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Public Perceptions Of Genetically Modified Food On Social Media: A Content Analysis Of Youtube Comments On Videos

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PUBLIC PERCEPTIONS OF GENETICALLY MODIFIED FOOD ON SOCIAL MEDIA: A
CONTENT ANALYSIS OF YOUTUBE COMMENTS ON VIDEOS

by

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DEDICATION

I dedicate this thesis to my parents, Zhaofu Zhang and Wei He, who always support me in pursuing higher education and achievement in academia. Without their finantial and spiritual support, I could never go such far. Dedication also to the people who help me with living and studying in the University of South Carolina, Columbia.

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ABSTRACT

Controversy about genetically modified (GM) food prevails on social media. Discussion about GM food includes the implementation of mandatory labeling as well as public concerns about potential health hazards posed by GM food. Previous studies mainly focus on traditional press and broadcast media, few investigate such controversial topics on social media. Interested in public opinion about this issue and possible influences of social media on public opinion, this study uses quantitative content analysis to examine the characteristics of user comments on a specific social media platform, YouTube. The purpose of the study is to investigate YouTube comments from several aspects, encompassing attributes, valence, sources cited to support opinions, motivation of commenting, along with other characteristics (uncertainty, interactivity, and hostility) embedded in these comments. In addition, the study also examines whether there are relationships between some of the variables mentioned above. Findings in this study showed that the most discussed issue related to GM food among YouTube users was informative education, and viewers were prone to comment in a negative tone. Interestingly, uncertainty manifested in the comments was associated with interactivity among commenters. Additionally, hostility toward GM food and mass media were highly associated with interactivity among commenters.

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CHAPTER 1

INTRODUCTION

Genetically modified food (GM food) is an important issue worldwide with both proponents and opponents. The dominant controversies associated with GM food in the United States pose questions regarding the implementation of mandatory labeling and public concerns about potential health hazards. However, genetically modified food is common in the United States. Food manufacturers estimate that 70 percent of processed foods contain at least one ingredient made from genetically engineered crops (Jaffe, 2012). Although the U.S. Food and Drug Administration approved the first GM salmon for human consumption in 2015, and released announcements responding to consumers' concerns about the reviewing process, environmental influence, and labeling issues (FDA, 2015), the idea that biotechnology poses risks to public health is still a concern for many. Understanding how these issues are communicated to the public, via the media and by organizations such as the FDA, helps us better understand public opinion and concerns surrounding GM food.

Previous content analyses have focused mainly on how traditional press and broadcast media cover GM food and its related controversies, as well as how the coverage associates with public perceptions (Mclnerney, Bird & Nucci, 2004; Lockie, 2006; Marks, Kalaitzandonakes, Allison & Zakharova, 2003). Few investigate such controversial topics on social media platforms, however, which leaves a gap in existing

research. Considering the reach of social media now, and the influence it has on many people's daily lives, this study seeks to help fill that gap by taking a closer look at public opinion expressed via comments on one social video-sharing platform, YouTube.

Built on the ideological and technological foundations of Web 2.0 and user generated content (Kaplan & Haenlein, 2010), social media has increased worldwide access to information about genetically modified food from a diverse range of sources and has involved users more in the exchange of knowledge and experiences. Social media (and other online technologies) have fundamentally changed the flow of communication from one-way (traditional mass media to the audience) to multi-faceted, two-way communication.

YouTube, one of the most popular video-sharing websites around the world, is of growing significance to study how a social media platform is employed for the exchange of science and health-related information. Also, people are increasingly using YouTube to share news-related videos (Anderson, 2015), setting the news agenda for themselves and watching videos at their own convenience (Pew Research Center, 2012). Due to its participative and collaborative advantages (Walther, DeAndrea, Kim & Anthony, 2010), any individual, non-profit organization, or media corporation can publish amateurish as well as professional content through this interface.

Accompanied with the social visualization of information is the interaction among anonymous online users regarding a specific topic via comments. Content communities (Kaplan & Haenlein, 2010), such as YouTube, make it possible for users to express their opinions and evaluations (Walther, DeAndrea, Kim & Anthony, 2010) about almost all the content and issues related to the videos. Social media users might be more prone than

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online news website users to engage in such user-to-content and user-to-user interactions (Ksiazek, Peer & Lessard, 2014), where interactivity is reflected by user comments. This interactivity may also be strengthened through questions raised by some comments (Ziegele, Breiner & Quiring, 2014), and uncivil comments can even flame the comment section of a website. However, how audiences interpret these comments has also triggered the concern that hostile user comments may distort science communication (Len- Ríos, Bhandari & Medvedeva, 2014). Interestingly, Monsanto, one of key biotechnology companies at the center of the GM food debates, has disabled comments on all videos on its YouTube channel. Although there does not appear to be an official announcement from Monsanto regarding reasons for disabling comments, one might assume that the company did this because user comments can affect how others interpret the content or more general impressions of the company/channel owner(s) (Monsanto Company, 2015).

A large body of research has studied different aspects of online comments in the fields of science communication and public health, as well as interactivity in journalism (Len- Ríos, Bhandari & Medvedeva, 2014; Regan et al., 2014; Holton, Lee & Coleman, 2014; Walther, DeAndrea, Kim & Anthony, 2010; Ksiazek, Peer & Lessard, 2014; Ksiazek, 2015; Weber, 2013). This study extends previous research on online news comments to user comments in a specific social media platform, and focuses on a specific topic that is relevant to the field of science communication and public health. Studying communication surrounding GM foods requires a thorough understanding of how scientific and health information flows from various sources (e.g., from organizations, scientists, and/or media) to the lay public.

The purpose of this study is to investigate YouTube comments from several aspects, including the attributes, valence, sources cited to support opinions, along with other characteristics (uncertainty, interactivity, and hostility) among user comments on videos about GM food. Further, source and nature of videos were considered, along with the perceived attributions of responsibility of potential hazards (as expressed by user comments). Studying characteristics of user comments is valuable for understanding not only public opinion related to the topic of GM food, but also interactivity on this social media platform. More specifically, this study focuses on videos from three different sources and analyzes user comments under the videos in order to explore the relationship between source and stance of users' comments. This paper first describes relevant literature and study variables, then details the methods used in the current research, followed by presenting and discussing the findings, conclusions, limitations, and directions for possible future research.

CHAPTER 2

LITERATURE REVIEW

2.1 CONTENT COMMUNITIES AND YOUTUBE COMMENTS

Kaplan and Haenlein (2010) classified YouTube as a content community, a type of social media with medium social-presence and low self-presentation. The main objective of content communities is the sharing of media content among users (Kaplan & Haenlein, 2010). YouTube offers various educational and entertainment-based videos to the lay public, many of which include science and health-related content. The comments sections of YouTube videos show the participatory and interactive nature of public discourse from users. YouTube enables registered users to comment on videos and reply to others' comments, while unregistered users can only watch videos and view comments on the videos. Channel owners can even disable or moderate (See Ksiazek, 2015, p. 567) comments from the public (YouTube, n.d.).

Besides communication variables such as media exposure, attention, and the content itself, which might affect public perceptions and attitudes toward GM food (Besley, 2015; Frewer, Miles & Marsh, 2002), research has shown that YouTube comments influence both video evaluations and attitudes toward a specific issue (Walther, DeAndrea, Kim & Anthony, 2010). In addition, user comments have been treated as a competing source of news, influencing individuals' perceptions in a previous study (Lee & Jang, 2010), and have had both direct and indirect effects on perceived

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media bias (Lee, 2012). In other words, audiences often infer opinions from user comments more than from news content.

Due to the subjectivity of user comments, we can also infer what users think about the video content from the comments. Each comment reflects individuals' opinions. Also, the characteristics of YouTube user comments might offer insights about how some of the effects mentioned above are achieved. Therefore, we assume that the characteristics of comments in different contexts might be different (meaning that video content or other factors might influence the comments under a video). Consequently, this study is interested in the characteristics of comments on videos from different sources regarding the important science- and health-related issue of GM food.

2.2 INTERPRETATION AND CONTROVERSY SURROUNDING GENETICALLY MODIFIED FOOD

No consensus has been reached so far upon the term used to describe this category of food. Aside from genetically modified food, several popular names have been employed: genetically modified organisms (GMOs), genetically engineered food (GE food), and "Frankenfood" have frequently showed up in news reports (Besley, 2005). Recently, the U.S. Food and Drug Administration announced its preference for the terms, "genetic engineering," "bioengineering," and "modern biotechnology," rather than "genetically modified," in its updated "Guidance for Industry" because the term "genetically modified" encompasses a broader range of methods that can be used to alter the genetic composition of a plant (FDA, Dec. 2015). The World Health Organization (WHO), however, uses the term "genetically modified foods." GM foods are defined as "the foods derived from organisms whose DNA has been modified in a way that does not

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occur naturally, e.g. through the introduction of a gene from a different organism"
(WHO, 2016, para. 3).

Besides different names being used for different communication purposes, controversy surrounding GM foods focuses mainly on the following aspects: Supporters advocate the benefits, which include increased productivity, less environmental pollution from pesticides and herbicides, and helping to relieve hunger in developing countries; however, opponents raise questions about gene drift, super-weeds, biodiversity, unknown long-term consequences, and public concerns regarding the ethics of technology, labeling, and possible health effects of consuming GM foods (Gaskell et al., 2004). Considering these concerns, one goal of the current study is to determine the most remarkable aspect(s) of GM foods among YouTube users. Thus, the first research question is as follows:

RQ1: Among YouTube user comments, what attributes regarding GM food are frequently mentioned?

