Who Disagrees with Scientists? Public beliefs about the Safety of Genetically Modified Food and Human Involvement in Global Warming

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1. Introduction

Population increase has spurred public and private investment in science with anticipations of understanding and responding to future challenges of food security and sustainability. However, science does not operate in a vacuum. Funding for science depends on public support for their activities, and the policy advice of scientists hinges on the public's trust and willingness to believe the results generated by scientists. In particular, it is unclear whether the general public believes the scientific evidence on the safety of genetically modified (GM) food or that human activities are partly to cause for global warming (GW). Thus, a limiting factor for possible return on scientific investment and resulting innovation may be public perception.

The majority of scientists belonging to The American Association for the Advancement of Science (AAAS) agree that it is safe to eat genetically modified (GM) foods and that human activities are causing GW (Pew, 2015). According to a recent survey conducted by the Pew Research Center, 88% and 87% of AAAS scientists believe that GM foods are safe to eat and GW is mostly due to human activity, respectively. While scientists have reached a near consensus, the general public is not as convinced. The same study revealed that only 37% and 50% of U.S. adults believe that GM foods are safe to eat and GW is mostly due to human activity, respectively.

A better understanding of why the general public disagrees with the scientific community is needed. It has been argued that agreement with science may be a politically partisan issue. The Anti-Reflexivity Thesis (McCright et al., 2013) posits that Republicans will agree with science that provides innovations for economic production (i.e., GM crops) and disagree with science that identifies negative impacts of economic production (i.e., GW), and Democrats will behave in an opposite manner. Furthermore, it has been argued that Republicans are more likely to deny scientific evidence (i.e., Mooney, 2005; Mooney, 2012) or not fully understand possible impacts of societal risks (Hamilton, Cutler, and Schaefer, 2012). However, it has also been argued that Republicans and Democrats are equally susceptible to biased assimilation of scientific information (Kahan, 2013).

Rabin and Schrag (1999) conjectured illusionary correlation contribute to the formation of false hypotheses. Illusionary correlation occurs when an individual believes a correlation to

exist between two events that uncorrelated, correlated but to a lesser extent than believed, or correlated in an opposite direction than believed (Chapman, 1967). A contemporary example of illusionary correlation is the causal connection between vaccinations and autism. Although a recent study found no increased risk for autistic disorder due to exposure to vaccines (DeStefano, Price, and Weintraub, 2013), some of the general public choose to avoid vaccinating children for fear that a vaccination will cause autism. Similar concerns about GM foods and autism have been voiced by some of the general public as well.

Variations in familiarity, or knowledge, about GM foods or GW may have some effect on disagreement with science across individuals. Jang (2013) concluded that participants selected scientific information based on preexisting beliefs. Furthermore, participants who had a high level of perceived science knowledge were more likely to strengthen a preexisting belief by preferring information that echoed a preexisting belief. Conversely, participants with a high level of actual scientific knowledge, not just perceived, did not display a preference for agreeable information when selecting scientific information to read.

Exploration into the psychology of beliefs and deviation from normative decision-making prompted the partition of two modes of thinking and deciding. Stanovich and West (2000) formally defined the two modes of cognitive function as System 1 and System 2, and the systems can be thought of more generally as intuition and reasoning, respectively (Kahneman, 2003). Individuals who have a tendency to rely on System 1 have a more interactional intelligence compared to individuals who have a tendency to rely on System 2 and have a more analytical intelligence.

The objective of this study was to determine the factors associated with disagreement with the scientific consensus regarding GM foods and human involvement in GW. While it is well established that many people not in agreement with the scientific community, it is not clear what factors affect the divergence. We hypothesize that political party affiliation will affect disagreement with science. Specifically, we hypothesize that Democrats will be more likely more likely to disagree with scientists about the safety of GM foods and Republicans will be more likely to disagree with scientists about human involvement in GW. Additionally, we hypothesize that individuals with higher levels of illusionary correlation about GM foods or GW will be more likely to disagree with scientists. We hypothesize that cognitive function, perceived

knowledge and actual knowledge about GM foods and GW affects disagreement with science, however, we have no *a priori* hypotheses about the direction of the effects.

