntary concern for preserving and enhancing the welfare of others, while the universalism dimension measures the appreciation and protection of the welfare of all people and nature (Schwartz, 2012). These may undergird, and thus enhance, the contextualized values of consumer knowledge and consumer safety. The self-direction dimension is comprised of independent thought and action, measuring individualism, autonomy, and independence (Schwartz, 2012), which may undergird, and thus enhance, the well-articulated personal-responsibility frame. We posit that (H_7) higher scores on the *benevolence* and *universalism* scales will moderate treatment effects in a positive direction, particularly the effects of exposure to contextualized values, on level of support for food and beverage policies, while higher scores on the *self-direction* scale will moderate treatment effects in a negative direction.

2. Research methodology

2.1. Data source

The study uses an online survey experiment, which provides the opportunity to conduct experiments outside the typical laboratory setting among a sample that reflects a broader, more diverse community. The study was approved by the university's Institutional Review Board in September 2014. The experiment was administered by SurveyMonkey in October 2014.

2.2. Study population

The study includes a random sample of 2580 adults, age 18 and

older who are members of the SurveyMonkey Contribute (SMC) online research panel. SurveyMonkey recruits SMC panelists from over 30 million people who answer SurveyMonkey surveys each month. Surveys are self-administered and accessible any time of day for a designated period. For every survey a panelist completes, a 50-cent donation is made by SurveyMonkey to a non-profit charity of the panelist's choice. Panelists can complete a unique survey only once and may leave the survey and the SMC panel at any time (SurveyMonkey, 2015).

2.3. Experimental design

2.3.1. Survey instrument
Survey questions were primarily drawn from previous studies, including the National Health Interview Survey and the California Health Interview Survey (California Department of Public Health, 2013; Parsons et al., 2014), the American National Election Studies survey, the truncated Schwartz value survey (Schwartz, 2012), and the American Attitudes toward Obesity Study (Oliver and Lee, 2005). The remaining measures of obesity causality, (healthy food affordability and the workplace environment) are derived from the literature (Beaulac et al., 2009; Yancey, 2009). The study also examines additional causal attributes of obesity including fatalism (Shugart, 2011), food addiction (Brownell and Gold, 2012), and the role of food advertising (Zimmerman, 2011). The question pertaining to perceptions of responsibility originate from previous studies measuring public opinion on who is responsible for addressing obesity (Evans et al., 2005; Niederdeppe, Shapiro, et al., 2011; Oliver and Lee, 2005).

All respondents were posed questions in the following order prior to treatment exposure: (1) social and demographic characteristics; (2) personal-health characteristics; and (3) political affiliation and political ideology. After treatment exposure, respondents were asked questions related to: (4) level of support for food and beverage policies (respondents in treatment groups only); (5) beliefs regarding causal attributes of obesity; (6) perceptions of responsibility to address obesity; and (7) correspondence with human value dimensions.

2.3.2. Study arms
SurveyMonkey randomly assigned each respondent to one of six study arms—five treatment groups and one control—using a sample-with-replacement random sampling strategy.

Respondents in the first three treatment groups were each exposed to only one treatment: (1) taste-engineering frame (TEF); (2) consumer knowledge value (CK); or (3) consumer safety value (CS). Respondents in Treatment group 4 were exposed to a combination of values (CK + CS), while respondents in Treatment group 5 were exposed to a comprehensive treatment (TEF + CK + CS). The control group was not exposed to any treatment (Table 1: *Treatments per Survey arm*).

The treatments are representative of how they might be discussed in a media report or some other forms of health advocacy materials to which respondents might routinely be exposed. Special attention was paid to increase the level of readability of each of the narratives using the Flesch-Kincaid Grade Level and the Flesch Reading Ease tests, which measure how easily an adult can read and understand a text passage in English (RFP Evaluation Centers, 2015).

2.4. Measures

2.4.1. Level of support for food and beverage policies
Respondents were asked to identify on a five-point ordinal scale (ranging from "*strongly oppose*" to "*strongly support*") the level to

which they supported four randomly-ordered food and beverage policies shown to have significant associations with food and beverage overconsumption: (1) increase healthy food availability in work sites (Jensen, 2011), schools (Story, Kaphingst, Robinson-O'Brien and Glanz, 2008), and hospitals (Winston et al., 2013); (2) require food manufacturers to advertise food products in accordance with their actual nutritional value (Colby et al., 2010); (3) prohibit all high fat, high sugar food advertising on television programming watched primarily by children (Harris, Sarda, Schwartz and Brownell, 2013); and (4) require food manufacturers to disclose the amount of additives in food products on food packaging, additives such as salt, sugar, and caffeine (Gillespie et al., 2015; Guenther et al., 2013).

2.4.2. Level of agreement on causal attributes & perceptions of responsibility
To measure the effects of treatment exposure on beliefs regarding obesity causal attributes, respondents were asked to identify, on a five-point ordinal scale (ranging from "*strongly disagree*" to "*strongly agree*"), the level to which they agreed with seven randomly-ordered responses to the statement "*Obesity is an issue in the U.S. because of*": (1) affordability; (2) food advertising; (3) modern, busy lifestyles; (4) lack of willpower; (5) lack of physical education in schools; (6) food addiction; and (7) the workplace environment.

