QUANTITATIVE CONTENT ANALYSIS OF COLONY COLLAPSE DISORDER IN
HONEYBEES

by

Henry Allen

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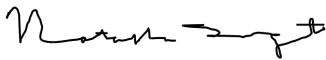
In

Communications

Approved:

_____
Sara K. Yeo, PhD
Thesis Faculty Supervisor

_____
Marouf Hasian, PhD
Chair, Department of Communication

_____
Natasha Seegert, PhD
Honors Faculty Advisor

_____
Sylvia D. Torti, PhD
Dean, Honors College

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ABSTRACT

Colony Collapse Disorder (CCD) is a phenomenon where commercial populations of the European Honeybee, *Apis meliffera*, experience significant decline due to the sudden loss of adult worker bees (USDA, 2018). The phenomenon has resulted in commercial beekeepers losing significant percentages of their hives (EPA, 2018) and is a problem with significant ramifications as honeybee pollination is responsible for one-third of the United States' food supply and billions of dollars in economic agricultural activity (USDA, 2018). Most of us rely on media to stay informed about environmental issues such as CCD. Exploring how news media communicate such topics to public audiences allows us to better understand the effects of media on public opinion, perceptions, and beliefs. To this end, I conducted a content analysis of newspaper coverage on CCD with a focus on framing i.e., how media present social reality (Scheufele, 1999). Specifically, I developed and quantified the presence of four media frames in news coverage about CCD. The frames are: (i) *importance explanations*; (ii) *behavior promotion*; (iii) *cause responsibility*; and (iv) *solution responsibility*. I found that media primarily used the effects of CCD on the economy and food supply as explanations of the importance of CCD. I also found few instances of articles offering self-efficacy for readers in the form of behavior or actions that could be taken to mitigate or prevent CCD. Additionally, articles were more likely to include mention of a cause of CCD than explore solutions to it. These findings suggest media typically frame CCD in an anthropocentric manner and provide a foundation for future research on framing.

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INTRODUCTION

Colony collapse disorder (CCD) is a widely reported phenomenon where commercial colonies of the European honeybee, *Apis meliffera*, experience sudden and significant decline due to the loss of adult worker bees (USDA, 2018). While it is not uncommon for hives to collapse, commercial beekeepers have been reporting unusually high losses of hives since 2006 (EPA, 2018). In some cases, beekeepers lost up to 90% of their hives (EPA, 2018). As might be expected with such a large-scale, unexpected phenomenon, media have covered this issue; a search of the news media database LexisNexis identified over 11,000 pieces of news that reference CCD from 2007 to 2020.[1] Prior communication research shows that media influence public perceptions of environmental issues like CCD. But exactly how media cover and frame the issue can have consequences for the public's agenda, which warrants an exploration of how CCD is being framed by media.

CCD is an issue with significant ramifications. According to the United States Department of Agriculture (2018), honeybee pollination is responsible, either directly or indirectly, for one-third of the nation's food supply. Various crops are dependent on commercial pollination, including almonds, apples, and broccoli (FDA, 2018). National food security and the agricultural industry of the U.S. are at risk due to CCD. Less understood is how millions of bees dying could adversely affect biodiversity and general ecological stability in numerous environments that have come to rely on a stable population of commercial honeybees. Further, our moral obligation to protect millions of

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[1] This search, conducted on April 5th, 2020, looked for news pieces referencing the term "colony collapse disorder", and returned 11,167 results from the LexisNexis database

honeybee colonies from collapse, a phenomenon for which humans may be responsible, is an issue that has been relatively unexplored. There are many reasons why public audiences should care about CCD, yet we know little about the reasons that are most emphasized in media coverage of this issue.

Initially, media used the term "Colony Collapse Disorder" as an umbrella explanation for the then-unexplained phenomenon of commercial honeybee hive losses (EPA, 2018). Copious research has since shown that a large range of issues contribute to hive losses, and not all of them can be classified as CCD (EPA, 2018). Scientifically, CCD is defined as "a dead colony with no adult bees and with no dead bee bodies but with a live queen, and usually honey and immature bees, still present," (USDA, 2018). Given this specific definition, fewer hive losses are being attributed to CCD, although loss rates remain high (EPA, 2018). As a result, CCD is very much a phenomenon in flux and is still not sufficiently understood. This leads to a situation where media framing could play a significant role in influencing public awareness, opinions, and understanding of CCD.

In this study, I characterize and examine how news media present the issue of CCD to the public. To this end, I conducted a quantitative content analysis of newspaper coverage of CCD. I was most interested in whether news media presented explanations for the importance of CCD, attributions of causes of or solutions to CCD, and calls to action, or self-efficacy information, in coverage of the issue. Given my interest in how media present information to publics, I review the literature surrounding a relevant media effects theory, framing.

LITERATURE REVIEW

Media have various effects on people's perceptions and opinions (Bengston et al., 1999). An example of media affecting public perception of an environmental issue can be found in Parlour and Schatzow (1978), where the Canadian public's concern for environmental problems was positively correlated with the relative amount of media coverage on those issues. Parlour and Schatzow's (1978) research primarily documents the effect of a quantity of news coverage, not the specific content of the coverage. This media effect is known as agenda setting, where media emphasis of certain issues contributes to increased salience and awareness of those issues in publics (McCombs & Shaw, 1972). Simply put, people find out about a situation or problem from news media, which leads to the issue increasing in salience on the public's agenda.

Per Parlour and Schatzhow (1978), the more often people see an environmental issue in the news, the greater its salience. This is not a surprising phenomenon—people expect that news media will inform them of what is important in the world. Media are in a uniquely powerful position, capable of constructing their audience's perception of reality, which is why it is important to understand *how* news media communicate the issues of the day.

Thus, my thesis concerns a related media effects theory known as framing. Framing is how media present social reality (Scheufele, 1999). It is well documented that the social reality presented in media is meaningfully influential in how audiences perceive the actual world. Media framing effects tell us that information in the news can heavily influence public perception, interpretation, and evaluation of issues (Aarøe,

2011). Climate change is a prime example of framing effects in the context of an environmental issue. The journalistic norm of balanced coverage led to a biased misrepresentation of the weight of scientific evidence about climate change, which had significant consequences for climate adaptation and mitigation (Boykoff & Boykoff, 2004). Media framing allows media to tell the public the causes and consequences of an issue, then seed the discussion on how to evaluate solutions (Nelson et. al, 1997). The concept of first impression bias explains that the first information a person encounters on a previously unknown topic will be strongly influential on their understanding and interpretation of subsequent information on the same topic (Lim et. al, 2000). At its onset, CCD was an issue primarily concerning commercial populations of a specific species of honeybee, which is not an area where most people would have an existing impression. For an issue such as CCD, the media's influence on the publics' perception is strong, especially since many publics' first impression of CCD came from news media coverage.

