Escherichia Coli (*E. coli*) contamination has been a long-existing concern for those engaged in cattle production, often causing negative public health and economic consequences. It has been recognized that one strategy to reduce *E. coli* contamination is to carry out certain behaviors and procedures on cattle production operations. Persuasive communication can be an important element in educational messages encouraging cattle producers to adopt these preventative behaviors. Since it is vital to know the best methods of presenting these messages to this audience, a study was conducted to assess the perceived credibility of different information sources that could be used to present the message of E. coli control behaviors to cattle producers.

E. coli refers to a group of bacteria that is normally found in the intestines of people and animals. Most are harmless and are vital to a healthy intestinal tract (CDC, 2012). Some types of *E. coli* do cause disease in humans and animals, including a strain known as shiga-toxin producing *E. coli* (STEC). STEC has been the focus of much research and news coverage due to its association with foodborne outbreaks (Rangel et al., 2005). STEC lives in the intestines of normal cattle and does not cause disease in the cattle (USDA, 2014b). The most studied type, known as STEC O157:H7, is estimated to be found in 28 percent of beef cattle (Gansheroff & O'Brien, 2000). In addition to STEC O157:H7, there are also other types of STEC that can cause disease in humans and whose prevalence is still being studied (Dargatz et al., 2013). These are usually called non-0157 STECS (CDC, 2012).

When a human is infected with STEC, it can cause gastroenteritis, bloody diarrhea and vomiting (USDA, 2014b). It can also cause mild fevers of less than 101 degree Fahrenheit. Most people recover after five to seven days, but 5-10% of those infected develop a life-threatening condition called hemolytic uremic syndrome (HUS). Symptoms of HUS include destruction of red blood cells, depressed platelet counts, lack of urine formation, swelling and acute renal failure (CDC, 2012). While most people can become infected, young children and the elderly are more likely to develop HUS and severe symptoms from infection (CDC, 2012).

In 1982, STECs were recognized as a human pathogen following two outbreaks that caused 33 hospitalizations from undercooked fast-food hamburgers (Rangel et al., 2005). The Centers for Disease Control and Prevention (CDC) estimates that there are 265,000 STEC infections each year, with *E. coli* 0157:H7 causing 36 percent of these cases (2012). In addition to the public health impact of STECs, they also cause economic losses for the beef industry. The United States Department of Agriculture (USDA) and the Food Safety Inspection Service (FSIS) estimate that almost 90,000 pounds of beef were recalled in 2013 (USDA, 2014a). More recently in 2014, *E. coli* 0157 infected 12 people and the Wolverine

Packing Company recalled approximately 1.8 million pounds of ground beef on May 19, 2014 (CDC, 2014).

E. coli contamination can be controlled by the use of Hazard Analysis Critical Control Point (HACCP) systems in beef processing facilities, as well as the use of safe-food handling practices by the food service industry and consumers. Pre-harvest strategies in animal production has also been highlighted as a way to prevent *E. coli* contamination (Food and Agriculture Organization of the United Nations, 2011). For example, it has been shown that feeding activities as well as the use of a commercial vaccine can affect *E. coli* shedding by beef cattle (Jacob, Calloway, & Nagaraja, 2009; Cull et al., 2012). The USDA suggests that the basic principles of cattle management such as clean water, clean feed, clean environment and biosecurity practices can provide the basis for the control of *E. coli* (USDA, 2014b).

The existence of these pre-harvest practices creates the opportunity to positively impact human health by focusing on modifying behaviors and management strategies carried out in cattle production. Communicating and providing education to producers about these strategies has been recognized as an important goal. When the USDA awarded a $25 million grant to reduce the occurrence of STEC in the beef production to 11 land-grant universities, including the University of Nebraska and Kansas State University, about one-third of the grant was dedicated to extension and education efforts (Moser, 2012). Based on this grant, a series of online-training modules that describe *E. coli* prevention in beef production were developed and released in fall 2014 (Hambright, 2014). For efforts like this to be successful, it is vital to consider how the communication can be modified to best transfer information and persuade the audience. Persuasive communication is considered to have five broad attributes, including source, message, channel, receiver and target variables (McGuire, 1984). The source variable, specifically the idea of source s, has long been deemed an important attribute for sources of information and been the focus of persuasive communication research (Pornpitakpan, 2004; Perloff, 2010).