To measure the effects of treatment exposure regarding perceptions of responsibility to address obesity, respondents were asked to identify, on a five-point ordinal scale, which of the following seven randomly-ordered agents bore a certain level of responsibility for addressing obesity (ranging from "*none*" to a "*great deal*"): (1) employers; (2) government; (3) individuals; (4) physicians; (5) society; (6) the food industry; and (7) schools.

2.4.3. Moderation effects of political orientation
To examine whether political orientation moderates the effect of treatment exposure on level of support for food and beverage policies, we constructed a three-item ordinal variable—political orientation—comprised of two, seven-item measures including political affiliation (ranging from "*strong Republican*" to "*strong Democrat*") and political ideology (ranging from "extremely conservative" to "*extremely liberal*"). From this new, composite variable, a set of three dummy variables (conservative, moderate, and liberal) were created and used in models testing for effect moderation.

2.4.4. Moderation effects of human value dimensions
To measure the moderation effects of human value dimensions, we use segments from the truncated version of the Schwartz Value Survey, recognized as the most widely-tested and comprehensive instrument for measuring moral dispositions (Longest et al., 2013). Respondents were asked to read seven statements pertaining to benevolence, universalism, and self-direction value dimensions and rate how much each she/he is similar to that hypothetical person on a six-point scale ranging from "*not like me at all*" to "*very much like me*" (Appendix 1: *Human Value Dimensions and Corresponding Statements*). We adjust for skewness in individual responses by subtracting the individual's average score across the three human value dimension scales from each of the three individual scales (Longest et al., 2013). Value dimension scales are centered and standardized to have a mean of 0 and a standard deviation of 1.

2.5. Statistical methods

A set of ordinal logistic regression models were used to test the effect of exposure to a treatment condition on level of support for food and beverage policies, level of agreement on causal attributes, and level of responsibility assigned to various agents to address

Table 1
Treatments per survey arm.

Survey arm	Treatment	Readability[a]
Control group	No treatment	NA
Treatment group 1: Taste-engineering frame (TEF)	*Changing tastes through advertising, food production, and the environment* "Lately there has been a lot of talk about the factors that influence food choices in America. For example, food advertising can lead to the selection of unhealthy food and beverages. Certain food additives, such as extra salt, sugar, and caffeine, can also increase the desire for unhealthy food. And the placement of snack food and sugary beverages at checkout counters, especially in non-grocery retail stores, can often result in unintended food purchases and overeating. Consumers should be able to make their own dietary choices. But they also need to be free from the influence of heavy advertising, exposures to habit forming food ingredients, and invasive food product placement."	11/43.2
Treatment group 2: Consumer knowledge (CK)	*Consumer knowledge is essential to healthy living* "Lately there has been a lot of talk about consumer knowledge and food choices in America. Food labeling and accurate food marketing can strengthen consumers' knowledge about food and beverage ingredients. Knowing what is in food and beverages can give consumers confidence when it comes to making informed decisions. Some research has shown that consumers make healthier food and beverage choices when more information is available. Consumers should be able to make their own dietary choices. But they also need the right information to help them make those choices."	9.4/53.9
Treatment group 3: Consumer safety (CS)	*Consumer safety is essential to healthy living* "Lately there has been a lot of talk about consumer safety and food choices in America. Concerns over the long term health effects of genetically modified (GM) food and processed food have been raised. Some research has shown that eating GM food can lead to diseases that are resistant to antibiotics. Certain additives in processed food, such as excess salt, sugar, and caffeine, have also been found to lead some people to crave and seek these foods as if they had become addicted to them. Consumers should be able to make their own dietary choices. But they also need to be safe from food and beverage products that expose them to health risks."	8.8/64.9
Treatment group 4: Consumer knowledge plus Consumer safety (CK + CS)	*Increasing consumer knowledge and ensuring consumer safety:* *Strategies for strengthening food choices* "Lately there has been a lot of talk about the role of consumer knowledge and consumer safety in strengthening food choices. For example, food labeling and accurate food marketing can strengthen consumers' knowledge about food and beverage ingredients. Knowing what is in food and beverages can give consumers confidence when it comes to making informed decisions. Some research has shown that consumers make healthier food and beverage choices when more information is available. Concerns over the long term health effects of genetically modified foods (GM) have also been raised. Some research has shown that eating GM foods can lead to diseases that are resistant to antibiotics. Certain additives in processed food, such as excess salt, sugar, and caffeine, have also been found to lead some people to crave and seek these foods as if they had become addicted to them. Consumers should be able to make their own dietary choices. But they also need the right information to help them make those choices. Moreover, consumers need to be safe from food and beverage products that expose them to health risks."	9.9/56.0
Treatment group 5: Consumer knowledge plus Consumer safety plus taste-engineering (TEF + CK + CS)	*The role of advertising, food production, and the environment on tastes:* *Can increasing consumer knowledge and ensuring consumer safety strengthen food choices?* "Lately there has been a lot of talk about the factors that influence food choices in America. For example, advertising can lead to the selection of unhealthy foods and beverages. Certain food additives, such as extra salt, sugar, and caffeine, can also increase the desire for unhealthy foods. And the placement of snack food and sugary beverages at checkout counters, especially in nongrocery retail stores, can often result in unintended food purchases and overeating. Increasing consumer knowledge could help address these effects. Food labeling and accurate food marketing can strengthen consumers' knowledge about food and beverage ingredients. Knowing what is in food and beverages can give consumers confidence when it comes to making informed decisions. Some research has shown that consumers make healthier food and beverage choices when more information is available. Ensuring consumer safety could also help. Concerns over the long term health effects of genetically modified foods (GM) have been raised. Some research has shown that eating GM foods can lead to diseases that are resistant to antibiotics. Certain additives in processed food, such as excess salt, sugar, and caffeine, have also been found to lead some people to crave and seek these foods as if they had become addicted to them. Consumers should be able to make their own dietary choices, but they need to be free from the influence of heavy advertising, exposures to habit forming food ingredients, and invasive food product placement. Moreover, consumers need the right information to help them make food choices and to be safe from food and beverage products that expose them to health risks.	11/47.5