But to what extent does the effect of media frames lead to action? A study by Östman (2014) found a correlation between adolescents' consumption of news media and their engagement in pro-environmental activity. Likewise, Chan (1998) concluded that mass communication was a highly influential contributor in establishing social norms that predicted a pro-environmental behavior in Hong Kong. A national survey in Taiwan found that exposure to media coverage on global warming had a positive direct correlation with certain environmentally friendly behaviors (Huang, 2016). Thus, there is evidence that media can promote environmental behavior. And the ways in which media frame issues are likely to play a role in promoting pro-environmental behaviors.

However, in order to understand the effects of framing on behavior, we first need to identify and understand the frames used by media in the context of CCD. By identifying and examining media framing of CCD, my study establishes a baseline for future research to investigate the effect of frames on prompting environmental behaviors among public audiences.

Content analysis of media frames is a common form of research in the field of communication (Matthes, 2009). One definition of framing provides that a frame works by emphasizing certain characteristics of an issue in a way that shapes a person's perception of the topic (Nelson et. al, 1997). This definition provides a broad spectrum of forms that a frame can take, under which nearly any type of rhetorical device used in media can be considered a frame. This broad definition for what constitutes a media frame allows for a myriad of unique research directions. However, a broad definition of framing also leads to a degree of ambiguity that blurs the line between framing and separate media effects like priming and agenda setting (Schuefele & Tewksbury, 2006; Cacciatore et. al, 2016). Schuefele (1999) produced a typology of framing that distinguished two types of frames – media frames and audience frames – both of which could be studied as either independent or dependent variables. Despite Schuefele's typology, framing researchers still struggle with developing a standard definition of framing (Entman, 1993; Carragee & Roefs, 2006; Cacciatore et. al, 2016). The methodology behind framing can be hard to pin down; a meta-analysis by Matthes (2009) found that there is a lack of cohesion in how communication researchers operationalize and conceptualize media framing.

Cacciatore et. al (2016) explain that the field's blurred conceptualization of framing prevents the meaningful progression of framing research and inhibits cross-disciplinary usage of media effects research. In their paper, Cacciatore et. al (2016) argue that the field should shift to a narrower conceptualization of framing that focuses on equivalency and the modification of how information is presented. Like CCD, media framing is very much a concept in flux. In an effort to avoid contributing to the lack of cohesion in framing research, the framing conceptualization presented by Cacciatore et. al (2016) served as the working definition of framing for this paper.

In my initial exploration of newspaper articles discussing CCD, I observed a tendency for articles to explain the importance of CCD in the context of the human food supply and agricultural economy. A literature review of media framing failed to find previous research investigating this topic and, specifically, how media frame CCD's importance to news consumers. These *importance explanations* are relatively unexplored. It has been noted by Scheufele (1999) that investigating specific content for framing effects does not contribute much to the progression of the media framing research field, which may explain the lack of prior research on *importance explanations*. However, the *importance explanation* can be interpreted as an applicability-based frame – the explanation is a conceptualization of how CCD is framed, and inherently targets existing schema in the audience to create a connection between CCD and already-known phenomena. This interpretation would allow *importance explanations* to fit comfortably in the range of meaningful framing research dictated by Cacciatore et. al (2016). Even if we reject that interpretation, the significance of CCD as an issue that impacts human and

environmental health and the ubiquitous presence of *importance explanations* in news should warrant at least a preliminary exploration.

A review of existing literature shows that news content about CCD has not been extensively examined. Therefore, this study is an initial examination of how news media frame and present an important environmental issue and, to this end, I pose five research questions:

RQ1:   What categories of *importance explanations* will the media typically employ for articles on CCD?

RQ2:   Do media typically include a single *importance explanation* in an article, or will articles contain multiple explanations?

RQ3:   Do news articles encourage *reactionary* or *preventative behaviors* in response to CCD?

RQ4:   Do articles generally attribute either a *cause* of CCD, or *solution* to CCD more often?

RQ5:   How might importance explanations, attribution of cause and solution, and behavior promotion interact with each other?

METHOD

I conducted an exploratory content analysis of United States-based newspaper articles published from January 1, 2007 to December 31, 2007. This time period was

selected for two reasons: (i) it was the beginning of widescale newspaper coverage on

CCD in the U.S.;[2] and (ii) it was the peak of public Google searches for "Colony

Collapse Disorder" according to Google Trends (Figure 1).

Figure 1. Google Trends chart illustrating Google searches for "Colony Collapse
Disorder" during the sample period[3].

Data Collection

I used the LexisNexis database for collecting my sample for three reasons. First,

the database has a vast array of searchable news articles from a variety of news sources.

Second, the database allows the use of Boolean queries for exact search terms. Third,

LexisNexis' wide variety of sample sorting options allowed me to further refine my

sample in ways that Boolean queries cannot, such as limiting results to newspaper articles

published in the United States between January 1st, 2007 and December 31st, 2007. These

factors made LexisNexis an ideal database for my exploratory content analysis by

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[2] A LexisNexis search for "colony collapse disorder" news pieces ordered by "oldest" reveals the first
article entry as January 31st, 2007. One earlier article, supposedly from 1970, is listed in the database but
closer inspection reveals the article was clearly written after 2007.
[3] Original chart available at: https://trends.google.com/trends/explore?date=2006-01-01%202020-04-
21&geo=US&q=colony%20collapse%20disorder

providing a large sample that could be sorted for exact keywords while limiting my search so that the analysis would be manageable.

I used the keywords, *honeybees, death,* and *colony collapse* to search the LexisNexis database.[4] The search terms were designed to account for multiple spellings, wordings, and combinations of the three key terms. The sample was limited to articles published in the United States. My final sample size was 113 articles.