2. Methods

2.1 Subjects

To address the research questions, an internet survey was developed and administered to a representative sample of the U.S. population. The survey was sent to a sample of 961 participants enrolled in an online panel maintained by Qualtrics© and their associated partners. The survey was fielded from April 24, 2013 through April 27, 2013. Qualtrics© prescreened participants by gender, education, and income to ensure the sample was representative of the U.S population. According to the 2012 U.S. Census Bureau, females represented 50.8% of the population, 28.2% of persons age 25+ held a Bachelor's degree, and the median household income was $52,762. Our sample closely matched these population statistics. Fifty-one percent of the survey sample was comprised of females (*SD* = 0.50), 29% percent held a Bachelor's degree (*SD* = 0.46), and the median income category was $40,000 to $59,999.

2.2 Survey Overview

After participants consented to take the survey, a variety of questions about the safety of GM foods and human involvement in GW were asked. Questions about the two societal risks were asked in blocks, and the blocks were counterbalanced across respondents to eliminate an order effect. Within a block were the following: 1) two questions to measure a participant's belief about the safety of GM foods or human involvement in GW; 2) a question to determine if a participant believed scientific research supported a belief; 3) three questions to determine if a participant held illusionary correlations about GM foods or GW; and 4) three questions to determine knowledge of GM foods or GW.

Participants finished the survey by completing the Cognitive Reflection Test (CRT) introduced by Frederick (2005) and answering standard demographic question. The CRT is a

three-question test designed to generate incorrect intuitive answers. The CRT has been used to measure the ability of an individual to engage in higher forms of reasoning.[1]

3. Summary Statistics and Econometric Models

3.1 Summary Statistics

A participant's belief about an issue was measured by asking the level of agreement with two statements. Statements about the safety of GM foods were: "Genetically modified crops are safe to eat" and "Food that has genetically modified ingredients is safe to eat." Statements about human involvement in GW were: "The Earth is getting warmer because of human actions" and "Human actions are a cause of global warming." Participants chose a level of agreement for each statement from a symmetric five-point scale with response options: Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, and Strongly Agree.

Answers were coded from one (Strongly Disagree) to five (Strongly Agree) and were summed across the two statements; so that a belief score for each issue could range from two to ten. Based on a belief score, beliefs for each issue were categorized into one of the following groups: *Believe*, *Deny*, or *Neutral*. For example, a participant whose prior belief score was in the two to five range was categorized in the *Deny* group, in the seven to ten range was categorized in the *Believe* group, and a score of six was categorized in the *Neutral* group.

Table 1 shows the relative frequencies of participant beliefs about the safety of GM foods or human involvement in GW. We found that approximately 32% and 64% of participants believed GM foods are safe to eat and human actions are causing GW, respectively. Conversely, approximately 37% of participants denied that GM food is safe to consume, compared to only 18% of participants who denied that human activities are causing global warming.

These findings are reasonably similar to those found by Pew (2015). Our survey found slightly lower but generally similar levels of support for belief in safety of GM food (32% vs. 37%), but we found much higher support for human involvement in GW (64% vs. 50%). The divergence in the latter issue could be attributed to differences in the way the questions were

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[1] The specific questions described are shown in the Appendix, except the demographic questions.

asked or the response categories used. To measure GW beliefs, Pew (2015) asked, "which of these three statements about the earth's temperature comes closest to your view?" response categories were "the earth is getting warmer mostly because of human activity such as burning fossil fuels" (49% picked this option) or "The earth is getting warmer mostly because of natural patterns in the earth's environment" (36% picked this option) or "There is no solid evidence that the earth is getting warmer" (11% picked this option) or "Don't know" (4% picked this option).