Source credibility "refers to the judgments made by a message recipient concerning the believability of a communicator" (Callison, 2001, p. 220). Source credibility research has deconstructed the concept and identified many dimensions, such as competence, dynamism, objectivity, and goodwill (Pornpitakpan, 2004; Perloff, 2010). Despite these varied dimensions, the two aspects of source credibility used with the "greatest regularity" are expertise and trustworthiness (Perloff, 2010, p. 167). Expertise is "the extent to which a communicator is perceived to be a source of valid assertions" (Hovland, Janis & Kelley, 1953, p. 21). Trustworthiness is "the degree of confidence in the communicator's intent to communicate the assertions he considers the most valid" (p. 21). Over the years, many studies have used trustworthiness and expertise to

examine how source credibility interacts with the other communication components such as message, channel, receiver and destination or target (Pornpitakpan, 2004). Some of this research has recognized that the source credibility of different types of sources is an important element when communicating information to those in rural and agricultural areas. Blackstock, Ingram, Burton, Brown, and Slee reviewed literature to discover the best ways to encourage farmers to change behavior related to improving water quality. Based on their findings, they believed that in-group messages were most likely to be processed and that "the use of people from farming backgrounds or trusted networks is likely to enhance message uptake" (2010, p. 5632).

Research looking at which sources that rural landowners or dairy farmers prefer to get new management information highlights the importance of these in-group sources. Different studies found that sources such as friends, relatives (Brunson & Price, 2009), high-achieving farmers (Sligo & Massey, 2007), consultants, nutritionists, veterinarians, and business partners (Russell & Bewley, 2013) were seen as the top sources for getting new information. For cattle producers, sources such as other producers, extension agents and veterinarians have been found to be preferred sources for new information (Vergot, Isreal & Mayo, 2005; Breiner et al., 2007). It should be noted that the sources that are most used by agricultural producers may not always be the same as the sources that are seen as the most credible. In 2012, Meena and Meena published a study examining sources of information used by dairy producers in India. Though there was some variation depending on specific tribal village, the most used sources included fellow farmers, neighbors and the "village quack" (p. 58). On the other hand, the sources that were considered the most credible included village development officers and extension personnel, in addition to neighbors. This suggests that just because a producer gets information from a certain source, it does not mean that they see it as the most credible source.

There is also evidence that how the source of information is identified can have an impact the perceived source credibility. Garnett (2013) conducted a study that involved subscribers to DTN/The Progressive Farmer, most of which were active or retired agricultural producers. They were presented with a news story that was either labeled as coming from a farm media source (DTN) or a mainstream source (The Chicago Tribune). This label significantly altered the perceptions of source credibility, with the respondents who had the farm media story seeing the report as more trustworthy, fair and less biased than the participants who read the mainstream media story. Earlier research carried out in 1995 by Marquart, O'Keefe and Gunther also found support for this perceived difference in the source credibility of different information sources. They found that dairy farmers perceived different levels of trust and expertise for different sources for receiving information about manufactured bovine growth hormone

(BGH). For example, other dairymen were perceived to have higher levels of trust than expertise. The reverse was true for government officials. If cattle producers are similar to these dairy producers, this research demonstrates that it is important to consider trustworthiness and expertise when considering the source credibility of the sources of information used to distribute information.

Other research has specifically examined trust from the perspective of those in agriculture. In 2008, Heffernan, Nielson, Thomson and Gunn interviewed cattle and sheep farmers in the United Kingdom and found that veterinarians and other farmers were seen as the top sources for information relating to biosecurity. Through a content analysis of the interviews, it was found that there was also a lack of trust in government sources. This distrust of government by agricultural producers was also discovered in a group of western Australian sheep and cattle farmers. Palmer, Sully, and Fozdar (2009a) surveyed these producers and found that they had high levels of trust for sources of biosecurity information such as neighbors, other farmers and animal health personnel, which contrasted to the low trust found for government sources. The finding of low trust of government sources was supported during in-depth interviews carried out by the same authors (2009b). The authors noted that for these agricultural producers, "trust in the messenger is more important than the message" (Palmer, Sully, and Fozdar, 2009a, p. 371). This research highlights the importance that source attributes, such as trust, and therefore source credibility, has when communicating with agricultural producers.

Based on the findings from previous literature, this current research aims to explore which sources cattle producers prefer to get information relating to pre-harvest strategies for *E. coli* prevention.

> RQ1: Which sources are cattle producers most likely to use to get information related to pre-harvest strategies for *E. coli* control for their beef operation?