The 113 articles came from 57 media outlets across 28 states. Of the media outlets, 59% had only 1 article about CCD, 17% had 2 articles, 12% had 3 articles, and 10% contained more than 3 articles. The publication that had the highest number of articles about this issue was the Pittsburgh Post-Gazette, which had 10 articles on CCD in this time period. A review of the articles from the Pittsburgh Post-Gazette revealed that the 10 articles were spread across 4 different editions of the paper. While LexisNexis has an option to search only articles published in certain sections of a newspaper (e.g., sports, business, art), I did not use that option as it could affect the explanation of CCD's importance that was in the article. For example, articles acquired from the Business section of a publication would likely focus primarily on the economic importance of CCD. Instead, I placed no limits on the LexisNexis query regarding the sections in which articles were published. Certain newspapers published multiple articles on CCD, while others published only one. Table 1 displays the publications from which the articles in the sample came.

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[4] Specific LexisNexis word query: ("honeybee*" OR "honey bee*" OR "honey-bee*") AND ("death*" OR "die*" OR "die-off") AND ("colony collapse" OR "colony collapse disorder" OR "colony-collapse*" OR "CCD")

Table 1. Publishers present in the sample, ordered by the number of articles provided and percentage composition of the sample.

Publisher	Number of Articles	Percentage of Sample
Pittsburgh Post-Gazette	10	8.8
The New York Times	7	6.2
Contra Costa Times	6	5.3
Pittsburgh Tribune Review	6	5.3
Inside Bay Area	5	4.4
University Wire	4	3.5
Charleston Gazette	3	2.7
Dayton Daily News	3	2.7
Deseret Morning News	3	2.7
Monterey County Herald	3	2.7
Pittsburgh Tribune-Review	3	2.7
The Atlanta Journal-Constitution	3	2.7
The Capital	3	2.7
Herald & Review	2	1.8
Sacramento Bee	2	1.8
Spokesman Review	2	1.8
St. Petersburg Times	2	1.8
The Bismarck Tribune	2	1.8
The Evening Sun	2	1.8
The Pantagraph	2	1.8
The Philadelphia Inquirer	2	1.8
The Santa Fe New Mexican	2	1.8
The Washington Post	2	1.8
Bangor Daily News	1	0.9
Cape Cod Times	1	0.9
Chambersburg Public Opinion	1	0.9
Daily Camera	1	0.9
Daily Press	1	0.9
Erie Times-News	1	0.9
Fayetteville Observer	1	0.9
Grand Forks Herald	1	0.9
Greeley Tribune	1	0.9
Indianapolis Business Journal	1	0.9
Lincoln Journal Star	1	0.9
Northwest Florida Daily News	1	0.9
Portland Press Herald	1	0.9
Reading Eagle	1	0.9
San Jose Mercury News	1	0.9
St. Louis Post-Dispatch	1	0.9
Star Tribune	1	0.9
Telegraph Herald	1	0.9
The Arizona Daily Sun	1	0.9
The Capital Times	1	0.9
The Columbian	1	0.9
The Dispatch	1	0.9
The Fayetteville Observer	1	0.9
The Free Press	1	0.9
The Herald	1	0.9
The Janesville Gazette	1	0.9
The Oklahoman	1	0.9
The Patriot Ledger	1	0.9
The Post-Star	1	0.9
The Tampa Tribune	1	0.9
The Times Leader	1	0.9
USA TODAY	1	0.9
Wilkes Barre Times Leader	1	0.9
Wyoming Tribune-Eagle	1	0.9

While coding the 113 articles, it became apparent that some articles were identical or nearly identical even though they were published by different newspapers. This is likely due to the usage of wire services, such as Associated Press or University Wire. These articles were still treated as separate articles in the sample, as they generally reached different audiences. This content analysis was intended to identify the overall 'plate' of information about CCD provided to the public, so the preponderance of wire services did not present a problem.

Data Coding

I coded all 113 articles individually. Because this is a pilot study and I was the sole coder on the project, I was unable to calculate intercoder reliability, a point to which I will return in my discussion of the findings. The codebook with the variables, their descriptions, and coding instructions was designed and developed in consultation with my thesis advisor (see Appendix). We conducted several rounds of conceptualization and operationalization, relying on inductive examinations of the sample to identify and define variables. Following the finalization of the codebook, I coded the sample on a variable-by-variable basis for each unit of analysis, the article.

Articles in the sample were coded for the presence of elements of four key variables: *importance explanation*, *behavior promotion*, *cause responsibility*, and *solution responsibility*. I examined five categories of importance explanations - *economic, food security, moral, ecological, and general scientific* (Table 2) - which were intended to cover the spectrum of ways in which the importance of CCD might be framed

in news. Notably, an article could contain more than one category of *importance*

explanation.

Table 2. Types of explanations about the importance of CCD, their definitions, and some examples from the sample of news articles.

Explanation Type	Definition	Example
Economic	Includes information about the economic impact of CCD	"…monumental job of pollinating $14.6 billion worth of the nation's fruit and vegetable crops annually."
Food Security	Includes information about the impact of CCD on our supply of food	"Honeybees pollinate about one-fourth to one-third of the world's food supply"
Moral	Includes information about a moral imperative for human actions related to CCD	"the more profound implication is that a species…will not continue to survive under the conditions that humankind has encroached."
Ecological	Includes information about the impact of CCD on biodiversity or ecology	"…the bumblebee provides for many other species, including birds and small mammals…"
Scientific	Includes general scientific value of understanding CCD	"because the quest for a cause for the beehive collapses… might also prove useful in investigating human disease outbreaks."

I defined an "importance explanation" by looking for mentions of *why* CCD

should be important to the reader in each article. For example, one unit in my sample

claimed that "…the latest bee *die-off* has the potential to jeopardize as much as $15

billion in agricultural production each year and cause $75 billion in indirect losses…"
(Wills, 2007). In this example, the importance of CCD is framed as an *economic* concern.

As mentioned previously, *importance explanations* are not mutually exclusive – a single article could feasibly employ all five categories. It is worth exploring how many *importance explanations* articles typically employ at once. After coding the *importance explanation* variables in the sample, the SPSS count by cases function was used to scan the number of *importance explanation* variables found to be present in each article. The count was then converted into its own variable that displayed *importance explanation* numeric combinations. The combinations were labeled as *1 importance explanation*, *2 importance explanations*, or *3+ importance explanations*. While separate categories could have been made for combinations of 3, 4, and 5 *importance explanations*, the low presence of combinations of 3, 4, and 5 explanations lead to the decision to combine the three categories into one category.

