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Media, influence, and agriculture: understanding the clashing communication about Iowa's water quality crisis

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University of Iowa

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MEDIA, INFLUENCE, AND AGRICULTURE: UNDERSTANDING THE CLASHING
COMMUNICATION ABOUT IOWA'S WATER QUALITY CRISIS

by

Joanna Marie Thrift Krajewski

A thesis submitted in partial fulfillment
of the requirements for the Doctor of Philosophy
degree in Mass Communications in the
Graduate College of
The University of Iowa

August 2017

Thesis Supervisor: Assistant Professor Kajsa E. Dalrymple

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Graduate College
The University of Iowa
Iowa City, Iowa

CERTIFICATE OF APPROVAL

PH.D. THESIS

This is to certify that the Ph.D. thesis of

Joanna Marie Thrift Krajewski

has been approved by the Examining Committee for
the thesis requirement for the Doctor of Philosophy degree
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To my grandmothers, Jadwiga Krajewska and Betty W. Thrift.

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ABSTRACT

In Iowa, the state with the largest percent of its land used for agriculture (90 percent) in the nation, compromised water quality is a chief concern among experts. The primary problem is related to the negative environmental impacts caused by nutrient runoff from fields. Although several innovative land-management practices have demonstrated nutrient reduction potential and other soil health related benefits, the practices are not widely utilized on Iowa farm fields. Thus, water quality is at the center of a contentious debate in the state and many farmers are receiving contradictory advice depending on the source of the information.

Media and interpersonal communication channels play a primary role in disseminating environmental risk information to the public and farmers (Katz & Lazarfeld, 1955; Rogers, 2010). However, little is known about the way contradictory risk information may shape farmer's conceptualizations of the water problems in Iowa. Correspondingly, little is known regarding the individuals who are most influential to farmer's behaviors related to these water issues. To address the potential communication process problems resulting from the clashing ideologies related to the environment and agriculture, this study seeks to investigate the flow of information and networks of influence within the agricultural community in Eastern Iowa.

Three studies are conducted to address media, interpersonal, and risk communication components at play in this context. Because mass media are a key source of risk information for the public (McCallum, Hammond, & Covello, 1991; Morton & Duck, 2001; Ho et al., 2013) the first study consists of a thematic textual analysis of online news articles about Iowa's water quality. A total of 305 articles, published by the Des Moines Register (DMR), Iowa Farmer Today (IFT), and the Farm Bureau Spokesman (FBS), are examined. Themes related to key narratives about Iowa's water quality problems and the way risks and uncertainty are conveyed

in the articles is also investigated. A combination of qualitative and quantitative data was collected to document the types of organizations and key spokespeople used as informational sources in the articles. Findings demonstrate that some messages simultaneously place the blame for causing and the responsibility for solving the problem on the farmers; while others suggest that nutrient excesses are not anthropogenic, are natural, expected, weather dependent, and uncontrollable. Based on the media sources themselves, and the organizations and individuals cited in the articles, this distinction reflects a preeminent pro-agriculture versus pro-environment ideological divide in Iowa.

The second study examines farmers' perspectives on the nutrient issues in Iowa, including their risk perceptions, and preferred sources of information on water quality, both mediated and interpersonal. The study utilizes intercept interviews conducted over a two-month period between July and September 2016 in Middle and Eastern Iowa. Analysis of risk perceptions, uncertainty levels, and current mitigation practices revealed a pattern of lower environmental risk perceptions associated with adoption of fewer nutrient reducing practices, and greater uncertainty regarding current nutrient levels.

The third and final study built upon data from the previous study and involved in-depth interviews with the individuals who were identified as influential to farmer's water related land management practices. Definitions of influencers from the level of the individual (i.e., self-identification as an influential), community (i.e., identification of an influential by other farmers), and media narratives (i.e., identification of an influential in an article or media source), in addition to definitions of influentials from previous literature were compared. Findings revealed that influence is highly related to employment position and opportunity to communicate with multiple, various farmers. Personal motivation for engaging in persuasive communication

efforts with farmers was revealed as an important factor which may help strengthen theoretical conceptualizations of influential individuals within social networks.

This project is a study of environmental communication products, processes, and effects and sought to disentangle the relationships between the risk representation and perception, and influence within agricultural network information flow—an area of research currently lacking. Results help extend scholarship in these areas and illuminate the differing conceptualizations of these variables by mainstream media, agricultural industry media, influential individuals, and agricultural producers themselves. This improved understanding paves the way for subsequent research and intervention efforts to communicate more productively with farmers. The effects of such efforts could help redirect negativity and blame away from farmers, and towards a more productive and holistic approach to solving Iowa’s water quality problems.

PUBLIC ABSTRACT

This dissertation project was meant to help improve our understanding of the way different people, organizations, and media are communicating about Iowa's water quality. I was particularly interested in better understanding how farmers view the issue of nutrients in Iowa's water and what they consider to be the risks associated with nutrients in water. I also wanted to better understand the way certain farming practices (the ones currently being recommended by the Iowa Nutrient Reduction Strategy) are viewed by farmers. The motivation for exploring these issues came from my desire to better explain the role that communication entities, both mass media and other people, have in shaping farmer's understanding of Iowa's water issues. The long-term ramifications of communication related to water issues could ultimately impact farming behaviors, and thus water quality, in the state of Iowa and beyond.

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CHAPTER ONE: INTRODUCTION

The American Midwest has become increasingly scrutinized for the negative environmental impacts caused by current industrialized agricultural practices. In Iowa, the state with the largest percent of its land used for agriculture (90 percent) in the nation, compromised water quality due to nutrient excesses is a chief concern among experts (Comito, Wolseth, & Morton, 2011; Jones, Kim, & Schilling, 2017; Nelson, Loomis, Jakus, Kealy, von Stackelburg, & Ostermiller, 2015; Osterberg & Kline, 2012; Schnoor, 2010). In 2013, the Iowa Nutrient Reduction Strategy (INRS), a major policy initiative to assess and reduce nutrients in Iowa's water, was published. The strategy's primary goals are to direct efforts to reduce nutrients in Iowa's waterways, through scientifically proven, field-based practices that are also cost effective (Iowa State University, 2016). However, there has been no legislation passed to ensure the recommended farming practices are used.

Dissension related to water quality and agriculture reached new heights in Iowa in January 2015 when the state's largest water utility provider, the Des Moines Water Works (DMWW), filed a lawsuit against three rural counties to the north of the treatment plant. The action was intended to force the counties to limit nutrient pollution before it entered the water of the Raccoon River that flows into Des Moines. Under the federal Clean Water Act (CWA), industrial facilities are required to mitigate potential water pollution, however, agricultural runoff is currently exempt from this regulation. The DMWW and many environmental advocates argue that this is likely due to the vital role agriculture plays on the economy in Iowa and the subsequent fear within the agricultural industry that changing to more sustainable practices will hinder economic growth (Osterberg & Kline, 2014). In 2012, total agricultural production and

related industries accounted for \$112.2 billion, or 33% of Iowa's total economic output (Iowa Ag Economic Contribution Study, 2014).

As McGuire, Morton, and Cast (2012) note “tensions between agricultural production and environmental goals of the farmer role in society permeate media, public agency efforts to increase adoption of conservation practices, and public conversations” (p. 57). However, these two agendas do not inherently conflict. As people who work with the land, farmers are fundamentally concerned with natural resource sustainability. Yet, with the politicization of the term environmentalist, we have seen representation of such polarized worldviews emerge. The DMWW lawsuit spurred the topic of water quality to the forefront of conversation for policy makers, environmental and advocacy groups, agricultural industry representatives, academics, farmers, and the public—though it may have also exacerbated these tensions (Eller, 2017; Hanson, Keller, Boland, & Lazarus, 2016; Masters, 2016).

Though the breadth of media attention on Iowa's water quality may seem beneficial by increasing awareness of the problem, the coverage of and conversations surrounding it are often laden with directly contradictory portrayals of the main issues (Arbuckle, Morton, & Hobbs, 2013; Comito et al., 2011). Thus, rather than increased awareness leading to increased mitigation behavior, the divergence in communication by trusted entities may be increasing uncertainty and confusion (Arbuckle, Morton, & Hobbs, 2013; Goodall & Reed, 2013). Consequently, the widespread use of nutrient reducing practices necessary to preserving Iowa's water quality may stall and Iowa's water challenges will remain significant.

Theoretically, this dissertation seeks to contribute to the conceptual understanding of the flow of risk-related information, the diffusion process, and interpersonal influence within one homogenized subculture in today's fragmented media landscape. The context specific agenda

driving this dissertation is to (a) better understand the risk communication farmers are receiving, both mediated and interpersonal, about Iowa's current water problems; and (b) uncover which messages, media sources, and individuals are the most important in shaping farmer's perceptions of this issue. This agenda is explored through three separate, yet interrelated, studies at three levels: mass media (Chapter Three), aggregate farmers (Chapter Four), and opinion leaders (Chapter Five). Implications from this research help illuminate important considerations for environmental, political, and agricultural sector communicators, such as the barriers and solutions to increasing the voluntary adoption of INRS recommended practices among farmers.

A Problem of Risk Communication

Most definitions of the word risk center on the notion of a hazard, exposure to danger, or most generally, something bad happening. Technical risk assessments measure risk as an expected value, a numeric probability based upon previous occurrences of a particular negative outcome. As Slovic (2001) notes, within much academic scholarship the dominant conceptualization of the term "views risk as 'the chance of injury, damage, or loss'" (p. 19). While the term risk is centered on a negative outcome, the key element that distinguishes the concept in both the social and natural sciences, and allows it to be measured, is in the *uncertainty* of that negative outcome. However, human perceptions of this uncertainty rarely align with the technical risk estimates of experts (Slovic, 2010). Slovic (1992) explains, "human beings have invented the concept of risk to help them understand and cope with the dangers and uncertainties of life" (p. 119). Thus, perceptions of risk are inherently idiosyncratic, personal, and influenced by various, multifaceted factors.

Informed by multiple disciplinary fields including psychology, sociology, public health, political science, and others, research from the field of risk communication is based largely on

understanding the subjective assessments and intuitive evaluations of riskiness that comprise public risk perceptions (Glik, 2007; Ritter, 2012). Communication itself, the act of transmitting information, is inherently crucial to human perception—of anything (Watzlawick, Bavelas, & Jackson, 2011). Consider the definition of risk communication set forth by Renn (1992, based on Covello, Slovic, and Von Winterfeldt, 1986):

Risk communication is defined as any purposeful exchange of information about health or environmental risks between interested parties. More specifically, risk communication is the act of conveying or transmitting information between parties about (a) levels of health or environmental risks; (b) the significance or meaning of health or environmental risks; or (c) decisions, actions, or policies aimed at managing or controlling health or environmental risks. Interested parties include government agencies, corporations and industry groups, unions, the media, scientists, professional organizations, public interest groups, and individual citizens (p. 172).

Access to clean, safe water for consumption is vital to human life, rendering any potential threat to this a clear risk. Yet, it is the *perception* of this risk that is more important to the daily lives of most people than any hydrologist's model-based calculation of risk. To understand the forces shaping these perceptions, the products of communication—both mediated and interpersonal—are a valuable and necessary starting place (Coleman, 1993; Dunwoody & Neuwirth, 1991; Lichtenberg & Zimmerman, 1999; Morton and Duck, 2001). This is the foundation for the first study in this dissertation (Chapter Three), which examines the mediated texts created by key information sources communicating about nutrients in Iowa's water—which presumably include discussions of the risks inherent to this issue.

However, this process is further complicated by certain attributes of the subculture at the center of the communication context—farmers. Studying farmers warrants particular consideration because the individuals belonging to this group are unique from the broader public based on behavioral, demographic, and situational characteristics (Dearing et al., 1996). In Wilkening’s (1962) early work on the communication of innovations within the agricultural realm, he writes about the unique challenges of agricultural communication, stating:

While the communication of agricultural information is not essentially different from the problem of communication in other areas, the multiplicity of farming units, the close integration of family and farm in most agricultural areas, and the widely varying economic, social, and cultural conditions make the problem of the communication of information to farm people particularly challenging to the practitioner and of great interest to the student of technological change (p. 40).

Considering that agriculture employs nearly 1.3 billion people and represents nearly 40 % of the global workforce (FAO, 2011), the communication constraints affecting this population are indeed worthy of special attention. While not all farmers, universally or in Iowa, are one homogenous group, individuals who self-identify as farmers represent a unique and significant subgroup within the context of studying environmental risk communication in Iowa. Thus, the broad focus for this dissertation is on individuals who self-identify as farmers, with the hope that differences between farmers based on commodity type, farm size, family history, etc., will be explored comprehensively in subsequent research.

Diffusion and the Flow of Risk Information

The “great interest” Wilkening (1962) described is evidenced by the pivotal, multidisciplinary body of research that grew out of his own, and others’ agriculturally-based

work on the spread of new information and technologies (Rogers, 1962; Ryan & Gross, 1943; 1950). Specifically, research tracking the spread of a new hybrid corn seed among farmers in Iowa laid the foundation of the Diffusion of Innovations paradigm, which seeks to describe “the process by which an innovation is communicated through certain channels over time throughout a social system” (Rogers, 2010, p.5). This early work demonstrated that adoption of new ideas, innovations, or practices occurs in a predictable pattern, with initial adoption slow but gradually increasing more and more rapidly over time until a level of adoption saturation occurs. The important role of communication, both mediated (especially initially) and interpersonal (especially later), within the diffusion process, underscores the need to consider the role that risk-related information, and resulting risk perceptions, may play within this process. For instance, concerning the present situation, do current Iowa farmers’ low perceptions of the risks related to nutrient excesses in water deem the adoption of nutrient reducing practices unnecessary in their view?

Previous social science risk research has demonstrated relationships between risk perceptions and behavior in contexts such as financial investment, vaccination, and environmental sustainability, though the strength and direction of these relationships is not always consistent (Baldassare & Katz, 1992; Brewer, Chapman, Gibbons, Gerrard, McCaul, & Weinstein, 2007; Ferrer, Portnoy, & Klein, 2013; Slovic, Flynn, & Layman, 1991; Weber & Milliman, 1997). Within the agricultural realm, economic risk perception is often cited as a potential barrier to the adoption of new technologies, and a relationship between high financial risk perception and low adoption behavior of new technology has been established in a few such studies (Abadi Ghadim, 2000; Feder and Umali, 1993; Linder et al., 1982; Marra, Pannell, & Ghadim, 2003; Tsur et al., 1990). However, a notable paucity of scholarship has investigated the

role of environmental risk perceptions among farmers and their behavioral (adoption) decisions related to practices affecting the environmental risk situation.

Tomas and Mathijs (2007) attempted to measure environmental risk perception, in addition to several motivation and belief related variables to predict participation in organic farming programs among Romanian farmers. The findings showed environmental risk perception was the strongest predictor of adoption within their model (Tomas & Mathijs, 2007). However, their study relied solely on a dichotomous measure, either presence or absence of ‘acknowledgment of the threat’ to a farmer’s family, community, and crops (each as individual statements) from water pollution, yielding the validity of these findings questionable. A similar study looking at best management practice adoption by Greiner, Patterson, and Miller (2009) investigated an array of variables including multiple levels and types of risk perceptions, including financial, yield related, and environmental, finding a positive correlation between risk perceptions of severe drought and utilization of an increased number of best management practices. However, this relationship was negatively correlated for two specific practices, leading the authors to conclude that a potential knowledge deficit existed regarding drought-risk mitigation potential of the practices.

Ritter (2012) looked at farmers’ risk perceptions towards both the environment and financial loss as associated with nutrient issues and best management practices, in addition to attitude toward nutrient loss and perceptions of social norms related to best management practices among farmers in Ohio. Counter to expectations, Ritter (2012) found that both attitude and risk perception did not reliably help predict behavior within the final model. However, a strong positive relationship did exist between risk perception and attitude. Similarly, Wilson, Howard, and Burnett (2014) looked at how farmer’s risk beliefs influenced attitudes toward

adopting one additional nutrient reduction practice, finding that as with Ritter's (2012) study, high environmental risk perceptions are a predictor of positive attitudes towards nutrient reduction behavior.

Though not all situated within the diffusion paradigm, these important findings regarding the connections between risk perceptions, environmental attitudes, and behaviors do indicate the potential role that nutrient-related risk perceptions may have in helping drive the diffusion process of water quality protecting behaviors. Thus, an argument can be made regarding the need to investigate risk perceptions within a social system to better understand the entirety of the diffusion process when the context of the innovation warrants it applicable. This sets the stage for a significant part of the second study in this dissertation (Chapter Four), which is the only part of this research concerned with the adoption outcome. The adoption outcome is used as a proxy for water quality protecting behavior and enables the exploration of the relationship between environmental risk perceptions and behavior. In this study, farmer's current use of nutrient management practices is documented and risk perceptions related to financial risk of the practices, and the environmental and human health related risks of nutrients in water, are measured.

Influentials in Social Networks

The second study (Chapter Four) also builds on the first study's examination of risk communication regarding nutrient excesses in Iowa's water by investigating the interpersonal channel of communication. Surveyed farmers were asked about their media use and information seeking behaviors related to water quality information, and asked to identify key individuals within their social networks who influenced their own water quality related farming behaviors.

Previous research on interpersonal communication and risk perception shows this communication channel often acts as a force to heighten personal risk perceptions (Dunwoody & Neuwirth, 1992; Morton & Duck, 2001). Correspondingly, interpersonal communication channels can help increase risk reduction behaviors when certain individuals are used as interpersonal risk information disseminators (Kelly et al., 1992; Welch Cline, Johnson, & Freeman, 1992). Studies demonstrate that within all social systems there are certain individuals who have particular influence on the beliefs and actions of their colleagues (Greenhalgh, Robert, Macfarlane, Bate, & Kyriankidou, 2004). The diffusion process relies on these individuals, often deemed opinion leaders (Greenhalgh et al., 2004; Rogers, 2010; Valente & Pumpuang, 2007). Where the mass media may be most important in producing awareness of a new idea or innovation, it is these individuals who help persuade others to adopt new ideas or change their behaviors (Rogers, 2010).

However, the power of this influential position within a network can have a variety of intended, or unintended effects. As Copp, Sill, and Brown (1958) state, “A temporal sequence is involved in agricultural communication in that messages are sent out through the mass media directed to awareness, then to groups, and finally to individuals. A farmer upsetting this sequence in any way prejudices progress at some point in the adoption process” (p. 70). Thus, if an important person within a network does not endorse a certain land-management practice for example, or believes that spreading certain information may have negative effects on them personally, these ‘negative’ opinion leaders have the power to significantly stall the diffusion process (Leonard-Barton, 1985). Similarly, certain network characteristics, such as the forces of homophily, the degree of similarity between two individuals who communicate, can influence the diffusion process (Rogers, 2010). Homophily within farmer networks is common, and may

be a useful trait to consider regarding the potential of farmer to farmer communication about nutrient reduction practices, due to the ease of communication enabled between homophilous individuals. However, high network homophily can also act as a barrier to diffusion due to the difficulty in receiving and accepting new information into such close-knit groups (Rogers, Medina, Rivera, & Wiley, 2005). Yet, thorough investigation into social networks could yield the identification of opinion leaders with additional ties outside of such a network and could help overcome this challenge (Granovetter, 1973; Rogers, 2010).

Given the valuable role of interpersonal communication with key influencers to the diffusion process, and the potential for these influences to help distribute vital risk information, it is important to question who controls and shapes the risk communication related to nutrients in water. Correspondingly, certain entities in Iowa are attempting to harness the power of such influential individuals as farmer advocates for some of the INRS recommended practices. For example, several watershed management authorities (WMAs) in Iowa have recently promoted certain farmers as “cover crop champions” in local agricultural newspapers to help bolster the use of cover crops (Iowa Department of Natural Resource [DNR], 2016). These WMAs were established to connect political, agricultural, and public stakeholders to work toward mutually acceptable solutions to the state’s water problems. It is theoretically and practically relevant to question whether these WMA-identified champions hold the same influential role within the agricultural community as theoretically defined opinion leaders. Thus, the third and final study of this dissertation (Chapter Five) centers on the issues of interpersonal influence in the agricultural realm and offers an in-depth investigation of several such influentials as identified by farmers surveyed in the second study. The third study seeks to understand these individuals’

role as influencers, and how this aligns with the conceptualizations of influencers identified through the previous two studies and with theoretical definitions of influence.

The Water Problem

Obtaining a better understanding of interpersonal influence within the agricultural realm in Iowa may ultimately offer particularly relevant insights for developing strategies to improve the state's water problems. To say "Iowa is an agricultural state," is an understatement. As the top producer of corn, soybeans, and pork in the nation, Iowa is *the* agricultural state—yielding over \$20 billion in 2007 from all its agricultural products (Iowa Farm Bureau [IFB], 2017). Second only to Texas in number of physical production units, Iowa alone is the producer of 28% of all pork in the US (IFB, 2017). Iowa's agricultural landscape has changed dramatically over the last half century moving away from the traditional, small-scale, family farms, giving way to massive, often corporately-owned corn and soybean row crop operations and confined animal feeding operations (CAFOs).

While all communities in the U.S. are required to treat human sewage and all industrial factories are required to mitigate water pollution, run-off from farm fields and excrement produced by animals farmed in CAFOs do not face such regulation (Pew, 2009). Correspondingly, the amount of waste generated by a city with a population of 100,000 people is proportional to the amount of waste produced from a confinement of 10,000 hogs (North Carolina Riverkeepers & Waterkeeper Alliance, 2009). The animal waste generated by CAFOs, which is often used as fertilizer and sprayed on corn and soybean fields, has the potential to contribute many different sources of pollutants to both surface and groundwater sources. These pollutants include: nutrients, such as nitrogen and phosphorus; pathogens, such as *E. coli* and Methicillin-resistant *Staphylococcus aureus* (MRSA), trace elements, such as arsenic and copper;

growth hormones; and antibiotics; among others (Burkholder et al., 2007; Carrel, Schweizer, Sarrazin, Smith, & Perencevich, 2014; Pew, 2009; Thu, 2010).

In 2012, over 50 percent of Iowa's water bodies were classified as impaired (Osterberg & Kline, 2012). Although this problem is multifaceted, the primary concern is related to excess levels of nutrients in waterways from agricultural practices that rely heavily on fertilizer use (both synthetic and natural, such as manure) (Green, Bekins, Kalkhoff, Hirsch, Liao, & Barnes, 2014). Such nutrient pollution, caused by excess nitrogen and phosphorus, causes increased algae growth that can produce elevated levels of toxins and bacterial growth in water, which have potentially serious health effects (Environmental Protection Agency [EPA], 2017). Locally, excess nutrients can make it more difficult for water treatment facilities to provide communities water safe for consumption; globally, excess nutrients in U.S. waterways result in hypoxic conditions that are ecologically devastating in the Gulf of Mexico (Donner & Kucharik, 2008; Jones, Wang, Schilling, & Chan, 2017; Schnoor, 2010).