[a] Based on Flesch-Kincaid Grade Level/Flesch Reading Ease Scale. Ranges include: 0—29 (very difficult); 30—49 (difficult); 50—59 (fairly difficult); 60—69 (standard); 70—79 (fairly easy); 80—89 (easy); 90—100 (very easy).

obesity. The validity of the proportional odds assumption in the ordinal logistic regression models was assessed by using the Brant test of parallel regression (results available upon request). Results show that each of the Likert, 5-item outcome measures were equal interval data. Therefore, parameter estimates from these models indicate the odds of having a higher-level of support, a higher-level of agreement, or assigning greater responsibility above any threshold compared to those below that threshold.

To estimate the interaction effect between exposure to a treatment and political orientation on level of support for food and beverage policies, we examine the difference in the cross-partial derivative of exposure to treatment when political orientation changes from 0 (e.g. liberal or moderate) to 1 (e.g. moderate or conservative) holding each of the covariates at its mean, and determine whether the difference in the predicted probabilities is significant at the *p* < 0.05 level (Karaca Mandic, Norton and Dowd, 2012). Age, gender, race/ethnicity, marital status, homeownership, education, and household income are included as controls in the interaction models since these covariates tend to be significantly associated with political orientation (Niederdeppe, Shapiro, et al., 2011). The results from these analyses provide the basis for stratifying the sample by political orientation and fitting a separate set of ordinal logistic regression models.

To estimate the interaction effect between exposure to a treatment and human value dimension scores, we fit a set of multivariate ordinal logistic regression models that include an interaction term between treatment and the benevolence, universalism, and self-direction value dimension scales. Because the difference between being in any one treatment group and the control group may or may not be significantly different at various levels of policy support for different values within each of the human value dimension scales, we examine the treatment/no treatment difference for various values of each value dimension scale allowing each to vary between its lower bound and upper bound limits in increments of 2.

Response randomization for the order of all responses was used to alleviate order and survey-fatigue bias. All analyses were conducted using Stata Statistical Software, version 14 (Stata Corp, College Station, TX).

3. Results

3.1. Sample population

Randomization to the six study arms resulted in balanced samples on demographic characteristics (Table 2: *Select Demographic Characteristics per Survey Arm*), suggesting that the effect of treatment narratives can be examined by comparing unadjusted results by study arm. Results of a sensitivity analysis, in which regressions controlled for key demographic characteristics and political orientation, offered similar results and are available upon request.

3.2. Level of support for food and beverage policies

Table 3 (*Level of Support for Food and Beverage Policies per Treatment Group*) presents odds ratios and their 95% confidence intervals of the effect of the treatments on level of support for policies that address food industry taste-engineering strategies. Statistically significant effects were found across most of the treatment groups in regards to support for food and beverage policies in comparison to the control group. Among those exposed to a taste-engineering frame (Treatment group 1) or a combination of the consumer knowledge and consumer safety values (Treatment group 4), the odds of having a higher level of support were significantly greater than the control group for 3 of the 4 policies.

Among those in Treatment group 5 — those exposed to the most comprehensive treatment—the odds of having a higher level of support for 2 of the 4 policies were significantly greater than the control group, while those exposed to only the consumer safety value (Treatment group 3) had significantly greater odds of having a higher level of support for 1 of the 4 policies than the control group. No statistically significant treatment effects were found for any of the food and beverage policies among those exposed to only the consumer knowledge value (Treatment group 2).

A summary index was created to examine whether exposure to the treatments increased the number of food and beverage policies that the public endorsed. Among those in Treatment group 1, Treatment group 4, and Treatment group 5, the odds of having a higher level of support for all policies were significantly greater than among those in the control group.