We created an indicator variables for each issue, denoted by *Disagree,* that was equal to one if a participant was in the Deny group, zero otherwise. The joint frequency of disagreement is shown in Table 2. Only 7% of participants disagreed with scientific consensus about both issues.

Descriptions of explanatory variables created from the remaining questions, and corresponding means, are shown in Table 3.

2.3 Econometric Models

To examine how individual differences affect disagreement with scientific consensus, we estimated two binary probit models that can be expressed by:

$$Disagree_{GM} = x_1'\beta_1 + \varepsilon_1, \tag{1}$$

$$Disagree_{GW} = x_2'\beta_2 + \varepsilon_2. \tag{2}$$

However, before examining the estimated marginal effects from the binary probit models, we estimated a bivariate probit to determine if tetrachoric correlation was significant between *Disagree_{GM}* and *Disagree_{GW}*. Tetrachoric correlation was a concern because the joint frequencies presented in Table 2 shows that the independent variables varied jointly for 60 percent of the participants. Estimating the binary probit models independently would result in biased estimates if a bivariate relationship between *Disagree_{GM}* and *Disagree_{GW}* was present.

To further examine heterogeneity in disagreement with scientific consensus, we estimated a multinomial logit where people were classified into one of four groups based on their agreement or disagreement on both GM and SW issues. For example, if a participant disagreed

with scientific consensus about both issues, then that participant was coded as one for the *Disagree GM & GW* and a zero for the remaining categories (i.e., *Do not disagree GM & GW*, *Disagree GM & do not disagree GW*, and *Do not disagree GM & disagree GW*). Due to an identification problem, the political party indicator variables for Democrats and Republicans were collapsed to create the variables *Combined Democrat* and *Combined Republican*.

4. Results

The estimated coefficients for the bivariate probit are displayed in table 4. As shown, the tetrachoric correlation between the two error terms in (1) and (2), denoted by Rho, was not significant and thus estimates from separate univariate probit models are not biased. Marginal effects estimated from equations (1) and (2) are displayed in table 5.

Unexpectedly, *Strong Democrat* was negative and significant in the Disagree GM model. Thus, participants that self-identified as being a strong democrat were less likely to disagree that GM foods are safe to eat. This does not confirm the Anti-Reflexivity Thesis. However, *Democrat* and *I don't know political party* were negative and significant and *Republican* and *Strong Republican* were positive and significant in the Disagree GW model. Indicating that participants self-identifying as democrat were less likely to disagree that human activities are responsible for GW, and participants self-identifying as republicans and strong republicans were more likely to disagree that human activities are responsible for GW. This does confirm the Anti-Reflexivity Thesis.

Illusionary Correlation was significant and positive in both models. Perceived Knowledge was significant and negative in both models. Actual Knowledge was significant in both models, however, it was negative in the Disagree GM model and positive in the Disagree GW model. Cognitive reflection test was significant and positive in both models. Bachelors was significant and negative in the Disagree GW model. Female was significant in both models, however, it was positive in the Disagree GM model and negative in the Disagree GW model.

Marginal effects from the multinomial logit model are displayed in table 6. Republicans were less likely to be in the *Do not disagree GM & disagree GW* category. The Illusionary

correlation variables were significant across all categories and all signs were as expected except for *Illusionary correlation GW* in the *Do not disagree GM & GW* category. Although, it was only significant at the 10% level.

Perceived knowledge GW was significant for all categories and *Perceived knowledge GM* was significant for all categories except *Do not disagree GM & disagree GW*. The signs of the *Perceived knowledge* variables indicated that participants who believed scientific research supported a belief were more likely to not disagree with the scientific consensus and less likely to disagree. *Actual Knowledge GM* was significant and positive for the *Do not disagree GM & GW* category and negative for the *Disagree GM & do not disagree GW* category. This result was not surprising as it indicated that participants with more knowledge were less likely to disagree with the scientific consensus that GM foods are safe to consume. *Actual Knowledge GW* was significant and positive in for the *Do not disagree GM & disagree GW* and *Disagree GM & GW* categories. This result was a bit surprising as it indicated that participants with more knowledge about GW are more likely to disagree that human activities are causing GW. Possibly, these participants have researched the topic and are knowledgeable but disagree, nevertheless.