This research also wants to explore how these preferences relate to the perceived credibility of the sources of information. Previous research, as explored above, suggests that sources that producers are more likely to use for information will have higher levels of trust and expertise, and therefore higher levels of source credibility.

> H1: The sources that cattle producers are more likely to use for information related to *E. coli* prevention will have higher levels of perceived source credibility than sources that they are less likely to use.

METHODS

Participants

This study used a survey questionnaire to study information source preferences of cattle producers and the perceived source credibility of these information sources for receiving information related to *E. coli* pre-harvest controls strategies. Participants in this study were individuals involved in cattle production, either in a managerial/owner or employee position, at a feedyard, cow-calf or stocker operation. The online link to the questionnaire used was delivered to a convenience sample of cattle producers who were members of the e-mail newsletter mailing list of three beef cattle or agricultural organizations: the Kansas Farm Bureau, the Beef Cattle Institute at Kansas State University and the American Angus Association. It should be noted while the list for the American Angus Association includes ranchers from all over the United States, the farmers and producers included on the lists for the Kansas Farm Bureau and the Beef Cattle Institute includes mostly farmers and producers from Kansas. These organizations were selected for the study due to connections made at the author's institution and the organizations' willingness to participate.

The survey link was included in the Kansas Farm Bureau's semiweekly e-mail-released e-news that was sent to 11,221 e-mail addresses over three weeks in March 2015. The addresses on this list include Kansas Farm Bureau voting members, or members who have an agricultural interest with income earned through production agriculture. The link was also sent to 960 members of the Beef Cattle Institute's e-mail newsletter subscriber list twice over two weeks in March and April 2015. Of the messages sent, 821 of the messages were delivered. Finally, the survey link was sent to the American Angus Association's 3,448 member Angus Beef Bulletin EXTRA newsletter mailing list, of which 3,268 were successfully delivered, at the start of April 2015. The link was also included in the March 27 and 31, 2015, online Angus Journal Daily News and mentioned in the April 13 episode of "The Angus Report." It is estimated that the survey link was delivered to 15,310 e-mail addresses, though it is hard to estimate the total number of cattle producers are in this total since the e-mail mailing lists for some of these organizations are not exclusive to cattle producers.

Procedure

The online questionnaire was developed in Qualtrics, an online survey tool. The questionnaire first asked participants if they were involved in cattle production as a way to check if the data was collected from the population of interest. Next, they were asked how likely they are to use five commonly-mentioned sources for new management information relating to pre-harvest strategies for *E. coli* prevention for their beef operation (Vergot, Isreal & Mayo,

2005; Breiner et al., 2007). These sources included (a) state and local extension personnel; (b) veterinarians; (c) other cattle producers; (d) government sources (e.g., USDA); (e) beef industry organizations (e.g., NCBA or Farm Bureau). The participants rated this on a five-point semantic differential scale for each (Unlikely/Likely).

Following this, they described the perceived trustworthiness and expertise of each of these sources. As the literature suggests, source credibility is usually considered to be combination of expertise and trustworthiness (Perloff, 2010). This study measured source credibility using a scale similar to ones used in previous studies (McCroskey & Young, 1981; Sinaga & Calison, 2008), though the scale is different from the original McCroskey Scale (1966). The survey instrument (see Appendix A) was designed to create a source credibility rating through a series of 7-point semantic differential scales. Participants rated each source of new information on 10 dimensions of expertise and trustworthiness. Expertise is composed of five dimensions: Experienced/Inexperienced, Informed/Uninformed, Trained/Untrained, Qualified/Unqualified, and Expert/Not Expert. Trustworthiness is composed of five dimensions: Honest/Dishonest, Trustworthy/Untrustworthy, Open minded/Closed minded, Fair/Unfair, and Ethical/Unethical. The survey finished with eight demographic questions, including questions relating to location and size of cattle operation, years in cattle operation and role on operation.