Partisans' opinions provide cues for studying issues related to GM food. Exploring which opinions are reflected most among YouTube user comments will help us learn more about public opinions on social media as well as shed light on the amelioration of science/health communication on such channels. In particular, valence (positive, negative or neutral) of user comments has been shown to affect public evaluations about events and issues (Walther, DeAndrea, Kim & Anthony, 2010). The dominant valence of user comments can also reflect opinions and evaluations of the issue of GM food among the general public. Thus, this study asks the following question:

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RQ2: What is the valence of comments (positive, negative or neutral) on YouTube videos about GM food?

Furthermore, trust in sources is a critical factor in determining public seeking of science and health information (Jasanoff, Markle, Peterson & Pinch, 2001). Thus, the sources in the videos might affect viewers' opinions regarding the topic of GM food. Additionally, as commenters might use other sources of information to support their opinions, this study is also interested in investigating which types of sources commenters use for backing up their arguments.

RQ3: Is source of video on YouTube associated with prevalent stance (pro-GM food, anti-GM food or neutral) of viewers' opinions toward GM food?

RQ4: What types of sources are commenters using to support their comments regarding GM food?

2.3 ATTRIBUTION OF RESPONSIBILITY

For people who oppose GM food due to potential GM food hazards, they might attribute the responsibility of such hazards to a variety of causes. Questions such as, "who is responsible for the safety of GM food?" and "who is responsible for public health and our environment?", have been raised for a long time. For example, is it biotechnology companies that advertise GM foods, politicians who have strong associations with interest groups, or the regulatory agencies overseeing GM food production and commercialism that should take responsibility?

Attribution theory emphasizes the process of attribution, which is mainly about how antecedents like information, beliefs, and motivation affect perceived causes, and how these perceived causes lead to consequences such as behavior, affect, and

expectancy (Kelly & Michela, 1980). Furthermore, attributions made by actors and observers can be intrinsically different. For example, Jones and Nisbett (1972) hypothesized that actors tend to attribute their actions to situational requirements, while observers tend to attribute the same actions to stable personal dispositions, which was confirmed by subsequent studies (Kelly & Michela, 1980). Thus, actors and observers base their judgements on different information. YouTube users who watch videos about GM food (observers, in this example) express their opinions about issues through comments and might attribute responsibility in a totally different way from the actors (speakers) in the videos. Semetko and Valkenburg (2000), in their research of news frames, interpreted "attribution of responsibility" as to attribute responsibility of an issue or problem for its cause or solution to either the government or to an individual or group. Iyengar (1989) categorized attributions of responsibility into causality and treatment responsibilities from a psychological perspective. Causal responsibility emphasizes the origin of the problem, while treatment responsibility focuses on who or what has the power either to alleviate or to forestall alleviation of the problem. These two definitions of responsibility are particularly useful in understanding public dialogue about social problems (Kim, Carvalho & Davis, 2010).

The negative consequences of attribution of responsibility can give rise to blame and be used in everyday language where, at times, responsibility and blame might be used interchangeably (Weiner, 1995). People might criticize GM food for being marketed and posing potential hazards to public health, attributing these responsibilities to individuals, organizations, or government. Specifically, attributions of negative consequences of GM food in the process of production, use, consumption and

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communication can be vastly varied. Research on GM food has been blamed for ethics issues such as golden rice research violating U.S. federal rules on human research (see, e.g., http://www.sciencemag.org/news/2013/09/golden-rice-not-so-golden-tufts). Major producers of genetically modified organisms, such as Monsanto, DuPont Pioneer, and Syngenta, are often blamed for contaminating the environment and posing risks to human health due to farming, producing, and marketing GM food. Some blame is directed at the FDA for approving GM food into market as well as for its regulations about labeling GM food voluntarily. On the other side, the anti-GM food advocates are blamed for preventing the progress of science. Even nonprofit organizations such as Greenpeace have been criticized for illegal actions related to protesting GM food issues. Although attributions of responsibility around GM food are complicated, this study is interested in how responsibility (of cause or solution) for the perceived problem of GM food is attributed among online user comments. Therefore, the next question is:

RQ5: What attributions of responsibility for perceived GM food risks are reflected in comments on YouTube?

2.4 UNCERTAINTY MATTERS

Uncertainty is essentially the lack of attributional confidence about causes and their effects, according to Berger and Calabrese (1975, as cited in Albrecht & Adelman, 1987). Mass media play a significant role in interpreting uncertainties from laboratory and scientific discourses to the public. Journalists, in particular, are facing a dilemma of being accused of both making categorical statements and making information about GM food appear uncertain and baffling in news reports (Friedman, Dunwoody & Rogers, 2012). Public response to uncertainty is increasingly of interest to researchers. Often, individuals

interpret uncertainty in a number of different ways, for different reasons, and with varying outcomes (Friedman, Dunwoody & Rogers, 2012).

For the issue of genetically modified food in the United States, expert sources or evaluators like scientists and medical professionals are the most trusted among the general public (Lang & Hallman, 2005). Ignorance and negligence are also critical factors related to public uncertainty surrounding GM food issues. People selectively pursue or attend to information relative to their own interests and even avoid information that is painstaking or makes them uncomfortable. In 2003, a national study reported that awareness among Americans of GM food and self-reported knowledge was still low and remained nearly unchanged through the years (Hallman et al., 2003).

Given the relatively high level of uncertainty surrounding the issue of GM foods, one might expect people to engage in information seeking and question asking in order to gain information that would be instrumental in uncertainty reduction (Berger & Calabrese, 1975). People also create uncertainty by asking questions about additional facts or the possible meaning of items (Ziegele, Breiner & Quiring, 2014). Uncertainty of one's attitude can motivate individuals to learn more about counterarguments as well (Knobloch-Westerwick & Meng, 2009). Besides those who strongly support or oppose GM food, there are many people who show low certainty on their standpoints on this issue. In addition to exploring which opinions are more prevalent on YouTube, this study aims to determine whether uncertainty regarding GM food is prevalent among YouTube viewers' comments, which leads to the following question:

RQ6: How prevalent is uncertainty in YouTube comments on videos about GM food?

2.5 THREE DIMENSIONS OF HOSTILITY

User comments have long been a concern among media and journalists due to the abusive nature of some comments (Hille & Bakker, 2014). Several studies have focused on the reasons for negativity in user comments. For example, Alonzo and Aiken (2004) studied the motives of flaming among user comments. Content also has a critical influence on the prevalence of hostility, and hostile comments, in general, are found less frequently than civil comments on online news sites (Ksiazek, 2015). However, flaming, which refers to displaying hostility by insulting, swearing or using other offensive language, appears to be very common on YouTube (Moor, Heuvelman & Verleur, 2010). As a result, user comments are deemed unable to contribute to a relevant and judicious debate most of the time (Noci et al., 2010).

According to Ksiazek (2015), hostility, expressed by hate speech, profanity, and obscene or offensive language, is an antonym of civility, and conceptualizations of civility and hostility vary from normative to contextual definitions. Previous research on hostility is generally divided into three categories of general aggression or antagonism, flaming, and trolling (Ksiazek, 2015). Aggressive comments come mainly in the form of shouting, insults or accusations of being incompetent (Ziegele, Breiner, & Oliver, 2014). In their study of YouTube comments, Moor, Heuvelman and Verleur (2010) defined flaming as an online participant insulting or using profane or offensive language, while trolling, as Hardaker (2010) described, is the posting of incendiary comments with the intent of provoking others into conflict.

In the current study, hostility is not only interpreted as opposing civility, but it also might reflect the biased inference about public opinion toward GM food in the video

affected by user comments (Lee, 2012). Besides the existing conceptualization, hostility is also manifested in this study in two other dimensions: hostility toward GM food and hostility toward media. Previous research on GM food and risk perception interpreted public opposition to GM food as the result of public misperceptions of the risks associated with GM food (Gaskell et al., 2004). Hostility toward GM food reflected in the comments on social media platforms is, on one hand, a way of opposing GM food with skepticism and criticism. On the other hand, users may also be hostile toward the media, which might be evident in their comments. In addition, trolling in this study is different from general degradation in that trolling usually contains aggressive or abusive words while degradation is meant to humiliate but does not contain such words. Thus, the next question in this research asks:

RQ7: How does hostility manifest among the comments on YouTube videos pertaining to GM food?

2.6 INTERACTIVITY: FROM "USER TO CONTENT" TO "USER TO USER"

Studies on interactivity have increased dramatically with the emergence of new communication channels (Kiousis, 2002), with social media being the focus of this research due to its ability to facilitate interactions similar to interpersonal communication (Walther and Burgoon, 1992; Williams et al., 1988). Feedback is of central display in interactive communication (Kiousis, 2002). Interactivity has been insightfully interpreted by Jensen (1998) as not only the relationship between text and reader, but also reciprocal human actions and communication associated with the use of media as well as para-social interaction via a medium.

Later research, studying comments on online news in particular (Ksiazek, Peer & Lessard, 2014), distinguishes user-to-content and user-to-user interactivity in terms of motives, for the former is driven by need for information, and the latter by need for social interaction. User-content interactivity, as defined in their research, is a basic form of feedback for the content creator. User-user interactivity is back and forth among viewers of the video; in other words, a dialogue or conversation between the commenters.