While the breadth of media attention related to this problem in Iowa are profuse with perspectives on the sources of nutrient excesses in water, the scientific consensus is clear. As the World Health Organization ([WHO] 2015, p. 1) states "The most common sources of both nitrate and nitrite in water include agricultural activities (inorganic fertilizers and manure), wastewater treatment, nitrogenous waste products from humans and discharges from industrial processes and motor vehicles (Kirmeyer et al., 1995; Environment Canada, 2003; USEPA, 2006; Keeney & Hatfield, 2008). Given the state's primary function as agricultural producer, this alone should resolve any question of causation. Under natural conditions nitrate concentrations in groundwater are typically miniscule, though soil type and geologic condition do contribute to these levels. However, the WHO's (2015) report warns that the increasing use of fertilizers, which has

occurred through the land use changes spurred by current industrialized agriculture in combination with the need to dispose of increased loads of animal waste, is the main factor responsible for “the progressive increase in nitrate levels in groundwater supplies over the last 20 years” (p. 3).

While the environmental effects of nutrient excesses, such as increased algal blooms causing eutrophication of aquatic ecosystems, are well documented because of national mass media attention focused on the ‘Dead Zone’ in the Gulf of Mexico, the human health effects are less well-known (Iowa Environmental Council, 2016). The specific nutrient of concern for drinking water consumption is nitrate-nitrogen (nitrate-N), and is the chemical compound focused on for the remainder of this dissertation. As an aside, it is interesting to note that the chemical response occurring within the body when nitrate is consumed reduces nitrate to nitrite—which is considered unsafe at much lower levels than nitrate (i.e. the drinking water standard for nitrite is 1 mg/L) (International Agency for Research on Cancer [IARC], 2010, Zeman et al., 2011).

The drinking water standard in the US of 10 milligrams per liter (mg/L, or parts per million [ppm]) of nitrate was established in 1962 to prevent blue-baby syndrome, methemoglobinemia, in infants (Iowa Environmental Council, 2016). Blue-baby syndrome, the most infamous threat from excess nitrate in water, is a life-threatening condition that decreases the blood’s ability to carry vital oxygen through the body (Knobeloch, Salna, Hogan, Postle, & Anderson, 2000). Current prevalence of blue-baby syndrome in the US is very low, though a lack of data makes the provision of exact rates nearly impossible (Fewtrell, 2004). Some argue that the establishment of the federal nitrate standards should be credited for these low levels, while

others call for the EPA to consider revising the unnecessarily stringent standards to increase the allowable nitrate level (Avery, 1999; Snow, 2000).

However, less well-known negative health effects have been linked to elevated nitrate concentrations in drinking water by numerous studies (Brender et al., 2013; IARC, 2010; Iowa Environmental Council, 2016; Ward, 2009; Ward, Kilfoy, Weyer, Anderson, Folsom, & Cerhan, 2010; Weyer et al., 2001; WHO, 2015; Zeman et al., 2011). These adverse health effects include: birth defects, including spina bifida, limb deficiency, cleft palate, and cleft lip (Brender et al., 2013); cancers, including bladder, ovarian, uterine, and rectal (IARC, 2010; Ward, 2009; Weyer et al., 2001); thyroid problems (Ward et al., 2010; WHO, 2015); and a variety of other health concerns, including tumors, stomach/intestinal difficulties, and bone, muscle, and nerve complaints (Zeman et al., 2011). Though the majority of these associations were found when nitrate levels are higher than the 10 ppm drinking water standard, some research suggests that nitrate concentrations lower than this level may be harmful (Brender et al., 2013; Iowa Environmental Council, 2016; Weyer et al., 2001). Recent data released from the Iowa Water Information System show “40 percent of the 61 sensors that were in Iowa in 2016 had an average daily concentration of nitrates above the federal drinking water standard” (Jordan, 2017, para. 6).

While this problem is ominous, Iowa and other Midwestern agricultural states are putting effort into nutrient reduction strategies which attempt to remedy the situation. However, in Iowa there has not been any regulatory action taken to mandate use of the practices recommended through the state’s nutrient reduction strategy (INRS). The vital economic role agriculture plays in the state, and the fear that environmentally sustainable agricultural practices may hinder economic growth, are likely factors staling such legislation. Thus, despite their own need to

acquiesce to the economic pressures of production, this dilemma is increasingly resting upon the shoulders of the agricultural producers themselves.

There are multiple practices farmers can implement which have documented scientific evidence demonstrating their nutrient reducing utility (Iowa Nutrient Reduction Strategy [INRS], 2013; McLellan et al., 2015). The practices included and discussed in this dissertation are based on the strategy’s recommendations, their nitrogen reducing potential, and their longevity of study within the realm of agricultural best management practices. See Table 1 below, for the list of practices, a brief description of each, and their reported potential to reduce nitrogen loads based on empirical work synthesized within the INRS.

Table 1. INRS Recommended Practices, Descriptions, and Nitrogen Reduction Potential

Practice	Description	Average Nitrate Reduction Potential when Implemented
Cover crops	A non-harvestable crop with significant, quickly growing root systems, planted on fields to help protect soil and utilize excess nutrients.	31% (Rye) 28% (Oat)
Reduced tillage	Which help increase organic matter and biotic life in the soil and helps decrease soil erosion.	90% (No till) 33% (Reduced till)
Buffer strips	Small areas of land along waterways which are not planted with crops and thus help trap sediment and filter nutrients and pesticides before they make it into the water.	91%
Installation of denitrification bioreactors	An installed, edge-of-field structure containing a carbon source, such as wood chips, which utilize and breakdown nitrate in drainage water.	43%
Wetland restoration	Creating or restoring wetlands in appropriate areas of farm fields which act as a filter to reduce nutrient loads and sediment loss.	52%

Table 1—continued

Extended rotations	A planting cycle of different crops, such as grasses or alfalfa, along with corn and soybean to improve soil health and reduce nitrate loss into surface water.	42%
Perennials	Planting crops or plants such as miscanthus and switchgrass, that grow back year after year.	72% (Energy crops) 85% (Land retirement)

Though the environmental potential for these practices is great, cultivating changes within the agricultural realm is tremendously challenging as Ryan and Gross (1943) demonstrated long ago. Yet, this also underscores one of the great utilities of theory in social science research. Theory can be used as a lens through which a contextual problem can be examined, and thus guide this investigation into the communication processes working to disseminate information and inspire or inhibit behavioral changes related to Iowa’s nutrient in water challenges. Theoretically, the broad goal of this study is to improve understanding of the flow and diffusion of environmental risk information; uncertainty, risk, and normative perceptions; the roles and definitions of interpersonal influencers and their networks; and the relationships between these concepts. The practical goal of this dissertation project is to investigate the numerous messages currently permeating media and interpersonal communication channels regarding Iowa’s water quality problems; and to understand how these messages are related to farmer uncertainty, risk perceptions, normative beliefs, and nutrient mitigation behaviors. Accomplishing these goals may eventually help yield implications for environmental and risk communicators in the agricultural realm, and potentially help drive needed changes in water quality protection in Iowa.

Outline of Chapters

This dissertation consists of six separate chapters. Following this introductory chapter, Chapter Two presents a comprehensive theoretical foundation and literature review. The chapter

begins by outlining early scholarship on the flow of information, leading into a targeted review of Diffusion of Innovations research. Diffusion of Innovations is used as a foundational theory for its utility in explaining the way new information spreads through a social system, via both mass mediated and interpersonal communication activities. Specifically, this research focuses on exploring the communication processes prior to an adoption outcome. Correspondingly, the way risks are communicated and the way environmental risk perceptions may drive or stall the diffusion process, is of great interest. Thus, the second section of Chapter Two outlines the concepts of risk perception and uncertainty, highlighting the important role of mass media and interpersonal communication in shaping risk perceptions. The third and final section of Chapter Two adds the concept of interpersonal influence, providing a review of conceptualizations of opinion leadership and challenges previous nebulous definitions of this concept as they relate to the subculture context of Iowa farmers.

Chapter Three focuses on the mediated communication surrounding the water quality and nutrient debates in Iowa. The way media may be shaping farmer's perceptions and beliefs related to water issues is key to this dissertation project. Thus, three media sources known to be highly circulated within the farming community are explored to uncover dominant themes related to nutrients in water. Findings from this exploratory analysis demonstrate directly competing narratives promoted by two seemingly opposing ideologies appearing throughout the articles: pro-agriculture and pro-environment. This study also demonstrates differing conceptualizations of risks and uncertainty related to the issues of water quality and nutrients within the analyzed sources. Finally, some individuals were cited consistently among all three sources; however, the way these individuals and their roles were portrayed differed between the two discrepant perspectives. The implications from this study center on the strategic communication utilized by

the Iowa Farm Bureau, as well as the narratives this entity used to align the water quality debates with political tropes related to personal freedom and governmental regulation.

Chapter Four focuses on the target audience of the two agricultural media sources from the first study, and is aimed at uncovering farmer's perspectives of Iowa's water quality, nutrients in water, risks associated with this issue, and risks associated with INRS recommended practices. This study also seeks to improve understanding influence within Iowa farming networks and identify who key interpersonal communication sources are for water and agriculture issues. Face-to-face surveys were used to capture both qualitative data to help illuminate farmer conceptualizations of key variables, and quantitative data via previously validated measurement scales to assess farmer risk perceptions. Findings from this survey demonstrate low risk perceptions related to both nutrients in water and the recommended strategies. The findings also show farmers' current use of nutrient-reducing practices are correlated with their perceptions of social norms, though this relationship is far from straightforward. The implications from this study relate to the need for improved communication of science related to nutrients in water and water quality in Iowa in general, especially the causes and definition of impaired water quality. Finally, several of the individuals identified as key influencers were the same as those identified as key spokespeople in the first study (Chapter Three).

Chapter Five centers on data collected through in-depth interviews conducted with those key individuals identified by respondents in the previous study (Chapter Four). Among the final sample was one well-known farmer lauded for his championing of cover crops and no-till practices, two local government employees working in the realm of natural resource conservation, two executives within one local agricultural business entity, and the Secretary of

Agriculture for the state of Iowa. Traditional conceptualizations of opinion leaders are compared to findings from the interviews with these individuals. Interviews comprehensively covered the topics of water quality and nutrients, risks related to these topics, and general characteristics of influencers within the agricultural realm. Theoretical implications based on these findings suggest that further explication of these influential roles is needed. Practically, consideration of personal motivations for engaging in persuasive communication on a particular issue, should be explored before enlisting the help of influentials for risk-information dissemination.

Chapter Six acts as a concluding piece bringing together the key findings from across the three studies. Theoretical implications call for revision and expansion of the preliminary communication processes covered by diffusion to account for the role that risk communication and the ‘manufacturing of uncertainty’ (Dunlap & McCright, 2010) induced by agri-industry group communication strategies may be producing among farmers. Similarly, current conceptualizations of opinion leaders are reviewed based on the amalgam of data across the three studies and arguments are made for needed updates to account for differing inherent power positions, employment roles, and personal motivations among influential individuals. Practical implications include the need for environmental advocacy and academic groups to adjust current communication strategies to better reflect those used by agribusiness entities, which align with key principles of public relations. In-depth discussion is offered regarding overall study design, including strengths and limitations for all three studies. The chapter concludes with a recommended path for future research to build on these studies and continue expanding theoretical knowledge related to environmental and risk communication, and interpersonal and organizational influence in the agricultural sector.

CHAPTER TWO: THEORETICAL FOUNDATION AND LITERATURE REVIEW

Resistance to changing current agricultural practices remains prominent in Iowa despite the Iowa Nutrient Reduction Strategy's (INRS) clear documentation of the nutrient reduction benefits achievable via the strategy's recommended practices. While past research has examined a variety of factors potentially relevant to the adoption of conservation agriculture among farmers (See Camboni & Napier, 1995 or Prokopy, Floress, Klotthor-Weinkauff, & Baumgart-Getz, 2008 for reviews), results tend to be mixed and vary depending on the specific practice. Wilson, Howard, and Burnett (2014) argue that too little is known about "what in general influences a farmer's attitude toward taking action, or what influences a farmer's willingness to adopt new practices beyond what he or she already has in place" (p. 6736). Correspondingly, little empirical work has investigated the way directly contradictory messages regarding water quality risks may impact perceptions or behavioral change related to nutrient reduction practices. Wilson et al. (2014) offer one of the few studies focused on the relationship between farmers' risk perceptions and attitudes towards conservation, however, variables related to risk information are notably absent. Explorations related to risk information, a crucial precursor to risk perception (Frewer & Shepherd, 1994), is lacking in existing literature on agricultural decision-making. To address this gap in the literature, the focus of this study is on the way risk information is communicated, diffused, and influential within agricultural networks.

This chapter offers a review of foundational literature and theoretical contributions related to the flow of information, risk communication, and networks of influence. Consequently, the chapter is organized as follows: first, mass communication scholarship related to the flow of information are reviewed, with special attention given to the theory of Diffusion of Innovations; next, conceptual foundations of risk and uncertainty perceptions are reviewed, and both media

and interpersonal communication's role in representing risk and influencing individual's perceptions, are emphasized; lastly, interpersonal networks and communication behaviors influencing the spread of information are explored, with conceptualizations related to key individual influencers in these networks featured.

The Flow of Information

While Diffusion of Innovations is a vast, encompassing theoretical orientation, the two-step flow model of communication provides a conceptual foundation for diffusion scholarship. Katz and Lazarsfeld (1955) posited that mediated broadcasts of information were extended by the interpersonal engagement of certain individuals who acted as a bridge between the mass media and the general public. In the wake of this early public opinion scholarship, research efforts attempted to trace the way information spreads throughout society via various interpersonal pathways (Southwell & Yzer, 2007). However, this research did not uniformly support the notion of the two-step flow model exclusively, rather it demonstrated that the flow of information and ideas across a society cannot be treated as a unidirectional, homogenous phenomenon (De Fleur, 1987; Rogers, 2000). Diverse social/cultural contexts and circumstances contribute to various and complex patterns of information diffusion. Thus, the next wave of scholarship went beyond documenting these information flows, to instead investigate the media and individual-level factors influencing acceptance of new information and willingness to share it with others (Rogers, 1962; Rosengren, 1973; Southwell & Yzer, 2007).

In the first edition of his seminal work, *Diffusion of Innovations* (1962), Rogers focused on compiling and analyzing the individual-level variables related to people's openness to new information. Consequently, a primary component of the Diffusion of Innovations theory rests on the assumption that personal characteristics of individuals make them more or less likely to

accept new information, ideas, or behaviors before or after others within their social system. Later work on diffusion (including later editions of Rogers's *Diffusion of Innovations* book) focused less on individuals' potential receptivity to new information and ideas, and instead was concerned with tracking information flows within social networks (Southwell & Yzer, 2007). For example, Milgram's (1967) study on "the small-world problem" showed how relatively few communication agents were needed to affect substantial informational flows and exchanges. Granovetter (1973; 1995) also studied the way communication with outer network members yields important outcomes, sometimes more so than through exposure to formal information sources or the closest members of one's network. Such pivotal studies helped fuel subsequent research emphasizing the utility of understanding social networks for studying diffusion processes (Schuster et al., 2006; Valente, 1995), to be discussed the third section of this chapter. The following section details more thoroughly the diffusions of innovation theory, outlines its utility within the agricultural realm, and highlights areas in need of more work.

Diffusion of Innovations

Diffusion of Innovations is a key theoretical framework for situating this research related to information flows and influence within networks. Rogers (2010) states that "diffusion is the process by which an innovation is communicated through certain channels over time throughout a social system" (p. 5). While many diffusion studies are focused on the outcome of innovation adoption, this study is focuses almost exclusively on the communication component. Rogers defines communication as "the process by which participants create and share information with one another in order to reach a mutual understanding" (2010, p.18). This definition highlights the issues central to this dissertation: the creation of and sharing of information; the way individual

actors contribute to that creation and sharing of information; and whether this information exchange does create a mutual understanding among all participants.

The origins of the diffusions of innovation theory are especially notable given the agricultural context of this dissertation. Until about 1960 virtually all diffusion research used data collected from American farmers (Valente & Rogers, 1995). Tracking the spread of a new hybrid corn seed among farmers in Iowa, the pivotal work by Ryan and Gross (1943) demonstrated that when plotted cumulatively, adoption of the seed formed an S-shaped curve. This research laid the foundation for the most fundamental premise of Diffusion of Innovations—that adoption of new ideas, innovations, or practices occurs in society in a predictable S-curve pattern (Valente & Rogers, 1995). Initially adoption rates are slow, but as time goes on and communication influences work within the society, the rate begins to increase rapidly until a level of adoption saturation occurs. Following their pivotal work documenting and plotting the adoption rates of the hybrid corn seed, Ryan and Gross (1950) reported on their subsequent work to classify the farmers they had studied into different categories based on adoption timing. Rogers (1962) and others (Beal & Bohlen, 1955; 1957), later expanded and generalized this classification of adopters into the five categories of: 1) innovators, 2) early adopters, 3) early majority, 4) late majority, and 5) laggards. Personal characteristics associated with each category were focused on in this early scholarship, partially to aid audience segmentation efforts of public relations and advertising practitioners of the time (1962; 1962a). For example, Rogers (1962a) highlighted the relationship between farmer innovativeness and other variables, such as: age (negatively correlated), social status (encompassing measures of wealth and income; positively correlated), education (positively correlated), size of farm

(positive), and specialization (when one commodity makes up a large share of the farming operation; positively correlated).

Another important component of the Diffusion of Innovations theory rests upon the stages involved in the decision to adopt an innovation. Beal, Rogers, and Bohlen, (1957) drafted the initial rendition of these stages, though eventually it was updated to consist of the following five stages: knowledge (learning of the innovation, that it exists and what it does), persuasion (finding out what it actually does, its relative advantage and other innovation based characteristics), decision (taking action to actually make the choice of adoption or rejection), implementation (using the innovation), and confirmation (communication with others in order to confirm your decision) (Rogers, 1962; 2010). While original diffusion scholarship tended to regard all innovations as equivalent units (be it accepting new information, ideas, behaviors, or implementing a new practice, etc.), later research demonstrated that “this oversimplification was dangerously incorrect” (Rogers, 2010, p. 220). Differing characteristics among innovations are especially relevant to consider based on the function of the early innovation-decision process stages, where information gathering and benefit assessments of the innovation are key. Subsequent research addressed this gap and demonstrated that the following five innovation attributes are most consequential: the relative advantage (how the innovation fills a particular need, or improves upon the old way), complexity (simple innovations are more easily adopted), compatibility (how well the innovation fits the value scheme and ideologies of the adopter), observability (people are more likely to try something if they can observe someone else using it first), and trialability (innovations that people can try out before they buy/adopt are seen as less risky and have higher adoption outcomes) (Rogers, 2010).

Research on the Diffusion of Innovations paradigm has continued to evolve from its rural sociological roots, eventually becoming widely utilized in nearly all the social science disciplines. For instance, in the mid 1960's diffusion research began occurring in developing country contexts, and after 1975, a new wave of diffusion research centered upon the spread of conservation and other ecologically-related innovations stemming from growing environmental concerns at that time (Valente & Rogers, 1995). While the diffusion paradigm is vast, encompassing, and interdisciplinary, the focus and use of the diffusion paradigm within this study centers on its utility in modeling the spread of information throughout a social system.

Diffusion and communication. Diffusion, like the two-step flow model of communication, posits that two specific channels of communication are paramount within the process, those being, 1) mass media and 2) interpersonal communication (Rogers, 2010). Interpersonal communication is often considered most important in influencing eventual decisions to adopt, while mass media is considered most crucial in the initial introduction/exposure to the idea or new information (Rogers, 2010; Sundstrom, 2015). Because of the pivotal role communication processes play within the diffusion process, communication has long been a pivotal component of diffusion scholarship. Wilkening (1962) writes about the importance of communication in his early work on agricultural innovation adoption, stating “the acceptance of innovation in agricultural requires more than communication of the technical aspects of the innovation; it involves the communication of ideas, feelings, and aspirations as well as information about the costs, techniques, and returns” (p. 39). Rogers also focused heavily upon the communication components influencing diffusion, even measuring communication behaviors in his early work characterizing differences among adopter categories (1962a). This work demonstrated that innovators and early adopters generally depend less on other farmers

(neighbors and friends) and more on farm magazines or direct contact with agricultural scientists, than later adopters who do depend most on the interpersonal sources (Rogers, 2010).

The importance of the interpersonal channel of communication among farmers has been emphasized in numerous agricultural innovation studies (Conley & Udry, 2001, 2010; Feder & Slade, 1984; Läßle, Renwick, & Thorne, 2015; Nowak, 1992; Padel, 2001; Padel et al., 2015). However, despite the unmistakable interpersonal communication influences at play within this context, it remains important to consider the role of mass media in the diffusion process. In several early studies, Rogers and his colleagues (Beal & Rogers, 1960; Rogers & Shoemaker, 1971) collected data on the importance of communication channels at different stages of the adoption process. These findings consistently demonstrated the importance of mass media in the preliminary knowledge stage, and the mass media's subsequent (and slight) decreased importance throughout the progression of the five stages. However, later research by Valente and Saba (1998) suggested that under certain conditions mass media may substitute for interpersonal communication in motivating adoption. Specifically, Valente and Saba (1998) found that a family planning media campaign in Bolivia helped move certain individuals with few contraceptive users in their personal networks to adopt contraceptives. Additionally, several studies examining adoption of agricultural technology have demonstrated that mass media not only acted to increase initial awareness, but also acted as an important source to decrease uncertainty (Padel, 2001; Feder & Slade, 1984; Schuster et al., 2006; Rogers, 2010).

The various roles that communication sources may play on uncertainty, and thus diffusion, brings up important considerations of the effects of risk and uncertainty within the diffusion paradigm. Though economic and yield related risks have been discussed in numerous agricultural diffusion studies, and highlighted as probable barriers to adoption (Byerlee & De

Polanco, 1986; del Río González, 2005; Feder & Umali, 1993; Johnson, 2010; Long et al., 2015; Marra & Carlson, 1987; Marra, Pannell, & Ghadim, 2003; Tsur, Sternberg, & Hochman, 1990), fewer studies sought to empirically investigate farmer's risk perceptions of new technologies/practices (Abadi Ghadim, 2000; Binswanger, Dayantha, Balaranaia, & Sillers, 1980; O'Mara, 1983; Ritter, 2012; Smale, Just, & Leathers, 1994; Wilson et al., 2014). It is important to note that most of these studies are interested in financial risk perceptions related to the new practice/technology rather than environmental risk perceptions. Interestingly, the two exceptions, Wilson et al. (2014) and Ritter (2012), are focused on farmer perceptions of risk as they relate to nutrient loss in soil. Overall, a relationship between increased financial risk perceptions and decreased farmer adoption is indicated, though several of these studies showed mixed results or yielded insufficient significance levels. Still, a gap remains related to farmer's environmental risk perceptions and diffusion. Virtually no research to-date has focused on the combination of mediated representations of risk and uncertainty (both related to the environmental context and the new practices), perceptions of risk among potential adopters, and the influence of key individuals within the diffusion process. This paucity in previous research provides the basis for this dissertation's three studies, as Study One (Chapter Three) examines mediated agricultural information, Study Two (Chapter Four) investigates farmer perceptions of the issues, and Study Three (Chapter Five) focuses on influential individuals.