Findings

For this study, 192 questionnaires were collected through Qualtrics. Questionnaires that involved individuals who did not complete the entire survey

Table 1

Likelihood to Use an Information Source for *E. coli* Control Information

Information Source	Mean	Standard Deviation
State and Local Extension Personnel	3.29	1.37
Veterinarian	4.17*	1.00
Government Sources	2.88**	1.24
Other Cattle Producers	3.42	1.60
Beef Industry Organization	3.17	1.21

Note: N=112. Sources ranked on a five-point semantic differential scale (Unlikely/Likely). *Significantly different from other sources at the $p<.001$ level. **Significantly different from others sources, except beef industry organizations, $p<.05$.

and participants who did not identify themselves as a cattle produces were removed, leaving 112 questionnaires for the final analysis. Of these participants, 89.3 percent identified themselves as being the owner of their operation, with the rest either being an employee or having another role on the ranch. Most of the participants (99.1 percent) identified as being non-Hispanic white. Seventy-five percent identified as being male. The participants had a mix of individuals who had been involved in cattle production 10 to 20 years (20.5 percent), 21 to 30 years (20.5 percent), 31 to 40 years (24.1 percent) and 41 to 50 years (23.2 percent), with the smallest groups being those involved less than 10 years (3.6 percent) or over 50 years (8.0 percent). The participants worked on a variety of sizes of operations, with 29.5 percent working on ranches with 1 to 49 cattle, 37.5 percent working on operations with 50 to 199 cattle, and 33.0 percent on farms with 200 or more cattle. Many participants (74.1 percent) graduated from college or greater, while 25.9 percent had not. Nearly half (49.1 percent) of the participants were from Kansas. The rest of the cattle producers were from a variety of other states.

Likelihood to Use an Information Source for *E. Coli* Information

A one-way within subjects (or repeated measures) ANOVA was

Table 2

Perceived Source Credibility of Information Sources

Information Source	Expertise Mean	Trustworthiness Mean	Source Credibility Mean	Standard Deviation
State and Local Extension	4.9	5.5	5.2	1.2
Veterinarian	6.1	5.9	6.0*	1.2
Government Sources	3.9	4.0	4.0*	1.3
Other Cattle Producers	4.8	5.1	5.0	1.0
Beef Industry Organization	5.1	5.6	5.2	1.2

Note: Sources ranked with seven-point semantic differential scales. *Significantly different from other sources at the p<.001 level.

conducted to compare the likelihood of the participants to depend on state and local extension personnel, veterinarians, other cattle producers, government sources or a beef industry organization for information related to pre-harvest control of *E. coli*. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(9)=21.28$, p=.011, therefore Greenhouse-Geisser corrected tests are reported (ε=.910). A significant finding was found for the likelihood to use these sources, F(3.6, 404.1)=24.7, p=.000. Post hoc tests using the Bonferroni correction revealed that the likelihood to use a veterinarian as a source (M=4.2, SD=1.0) was significantly different from all other sources (p=0.000) (see Table 1). No significant differences were found between the likelihood to use extension personnel (M=3.3, SD=1.4), other cattle producers (M=3.4, SD=1.2) or beef industry organizations (M=3.2, SD=1.2) as an information source. Likelihood to use government sources (M=2.9, SD=1.2) was significantly different from all other sources (p=0.009), except beef industry organizations (p=0.689). Despite this lack of difference, these findings suggest that these cattle producers have a clear preference for the sources they are likely to get information related to *E. coli* control, with veterinarians being the top source. Other information sources are ranked lower, with government sources being ranked at or near the bottom.

Source Credibility

To analyze the perceived source credibility for each of the information

Table 3

Differences Between Likelihood to Use and Perceived Source Credibility

Information Source	Likelihood Mean	Source Credibility Mean	t	Significance
State and Local Extension	4.4	5.3	5.2	.000
Veterinarian	5.8	6.0	1.4	.175
Government Sources	3.8	4.1	1.4	.154
Other Cattle Producers	4.6	4.9	1.8	.075
Beef Industry Organization	4.3	5.1	4.7	.000

Note: Degree of Freedom for each comparison = 111.

sources, the five items related to expertise were averaged into single number for the perceived expertise of state and local extension personnel (α=.918), veterinarians (α=.847), government sources (α=.948), beef industry organizations (α=.935) and other cattle producers (α=.887). Also, the five items related to trustworthiness were averaged into single number for the perceived expertise of state and local extension personnel (α=.878), veterinarians (α=.836), government sources (α=.896), beef industry organizations (α=.923) and other cattle producers (α=.881). Following this, the values for trustworthiness and expertise were averaged into a composite score for source credibility for each information source. Next, a one-way within subjects (or repeated measures) ANOVA was conducted to compare these scores for source credibility for each of the information sources. A significant difference was found for source credibility, Wilks' $\lambda = 0.29$, $F(4, 122) = 73.5$, $p = 0.000$. Post hoc tests using the Bonferroni correction revealed that the source credibility of veterinarians (M=6.0, SD=1.2) were significantly higher than the other information sources (p=0.000) (see Table 2). Also, the credibility of government sources (M=4.0, SD=1.3) were significantly lower than all of the other sources (p=0.000). No significant differences between the source credibility of extension personnel (M=5.2, SD=1.2), beef industry organizations (M=5.2, SD=1.2) and other cattle producers (M=5.0, SD=1.0) were found. These findings suggest that veterinarians are perceived to be the most credible source for *E. coli* control information, while government sources are perceived to be the least credible. Other sources are seen to be similar in source credibility. These findings provide support for H1, since the source that these cattle producers were most likely to use for *E. coli* control information also had the highest perceived credibility. Also, the source with the lowest source credibility was also one of the sources least likely to be used for information.