Behavior promotion was defined as whether an article contained a call to action, which had three categories. Articles were coded as "0" if they did not contain any behavioral call to action. Reactionary and preventative calls to action were coded as "1" and "2," respectively. Articles that contained preventative and reactionary behavior promotion were treated as mutually exclusive. In other words, an article could only be coded as promoting either a preventative or reactionary behavior, or excluding this efficacy information.

Cause and *solution responsibility* were defined as whether an article targeted a group, entity, agent, or phenomenon as responsible for causing (*cause responsibility*) or

offering solutions to (*solution responsibility*) CCD. In assessing the presence of *cause responsibility*, articles were coded as "0" if they did not attempt to identify an agent as the cause of CCD, and a "1" if they did. For *solution responsibility*, articles were coded as "0" if they did not mention a potential solution, and a "1" if they did. The variables were coded separately and are, therefore, not mutually exclusive. In other words, articles could have both *cause* and *solution responsibility* present.

RESULTS

I coded 113 articles for the variables of interest to address my research questions. RQ1 asked what varieties of importance explanations media would typically employ for articles on CCD. I found that *economic* and *food security* explanations were more prevalent; each was present in over 60% of the sample (Figure 2). In contrast, ecological explanations for CCD were only present in 17.7% of the sample. Lastly, moral and general scientific explanations were barely present in my sample of articles and were present in only 2.7% and 1.8% of the sample, respectively.

Figure 2. The distribution of *importance explanation* categories in the sample. Multiple importance explanations could be present in a single article, which explains why the percentages displayed sum pass 100%.
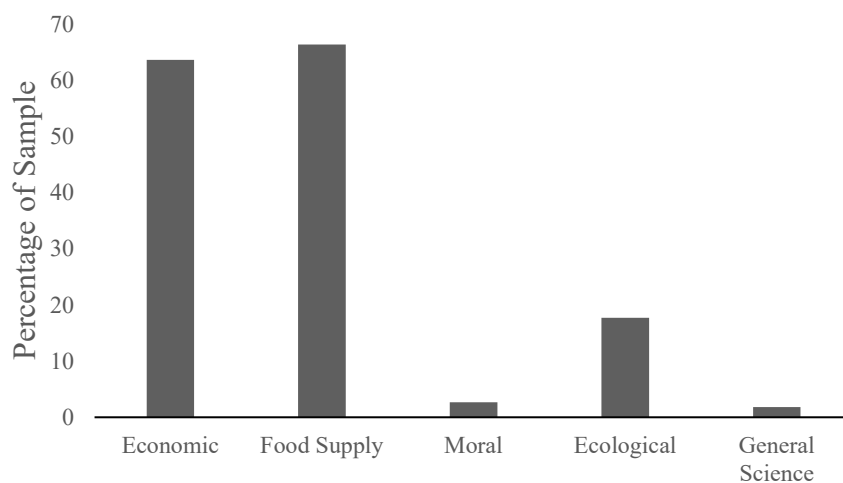
RQ2 asked if media would typically use a one or more importance explanations in an article. My coded data show that the majority of articles (43.4%) included two importance explanations, while 34.5% of articles used only one (Figure 3). Of the 113 articles, only 12.4% were found to have not have explanations about the importance of CCD.

Figure 3. The distribution of the number of *importance explanation* categories used in articles in the sample.
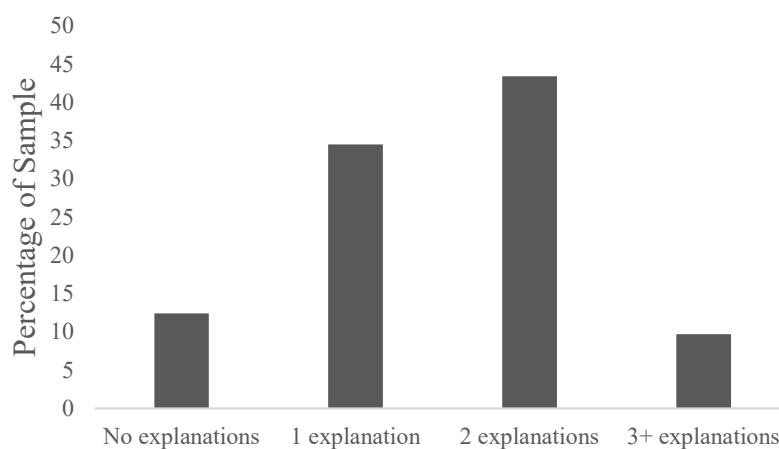

To address RQ3, which asked whether articles would generally promote reactionary or preventative efficacy response to CCD, I found that it was most common for articles to have no efficacy information; 63.7% of the sample fell into this category (Figure 4). Between reactionary and preventative behavior recommendations, articles promoted reactionary behaviors (21.2%) more often than preventative ones (15%).

Figure 4. The presence/absence of *reactionary* and *preventative* categories of *behavior promotion*. These categories were treated as mutually exclusive.
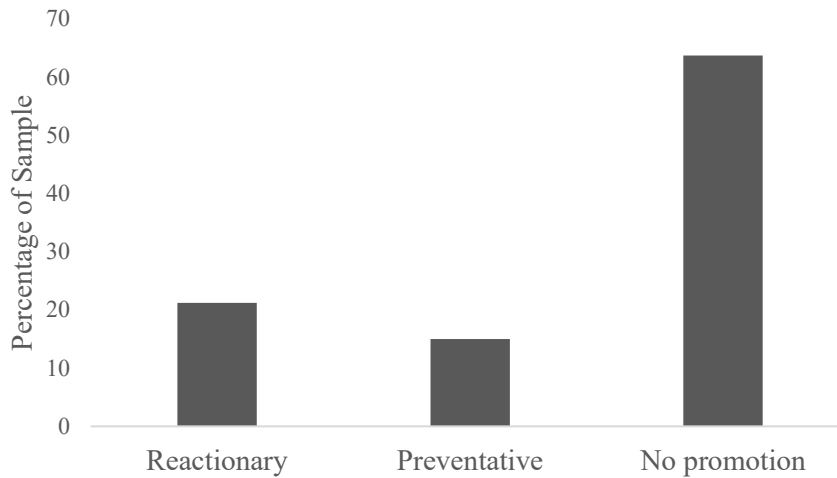
In response to RQ4, Figure 5 shows that an attribution of responsibility for the cause of CCD was present in 69% of the sample, while only 37.2% of articles contained attribution of solution responsibility. Articles that failed to attribute a cause or solution to an agent made up 22% of the sample.