Considering our current global environmental landscape and the way issues are presented interpersonally and through the media, we need to revise our understanding of the diffusion process. Weenig and Midden (1991) argued "there is a curious blind spot about negative advice and the nondiffusion of unsuccessful innovations" within diffusion literature (p. 734). Building upon the notion, I argue that risk and uncertainty information may constitute such negative

advice and thus disrupt the diffusion of environmental information within the agricultural realm—rendering Rogers’ (2010) notion of reaching “a mutual understanding” (p. 18) impossible. The following section will offer a brief discussion and review of previous literature on risk and uncertainty conceptualizations, eventually focusing on the critical roles of mediated and interpersonal communication channels in the formation of risk perceptions.

Risk Perception

In a general sense, uncertainty is a concept based on a lack of knowledge or information that results in the potential for a variety of outcomes. While the concept is defined in numerous ways by a variety of fields and disciplines, Brashers’ (2001) broad, comprehensive conceptualization encompasses most meanings of the term. Brashers states: “Uncertainty exists when details of a situation are ambiguous, complex, unpredictable, or probabilistic; when information is unavailable or inconsistent; and when people feel insecure about their own state of knowledge, or the state of knowledge in general” (2001, p. 478). Risk, then, can be considered a specified situation of uncertainty—one which represents the balance between the chance of an outcome occurring and the potential consequences if it does occur (Slovic et al., 1979).

The inclusion of the term probabilistic into Brasher’s (2001) conceptualization of uncertainty is important due to the strong valence of probability in many quantitative measures of uncertainty. In these numeric representations of the term, the curvilinear relationship between probability and uncertainty is key. That is, certainty is only possible when something has a probability of 0% or 100%, and the further from these two points a probability goes, the greater uncertainty becomes. Similarly, technical conceptualizations of risk, stemming from the actuarial and natural sciences, often define risk through calculations of the probability of an event multiplied by the magnitude of its consequences (Slovic, 1987). The assumption of such

probabilistic calculations is that people will react similarly to risks with low consequences and high likelihood of occurring, and to the opposite interaction, risks with high consequences and low likelihoods, if they are equivalent numerically (Kasperson et al., 1988).

However, individual's perceptions of risks rarely align with these technical risk calculations (Slovic, 2010). Risk perception, the study of which is informed by multiple disciplinary fields including psychology, sociology, public health, political science, and others, is based mostly on subjective assessments of risk and intuition to evaluate riskiness of situations (Glik, 2007; Ritter, 2012). Slovic (1992) states:

Risk is inherently subjective. Risk does not exist out there, independent of our minds and cultures, waiting to be measured. Instead, human beings have invented the concept of risk to help them understand and cope with the dangers and uncertainties of life (p. 119).

Many original studies of risk perception produced findings supporting the notion that people generally dislike uncertainty and prefer when scientists give them absolutes, rather than probabilities of likely occurrence (Slovic et al., 1979; Sjoberg, 2000; Fischhoff, 1995; Frewer et al., 2003). However, this combined with the dominant notion among the scientific community that people could not understand these probabilities gave way to the deficit model of communication (Sturgis & Allum, 2004; Wynne, 1991). This model emphasized the notion that the public could not appropriately make sense of scientific risk related material because of a deficit on their part, and that it is the responsibility of scientists/experts to fill that deficit (Gross, 1994; McComas, 2004). This gave way to the scientific communities' "sanitization" of risk-related communication material, through the control of various communication sources and the omission of any uncertainty information involved in their prediction models or assessments (Thompson, 2002; Powell et al., 2007; Fischhoff, 1995; Frewer et al., 2003). This helped

exacerbate a disconnect between the scientific community and the public, and unfortunately, residual feelings of mistrust towards scientists continues today.

Recognition of this disconnect, and the inherent problems with the deficit model's perspective, helped spur a risk communication paradigm "which promotes risk communication as a two-way process in which both expert and public perspectives should inform each other" (De Boer, McCarthy, Brennan, Kelly, & Ritson, 2005, p. 248). Critical to this paradigm shift was a significant body of research devoted to understanding public risk perception. Cross-disciplinary scholarship over the last several decades has identified a number of factors which consistently influence these perceptions (Slovic, 2010). Some factors center on characteristics of the hazard itself, including the dreadedness of the potential outcome, the potential controllability of the hazard, and whether it is naturally occurring or man-made (Glik, 2007; Sjöberg, 2000; Slovic et al., 1979). Another realm of risk perception factors are sociocultural and/or contextually based, such as gender and socioeconomic status (Flynn, Slovic, Mertz, 1994; Koundouri, Nauges, Tzouvelekas, 2006; Larson et al., 2009). Psychological characteristics, such as perceptions of knowledge (Powell et al., 2007), trust and credibility (Siegrist, Cvetkovich, & Roth, 2000), issue relevance and involvement (Hart, Stedman, McComas, 2015; Nathan, Heath, and Douglas, 1992), and emotions (Frewer et al., 2003; Powell et al., 2007; Bradac, 2001; Brashers; 2001) are each also important factors in people's perceptions of risk.

While these factors all play important roles in the way risks are perceived, a substantial body of research highlights mass media (Combs & Slovic, 1979; Covello, von Winterfeldt, & Slovic, 1987; Culbertson & Stempel, 1985; Dahlstrom et al., 2012; Freudenburg, Coleman, Gonzales, & Helgeland, 1995; Greenberg, Sachsman, Sandman, & Salomone, 1989; Ho, Scheufele, & Corley, 2013; Jones, Denham, & Springston, 2007; Mazur, 1981; Pilisuk &

Acredolo, 1988; Sharlin, 1987; Slovic et al., 1979; Trumbo, 1998; Zhao, Leiserowitz, Maibach, & Roser-Renouf, 2011) and interpersonal communication's (Coleman, 1993; Dunwoody & Neuwirth, 1991; Ho et al., 2013; Jones et al., 2007; Kelly et al., 1992; Mazur & Hall, 1990; Morton and Duck, 2001; Trumbo, 1998; Welch Cline, Johnson, & Freeman, 1992) importance in shaping risk perceptions. Thus, the way risks are communicated, through mass media and interpersonal communication, is not only crucial to investigate to better understand the diffusion of risk information within agricultural communities, but also is foundational to the investigation of risk perception impacts on the diffusion process. The following section will review findings related to the media's role in cultivating perceptions of risk and uncertainty, eventually focusing on how these concepts have been studied within the environmental and agricultural realms.

Mass media and risk. While uncertainty itself may be a psychological state, mediated information and the way it is conveyed and expressed, significantly influences an individual's levels of uncertainty (Bottorff, Ratner, Johnson, Lovato, & Joan, 1998; Hurley, Kosenko, & Brashers, 2011). Correspondingly, individual perceptions of risks are affected by how information is communicated prompting some risk communication scholars to suggest that whoever controls the definition of a risk also controls the particular solution to that risk (Bottorff et al., 2011; Slovic, 1997). Early studies of health and environmental risk coverage in news media demonstrated that some risks, such as chemical additives in food or nuclear power plant accidents, can be made more salient through extensive coverage (Coleman, 1993; Mazur, 1981; Sharlin, 1987). Slovic, Fischhoff, and Lichtenstein (1987) found that while people tend to base their risk perceptions on what they are exposed to in both the media and their daily lives, people also tend to ignore mediated evidence that contradicts with their current beliefs. Similarly, Culbertson and Stempel (1985) and others, explored the relationship between mass media

consumption and perceptions of public versus personal risk, finding that there is a tendency for individuals to consider themselves immune to hazards they consider others susceptible to (Coleman, 1993; Pilisuk & Acredolo, 1988; Slovic et al., 1987; Weinstein, 1987). Specifically, Coleman (1993) found that television news had a heightening effect on personal risk perceptions more so than the influence of interpersonal communication. This finding was important in helping expand previous notions related to the impersonal impact hypothesis which suggested media messages only had the potential to influence beliefs about societal-level risk perceptions, rather than one's own perception of personal risk (Morton & Duck, 2001; Tyler & Cook, 1984).

Research on the potential for media to influence both personal and societal risk eventually focused on message based characteristics important in influencing perceptions. For example, Stapel and Velthuijsen (1996) showed that "vivid and self-relevant" messages had the potential to influence both personal and societal risk perceptions, while Basil and Brown (1997) found similar effects on risk perceptions based on audiences' level of identification with the communication source. Research in this vein also began to explore differences between types of media and risk perceptions, leading to a heavy focus on news media risk coverage. Greenberg et al. (1989), content analyzed television news coverage of environmental risks in the mid 1980's, finding that coverage was disproportionately centered upon "sudden and violent" risks whereas coverage of chronic risks (such as smoking, asbestos, and sunburns) were much less frequent. These researchers attributed this in part to traditional determinants of news which emphasize the unusual and spectacular, and the availability of dramatic images (Greenberg, 1989).

News media's tendency to highlight dramatic or sensational aspects of risk events has been a common theme within subsequent research (Covello & Sandman, 2001; Dahlstrom, Dudo, & Brossard, 2012; Friedman, Gorney, & Egolf, 1987; Freudenburg et al., 1995; Gorney,

1992; Hofstetter & Dozier, 1986). Covello and Sandman (2001) argue “a major conclusion from research focused on the news media is that journalists are highly selective in reporting about risk, and particularly inclined toward stories that involve people in unusual, dramatic, confrontational, negative, or sensational situations” (p. 167). However, some studies in this area highlight nuanced relationships between news media sensationalism and risk coverage. Particularly notable are several studies of network television news media coverage of the Chernobyl nuclear disaster. Friedman, Gorney, and Egolf (1987) and Gorney (1992) found that despite the inclusion of aspects of sensationalism among all three major news network’s coverage of the disaster, the “coverage also contained a preponderance of reassuring statements, innocuous graphics and neutral work linkages” (Gorney, 1992, p. 463). Much later, in a rare study focused on message-level effects, Dahlstrom et al. (2012) tested the relationships between risk precision information, sensationalism, and self-efficacy. While the authors note small effect sizes and highlight the need to situate mediated messages with a broad framework of risk perception factors, the study demonstrated that imprecise risk information mediated the relationship between sensational messaging and risk perception (Dahlstrom et al., 2012).

Broad implications of overly-sensational news coverage center upon their potential to increase fear unnecessarily and even “inhibit the ability of media users to consider an issue’s genuine risks” (Dahlstrom et al, 2012, p. 156). This highlights the important relationship between representations of risk and public fear. One risk communication theory, the Extended Parallel Process Model (EPPM), was developed to help produce effective risk communication messages—messages that elicit audiences to engage in appropriate risk mitigation behaviors (McMahan, Witte, & Meyer, 1998). The model also has great utility in explaining the reactions people have to fear based communication messages (Maloney, Lapinski, & Witte, 2011; Witte,

1997). According to the EPPM, a message using fear-based cues needs to have a balance of threat components (severity and susceptibility) and efficacy (self and response), for maximum effectiveness. Essentially, the EPPM suggests that if a communication message has high levels of threat messaging without the inclusion of an appropriate solution (efficacy), or if the solution is perceived as weak, then people are driven to engage in fear-control processing. This includes defensive avoidance, message minimization and/or perceived manipulation, resulting in message rejection (Witte, 1995). Alternatively, when both threat and efficacy messaging are equally high, danger-control processing is elicited which results in cognitive involvement enabling attitude, intention, or behavior changes (Witte, 1992; 1994).

Given the substantial literature on the utility of the EPPM in analyzing audience reactions to communication messages, some scholars have also used the model as an evaluative tool to analyze health and environmental risk representations in the media (Brown & Lewis, 2003; Kline & Mattson, 2000; Lee, 2011; O'Neill & Nicholson-Cole, 2009). While these studies overall highlight a lack of efficacy messaging components in health and environmental media, Lee (2011) found the opposite (i.e. efficacy message predominance) in news clips about the human papillomavirus vaccine. Lee (2011) argues that this may lose the audience's attention altogether, rather than facilitate increased engagement. None of these studies of media content found media producers had effectively been able to balance these important constructs.

The cognitive processing effects of risk messaging are interesting to consider in the context of Iowa's agricultural impacts on water quality. It is possible that farmers, colloquially deemed the 'original environmentalists,' are avoiding messages which rely too heavily on threat components, such as severity of negative environmental outcomes of nutrients in water, in order to resolve the mental distress these messages produce. Along these lines, another possibility may

be related to farmer's selection of media on the topic of environmental issues. Farmers may avoid media sources which they associate, or have previously had experience with, producing such cognitive dissonance.

In a study of the protection motivation theory, which like the EPPM relies on an interplay of both threat and efficacy, Neuwirth, Dunwoody, and Griffin (2000), demonstrated that high-severity messaging was related to increased risk information-seeking behavior. This aligns with the premise of Uncertainty Management Theory, which suggests that in some cases individuals may use uncertainty as a tool or resource, actively seeking information to cultivate uncertainty or reduce certainty (Bradac, 2001; Brashers, 2001). Studies utilizing this theory have effectually helped render early assumptions related to the deficit model of communication untrue, showing that greater uncertainty does not always equate to higher risk perception (Bradac, 2001; Brashers, 2001; Fischhoff, 1995; Frewer et al., 2003; Powell et al., 2007). Studying the application of Uncertainty Management Theory to women's information seeking related to breast cancer risk perceptions, Jones et al. (2007) demonstrated that most women, regardless of age or family history, have at some point engaged in a communication behavior meant to manage uncertainty about personal breast cancer risk. They also found that these behaviors (talking to family about breast cancer and reading particular magazines/journals) in turn had influences on participants' risk perceptions (Jones et al., 2007). The far-reaching capacity of uncertainty management, based on the main premise that individuals at times seek information to increase or decrease uncertainty, may be helpful in explaining farmer's communication behaviors related to the water quality situation in Iowa. Farmers may be turning to certain information sources to produce higher uncertainty regarding the current state of Iowa's water quality, to cope with the cognitive discomfort produced by information equating poor water quality with farming.

A quarter of a century ago, Renn (1992) argued “dissent and ambiguity are inevitable and irreversible parts of risk information in addition to the uncertainty of the consequences” (p. 481). Uncertainty Management Theory also suggests the potential that communicators alter their own language according to their perception of a message recipient’s need for greater or less uncertainty (Bradac, 2001). However, most communication research on uncertainty centers upon the role of communication in the management of uncertainty, leaving little literature on the potential for messages to reflect, convey, and create uncertainty (Hurley, Kosenko, & Brashers, 2011). Some scholarship on global warming/climate change communication emphasizes implications related to divergent ideological messages within news coverage of environmental issues, though this has rarely been the research focus. For example, McCright and Dunlap (2000; 2003; Dunlap & McCright, 2010) and Freudenburg, Gramlin, and Davidson’s (2008) work indicates that competing political messages and corresponding public figures may help increase public uncertainty about climate change, even when the science is represented as fact. Arbuckle et al. (2015), studying farmer’s perceptions of climate change, argue that the mediation of misleading, counter-information by certain interest groups has “muddled public understanding of climate change and retarded public action” (p. 213) in both the public and agricultural realms.

Others have argued that the news media’s coverage of risk stems from the guidelines and values driving the practice of good journalism (Boykoff, 2007; Boykoff & Boykoff 2004; 2007; Covello & Sandman, 2001; Renn, 1992; Wilkins & Patterson, 1987; Zhao et al., 2011). For example, one of the premises of journalism is to present opposing views equally. Renn (1992) states “the media, in contrast [to political and scientific realms], transmit the claims of the different camps to the audience regardless of how much scientific evidence each of them has been able to compile and whether it represents a majority or minority opinion” (p. 481).

Discussing this same quandary, Covello and Sandman (2001) state “thus truth in journalism is quite different from truth in science” (p. 168).

Narratives are another approach to providing risk information utilized by news media and other communication sources alike. Narrative approaches tend to rely on stories, anecdotes, and case studies to help personalize information potentially making it easier to recall than facts and figures (McComas, 2004). Writing about the way news media “shape complex science, policy, and political debate into narratives” (p. 1476) Smith (2005), points out that media discourses do not necessarily reflect the reality of environmental risk, rather they are rule-bound, codified reflections of what risk reality *should* be. For instance, Smith (2005) interviews several journalists who recount their use of the narrative device of “located flood damage, coastal erosion, or the arrival of ‘exotic’ diseases/species” (p.1477) to get climate change stories on the air. It is important to consider that while journalists have the goal of reporting objective, accurate information, they simultaneously must be concerned with the economics of media consumption related to maintaining an audience. Thus, packaging media messages into predictable, familiar tropes functions to help attract and maintain audience attention. To help explain this process, Dahlstrom (2014) highlights gatekeeping theory, which he defines as “the upstream influences of organizational routines, external pressures, and internal goals of media industries to shape the messages and formats that eventually emerge for audience consumption” (p. 13615). The importance then, based on gatekeeping theory, is that news stories are not pre-established, autonomous things transmitted to the public; rather reality is created by “a selective structuring that creates units that fit the organizational needs” (Dahlstrom, 2014, p. 13615).

Given the context of this dissertation—the agricultural realm—it is important to consider not only mainstream news media and resulting risk representations or narratives, but also

mediated information disseminated by agricultural industry sources. Non-mainstream sources may be equally or more important in shaping farmer's perceptions of water quality and nutrient issues in Iowa, thus it is relevant to review what is known regarding farmer's media preferences. Some literature does exist on this topic, due in part to the potential role media may play in changing farming practices (Duram, 1999, Egri, 1999, Hall & Rhoades, 2010; Chiu, Cheyney, Ramirez, & Gerr, 2015). For example, Egri (1999) found that significantly fewer organic farmers relied on governmental publications, agricultural extension agents, and industry supplier communication products, than conventional farmers. Mirroring some of Slovic et al.'s (1987) findings regarding the tendency for people to seek risk information that aligns with their own preconceptions, Egri (1999) suggests that conventional farmers preferred these sources as they supported their own pre-existing practices and biases. In a similar study, Duram (1999) found that many farmers mistrusted university extension service publications, because they felt the universities overly emphasized environmentally sustainable agricultural practices. Hall and Rhoades (2010) conducted the only study to-date exploring the influence of media preference on adoption of farming practices, finding that agricultural publications were the most influential source among grain farmers in Ohio. Correspondingly, Chiu et al. (2015) found that daily newspapers and agricultural publications are the preferred communication source among Iowa farmers for agricultural health and safety information.

The lack of literature investigating the way agricultural media portray environmental risk specifically is problematic considering the important role media plays in diffusion of risk information and shaping risk perceptions—and the affinity for agricultural publications among farmers. This is also important to consider based on climate change communication literature contending that some “interest groups have mounted substantial counter-efforts to ‘manufacture

uncertainty’ regarding the phenomenon and shape discourse about how society should or should not respond” (Arbuckle et al., 2015, p. 212). These groups often use denial-based strategies, such as the denial of climate change altogether, its seriousness, and anthropogenic causes (Dunlap & McCright, 2010). Correspondingly, Arbuckle et al. (2015) and others suggest that such mediation by agricultural interest groups “has muddled public understanding of climate change and retarded public action” (p.213), calling for the climate change research community to engage with the farm press to help combat this “denial machine” (Dunlap & McCright, 2010; Weber & Stern, 2011). However, a necessary precursor should be to understand the way the farm press is representing environmental problems, the corresponding risk narratives being promulgated within this community, and who the key sources are disseminating various representations of the issues. These issues are each addressed through the research questions posited in the first study (Chapter Three), listed below:

RQ1: What are the key messages about Iowa’s water quality and nutrients in water appearing within highly circulated agricultural and mainstream news media sources?

RQ1a: How are risks and uncertainties regarding Iowa’s impaired water quality and nutrients in water conveyed through these sources?

RQ2: Who are the individuals appearing consistently as spokespeople and information sources within the water/agriculture nexus in Iowa in each news media source?

RQ2a: How are these individuals portrayed as influential within the water/agricultural realm in each of the sources?

Interpersonal communication and risk. Understanding the media’s portrayals of Iowa’s water quality and risks related to nutrient excesses only helps illuminate one facet of the communication forces working to influence farmer’s perspectives and beliefs related to these

issues. Early scholars argued that mass media's potential to influence individuals is limited because of interpersonal communication's preeminence (Lazarsfeld, Berelson, & Gaudet, 1948). Later research helped demonstrate that while mass media serves the vital function of increasing awareness and may influence perceptions, interpersonal communication is what drives behavior change (Morton & Duck, 2001; Rogers & Storey, 1987). Additionally, the relatively high scientific complexity of nutrient pollution may result in some difficulty comprehensively understanding mediated information on this issue among non-scientists (Sterman, 2008). Other scholarship suggests the possibility that selective exposure to media, based on individual ideology, partisanship, and trust, may be influencing exposure to mass mediated information on environmental issues (Kahan et al., 2012; Nisbet & Kotcher, 2009; Prior, 2005). These issues lead some individuals to prefer gathering environmental information through communication with other individuals in their social networks (Dalrymple et al., 2012; Nisbet & Kotcher, 2009).

Previous literature consistently demonstrates that interpersonal communication is a key channel in both the diffusion of agricultural practices (Conley & Udry, 2001, 2010; Feder & Slade, 1984; Läpple et al., 2015; Nowak, 1992; Padel, 2001; Padel et al., 2015) and risk information (Coleman, 1993; Dunwoody & Neuwirth, 1991; Ho et al., 2013; Jones et al., 2007; Mazur & Hall, 1990; Morton & Duck, 2001; Trumbo, 1996; Cline et al., 1992). Studying the communication preferences of farmers in Iowa, Chiu et al. (2015) found that participants ranked other farmers as the most useful (as opposed to preferred) source of information for agricultural health and safety information. However, as Weenig and Midden (1991) have argued, too little is known about how exactly social influence takes place and "how it is affected by existing communication networks" (p. 734). Considering the importance of interpersonal communication with individuals in one's own social network, examining Iowa farmers' interpersonal networks,

and chiefly, who in these networks holds the most influence, is also a necessary component of this research.

Though this research has not always produced consistent results, in general, literature suggests interpersonal communication acts as a force to heighten risk perceptions, especially judgements of personal risk (Dunwoody & Neuwirth, 1992; Morton & Duck, 2001). However, as Dunwoody and Neuwirth (1991) emphasize, this relationship is still reliant on the mass media in that interpersonal communication only tends to increase risk perceptions if the issue has also been recently made salient by the media. Different investigations have considered specific facets of the relationship between interpersonal communication and risk perceptions to attempt a more comprehensive understanding of this relationship (though most of these studies do not exclusively focus on interpersonal sources and include media source variables). For example, Mazur and Hall (1990) investigated the differences in individual and societal-level risk judgements of radon, finding that interpersonal communication with family was only most important in influencing national-level risk judgments, rather than judgements about one's own home.