As a further exploration of the relationship between the likelihood to use a source and its perceived source credibility, a series of paired-samples t-tests were conducted to compare likelihood and source credibility. To do so, data for likelihood were transformed to a seven-point scale to enable a comparison with the reported source credibility scores (see Table 3). While significant differences were found for likelihood to use and credibility for extension personnel and beef industry organizations, no differences were found for veterinarians, government sources, and other cattle producers. These findings suggest that for these sources, source credibility and likelihood to use are essentially the same for these cattle producers.

DISCUSSION

In terms of communicating information about pre-harvest *E. coli* control strategies to cattle producers, the findings in the current study are significant. The findings that veterinarians are perceived to be the most credible source, as well as the source of information that the cattle producers who participated in the study would most likely use for this information, highlight the importance of veterinarians in these communication efforts. Using veterinarians as the source for *E. coli* information would seem to be the best way to distribute the information, as well as enhancing the possibility that the audience will accept the message. Communication and education programs might also consider that it would be best to avoid presenting messages that are perceived to be from a government source. The fact that government sources were the least likely to be used for *E. coli* control information and seen as the least credible suggests that messages from government sources would not be as successful as messages presented by other information sources. In addition, the finding that for government sources, as well as veterinarians, that the likelihood to use was found to be the same as the perceived source credibility emphasizes the importance of credibility for the sources that producers feel most strongly about using or not using for *E. coli* control information.

While these are important findings, it is important to consider the limitations of this study. Since this study was conducted using a convenience sample of cattle producers who were members of the digital mailing list of different beef cattle organizations, it is hard to generalize these findings to the larger cattle producer population since a representative sample frame was not used. Also, it is unclear how membership or association with these different organizations may affect their perception and use of different information sources compared to the larger cattle producer population. Finally, it should be mentioned that the e-mailing lists created the potential to reach more than 15,000 producers, yet only 192 surveys were completed, of which 112 were able to be used in the data analysis. Considering this low response rate, it is possible that the producers who elected to participate in the study may not represent the larger producer population. It is possible that the length of the survey and time needed to complete the survey may have contributed to the low response rate.

Future studies should attempt to use a more representative sample frame. Also future research should explore if presenting messages through different information sources, such as veterinarians and government sources, has an impact on how these messages impact attitudes toward and intentions to adopt pre-harvest control strategies. Knowing this will provide more information that can be used to decide how to present messages about pre-harvest control to cattle producers.

Despite its limitations, this study demonstrates that cattle producers are more likely to use certain information sources for *E. coli* control information than others, and that the source that they are most likely to use, veterinarians, is also perceived to be the most credible source. On the other hand, the source the producers are least likely to use, government sources, is also perceived to be the least credible. Knowing this information will enable communicators and educators who are trying to encourage the adoption of pre-harvest control strategies for *E. coli* to make better decisions about how best to present this vital information to their audience.

REFERENCES

Blackstock, K. L., Ingram, J., Burton, R., Brown, K. M., & Slee, B. (2010). Understanding and influencing behaviour change by farmers to improve water quality. Science of the Total Environment, 408(23), 5631-5638. doi:http://dx.doi.org/10.1016/j.scitotenv.2009.04.029

Breiner, S.J., Boone, K.M., Blasi, D.A., Grau, S.A., Schroeder, Barnhardt, B.B., Breiner, R.M., & Bryant, A.M. (2007, March). Veterinarians most popular source of information utilized by cow-calf producers. Paper presented at Cattlemen's Day 2007, Manhattan, KS. Retrieved from http://krex.k-state.edu/dspace/handle/2097/2406.

Brunson, M., & Price, E. A. (2009). Information use and delivery preferences among small acreage owners in areas of rapid exurban population growth. Journal of Extension, 47(5), 5FEA4. Retrieved from http://www.joe.org/joe/2009october/a4.php.

