Can You Cite That? Describing Tennessee Consumers' Use of GMO Information Channels and Sources

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Abstract

The purpose of this study was to better understand where and how Tennessee consumers receive information about genetically modified (GM) products by examining the use of informational channels and sources among consumers with negative-leaning, neutral, and positive-leaning perceptions of GM products. Twenty percent of respondents were categorized as having negative-leaning perceptions, roughly two-thirds held neutral perceptions, and only 10% of respondents had positive-leaning perceptions. The use of information channels was similar across all perception groups, with websites, word-of-mouth communication, television, and social media as the primary channels used. However, respondents with negative GM perceptions primarily used food bloggers, family, and friends as informational sources, while those with positive-leaning perceptions used food scientists, USDA professionals, and agricultural producers. The findings of this study offer implications for a variety of audiences and communication goals, whether such goals be to market to an existing consumer base or develop an educational campaign to address misconceptions among consumer groups.

Keywords

GMO perceptions, grouping, public opinion, survey, communication

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Introduction and Problem Statement

Genetically modified organisms (GMOs) have become widely used in agriculture in recent years, largely due to the rapidly increasing human population and related challenges, such as decreasing land area and water resources (Long & Ort, 2010; Oliver, 2014). Many consumers, often younger (Hefferon & Anderson, 2016), middle class (Kahn, 2021), and women (Funk, 2020), are against the use of GMOs for a myriad of reasons, such as concern about the effects on human health and consequences of altering an organism's genome (Kahn, 2021; Oliver, 2014; Yang & Chen, 2016), the impact on natural biodiversity and the environment (Fischer & Hess, 2021; Trivedi et al., 2016), a lack of perceived benefits for consumers (Fresco, 2001; Kahn, 2021), and social and ethical issues associated with GMO technology (Fischer & Hess, 2021).

In the early to mid-1990s, there were more scientific articles published about GMOs than news articles, but in 1999, yearly published GMO news articles far exceeded academic articles (Wunderlich & Gatto, 2015). Global online GMO content in the media has been found to be 90% – 95% negative (Abbott et al., 2001; Abbott & Lucht, 2001). Online news titles and Google search pages have been found to have more negative than positive terms related to GMOs, while federal websites use positive and negative terms equally (Jiang et al., 2018). The framing of science and health-related topics, as well as access to this information, can influence public opinions about agriculture (Jiang et al., 2018). Therefore, it is necessary to understand the sources, the individuals or institutions that originate a message, and channels, the means by which a message gets to receivers, that individuals utilize for GMO information (O'Keefe et al., 1998; Stone et al., 1999; Tucker & Napier, 2002).

Theoretical and Conceptual Framework

Information Sources

Sources can include government and academic institutions, businesses and non-government organizations, and individuals, such as friends, family, neighbors, opinion leaders, and so forth (Söderlund & Lundin, 2017). Many consumers turn to online sources for their GMO information, which tend to discuss very different GMO topics. For example, Jiang and colleagues (2018) found that only 10% of the most central GMO-related words were shared by federal websites, highly trafficked websites, and online news sources, and 42% to 78% of words were unique to each source. Online news titles were most often argumentative and featured more negative than positive terms for GMOs, while federal websites focused on regulatory processes (Jiang et al., 2018). There is a lack of trust in media sources, as 56% of Americans say news media are doing a very or somewhat bad job covering issues about GMO foods; this figure rises to 73% when compared to those with higher self-reported science knowledge (Funk & Kennedy, 2016).

Interestingly, the sources that individuals turn to for information are often not the same sources they cite as credible (Sharma et al., 2008; Wilkins et al., 2018). For example, individuals often find scientists and agricultural officers to be the most credible (Funk & Kennedy, 2016; Sharma et al., 2008). Local leaders, like opinion leaders and progressive farmers, are often cited as the second most credible source (Kumar Sharm et al., 2008). Word-of-mouth communication between friends, family, and neighbors were also frequently used and perceived as highly credible (Sharma et al., 2008). Yet, studies still show the internet is one of the most preferred methods for obtaining GMO information (Aleksejeva, 2014; Cui & Shoemaker, 2018).