Similar work conducted by Coleman (1993) examined differences in personal and societal level risk perceptions for a variety of different hazard types. These findings demonstrated that interpersonal communication was associated more with increased societal-level risk perceptions than personal-level risk. Trumbo (1996) investigated how communication channels were associated with levels of concern within risk perceptions of an environmental health issue, finding that interpersonal communication only played a significant role in risk perceptions among those with the highest levels of concern. Jones et al. (2007) investigated how different communication sources impacted the accuracy of breast cancer risk perceptions. Results

suggest communication with peers helps improve accuracy of breast cancer risk estimates, though communication with family members and consumption of certain media sources tend to produce over-estimates of this risk (Jones et al., 2007). Ho et al. (2013) look at the interaction between levels of interpersonal communication and elaborative processing of information on perceptions of risks related to nanotechnologies. Findings demonstrate that individuals who engage in both high levels of interpersonal communication and high news elaboration, are more likely to perceive the benefits of nanotechnology outweigh the risks (Ho et al., 2013).

The way risk and uncertainty are communicated through both mass media and interpersonal networks is crucial to investigate to better understand the way risk information flows and the way risk perceptions are shaped in the agricultural realm. Issues related to risk and uncertainty abound in the context of water quality and agriculture, and the way media messages and interpersonal influencers portray these concepts may have important impacts on farmer risk perceptions, potentially impacting the diffusion process. Thus, the second study in this dissertation seeks to uncover farmers' perceptions of nutrient in water issues, including the risks related to these, and their perceptions of both mediated and interpersonal information sources regarding water and agriculture. These items are addressed through the following research questions:

RQ3: How do farmers conceptualize Iowa's current water quality, the issue of nutrients in water, and the risks associated with nutrients in water?

RQ3a: How do farmer's beliefs about nutrients, perceptions of risk, uncertainty level, and normative beliefs correspond to their current nutrient reduction practices?

RQ3b: What do farmers believe are the primary barriers to the adoption of nutrient reduction practices among more Iowa farmers?

RQ4: Who do farmers identify as influential individuals and mediated sources for water quality related information and land-management practices?

Influential Individuals and Diffusion

Centered mostly on preventive behaviors rather than risk perceptions, several health communication studies of AIDS/HIV risk reduction focus on the role of interpersonal communication in disseminating risk information among at risk groups. Welch Cline et al. (1992) evaluated the efficacy of the Surgeon General's anti-AIDS campaign to "know your partner." The authors found that intimate interpersonal communication regarding such a "taboo" topic among undergraduate college students was not only rare, but also ineffective at producing appropriate preventive behaviors (i.e. condom use). Kelly et al. (1992) investigated the utility of enlisting popular, "trendsetting" individuals to discuss and encourage AIDS/HIV preventive behaviors among homosexual males. Findings demonstrated that these individuals, who were trained to serve as "behavior change endorsers," were more influential in affecting behavioral changes among the gay community than traditional AIDS prevention programs.

Kelly et al.'s (1992) study highlights that there are certain individuals within interpersonal networks who are particularly influential and hold special persuasive power. The importance of these individuals, deemed opinion leaders in much literature, has been recognized since Lazarfeld, Katz, and others (1948; 1955) early work on the flow of information through social systems. Though interpersonal communication is the key channel of communication used to further diffusion, the influence of these individuals within that process is distinct from others (Keller & Berry, 2003). Given the hotly-contested, dual-sided, emotionally and politically

charged debate surrounding the issue of water quality impacts from agriculture in Iowa, it is important to investigate whether previous theoretically-derived definitions of influentials apply to this context. The remainder of this chapter provides a review of theoretical conceptualizations of influentials individuals within social networks.

According to Greenhalgh et al. (2004), opinion leaders are “some persons have a particular influence on the beliefs and actions of their colleagues” (p. 602). Opinion leaders, who often fall in the “early adopter” category, are a vital mechanism in the diffusion process because other people in the social system look to them for information and advice about new ideas or innovations (Rogers, 2010). Lazarsfeld et al. (1948) identified particular individuals who were most engaged with an issue, paid close attention and discussed it often with others, and considered themselves persuasive in advising on that issue. In this sense, opinion leaders function by connecting information from the mass media to their interpersonal networks as described in the two-step flow model (Greenhalgh et al. 2004; Katz & Lazarsfeld, 1955; Valente & Pumpuang, 2007). This can be similar to the gatekeeping role played by innovators, the venturesome first and smallest adopter category (Rogers, 2010). However, innovators differ from opinion leaders due to their characteristic lack of integration within local social systems, and are the risk-taking individuals who may launch a new idea into a system by “importing the innovation from outside the system’s boundaries” (Rogers, 2010, p.283). It is then, following this initial import into the system, where the respected opinion leaders’ influence begins driving the diffusion of information.

To better understand interpersonal network communication flows, it is important to highlight the differential forces of heterophily and homophily (Rogers, 2010). Homophily describes a fundamental principle of human communication—similarity breeds increased

exchanges of ideas and information among individuals. Homophily is thus the degree of similarity between two individuals who communicate (Rogers, 2010). Heterophily, on the other hand, is the degree of difference between two individuals who communicate. Communication is generally considered to be more effective between homophilous individuals because both the sender and receiver share common meanings and mutual understandings (Greenhalgh et al., 2004). Homophilous communication requires less effort than heterophilous communication and is accordingly more comfortable. However, new information is rarely transmitted into a social network via homophilous communication, rather it is through heterophily that new ideas are introduced (Rogers et al., 2005). In this sense, heterophilous interpersonal links act as bridges in conveying new information, as argued in Granovetter's (1973) "strength-of-weak-ties" principle. Opinion leaders are often the individuals who serve this purpose. Once the ideas are introduced homophily generally takes over prominence, accelerating the in-group diffusion process. One caveat is that without heterophilic connections, homophily can act as a barrier to diffusion. If this occurs, Rogers (2010) suggests that identification of other opinion leaders within the group who have more extended outsider ties is necessary.

Research on opinion leadership suggests differing types of influencers can be identified within communities, though it is helpful to first outline the cross-cutting characteristics scholars deem fundamental to opinion leadership status. Three main dimensions of personal qualities are generally agreed upon as the most central factors (Katz, 1957; Nisbet & Kotcher, 2009; Valente & Pumpuang, 2007). These dimensions are: personal values ("who one is"); competence, expertise, and knowledge ("what one knows"); and their social position, including number of contacts/friends/acquaintances ("whom one knows") (Katz, 1957, p. 10). As a function of the combination of all three dimensions, opinion leaders are not only able to import

new information into their social groups and increase awareness of issues, but they are also able to influence how others should respond or behave (Weimann, 1994). Nisbet and Kotcher (2009) write:

This influence may occur by giving advice and recommendations, by serving as a role model that others can imitate, by persuading or convincing others, or by way of contagion, a process where ideas or behaviors are spread with the initiator and the recipient unaware of any intentional attempt at influence (p. 332).

The explication of the way opinion leaders influence their networks highlights the important role these individuals play in spreading normative information within their social systems and upholding social norms (Dalrymple & Young, 2016). Normative information, or social norms, can be conceptualized as observed or perceived patterns that demonstrate acceptable beliefs, attitudes, and behaviors (Carter, Bingham, Zakrajsek, Shope, & Sayer, 2014). Communication helps formulate an individual's perceptions of norms, but also acts as a "conduit of influence" through communicated support for adhering to norms (Lapinsky & Rimal, 2005, p. 127). Scholarship on normative influence often centers on and distinguishes between several types of norms, including: descriptive norms, referring to perceptions about what is done by most people; injunctive norms, referring to perceptions about what should be done; and subjective norms, referring to perceptions about what important others believe should be done (Azjen, 1991; Cialdini, Reno, & Kallgren, 1990; Finlay, Trafimow, & Moroi, 1999). Nisbet and Kotcher's (2009, above) description of opinion leaders and their influence as role models, demonstrates the way opinion leaders may help transmit information on each of these types of norms (Valente & Davis, 1999).

Identifying and differentiating types of influentials. Identifying opinion leaders has been done in a variety of innovative ways and some literature has outlined numerous recruitment strategies (Coleman, Katz, & Menzel, 1966; Dalrymple et al., 2013; Katz, 1957; Kelly et al., 1992; Kim, 2007; Locock, Dopson, Chambers, & Gabbay, 2001; Lomas, Enkin, Anderson, Hannah, Vayda, & Singer, 1991; Nisbet & Kotcher, 2009; Schenk & Döbler, 2002; Valente & Davis, 1999; Valente & Pumpuang, 2007; Weimann, 1994). While methodological considerations will be discussed more comprehensively in Chapter Five, the most common strategies of opinion leader identification include: self-designation using survey scales; key informant analysis by asking individuals to rate influential; sociometric analysis using visual maps of information giving and seeking; and other observational methods involving in-group observation of communication behaviors (Nisbet & Kotcher, 2009; Rogers, 2010). Considering the specific research context and population being studied is crucial to picking an appropriate recruitment method. For example, Kelly et al.'s (1992) study employed bartenders at popular night clubs within gay communities as key informants to observe and identify the most socially connected patrons; while Dalrymple et al. (2013) utilized bait-shop vendors/owners to explore opinion leadership in the dissemination of information on aquatic invasive species risks. No one method of opinion leader identification is necessarily superior, rather contextual constraints and the study's population are key considerations for all opinion leadership research.

Correspondingly, it is important to recognize that not all opinion leaders are the same. Some opinion leaders may hold this powerful status across the gamut of issues, called polymorphism; whereas others will only be considered opinion leaders on a single topic, called monomorphism (Greenhalgh et al. 2004; Rogers & Cartano, 1962; Rogers, 2010). Such distinctions along with concerns about the inclusive ability of any one method to accurately and

comprehensively identify opinion leaders, has prompted some scholars to offer categorizations of opinion leaders (Greenhalgh et al. 2004; Nisbet & Kotcher, 2009; Valente & Pumpuang, 2007).

While Valente and Pumpuang (2007) do not offer a review of opinion leader types per se, they do outline at least ten techniques for identifying opinion leaders which they assert may yield differing types of influentials. Nisbet and Kotcher (2009) extend this work by additionally offering a comprehensive synthesis of influential typologies based on varying schools of research on opinion leaders and identification strategies. For example, the authors highlight three categories of opinion leaders based on self-identification strategies, including: issue-specific opinion leaders, influence as personality strength, and Roper ASW influentials. Issue-specific opinion leaders align most with Lazarsfeld et al.'s (1948) original conceptualizations relying on intense involvement with a specific topic, heightened knowledge on that topic, and close attention to media on the topic. The influential as personality strength category derives from the work of Weimann, Tustin, Van Vuuren, and Joubert, (2007) who apply the Personality Strength Scale to help identify influencers. Confidence, leadership, persuasiveness, and frequency of giving advice are traits found to be particularly important within this classification. Finally, Roper ASW influentials is based on Keller and Berry's (2003) conceptualization that the more politically and socially active Americans are also considered thought leaders among their peers. Thus, measures within Keller and Berry's (2003) identification scale measure levels of political involvement, participation, and opinion expression. Overall, it is important to note that while self-identification may simplify the categorization process, these categories are also useful to helping understand opinion leadership in studies where these individuals are identified by other means.

Greenhalgh et al. (2004) offer an extensive, evidence-based model for “considering Diffusion of Innovations in health service organizations” (p. 581), rather than a direct outline of opinion leader types. However, in describing their model they synthesize a vast body of diffusion literature and they offer a comprehensive review of types of interpersonal dissemination forces. Several of these forces act as parallel alternatives to the traditional diffusion paradigm definition of opinion leaders. For example, Greenhalgh et al. (2007) emphasize the role of champions. Champions are enthusiastic supporters of the innovation or new idea—a key difference from opinion leaders, as Rogers (2010) emphasizes, who do not necessarily have to support or endorse new ideas. Based on criticism of the pro-innovative bias in much diffusion research, highlighting this distinction is important. Locock et al. (2007) also discuss how champions do not necessarily have the social power opinion leaders intrinsically have. However, Rogers (2010) downplays these key differences when discussing the role of champions in organizational settings, stating that “champions in an organization play a role something like that of an opinion leader in a community” (p. 415). The ambiguity of the champion role mirrors Greenhalgh et al.’s (2004) assertion that despite their utility “there is very little direct empirical evidence on how to identify, and systematically harness the energy of, organizational champions” (p.603)

These alternative but parallel influential forces are important to consider because as Locock et al. (2007) have noted, the co-existence of several key influential powers, especially if in opposition on a new topic, could act to stall important community changes. Champions are also important to highlight given this research context, because the term champion is being used by both environmental and agricultural groups to describe certain farmers who have a history of utilizing cover crops. The use of ‘champion’ farmers must be investigated further considering the potential role these individuals play within the flow of information related to nutrient excesses in

water, and their potential influence on other farmers in both a normative and behavioral change capacity. Correspondingly, innovators, who differ from opinion leaders due to their characteristic lack of integration within local social systems, are considered the least risk-averse individuals in society who launch new ideas into network from the outside (Rogers, 2010). This begs the questions of whether the function of champion farmers is more aligned with diffusion's conceptualizations of innovators, and thus essentially whether champion farmers are less socially influential than agricultural network opinion leaders. Investigating this further is important to due to the ambiguity between conceptualizations of champions and opinion leaders, and it calls into question whether the influencers in modern agricultural communities align with traditional conceptualizations of influencers overall.

Although much is known about the roles and functions of interpersonal communication within the diffusion process, it is unclear how exactly differing forces from important stakeholders in the agricultural community will influence farmers' risk perceptions of an issue as contentious as nutrients in water. These are the issues explored in the third study in this dissertation, conducted through interviews with the individuals named by farmers and in the media as influential in the realm of water and agriculture. The following research questions are posited:

RQ5: How do influential individuals within the agricultural community (i.e. individuals who were identified as influential in Studies One and Two) conceptualize the state's water quality problems and risks related to these problems?

RQ5a: How do influentials' conceptualizations conflict or align with farmers' conceptualizations of water quality and risk (in Chapter Four) and with dominant

themes emerging from the textual analysis (in Chapter Three) related to water quality and risk?

RQ6: How do the influential individuals in Eastern Central Iowa’s agricultural community conceptualize their role as a source of information/influence?

RQ6a: How do the individual’s perceptions of their role compare with their networks’ perceptions of their influential power; and how does this compare to theoretical conceptualizations of influentials?

In summary, this review has emphasized the important role that both mass media and interpersonal communication play in the transmission of information across society, and the relationship between risk representations within mass media and via interpersonal communication, and personal perceptions of risk. Aligning with the pattern of the flow of information described by the two-step flow model and diffusion, Ball-Rokeach (1998) argues that “media agendas set interpersonal network agendas and that both, in combination, set personal agendas” (p. 21). However, the simplicity of this process seems to ignore the potential for personal agendas to deviate from mainstream media representations—or important networks’ agendas—for the effects of directly competing media and/or interpersonal agendas. As Wilkening (1962) argued over half a century ago:

Acceptance of new practices is not necessarily the test of effective communication. The criteria of effective communication is the understanding of the new practice and its consequences in order that intelligent decisions can be made with respect to its adoption or rejection (p. 39).

Considering this point, it is important to question whether the type of communication Iowa farmers have been exposed to regarding the risks of nutrients in water, and nutrient reducing

practices, enables such informed decision making. It is crucial to explore mass media and interpersonal communication in Iowa related to these increasingly contentious water issues. Writing about the origin and evolution of the concept of risk, and its relevance to media scholarship, Mairal (2011) offers an important reflection of the narrative purpose of risk, stating, “we may affirm that risk is an expert concept that nonetheless crossed over into the cultural sphere through narrative, which spread the idea among a progressively wider public” (p. 65). There is a gap in the literature addressing the way that competing risk representations within important media and from important interpersonal communication sources will encourage differing risk perceptions, which in turn may disrupt the diffusion process related to risk-reducing behaviors.

Additionally, in view of the criticisms of diffusion research, including the pro-innovation bias, individual blame bias, and reliance on a top-down approach, (Locock et al., 2001; Padel, 2001; Rogers, 2010; Singhal et al, 2010; Sundstrom, 2015), this research attempts to demonstrate the utility of the diffusion framework to guide a study of the flow of information without an adoption outcome as the primary focus. Correspondingly, such criticisms of diffusion often rest on the lack of actor involvement during the research process. Padel (2001; 2015) points out that engagement with farmers throughout the entirety of an agricultural diffusion research endeavor will help alleviate many of the trust/credibility barriers currently constraining advancement in the diffusion research paradigm. These concerns are addressed methodologically in this dissertation by the conscientious attention given to privileging farmers and their perspectives related to the media and interpersonal information sources they feel are most influential. Finally, as both Padel (2015) and Rogers (2010) suggest, there is a lack of diffusion research focusing on institutional pressures (such as chemical and seed manufacturers, farm commodity groups, etc.) shaping

farmer perceptions and constraining their decisions. This was also given consideration throughout the three studies, and is elucidated in the discussion of the three study's findings together, presented in the final chapter (Chapter Six) of this dissertation.

CHAPTER THREE: UNDERSTANDING THE MEDIATED CONVERSATION ABOUT IOWA'S WATER QUALITY

The mass media are a key source of risk information for the public (McCallum, Hammond, & Covello, 1991; Morton & Duck, 2001; Ho et al., 2013) rendering the lack of literature investigating the way agricultural media portray environmental risks problematic. Considering the important role media play in diffusion of information (Rogers, 2010) and the affinity for agricultural publications among farmer populations (Chiu et al., 2015), there is a need to investigate media produced by and for the agricultural sector. Arbuckle et al. (2015) highlight the need for the climate change research community to engage with the farm press to help combat the “denial machine” tactics used to “manufacture uncertainty” (Dunlap & McCright, 2010) among farmer audiences regarding climate science. This study represents a necessary precursor in the attempt to understand the way the farm press is representing one key environmental issue, the corresponding risk narratives associated with this issue, and who the key information sources are being used as sources within these media products.

Research Questions

Considering the need to empirically document and examine the media messages that may be shaping farmer's risk perceptions and increasing or decreasing their uncertainty, the following research questions are posed:

RQ1: What are the key messages about Iowa's water quality and nutrients in water appearing within highly circulated agricultural and mainstream news media sources in Iowa?

RQ1a: How are risks and uncertainties regarding Iowa's impaired water quality and nutrients in water conveyed through these sources?

RQ2: Who are the individuals appearing consistently as spokespeople and information sources within the water/agriculture nexus in Iowa in each news media source?

RQ2a: How are these individuals portrayed as influential within the water/agricultural realm in each of the sources?

A thematic textual analysis of online news and editorial articles about Iowa's water quality was conducted to answer these research questions. Themes related to key narratives about Iowa's water quality problems and nutrients in Iowa's waterways are identified and assessed qualitatively. Additional quantitative data was collected to document and describe the organizations and key spokespeople used as informational sources within the sample. The remainder of this chapter is organized as follows. First, justification for the use and purpose of thematic textual analysis methodology are offered, and a discussion of the data analysis procedure used in this study is provided. Next, descriptive findings from the data analysis are presented, followed by a discussion of the key thematic findings, including the way risk and uncertainty are represented. Key spokespeople and organizational information sources found in the articles are then presented and discussed. The chapter concludes with a brief final discussion (theoretical and practical implications, and strengths and limitations from each study, are presented in Chapter Six).

Method: Textual Analysis

In order to uncover the various perspectives on Iowa's water issues being promoted to Iowa farmers it is necessary to study the media products farmers consume. Because "the way we use language is rarely innocent," it is important to assess these texts for key themes, words, viewpoints, emphases, and absences (Tonkiss, 1998, p. 247). Conducting a qualitative textual analysis, with the complementary addition of some descriptive quantitative data collection (i.e.

frequency of the sources, spokespeople, and organizations cited most often), is the most appropriate method to ensure manifest, latent and nuanced meanings of the messages within the media of interest are captured. Textual analysis is a type of inductive, qualitative analysis that allows the researcher to go beyond the manifest content, to focus on the underlying cultural assumptions of the text (Fursich, 2007). Given the research context of this study, this type of analysis will allow for the most thorough and accurate investigation of media content. This research explores a highly politicized, publicly controversial issue (agriculture's impact on water quality), that has the potential to illicit emotionally charged responses from audiences (Comito et al., 2011; Osterberg & Kline, 2014). Correspondingly, the media coverage of this issue often contains nuanced messages which may not manifestly display the overall meaning. Thus, it is crucial that the method used to investigate this media content be able to uncover the latent meanings of texts and messages.

Textual analysis “can provide a better understanding of a phenomenon about which little is known” and “is appropriate for investigations of an uncharted area or to gain a fresh perspective on a familiar situation” (Bowen, 2008, p. 138). Because of the importance media has in shaping risk perceptions, and the paucity of empirical work documenting the way that risks and uncertainties related to environmental problems impacted by agriculture are reported within the media, this is crucial to investigate in a way that can encompass the scope of potential media representations. This makes the creation of pre-determined coding categories and precise variable definitions more difficult, and potentially less relevant or comprehensive.

Thematic analysis involves searching for themes that emerge as important to the depiction of the phenomenon being studied (Boyatzis, 1998; Fairclough, 2003). Thus, the texts chosen are thematically analyzed because this method enables the identification of main themes

and perspectives represented in nutrients in water-related news discourses. This process involves the identification of themes through “careful reading and re-reading of the data” (Rice & Ezzy, 1999, p. 258). A theme “captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set” (Braun & Clarke, 2006, p.82). The process of thematic analysis is “a form of pattern recognition within the data, where emerging themes become the categories for analysis” (Fereday & Muir-Cochrane, 2006, p. 82). This type of analysis has the potential to provide a “rich and detailed, yet complex” (Braun & Clarke, 2006, p. 82) account of the data, and thus contribute to better understanding of the studied phenomena.

To summarize, this is the most appropriate and necessary methodology to use for this research because it is the best way to accurately and comprehensively capture the latent meanings and nuanced messages appearing within media coverage of Iowa’s agriculturally induced water problems. This will be the first systematic examination of these three texts, and is the first scholastic attempt to better understand the mediated conversation about water quality in the agricultural realm. Also, as a preliminary stage of the broader dissertation agenda, the exploratory nature of textual analysis renders it the best-suited method, as opposed to beginning with predetermined items to code and rigid criteria for variable definitions. This allows the research questions to be answered by the emergence of important themes, and patterns between these themes, derived directly from the data in the most encompassing way (Fursich, 2007).