Callison, C. (2001). Do PR practitioners have a PR problem?: The effect of associating a source with public relations and client-negative news on audience perception of credibility. Journal of Public Relations Research, 13(3), 219-234. doi: http://dx.doi.org/10.1207/S1532754XJPRR1303_2

Centers of Disease Control and Prevention (2012). *E. coli* (Escherichia coli). Retrieved from http://www.cdc.gov/ecoli/

Centers of Disease Control and Prevention (2014). Multistate Outbreak of Shiga toxin-producing Escherichia coli O157:H7 Infections Linked to Ground Beef. Retrieved from http://www.cdc.gov/ecoli/2014/O157H7-05-14/index.html.

Cull, C.A., Paddock, Z.D., Nagaraja, T.G., Bello, N. M., Babcock, A. H., & Renter, D. G. (2012). Efficacy of a vaccine and a direct-fed microbial against fecal shedding of Escherichia coli O157:H7 in a randomized pen-level field trial of commercial feedlot cattle. Vaccine, 30(43), 6210-6215. doi: http://dx.doi.org/10.1016/j.vaccine.2012.05.080 .

Dargatz, D.A., Bai, J., Lubbers, B.V., Kopral, C.A., An, Baoyan, & Anderson, G.A. (2013). Prevalence of Escherichia coli O-Types and Shiga-Toxin Genes in Fecal Samples from Feedlot Cattle. Foodborne Pathogens and Disease, 10(4), 392-396. doi: http://dx.doi.org/10.1089/fpd.2012.1289 .

Food and Agriculture Organization of the United Nations (2011). Preventing *E. coli* in Food. Retrieved from http://www.fao.org/fileadmin/user_upload/agns/pdf/Preventing_Ecoli.pdf

Gansheroff, L.J.; O'Brien, A.D. (2000). Escherichia coli O157:H7 in beef cattle presented for slaughter in the U.S.: higher prevalence rates than previously estimated. Proceedings of the National Academy of Sciences of the United State, 97(7), 2959-2961. doi: http://dx.doi.org/10.1073/pnas.97.7.2959.

Garnett, E. (2013). The effect of source on agricultural producers' perceptions of credibility. (Masters project). Retrieved from https://mospace.umsystem.edu/xmlui/handle/10355/41122.

Hambright, A. (2014, October 7). BCI develops training modules in collaboration with $25 million research effort. K-State Research and Extension News. Retrieved from http://www.ksre.ksu.edu/news/story/BCI_training100714.aspx.

Heffernan, C., Nielsen, L., Thomson, K., & Gunn, G. (2008). An exploration of the drivers to bio-security collective action among a sample of UK cattle and sheep farmers. Preventive Veterinary Medicine, 87(3–4), 358-372. doi:http://dx.doi.org/10.1016/j.prevetmed.2008.05.007

Hovland, C. I., Janis, I. L., & Kelley, H. H. (1953). Communication and persuasion: Psychological studies of opinion change (8th ed.). New Haven: Yale University Press.

Jacob, M.E., Callaway, T.R., & Nagaraja, T.G. (2009). Dietary Interactions and Interventions Affecting Escherichia coli O157 Colonization and Shedding in Cattle. Foodborne Pathogens and Disease, 6(7), 785-792. doi: http://dx.doi.org/10.1089/fpd.2009.0306.

Marquart, J., O'Keefe, G. J., & Gunther, A. C. (1995). Believing in biotech: Farmers' perceptions of the credibility of BGH information sources. Science Communication, 16(4), 388-402. doi: http://dx.doi.org/10.1177/1075547095016004002.

McCroskey, J. C. (1966). Scales for the measurement of ethos. *Speech Monographs, 33*(1), 65. Retrieved from

http://search.ebscohost.com.er.lib.k-state.edu/login.aspx?direct=true&db=ufh&AN=9935006&site=ehost-live

McCroskey, J. C., & Young, T. J. (1981). Ethos and credibility: The construct and its measurement after three decades. Central States Speech Journal, 32(1), 24-34. doi: http://dx.doi.org/10.1080/10510978109368075.

McGuire, W. J. (1984). Public communication as a strategy for inducing health promoting behavioral change. Preventive Medicine, 13(3), 299-319. doi: http://dx.doi.org/10.1016/0091-7435(84)90086-0.

Meena, H., & Meena, K. (2012). Sources of information and knowledge of farmers about dairy farming. J.Rec Adv Agr, 1(2), 56-62.