Figure 5. The spread of the *cause responsibility* and *solution responsibility* variables in the sample. These variables go hand-in-hand, which is why they are combined on a single chart. Both variables could be present in a single article, allowing the percentages shown to sum beyond 100%.
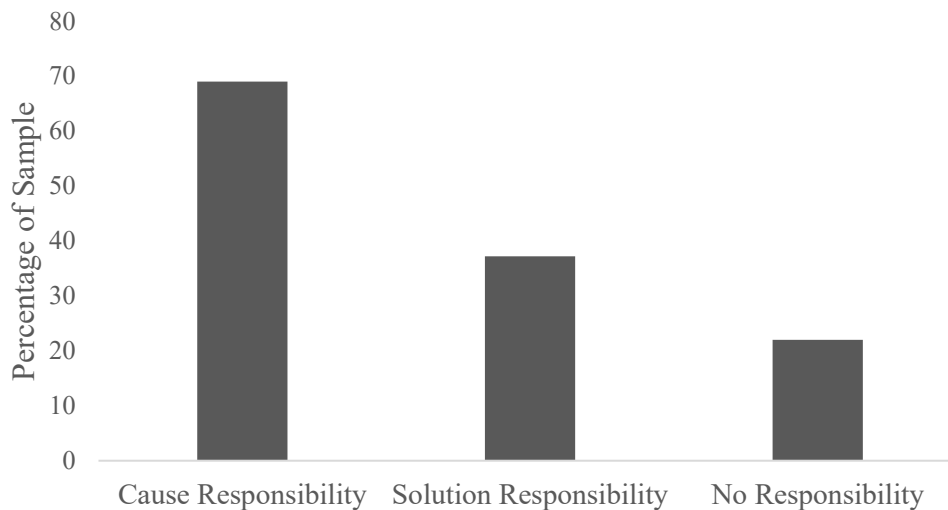
To determine how included importance explanations, behavior promotion, and attributions of causes and solutions might affect each other (RQ5), a Chi Square test of association was conducted. I examine the effects of importance explanation inclusion on the presence of efficacy information in Figure 6. Interestingly, promotion of preventative and reactionary behaviors was only present in articles that included explanations for the importance of CCD, X^2 (2, 113) = 9.1, p = .011. A Chi Square test found that the presence of importance explanations had a positive correlation with the attribution of cause (X^2 (1, 113) = 8.294., p = .004), but had no discernable effect on the attribution of solution (X^2 (1, 113) = 6.169., p = .013) in the articles (Figure 7).

Figure 6. A crosstabulation of *behavior promotion* by the presence of *importance explanations.*
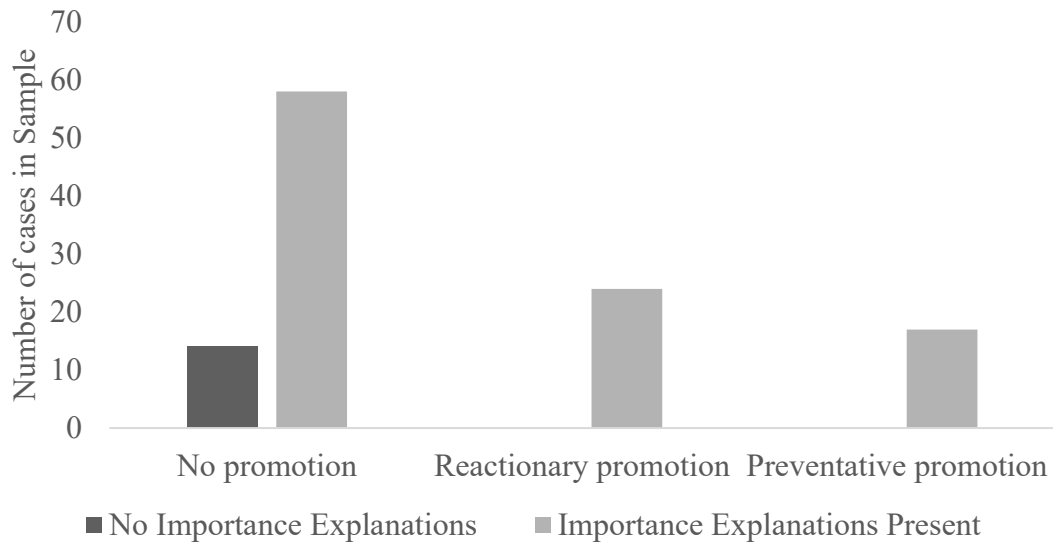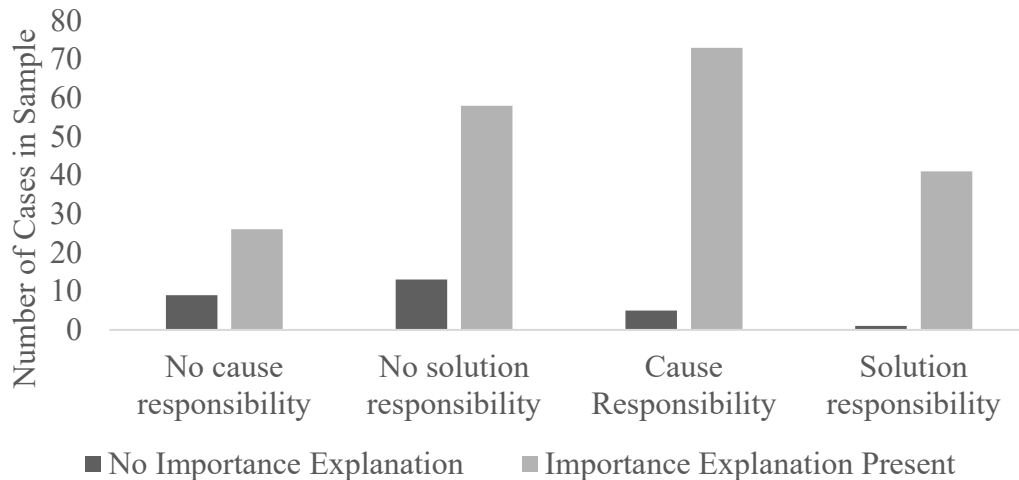
Figure 7. A crosstabulation of *cause* and *solution responsibility* by the presence of *importance explanations.*

DISCUSSION

The goal of this project was to identify and examine four frames used in news articles to present information about an environmental issue, colony collapse disorder (CCD). I conducted this content analysis to determine how media are presenting the issue of CCD, which constitutes a baseline understanding for future research and experiments that can investigate how media frames might influence public perception and agenda setting. Before a discussion of my results, I first identify the limitations of the present work.