Considerations of validity and reliability. Research quality in thematic textual analysis is strengthened through the researcher’s meticulous description of the analysis process (Babbie, 2013; Elo & Kyngas, 2007). The more precise and detailed the reports of this process, the clearer the link between data and results become. Reliability in thematic analysis has also been

described as consistency of judgement (Boyatzis, 1998). Generalizability is not the focus in a study of this type, but instead a deep understanding of the phenomena. Thus, there is a great onus upon the researcher to dependably analyze the data. Elo and Kyngas (2007) argue that to facilitate the highest degree of reliability the researcher must ensure that the context, selection and inclusion criteria, data collection, and process of analysis are described as thoroughly and accurately as possible. Considerations of validity should also be addressed through a high degree of detail in the description and explanation of both procedure and analysis (Denizen & Lincoln, 1998). Finally, member checking, or consulting about data and interpretations of findings with study population members throughout various stages of the analysis (i.e. presenting and discussing findings with key informants) is another important activity to ensure validity (Creswell & Miller, 2000).

Sample

The sample for the analysis includes written articles published between March 1st, 2015 through August 31st, 2016, by the DMR, IFT, and the FBS. The 15-month period represents a time in Iowa where much news discourse centered on Iowa's water quality due to the Des Moines Water Works (DMWW) lawsuit, and helps ensure the sample is representative of the mediated conversation many Iowa farmers were exposed to recently. This timeframe was also chosen because it aligns with the subsequent research (presented in Chapter Four) which asked participant farmers about their media use over the last year. The three newspaper/periodical sources have been identified as highly circulated and utilized by the agricultural community through previous research (Comito et al., 2011; Readex Research, 2015) and personal conversations with Iowa farmers. Thus, although each source represents a different type of publication (i.e. DMR is a newspaper, IFT is an agricultural news source, and FBS is a

corporation publication that often functions as a public relations tool despite calling itself an “agricultural news source” (Iowa Farm Bureau, 2016)), these three sources are each important news and information sources for Iowan farmers. Because of the relevance of each media source to the population of interest in this dissertation (Iowa farmers) these three sources are included despite these differences in publication type.

The three sources also represent a range of political ideologies which may be relevant to the environmental narratives each promotes (Dahlstrom, 2014). The DMR originated as a “voice of pragmatic conservatism” however, the past century has seen its editorial philosophy come to represent a more liberal perspective (Friedricks, 2000, p. 40). The DMR is also the premier print newspaper in the state, with daily statewide readership of 220,600 (Register Media, 2016).

The Iowa FBS on the other hand seemingly represents a conservative perspective. In its ‘Frequently Asked Questions’ section, the Bureau’s website contains a question about whether the Farm Bureau is “a politically conservative organization” (Iowa Farm Bureau FAQ, 2016). Their indirect answer centers on the Bureau’s policy to “represent its members and the issues important to them” rather than counter or directly negate the presumption. The conservative leaning of the organization aligns with previous literature regarding agricultural groups whose anti-liberal predilections are outwardly represented through opposition to climate change legislation (Arbuckle, 2013). According to the Iowa Farm Bureau’s website, the Iowa FBS is “Iowa’s leading agricultural news source and the largest circulation ag newspaper in Iowa” (Iowa Farm Bureau, 2016). While no specific circulation numbers could be found, the print version of the FBS is sent to its 156,000 members (unless they opt out) and is available online to all paying members once logged in. As mentioned previously, it is important to recognize that

this publication likely functions as public relations tool for the Farm Bureau corporation, thus the objectivity of traditional news media may not be present in articles published by this source.

IFT is a three-decade old publication “focused entirely on the issues facing Iowa’s farmers” which originated as an extension from the Cedar Rapids Gazette (IFT, 2016). While no documentation exists regarding political leanings of the news source, it has won numerous agricultural media sector awards and was ranked as the “most credible source of agricultural information” in a preference survey sponsored by the company (Readex Research, 2015). Results from that survey also showed both IFT and the FBS were ranked as top two most useful publications to respondents’ farming operations and the most enjoyed farming publications. IFT is distributed in print to approximately 70,000 farmers each week and is available online for free to anyone (IFT, 2016).

The unit of analysis for this study is each individual article. Only local news stories, editorials, and op-eds are included. Associated Press articles about the water situation in the U.S., other countries, and other states are excluded. The scope of this study is centered on Iowa alone and news related to other places will not help answer the study’s research questions. Other content exclusive to the online versions of these articles, such as blog posts and reader comments, are also excluded from the sample since most farmers still rely primarily on print sources (Chiu et al., 2015). While blogs or comments may provide interesting insight or differing perspectives on the issue of Iowa’s water quality, the goal of this study is to better understand the official communication published by these three sources. Articles published by the media source are also likely to be considered more credible than blog posts or comments by other readers (Arbuckle, 2013).

The Boolean string: “"nutrient" OR "nutrients" AND "water" AND "quality"” was used to search each of the three sites. This is the most appropriate search string and word combination to use because it includes the two key terms associated with the primary issue being explored. Searching only “water quality” produces several thousand results from each of the sites and it includes items completely unrelated to the context. Searching for “nutrients” alone has the same effect. For example, articles concerned with the nutrient density of various Iowa grown vegetables appears when searching “nutrients” alone. Also, the use of these two terms safeguards the neutrality of the search (i.e. as opposed to “*impacted* water quality” or “nutrient *reduction*”), while keeping it broad enough to encompass all perspectives.

The ProQuest database through the University of Iowa Libraries was used for the DMR sample (this was the only one of the three sources for which it was available). Through the ProQuest search tool it was possible to apply a variety of filters to help refine the resulting articles. Preliminary explorations of articles without any filters applied showed a tendency for nutrition and cooking related articles to be captured by the nutrient terms. Thus, the following filters were applied to exclude articles on these non-related topics: proteins, carbohydrates, recipes, nutrition, fruits, diet, dietary minerals, vegetables, vitamins, exercise, physical fitness, age, frozen foods. The search engines used for the IFT and FBS articles were from the respective journals’ websites and did not have advanced search options. Likely due to these sources being agricultural journals, the vast majority of the articles resulting from the Boolean search string alone were relevant. A final review was conducted of all articles and any irrelevant or duplicate articles were excluded before analysis commenced. As with the ProQuest search filters applied to the DMR database, articles were deemed irrelevant only if they did not relate to agriculture, farming, the environment, or water; the few articles which were removed due to relevancy were

each related to cooking. The Boolean search string, date range, eligibility criteria, and exclusion based on final review, yielded a sample of 305 articles total, with 150 articles from the DMR, 87 from the IFT, and 68 from the FBS.

Analysis Procedure

There are several important procedural steps and stages necessary for conducting a high quality thematic textual analysis. The following five stages (briefly discussed below) have been adapted and synthesized from Attride-Sterling (2001), Braun and Clarke (2006), Fereday & Muir-Cochrane, 2006; and Boyatzis, (1998), and describe the steps utilized for this analysis.

1. Getting to know the data. The most important preliminary stage is becoming familiar with the data, which entailed immersing oneself within the texts and completing at least one full, detailed reading of the complete data set.
2. Begin generating codes. The second stage involved creating the initial codes based on detailed re-reading of the texts. This stage (done manually in Microsoft Excel without the use of thematic analysis software) consisted of highlighting or demarcating sections of the texts; and creating and documenting applicable codes for key messages, words, phrases, and topics. Risk messages are conceptualized broadly based on literature outlined in Chapter Two (including Covello & Sandman, 2001; Slovic, 2001; and Witte, 1992), though the conceptualization for this study was purposefully encompassing due to the exploratory nature of this research. Thus, sentiments expressing appraisals of nutrients in water as potentially hazardous or threatening in anyway were of chief interest. It was important at this stage to code for as many things as possible which were applicable to answering each research question. Once this was complete, all data representing the same codes were collated together.

3. Searching for themes. At this stage the list of codes was reviewed and sorted to organize into more broad, encompassing categories of themes.
4. Reviewing themes. This stage had two steps: first, reviewing all of the data extracted for the codes and making sure they fit within the theme categories assigned; second, reviewing themes in relation to each other and to the entire dataset to assess how well the themes and relationships between themes conveyed the dataset as a whole.
5. Continuing to define, refine, and name themes. This step was about “capturing the essence” of what each theme was about and how it represented those aspects of the data. It involved analyzing each theme for its individual narratives and key messages (and in this case—the two competing messages present within each major theme) and determining how it fit into the overall narrative. This stage was also when the findings section of this chapter was outlined and drafted. Sub-themes were refined to adequately address the risk and uncertainty related research questions. This stage included additional validity checks through member checking. Member checking consists of taking data interpretations back to credible resources regarding the study context and farmer key informants (Creswell & Miller, 2000). Key informants included three employees of the Natural Resource Conservation Service in Johnson County, one farmer from Johnson County, one farmer from Washington County, and one academic specializing in water quality. These meeting took place from late mid-August through mid-November 2016.

Finalizing the written report was the last stage of this study. Attention to detail was crucial in the production of an accurate and complete account of this data collection process, analysis procedure, and presentation of findings. The keen attention to detail and the comprehensive analysis process undertaken for this study should ensure the results yielded are

both reliable and valid (Babbie, 2013; Boyatzis, 1998; Creswell & Miller, 2000; Denizen & Lincoln, 1998; Elo & Kyngas, 2007).

Findings

Iowa's water issues related to excess nutrients and the risks related to nutrients in water, reflected two distinct, and at times, directly contradictory perspectives. For the remainder of the dissertation the two dominant perspectives are categorized broadly as 'pro-agricultural' and 'pro-environmental.' Overall, there was a trend for pro-agricultural articles to be published in the agricultural news sources (IFT and FBS) and the pro-environmental articles to be published by the mainstream news media source (DMR). However, the discrepant representations were not always based on the particular media source publishing the article, rather the representations seemed most aligned with the particular authors' environmental, agricultural, and political ideologies. For example, the DMR register published several op-eds written by agricultural industry supporters (mostly state legislatures), while IFT published several op-eds written by environmental health researchers.

In general, the pro-agriculture articles portrayed Iowa's water issues with positive messages, often touting the progress farmers have made in reducing nutrient loads in Iowa's water, or understating the notion of nutrient excesses being problematic. The pro-agriculture articles covered the Des Moines Water Works (DMWW) litigation and any potential governmental regulatory action regarding nutrient reduction with threat-heavy, pessimistic messages and a deeply negative tone. The articles reflecting a pro-environment perspective emphasized the agriculturally based causes of Iowa's nutrient excesses, the need for regulation to help resolve the problem, and the environmental and human health threats from nutrient excess in water. There were prominent differences among the individuals interviewed and cited as

information sources within the DMR and the two agricultural media sources. Key sources within the agricultural media tended to be leaders or owners of agri-business entities and individuals associated with ISU; whereas the DMR articles cited a larger variety of spokespeople across various governmental, academic, advocacy, and other sectors.

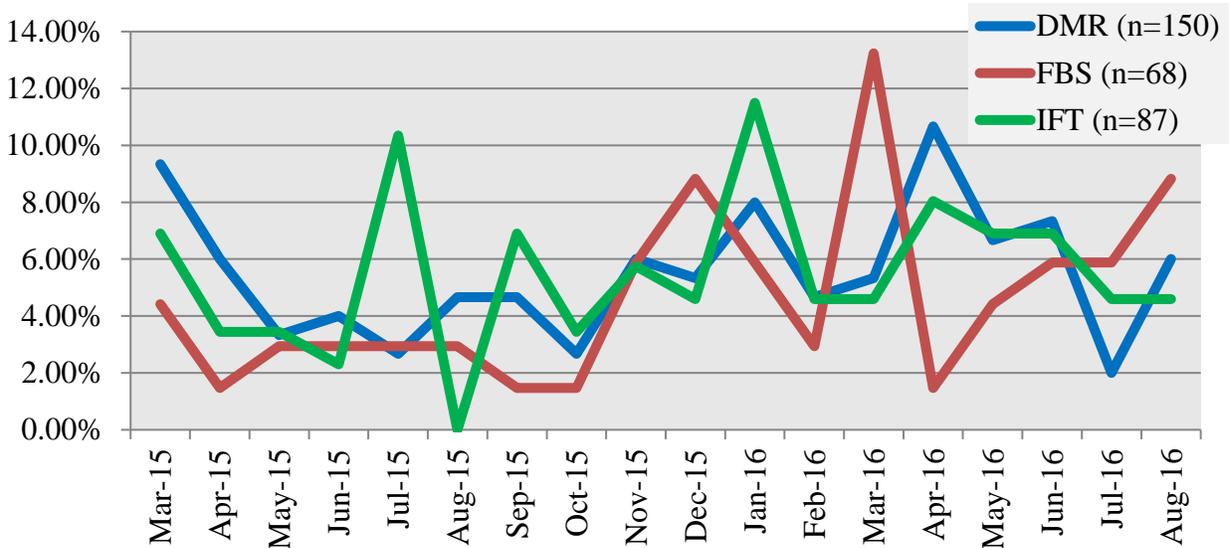
The remainder of this chapter is organized as follows: first, descriptive findings related to the sample are presented; next, key themes present within both the pro-agricultural and pro-environmental perspectives are outlined and the directly competing messages within each theme are highlighted through examples from the texts; next, examples of risk and uncertainty messaging are discussed and analyzed; and finally, the key information sources (individuals and organizations) cited within the media sources are discussed.

Descriptive Findings

There were several descriptive findings from the sample which help provide a foundation for understanding the way water issues are covered by Iowa media. For example, coverage of water issues in all three sources seemed to follow a similar seasonal pattern. The number of articles covering water quality peaked slightly in the spring and decreased slightly in the fall (see Figure 1 for the distribution of articles from each source per month). This may be due to increased rainfall and flooding during the spring in Iowa. This aligns with other studies of water issue news coverage which have found similar increases in media attention during times of heavy weather events (Altaweel & Bone, 2012; Wei et al., 2015; Xiong et al., 2016). The potentially negative repercussions for Iowa's water quality from nutrient runoff during heavy rainfall render the topic timely for spring news reports. Correspondingly, early and mid-fall are harvest times for Iowa's agricultural producers, potentially resulting in decreased readership at this time due to the heavy workload of harvesting corn and soybeans. The spike in articles in January 2016 is

likely due to the beginning of the new legislative session, where the issue of water quality funding was a key issue for legislatures. This parallels findings from previous scholarship showing increased news reporting on climate change during relevant political events (Weathers & Kendall, 2015).

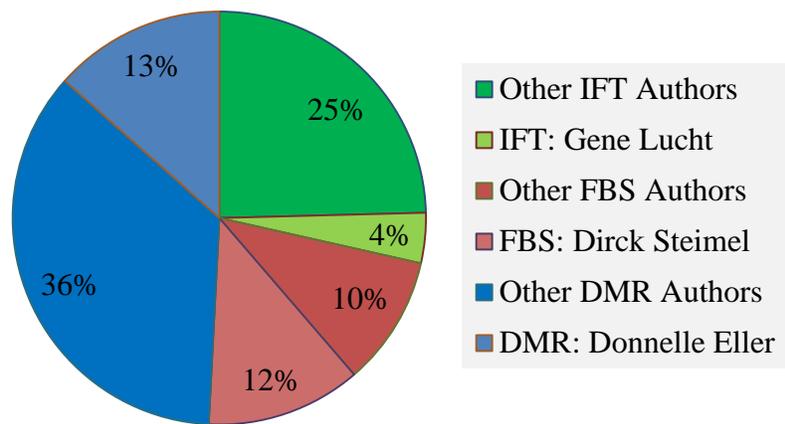
Figure 1. Proportion of Articles per Month



Another similarity among the three media sources was an ambiguity between op-ed articles and news reports. The articles obtained from the ProQuest database for the DMR sample were all classified as “News,” however, as the articles were reviewed it became apparent that many were op-eds. Non-anonymous op-ed articles often ended with the authors’ name and a brief introduction, such as “DAVID OSTERBERG, a former state representative from Mount Vernon, is co-founder of the nonpartisan Iowa Policy Project in Iowa City and is a professor of the Department of Occupational and Environmental Health at the University of Iowa. Contact: dosterberg@iowapolicyproject.org” (Osterberg, DMR, Stop winking at the problem of water quality, 28 May 2016). Correspondingly, there were several writers for each media source who authored a discrepantly high proportion of the articles included in the final sample. This is

important to note because it means that many of the themes, messages, and other findings may reflect the perspectives of these select prolific individuals. Figure 2 (below) shows the distribution of articles authored by the most prolific writer per source, compared with the distribution of articles written by other authors for each source.

Figure 2. Articles Authored by Most Prolific Writers per Source



Key Themes and Competing Narratives

As Neil Hamilton, director of the Agricultural Law Center at Drake University points out in a DMR op-ed, “The public's challenge in understanding any unfolding story is sorting through the narratives created by those trying to shape public opinion” (Hamilton, DMR, “Iowa's clean water debate: What to believe?” 26 May 2015). This notion is at the heart of the findings from this analysis. RQ1 (*What are the key messages about Iowa’s water quality and nutrients in water appearing within popular agricultural and mainstream news media sources?*) also directly addresses this. The thematic analysis conducted to answer this question yielded the discovery of five primary themes present across all three media sources. See Table 2 for themes and the differing narratives associated with each theme based on pro-agriculture or pro-environment perspective.

Table 2. Key Themes and Competing Narratives

Key Themes	Contradictory Narratives between Pro-Agricultural (shown first) and Pro-Environmental Perspectives
1. Origin of Excess Nutrients	Mother nature, naturally occurring, God, or weather VS. Current conventional agricultural practices
2. Des Moines Water Works (DMWW) Lawsuit	Lawsuit is a waste of time, money, resources; ineffective approach to making change; vilifies farmers and contributing to Rural/Urban divide VS. Lawsuit is the most important step towards real change; was key to bringing Iowa's poor water quality to the forefront of the political and public agenda
3. Division and Responsibility	Everyone pollutes, it comes from cities too, so all the state's taxpayers and government should pay for water quality improvement efforts; the "city slickers" are blaming farmers VS. The agricultural industry and producers who are the polluters, should be responsible for paying to clean up the state's water; the urban environmentalists.
4. Progress of Adoption	Much progress has been made, most farmers are using water-quality related conservation practices on their fields VS. Not nearly enough progress has been made, the scale of farmers using these practices will do very little to improve water quality
5. Voluntary Nature of Iowa Nutrient Reduction Strategy (INRS)	INRS is working and needs to remain voluntary VS. INRS is not enough and needs to impose regulations

These themes document the five key messages being conveyed via the three investigated media sources to farmers and the public about Iowa's water quality. The analysis procedure revealed that within each primary theme, two contradictory narratives were being promoted by the two opposing perspectives. Each of the themes, along with the key message from both perspectives, will be described in detail below.

Origin of excess nutrients. Despite there being little question among the scientific community regarding the source of nutrient excess in Iowa's water (EPA; 2017; Jones et al., 2017; Licht et al., 2016; Morefield et al., 2016; Osterberg & Kline; 2014), this was a key issue

and point of contention addressed within many articles. Numerous articles appearing in the two agricultural sources and those written by individuals with agricultural ties in the DMR presented the issue of nutrient excesses as natural, dependent primarily on weather, as a consequence of “Mother Nature,” or “God’s will.” For example, writing about the issue in a DMR op-ed, Senator Charles Grassley writes:

Nitrogen is found naturally in soil, in fertilizer and municipal wastewater. The data shows that there hasn't been an increase in nitrates in our water year on year. Rather there are big spikes some years after massive rains. It's not as simple as claiming farmers are using too much fertilizer. (Grassley, DMR, Grassley: Regulating ag runoff is impractical, 13 December 2015).

In an anonymous DMR op-ed published a week prior to Senator Grassley’s op-ed, several quotes from a recent speech by Grassley described his perspective differently, suggesting that it is God who is responsible for any nutrient excesses. The op-ed states:

Unfortunately, Grassley also thinks that because God gives us rain, God is to blame for our polluted waterways, and we dare not mess with His divine plan. "It's not the fault of the farmer," the senator says. "God determines if it's going to rain 10 inches ... Do people think government can do anything when it's going to rain 10 inches?" (N. a., DMR, Don't blame God for water woes, 06 December 2015).

Interestingly, “science” was consistently cited to support the pro-agriculture messages regarding the origin of nutrient excesses in water. For example, one FBS article states: “Myths often told and retold in the ongoing discussions over water quality issues in Iowa typically do not hold up to the scrutiny of science” (Steimel, FBS, Myths about Iowa water quality issues need to be busted, 7 December 2015). The article goes on, citing Iowa State University (ISU) soil scientist

Dr. Michael Castellano, who states: “there is a myth that nitrate problems in Iowa waterways are primarily caused by farmers’ mismanagement of fertilizer.” While the notion that “discussions over water quality” are filled with myths and not supported by science are misleading at the very least, so too are the direct quotes used from ISU’s Castellano. The FBS article (above) continues with the following quoted statements by Castellano: "Natural loss of nitrate is really the main thing that is causing us to lose nutrients into our waterways," and "fertilizer applications really have very little to do with it." The verity of the first statement relies on a curious definition of “natural,” because the primary reason nutrients runoff fields during heavy rainfall is due to current industrialized row crop land use (Schilling et al., 2010). Prior to the shift in agricultural commodity trends over the last half century, “natural loss of nitrate” was not a problem (Schilling et al., 2008; 2010; Schnoor, 2010; WHO, 2015). The second statement regarding fertilizer application is only true in the sense that fertilizer application does not directly result in losing nutrients to water, though over application of fertilizer and poor timing of fertilizer is a primary contributor to excess nutrients in water (IDNR; 2017; Osterberg & Kline, 2014; Schnoor, 2010; Ward, 2008). The presentation of misleading information and semi-factual reporting, in combination with certain scientists promoting such sentiments, may confuse readers or calls into question reports detailing the situation in distinctly opposite ways. For example, a DMR staff writer reports on a recent study conducted by a University of Iowa researcher to gauge the causes of nutrient pollution in the Raccoon River (the river at the center of the DMWW lawsuit), stating:

A state study on the origins of pollutants in the Raccoon River near Des Moines showed that turf grass and pasture accounted for only 1 to 1.5 percent of the maximum daily load of nitrogen, while about 85 percent came from agricultural sources, said Chris Jones,

hydroscience researcher with the Iowa Geological Survey (Kilen, DMR, Striving for the perfect lawn could be hurting Iowa, 16 July 2016).

The contradictory messages regarding the origins of nutrient excesses provide a foundation for the subsequent themes uncovered in this analysis.

Des Moines Water Works lawsuit. As indicated by the study results related to the Raccoon River, the DMWW lawsuit was a widely referenced topic within the sample of articles. Correspondingly, Bill Stowe, CEO of DMWW, was one of the most prominently featured individuals named within the articles. Stowe addressed his critics directly in a DMR op-ed in January 2016—one year after filing an unprecedented lawsuit against three drainage districts north of Des Moines. The following selection from that article offers a glimpse into the two competing perspectives represented regarding the lawsuit in the articles; i.e. support for the litigation and its potential to affect positive environmental change versus opposition to the legal action as an attack on agricultural producers.

The year 2015 marked a turning point in water quality throughout Iowa. This turning point wasn't defined by Des Moines Water Works' decision to sue drainage districts in three upstream counties for their discharge of agricultural pollutants into the waters of our state. Rather, it was defined by significant failures in environmental protection that continue to lead to public health risks for Iowans as well as other Mississippi River watershed communities downstream from Iowa (Stowe, DMR, When water quality reached turning point, 10 Jan 2016).