According to previous research, online user comments have been studied in different contexts (Ziegele & Quiring, 2013; Ruiz et al., 2011); thus, the study of interactivity of comments on YouTube can follow suit. Sharing personal experience in user comments related to health news is of great use for other viewers (Secko, Tlalka, Dunlop, Kingdon & Amend, 2011). Reason why people comment varies, from congratulating the author, getting further elaboration, voicing conflicting opinions, pointing out factual errors, building a backlink, replying to others' comments, to spam (Bestor, n.d.). And of course, there might be other reasons. The current study seeks to add to existing research in this area by exploring the motives of YouTube users to reply to comments on videos about GM food. Thus, the following final question is raised:

RQ8: What factors seem to motivate users to reply to comments under videos regarding GM food on YouTube?

In addition, in terms of the exploratory work that Ziegele, Breiner and Quiring (2014) have done on discussion factors that make a comment more likely to receive replies, the current study is also interested in exploring the relationship between two of those discussion factors and interactivity on the topic of GM food. According to previous research (Ziegele, Breiner & Quiring, 2014), comments were more likely to receive

responses when commenters asked questions to close gaps in their own knowledge (showing uncertainty). Therefore, the first hypothesis is:

H1: Uncertainty will be highly associated with interactivity in viewer comments on GM food videos on YouTube.

Also, previous research indicated that offensive comments were more likely to receive response comments (Ziegele, Breiner & Quiring, 2014). Thus, this study proposes the following final hypothesis:

H2: Hostility (presence, degree, and target) will be highly associated with interactivity in viewer comments on GM food videos on YouTube.

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CHAPTER 3

METHOD

The current study employed content analysis in order to examine the characteristics of user comments on YouTube videos regarding GM food. Content analysis, as potentially one of the most important research techniques in the social sciences and indigenous to communication research, makes replicable and valid inferences from data to their context (Krippendorf, 1989). Content analysis assures not only that all units of analysis receive equal treatment but also allows researchers to establish their own context for inquiry, which enables the content analyst to provide aggregate accounts of inferences from large bodies of data that reveal trends, patterns, and differences no longer obvious to the public (Krippendorf, 1989). In this regard, content analysis helps this study explore discussion patterns about an important science/health topic on social media.

3.1 SUMMARY OF SAMPLING AND CODING PROCEDURE

Purposive sampling was employed because of the nature of this research, i.e., as YouTube is one of the most popular video-sharing websites in the world, it has seemingly unlimited content as well as a substantial user base (Riff, Lacy & Fico, 2014). Two steps were taken to determine the final sample for this study. The first step involved searching YouTube content using the key words, "genetically modified food." Next, the YouTube filter "most viewed" was used to sort out sample videos and the top five most viewed

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videos were selected. As the unit of analysis in this study is the individual comment, in the second step, the number of comments to sample related to each video was determined by the video with the fewest comments (approximately 200 comments). Across the five videos included in this study, the total sample size was 1,010, with around 200 comments being analyzed per video. In addition, systematic sampling was employed to sample the comments under each video for further analysis (Riffe, Lacy & Fico, 2014). For example, the total number of comments on the first video was 4,842; from the first displayed comment, the researcher selected every 24th comment as the sample; thus, the final sample from the first video was 201. Sampling of comments for the rest of the videos followed the same format. The number of comments on the second video was 3,436; every 17th comment from the second comment was chosen, and the final sample was 203. For the third video, every 16th comment was chosen from the total of 3,253; thus, the final sample size for the third video was 204. The fourth video had a total of 212 comments, and the first 200 comments were chosen for that sub-sample. The last video had 2,630 comments in total, and after choosing every 13th comment, 202 comments remained. The sampled comments were then put into a spreadsheet and printed out for two graduate student coders.

The five YouTube videos are "14-year-old girl picks fight with bully TV host – and Wins" uploaded by Kids' Right to Know, "What's a GMO?" by Jimmy Kimmel Live, "Mr. Know-it-all: Genetically modified food at dinner parties-Wired" by *Wired* Magazine, "Neil DeGrasse Tyson on GMO food" by Neil DeGrasse Tyson Videos (unidentifiable channel owner), and "Eyes of Nye – GM foods" by BallawdeQuincewold (unidentifiable channel owner). These videos are listed in order from the most watched to

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the least among the top five most viewed videos on this topic as listed by YouTube[1].

Although purposively sampled, the five videos cover very broad themes in relation to

GM food, such as science, education, entertainment, and activism.

3.2 MEASURES

     This section summarizes the major variables included in this study (see the

Appendix for more coding details). Characteristics of comments, concerning aspects

regarding the topic, valence of opinion, attribution of responsibility, uncertainty, hostility,

and interactivity were measured in order to answer research questions and test

hypotheses. Additional variables include descriptive factors of videos (nature, source,

standpoint, etc.), and the number of response comments received by a single comment.

     The prevalent attributes of GM food. Attributes of GM food were measured by

whether the comment involves the following issues related to GM food: the potential

health hazards associated with GM food, the labeling issue, ethics of GM food, benefits,

environmental concerns, informative education of GM food knowledge, and other (see

codebook, entry VI).

     Valence of comment and opinion. Valence of comment will be measured with

positive, negative, and neutral tone of comments. In order to evaluate the comment

valence, Walther, DeAndrea, Kim, and Anthony (2010) gave some good guidance in their

research. In this study, positive tone will be visible through positive words and friendly

approaches to other commenters, while negative tone means the comment includes

pessimistic, sarcastic, or aggressive words. Neutral tone means neither positive nor

negative emotions are evident in the comments. For example, positive tone could be

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[1] Because the data on YouTube changes over time, all information is based on the date when it was collected. The samples were collected during March 6, 2016 and April 15, 2016.

something like, "funny this is GMO food is a lot safer because…"; negative might be something like, "sorry but most of your food is GMO" "kind of sad that…"; and neutral might be something like, "GMO…OMG It tastes just like gluten." (see codebook, entry VIII).

Stance of opinion. Stance of opinion was measured in a way of pro-GM food versus anti-GM food. In addition, if the comment contains both sides of opinion, it will be counted as neutral. If the opinion is not related to GM food, but rather other issues, it should be coded as an absence of opinion about GM food (see codebook, entry IV).

Attribution of responsibility. Attribution will be measured by looking for inferences about whose responsibility to which issue/problem is attributed in the comments (Semetko & Valkenburg, 2000). Attribution of causal and solution responsibility were categorized into individual-level and societal-level causes and solutions (Kim & Willis, 2007). This study applied Kim and Willis's (2007) framework of attribution of responsibility to the issues of GM food. Therefore, causal responsibility could be attributed to the propaganda and monopoly of large corporations, irresponsible test processes by authorities, biased reports, misguidance or misinformation of consumer advocacy groups, lack of knowledge about GM food and biotechnology, and distrust of government. On the other hand, solution responsibility might be attributed to fulfillment of one's knowledge, purchase of organic food instead, labeling of GM food, further research, strict testing processes, unbiased report of mass media about GM food, and public education about knowledge of GM food (see Table 1) (see codebook, entries IX and X).

Table 3.1: Attributions of Causal and Solution Responsibility of GM Food Controversy

Individual-level causes	Individual-level solutions
Misguidance or misinformation Spread of rumor about hazards of GM food Lack of knowledge about GM food Distrust of government/politicians/regulatory authorities	Information seeking on one's own Purchasing organic food instead
Societal-level causes	**Societal-level solutions**
Propaganda or manipulation over GM food by large biotech corporations Irresponsible test by regulating authorities Biased journalistic practice Competition between GM food and organic food Activism of anti/pro-GM food advocates	Labeling Need of further research Strict testing process Unbiased report of mass media about GM food Public education about knowledge of GM food

Uncertainty. In this study, uncertainty was measured with questions being raised about GM food or its related issues in the user comments. Questions usually reflected that commenters were unclear about their knowledge of GM food and/or related issues and were hoping to get answers from other people. This could be associated with further interaction with other commenters.

Sources Cited. To resolve uncertainty and controversy about GM food, people turn to a variety of resources for assistance. The sources of information regarding GM food posted by users in their comments can reflect public acquisition of science/health information to some extent. The sources cited by commenters were categorized as personal anecdotes, research/scientific studies, policies, and news articles. Also, coders could specify new categories under an "other" option (see codebook, entry VII).

Hostility. Hostility was measured in three ways. First, it was measured in terms of presence or absence of hostile expression in the comments. Hostile expression in the comment includes words reflecting negative emotion such as fear and anger, use of swear

words, or ranting. In addition, hostility can be directed to the media itself, news media in particular. For example, "I dislike Wired a little more because of this video now." Furthermore, hostility can also be reflected as the degradation of GM food, content or source of the video, other commenters, and stakeholders of GM food such as corporations or government (see codebook, entry XII for RQ7; entries II, III, V [8] and XII for H2).

Interactivity. As the number of replies and "likes" an individual comment received could reflect how commenters interact with each other, interactivity was operationalized as the number of replies and "likes" to each comment. (see codebook, entries II and III).

Motive. The motives are measured with two aspects: user-content comments and user-user comments. For user-content comments, the motives could be congratulating the speakers in the video, and/or evaluating the video. While user-user comments could be evident as advocating other commenters' opinions or voicing opposite opinions due to conflicting views. Furthermore, some motives can be applied to both sides; for example, stating opinions about GM food, asking questions to require further elaboration on the video or topic, pointing out facts or factual errors about GM food, trolling, and spamming (see codebook, entry V).