Information Channels

Channels can traditionally be grouped into personal networks (e.g., family, friends, opinion leaders, printed media, and electronic media) (Csótó, 2011), though the internet has largely influenced recent dissemination of GMO-related information because it is quick and accessible. A recent study found participants' stated preferred interpersonal method of gaining science knowledge was word-of-mouth communication and personal experiences, but participants actually used media outlets, especially digital ones, most often to gain science information (Brondi et al., 2021). However, printed and electronic media portrayal of the GMO debate has fundamentally shaped individual beliefs so that GMOs are inherently *bad*. For instance, Fischer and Hess (2021) found Swedish newspaper coverage of GMOs was intense and mostly negative in the mid-1990s but became less negative over time; by the end of the study period, most articles were neutral. Studies show low GMO knowledge tends to disproportionately relate to reliance on mass media as a source of GMO information (Aleksejeva, 2014; Turker et al., 2013; Wunderlich & Gatto, 2015), which may, in part, be due to more mass media articles about GMOs than academic ones (Wunderlich & Gatto, 2015).

Purpose

The two objectives that guided this study were to describe respondents with negative, neutral, and positive perceptions of GMO products based on their use of:
1. Information channels
2. Information sources

We utilize this framework as opposed to other suitable theories in the field, such as the PRISM or RISP frameworks for several reasons. First, the information sources and channels framework has roots in the interdisciplinary Diffusion of Innovations theory (Rogers, 1995), which posits that adoption of new innovations is influenced by information and opinions shared among potential users (MacVaugh & Schiavone, 2010). Second, the PRISM framework considers the use of information as an output rather than a process (Aqil et al., 2009), while information sources and channels acknowledge that information about scientific innovations can be ephemeral and biased. Third, the RISP model focuses on risk communication and use of this model would imply that GMO innovations are inherently risky. However, future research could expand the following methods by using other frameworks to strengthen our understanding of how individuals receive and process GMO information.

Methods

Population and Sample

The population of interest was Tennessee residents aged 18 or older. An online link to a questionnaire was distributed to a total of 1,115 Tennessee residents who opted-in using a third-party company, Qualtrics. Qualtrics recruits participants through actively managed market research panels and social media platforms, and they employ digital fingerprinting technology and IP address checks, as well as work with panel partners who also employ such methods (European Society for Opinion and Market Research, 2019). Opt-in participant recruitment is a form of convenience, or river, sampling and is not random. Participants must be willing to be contacted when responses are needed (Baker et al., 2013). The online link to the questionnaire was distributed by Qualtrics to Tennessee residents, and responses were collected gradually from Qualtrics' recruitment pools until there were 500 responses that met the study criterion. Useable responses were obtained from 501 residents for a participation rate of 44.93%. Due to the sampling techniques of opt-in sampling, participation rates are reported rather than true response rates (Baker et al., 2013), which may be a limitation of this study. Non-probability panels are also considered non-representative of the target population and are subject to the potential for exclusion, selection, and non-participation biases (Baker et al., 2013). To better examine the extent to which the sample was reflective of the larger population, demographic characteristics of respondents were compared to Tennessee demographic data. Comparisons revealed the percentage of females compared to males was not representative of the Tennessee population, which is a limitation of the current study.

More respondents in this study identified as female (n = 378; 75.4%) than male (n = 378; 22.2%), and few identified as nonbinary (n = 9; 1.8%) or other (n = 3; 0.6%). Compared to other race categories, more respondents identified as White (n = 408; 81.4%), followed by Black (n = 67; 13.4%). Compared to other education categories, the largest number of respondents reported having completed high school (n = 150; 29.9%) or some college (n = 142; 28.3%). Lastly, most (n = 423; 84.4%) made less than $80,000 annually. Limitations of non-probability online sampling procedures include the potential for exclusion, selection, and non-participation biases (Baker et al., 2013). In this study, the percentage of females compared to males is not representative of the Tennessee population.