First, the LexisNexis database did not necessarily provide a comprehensive sample of the broad population of articles about CCD. Even with the developed parameters limiting the sample, it is likely that more than 113 articles fitting those parameters were published in the sampling period. LexisNexis is limited to the articles within its database, which does not equate to every possible article within the sample parameters. A study by Weaver & Bimber (2008) compared Google News and

LexisNexis' ability to find relevant newspaper articles based on identical search parameters; LexisNexis returned less than half as many relevant newspaper articles as Google News. Weaver and Bimber (2008) concluded that LexisNexis is simply blind to a large number of newspaper articles that exist.

The shortcomings of LexisNexis also limit the sample size of this project. A sample size of 113 is too small to conduct many statistical tests that would be appropriate in this context. While adequate for a pilot study, the relatively small sample size limited the types of statistical analysis I was able to conduct because of a lack of power. Future studies should aim to develop a larger sample size, perhaps by modifying search terms and parameters to allow more articles in the sample. For example, future studies could remove the limitation that articles in the sample were published in the United States.

Another limitation is the lack of multiple coders. I coded the articles on my own, which left the coding of data vulnerable to biases present in a single coder. Single-person coding also translates to single-person reviewing of the codebook during the coding process, which increases the chance of human error in the sample notation. However, the codebook itself was developed in cooperation with my faculty research mentor, which may alleviate some concern about bias overly influencing the fundamental coding parameters. Although the preliminary analysis could still inform a future project by providing coders a better understanding of the media frames conceptualized.

With the limitations of the present work in mind, I now turn to the implications of my findings. The prevalence of *economic* and *food security importance explanations* suggest that news media are framing CCD as an anthropocentric issue. At the same time, the exceedingly low presence of *moral* explanations in CCD articles contribute to media

framing of CCD as a human-centered environmental issue. Economy and food security derived from commercial honeybee pollination are primarily concerns for human well-being. An information consumer might conclude that, at least in the context of the CCD, publics are being told to only worry when human health and well-being are at stake. In the context of environmental issues, this is a worrisome mindset to cultivate. Widespread anthropocentrism can lead to disastrous outcomes, such as the publics being largely unaware of human activities being responsible for current mass extinctions (Crist & Kopnina, 2014). While the presence of ecological explanations was the third most prevalent in the sample, the number of articles that included such explanations were low relative to those that included explanations about the economy and food security.

The substantial lack of efficacy information also lends itself to media framing CCD in an anthropocentric manner. Whether it is a journalist's place to include a call to action or simply report information objectively is debatable. However, prior communication research shows that providing efficacy information in media can influence efficacy behaviors by publics in environmental contexts (Chan, 1998; Ho et. al, 2015; Huang, 2016). If a media publisher were interested in promoting a behavioral response to CCD, research indicates that including efficacy information is a must. That I found few articles promoting reactionary or preventative responses was unexpected, and suggests two possible conclusions: news media were not interested in promoting a behavior in response to CCD (suggesting anthropocentrism through apathy), or the coding process for efficacy information was flawed and did not properly detect behavior promotion in the sample. Future research would likely benefit from reconceptualizing the *behavior promotion* variable, as it may simply have not been operationalized effectively

by the single-person coder. If a re-coded analysis produces the same results for *behavior promotion*, future research should explore why news media may have avoided promoting behavior in response to CCD.

Attribution of responsibility for the cause of CCD was present in a large portion of the sample, which suggests that news media appear to be assigning blame in the context of CCD. Attributions of responsibility for solutions to CCD comprised a much smaller proportion of the sample, suggesting that media are not as concerned with strategies to mitigate or prevent CCD. That said, it may be that journalists treat attribution of cause responsibility in a similar manner to that of solution responsibility, as discovering the cause of a problem is often a necessary condition for finding a solution.

The significant correlation between the presence of *importance explanations* and that of efficacy information suggests that inclusion of explanations is a key component in an article's attempt to provide efficacy information. O'Connor et. al (1999) found that risk perception of global warming was a predictor of global warming response behavior. Conceptually, *importance explanations* could be a component of risk perception – understanding why an issue is important generally entails knowing its consequences. The *food security* variable exemplifies this idea; a third of the United States' food supply is at risk because of CCD. If future research finds a positive link between importance explanations and risk perception, it follows that articles attempting to promote an environmental behavior would use importance explanations as a way of increasing perceived risk.

One purpose of this content analysis was to provide a baseline for future research on media framing of CCD. Moving forward, researchers should evaluate whether

importance explanations impact audiences' perceptions and the publics' agenda. Importance explanations provide information to audiences, but communication of information may not translate to changes in perception. Research by Druckman & Bolsen (2011) suggests that presenting factual information to people is no more effective than background factors (like personal values) in developing opinions on new technology. While CCD is not a technology, it was certainly a new environmental issue to publics in 2007. The nature of this content analysis does not determine whether the inventoried importance explanations actually influence anything – we only know that they are present. For all we know, public audiences may not even be consciously aware of importance explanations while reading an article, which presents an opportunity for future investigations of this issue.

One concept that could link importance explanations to real effect is risk perception. Future scholarship should explore a link between the presence of importance explanations in an article, and whether reading that article has any impact on the reader's risk perceptions associated with CCD. The effects of various explanations on risk perceptions should be assessed and compared. This type of media framing may better conform to the narrow, equivalency-based conceptualization of media framing proposed by Cacciatore et. al (2016). Lastly, future research should explore whether observed behavior promotion in newspaper articles leads to actual behaviors by publics and can use the articles in the present sample as a source of real-world stimuli for constructing experimental conditions.

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TABLES AND FIGURES

Table 1. Publishers present in the sample, ordered by the number of articles provided and percentage composition of the sample.