3.2.1. Between-treatment groups analysis

Since these data can help inform the development of effective messaging strategies to influence policy support, we tested whether the coefficients of the treatment groups significantly differed from each other (available upon request). The results suggest that the odds of having a higher level of support for food and beverage policies were significantly greater among respondents in Treatment group 1 and Treatment group 5 in comparison to Treatment group 2. For example, both Treatment group 1 and Treatment group 5 had significantly greater odds of having a higher level of support for a policy requiring healthy food availability in workplaces, hospitals, and schools (Treatment group 1: OR 1.39; 95% CI: 1.07, 1.80 and Treatment group 5: OR 1.33; 95% CI: 1.03, 1.71). We note that there were no significant differences between the coefficients for Treatment 5 (TEF + CK + CS) and either Treatment 1 (TEF) or Treatment 4 (CK + CS).

3.3. Level of agreement on causal attributes & perceptions of responsibility

Table 4 (*Causal Attributes*) presents odds ratios and their 95% confidence intervals for treatment effects on level of agreement regarding causal attributes and levels of responsibility assigned to various agents. The results indicate that exposure to a treatment had significant effects on respondents' beliefs regarding what causes obesity among those in Treatment group 1 and Treatment group 5. For example, the odds of having a higher level of agreement that obesity is caused by food advertising were significantly greater in Treatment group 1 and Treatment group 5 than the control group. However, exposure to a treatment did not significantly influence the level of responsibility assigned to various agents, with the exception of Treatment group 5, which had significantly greater odds of attributing more responsibility to the government, the food industry, and schools than the control group (Table 5: *Perceptions of Responsibility*).

3.4. Moderation effects of political orientation & human value dimension scores

Results from tests of moderation suggest that conservative and liberal political orientation significantly moderated the effect of the treatment on level of support for a subset of food and beverage policies in two treatment groups: Treatment group 4 and Treatment group 5 (Appendix 2: *Conditional Marginal Effects of Political Orientation*). Therefore, a second set of regression models measuring level of support for food and beverage policies in stratified populations of conservatives and liberals were fitted. Among conservative respondents, those exposed to the CK + CS treatment in Treatment group 4 had significantly greater odds than

Table 2
Select demographic characteristics per survey arm.

Demographic characteristic	Control group	Treatment 1 (TEF)	Treatment 2 (CK)	Treatment 3 (CS)	Treatment 4 (CK + CS)	Treatment 5 (TEF + CK + CS)	Total Sample	U.S. Population[a]
	(n = 422)	(n = 411)	(n = 416)	(n = 416)	(n = 499)	(n = 416)	(N = 2580)	
Female (%)	54.0	54.1	54.3	53.5	57.2	53.4	54.5	50.8
Age (%)								
18−29 years	24.2	21.6	24.8	23.5	23.1	24.0	23.5	15.8
30−44 years	23.0	25.6	24.1	24.2	25.9	24.5	24.6	19.8
45−60 years	30.1	29.7	32.4	33.2	29.3	31.6	31.0	21.0
>60 years	22.8	23.1	18.7	19.1	21.7	19.9	20.9	18.5
Race/Ethnicity (%)								
American Indian	0.5	1.2	1.0	0.5	0.4	1.9	0.9	0.9
Asian	4.3	4.9	6.3	4.3	4.0	4.6	4.7	4.8
African American	3.6	3.7	2.9	4.1	2.6	3.6	3.4	12.6
Latino	3.8	5.1	3.9	4.3	4.6	3.9	4.3	16.3
Non-Latino White	87.9	85.2	86.1	86.8	88.4	86.1	86.8	72.4
Marital status (%)								
Married	52.4	50.9	51.0	49.8	50.5	46.2	50.1	48.1
Widowed	3.8	3.7	3.1	1.7	3.6	1.9	3.0	6.0
Divorced	11.4	13.1	13.9	13.7	9.2	12.3	12.2	11.0
Separated	2.4	2.2	0.7	2.9	1.4	1.7	1.9	2.2
Never married	30.1	30.2	31.3	32.0	35.3	38.0	32.9	32.7
Educational attainment (%)								
Less high school diploma	1.4	0.9	1.5	1.2	1.0	1.5	1.3	13.7
High school diploma	10.0	8.4	9.8	9.5	10.5	10.0	9.7	28.0
Some college	27.7	32.8	31.1	32.4	30.6	32.0	31.0	29.1
Bachelors degree	35.1	33.0	31.5	33.2	32.0	28.8	32.3	18.2
Graduate degree	25.8	24.8	26.2	23.7	25.9	27.8	25.7	10.9
Income (%)								
$0 to $24K	13.7	11.0	11.6	12.3	9.6	20.1	12.9	23.8
$25K to $49K	18.9	14.5	20.1	21.9	20.2	21.3	19.5	23.9
$50K to $99K	36.9	37.0	33.4	30.3	37.4	29.7	34.2	29.8
$100K to$149K	16.9	21.0	20.1	20.7	17.9	18.6	19.2	12.7
$150K or more	13.7	16.6	14.8	14.7	14.9	10.2	14.2	9.9

Note: Columns sum to 100% down rows within variable blocks; Percentages may not sum to 100 because of rounding error.
[a] 2013 American Community Survey (ACS). Available at: http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1901&prodType=table.

conservative respondents in the control group of having a higher level of support for a policy requiring food companies to disclose the amount and type of additives in food (OR 2.23; 95% CI: 1.32, 3.79) and a policy prohibiting television food advertising to children (OR 2.08; 95% CI: 1.28, 3.41), adjusting for all other factors. Among liberal respondents, those exposed to the TEF + CK + CS treatment in Treatment group 5 had significantly greater odds than liberal respondents in the control group of having a higher level of support for a policy requiring food companies to disclose the amount and type of additives in food (OR 2.11; 95% CI: 1.33, 3.36) and a policy requiring food companies to advertise food in accordance with its nutritional value, adjusting for all other factors (OR 2.18; 95% CI: 1.40, 3.40).