The measure of cognitive function, *Cognitive reflection test*, was significant and negative for the *Do not disagree GM & GW* category and positive for the *Disagree GM & do not disagree GW* and *Do not disagree GM & disagree GW* categories. Thus, it does not appear that interactional intelligence is associated with divergence from the scientific community. Rather, individuals who rely more on analytical intelligence were more likely to disagree with scientific consensus about GM food safety and human involvement in GW. Participants who have received a Bachelor's degree and are female were less likely to be in the *Do not disagree GM & disagree GW*. Females were also less likely to be in the *Do not disagree GM & GW* category and more likely to be in the *Disagree GM & do not disagree GW* category.

5. Conclusions

There is great uncertainty because of challenges presented by increasing population growth and global warming, and although there will always be disagreement regarding which policies are best pursued, the issues are further complicated by public dispute over the present state of

scientific knowledge. The ability of scientists, and for scientific knowledge, to contribute to these pressing issues will hinge on public acceptance. This study sought to provide a better understanding of why the general public does not agree with the scientific community about GM food safety and human involvement in GW.

We found that political party affiliation does affect disagreement with science, however, political affiliation was not the most significant factor and did not always have the expected effect. Participants that self-identified as being a strong Democrat were less likely to disagree that GM foods safe to consume. Furthermore, Republicans were less likely to be in the category that disagreed about human involvement in GW and did not disagree about GM food safety. Finally, Democrats were less likely to disagree that human activities are causing GW.

Illusionary correlations, perceived knowledge, and actual knowledge appear to all be important factors when examining public divergence from the scientific community. It is possible that scientific communication with the general public should focus more on decreasing illusionary correlations. Participants with higher levels of perceived knowledge were less likely to disagree and may indicate that there was familiarity with scientific consensus about the issues. A peculiar finding was that participants with more knowledge about GW were more likely to disagree that human actions are causing it. Although, participants with more knowledge about GM foods were less likely to disagree about the safety. Those results were contradicting and are difficult to explain.

Increased cognitive function was associated with disagreement with science. This result was also perplexing and may indicate that people who are more analytical are more likely to have beliefs that contradict the scientific community. Gender may play a larger role in disagreement with science than political affiliation. Females were more likely to disagree with science about GM safety and less likely to disagree about human involvement in GW.

Future research may provide more insights into the kinds of information that are likely to be most influential. Stories or emotional appeals may have more pronounced effects on beliefs.

References

Chapman, L.J. 1967. "Illusory Correlation in Observational Report." *Journal of Verbal Learning and Verbal Behavior* 6:151-155.

DeStefano, F., C.S. Price, and E.S. Weintraub. 2013. "Increasing Exposure to Antibody-Stimulating Proteins and Polysaccharides in Vaccines Is Not Associated with Risk of Autism." *The Journal of Pediatrics* 163:561-567.

Hamilton, L.C., M.J. Cutler, and A. Schaefer. 2012. "Public Knowledge and Concern about Polar-Region Warming" *Polar Geography* 35:155-168.

Jang, S.M. 2013. "Seeking Congruency or Incongruency Online? Examining Selective Exposure to Four Controversial Science Issues." *Science Communication*, in press.

Kahan, D.M. 2013. "Ideology, Motivated Reasoning, and Cognitive Reflection." *Judgment and Decision Making* 8:407–424.

Kahneman, D. 2003. "Maps of Bounded Rationality: Psychology for Behavioral Economics." *American Economic Review* 95:1149-1475.

McCright, A.M., K. Dentzman, M. Charters, and T. Dietz. 2013. "The Influence of Political Ideology on Trust in Science." *Environmental Research Letters* 8:044029.

Mooney, C. 2012. *The Republican Brain: The Science of Why They Deny Science – and Reality*. New Jersey: Wiley.