Instrumentation

Respondents' perceptions of GMO products were assessed using nine items reflective of commonly reported perceptions of GMO products held by consumers (e.g., *GMOs are bad for your health* and *GMOs help increase food production*). Responses were collected using a five-point Likert scale: 1 = *strongly disagree*; 2 = *somewhat disagree*; 3 = *neither agree nor disagree*; 4 = *somewhat agree*; and 5 = *strongly agree*. A construct mean was computed to represent respondents' overall perceptions of GMO products, and negatively worded items were reverse coded. Respondents were then categorized based on their GMO perceptions score: negative-leaning perceptions = 1.00–2.33; neutral perceptions = 2.34–3.67; and positive-leaning perceptions = 3.68–5.00. These same parameters have been previously used for grouping purposes in other areas of agricultural education and communications research (Haynes & Stripling, 2014). Respondents' use of information sources was assessed using twelve items. Respondents were asked to indicate how much information about GMO products they had obtained from each source, and responses were collected on a 5-point ordinal scale: 1 = *none at all*; 2 = *a little*; 3 = *some*; 4 = *a lot*; and 5 = *a great deal*. Lastly, respondents' use of information channels was assessed using the previously described format but with seven information channel items (e.g., social media, television). The questionnaire was reviewed for content and face validity by a panel of experts consisting of three faculty members with experience in science communication and marketing. The questionnaire was evaluated for readability, clarity, and style (Colton & Covert, 2007). A field test was conducted with fifty respondents to ensure survey item validation, check for low quality responses, and assess initial scale estimates. Pilot and post hoc reliability estimates for GMO perceptions were calculated using Cronbach's alpha (pilot α = 0.87; posthoc α = 0.89), which are acceptable levels according to Field (2013).

Data Analysis

Data were analyzed using the SPSS 27 statistical software package. Descriptive statistics, including frequencies and percentages, were used reported for all objectives. Median scores were also reported with frequency distributions as the measure of central tendency (Boone & Boone, 2012).

Findings

Objective One

For all objectives, respondents were grouped into one of three categories based on their GMO perceptions. Ninety-eight respondents (19.56%) were in the negative-leaning perceptions group, 343 (68.46%) were in the neutral perceptions group, and sixty (11.98%) were in the positive-leaning perceptions group. A description of how respondents were grouped is provided in the instrumentation section.

Objective one was to describe respondents with negative, neutral, and positive perceptions of GMO products based on their GMO information channels. Respondents with negative-leaning perceptions of GMO products (N = 98) received varying degrees of information via a variety of channels (see Table 1). Compared to the other channels listed, more respondents in the negative perceptions group received at least some information about GMO products from websites (n = 82; 83.7%), word-of-mouth communication (n = 80; 81.6%), social media (n = 72; 73.5%), and television (n = 70; 71.4%). Negative-leaning respondents who received information about GMO products from health books (n = 55; 5.6%) reported receiving a lot (n = 10; 10.2%) or a great deal (n = 12; 12.2%) of information via that channel. Lastly, more than half of the negative-leaning respondents reported receiving no information at all from radio (n = 68; 60.2%) and newspaper (n = 68; 69.4%) channels.

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Table 1

Information Channel Use Among Respondents with Negative-Leaning Perceptions of GMO Products (N = 98)

Channel	None at all		A little		Some		A lot		A great deal		Median
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
Websites	16	16.3	24	24.5	32	32.7	17	17.3	9	9.2	3.00
Word-of-mouth	18	18.4	30	30.6	31	31.6	12	12.2	7	7.1	3.00
Social media	26	26.5	22	22.4	28	28.6	15	15.3	7	7.1	3.00
Health books	43	43.9	16	16.3	17	17.3	10	10.2	12	12.2	2.00
Television	28	28.6	35	35.7	26	26.5	6	6.1	3	3.1	2.00
Radio	59	60.2	19	19.4	15	15.3	2	2.0	3	3.1	1.00
Newspaper	68	69.4	20	20.4	8	8.2	1	1.0	1	1.0	1.00

Note. Response scale: 1 = *none at all*; 2 = *a little*; 3 = *some*; 4 = *a lot*; 5 = *a great deal.*

Respondents with neutral perceptions of GMO products (*N* = 343) did not report receiving a lot or great deal of information from any single information channel (Table 2). Of the channels that were utilized, the largest number of respondents (*n* = 222; 64.7%) reported receiving at least a little information about GMO products from television. In addition, more than half of the respondents in this group received at least a little information from websites (*n* = 204; 59.5%), social media (*n* = 179; 52.2%), and word-of-mouth (*n* = 196; 57.1%). Regarding the lesser utilized channels, more than half of the neutral respondents did not obtain any GMO product information from health books (*n* = 207; 60.3%), newspapers (*n* = 208; 60.6%), or radio channels (*n* = 236; 68.8%).

Table 2

Information Channel Use Among Respondents with Neutral Perceptions of GMO Products (N = 343).