3.3 INTERCODER RELIABILITY

Intercoder reliability was assessed on a random sample of 100 out of total 1,010 comments. In order to establish reliability, 20 comments were randomly selected from each video.

Two coders were trained and refinements to the initial codebook were made through a pretest using comments not included in the final sample. Intercoder reliability

was measured mainly using Krippendorf's alpha. As Krippendorf suggested relying on variables with alphas above .80 and only consider variables with reliabilities between α= .667 and α= .800 for drawing tentative conclusions (Krippendorff, 2004; Lombard, Snyder-Ducn, & Bracken, 2002), the variables with values lower than α=.667 were dropped.

A first attempt at establishing intercoder reliability was conducted between two coders for the set of 100 comments, randomly selected from the intended samples. However, the intercoder reliability of each variable was very low and inconsistent. The value of each variable varied intensely from α=.29 to α=.94. The low intercoder agreement could be attributed to a few factors. First of all, the initial training of coders was not enough for such a complex topic; second, there were so many values for each variable, which increased difficulty trying to reach agreement between coders. For these reasons, more coder trainings took place with revisions made to the coding protocol for a second attempt at coding.

Given more practice on coding and high agreement between coders on practice rounds before coding, the second attempt achieved much more satisfying alpha coefficient values. Variables and alpha values are listed here. Response in the coding protocol) had two possible options, response to video (α= .98) and to other commenters (α= .98). Stance of Commenter had four possibilities: (1) no stance specified α= .912; (2) pro-GM food α= .914; (3) anti-GM food α= .894; (4) neutral α= .82.

Motive to comment had ten possible options: congratulate/reproach the speakers in the video α= .778; evaluate the video α= .892; advocate other commenters' opinion α= .754; voice opposite opinion against other commenters α= .979; state own opinion about

GM food α= .88; ask a question to require further elaboration on the video content or topic α= .824; point out facts/factual errors concerning GM food α= .939; troll α= .875; spam α= .663; other α=- .005. For the attribute of comments, nine variables were checked for intercoder reliability: no attribute α= .927; health α= .951; labeling α= 1; ethics α= .862; benefits α= .918; environmental concern α= 1; informative education α= .875; regulation and management α= .928; scientific studies α= .835; other α= unidentified.

Sources cited by the commenters were divided into seven categories including no evidence used to support comment (α= .891), personal anecdote (α= .889), research or scientific studies (α= .951), policies (α= 1), news article (α= 1), opinion from others (α= .558), and other (α= unidentified). Valence had three possibilities: positive (α= .847), negative (α= .9), and neutral (α= .857).

Causal attribution of responsibility had nine possible options: no causal attribution (α= .937), distrust of government/politicians/regulatory authorities (α= .641), lack of knowledge (α= .754), misguidance or misinformation (α= .859), spread of rumor about food hazard (α= .884), lack of careful studies (α= .717), propaganda or manipulation of large biotechnology companies (α= .886), competition between GM food and organic food (α= .824), biased report of mass media (α= .824), and other (α= unidentified). Solution attribution of responsibility included categories such as no solution (α= .86), information seeking on one's own (α= .835), purchase organic food instead (α= .853), labeling (α= 1), need of further research (α= .884), strict testing process (α= 1), unbiased report (α= .713), public education (α= .841), corporate social responsibility (α= .94) and other (α= 1).

Finally, question (XI) about GM food had two possible options: yes (α= .855) or no (α= .853). Degradation (XII) had eight dimensions including no abusive words being showed (α= .92), other commenters (α= 1), mass media (α= 1), GM food (α= .713), science (α= 1), authorities (α= .864), advocates (α= .713), lay public (α= 1), and other (α= unidentified).

CHAPTER 4

FINDINGS

All videos were measured with four variables, including category, nature of video, nature of source, and standpoint of the video clip. The first video, "14-year-old girl picks fight with bully TV host – and wins!," was uploaded by a nonprofit organization, Kid's Right to Know, which was categorized by YouTube.com as nonprofit and activism. The nature of the video was coded as persuasion/propaganda based on the purpose of the uploader. Nature of Source was determined by the uploader's account, which is, in this case, a consumer advocacy group. Accordingly, standpoint in this video was coded as anti-GM food. The other four videos were analyzed following the same format (see Figure 4.1).

As shown in Figure 4.1, except for the one video that was coded as persuasion and propaganda, the rest were mainly for the purpose of education, entertainment, or both. The sources of the five videos are as follows: consumer advocacy group[2], broadcast media, print media, scientist, and science educator. The standpoints presented in the five videos were pro-GM food, anti-GM food, and neutral position.

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[2] Consumer advocacy group mainly refers to individuals or organizations that promote or protect the interests of buying public.

	Video 1	Video 2	Video 3	Video 4	Video 5
Video Category	Nonprofits & Activism	Entertainment	Science & Technology	Film & Animation	Entertainment
Nature of Video	Persuasion/ Propaganda	Entertainment	Education	Education/ Entertainment	Education/ Entertainment
Nature of Source	Consumer Advocacy Group	Broadcast Media	Scientist	Print Media	Science Educator
Standpoint	Anti-GM food	Neutral	Pro-GM food	Neutral	Neutral

Figure 4.1: Video Demographics

In order to answer the first research question (**RQ1**), which asked what aspects of GM food are most concerning to social media users (as evidenced by their discussion and comments), results showed the frequency of nine attributes that appeared in the video comments. Table 4.1 shows the frequencies and proportions of attributes among the 675 comments that included mentions of controversial issues regarding GM foods (of 1,010 total comments); 335 comments contained no mentions of controversial issues related to GM food (see Table 4.1).

Table 4.1*:* Frequency and proportion of attributes present in comments mentioning controversial issues regarding GM food

Attribute	Frequency	Proportion	
		N=675	N=1,010
Informative Education	328	48.6%	32.5%
Health issues	250	37.0%	24.8%
Ethical issues	229	33.9%	22.7%
Scientific Studies	176	26.1%	17.4%
Regulation and Management	90	13.3%	8.9%
Benefits	83	12.3%	8.2%
Labeling issues	63	9.3%	6.2%
Environmental Concern	56	8.3%	5.5%
Other	7	1.0%	0.7%

According to Table 4.1, informative education, health issues, and ethical issues are most frequently mentioned among user comments, followed by scientific studies, regulation and management, benefits and labeling. Environmental concern is the least mentioned attribute of GM food issues. In addition, religious and legal issues are also mentioned in the comments under the "Other" option.

Moreover, the controversial issues about GM food discussed the most among user comments across different videos aligned with the issues discussed most among total comments for the most part, though there were small changes in the distribution across videos.

RQ2 inquired about the tone of viewer comments and which valenced comments are most prevalent on YouTube. Results showed that 46.7% (n=472) of user comments were negative, while 45.8% (n=463) of total comments had a neutral tone. Only 7.4% (n=75) of the total comments were positive. However, the prevalence of tone in comments on videos from different sources varied. The tone had a weak but significant association with source of video (χ^2 = 25.885, df = 8, p=.001 < .05; Cramer's V= .113). Videos from consumer advocacy group, print media, and science educator were dominated by comments with a negative tone. Comments with a neutral tone were most prevalent on the video from broadcast media and scientist. For positive comments, the most were on the video from consumer advocacy group, followed by print media, and then science educator.

RQ3 asked about the relationship between the source of video and the prevalence of stance among comments. Stance refers to opinions related to GM food, which can be pro-GM food, anti-GM food, or neutral. After screening for comments that do not express any stance related to GM food (n=116), the valid number of comments with a stance is 894. Applying Crosstabs in SPSS, the results show that the number of comments with a neutral stance (n=322) were more prevalent than those with pro-GM food stance (n=264) or anti-GM food stance (n=308). The value of the chi square was 67.490 and the degrees of freedom were 8; the significance of the chi square was well below the standard

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indicator of a significant result ($p < .001$). Therefore, we can conclude that there is a statistically significant relationship between the source of video and the stance of comment. However, the effect size associated with this relationship was small (Cramer's V= .194). More specifically, the anti-GM food stance (n=84) was prevalent among comments on the video from the consumer advocacy group, which may reflect the anti-GM food stance put forth in the video from the consumer advocacy group. Likewise, the stance of the majority of comments on the video from broadcast media seemed to be reflective of the dominant stance in the video (neutral).