A recent poll cited by and conducted for the DMR (in conjunction with Mediacom) showed a majority of Iowan's support the DMWW lawsuit, "Sixty percent of Iowans support the utility's lawsuit as the right approach, similar to the 63 percent approval in an Iowa Poll a year ago"

(Eller, DMR, Most Iowans back water suit, split on footing the bill, 28 February 2016).

Defenders of the lawsuit argue that it brought critically needed attention to Iowa's poor water quality and has raised awareness of the issue in both the political and public spheres. Former state senator and democratic candidate for governor, Jack Hatch, expressed this argument in a DMR op-ed, writing: "the lawsuit is a gutsy move that represents an important breakthrough in one way: Iowans are sitting up and paying attention to the debate over dirty water. When the DMWW Board said they were mad as hell and not going to take it anymore, Iowans tuned in" (Hatch, DMR, State leaders must show courage on water, 29 December 2015).

Perhaps most striking within the narratives regarding the DMWW lawsuit was the notion that the agricultural industry embarked on a concerted propaganda campaign to sway public perception against the lawsuit and the company's CEO. Senator Hatch explains:

It's another in a long, ugly chain of rural-vs.-urban fights. Gov. Terry Branstad, Agriculture Secretary Bill Northey and the urban friends they've employed as messengers, such as Des Moines Council Member Christine Hensley, are salivating at the chance to trick rural Iowans into believing Des Moines has it in for them again (Hatch, DMR, State leaders must show courage on water, 29 December 2015).

Drake University Professor, Dr. Neil Hamilton, also addresses this and summarizes the main arguments against the lawsuit in his May 2015 op-ed:

Clearly a strenuous effort is underway to sell Iowans on the idea the lawsuit is unfair and unhelpful. There are at least five pillars to this narrative: Farmers are doing everything possible to reduce excess nitrates leaving the land and entering public waters; Clean water is a new issue for agriculture, as evidenced by the Nutrient Reduction Strategy only being crafted in 2013; The lawsuit means progress in addressing water quality will stop;

The lawsuit threatens every farmer in Iowa; and Water quality is getting better; we just need time for voluntary efforts to work. (Hamilton, DMR, Iowa's clean water debate: What to believe? 26 May 2015).

Professor Hamilton goes on to state: “The narrative is appealing. Unfortunately, all five pillars are to some degree untrue.” Yet, these arguments against the lawsuit appeared consistently within all three sources. This disparaging suggestion regarding the propagandizing effort from the agricultural industry is strengthened further by the numerous and notable individuals who wrote their own op-eds exemplifying Hamilton’s arguments. For example, Secretary of Agriculture Bill Northey wrote one such op-ed, stating:

Farmers, landowners, state and federal agencies, agriculture organizations, Secretary Tom Vilsack, Gov. Terry Branstad, Iowa legislative leaders, agribusinesses, farmer cooperatives, Iowa Soil and Water Conservation Districts, cities, counties, Iowa colleges and universities, environmental groups and many others are all working together to address water quality. Unfortunately, the outlier is the Des Moines Water Works, which has attempted to stand in the way of these collaborative efforts. (Northey, DMR, Water quality progress requires cooperation, 20 December 2015).

Similarly harsh, yet intriguingly bizarre, is the article analogizing the DMWW lawsuit to a person giving up on their own two year old daughter. The article asserts that the DMWW’s choice to sue the drainage districts north of Des Moines, only gave the INRS two years to succeed in making significant improvements to Iowa’s agriculturally induced water quality problems—analogous, the author asserts, with the lackluster accomplishments of a two year old child. Author Zach Bader, the Online Community Manager at Iowa Farm Bureau, writes:

Identifying letters and colors isn't going to get her into college (much less a full-ride scholarship), kisses for the baby aren't going to win points in job interviews, and no one's going to hire an aerospace engineer who can't consistently make it to the potty on time. Instead, I'm in favor of the mentality Des Moines Water Works is taking toward another two-year-old, Iowa's Nutrient Reduction Strategy. (Bader, IFB, "Like Des Moines Water Works, I'm prematurely giving up on my two year old," 27 August 2016)

Governor Branstad is another prolific and powerful opponent of the lawsuit, and was cited in numerous articles opposing it. However, some of his statements do seem to lend unintentional credence to the pro-environmental argument that the lawsuit has helped spur progress in water quality improvement. For example, in January 2016 he is quoted, stating:

"Unfortunately the issue of protecting our state's water quality risks tearing apart the fabric of Iowa, pitting Des Moines against rural Iowa," Branstad told lawmakers in his address to the Legislature. "Simply put, we must significantly accelerate our water quality efforts to avoid eroding our path to prosperity" (Petroski, DMR, Statehouse tepid on water plan, 19 January 2016).

Division and responsibility. Governor Branstad's above statements help underscore another key message appearing within Iowa's water quality media coverage. There were many blatant statements made by each media source regarding the division between rural Iowans (i.e. farmers) and the state's urban dwellers (referred to as "city slickers" in several articles). This divide seems to stem largely from the question of fiduciary responsibility for water quality improvement. This is explicated in one DRM report, stating, "Farmers say they already are funding conservation efforts, but environmentalists argue that the agriculture industry has

shirked financial responsibility for a problem it helped create.” (Pfannenstiel, DMR, Keeping tabs on water upgrades, 17 June 2016).

Sometimes the division between urban and rural Iowans was emphasized through an effort to portray Iowa’s water quality problems as a result of actions from all Iowans equally. For example, Representative Todd Prichard was quoted in the FBS saying, "The solution to dealing with water quality in Iowa is a collaborative effort. Everybody pollutes, everybody is a part of the problem and needs to be a part of the solution. We all depend on water" (Baratta, FBS, Water quality academy showcases farmers’ conservation efforts, 18 July 2016).

Another division apparent through this analysis focused on two specific Iowa cities—Cedar Rapids and Des Moines. Many of the pro-agriculture articles highlighted the city of Cedar Rapids as a positive example of municipal collaboration with the farming community to find solutions to water problems—rather than sue them, as it was inferred Des Moines did. Often this particular narrative was expounded by the description of Cedar Rapids’ water quality improvement efforts, which have included initiating several watershed management programs. These efforts were not only lauded but also attributed to helping mend the urban/rural divide that Des Moines, through the DMWW lawsuit, was exacerbating. For instance, a farmer is quoted in the a FBS article, stating:

“I farm upstream from Cedar Rapids. To hear them come out with a program working with farmers really is a stark contrast to Des Moines Water Works," he said. "As a farmer, I appreciate it. Where one is looking for winners and losers, farmers are always looking for solutions. We’re problem solvers. Give us a chance" (Block, FBS, Farm and city partnerships can solve water quality challenges, 29 February 2016).

Agricultural progress. A central theme among all three media sources was related to the progress being made by the agricultural community in resolving water quality problems. Shawn Richmond, Director of Environmental Technology for the Iowa Nutrient Research and Education Council (INREC), was quoted in a DMR article, stating:

“(Farmers are) eager to better quantify and better educate the public, in particular, about the progress they have made while owning there is progress yet to be made,” Richmond said. “They all recognize that. But some of the (public) discussion seems to have been in the vein of, ‘When is agriculture going to start doing something?’ And we say that’s a falsehood. There has been a lot of great work done.” (Pfannenstiel, DMR, Keeping tabs on water upgrades, 17 June 2016)

Many articles in the FBS and IFT address the progress made by farmers even more deliberately, citing farmers’ financial investments and adoption rates of nutrient reducing practices. For example, one FBS article states, “Iowa farmers have substantially changed their tillage and other farming practices in the past decade to conserve topsoil, reduce nutrient losses and improve water quality, according to a recent Iowa Farm and Rural Life Poll. Farmers have invested as much as \$2.2 billion in the last 10 years to make those conservation improvements” (Steimel, FBS, Study shows farmers’ efforts can improve water quality, 27 June 2016).

However, the DMR published several articles calling this notion of progress into question. For example, one article, titled “Millions are spent for a drop in the bucket” reports on an Environmental Working Group study of eight high-priority watersheds in Iowa. The study found very little increase in the adoption of several key nutrient reduction practices. The article also states that the study indicates “taxpayers are getting minimal additional environmental benefits despite millions of dollars spent” (Eller, DMR, Millions are spent for a drop in the

bucket, 7 February 2016). Craig Cox, Environmental Working Group's Senior Vice President for Agriculture and Natural Resources is also quoted in the article, stating "It was disappointing to see the extent of conservation practices that disappeared from the landscape. I think it explains a lot about why we don't see much progress in cleaning up water."

Especially prevalent within the pro-agriculture articles was discussion concerning adoption of one nutrient management strategy in particular—cover crops. Examining the article headlines alone demonstrate this trend, for example, “Cover crop growth prior to planting provides benefits” (Mueller & Castellano, IFT, 13 March 2016), “What to expect from forage cover crops” (Redfearn, Volesky, & Anderson, IFT, 19 January 2016), and “Cover crops gaining momentum with farmers” (Kort, FBS, 28 March 2016). This preeminence of discussion related to cover crops demonstrates a tendency for cover crops to be used as a proxy for evidence of progress implementing the INRS recommended practices. Senator Grassley states in an op-ed “Iowa's Nutrient Reduction Strategy is just a couple years old and, contrary to the Register's assertions, farmers are responding. For instance, there was a 250 percent increase in planting of cover crops in 2014” (Grassley, DMR, Grassley: Regulating ag runoff is impractical, 13 December 2015). However, as was emphasized in one IFT article, a more realistic perspective on adoption of cover crops among Iowa farmers is that while some progress has been made, much more is needed to affect nutrient reduction in Iowa waters. Sean McMahon, Director of Iowa Agriculture Water Alliance, states ““Last year, roughly 500,000 acres were planted to cover crops. Five years ago, that amount was 10,000 acres. That is still only 2 percent of row crop acres in Iowa. We need to get that closer to 17 million acres”” (DeYoung, IFT, Producers hear water quality concerns, 05 February 2016).

Voluntary nature of INRS. The INRS, a document created by Iowa legislature's in 2013 as a response to impending federal action against the state for its water pollution problems (Osterberg & Kline, 2014), is criticized by many for its voluntary nature. In a DMR op-ed, an anonymous writer highlights this perspective, explaining:

Voluntary compliance with clean-water standards and warm words of encouragement are not working. If they were, there would be no lawsuit and there would be no debate over who should pay for cleaning up our water to make it safe for drinking. As long as the Nutrient Reduction Strategy remains voluntary, it will be nothing more than a pipe dream -- a litany of actions that could, maybe, possibly, be taken, or could much more easily be ignored. Turning that strategy into reality will require a substantial public investment in conservation programs, and that's something our elected leaders can, and should, provide. (N. a., DMR, Don't blame God for water woes, 06 December 2015).

On the other hand, many messages representing the pro-agriculture perspective view the voluntary nature of the document as critical to its success (even if this success has not happened yet). Several key agricultural industry supporters focus on Iowa farmer values an argument for keeping the INRS voluntary. Emphasizing this perspective, Senator Joni Ernst, who grew up herself on an Iowa farm, was quoted, stating: "Because we understand the value of protecting our air, our land and our water, we can do it voluntarily, without big government mandates" Eller, DMR, Grassley: Regulations can't control what God determines, 24 November 2015).

Another argument for keeping the strategy voluntary concerns the nuanced nature of many of the recommended nutrient reducing practices. For example, in one FBS article, cover crops are being promoted throughout the article, yet the article concludes with the warning: "Cover crops don't work on every farm in Iowa, agronomists caution. That's especially true in

the state's northern counties, where it's tough to get cover crop seed planted and germinated before a hard freeze" (Steimel, FBS, Cover crop season, 26 August 2016). Other examples of messages from the pro-agriculture side center on concerns related to duration of time needed for practices to yield improvements, suggesting regulations will not appropriately account for this. Plymouth County Supervisor, Don Kass, writes in a DMR op-ed:

This two-year old strategy is based in science, and points farmers toward an array of best practices, since what is right for production on soils in northeast Iowa is much different than what is needed in southwest Iowa. Though we would all like for problems to be solved overnight, the Nutrient Reduction Strategy must be allowed time to work. (Kass, DMR, Stowe needs to get his story straight, 17 January 2016).

Risk and Uncertainty Messages

Considering mass media are a key source of risk information for the public (Coleman, 1993; Covello & Sandman, 2001; McCallum et al., 1991; Nisbet, 2009), and excess nutrients in water pose a threat to public and environmental health, it was important to investigate how risk and uncertainty were conveyed in media coverage of Iowa's water quality (*RQ1a*: How are risks and uncertainties regarding Iowa's impaired water quality and nutrients in water conveyed through popular mainstream and agricultural media sources?). Risk messages, sentiments expressly focused on nutrients in water as potentially hazardous or threat-based appraisals of the issue (McMahan et al., 1998; Sandman, 2012), which centered on negative outcomes to the environmental and human health in Iowa were intermittent throughout the full sample of articles and were rare within the pro-agriculture perspective articles. Among the full sample of articles, certainty regarding the current state of Iowa's water quality and levels of nutrients in water was conveyed as generally high—though the specific appraisals differed. Regardless of perspective,

i.e. Iowa's water quality is improving and nutrients are naturally occurring, or Iowa's water is extremely polluted from agriculturally promoted nutrient excesses, uncertainty about the situation was rarely expressed. However, high uncertainty was conveyed within pro-agriculture articles regarding the future of regulations for individual farmers and the agricultural industry; while in pro-environmental articles high uncertainty was expressed related to funding water quality improvement efforts.

Risks in the pro-agriculture media. Both risk and uncertainty were present primarily in relation to the threat of governmental sanctions and/or regulatory repercussions of impaired water quality and nutrient excesses in water. Risks related to public health or environmental health were nearly absent among the articles published in the two agricultural media sources. The exceptions were in two IFT articles published as op-eds and authored by non-farmer environmental activists—both of whom are also professors in the Occupational and Environmental Health department at the University of Iowa's College of Public Health (Osterberg, Fetty, & Wong, IFT, Change manure application rules, 04 June 2016; Rossman, IFT, Farmers can protect pond fish from runoff with careful conservation, 25 September 2015).

Risks related to threats of government intervention and future farm regulations often related to potential future ramifications from 1) doing nothing to improve the current state of Iowa's water quality, 2) the DMWW lawsuit (for example, see Branstad's comments above from 'Petroski, DMR, Statehouse tepid on water plan, 19 January 2016'), and 3) the federal Waters of the United States (WOTUS) rule. In June 2014, the EPA and US Army Corps of Engineers proposed WOTUS to clarify which waterways (including streams and wetlands, etc.) are considered protected under the Clean Water Act. Many people across the U.S., especially those in the agricultural and manufacturing sectors, worried about future permitting requirements near

waterways smaller than those originally deemed a ‘waterway of the United States’ under the Clean Water Act (only to “navigable waters” were covered). Governor Brandstad described his perspective on the WOTUS rule in a IFT article, stating:

“The WOTUS rule is a federal overreach that imposes significant barriers and impairs Iowa’s ability to advance innovative, water quality practices that would actually advance our common goal of water quality. I ran for governor in 2010 to return predictability and stability to Iowa and this federal rule increases, rather than decreases uncertainty for Iowa farmers and small businesses” (N.a., IFT, Branstad joins WOTUS legal challenge, 25 November 2015).

His quote directly hits at the heart of this type of risk representation in the pro-agricultural articles—the fear of governmental regulation and control. Governor Branstad’s comments also explicitly highlight the uncertainty of this risk, in that the threat of sanctions alone is worrying and likely to produce a negative outcome for farmers.

There is also a more latent concern depicted by some Iowa legislatures and farmer quoted in the pro-agriculture articles regarding the notion of losing personal control. This is emphasized through a prominent ‘fear of regulation’ theme, which highlights a connection between political ideology and the water sector. For example, an IFT article states “Branstad said the federal government’s rule seems to be more concerned with Federal control over local water bodies than actually improving water quality” (N.a., IFT, Branstad joins WOTUS legal challenge, 25 November 2015). This reflects a conservative, republican perspective of ‘the dangerous nature of big government.’ As previous research indicates, farmers are generally considered to be politically conservative (Church et al., 2016), thus the prominence of these risk themes may be

symptomatic of the agricultural media capitalizing on mainstream conservative ideological narratives to appease readers.

Risk in the pro-environment media. The risks of excess nutrients in water presented and conveyed through many of the DMR news reports, and the op-eds in both IFT and the DMR, were centered on implications to environmental and human health in Iowa. These risks were also uniformly presented with little to no uncertainty, as already occurring, and in an ominous tone. For example, an anonymous op-ed in the DMR states:

Residents go boating in manure-scented rivers, swim in noxious lakes and picnic alongside fish kills. This state has received national recognition for being a major contributor to the "dead zone" in the Gulf of Mexico. Government officials will not stand up to polluters, enforce existing laws on conservation or fund efforts to clean up the mess. The number of lakes, rivers and streams impaired due to pollution has climbed 15 percent in two years. Our drinking water is regularly at risk (Anonymous DMR, Clean water is best gift for Iowa, 20 December 2015).

Another article, written by a DMR reporter, presents the risk to human health by citing the EPA nitrate standards allowed for drinking water: "The Environmental Protection Agency says that more than 10 milligrams per liter of nitrates in drinking water risks human health" (Kilen, DMR, A tug of war between farming, environment, 20 June 2016). In the same article Kilen goes on to outline the potential ramifications of exceeding 10 milligrams per liter, "a level that, without treatment, can be deadly to infants 6 months and younger, the EPA says. Symptoms include shortness of breath and blue-tinted skin, a condition known as blue baby syndrome." Another DMR article compares Iowa's water quality situation to that of Flint, MI, and addresses the human health risks more blatantly: "The Water Works lawsuit is over fertilizers and other

pollutants that have contaminated Des Moines' water through high nitrate concentrations, which are linked to cancer, miscarriage and even infant deaths” (Basu, DMR, Flint's water woes -- and Des Moines’, 13 January 2016).

The discrepancy in reporting on the risks related to water quality in Iowa between the pro-agricultural and pro-environmental media is concerning. Questions related to news media coverage and portrayal of risks often raise concerns about whether the media is responsible for making people more fearful than necessary (Dahlstrom et al., 2012; Greenberg et al., 1989; Witte, 1992). However, as Ropeik (2012) and others point out, it is often the case that “media reporting leaves us less scared than the evidence warrants” (Ashe, 2013, p. 28). Sandman (1987; 2012) argues that risk is the sum of hazard and outrage, and that effective risk communicators will work to decrease the public’s perception of outrage to manage public risk perceptions most effectively. Alternatively, he suggests that entities like advocacy groups, whose causes would benefit from increased public outrage, should focus their communication on highlighting outrage factors (i.e. dread, mortality, control). Consequently, it seems likely that the individuals who read the pro-environmental accounts of the nutrient issues will have a higher level of fear of nutrient excesses and subsequent outrage. However, the lack of risk portrayals related to human and environmental health effects in the pro-agricultural media may indicate an effort to decrease public and farmer outrage. Considering that the readers of pro-agricultural media are also the individuals who have the most power to improve the water quality situation through their own actions, this lack of risk portrayal is potentially problematic for the health and safety of Iowans.

However, considering the relationship between threat messaging and efficacy messaging based on the EPPM (Witte, 1992), efficacy messaging help spur the most effective cognitive processing among readers of articles with high threat messages. Yet, rather than the pro-

environmental articles which promoted the threats of nutrients in water rather than threats to regulation, it was the pro-agricultural sources which often provided more efficacy related information. Pro-environmental articles tended to provide less personal-level solutions and focused on the need for Iowa's legislature to act. Whereas, the pro-agriculture articles did discuss nutrient reducing practices as a way to help decrease the threat of government regulation. These findings mirror previous research which has noted "that agricultural trade publication editors tend to attenuate risk by reporting on actions farmers can take to mitigate impacts to a particular risk" (Abrams & Meyers; Church et al., 2016, p. 13). Research with audiences of pro-agriculture media is needed to determine whether the lack of environmental and health risk representation is reflected in risk perceptions of excess nutrients in water, and will be addressed subsequently in Chapter Four.

Uncertainty and journalistic norms. Overall, the presence of uncertainty was rare within each individual article. Among pro-agricultural media, uncertainty was addressed through the threat of regulation and related unpredictability of future government sanctions, which may impact the economics of farming. In pro-environmental media, the uncertainty centered upon funding water quality improvement. It is also likely that among readers of both types of media, uncertainty increased or remained high given the discrepant messages.

However, a different aspect of the concept of uncertainty was present in the few articles which presented both side of the competing perspectives on nutrients in Iowa's water. These articles inherently reflected a latent tone of uncertainty by not taking a firm stance either way.

Consider the following selection from a DMR article in June 2016:

Des Moines Water Works officials and some scientists say that agriculture practices have led to the high levels, principally from fertilizer that leaches into waterways.

But Iowa Farm Bureau spokeswoman Laurie Johns wrote in an email that "a number of factors influence nitrate levels, and they can fluctuate day by day." She said farmers are collaborating on solutions, but nitrate levels have trended down in recent years.

Chris Jones, a hydrosience research engineer at the University of Iowa, counters: "There can be no dispute that nitrate levels are far higher than what we think is the natural condition for Iowa streams." He said that annual median milligrams per liter of nitrates in Iowa streams were in the 1 to 2 range in 1905, 4 in 1940 and 9 today. And in most Iowa streams, the trend is upward since 1986, Jones said. (Kilen, DMR, A tug of war between farming, environment, 20 June 2016).

The above text highlights what Ashe (2013) describes as the "problem of incommensurate scientific and journalistic cultures" (p. 25). On one hand, the objectivity presented in unbiasedly reporting both sides is commendable, but it also works to decrease the weight of the scientific evidence underlying the reality of the situation. Ashe (2013) goes on to state "When faced with two contradictory accounts of an issue, journalists fulfil their obligations to objectivity by covering both. Scientists often feel that they should be more aware of the qualifications of those propounding the two accounts" (p. 25). However, this requires a high level of scientific literacy to ensure journalists are consistently able to accurately reflect the scientifically veracious points of an issue. Ultimately this points to implications beyond balanced coverage of controversial issues, such as the need for improved scientific literacy education for journalists (Ashe, 2013)—and perhaps for everyone.