Mooney, C. 2005. *The Republican War on Science*. New York: Basic Books.

Pew Research Center, January 29, 2015, "Public and Scientists' Views on Science and Society."

Rabin, M., and J.L. Schrag. 1999. "First Impressions Matter: A Model of Confimatory Bias." *The Quarterly Journal of Economics* 114:37-82.

Stanovich, K.E., and R.F. West. 2000. "Individual Differences in Reasoning: Implications for the Rationality Debate?" *Behavorial and Brain Sciences* 23:645-665.

Table 1. Relative Frequencies of Beliefs about the Safety of Genetically Modified Foods and Human Involvement in Global Warming

Variables	Descriptions	Relative Frequencies	
		GM	GW
Believe	Participants who believe GM foods are safe to eat or human actions are causing GW.	0.319	0.639
Deny	Participants who deny GM foods are safe to eat or human actions are causing GW.	0.366	0.183
Neutral	Participants who neither believe nor deny GM foods are safe to eat or human actions are causing GW.	0.315	0.178

Table 2. Joint Frequency of Disagreement with Scientific Consensus about the Safety of Genetically Modified Foods and Human Involvement in Global Warming

Safety of Genetically Modified Foods	Human Involvement in Global Warming		
	Do not disagree	*Disagree*	
Do not disagree	505 (53%)	105 (11%)	610 (63%)
Disagree	281 (29%)	70 (7%)	351 (37%)
	786 (82%)	175 (18%)	961 (100%)

Note: Percentages in parentheses are relative frequencies.

Table 3. Descriptions and Means of Explanatory Variables

Explanatory Variables	Descriptions	Means
Strong Democrat	1 if a participant self-identified as a Strong Democrat, 0 otherwise.	0.094
Democrat	1 if a participant self-identified as a Democrat, 0 otherwise.	0.194
Lean Democrat	1 if a participant self-identified as an Independent Lean Democrat,	0.106
Lean Republican	1 if a participant self-identified as an Independent Lean	0.079
Republican	1 if a participant self-identified as a Republican, 0 otherwise.	0.148
Strong Republican	1 if a participant self-identified as a Strong Republican, 0	0.063
Other political party	1 if a participant self-identified as a belonging to a political party other than Democrat or Republican, 0 otherwise.	0.034
I don't known political party	1 if a participant self-identified as not knowing their political party, 0 otherwise.	0.061
Illusionary correlation GM	An integer variable ranging from 3 (strongly disagree) to 15 (strongly agree), determined by the sum of three level of agreement questions measuring illusionary correlations about GM foods.	8.978
Illusionary correlation GW	An integer variable ranging from 3 (strongly disagree) to 15 (strongly agree), determined by the sum of three level of agreement questions measuring illusionary correlations about human involvement in GW.	7.714
Perceived knowledge GM	An integer variable ranging from 1 (strongly disagree) to 5 (strongly agree), determined by the level of agreement that scientific research supported a belief about the safety of GM foods.	3.282
Perceived knowledge GW	An integer variable ranging from 1 (strongly disagree) to 5 (strongly agree), determined by the level of agreement that scientific research supported a belief about human involvement in GW.	3.661
Actual knowledge GM	An integer variable ranging from 0 to 3, determined by the number of correctly answered true/false questions about GM foods.	2.049
Actual knowledge GW	An integer variable ranging from 0 to 3, determined by the number of correctly answered true/false questions about GW.	1.060
CRT	An integer variable ranging from 0 to 3, determined by the number of correctly answered Cognitive Reflection Test questions.	0.318
Age	Age in years.	26.773
Bachelors	1 if Bachelor's degree or higher, 0 otherwise.	0.292
Female	1 if female, 0 if male.	0.512
Income	An integer variable ranging from 1 to 8, used to represent income categories (1=$0-19,999, 2=$20,000-$39,999…8=$140,000 or more).	3.353