To gain better understanding of the practical significance of the treatment effects on level of support for food and beverage policies, we compute the average marginal effects of treatment group status among conservatives (Fig. 1) and liberals (Fig. 2). For example, the probability of strongly supporting a policy to disclose additives on food packaging is 44 percent among conservatives exposed to contextualized values in Treatment group 4, compared to 26 percent among conservatives in the control (Fig. 1).

In regards to human value dimensions, results from tests of moderation show that out of a total of 240 possible cases of moderation by value dimensions (three value dimensions × four treatments × four policies × five levels of support), only 5 were

significant. There is no clear pattern among these results to suggest the moderation of treatments by value dimensions.

4. Discussion

These data support four key findings. First, a taste-engineering frame can significantly enhance public support for policies that address taste-engineering strategies used by the food industry. In comparison to a control group not exposed to a treatment, a taste-engineering frame performed well, supporting our first hypothesis. Compared to a treatment with one contextualized value, a taste-engineering frame is consistently more effective in increasing public support of food and beverage policies. This evidence suggests the power of frames to articulate complex causal ideas in a way that influences opinion. It could be that by emphasizing the food industry's overtly causal role in obesity, a taste-engineering frame is able to activate/prime anti-industry sentiment that then makes regulation of that industry more palatable among the public. This is somewhat supported by our findings showing that a taste-engineering frame significantly influences respondents' perceptions about food advertising and food addiction as causal attributes of obesity, thereby partially supporting our fourth hypothesis.

Second, the contextualized values that make up the emerging consumer sovereignty theme, when used together, can significantly enhance public support for policies that address taste-engineering

Table 3
Level of support for food & beverage policies per treatment group.

Treatment group[a]	Food & beverage policies				
	Disclose additives on packaging	Advertise actual nutritional value	Prohibit TV food & bev ads to children	Increase healthy food availability	Index of policies[b]
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Treatment group 1 (TEF)	1.37* [1.05, 1.79]	1.29† [0.99, 1.67]	1.32* [1.03, 1.68]	1.35* [1.04, 1.74]	1.39** [1.09, 1.77]
Treatment group 2 (CK)	1.18 [0.91, 1.53]	1.21 [0.94, 1.55]	1.10 [0.86, 1.40]	0.97 [0.75, 1.25]	1.13 [0.89, 1.43]
Treatment group 3 (CS)	1.21 [0.94, 1.57]	1.30* [1.01, 1.68]	1.12 [0.88, 1.43]	1.08 [0.84, 1.39]	1.19 [0.94, 1.51]
Treatment group 4 (CK + CS)	1.31* [1.02, 1.68]	1.42** [1.11, 1.81]	1.29* [1.03, 1.63]	1.07 [0.84, 1.36]	1.31* [1.04, 1.64]
Treatment group 5 (TEF + CK + CS)	1.40* [1.08, 1.82]	1.58*** [1.23, 2.05]	1.18 [0.92, 1.50]	1.29† [0.99, 1.66]	1.38** [1.09, 1.75]

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, †$p < 0.10$.
OR indicates odds ratios; CI, confidence interval.
[a] Reference is the control group that received no treatment.
[b] Represents a summary index of having a higher level of support for all four (4) food and beverage policies.

strategies used by the food industry, thereby partially supporting our second hypothesis. When used alongside a taste-engineering frame, contextualized values can also significantly influence the public's perception regarding who is responsible for addressing obesity, thereby partially supporting our fifth hypothesis. This is initial evidence that consumer knowledge and consumer safety effectively articulate domain-specific values that can shift opinion about the food industry and consumption. This evidence can support efforts by obesity experts to shape discourse with new evaluations of consumption. However, since the between-groups analysis showed no significant difference between Treatment 5 with Treatment 1 or Treatment 4, any cumulative effect of contextualized values with causal frames is unclear.

Third, we found that political orientation significantly moderates the effect of exposure to a combined consumer knowledge/consumer safety values treatment as well as a combined taste-engineering frame/consumer knowledge/consumer safety values treatment on level of support for food and beverage policies,

thereby partially supporting our sixth hypothesis. These findings suggest that exposure to a taste-engineering frame and contextualized values may circumvent the influence of political orientation on thinking about critical social concerns such as obesity, as well as level of support for food-targeted, obesity prevention policies.