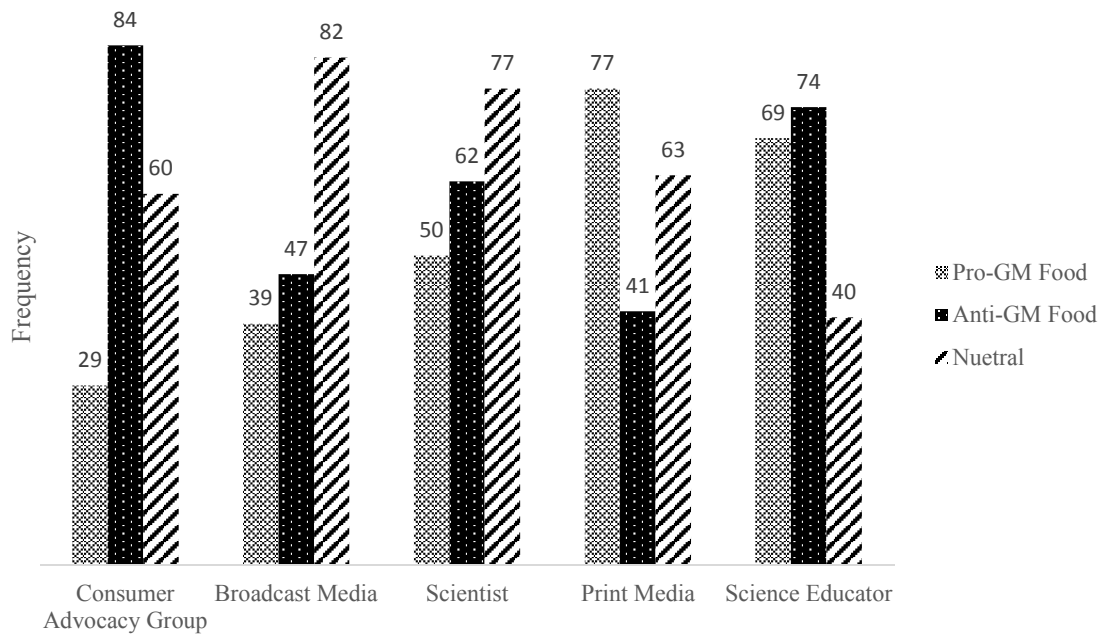Figure 4.2: Frequency of GM-Food Stance according to Video Source (n=894)

RQ4 examined the frequency of sources cited in video viewer comments. However, it is important to note that only 21.3% (n=217) of the comments cited sources. Among those comments, research/scientific studies were cited 82 times, personal anecdotes were mentioned 62 times, policies were cited 36 times, and news article were

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mentioned 23 times. "Other" sources used by commenters to support their opinions appeared 50 times, including opinions from notable or well-known people, Googled information, history, and the Bible.

RQ5 asked: What attributions of responsibility for perceived GM food risks are reflected in comments on YouTube? The proportion of total comments that mentioned at least one causal attribution of responsibility is 45.3% (n=458). "Lack of knowledge" about GM food was the most frequently mentioned causal attribution of responsibility appearing in the comments, followed by "misguidance/misinformation," and "propaganda or manipulation of large biotech companies" (see Table 4.2).

Table 4.2: Frequency and Proportion of Causal Attribution of Responsibility among Comments

Causal Attribution of Responsibility	Frequency	Proportion	
		N=458	N=1,010
Lack of knowledge	263	57.4%	26.0%
Misguidance/misinformation	174	38.0%	17.2%
Propaganda or manipulation of large biotech companies	124	27.1%	12.3%
Spread of rumor	53	11.6%	5.2%
Lack of careful scientific studies	51	11.1%	5.0%
Biased mass media	47	10.3%	4.7%
Other	41	9.0%	4.1%
GM food vs. organic food	28	6.1%	2.8%

RQ5 also sought attributions of responsibility for solutions related to GM food; and 23.4% of comments (n=236) mentioned at least one solution for resolving the controversy related to GM food. The most frequently appearing attribution of responsibility for solutions appearing in these comments was "self information seeking,"

which calls on viewers to fulfil their knowledge about GM food by themselves. "Public education" and "labeling" came in second and third in terms of frequencies and proportions among viewer comments. Commenters also suggested that longer-term research and more testing will contribute to solving controversy surrounding GM food among the general public; thus, "need of further research" was the fourth most prevalent after "labeling" (see Table 4.3).

Table 4.3: Frequency and Proportion of Solution Attribution of Responsibility among Comments

Solution Attribution of Responsibility	Frequency	Proportion	
		N=236	N=1,010
Self information seeking	140	59.3%	13.9%
Public education	84	35.6%	8.3%
Labeling	34	14.4.%	3.4%
Need of further research	30	12.7%	3.0%
Corporate social responsibility	21	8.9%	2.1%
Unbiased report	20	8.5%	2.0%
Strict testing process	19	8.1%	1.9%
Purchasing non-GM food instead	15	6.4%	1.5%
Other	8	3.4%	0.8%

RQ6 intended to examine whether uncertainty about GM food is prevalent among user comments. Among the comments, 36% (n=332) neither support nor oppose GM food. Only 16% (n=162) of total comments asked at least one question about the topic related to the video as well as GM food, such as "what was the video about?" or "Is GM food safe?", of which 14.2% (n=143) raised questions specifically related to GM food. The major purpose of comments seemed to be to state opinions about GM food (n=444; 44.0%), to argue with other commenters (n=422; 41.8%), and to inform other

commenters about GM food (n=354; 35.0%). However, many comments implied that the major reason GM food became a public controversy was "lack of knowledge," which seems to indicate that there is some uncertainty about GM food among the general public.

Table 4.4: Frequency and proportion of motivation of user comments

Motives	Frequency	Proportion (N=1,010)
State own opinion about GM food	444	44.0%
Voice opposite opinion against other commenters (User-User)	422	41.8%
Point out facts/ factual errors concerning GM food	354	35.0%
Troll	257	25.4%
Evaluate the video (User-Content)	188	18.6%
Ask a question to require further elaboration on the video or topic	162	16.0%
Congratulate/reproach the speakers in the video (User-Content)	118	11.7%
Advocate other commenter's opinion (User-User)	50	5.0%
Other	38	3.8%

RQ7 examined hostility reflected in users' comments on YouTube. Hostility was measured along three dimensions: prevalence, target, and frequency. First, the prevalence of hostility among YouTube comments was investigated, and results showed that 42.3% (n=427) of the comments illustrated at least degradation, besides using aggressive or abusive words in their comments. Further, 25.4% (n=257) of total comments aimed at trolling. For the comments that showed degradation, 35.6% (n=152) were directed at other commenters, while many others were directed at authorities (n=91), including regulatory agencies and companies, and mass media (n=77) (see Table 4.5).

Table 4.5: Frequency and proportion of hostility target among user comment

Target	Frequency	Proportion	
		N=427	N=1,010
Other Commenters	152	35.6%	15.0%
Authorities	91	21.3%	9.0%
Mass Media	77	18%	7.6%
Pro/Anti-GM Food Advocates	66	15.4%	6.5%
GM Food	61	14.3%	6.0%
Science	35	8.2%	3.5%
Lay Public	27	6.3%	2.7%
Other	5	1.2%	0.5%

In addition, there were significant relationships between source of video and most of the degradation targets, including other commenters (χ^2 = 36.082, df = 4, p=.000 < .05), mass media (χ^2 = 57.657, df = 4, p=.000 < .05), science (χ^2 = 50.203, df = 4, p=.000 < .05), and lay public (χ^2 = 28.178, df = 4, p=.000 < .05). Other commenters were frequently the target of degradation in comments under videos from the science educator (n=54), broadcast media (n=32), and scientist (n=30). Degradation toward mass media appeared most frequently among comments under the videos from the consumer advocacy group (n=36), print media (n=23), and broadcast media (n=12). Degradation toward science appeared most frequently among comments under the videos from the scientist (n=22) and the science educator (n=10). Degradation to lay public was prevalent among comments on the video from broadcast media (n=16).

The last research question **(RQ8)** investigated the motivations for users writing comments on YouTube videos (cf. Table 4.4 & Table 4.6). Among comments that mainly focus on the content of the video (user to content; n=384), the prevalent feature was that 45.8% of commenters stated their own opinion about GM food (n=176). The commenters

also frequently evaluated the video, congratulated or reproached the speakers in the video, pointed out facts or factual errors in the video, and trolled. Comments that reply to other commenters (user to user; n=626) reflect an overwhelming trend to argue with other commenters (n=418), rather than to agree with them (n=50).

Table 4.6: Frequency and proportion of motives among "User to User" comments and "User to Content" comments

Motivations	Frequency	Proportion
User to Content		**N=384**
State own opinion about GM food	176	45.8%
Evaluate the video	152	39.6%
Congratulate or reproache the speakers in the video	105	27.3%
pointed out facts or factual errors in the video	104	27.1%
Trolling	109	28.4%
Ask a question to require further elaboration	51	13.3%
Other	17	4.4%
Voice opposite opinion against other commenter	4	1.0%
Advocate other commenter's opinion	0	0%
User to User		**N=626**
Voice opposite opinion against other commenter	418	66.8%
State own opinion about GM food	268	42.8%
Pointed out facts or factual errors in the video	250	39.9%
Trolling	148	23.6%
Ask a question to require further elaboration	111	17.7%
Advocate other commenter's opinion	50	8.0%
Evaluate the video	36	5.8%
Other	21	3.4%
Congratulate or reproach the speakers in the video	13	2.1%

That concludes results related to the research questions in this study. Recall, however, that there were two hypotheses proposed as well, both of which involved the variable of interactivity. Interactivity was measured in two ways: user to user and user to content. Among total comments, 62% of comments were to reply to other users (n=626), and 38% were to comment on the video content (n=384).

The first hypothesis (**H1**) proposed that uncertainty would be associated with interactivity in comments among GM food video viewers on YouTube. Uncertainty was measured by questions being raised in users' comments, and interactivity in this hypothesis was operationalized as number of replies or number of likes. According to t-tests, the results showed there was a significant difference between interactivity and uncertainty when uncertainty was operationalized as number of likes ($t= -2.220$, $p=.027$). Comments with questions had an average of 2.40 likes ($SD=12.91$) while those without questions had an average of 1.12 likes ($SD=4.44$). This result shows that comments containing questions (uncertainty) seem to be associated with more interactivity (than those that do not raise questions) when interactivity is measured in terms of "likes" in response to comments.