Channel	None at all		A little		Some		A lot		A great deal		Median
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
Television	121	35.3	98	28.6	84	24.5	34	9.9	6	1.7	2.00
Websites	139	40.5	93	27.1	65	19.0	28	8.2	18	5.2	2.00
Social media	164	47.8	89	25.9	47	13.7	29	8.5	14	4.1	2.00
Word of mouth	147	42.9	103	30.0	68	19.8	17	5.0	8	2.3	2.00
Health books	207	60.3	53	15.5	54	15.7	20	5.8	9	2.6	1.00
Newspaper	208	60.6	79	23.0	42	12.2	9	2.6	5	1.5	1.00
Radio	236	68.8	53	15.5	33	9.6	12	3.5	9	2.6	1.00

Note. Response scale: 1 = *none at all*; 2 = *a little*; 3 = *some*; 4 = *a lot*; 5 = *a great deal*.

Lastly, respondents with positive-leaning perceptions of GMO products (*N* = 60) also did not receive a great deal of information about GMO products through any single information channel (Table 3). Compared to the other channels listed, more respondents in this group received at least a little information from websites (*n* = 50; 83.3%), television (*n* = 49; 81.7%), and word-of-mouth (*n* = 45; 75.0%). In addition, slightly more than half of the respondents in the positive-leaning group reported receiving at least a little information from social media (*n* = 39; 65.0%) and health books (*n* = 50; 30.0%). Positive-leaning respondents reporting receiving no information from newspapers (*n* = 37; 61.7%) and radio channels (*n* = 41; 68.3%).

Table 3

Information Channel Use Among Respondents with Positive-Leaning Perceptions of GMO Products (N = 60)

Channel	None at all		A little		Some		A lot		A great deal		Median
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
Websites	10	16.7	16	26.7	15	25.0	15	25.0	4	6.7	3.00
Television	11	18.3	25	41.7	16	26.7	5	8.3	3	5.0	2.00
Social media	21	35.0	16	26.7	10	16.7	9	15.0	4	6.7	2.00
Word of mouth	15	25.0	23	38.3	14	23.3	7	11.7	1	1.7	2.00
Health books	30	50.0	10	16.7	14	23.3	5	8.3	1	1.7	1.50
Newspaper	37	61.7	17	28.3	3	5.0	3	5.0	0	0.0	1.00
Radio	41	68.3	11	18.3	5	8.3	3	5.0	0	0.0	1.00

Note. Response scale: 1 = *none at all*; 2 = *a little*; 3 = *some*; 4 = *a lot*; 5 = *a great deal*.

Objective Two

Objective two sought to describe the GMO information sources respondents with negative, neutral, and positive perceptions used. Overall, respondents with negative-leaning perceptions of GMO products did not receive a lot or a great deal of information from any single source (Table 4). Of the sources listed, more respondents in this group obtained at least some information about GMO products from food bloggers (*n* = 64; 65.3%), family (*n* = 64; 65.3%), and friends (*n* = 61; 62.2%). In addition, roughly half of the negative-leaning respondents reported receiving at least a little information from USDA professionals (*n* = 53; 54.1%) and other consumers (*n* = 43; 43.9%). Many respondents in this group reported receiving no information at all about GMO products from college classes (*n* = 67; 68.4%), universities (*n* = 69; 70.4%), or Tennessee Extension services (*n* = 72; 73.5%).

Table 4

Information Source Use Among Respondents with Negative-Leaning Perceptions of GMO Products (N = 98)

Source	None at all		A little		Some		A lot		A great deal		Median
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
Food bloggers[a]	34	34.7	32	32.7	19	19.4	8	8.2	4	4.1	2.00
Family	37	37.8	25	25.5	28	28.6	6	6.1	2	2.0	2.00
Food scientists	47	48.0	18	18.4	17	17.3	10	10.2	6	6.1	2.00
Friends[b]	34	34.7	29	29.6	28	28.6	3	3.1	2	2.0	2.00
USDA professionals[a]	45	45.9	23	23.5	16	16.3	7	7.1	6	6.1	2.00
Other consumers	41	41.8	28	28.6	22	22.4	4	4.1	3	3.1	2.00
Agricultural producers	55	56.1	16	16.3	18	18.4	4	4.1	5	5.1	1.00
Work/coworker	56	57.1	20	20.4	14	14.3	6	6.1	2	2.0	1.00
Former high school class	63	64.3	16	16.3	15	15.3	3	3.1	1	1.0	1.00
College class[d]	67	68.4	13	13.3	8	8.2	4	4.1	3	3.1	1.00
Universities[b]	69	70.4	15	15.3	6	6.1	3	3.1	3	3.1	1.00
Tennessee Extension services[b]	72	73.5	15	15.3	4	4.1	4	4.1	1	1.0	1.00

Note. Response scale: 1 = *none at all*; 2 = *a little*; 3 = *some*; 4 = *a lot*; 5 = *a great deal*
[a] Responses missing from 1 participant. [b] Responses missing from 2 participants. [c] Responses missing from 3 participants.