But why did political orientation matter in a few of the treatment groups over others? Because the usual starting point among conservative audiences begins with individual choice on diet and exercise (Niederdeppe, Robert and Kindig, 2011), shifting opinions about policy interventions to address obesity involves looking beyond personal responsibility. It could be that the contextualized values examined here, by emphasizing the importance of volition and individual agency in Treatment 4, can effectively minimize conservatives' wariness towards certain population-based, food and beverage policies. Similarly, pairing these contextualized values alongside a taste-engineering frame may have also appealed to beliefs among liberals for governmental intervention to redress food industry transgressions on consumer freedom. This suggests

Table 4
Level of agreement on causal attributes of obesity per treatment group.

Treatment group[a]	Causal attribute						
	Affordability	Advertising	Lack of PE	Work environment	Lack of willpower	Lifestyle	Food addiction
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Treatment group 1 (TEF)	1.03 [0.80, 1.32]	1.60*** [1.25, 2.06]	1.11 [0.86, 1.42]	0.93 [0.72, 1.19]	1.30* [1.02, 1.66]	0.93 [0.73, 1.18]	1.28† [0.99, 1.64]
Treatment group 2 (CK)	1.08 [0.85, 1.39]	1.06 [0.83, 1.36]	1.02 [0.80, 1.31]	1.00 [0.78, 1.29]	0.97 [0.76, 1.25]	0.95 [0.74, 1.20]	1.12 [0.88, 1.45]
Treatment group 3 (CS)	1.03 [0.81, 1.32]	1.11 [0.87, 1.42]	0.95 [0.74, 1.22]	0.91 [0.71, 1.17]	1.03 [0.80, 1.31]	0.83 [0.65, 1.06]	1.02 [0.79, 1.31]
Treatment group 4 (CK + CS)	1.06 [0.84, 1.35]	1.09 [0.86, 1.38]	1.19 [0.94, 1.52]	0.85 [0.67, 1.08]	1.01 [0.80, 1.28]	0.83 [0.66, 1.05]	1.08 [0.85, 1.37]
Treatment group 5 (TEF + CK + CS)	1.16 [0.91, 1.49]	1.33* [1.04, 1.70]	1.20 [0.94, 1.53]	1.03 [0.80, 1.32]	0.87 [0.68, 1.12]	0.83 [0.65, 1.06]	1.12 [0.88, 1.44]

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, †$p < 0.10$.
OR indicates odds ratios; CI, confidence interval.
[a] Reference is the control group that received no treatment.

Table 5
Level of perceptions of responsibility per treatment group.

Treatment group[a]	Responsible agents						
	Employers	Government	Individuals	Physicians	Society	Industry	Schools
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Treatment group 1 (TEF)	0.91 (0.71, 1.16)	0.96 (0.75, 1.23)	0.88 (0.66, 1.16)	1.10 (0.86, 1.40)	0.93 (0.72, 1.19)	1.02 (0.80, 1.30)	1.02 (0.80, 1.32)
Treatment group 2 (CK)	1.05 (0.82, 1.35)	1.03 (0.81, 1.31)	0.99 (0.74, 1.31)	1.09 (0.86, 1.39)	1.03 (0.81, 1.32)	1.22 (095, 1.55)	1.06 (0.83, 1.35)
Treatment group 3 (CS)	0.99 (0.78, 1.27)	0.93 (0.73, 1.18)	0.97 (0.74, 1.29)	0.87 (0.68, 1.11)	1.06 (0.83, 1.36)	1.00 (0.78, 1.27)	1.16 (0.91 1.48)
Treatment group 4 (CK + CS)	0.94 (0.75, 1.20)	1.08 (0.86, 1.37)	0.77 (0.59, 1.00)	1.04 (0.83, 1.32)	0.92 (0.73, 1.17)	1.18 (0.94, 1.49)	1.10 (0.87, 1.39)
Treatment group 5 (TEF + CK + CS)	0.99 (0.78, 1.27)	1.32* (1.03, 1.68)	0.83 (0.63, 1.10)	1.07 (0.85, 1.37)	1.18 (0.92, 1.51)	1.32* (1.04, 1.70)	1.31* (1.02, 1.67)

***p < 0.001, **p < 0.01, *p < 0.05, †p < 0.10.
OR indicates odds ratios; CI, confidence interval.
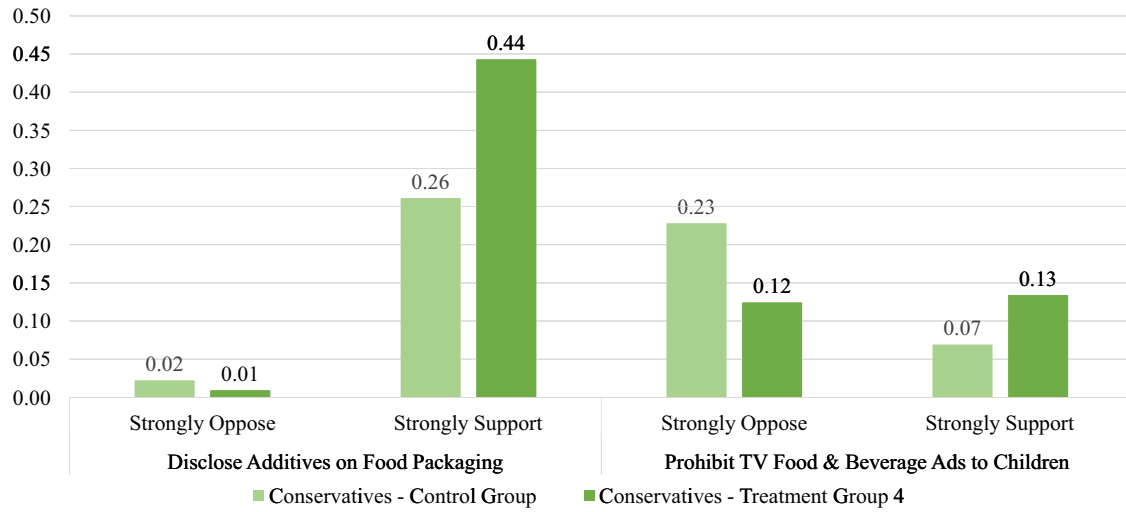 [a] Reference is the control group that received no treatment.