However, based on this study's operationalization of interactivity, H1 can also be interpreted as to whether a comment that contains questions about GM food had more replies than others. In this regard, uncertainty and interactivity were operationalized as comments with questions and "number of replies." Comments with questions had more replies on average (M=1.00, SD=3.899) than those without questions (M=.89, SD=4.671). However, there was no significant difference between them ($t= -.258$, $p=.796$). Based on the above results, there was a relationship between interactivity and uncertainty, but it depends on how we look at interactivity. Therefore H1 was partially supported.

The second hypothesis (**H2**) proposed that there would be an association between hostility and interactivity in comments on YouTube videos related to GM food. Hostility was measured by three operational variables including presence, degree (degradation or

troll), and target. As presence of hostility in the comments was examined in RQ7, this hypothesis mainly tested how the other two aspects of hostility – degree and target – affected user interaction. Overall, trolling comments had slightly more replies (M= .93, SD=3.433) than non-trolling comments (M=.90, SD=4.884), though these differences were not statistically significant (t = .102, p = .919). Likewise, there were more replies to degrading comments (M=1.26, SD=6.696) than there were in response to comments that did not contain degrading content (M= .65, SD=1.742); and this difference was significant (t = -2.094, p = .036). Thus, H2 was partially supported.

The results also suggested that hostility to other commenters, mass media, GM food, science, and lay public was significantly associated with interactivity, with a relatively low degree of association via Eta (see table 4.7). Among these targets, GM food had the highest degree of association with commenters' interactivity, followed by mass media.

Table 4.7: Cross-tabulation for Association between Hostility Target and Interactivity

Target			**Interactivity** (Number of Replies)	
	Pearson Chi-Square (χ^2)	Degree of Freedom (df)	Sig. (p)	Eta
Other Commenters	68.321	19	.000***	.003
Mass Media	78.413	19	.000***	.073
GM Food	57.645	19	.000***	.091
Science	32.392	19	.028**	.019
Authorities	26.807	19	.109	.009
Advocates	19.332	19	.436	.013
Lay Public	80.788	19	.000***	.017

Note: ***p < .001, **p <.05, * p< .01; 0 < Eta < 1

CHAPTER 5

DISCUSSION

Aiming to explore the characteristics of user comments about GM food on social media, this study did a content analysis of user comments from YouTube videos about GM food. To the author's knowledge, disscusion about GM food on social media was previously yet to be investigated by scholarly research. Therefore, the current study explored the major characteristics of user comments regarding a controversial science and health topic – genetically modified food – on social media.

According to the study's findings, the types of controversial issues related to GM food that are discussed most among YouTube users are informative education, health issues, ethical issues, and scientific research. In particular, most commenters expressed their concerns about public ignorance and misguidance about GM food. Regarding health issues, for example, issues of safety of GM food for human consumption is an important concern mentioned in YouTube video comments.

Findings also indicate that comments with a negative tone are highly prevalent on social media. In particular, videos from the consumer advocacy group, science educator and print media, had the most negative comments, while videos from broadcast media and scientist had more neutral comments than negative comments. Because previous research has shown that videos with more positive comments are perceived better than videos with negative comments (Walther, DeAndrea, Kim & Anthony, 2010), the video

sources with negative comments – in particular, the consumer advocacy group – Kids'
Right to Know – may want to present information in a different way in order to receive
better evaluations from viewers. Additionally, the group may want to monitor and
interact more with viewers on their YouTube page and possibly on other social media.
Generally, YouTube viewers seem to have negative or somewhat indifferent feelings
toward GM foods. Most of the commenters implied neither pro-GM food nor anti-GM
food stance in their comments; however, the proportion of anti-GM food comments were
greater than pro-GM food comments, which seems to indicate that many social media
users still hold negative or conservative views toward GM food.

Looking at these results more closely, different videos had different proportions
of valenced comments. The anti-GM food stance was prevalent in videos from both the
consumer advocacy group and the science educator. A neutral stance to GM food was
dominant in videos from broadcast media and scientist. The pro-GM food stance was
dominant in the video source from print media. From these results, we could speculate
that the stance of commenters held about GM food might be affected by the video
uploaders, possibly due to perceived intentions to sway public opinion through posting
the videos. For example, the caption of the video uploaded by Kids' Right to Know
(Video 1) attempted to establish an image that a brave yound girl argued with
intimidating TV hosts about GM food, but the content of the video had nothing to do with
the caption. One could also assume that the video was trying to promote the anti-GM
food ideology or advertise the organization (Freeman & Chapman, 2007). Perceptions
might be different for videos from the scientist and from print and broadcast media.
Although news stories appear to be neutral or objective, the users' comments could affect

each other. Since individuals do not wish to be isolated from others by expressing an unpopular opinion, their perceptions of the popular opinion climate could have affected what some commenters wrote (Walther & Jang, 2012).

Although the findings showed a weak correlation between "stance" and "source of video," examination of the relationship between these two variables could go further in future research. It could lead to a new hypothesis, for example, that video source might affect the stance among user comments. Or we might also hypothesize that the stance of video source may affect the stance among comments under videos in follow-up studies.

Although most of the comments in this study did not cite sources to back up their point of view, the most cited source among those who did use additional resources to support their arguments was evidence from scientific studies or research. In these instances, commenters often copied URLs of journal articles, science videos or blogs, and/or statistics from a poll or survey to share in their comments and/or simply quoted the findings of scienfic research. For example, a commenter named "evnwood" included a link to Google Scholar studies about GM food safety in order to refute another commenter. Among the comments, personal experience was also frequently cited to persuade others. For instance, the commenter "redgibson1" talked about his work experience at Chipotle, where the manager told him the public was in favor of "non-GMO;" thus the restaurant labeled items "non-GMO" as a promotional tactic for the company. Although the reliability of source information was not examined by this study, findings suggested that scientific studies/research and personal experiences were the preferred types of evidence used by commenters to discuss GM food. This somewhat contradicts what Len-Rios, Bhandari and Medvedeva (2014) found in their study where

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commenters on a news story cited personal experience more frequently than scientific evidence (though personal experiences were also shared frequently in YouTube viewer comments). It could be that social media users may favor scientific information that is available online over personal experience in order to back up their opinions on GM food, which is a controversial and less personal topic than breastfeeding (the focus of the Len-Rios, et al, study and news article).

Based on the findings related to causal attribution of responsibility in this study, the controversy surrounding GM food is largely accredited to lack of knowledge and misinformation among the general public. One who supports GM food may attribute the controversy surrounding GM food to those who oppose GM food out of fear or misguidance. In turn, one who opposes GM food may regard the controversy surrounding GM food as being caused by enthusiasts who follow fads without knowing facts. While one who neither supports nor opposes GM food (neutral stance) may attribute the controversy related to GM food between both pro and anti sides to sensationalism and a lack of in-depth research. According to our findings related to solution attribution of responsibility, comments mostly implied self-information seeking and public education as solutions to the controversy surroudning GM food. As suggested by the findings, labeling can also be an alternative solution to help resolve the controversy.

Uncertainty is not prevalent among YouTube viewer comments according to this study. However, uncertainty about GM food in one's comment can incur more responses in terms of "likes" than those without uncertainty. Because simply clicking a "like" botton requires less effort than writing a comment, many users might choose to reply to other commenters in this way. In addition, rather than raising questions about GM food,

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commenters were more likely to show their knowledge and state own opinions about GM food through writing a comment (according to this study's findings). Questions were used more to show doubt about others' arguments or their stance about GM food.

The findings also indicated that a certain degree of hostility exists among comments on YouTube videos about GM food, as many commenters are intentionally trolling on the interface. Hostile comments, however, are still less common than non-hostile comments among social media users, which extends Ksiazek's (2015) finding that online news users appear to be more civil than hostile to another genre of media. Furthermore, the targets of hostility in the comments mainly appear to be other commenters, government, regulatory agencies, mass media, and pro/anti-GM food advocates. There are some comments that direct hostility toward GM food itself based on beliefs about its potential threat. Generally, however, YouTube users seem to have a sense of objectivity toward GM food.

As the findings indicate, video viewers were more prone to react to other users than to the content. For most comments that were in response to other comments, the motivations seemed to be primarily arguing against other's opinions and/or further refuting others' claims, which supports previous research that a sense of disagreement is a strong trigger to write a response on social media (Ziegele, Breiner & Quiring, 2014).

As for the association between three primary characteristics – interactivity, uncertainty and hostility, the findings indicate only weak relationships between uncertainty and interactivity, as well as between hostility and interactivity. The difference between comments with uncertainty or hostility and comments without them, as they related to interactivity, is not significant. Therefore, the current study is not able to fully

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support the ideas that uncertainty and hostility are highly associated with interactivity in comments on social media.

5.1 LIMITATIONS AND IMPLICATION

The current study explores the characteristics of discussion regarding GM food on social media, as well as the association between these factors via content analysis. Although this research contributes to previous research in these areas, this study contains several limitations that should be addressed in future research. Firstly, the current study is limited to only one social media platform – YouTube. For different types of social media platforms, there are differences in demographics of users, such as age, gender, and education, which might be factors that affect samples of content. Also, social media has its own limitations due to anonymity and deficiency in generalization of data. For instance, these findings should not be generalized to all U.S. YouTube users because commenters could be from anywhere (we only know that they speak English).