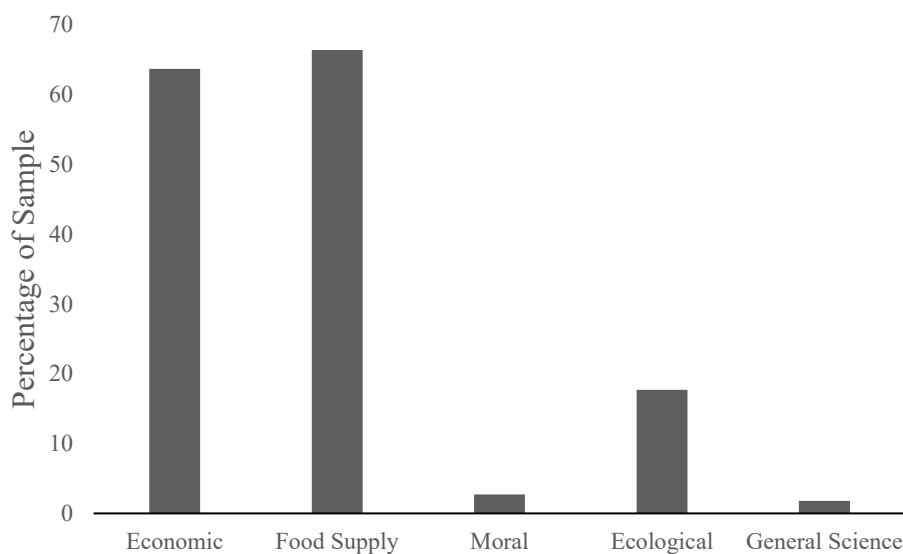| Publisher	Number of Articles	Percentage of Sample
Pittsburgh Post-Gazette	10	8.8
The New York Times	7	6.2
Contra Costa Times	6	5.3
Pittsburgh Tribune Review	6	5.3
Inside Bay Area	5	4.4
University Wire	4	3.5
Charleston Gazette	3	2.7
Dayton Daily News	3	2.7
Deseret Morning News	3	2.7
Monterey County Herald	3	2.7
Pittsburgh Tribune-Review	3	2.7
The Atlanta Journal-Constitution	3	2.7
The Capital	3	2.7
Herald & Review	2	1.8
Sacramento Bee	2	1.8
Spokesman Review	2	1.8
St. Petersburg Times	2	1.8
The Bismarck Tribune	2	1.8
The Evening Sun	2	1.8
The Pantagraph	2	1.8
The Philadelphia Inquirer	2	1.8
The Santa Fe New Mexican	2	1.8
The Washington Post	2	1.8
Bangor Daily News	1	0.9
Cape Cod Times	1	0.9
Chambersburg Public Opinion	1	0.9
Daily Camera	1	0.9
Daily Press	1	0.9
Erie Times-News	1	0.9
Fayetteville Observer	1	0.9
Grand Forks Herald	1	0.9
Greeley Tribune	1	0.9
Indianapolis Business Journal	1	0.9
Lincoln Journal Star	1	0.9
Northwest Florida Daily News	1	0.9
Portland Press Herald	1	0.9
Reading Eagle	1	0.9
San Jose Mercury News	1	0.9
St. Louis Post-Dispatch	1	0.9
Star Tribune	1	0.9
Telegraph Herald	1	0.9
The Arizona Daily Sun	1	0.9
The Capital Times	1	0.9
The Columbian	1	0.9
The Dispatch	1	0.9
The Fayetteville Observer	1	0.9
The Free Press	1	0.9
The Herald	1	0.9
The Janesville Gazette	1	0.9
The Oklahoman	1	0.9
The Patriot Ledger	1	0.9
The Post-Star	1	0.9
The Tampa Tribune	1	0.9
The Times Leader	1	0.9
USA TODAY	1	0.9
Wilkes Barre Times Leader	1	0.9
Wyoming Tribune-Eagle	1	0.9

Table 2. Types of explanations about the importance of CCD, their definitions, and some examples from the sample of news articles.

Explanation Type	Definition	Example
Economic	Includes information about the economic impact of CCD	"…monumental job of pollinating $14.6 billion worth of the nation's fruit and vegetable crops annually."
Food Security	Includes information about the impact of CCD on our supply of food	"Honeybees pollinate about one-fourth to one-third of the world's food supply"
Moral	Includes information about a moral imperative for human actions related to CCD	"the more profound implication is that a species…will not continue to survive under the conditions that humankind has encroached."
Ecological	Includes information about the impact of CCD on biodiversity or ecology	"…the bumblebee provides for many other species, including birds and small mammals…"
Scientific	Includes general scientific value of understanding CCD	"because the quest for a cause for the beehive collapses… might also prove useful in investigating human disease outbreaks."

Figure 1. Google Trends chart illustrating Google searches for "Colony Collapse Disorder" during the sample period[5].

Figure 2. The distribution of *importance explanation* categories in the sample. Multiple importance explanations could be present in a single article, which explains why the percentages displayed sum pass 100%.

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[5] Original chart available at: https://trends.google.com/trends/explore?date=2006-01-01%202020-04-21&geo=US&q=colony%20collapse%20disorder

Figure 3. The distribution of the number of *importance explanation* categories used in articles in the sample.
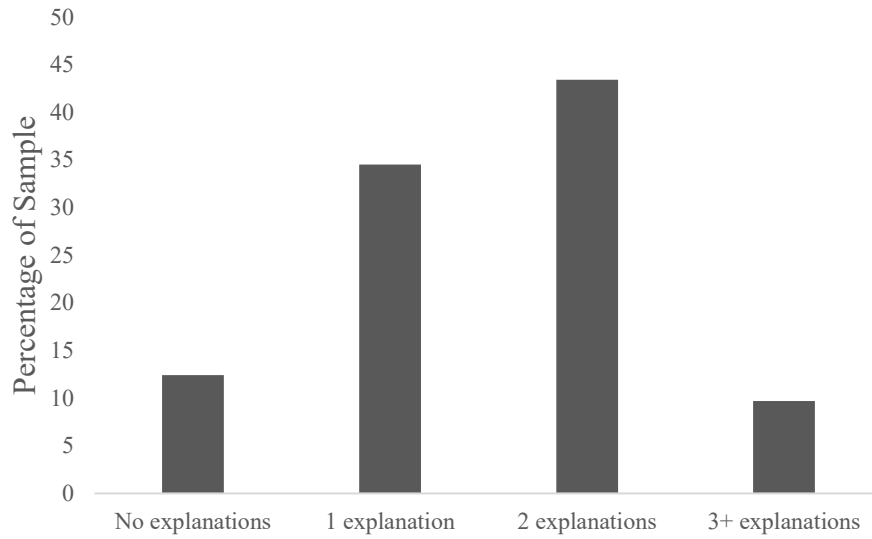