Respondents in the neutral GMO perceptions group did not receive much information from any of the sources listed, with all sources having a median value of 1.00 for response distribution (Table 5). When compared to the other sources, more respondents in this group reported receiving at least a little information from USDA professionals (*n* = 161; 46.9%), family members (*n* = 154; 44.9%), friends (*n* = 153; 44.6%), and agricultural producers (*n* = 152; 44.3%). Many respondents in this group (*n* = 239; 69.7%) reported receiving no information at all about GMO products from Tennessee Extension services.

Table 5

Information Source Use by Respondents with Neutral Perceptions of GMO Products (N = 343)

Source	None at all		A little		Some		A lot		A great deal		Median
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
USDA professionals[a]	182	53.1	77	22.4	48	14.0	26	7.6	7	2.0	1.00
Family[b]	189	55.1	64	18.7	65	19.0	17	5.0	6	1.7	1.00
Agricultural producers[b]	191	55.7	76	22.2	45	13.1	20	5.8	9	2.6	1.00
Friends[b]	190	55.4	72	21.0	60	17.5	15	4.4	4	1.2	1.00
Food scientists[c]	207	60.3	56	16.3	48	14.0	18	5.2	10	2.9	1.00
High school class[c]	202	58.9	65	19.0	46	13.4	20	5.8	6	1.7	1.00
Food bloggers[c]	201	58.6	70	20.4	48	14.0	12	3.5	8	2.3	1.00
Work/coworker[a]	207	60.3	71	20.7	43	12.5	14	4.1	5	1.5	1.00
Other consumers[d]	206	60.1	72	21.0	41	12.0	13	3.8	6	1.7	1.00
Universities[e]	233	67.9	39	11.4	43	12.5	15	4.4	6	1.7	1.00
Tennessee Extension services[f]	239	69.7	39	11.4	40	11.7	12	3.5	7	2.0	1.00
College class[c]	245	71.4	36	10.5	34	9.9	16	4.7	8	2.3	1.00

Note. *Note.* Response scale: 1 = *none at all*; 2 = *a little*; 3 = *some*; 4 = *a lot*; 5 = *a great deal*
[a] Responses missing from 3 participants. [b] Responses missing from 2 participants.
[c] Responses missing from 4 participants. [d] Responses missing from 5 participants. [e] Responses missing from 7 participants. [f] Responses missing from 6 participants.

Respondents with positive-leaning perceptions of GMO products received at least a little information from the various information sources (Table 6). Compared to the other sources, more respondents in the positive-leaning perceptions group received at least a little information from food scientists (*n* = 42; 70.0%), USDA professionals (*n* = 40; 66.7%), and agricultural producers (*n* = 36; 60.0%). In addition, more than half of the positive-leaning respondents reported receiving at least a little information from family (*n* = 32; 53.3%) and friends (*n* = 32; 53.3%). Few respondents in this group (*n* = 19; 31.7%) received any amount of information about GMO products from Tennessee Extension services.

Table 6

Information Source Use by Respondents with Positive-Leaning Perceptions of GMO Products (N = 60)

Source	None at all		A little		Some		A lot		A great deal		Median
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
USDA professionals	20	33.3	14	23.3	17	28.3	8	13.3	1	1.7	2.00
Food scientist [a]	18	30.0	17	28.3	19	31.7	4	6.7	1	1.7	2.00
Agricultural producers	24	40.0	17	28.3	12	20.0	4	6.7	3	5.0	2.00
College class	33	55.0	8	13.3	6	10.0	11	18.3	2	3.3	1.00
Family	28	46.7	12	20.0	14	23.3	5	8.3	1	1.7	2.00
Universities[a]	33	55.0	11	18.3	6	10.0	6	10.0	3	5.0	1.00
Former high school class	35	58.3	8	13.3	9	15.0	5	8.3	3	5.0	1.00
Food bloggers[a]	32	53.3	12	20.0	7	11.7	8	13.3	0	0	1.00
Friends	28	46.7	18	30.0	12	20.0	1	1.7	1	1.7	2.00
Other consumers[a]	31	51.7	14	23.3	12	20.0	1	1.7	1	1.7	1.00
Work/coworker [a]	33	55.0	13	21.7	12	20.0	0	0	1	1.7	1.00
Tennessee Extension services[a]	41	68.3	8	13.3	6	10.0	3	5.0	1	1.7	1.00

Note. Response scale: 1 = *none at all*; 2 = *a little*; 3 = *some*; 4 = *a lot*; 5 = *a great deal.*
[a] Responses missing from 1 participant.