Fig. 1. Average marginal effects of treatment group status on level of support for food & beverage policies among conservatives.
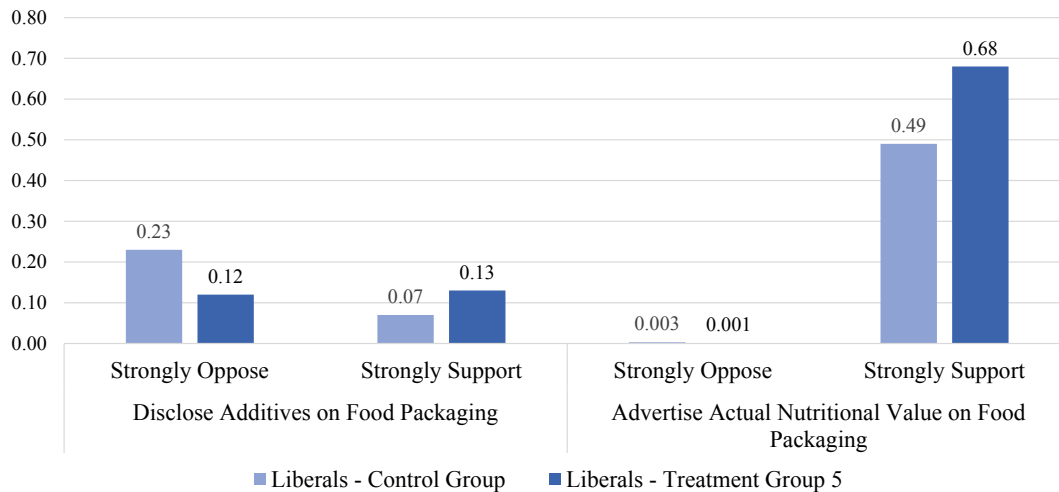

Fig. 2. Average marginal effects of treatment exposure on level of support for food & beverage policies among liberals.

the possibility that articulating new values related to consumption and sovereignty may build political and ideological common ground for new policies (Kindig, 2015).

Finally, these data suggest that the effects of exposure to a taste-engineering frame and contextualized values are not influenced by fundamental, human value dimensions. We found no clear evidence that the human value dimensions we tested are made salient to respondents by causal framing or contextualized values. This reflects research that demonstrates that foundational human values may only be loosely coupled with specific attitudes or behaviors, especially in complex institutional environments such as that of the food industry and policy (Patterson, 2014; Swidler, 1986; Vaisey, 2009). It is theoretically possible that consumer knowledge and consumer safety are related to other value dimensions besides those examined here, which is an area of future research to consider. These results should not be read to mean that values are unimportant. Instead, their role in public policy formation is more complex than often considered, likely requiring domain-relevant articulation.

4.1. Limitations

This study has several limitations. First, because the survey experiment was conducted over the internet, the study was unable to control for the amount of time a respondent was exposed to the treatment. This limitation would result in underestimating the treatment effect on the primary and secondary outcomes. Second, the study respondents are members of SurveyMonkey's Contribute online research panel, which is a non-probability sample. Therefore, the respondents skew from the general U.S. population in a few ways, such as having higher income and education levels, which may raise concerns about external validity and generalizability (SurveyMonkey). Future research should be conducted with a nationally representative sample to strengthen the generalizability of these findings.

Third, although careful attention was paid to increase the readability of the treatments, both the TEF and TEF + CK + CS treatments had considerably lower scores in reading ease than others. This could have resulted in misunderstanding of those particular treatments or significant differences in treatment effects

between respondents with different levels of educational attainment. To investigate this concern, we measured the interaction effect between educational attainment and treatment exposure on level of support for food and beverage policies. The results suggest that educational attainment did not significantly moderate the effects of the treatment on the outcomes of interest.

Finally, we note that the effectiveness of a taste-engineering frame and the contextualized values is tested against a control exposed to no treatment. We presumed that the status quo frame of reference would be personal responsibility. Future research should examine the effectiveness of a taste-engineering frame against the personal-responsibility frame on public support of obesity prevention policies.