Table 4. Coefficient Estimates from the Bivariate Probit Model

Explanatory Variables	Dependent Variables			
	Disagree GM		*Disagree GW*	
	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Constant	-1.854***	0.322	-1.796***	0.476
Strong Democrat	-0.429**	0.180	0.115	0.264
Democrat	-0.148	0.151	-0.577**	0.249
Lean Democrat	0.015	0.185	0.108	0.251
Lean Republican	0.159	0.212	-0.004	0.227
Republican	-0.014	0.162	0.346*	0.186
Strong Republican	-0.124	0.206	0.427*	0.246
Other political party	0.067	0.272	-0.515	0.367
I don't known political party	0.083	0.219	-0.624	0.422
Illusionary correlation GM/GW	0.292***	0.024	0.262***	0.033
Perceived knowledge GM/GW	-0.355***	0.061	-0.485***	0.081
Actual knowledge GM/GW	-0.111**	0.051	0.241***	0.083
Cognitive reflection test	0.143*	0.086	0.210*	0.118
Age	-0.001	0.004	0.004	0.005
Bachelors	0.010	0.118	-0.332**	0.154
Female	0.335***	0.101	-0.334***	0.128
Income	0.008	0.031	0.023	0.042
Rho	1.151	0.097		
Log Likelihood	-757.957			

Note: Estimates are from a bivariate probit model using 953 observations. Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% level.

Table 5. Marginal Effects from the Univariate Probit Models

	Dependent Variables			
	Disagree GM		*Disagree GW*	
Explanatory Variables	Marginal Effects	Standard Error	Marginal Effects	Standard Error
Strong Democrat	-0.115**	0.049	0.010	0.044
Democrat	-0.040	0.041	-0.090***	0.029
Lean Democrat	0.006	0.050	0.018	0.039
Lean Republican	0.047	0.057	-0.002	0.038
Republican	0.000	0.044	0.062*	0.033
Strong Republican	-0.033	0.057	0.082*	0.048
Other political party	0.018	0.075	-0.072	0.045
I don't known political party	0.025	0.059	-0.089**	0.038
Illusionary correlation GM/GW	0.081***	0.005	0.043***	0.005
Perceived knowledge GM/GW	-0.101***	0.016	-0.085***	0.011
Actual knowledge GM/GW	-0.030**	0.014	0.041***	0.012
Cognitive reflection test	0.041*	0.023	0.035*	0.017
Age	-0.000	0.001	0.001	0.001
Bachelors	0.002	0.033	-0.053**	0.023
Female	0.097***	0.028	-0.057***	0.021
Income	0.002	0.008	0.001	0.006
Log Likelihood	-474.245		-287.609	

Note: Estimates are from univariate probit models using 954 and 960 observations. Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% level.

Table 6. Marginal Effects from the Multinomial Logit Model

Explanatory Variables	Dependent Variables			
	Do not disagree GM & GW	*Disagree GM & do not disagree GW*	*Do not disagree GM & disagree GW*	*Disagree GM & GW*
Combined Democrat	0.056	-0.042	-0.004	-0.010
	(0.042)	(0.041)	(0.014)	(0.007)
Combined Republican	-0.044	0.008	-0.036***	0.000
	(0.047)	(0.046)	(0.014)	(0.006)
Illusionary correlation GM	-0.088***	0.103***	-0.020***	0.004***
	(0.010)	(0.009)	(0.004)	(0.002)
Illusionary correlation GW	0.015*	-0.045***	0.020***	0.010***
	(0.099)	(0.008)	(0.004)	(0.002)
Perceived knowledge GM	0.095***	-0.095***	0.012	-0.011***
	(0.023)	(0.002)	(0.008)	(0.004)
Perceived knowledge GW	0.119***	-0.070***	-0.032***	-0.016***
	(0.026)	(0.025)	(0.008)	(0.005)
Actual knowledge GM	0.039**	-0.046**	0.006	0.001
	(0.019)	(0.018)	(0.007)	(0.003)
Actual knowledge GW	-0.022	-0.001	0.016**	0.007**
	(0.022)	(0.021)	(0.007)	(0.003)
Cognitive reflection test	-0.088***	0.067**	0.015*	0.005
	(0.049)	(0.030)	(0.009)	(0.005)
Age	0.001	-0.002	0.000	0.000
	(0.001)	(0.001)	(0.000)	(0.000)
Bachelors	0.040	-0.002	-0.032**	-0.005
	(0.044)	(0.042)	(0.014)	(0.005)
Female	-0.114***	0.0138***	-0.019*	-0.005
	(0.037)	(0.035)	(0.011)	(0.005)
Income	-0.014	0.011	0.004	-0.001
	(0.011)	(0.011)	(0.003)	(0.002)
Log Likelihood	-727.036			