Conclusions, Discussion, and Recommendations

Conclusions

The findings of this study provide insight regarding how respondents with varying perceptions of GMO food products receive their information about such products. Segmenting consumers based on their GMO perceptions (i.e., negative-leaning, neutral, and positive-leaning) can guide recommendations for a variety of audiences and communication goals, whether such goals be to market GMO products to existing consumer bases or develop an educational campaign to address GMO misconceptions. Further, while this is a state-based study and the ability to generalize is limited, these findings contribute to the larger body of literature pertaining to consumers' GMO information-seeking behaviors.

Twenty percent of respondents were categorized as having negative-leaning perceptions of GMO products, roughly two-thirds held neutral perceptions, and only 10% of respondents had positive-leaning perceptions of GMO products. Websites, word-of-mouth communication, television, and social media were the primary information channels used by all perception groups. Respondents with neutral perceptions, however, did not utilize any information channel to much extent. Regarding information sources, respondents in the negative group received information primarily from food bloggers, family, friends, and other consumers. Respondents in the neutral group received information from USDA professionals, family members, friends, and agricultural producers. Lastly, a slight shift toward more scientific-based sources, such as food scientists, USDA professionals, and agricultural producers, was observed among respondents with positive-leaning perceptions of GM products.

Overall, these findings reveal that individuals are actively seeking only “some” GMO information and most often, are not seeking any information at all, regardless of perception leanings. More importantly, participants’ preferred methods of receiving GMO information are not factchecked and peer reviewed, leaving room for misinformation. Misinformation about the COVID-19 pandemic has been found to increase information avoidance and heuristic processing, as well as decrease the measures individuals took to prevent and treat COVID-19 (Kim et al., 2020). Misinformation about GMO soybeans was associated with feelings of anxiety and a lack of trust in scientists and the government (Jiang & Fang, 2019), which in turn leads to individuals using these sources less for information. The challenge then is for agricultural communicators to find ways to reach people about GMOs without them having to seek out the information themselves through unreliable sources.

Discussion and Recommendations

The relatively high use of informal information channels like websites, family, friends, and word-of-mouth communication across all perception groups is consistent with prior findings (Cui & Shoemaker, 2018; Tucker & Napier, 2002; Wolske et al., 2020). The findings from the current study and prior research suggest that segmenting consumers based on their GMO perceptions may be unnecessary to examine information channels. However, it may be advantageous to segment consumer audiences by socioeconomic variables or measures of trust in science when analyzing information channel use (Funk et al., 2020). Though for informational sources, segmenting respondents into perceptions groups has provided beneficial insight for practitioners and researchers.

Across perception groups, relatively little information about GMO products was obtained from Tennessee Extension services, which suggests room for Extension’s involvement in this area, perhaps through working with agricultural communicators to develop educational campaigns for consumers, workshops for producers, or marketing materials for producers to use to promote understanding of GMO science to consumers with negative or neutral perceptions. This raises the question of how well positioned extension specialists or agents are in terms of collaborating with agricultural communicators. Additionally, we need to examine the roles and effectiveness of agents, specialists, and agricultural communicators in facilitating dialogue about GMO products between producers and consumers. Producers in Tennessee should also continue to converse with their supportive consumer base, which may, in turn, facilitate positive discussions among consumers via personal networking (Chen et al., 2021; Csótó, 2011; Wolske et al., 2020).

Regarding future research, qualitative inquiry is needed to examine how the language and tones of USDA messages are perceived by consumers and shape their perceptions. Similar research is needed to explore the role of food bloggers or similar influencers on consumers’ perceptions of GMO products. Research should also seek to identify the potential for evidence-based food blogs from university researchers or other scientists. To help accomplish this, consumers' perceived trust in science and scientists should be further examined (Runge et al., 2018; Xu & Lu, 2019), and methods of increasing consumers' trust in evidence-based blogs from universities or scientists should be established. Lastly, considering roughly two-thirds of respondents in this study fell within the neutral perceptions category, research should continue to explore the phenomena of neutral public opinions on controversial topics such as GMOs. This area of research is of the upmost importance to efforts to better develop and disseminate evidence-based information to help consumers make informed purchasing decisions.

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