Figure 4. The presence/absence of *reactionary* and *preventative* categories of *behavior promotion*. These categories were treated as mutually exclusive.
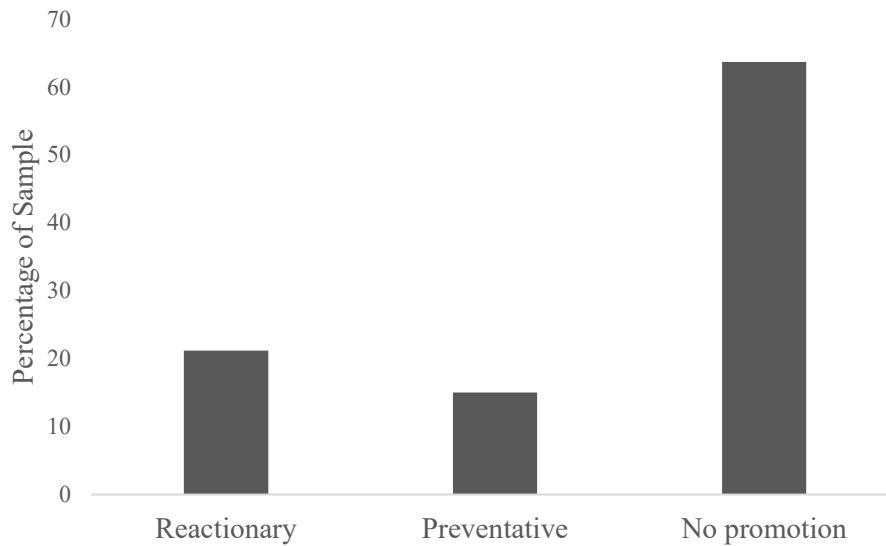
Figure 5. The spread of the *cause responsibility* and *solution responsibility* variables in the sample. These variables go hand-in-hand, which is why they are combined on a single chart. Both variables could be present in a single article, allowing the percentages shown to sum beyond 100%.
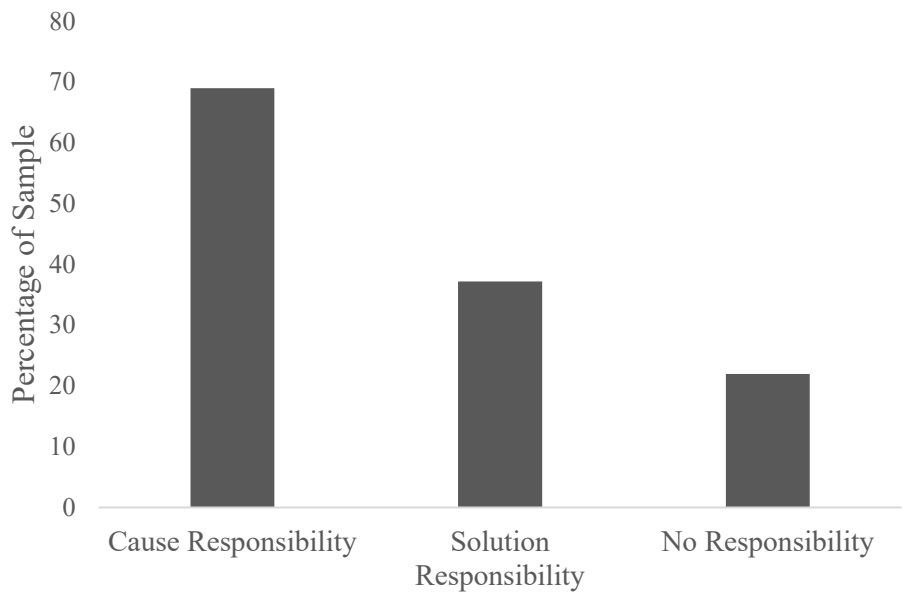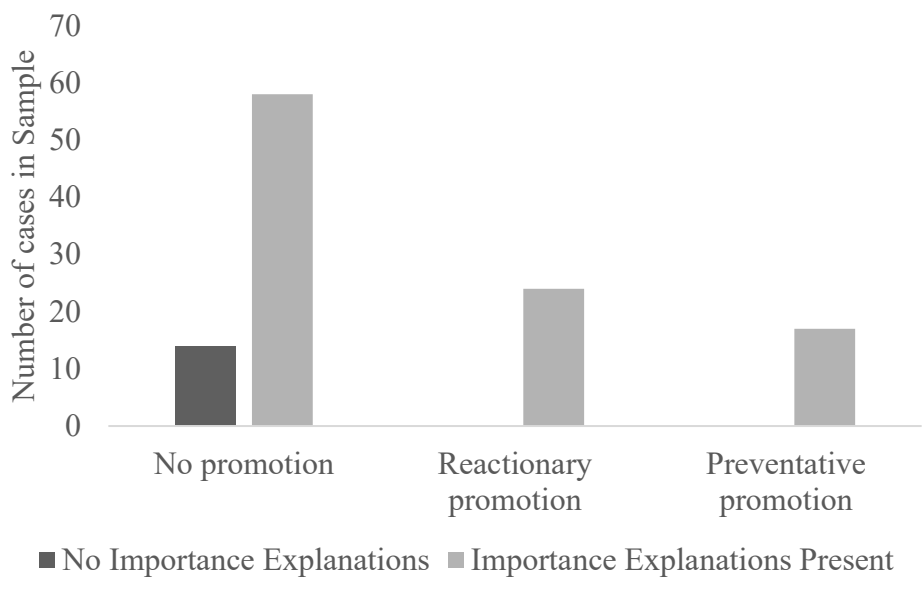

Figure 6. A crosstabulation of *behavior promotion* by the presence of *importance explanations*.

Figure 7. A crosstabulation of *cause* and *solution responsibility* by the presence of *importance explanations.*

APPENDIX A

Name of Candidate: Henry Allen

Birth date: September 23rd, 1998

Birth place: Anchorage, Alaska

Address: 1419 E 1700 S
                     Salt Lake City, Utah, 84105