Furthermore, sample collection took place during a short period, but social media data is changing all the time. This study would have produced different results if data were collected at a different time. Only the number of replies were taken into consideration in this study, while the number of likes could affect the results as it also indicates a response from others. The range of the number of replies was also huge. For example, a few comments have a very high response rate with up to 99 replies; however, many other comments have only one response. In addition, the fourth video had the fewest responses with only 200 comments in total. Because certain commenters had written most of comments and responded under this video when the samples were collected, the results might be skewed without much diversity among sampled comments.

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Third, due to low inter-coder reliability in the pretest, some variables were dropped or not analyzed in the findings, including distrust of government, politicians or regulatory authorities, and "other" possibilities that were not analyzed in the study.

Fourth, both hypotheses about the association between interactivity and the other two variables – uncertainty and hostility - were only partially supported based on t-tests due to lack of significance. Uncertainty was measured by commenters raising questions in this study. In future research, the variable "uncertainty" could be operationalized in other ways and might be able to reach better results. In follow-up studies, expression of lack of knowledge, and/or an unclear standpoint (neither support nor oppose) of GM food could be used to measure uncertainty. Many comments have neither pro-GM food stance nor anti-GM food stance, which could reflect uncertainty about GM food to some extent. Meanwhile, lack of knowledge about GM food may suggest uncertainty about GM food as well.

Fifth, this study did not generate its own definitions for coding trolling and questions. The primary coding criteria were largely based on Ksiazek's (2015) work of trolling and Ziegele, Breiner and Quiring's (2014) definition of question, as well as coders' experience. Many techniques can be used to define troll, such as name-calling to show insults to a specific commenter, ad-hominem attacks that try to refute an opinion by alleging dirty words to those who have an opposite standpoint, emotional rants, bullying and harassment with completely off-topic posts, as well as rumors and slander to an entity, etc. Therefore, future research can develop better definitions for these concepts and employ textual analysis on the front end to develop these definitions.

Finally, this study is confined to investigating prevalence of variables and associations between variables, rather than causal relationships, because of the limitation of the research method – content analysis. Only a few videos are coded in this study, and of course, there are more videos available online. This study should encourage researchers to go further to investigate cause and effect of these discussion characteristics and the mode of users' discussion regarding controversial science/public health topics in future research using multiple methods, such as surveys and experiments.

5.2 CONCLUSION

This study is valuable due to its exploratory nature investigating how science as well as health communication work on social media. With so many media options available now, people prefer to access information that interests them (Wise, Hamman & Thorson, 2006) and social media provides an interface for people to gather information and exchange ideas and opinions. Social media also provides users with substantial content in terms of science and health information. Studying how this content is perceived by social media users, and how users treat scientific information on social media, can shed light on how to manage and communicate this type of information efficiently to avoid confusion. Additionally, interactivity between users via commenting on social media could potentially accelerate the efficient consumption of scientific information and may offer insights for those involved in science and health communication.

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APPENDIX A – CODING PROTOCOL

INTRODUCTION

This study examines user comments on the five most watched videos on YouTube regarding different aspects of GM food. The purpose of this study is to investigate the relationships between the major attributes of user comments on this social media platform, which can be a useful contribution to existing research encompassing GM food, science/health communication, social media, and online user comments.

CODING INSTRUCTION

Watch the videos before coding because comments are mostly based on the content of the videos. A two-step coding scheme is required. In the first part of the coding process, coders should code the basic information of the video. Those Videos were purposively chosen for coding using consecutive-unit sampling after being filtered by "view count" on YouTube.

CODER ID: 1. ORCHID   2. APRIL

SECTION ONE: VIDEO DEMOGRAPHICS

I. Video ID

VIDEO 1: 14-year-old girl picks fight with bully TV host – and WINS!

This video is about a 14-year-old activist, Rachel Parent, who debated Kevin O'Leary on the issue of genetically modified food in a Canadian news television series, The Lang and O'Leary Exchange, which was aired on CBC Television and CBC News Network.

VIDEO 2: What's a GMO

This video is from Jimmy Kimmel Live! – an American late-night talk show which was broadcasted on ABC. The show is mainly interested in those who have strong opinions. As critics of genetically modified organisms claim that they pose health risks to the public, the show sent a crew to a local farmers' markets to ask people's opinions about what the letters "GMO" mean to them and why they avoid GMOs.

VIDEO 3: Neil deGrasse Tyson on GMO food!

This video is a video clip filming Neil deGrasse Tyson, an astrophysicist and science communicator, talking about genetically modified foods.

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VIDEO 4: Mr. Know-It-All: Genetically Modified Food at Dinner Parties – WIRED

This animated video offers advice about whether it's proper to warn one's GMO-averse friends ahead of time when serving genetically modified food at dinner parties. Mr. Know-It-All is an American animated web series, which is based on a popular advice column, distributed by technology magazine, Wired.

VIDEO 5: Eyes of Nye – GM foods – HTS2100 edition

This video is from an episode of the show, "The Eyes of Nye," a science program hosted by Bill Nye. It provides certain facts about genetically modified foods after Nye heard from various sides of this controversial issue by talking to traditional wheat breeders, organic agriculture researchers, and corporate genetic engineers.

II. Video Category

- o Nonprofits & Activism
- o Entertainment
- o Film & Animation
- o Science & Technology

III. Nature of Video (Check all that apply)

After watching the video, you might consider what the communication purpose of the video is and check all options that apply.
Education: To teach public about the knowledge of GM food.
Persuasion/ Propaganda: The purpose is to promote or publicize a particular point of view, or is of a biased or misleading nature.
Entertainment: The purpose of the video is to entertain viewers or make fun on a specific topic concerning GM food.

Education
Persuasion/Propaganda
Entertainment

IV. Nature of Source

Source should be decided based on a combination of video publisher and source of information.
In order to determine the nature of video source, first click channel for the description of the video publisher. Then consider whether the channel belongs to an individual or a group. The channel can belong to an anonymous individual user, or can be an official channel of a TV program or an organization.
If the video is uploaded by an unidentified person or group, the primary speaker in the video determines the nature of source.

Consumer advocacy group refers to the group that support consumers' rights and interests.
Broadcast/Print Media includes TV program and magazine.

- o   Consumer Advocacy Group
- o   Broadcast Media
- o   Print Media
- o   Scientist
- o   Science Educator

V. Standpoint of View

Consider if there is a dominant standpoint of view in the video, e.g., if the video supports, opposes or show no stance to GM food.

- o   Pro-GM food
- o   Anti-GM food
- o   Neutral

SECTION TWO: COMMENT DEMOGRAPHICS

I. User Comment ID: _____

II. This Comment Is:

At the beginning of a comment, symbol "+username" indicates that the comment is in response to other comments.

- o   In response to the video content [1]
- o   In response to other comments [2]

III. The Number of Replies to the Comment: _____
     The Number of Likes to the Comment: _____

IV. If the Comment Contains Any Stance of Commenter, It Is:

If the comment is spam or cannot tell a stance of commenter on GM food, go to this option.
The stance of pro-GM food is reflected by means of supporting consumption, developing biotechnology, and/or critique of the other side opposing GM food. In other words, it represents positive attitude and opinions toward GM food in general.
The negative stance of GM food is evidenced by the critique of GM food or biotechnology, opposing consumption, and/or the critique of the opposite side. Choice "Both" stands for neutral.

This option "Both" also represents that the commenter both applauds and opposes GM food without a clear standpoint showing either favor or disapproval, which reflects uncertainty to some degree.

- o No stance specified in the comment [0]
- o Pro-GM food [1]
- o Anti-GM food [2]
- o Neutral (Both) [3]

V. The Comment Serves to (Check all that apply)

1. Congratulate/Reproach the speaker in the video: If the commenter expresses any praise or admiration for the speakers in the video. Or if the comment shows any disapproval or disappointment to the speakers in the video without any reason.
e.g., "Good for you, Bill," "Bill Nye is awesome." "O'Leary only cares about money."
2. Evaluate the video: If the commenter gives any judgement about the value of the content (can be either supportive or opposite views), such as how good or bad the video is. From this point, the commenter explains the reasons why he/she agrees/disagrees with the speakers in the video.
e.g., "Definitely, it was very helpful…," "It's so refreshing seeing someone actually give explanations with the credentials to back them up…," "good point," or "This video made me sad."
3. Advocate other commenters' opinion(s): Circle this if the comment obviously refers to other commenters and show strong support for their opinions.
e.g., "This is possibly my favorite comment on YouTube…" or "Love your comment!"
4. Voice opposite opinion against other commenters: If comment questions about others' arguments or attempts to clarify its own position, e.g., "Actually no…"
5. Commenters might state their own opinions about the issues around GM food, such as labeling, testing, regulation, ethics, etc., which is NOT OBVIOUSLY or DIRECTLY to either support or oppose other commenters' opinions.
6. Ask a question to require further elaboration on the video or GM food-related topic: Rhetorical questions without expectation for answers should NOT be considered questions, e.g., "If these people care about the environment and health, why are they focusing on GMOs instead of the meat industry?" "Do you like banana's and seedless watermelon? Congrats, those are GMOs…"
e.g., "I wonder…" "so did they accept GMO labeling?"
7. Point out facts/ factual errors concerning GM food itself: If the commenter mentioned "facts" or "logical fallacy" in their comment, and tried to clarify some knowledge about GM food.
e.g., "The pesticides that are injected in the seeds cause leaky gut in humans."
8. Troll: Offensive or provocative words, e.g., words aiming to upset or elicit angry response from others "Screw all you!!! Let's fight!"
9. Other; please specify: When none of above choices applies to describing the motive of the commenter, list it out here; Comments sometimes only reflect the feelings of commenters, such as anger, fear, surprise, depression, enjoyment, affection, etc.; Spam refers to irrelevant or inappropriate messages, e.g., ads of individual channel