Key Individuals and Organizations

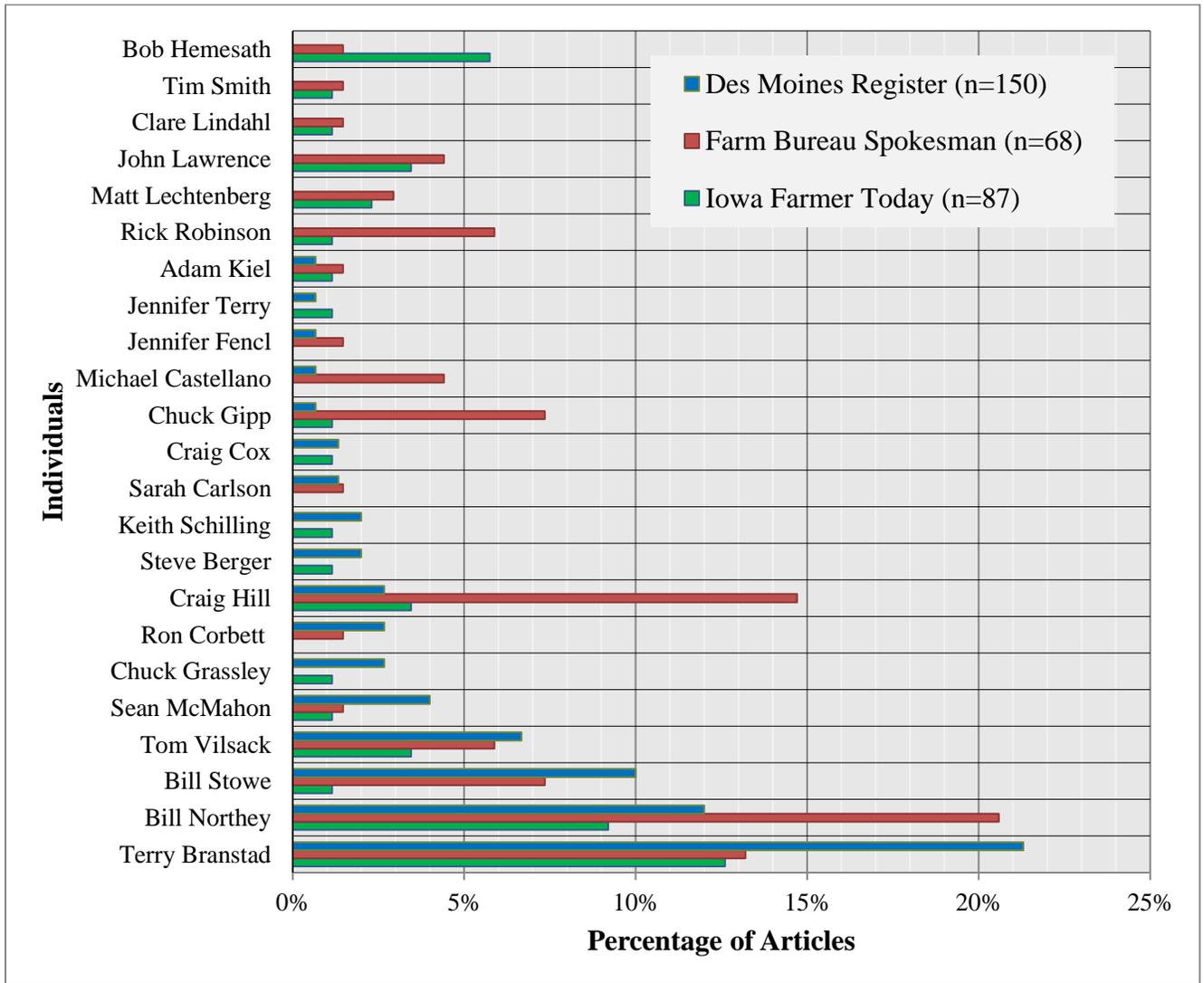
To answer RQ2 (*Who are the individuals appearing consistently as spokespeople and information sources within the water/agriculture nexus in Iowa in each news media source?*) key

spokespeople and sources were identified and data was collected to document the number of times individuals were cited in the articles. See Table 3 for individuals, titles and professional affiliations. Individuals who appeared in two of the three sources are included in the graphical distribution of key individuals in Figure 3.

Table 3. Individual Titles and Affiliations

Individuals	Title/Professional Affiliation
Terry Branstad	Governor of Iowa
Bill Northey	Iowa Secretary of Agriculture
Bill Stowe	CEO Des Moines Water Works
Tom Vilsack	US Secretary of Agriculture
Sean McMahon	Executive Director Iowa Agricultural Water alliance
Chuck Grassley	US Senator for Iowa
Ron Corbett	Cedar Rapids Mayor
Craig Hill	Iowa Farm Bureau President
Steve Berger	Farmer, Wellman, Iowa
Keith Schilling	Research scientist, University of Iowa, US Geological Survey
Sarah Carlson	Midwest Cover Crop Director, Practical Farmers of Iowa
Craig Cox	Senior Vice President, Agriculture and Natural Resources, Environmental Working Group
Chuck Gipp	Director, Iowa Department of Natural Resources
Michael Castellano	Associate Professor, Iowa State University
Jennifer Fencil	Environmental Services Director at East Central Iowa Council of Governments
Jennifer Terry	Attorney / Environmental Advocacy Leader at Des Moines Water Works
Adam Kiel	Operations Manager Iowa Soybean Association
Rick Robinson	Environmental Policy Advisor at Iowa Farm Bureau Federation
Matt Lechtenberg	Water Quality Initiative Coordinator at Iowa Department of Agriculture and Land Stewardship
John Lawrence	Director for Agriculture and Natural Resources for Iowa State University Extension and Outreach
Clare Lindahl	Executive Director at Conservation Districts of Iowa
Tim Smith	Farmer, Eagle Grove, Iowa
Bob Hemesath	Chairman Iowa Corn Growers Association

Figure 3. Most Cited Individuals in Each Source



Villain versus hero. Examining the coverage related to several key individuals yielded some interesting discrepancies between the media sources. Such discrepancies are well illustrated by comparing the coverage of Bill Stowe, CEO of DMWW, and Craig Hill, Iowa Farm Bureau President. Stowe appeared much more often in the FBS than IFT—nearly as frequently as he appeared in the DMR. However, the coverage related to Stowe differed significantly between the sources. Nearly every article mentioning Stowe in the FBS represented him, and the DMWW lawsuit, as negative and as dangerous to farmers. A review of the article

titles alone reveals the disapproving tone of the coverage, as in the article entitled, “Is the Des Moines Water Works leader really worth a half million bucks?” (Steimel, 17 November, 2015). Steimel writes in another FBS piece: “Water Works CEO Bill Stowe views his lawsuit against drainage districts in northwest Iowa as the ideal tool to force added regulations on farming practices in Iowa and, ultimately, around the country. Any other plan he calls inadequate, unrealistic and not tough enough on farmers” (Steimel, FBS, “Others work for water quality, but Water Works sits,” 25 January 2016). Emphasizing that Stowe believes any water quality improvement effort must be “tough on farmers” helps seed the vilification of Stowe within the agricultural community, and among rural Iowans generally. In April 2016, Steimel writes:

After observing Des Moines Water Works’ (DMWW) CEO Bill Stowe during the past couple of years, I’ve really started to wonder about his role. Is this guy the manager of a utility that supplies water to much of central Iowa? Or is he really an environmental activist who is simply trying to bend Iowa agriculture to his vision of farmers spending tons of time applying for environmental permits and adhering to one-size-fits-all regulations (Steimel, FBS, “Is Water Works leader really an anti-farm activist,” 25 January 2016).

This critical, antagonistic depiction of Stowe supports Drake University Law Professor, Hamilton’s argument of a concerted effort by the agricultural industry to “sell” Iowans the idea that the DMWW lawsuit is bad for Iowa (Hamilton, DMR, Iowa's clean water debate: What to believe? 26 May 2015).

In contrast with the negative coverage of Stowe, the FBS reported on their own President, Craig Hill effusively. The coverage directly lauded Hill, or reported on him in ways likely meant to increase his—and the Iowa Farm Bureau’s—appeal to farmers. For example, Hill is cited in

several articles touting the achievements of Iowa farmers in their adoption of nutrient reducing practices. Hill is quoted in one article stating ““It really demonstrates the progress we are making in water quality and conservation all over the state,”” (Steimel, FBS, Awards provide a look at water quality gains, 22 August 2016). The coverage depicting Hill as both a champion of farmers and conservation in Iowa is interesting considering a recent article published in the Cedar Rapids Gazette which quotes Hill stating: ““Nitrates are overstated as a problem”” (Jordan, 2017). The article, titled, “Farm Bureau Flourishes as Water Quality Flags” goes on to cite Hill stating that he also does not see the need for regular nitrate testing (Jordan, 2017).

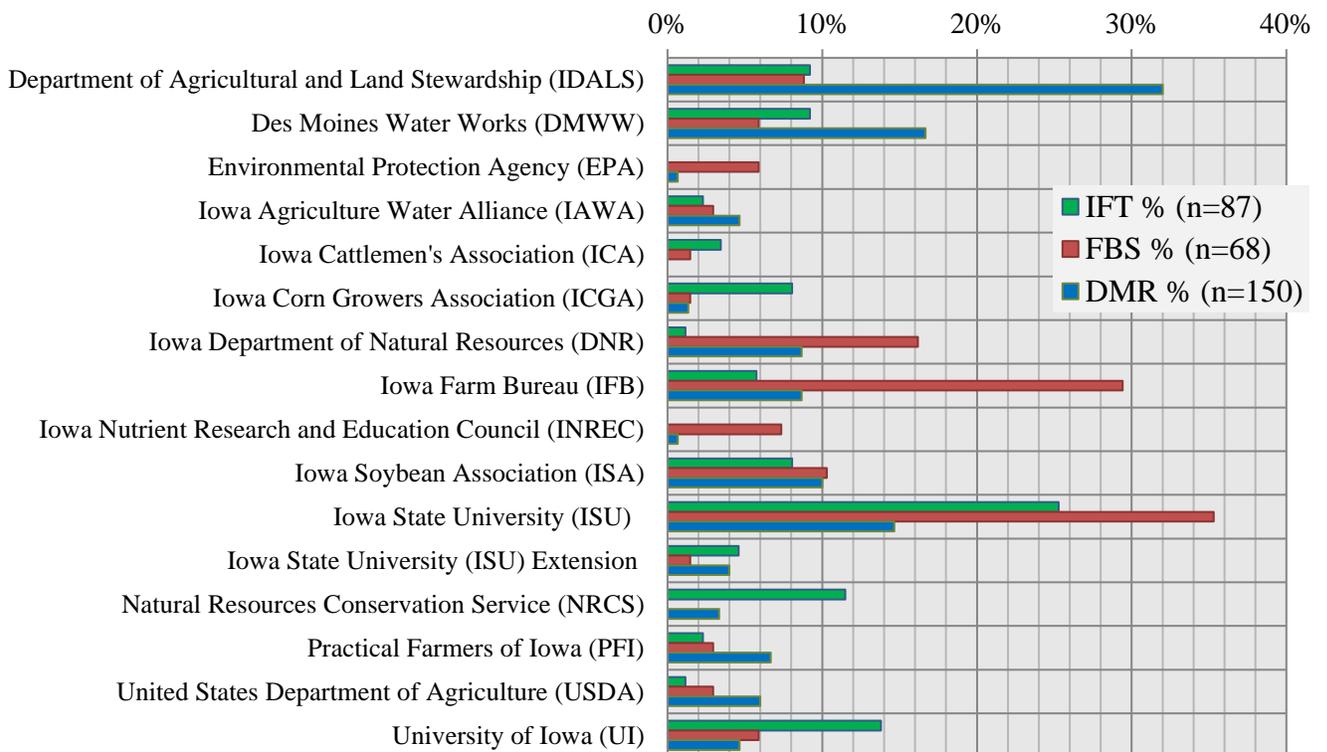
The second part of RQ2 (*a: How are these individuals portrayed as influential within the water/agricultural realm in each of the sources?*) is difficult to answer because little content in the articles indicated influential status of cited individuals. Often, the indication of influence was explicit only through the person’s described position within the realm of agriculture in Iowa. For example, Bill Northey, who was one of the most cited individuals among all three media sources, was always introduced as the state’s ‘Secretary of Agriculture.’ Given the context of these articles this inherently lend Northey credibility.

Another way certain individuals were portrayed as influential was through descriptions of the length of time the person had been in agriculture. For example, Steve Berger, a farmer extolled for his commitment to conservation agriculture in both IFT and the DMR (and by fellow farmers, to be discussed in the following chapters) is introduced in one article with the phrase: “who with his late father, Dennis, worked for decades building up their farm’s soil health so it would better hold water and nutrients” (N.a., IFT, Meet Iowa's poster child for farm conservation, 25 January 2016). Years in agriculture was used as an indicator of experience and seemingly a proxy for credibility. In Berger’s case, the article’s title: *Meet Iowa's poster child for*

farm conservation, also suggests his influential status. However, overall, this type of description of individuals beyond their name, title, and organizational affiliation was rare.

Interestingly, water sector researchers and academics were rarely quoted within the articles. This aligns with previous research on water news coverage showing academics and scientists seldom quoted in water-related news articles, while governmental officials are cited ubiquitously (Hurlimann & Dolnicar, 2012; Wei et al., 2015; Xiong et al., 2016). Building on this previous work, this study’s findings demonstrated a skewed relationship within the representation of the state’s three public universities. See Figure 4 (below) showing the distribution of all organizations appearing in the sampled articles (please note: criteria for inclusion was the same as Figure 3, requiring more than one mention in the sampled articles).

Figure 4. Most Cited Organizations per Media Source



Iowa State University was disproportionately cited among all three sources, but this discrepancy was most extreme among the FBS articles. While the University of Northern Iowa was completely absent in the sample, the University of Iowa was also rarely cited despite the various water-related research endeavors at the institution. This is likely due to Iowa State University being the land-grant institution for the state and having prominent agricultural programs in the curriculum.

Discussion

It is important to study the way prominent news and agricultural media sources describe and discuss Iowa's water quality not only because they are key information channels for Iowa farmers (Chiu et al., 2015; Comito et al., 2011), but also because these mediated products may be shaping farmers' risk perceptions related to nutrient excesses in their water ways. Since risk perception may ultimately influence behaviors (Brewer et al., 2007) which could increase or decrease nutrient levels in Iowa water, understanding current mediated narratives is foundational for this dissertation. The purpose of this exploratory textual analysis study was to: 1) investigate how three informational media sources present key issues related to Iowa's water quality; 2) document how these discourses convey risks and uncertainty related to nutrient excesses in water; and 3) identify who key spokespeople and organization are in the realm of agriculture and water quality in Iowa.

Two dominant perspectives, categorized as 'pro-agriculture' and 'pro-environment,' were consistently presented within the articles in the sample. Contradictory narratives related to the origin of nutrients excess in water, the necessity of regulatory action related to this problem, and the DMWW lawsuit, among others, were promulgated through the articles. The presence of contradictory messages seemed to parallel current divisions in the U.S. political landscape,

where divisive media portrayals of issues (and questions of what the facts are) contributes to a divided general public. For Iowa, these contradictory narratives are likely to continue to exacerbate the divides between “city slickers” and farmers, while doing little to improve the state’s water quality.

The discrepant coverage of nutrient excesses in water highlights the possibility that public and farmer perceptions of water and environmental problems may not be reflective of current scientific understanding. Beyond the potential role that scientific literacy may be playing, the FBS, a highly circulated and influential communication channel in the farming community is portraying nutrient issues in ways that call into question the assertions of numerous scientific authorities (EPA; 2017; Jones et al., 2017; Licht et al., 2016; Morefield et al., 2016; Osterberg & Kline; 2014). This may be resulting in yet another disconnect between the scientific community and the public, much like Weathers and Kendall’s (2015) findings underlying their argument that “there is a serious disconnect between what the public health community knows about the health threats associated with climate change and what the public knows” (p. 606). A similar disconnect in the realm of water quality is likely, though subsequent research is necessary to understand audience’s actual knowledge.

Correspondingly, the discrepant reporting on risks of nutrients in water discovered through these articles suggest that the Iowa Farm Bureau may be attempting to decrease the public ‘outrage’ (Sandman, 1987; 2012) related to environmental and health risks of nutrients. If farmer audiences believe the Farm Bureau to be more credible than other organizations, this can result in audiences who are less concerned about, or prepared for, certain risks than scientific evidence suggests they should be (Ashe, 2013; Ropeik, 2012). Alternatively, the risk related messages being spread by the Iowa Farm Bureau may be intended to increase farmer’s outrage

directed at the DMWW, and thus decrease any potential support among their constituents regarding governmental regulation of agricultural land.

In conclusion, the findings from this thematic textual analysis help illuminate the underlying positions of the three media sources and provides valuable insights into the overall water quality debates currently profuse in Iowa. The data uncovered in this study contribute to the subsequent studies in this dissertation, both of which directly address the potential audiences and/or creators of these texts. As Fairclough (2003) suggests, the “relationships between different discourses are one element of the relationships between different people—they may complement one another, compete with one another, one can dominate others, and so forth” (p. 124). The methodological sequence of first examining texts and using this data to subsequently inform audience research, supports and enables the recommended “mass communication as a totality” approach to research in this field (Philo, 2007, p.194). Theoretical and practical implications, and study design strengths and weaknesses will be discussed in Chapter Six.

CHAPTER FOUR: UNDERSTANDING FARMER'S RISK PERCEPTIONS, NUTRIENT BELIEFS, AND INFORMATION SOURCES

The way risk and uncertainty are communicated through mass media and interpersonal networks is important to investigate to better understand the flow of risk information and how risk perceptions are shaped (Coleman, 1993; Dunwoody & Neuwirth, 1991; Ho et al., 2013; Jones et al., 2007; Morton & Duck, 2001) in the agricultural realm. Issues related to risk and uncertainty abound in the context of water quality and agriculture in Iowa, and the way media and interpersonal influencers portray these issues may impact farmer risk perceptions, and potentially the diffusion process. While the previous study (Chapter Three) explored media perceptions of the issues, this study is focused on interpersonal representations of the issues. The purpose of this study is to describe how farmers conceptualize risks related to nutrients in water; who and what are influential information sources about nutrients in water; and the potential connections between farmer's perceptions of the key variables and their current nutrient management practices.

Research Questions

Considering the need to empirically document and examine farmers' perceptions of nutrients in water, including the risks related to this, and their perceptions of both mediated and interpersonal information sources regarding water and agriculture, the following research questions are posed:

RQ3: How do farmers conceptualize Iowa's current water quality, the issue of nutrients in water, and the risks associated with nutrients in water?

RQ4: How do farmer's beliefs about nutrients, perceptions of risk, uncertainty level, and normative beliefs correspond to their current use of nutrient reduction practices?

RQ4a: What do farmers believe are the primary barriers to the adoption of nutrient reduction practices among more Iowa farmers?

RQ5: Who do farmers identify as influential individuals and mediated sources for water quality related information and land management practices?

In order to answer these research questions, intercept interviews, which consisted of completion of a face-to-face survey instrument, were conducted between July and September 2016. The questionnaire was developed to assess farmers' risk perceptions of nutrient excesses in water, recommended nutrient reduction practices, uncertainty levels related to both risks, and perceptions of influential information sources, through the complimentary use of open-ended and closed question types. The remainder of this chapter is organized as follows. First, justification for the use of face-to-face, semi-structured intercept interviews, description of the sampling procedure, and operationalization of key variables are provided. Next, results are presented related to farmer's conceptualizations of Iowa's water quality, nutrient issues, and the risks of these issues. Subsequently, correlations between farmer's use of nutrient reduction practices and their perceptions of key variables are presented. Following this, results related to important media and interpersonal communication sources for water quality information are provided. The chapter concludes with a brief final discussion (theoretical and practical implications, and strengths and limitations, are presented in Chapter Six).

Method: Intercept Interviews

Justification

Face-to-face data collection for survey research is considered a "superior data collection technique" (de Leeuw, 1992, p. 15; Dillman, 2009; Heerwegh & Loosveldt, 2008) due to the method's many advantages. First, this research mode typically attains higher response rates than

telephone, mail, and web-based surveys, as people are generally more willing to talk to a person who is immediately in front of them rather than complete a self-administered survey (Babbie, 2013). Correspondingly, recruiting farmers who are attending an event ensured they were not losing any work or family time by participating in an in-depth conversation with the researcher. Face-to-face data collection is the least burdensome on respondents as they only require the auditory channel; whereas the demand for literacy in the case of self-administered surveys (via mail or internet) increases the cognitive burden placed on respondents (Bowling, 2005). As Bowling (2005) points out, an encouraging interviewer can maintain respondent motivation with longer questionnaires, help clarify ambiguous questions, use visual aides to show response options, probe for more detailed responses, and control the order of the questions. Face-to-face interviews also result in lower instances of “don’t know” and “no answer” responses, and previous research shows an increased propensity for satisficing behavior among respondents of alternative surveys modes (Heerwegh & Loosveldt, 2008). Face-to-face surveying allows for non-verbal communication cues between the interviewer and respondent, which is important when a respondent’s motivation is lagging, or a respondent is skeptical of answering particular questions. The interviewer’s enthusiasm can help engage and soothe these respondents (Holbrook, Green, and Krosnick, 2003).

The combined use of open and closed-ended questions is another important component to consider regarding research mode. While open-ended questions “can lead to a greater level of discovery” (Gillham, 2000, p. 5) free from the “conceptual boundaries that exist in a structured quantitative instrument” (Vitale, Armenakis, & Field, 2008, p. 88), they also require more time and effort to analyze (Krosnick & Presser, 2010). Open-ended questions result in data that is less easily aggregated and comparable across participants. However, surveys relying solely on

closed-ended/scale-based questions often suffer from artificiality (Babbie, 2013). Close-ended and scale-based questions often rely on strong prior research and comprehensive understanding of a given topic to ensure a complete list of appropriate answers is predetermined for each respondent (Krosnick & Preser, 2010). In cases lacking data from previous empirical research, creating a standardized, valid survey instrument entails a preliminary research agenda dedicated to instrument creation. As this was outside the scope of the present study, the reliance on slight adaptations to previously validated instruments measuring risk perceptions, uncertainty, and social norms was complemented with the addition of open-ended questions. Combining the quantitative measures with open-ended questions enhanced the analysis, provided richer detail to the findings, enabled corroboration of the data via triangulation, and provided unique insight on this understudied context (Vitale et al., 2008).

Considerations of Validity and Reliability

Babbie (2013) argues that traditional survey research can suffer from artificiality, which he describes as putting “a strain on validity” (p. 287). The inclusion of open-ended questions allowed and encouraged respondents to describe their perceptions in their own words, which increased validity. Reliability however, suffered due to the presence of open-ended questions which yielded narrative, subjective, non-standardized results. Yet, as many qualitative scholars argue, the goal of this type of research should not necessarily be to attain the same results, but instead should be to yield consistent and dependable results (Denizen & Lincoln, 1998; Lincoln & Guba, 1985; Zohrabi, 2013). In this case, the inclusion of both open and closed-ended questions helped improve reliability through data triangulation. As with the first study (see Chapter Three), researcher recognition of the inherent and potential weaknesses of a particular

research method, and keen attention to detail in the reporting of methodological and analytic procedures, were both crucial to ensuring reliability and validity in this study.