Moser, D. (2012, January 23). UNL leads $25 million project targeting *E. coli* threat to food safety. UNL Announce. Retrieved from http://newsroom.unl.edu/announce/todayatunl/918/5534

Palmer, S., Sully, M., & Fozdar, F. (2009a). Farmers, animal disease reporting and the effect of trust: A study of west australian sheep and cattle farmers. Rural Society, 19(1), 32-48. doi: http://dx.doi.org/10.5172/rsj.351.19.1.32.

Palmer, S., Fozdar, F., & Sully, M. (2009b). The effect of trust on west Australian farmers' responses to infectious livestock diseases. Sociologia Ruralis, 49(4), 360-374. doi: http://dx.doi.org/10.1111/j.1467-9523.2009.00495.x.

Perloff, R. M. (2010). The dynamics of persuasion: Communication and attitudes in the twenty-first century (4th ed.) New York: Routledge.

Pornpitakpan, C. (2004). The persuasiveness of source credibility: A critical review of five decades' evidence. Journal of Applied Social Psychology, 34(2), 243-281. doi: http://dx.doi.org/10.1111/j.1559-1816.2004.tb02547.x.

Prokopy, L. S., Floress, K., Klotthor-Weinkauf, D., & Baumgart-Getz, A. (2008). Determinants of agricultural best management practice adoption: Evidence from the literature. Journal of Soil and Water Conservation, 63(5), 300-311. doi: http://dx.doi.org/10.2489/jswc.63.5.300.

Rangel, J.M., Sparling, P.H., Crowe, C., Griffin, P.M., & Swerdlow, D.L. (2005). Epidemiology of Escherichia *coli* O157:H7 outbreaks, United States, 1982-2002. *Emerging Infectious Diseases, 11(4),* 603-609.

Russell, R. A., & Bewley, J. M. (2013). Characterization of Kentucky dairy producer decision-making behavior. Journal of Dairy Science, 96(7), 4751-4758. doi:http://dx.doi.org/10.3168/jds.2012-6538

Sinaga, S., & Callison, C. (2008). Credibility of PR practitioners: The impact of professional journalism background on trustworthiness, expertness, and homophily evaluations. Public Relations Review, 34(3), 291-293. doi:10.1016/j.pubrev.2008.04.002

Sligo, F. X., & Massey, C. (2007). Risk, trust and knowledge networks in farmers' learning. Journal of Rural Studies, 23(2), 170-182. doi:http://dx.doi.org/10.1016/j.jrurstud.2006.06.001

U.S. Department of Agriculture (USDA). (2014a). Summery of Recall Cases in Calendar Year 2013. Retrieved from http://www.fsis.usda.gov/wps/portal/fsis/topics/recalls-and-public-health-alerts/recall-summaries

U.S. Department of Agriculture (USDA). (2014b). Pre-Harvest Management Controls and Intervention Options for Reducing Shiga Toxin-Producing Escherichia coli Shedding in Cattle: An Overview of Current Research. Retrieved from http://www.fsis.usda.gov/wps/wcm/connect/d5314cc7-1ef7-4586-bca2-f2ed86d9532f/Reducing-Ecoli-Shedding-in-Cattle.pdf?MOD=AJPERES.

Vergot III, P., Israel, G., & Mayo, D. E. (2005). Sources and channels of information used by beef cattle producers in 12 counties of the northwest Florida extension district. Journal of Extension, 43(2). Retrieved from http://www.joe.org/joe/2005april/rb6p.shtml

APPENDIX A

Questionnaire

I am personally involved in cattle production, either in a managerial or employee position, at a feedyard, cow-calf or stocker operation.

Agree
Disagree

How likely are you to depend on the following sources for information relating to pre-harvest strategies for *E. coli* prevention for your beef operation?

	Unlikely				Likely
State and local extension personnel	1	2	3	4	5
Veterinarian	1	2	3	4	5
Other cattle producers	1	2	3	4	5
Government sources (e.g., USDA)	1	2	3	4	5
Beef industry organization (e.g., NCBA)	1	2	3	4	5

For each pair of adjectives below, mark the point between them that reflects your feeling state and local extension personnel.