Congratulate/reproach the speakers in the video [1]
Evaluate the video [2]
Advocate other commenters' opinion(s) [3]
Voice opposite opinion against commenters [4]
State own opinion about GM food [5]
Ask a question to require further elaboration on the video or topic [6]
Point out facts/ factual error(s) concerning GM food [7]
Troll (Offensive or provocative words) [8]
Other; please specify: _____ [9]

VI. The Comment Involves Any of Controversial Issues Concerning GM Food (Check all that apply)

If the comment has nothing to do with attributes about GM food, choose option "None".
1. Health: potential health hazards such as "cancer", "tumors" or other risks posed to either laboratory animals or humans; whether GM food is healthy or not.
2. Labeling: mandatory labeling of GM food; public right to know; people have choice.
3. Ethical issues: human experiments, monopoly of large companies, mad science, misguidance and negligence of regulatory authorities, etc.
4: Benefits encompass feeding/addressing hunger, increasing productivity (quantitative and qualitative), resistance of disease and parasites, adaptation to the climate, nutritional value, etc.
5. Environmental concerns: GM food might destroy the diversity of species on the planet or have the risks of spreading and contamination the environment.
6. Informative education: If the commenter mentions that the public is ignorant about GM food and people need to be more informed of GM food knowledge; misinformation of public;
7. Regulation and management: testing and marketing of GM food
8. Scientific studies: theory, method and literature about research regarding genetic engineering, whether they are true or not
9. Other: If the concern is something other than those listed here, select other and write in what the concern seems to be.

None [0]
Potential health hazards [1]
Labeling [2]
Ethics (human experiments, monopoly of large companies, mad science, etc.) [3]
Benefits [4]
Environmental concern [5]
Informative education [6]
Regulation and management [7]
Scientific studies [8]
Other; please specify: _____ [9]

VII. Any of following sources used by the commenter to support his/her argument (Check all that apply)

Commenters might use other sources to support their opinions or arguments, either in the form of quotation or attached hyperlink.
1. Personal anecdote refers to description of personal experience about GM food.
2. Research/ scientific studies: journal articles, hyperlinks of science video/blog, statistics and mentions of studies of GM food in the comment.
3. Policies: banning or labeling GM food in the market; testing standard, etc.
4. News article: it can be forms of hyperlinks of newspaper and magazine
5. Other: one possibility could be that commenter quotes others' opinion, such as from celebrities, politicians and company administrators, etc.

No evidence to support the argument [0]
Personal anecdote [1]
Research/scientific studies [2]
Policies [3]
News article [4]
Other; please specify: _____ [5]

VIII. Valence of Comment

"Valence" means the comment is written in positive, negative or neutral tones. Positive (1) tone means that the comment includes positive words and friendly approaches to other commenters, while negative (2) tone means the comment includes pessimistic or sarcastic words. Neutral (3) tone means neither positive nor negative emotions or words are expressed in the comments. Examples: Positive: "funny this is GMO food is a lot safer because…"/ Negative: "sorry but most of your food is GMO" "kind of sad that…"/ Neutral: "GMO…OMG It tastes just like gluten."

o   Positive [1]
o   Negative [2]
o   Neutral [3]

IX. If the comment suggests that causal attributions of responsibility for the issue/problem of GM food, select all causes that apply below:

If the comment has nothing to do with GM food, it should be counted as an absence of causal attribution of responsibility (0).
(1) Lack of knowledge: The comment can also attribute the controversy of GM food to certain person or the public in terms of lack of knowledge about it, e.g., "The Pro-GMO enthusiasts know nothing", "I don't know about GMO, but I know it's bad".
(2) Misguidance or misinformation: the comment can attribute controversy of GM food to anti/pro-GM food advocates for being guided with false or inaccurate information or even communicating such information.

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(3) Spread of rumor about GM food hazards: Some statements might appear in the form of a story that tells consuming GM food kills people and that GM food can be poisonous or posing exaggerated risks on health; Conspiracy theorists (or anti-GM food advocates).

(4) Lack of careful studies: Criticisms to scientists or academia on eager for quick success and instant benefit without considering long-term effect (e.g. mad science); distrust of scientists.

(5) Propaganda/ Manipulation of large biotechnology companies: Biotechnology companies, such as Monsanto, might be blamed for lobbying regulators, paying the speakers in the video to speak good of GM food and/or moral problems.

(6) Competition/conflict between GM food and Organic food: biotech company might threaten the development of the organic industry, which is reflected by the opposition between organic food and GM food; (legal issues) traditional/organic food farmers might protest against or even sue GM food company for monopoly, patent, etc.

(7) Biased report of mass media: bad journalistic practices such as lack of investigation; use of scary words in the report; bribery/corruption with large biotechnology companies.

(8) Other: including distrust of government/politicians/regulatory authorities, such as the skepticism or blame about government/a certain politician (i.e. Hilary Clinton) of negligence or betraying promise; Regulatory authorities (i.e. FDA or WHO) of being bribed, wrong test, hidden truth from public (labeling), and misguidance, etc.

No causal attribution of responsibility included [0]
Lack of knowledge [1]
Misguidance or misinformation [2]
Spread of rumor about GM food hazards [3]
Lack of careful scientific studies [4]
Propaganda/ Manipulation of large biotechnology companies [5]
Competition between GM food and Organic food [6]
Biased report of mass media [7]
Other; please specify: _____ [8]

X. If the comment suggests any solutions to alleviate the public concern caused by the issues of GM food, select all the solutions that apply:

If no solution is suggested in the comment, check only the first option.
Information seeking on one's own (1) means seeking more information about GM food by oneself through science blogs, news websites, etc.
Suggestions of purchasing non-GM food or organic food instead (2) are given in the comment for those who do not trust GM food.
Labeling (3) all GM food endorses customers' right to know and make choice by themselves.
Need of further research (4) in this field requires studies on GM food should be moral, long-term, or healthy before marketing.
Strict testing process (5) can be reflected by the commenters calling on more testing on GM food.

Unbiased report (6) of GM food in mass media outlets, such as giving up the use of word "Frankenfood" and doing more research before reporting.

Public education (7) means lay public should not be ignorant to science and need to be more educated about knowledge of GM food, which is also a method to resolve controversy.

Corporate social responsibility (8): biotech company (or media corporation) should take the responsibility for social and environmental impact it caused.

Other (9): complete ban on GM food, etc.

No solutions included [0]
Information seeking on one's own [1]
Purchasing Non-GM food or organic food instead [2]
Labeling [3]
Need of further research [4]
Strict testing process [5]
Unbiased report [6]
Public education [7]
Corporate Social Responsibility [8]
Other; please specify: _____ [9]

XI. Is there a question regarding GM food in the comment?

The comment can inquire about GM food, such as the stance or opinion about GM food from the speaker in the video and public opinion about GM food, e.g., "Soo… Is the majority against or with GMO's?" Or the commenter may want to seek answer about pros and cons of GM food, and they may also ask for further information about political, economic or ethical aspects of GM food.

If the comment is not about GM food at all, or if it is not clear whether GM food is the focus of the comment, it should not be coded as uncertainty at all, e.g., "No offense but what was the video about?"

No judgment should be placed on the information about GM food whether it is correct or not when coding.

o No [1]
o Yes [2]

XII. If the Comment Contains Any Aggressive/ Abusive Words, It Serves to Show Degradation to:

Words that arouse fear or anger (e.g. "victim," "fuck" and "bitch," etc.), swear words and rants are all counted as hostility. For more information, such as how to detect these hostile words, please see word dictionaries.

If there are no aggressive or abusive words that show insult and degradation in the comment, check option 0.

1. Other commenters: include any commenter on the video, either a certain commenter (i.e. usually in such form "+ user name") or general people who have commented on this video, e.g., "explain how I'm wrong girl"

2. Mass Media: a specific media outlet, such as news media channels on YouTube, as well as people who work in related to media corporation, for example the hosts of the TV program in the video, e.g., "Jimmy Kimmel= Asshole!" "Bill Nye is a shill"

3. GM food: terms like "GMO", "genetically modified products", etc., e.g., "GMO= Poisonous!"

4. Science: science itself; experts in biotechnology and science educators, e.g., Neil Tyson or Bill Nye in the video, "Bill Nye is a shill"

5. Authorities: government (or regulators, politicians, etc.) and companies (or administrators), which can be either person or organization, e.g. "Obama isn't just a child molester, he's a gay Nazi lizard man too!" / "Monsanto shill"

6. Pro/Anti-GM food advocates: Because the girl, Rachel Parent, belongs to customer advocacy group, the comment that targets her should apply to this option.

7. Lay public: interviewees in the videos or general American public the comment refers to.

No such word included [0]
Other commenters [1]
Mass Media [2]
GM food [3]
Science [4]
Authorities [5]
Pro/Anti-GM food advocates [6]
Lay public [7]