Note: Estimates are from univariate probit models using 953 observations. Standard errors are reported in parenthesis. Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% level.

Appendix

Q2 To what extent do you agree or disagree with the following statement? "Genetically modified crops are safe to eat."
- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Neither Agree nor Disagree (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q3 To what extent do you agree or disagree with the following statement? "Food that has genetically modified ingredients is safe to eat."
- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Neither Agree nor Disagree (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q4 To what extent do you agree or disagree with the following statement?"Scientific research supports my views about the safety of genetically modified crops."
- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Neither Agree nor Disagree (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q5 To what extent do you agree or disagree with the following statement? "Genetically modified crops have caused an increase in food allergies."
- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Neither Agree nor Disagree (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q6 To what extent do you agree or disagree with the following statement? "Genetically modified crops have caused an increase in incidence of Autism."
- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Neither Agree nor Disagree (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q7 To what extent do you agree or disagree with the following statement? "Genetically modified crops were invented by Monsanto and are ruining humanity."
- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Neither Agree nor Disagree (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q8 Is the following statement true or false? "Ordinary tomatoes do not contain genes while genetically modified tomatoes do."
- ○ True (1)
- ○ False (2)

Q9 Is the following statement true or false? "By eating a genetically modified fruit a person's genes could become modified."
- ○ True (1)
- ○ False (2)

Q10 Is the following statement true or false? "Genetically modified animals are always bigger than ordinary ones."
- ○ True (1)
- ○ False (2)

Q17 To what extent do you agree or disagree with the following statement? "The Earth is getting warmer because of human actions."
- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Neither Agree nor Disagree (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q18 To what extent do you agree or disagree with the following statement? "Human actions are a cause of global warming."
- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Neither Agree nor Disagree (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q19 To what extent do you agree or disagree with the following statement? "Scientific research supports my views about human activity and global warming."

○ Strongly Disagree (1)
○ Disagree (2)
○ Neither Agree nor Disagree (3)
○ Agree (4)
○ Strongly Agree (5)

Q20 To what extent do you agree or disagree with the following statement? "The Earth is not warming, the Earth is actually cooling."

○ Strongly Disagree (1)
○ Disagree (2)
○ Neither Agree nor Disagree (3)
○ Agree (4)
○ Strongly Agree (5)

Q21 To what extent do you agree or disagree with the following statement? "The warming of the Earth is just a natural cycle."

○ Strongly Disagree (1)
○ Disagree (2)
○ Neither Agree nor Disagree (3)
○ Agree (4)
○ Strongly Agree (5)

Q22 To what extent do you agree or disagree with the following statement? "Global warming is a conspiracy to redistribute wealth from the United States to other countries."

○ Strongly Disagree (1)
○ Disagree (2)
○ Neither Agree nor Disagree (3)
○ Agree (4)
○ Strongly Agree (5)

Q23 Is the following statement true or false? "Climate often changes from year to year."

○ True (1)
○ False (2)

Q24 Is the following statement true or false? "Changes in local weather indicate changes in climate."

○ True (1)
○ False (2)

Q25 Is the following statement true or false? "The greenhouse effect is the same thing as global warming."

○ True (1)

○ False (2)

Q41 A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?

Q42 If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

Q43 In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half the lake?