Experienced	○	○	○	○	○	○	○	Inexperienced
Uninformed	○	○	○	○	○	○	○	Informed
Trained	○	○	○	○	○	○	○	Untrained
Qualified	○	○	○	○	○	○	○	Unqualified
Expert	○	○	○	○	○	○	○	Not expert
Dishonest	○	○	○	○	○	○	○	Honest
Untrustworthy	○	○	○	○	○	○	○	Trustworthy
Open-minded	○	○	○	○	○	○	○	Closed-minded
Fair	○	○	○	○	○	○	○	Unfair

Ethical Unethical	○	○	○	○	○	○	○	

For each pair of adjectives below, mark the point between them that reflects your feeling toward veterinarians.

Experienced Inexperienced	○	○	○	○	○	○	○	
Uninformed Informed	○	○	○	○	○	○	○	
Trained Untrained	○	○	○	○	○	○	○	
Qualified Unqualified	○	○	○	○	○	○	○	
Expert	○	○	○	○	○	○	○	Not expert
Dishonest Honest	○	○	○	○	○	○	○	
Untrustworthy Trustworthy	○	○	○	○	○	○	○	
Open-minded Closed-minded	○	○	○	○	○	○	○	
Fair Unfair	○	○	○	○	○	○	○	
Ethical Unethical	○	○	○	○	○	○	○	

For each pair of adjectives below, mark the point between them that reflects your feeling toward other cattle producers.

Experienced Inexperienced	○	○	○	○	○	○	○	
Uninformed Informed	○	○	○	○	○	○	○	
Trained Untrained	○	○	○	○	○	○	○	
Qualified Unqualified	○	○	○	○	○	○	○	
Expert	○	○	○	○	○	○	○	Not expert

Dishonest	○	○	○	○	○	○	○	
Honest								
Untrustworthy	○	○	○	○	○	○	○	
Trustworthy								
Open-minded	○	○	○	○	○	○	○	
Closed-minded								
Fair	○	○	○	○	○	○	○	
Unfair								
Ethical	○	○	○	○	○	○	○	
Unethical								

For each pair of adjectives below, mark the point between them that reflects your feeling toward government sources, such as the USDA.

Experienced	○	○	○	○	○	○	○	
Inexperienced								
Uninformed	○	○	○	○	○	○	○	
Informed								
Trained	○	○	○	○	○	○	○	
Untrained								
Qualified	○	○	○	○	○	○	○	
Unqualified								
Expert	○	○	○	○	○	○	○	Not expert
Dishonest	○	○	○	○	○	○	○	
Honest								
Untrustworthy	○	○	○	○	○	○	○	
Trustworthy								
Open-minded	○	○	○	○	○	○	○	
Closed-minded								
Fair	○	○	○	○	○	○	○	
Unfair								
Ethical	○	○	○	○	○	○	○	
Unethical								

For each pair of adjectives below, mark the point between them that reflects your feeling toward beef industry organizations.

Experienced	○	○	○	○	○	○	○
Inexperienced							

Uninformed	○	○	○	○	○	○	○	
Informed								
Trained	○	○	○	○	○	○	○	
Untrained								
Qualified	○	○	○	○	○	○	○	
Unqualified								
Expert	○	○	○	○	○	○	○	Not expert
Dishonest	○	○	○	○	○	○	○	
Honest								
Untrustworthy	○	○	○	○	○	○	○	
Trustworthy								
Open-minded	○	○	○	○	○	○	○	
Closed-minded								
Fair	○	○	○	○	○	○	○	
Unfair								
Ethical	○	○	○	○	○	○	○	
Unethical								

How many head of cattle are on your operation?

a. 1 to 49
b. 50 to 199
c. 200 to 999
d. 1,000 to 4,999
e. 5,000 or More

Which state is your operation primarily located?

How many years has your operation been involved in cattle production?

a. Under 10 Years
b. 10 to 20 Years
c. 21 to 30 Years
d. 31 to 40 Years
e. 41 to 50 Years
f. Over 50 years

How many years have you, personally, been involved in cattle production?

a. Under 10 Years
b. 10 to 20 Years
c. 21 to 30 Years

d. 31 to 40 Years
e. 41 to 50 Years
f. Over 50 years

What is your role on your operation?

a. Owner
b. Employee
c. Other

What is the highest level of education you have completed?

a. Some high school
b. High school graduate
c. Some college
d. Trade/technical/vocational training
e. College graduate
f. Some postgraduate work
g. Post graduate degree

How do you describe yourself? (please check the one option that best describes you)

a. American Indian or Alaska Native
b. Hawaiian or Other Pacific Islander
c. Asian or Asian American
d. Black or African American
e. Hispanic or Latino
f. Non-Hispanic White

Gender

a. Male
b. Female