5. Conclusion

The more an issue is framed in terms of involuntary, universal, environmental, and knowingly-created risk, the more likely people are to support policies that burden powerful groups (Nathanson, 1999), such as the food industry. Our study finds that exposing people to information about food industry misdeeds increases support for food-industry related, obesity prevention policies; an effect that is somewhat enhanced when values associated with consumer sovereignty are involved. These data suggest that the use of a taste-engineering frame as well the contextualized values of consumer knowledge and consumer safety, could increase public support of policies requiring the food industry to establish 'no harm' practices.

Acknowledgements

Appendix 1. Human value dimensions and corresponding statements[a]

Human value dimension	Corresponding statements
	1) It is important to her/him to be loyal to her/his friends. She/he wants to devote herself/himself to people close to her/him.
Benevolence *Emphasizes a voluntary concern for preserving and enhancing the welfare of all people and nature*	
	2) Its very important to her/him to help the people around her/him. She/he wants to care for their well-being.
	1) She/he thinks it is important that every person in the world should be treated equally. She/he believes everyone should have equal opportunities in life.
Universalism *Underscores understanding, appreciation, and protection of the welfare of all people and nature*	2) It is important to her/him to listen to people who are different from her/him. Even when she/he disagrees with them, she/he still wants to understand them.
	3) She/he strongly believes that people should care for nature. Looking after the environment is important to her/him.
	1) Thinking up new ideas and being creative is important to her/him. She/he likes to do things in her/his own original way.
Self-Direction *Comprised of independent thought and action; derives from the need to obtain individualism, autonomy, and independence*	
	2) It is important to her/him to make her/his own decisions about what she/he does. She/he likes to be free and not depend on others.

[a] Schwartz (2012).

Appendix 2. Conditional marginal effects of political orientation on level of support for food & beverage policies among treatment groups[a]

Policy	Level of Support	Treatment group 4			Treatment group 5		
		Conservative	Non-conservative	Marginal difference	Liberal	Non-liberal	Marginal difference
		Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
		[95% CI]	[95% CI]	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Disclose additives on packaging	Strongly support	−0.017 [−0.0744, 0.0402]	0.103 [0.0237, 0.1829]	−0.120 [−0.2185, −0.2229]	−0.032 [−0.1023, 0.0385]	0.081 [0.0158, 0.1461]	−0.113 [−0.2088, −0.0169]
	Support	0.011 [−0.02618, 0.04862]	−0.044 [−0.08311, −0.0050]	0.055 [0.0011, 0.1094]	0.014 [−0.0152, 0.0429]	−0.057 [−0.1043, −0.0099]	0.071 [0.0155, 0.1265]
	Neither support or oppose	0.005 [−0.01119, 0.0205]	−0.045 [−0.0773, −0.0129]	0.050 [.01389, .0857]	0.014 [−0.0177, 0.0453]	−0.019 [−0.0338, −0.0044]	0.033 [−0.0019, 0.0677]
	Oppose	0.008 [−0.0018, 0.0033]	−0.009 [−0.0151, −0.0021]	0.009 [.0023, .0165]	0.003 [−0.0034, 0.0087]	−0.003 [−0.0054, −0.0006]	0.006 [−0.0011, 0.0122]
	Strongly oppose	0.001 [−0.0011, 0.0020]	−0.006 [−0.0098, −0.0012]	0.006 [.0013, .0106]	0.002 [−0.0022, 0.0055]	−0.002 [−0.0033, −0.0002]	0.003 [−0.0008, 0.0077]
Prohibit TV food & bev ads to children	Strongly support	0.000 [−0.0392, 0.0400]	0.066 [0.0236, 0.1077]	−0.065 [−0.1231, −0.0075]			
	Support	0.000 [−0.0128, 0.01301]	0.054 [0.0241, 0.0832]	−0.054 [−0.0857, −0.0213]			
	Neither support or oppose	0.000 [−0.0190, 0.0186]	0.004 [−0.0075, 0.0151]	−0.004 [−0.0259, .0180]			
	Oppose	0.000 [−0.0203, .0199]	−0.059 [−0.0928, −.0249]	0.059 [0.0192, .0981]			
	Strongly oppose	0.000 [−0.0138, 0.0135]	−0.064 [−0.0975, −0.0309]	0.064 [0.0281, 0.1001]			
Advertise actual nutritional value	Strongly support				−0.013 [−0.0801, 0.0533]	0.116 [0.0495, 0.1818]	−0.129 [−0.2230, −0.351]
	Support				0.003 [−0.0123, 0.0189]	−0.068 [−0.1091, −0.0265]	0.071 [0.0269, 0.1153]
	Neither support or oppose				0.007 [−0.0297, 0.0445]	−0.038 [−0.0576, −0.0173]	0.045 [0.0026, 0.0871]
	Oppose				0.002 [−0.0075, .0112]	−0.007 [−0.0111, −0.0030]	0.009 [−0.0013, 0.0191]
	Strongly oppose				0.001 [−0.0038, 0.0056]	−0.003 [−0.0053, −0.0012]	0.004 [−0.0009, 0.0094]

[a] Conditional marginal effects calculated at sample means.

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