In summary, face-to-face data collection through intercept interviews was the best method to answer the study's research questions regarding the way farmers conceptualize water quality in Iowa and perceive the risks, uncertainties, and norms associated with the problem of nutrient excesses. Not only did the method allow for high response rates and fewer "I don't know" responses than traditional survey modes, but also yielded valid results for an exploratory study of this type. The combined use of open and closed-ended question types was meant to "capture the benefits of both quantitative and qualitative data collection and analysis" (Vitale, 2008, p. 88) and was recommended by numerous scholars (Creswell, 2003; Dillman, 2009; Erickson & Kaplan, 2000; Krosnick & Presser; Vitale et al., 2008; Zohrabi, 2013). The overall focus of this study was not generalizability, but rather to produce findings that helped illuminate nuanced conceptualizations of understudied phenomena within the farming community. This required access to participants only achievable through in-person contact, which was also central for the subsequent study of influencer networks (in Chapter Five).

Sample

This dissertation focuses on farmers in the state of Iowa, the top producer of corn and soybeans in the U.S. (USDA, 2016). A small geographic scale was essential for uncovering the individual level data needed to address this study's research questions and for the subsequent study of interpersonal influencers (see Chapter Five). Thus, this study included self-identified farmers living and farming in the Middle and Lower Iowa River Watersheds. (Please see Appendix A for map view of area.) The two Hydrologic Unit Code (HUC) eight-sized watersheds make up the lower portion of the much larger Iowa Cedar River Basin.

The Iowa River is a major tributary to the Mississippi River and the Iowa Cedar River Basin is the primary contributor of nutrients to the upper Mississippi River basin (Iowa Cedar Watershed Interagency Coordination Team, 2016). Therefore, this area of Iowa is especially important as the water quality issues have far-reaching effects beyond Iowa. Approximately 93% of the total land in the Iowa Cedar River Basin is used for agricultural purposes (Iowa Cedar Watershed Interagency Coordination Team, 2016). The watershed has been considered a “good test bed for testing [land] management practices (such as conservation improvements to reduce soil erosion from agriculture)” and a “remarkable natural laboratory for investigating problems of fundamental scientific interest” (Iowa Cedar Watershed Interagency Coordination Team, 2016).

Only farmers living within a small land area within the Iowa Cedar Rivers Basin were included in this study because this lowered the total study area from 12,620 square miles (8,076,800 acres) to less than 1,500 square miles (960,000 acres). Overall, it was necessary to study a small, defined geographic area to allow for more depth of the data collected. Additionally, the smaller study area still includes one of the three major municipalities (Iowa City/Coralville) in the Iowa Cedar Rivers Basin. Including one larger, urban center in the study area was done in consideration of the subsequent study (Chapter Five), given the likelihood of influential individuals to live in slightly more metropolitan areas (Rogers, 2013).

Predetermining the sample size needed to detect moderate effect size, power, and significance levels did not directly reflect the research objectives of this study and corresponds to traditionally quantitative lines of inquiry. However, it was necessary to consider appropriate sample size, which was done by consulting previous research of this type. Different scholars have described appropriate sampling frames for surveys of this type to be between 30 (Creswell,

2002) and 65 (Onwuegbuzie & Collins, 2007) participants. The similar study conducted by Chiu et al. (2015), yielded a sample of 195 participants, however, this research relied on self-administered questionnaires and used three research assistants to recruit participants. As this study utilizes only one surveyor and face-to-face surveys, a more manageable goal of 50 participants was set forth. Final recruitment nearly doubled this goal with 97 participants.

Procedure

Because the goal was not to generalize findings across all farmers but instead to obtain deeper insights into this population and the study phenomena, a purposive modified snowball sampling scheme was utilized (Onwuegbuzie & Collins, 2007). Farmers were recruited for participation at multiple farming events held in the months of July, August, and September. The recruiting events included: three county fairs (one week at each), three Natural Resource Conservation Service (NRCS) sponsored field-days, one “farm-inar” (i.e. farming seminar), one legislative farm day, and one large regional agricultural show. Each of these events was relevant for recruiting farmers living in the study area while also providing a loosely structured, relaxed environment appropriate for one-on-one conversations. In particular, county fairs are events which were originally intended to bring “farm people” together to learn improved farming methods (Bonney, 1983) and these fairs remain important social and educational events for agricultural families. This unique sampling and recruitment strategy was loosely based on two similar social science studies of farmers (Chiu et al., 2015; Sorensen, 2008). All but one event was held in Eastern Iowa within the Middle and Lower Iowa River Watersheds.

Copious field notes were taken upon arrival at each event and following most interviews (Denizen & Lincoln, 1998). Participants were recruited by approaching various individuals, introducing the interviewer and briefly describing the study purpose, and asking whether the

individual would be willing to participate. Following verbal agreement, the interviewer would begin asking the predetermined questionnaire items (discussed in the following section). All responses were written out verbatim by the interviewer as the participant spoke. If the interviewer was unclear on an answer, or the participant seemed interested in expounding on a particular topic, follow up questions were sometimes asked by the interviewer and respondent answers to these questions were also documented (Guba & Lincoln, 1994).

Variables

The conceptualizations and operationalization of key variables, including both the quantitative scale questions and the qualitative open-ended questions, are detailed below. As previously discussed, validated measurement scales were adapted for use in this study whenever possible. See Appendix B for complete questionnaire.

Water quality and nutrient beliefs. The introductory section of the survey was meant to assess how farmers are conceptualizing Iowa's water quality and the issue of nutrients in water. The questionnaire began with several open-ended questions, in part because it was helpful in establishing interviewer rapport with participants. For example, the first question all participants were asked was: "How would you describe Iowa's water quality overall?" Additionally, participants were asked: "Can you explain to me what nutrients are and how they get in the water?"; "In your opinion, are nutrient levels in Iowa's waterways higher or lower than normal right now?"; "What are normal levels of nutrients?"; "What do you consider to be the biggest problem for Iowa's water quality right now?"

Seven additional nutrient belief and opinion related statements were measured quantitatively, assessed through Likert-scale agreement from 1 ("strongly agree") to 5 ("strongly disagree"). Specifically, the respondents were instructed to rank their agreement for each of the

following statements: (1)* “nutrients from agricultural fields contribute to water quality problems in Iowa” ($M = 3.40, SD = .96$), (2) “nutrients in water are a problem in Iowa, but it is not related to farming” ($M = 2.89, SD = .93$), (3) “nutrients in Iowa’s water could be reduced by changing the way we farm” ($M = 3.38, SD = 1.04$), (4) “reducing nutrients would improve water quality” ($M = 3.13, SD = .99$), (5) “river and stream water in Iowa should be treated before consumption” ($M = 3.90, SD = .85$), (6)* “what I do on my farm doesn’t make much difference in overall water quality” ($M = 2.36, SD = .96$), (7) “human behavior will not change levels of nutrients in water” ($M = 2.08, SD = .84$). *Starred questions indicated items from Ritter’s (2012) survey of Ohio farmers and their beliefs about nutrient runoff.

Risk perception. Risk represents the balance between the chance of an outcome occurring and the potential consequences if it does occur (Slovic et al., 1979). Risk perception is defined in this dissertation as the subjective assessment of risk and is conceptualized as the likelihood of and severity of negative consequences occurring to oneself and/or society (Glik, 2007; O’Connor, Bord, Fisher, 1999; Ritter, 2012). Respondents were asked one open-ended question: “What are the risks, if any, related to nutrient excesses in water?” to introduce risk into the conversation and to provide unbiased responses prior to the quantitative risk perceptions scales assessed (described below).

Risk perceptions were measured quantitatively for two separate items: 1) nutrients in Iowa’s waterways, in terms of the negative consequences participants determined themselves per their answer to an open-ended risk conceptualization question, and 2) Iowa Nutrient Reduction Strategy (INRS) recommended practices, in terms of profit and yield consequences.

Some studies have used five-point Likert scales, with response options ranging from ‘no risk’ to ‘extreme risk,’ to measure assessments of perceived riskiness directly (e.g. ‘To what

extent do nutrients in water pose a risk to human health?’) (Lo, 2013; Satterfield, Mertz, & Slovic, 2004). This study uses this question type to assess farmer’s risk perceptions of each of the seven included INRS practices, as well as one of the three risk measures used to assess riskiness of nutrients in water. To assess yield/profit based riskiness of each INRS practice, respondents are asked, “to what extent do you feel a farmer’s yields or profits would be at risk from using each practice on one or more of your fields.” Respondents were instructed to answer from 1 = “no risk” to 5 = “maximum risk” for each of the following practices, (1) cover crops ($M = 2.27, SD = .82$), (2) reduced tillage ($M = 1.86, SD = .73$), (3) buffer strips ($M = 1.69, SD = .65$), (4) wetlands ($M = 2.24, SD = 1.04$), (5) bioreactors ($M = 2.93, SD = 1.15$), (6) perennials ($M = 1.96, SD = .84$), (7) extended rotations ($M = 2.06, SD = .84$). To assess riskiness of nutrients in water respondents were asked use the same 1 = “no risk” to 5 = “maximum risk” answer scale to answer “To what extent do excess nutrients in water pose a risk to”: (1) “farmer’s yields/profit potential” ($M = 2.81, SD = 1$), (2) “ecosystem/environmental health” ($M = 3.41, SD = .94$), (3) “human health” ($M = 3.31, SD = .98$). The first item (1) represents a measure of financial riskiness; the second two items (2 and 3) were combined as a composite measure of environmental and human health riskiness, with a Cronbach’s α of .91.

Several previous environmental and health risk perception studies have also used statements without the term “risk” being directly present, but instead asking Likert-scale based questions to gauge items which reflect risk, such as likelihood of occurrence and seriousness of the problem (Arbuckle, 2013; Bard & Barry, 2000; Lo, 2013; Ritter, 2012; Sulewski & Kłoczko-Gajewska, 2014). Specifically, likelihood of negative consequences from nutrient excesses in water were assessed on a scale from 1 = “no chance” to 7 = “certain to happen,” by asking the respondent, “how likely is it that excess nutrients will negatively impact”: (1) “farmer’s

yields/profit potential” ($M = 4.25$, $SD = 1.55$), (2) “ecosystem/environmental health” ($M = 4.42$, $SD = 1.37$), (3) “human health” ($M = 4.23$, $SD = 1.5$). The three items were combined for a composite measure of risk likelihood, with a Cronbach’s α of .894. Severity of negative consequences from nutrient excesses in water were assessed on a scale from 1 = ”not at all serious” to 7 = ”the most serious,” by asking the respondent, “how serious do you feel the negative consequences of excess nutrients in water are to”: (1) “you and your family” ($M = 3.77$, $SD = 1.54$), (2) “your local community” ($M = 3.82$, $SD = 1.52$), (3) “the US as a whole” ($M = 4.24$, $SD = 1.33$), (4) “people all over the world” ($M = 4.44$, $SD = 1.39$), (5) “the environment” ($M = 4.36$, $SD = 1.40$). The five items were combined as a composite measure of risk severity, with a Cronbach’s α of .93.

Uncertainty. While this dissertation overall aligns with Brashers (2001) description of uncertainty as “when details of a situation are ambiguous, complex, unpredictable, or probabilistic; when information is unavailable or inconsistent; and when people feel insecure about their own state of knowledge or the state of knowledge in general” (p. 43), only one portion of this encompassing definition is assessed by this survey—certainty of knowledge. Powell et al., (2007) emphasize that conceptualizations of uncertainty in the literature often encompass individual perceptions of ‘knowing’. This study is focused on investigating uncertainty of knowledge produced by contradictory messages about nutrients in water through media and interpersonal exposure. While the risks of nutrients in water are scientifically known, most non-experts only know about what has been reported in the media and thus have been exposed to a variety of messages regarding the “science” related to nutrients in water (see Chapter Three).

The first uncertainty measure is intended to assess uncertainty regarding “the state of knowledge in general” per Brasher’s (2001) definition and was adapted from Arbuckle et al.’s (2013) measurement of Iowa farmer’s perceptions of scientific evidence of climate change. Respondents were asked to rate their degree of agreement from 1 = “strongly disagree” to 5 = “strongly agree” with the statements: “There is not sufficient scientific evidence to know with certainty”: (1) “the actual nutrient loads in Iowa’s water” ($M = 3.32, SD = .97$), (2) “whether nutrients in Iowa’s water pose a threat to ecological/environmental health” ($M = 3.19, SD = .914$), (3) “whether nutrients in Iowa’s water pose a threat to human health” ($M = 3.16, SD = .938$). The three items were combined for a composite measure of scientific certainty, with a Cronbach’s α of .88.

The questionnaire contained one additional measure intended to assess uncertainty regarding “their own state of knowledge” per Brasher’s (2001) definition. This item measured farmer’s certainty related to their own knowledge of the yield/profit risks of the INRS practices discussed. The question was loosely based on previous quantitative assessment scales for uncertainty perceptions (Johnson & Slovic, 1995; Retzbach, Otto, and Maier, 2015). Respondents were asked to answer on a scale from 0-100, with 0 = “not at all certain” to 100 = “absolutely certain,” the question, “How certain do you feel about your knowledge of the financial risks of using these practices overall” ($M = 61.9, SD = 18.3$).

Nutrient management practices. The practices included in the survey are based on the INRS list of recommended practices. The INRS lists over 20 different practices, with varying degrees of technical knowledge needed to understand the practice, varying nitrate reduction ability, and varying utility on Iowa farmland. Thus, this list was shortened to reflect only the practices having the highest nitrate reduction ability (average reduction greater than 10%) and

those which are most regularly discussed within the mainstream and agricultural media (to ensure participant familiarity with each practice). The recommended behaviors were each listed on the questionnaire, and respondents were asked whether they currently used (0 = “no,” 1 = “yes”) the following practices: (1) cover crops ($M = .62, SD = .49$), (2) reduced tillage ($M = .95, SD = .23$), (3) buffer strips ($M = .75, SD = .44$), (4) wetlands ($M = .2, SD = .4$), (5) bioreactors ($M = .01, SD = .1$), (6) perennials ($M = .53, SD = .5$), (7) extended rotations ($M = .7, SD = .46$). This is similar to Ritter (2012), who listed 14 nutrient management behaviors, and asked respondents to answer whether they ‘never’, ‘sometimes’, or ‘always’ use them. The practices were also listed in the survey to assess perceived risks to yield and/or profits related to each practice (as discussed in Risk Perception section above). One open-ended question, “what do you believe are the main reasons why a farmer would NOT choose to use any of the INRS recommended practices on his/her farm?” was also asked to assess farmer’s perceptions of the main barriers to the adoption of nutrient reducing practices in general.

To enable the Pearson’s correlation coefficient calculations needed to assess the strength of association between farmer’s use of nutrient reduction practices and the composite measure of farmers’ perceptions of risks, uncertainty, nutrient beliefs, and norms (needed to comprehensively answer RQ4), a summative scale was created for the number of practices used for each respondent. The binary (yes/no) data regarding farmers use of each practice was summed to create a composite measure of the number of practices currently used by each respondent ($M = 3.73, SD = 1.19$). This was done to better interpret the data and enable more meaningful results from the Pearson’s correlation coefficient calculations.

Mass media. Mass media is a significant source of risk information, and often people’s knowledge of science and technology is influenced by media content (Einsiedel & Thorne, 1999;

Rogers, 2003). This study is focused specifically on informational media use regarding water quality. Because people sometimes utilize certain media consciously as a source to increase uncertainty, or decrease it (Bradac, 2001), media use was assessed by asking respondents 1) what source(s) of media they used in the past year that was most important to their understanding of water quality issues in Iowa; and 2) what media source(s) they would use to find out more information on a water quality related topic (introduced by the original source). These two questions were open-ended, and participants were encouraged to discuss in more detail if desired. An additional open-ended question was asked regarding the organizations participants perceived as most important for information on the water quality.

Interpersonal influencers. Interpersonal relationships and communication among farmers are important to farming practices (Chiu et al., 2015; Padel, 2001; Rogers, 2010). This variable was also necessary for the final study in this dissertation, as the influential individuals' farmers identified directly informed the subsequent sample of interviewees (see Chapter Five). Respondents were asked three or four (depending on response) open-ended questions and two dichotomous (yes/no). The technique used to uncover influential individuals in these farmers' networks follows a slight modification of the sociometric method for measuring opinion leadership within networks (Rogers, 2003; Rogers & Cartano, 1962; Valente and Pumpuang, 2007). The sociometric approach has been used in numerous studies of influencers for a variety of community and social system contexts; and yields highly valid results (see Valente & Pumpuang, 2007).

Respondents were first asked to think about and discuss the people who they generally talk to regarding water quality and/or nutrient issues. They were then asked to name the particular person whose advice had been most important to their farming decisions related to

water quality and nutrients. Next, they were asked to briefly describe why this person has been influential to these decisions. Subsequently, a yes/no follow-up question was asked to assess whether they also consider that person important to their general farming practices not related to water quality. This question was intended to illuminate the degree of polymorphism or monomorphism among these influentials (Katz & Lazarsfeld, 1955; Rogers, 2003), potentially helpful to the analysis in Chapter Five. Finally, respondents were asked whether the influential person was someone who other farmers in their area would also consider important to farming decisions. If the answer was no, they were asked to name at least one other farmer they believed may be considered influential to other farmers in the area.

Social norms. In this study, social norms are conceptualized as observed or perceived patterns that demonstrate acceptable beliefs, attitudes, and behaviors (Carter et al., 2014). Subjective norms are perceptions about what important others believe should be done, descriptive norms are perceptions about what is done by most people, and injunctive norms are personal perceptions about what should be done (Azjen, 1991; Cialdini et al., 1990; Finlay et al., 1999; Hall & Rhoades, 2010). These three types of norms were assessed in terms of current farming practices by asking respondents to rate their agreement (from 1 = “strongly disagree” to 5 = “strongly agree”) with the following statements: (1) “I believe most other farmers in my area are currently using at least one INRS practice on their farm” ($M = 4.25$, $SD = .75$) (descriptive), (2) “Most farmers whose opinions matter to me consider environmental impacts when making nutrient management decisions” ($M = 4.11$, $SD = .68$) (subjective), (3) “Most farmers in my community expect other farmers to use nutrient management practices on their farm” ($M = 3.67$, $SD = .87$) (injunctive), (4) “When it comes to my nutrient management practices, I want to be like other farmers in my community” ($M = 3.48$, $SD = .82$) (injunctive). The structure and

content of the statements were adapted from Ritter (2012). All four items were combined into a composite measure of social norms, yielding a Cronbach's α of .672.

Demographics. Questions measuring respondent age, education level, number of years farming, type of product farmed, land ownership status, and acres farmed were included in the survey. These demographic questions reflect those asked to farmers in other similar survey-based studies (Bard & Barry, 2000; Chiu et al., 2015; Ritter, 2012). No question regarding income was included as it may have been considered too invasive to discuss with a stranger (E. Anderson, personal communication, March 7, 2016). Additionally, no question regarding geographic location was included per IRB instruction (ID #: 201403809). Because information was collected regarding size of farmer's land, including county of habitation would enable the potential identification of some participants and thus was avoided. Please see Appendix B for complete questionnaire.

Findings

Sample Demographics

Mean age of the 97 total respondents was 48 ($SD = 14.98$), ranging from 18 to 85 years old. Six women participated, representing 6.2 percent of the total sample. Respondents had been farming between one and 65 years, with a mean of 26.6 years ($SD = 16.26$). Level of education yielded the following distribution: less than high school diploma ($n = 1, 1\%$), high school diploma ($n = 29, 30.2\%$), technical degree or completed a trade school program ($n = 4, 4.16\%$), attended some college ($n = 19, 19.7\%$), associate's degrees ($n = 12, 12.5\%$), bachelor's degrees ($n = 30, 31.25\%$), and graduate degree ($n = 1, 1\%$).

Farm sizes ranged from four to 4500 acres, with a mean size of 672 ($SD = 753.78$) acres. Fifty-five respondents (56.7%) owned the majority of the land they farm, 23 (23.7%) rent the

majority, and 16 (16.4%) participants own half and rent half of the land they farm. Four individuals (4.1%) answered ‘other’ to this question, all of whom explained that they worked on a farm and did not rent or own the land. Eighty-five participants (87.6 %) considered themselves the primary decision makers for the land they farmed. Participants farmed a variety of commodities, with corn (n = 86, 89.6%), soybeans (n = 80, 83.3%), and cattle/beef (n = 55, 57.3%) being the three most common products. Table 4 below shows products farmed by survey participants (these commodity categories are not mutually exclusive).

Table 4. Products Farmed

Product	N	(%)
Corn	86	(89.58)
Soybeans	80	(83.33)
Cattle/Beef	55	(57.29)
Hay	38	(39.58)
Hogs	13	(13.54)
Oats	13	(13.54)
Pasture	10	(10.42)
Other Livestock	9	(9.38)
Alfalfa	5	(5.21)
Other Crop	4	(4.17)
Produce	3	(3.13)
Dairy Cows	1	(1.04)
Grain	1	(1.04)

Conceptualizing Iowa’s Water Quality

To assess the first part of RQ3 (*How do farmers conceptualize Iowa’s current water quality, the issue of nutrients in water, and the risks associated with nutrients in water?*) participants were asked: “How would you describe Iowa’s water quality overall?” This wording was meant to ensure respondents were not prompted to answer with valanced assessments of the state of water quality unless that is how they chose to conceptualize the topic. However, most participants did conceptualize water quality as being somewhere on a spectrum between good and bad. Many respondents answering in this way considered Iowa’s water quality to be “good,”

“pretty good,” “better than most states,” “above average” or some other similarly positive description. See Table 5 for a list of the most common responses and the frequency of these answers.

Table 5. Descriptions of Iowa’s Water Quality

Descriptor Term	N	(%)
Good	12	(12.37)
Pretty good	15	(15.46)
Better than other/most states	5	(5.15)
Better than it used to be	8	(8.25)
Fairly good	2	(2.06)
Safe	2	(2.06)
Fine	3	(3.09)
Average	1	(1.03)
Could be improved	3	(3.09)
Could be better	3	(3.09)
Poor	1	(1.03)
Terrible	1	(1.03)
Other terms/statements	41	(42.27)
Total	97	(100.00)

These results showed that nearly half (n=47) of the respondents believe that Iowa currently has good water quality. In addition to the positive assessments of water quality several other important themes emerged within these responses, each theme is detailed below.

Iowa’s water quality is improving. For example, statements such as: “Getting better every year - farmers are getting more important because they realize the connection to water” were common. Several respondents answered the question with the word “improving.” The notion of improving water quality was represented as both occurring in the short-term, as the first example above indicates via “better every year,” and over a longer time period demonstrated in other responses such as: “Should be better than it was 20 years ago because of conservation practices” and “it’s better now than a year ago because people are more watchful.” Many people seemed to associate the increased attention of the issue as indication of improvement. For

instance, one respondent correlated the increased potential for water quality testing and monitoring, and associated knowledge that provides, as a direct path to improved outcomes, stating: “Improving, there is more testing available and done, so we know more than we used to because if we learn more, we learn to control it.”

Quality based on location. Another common theme among the responses was the importance of location. Some of these responses used a location as a qualifier to reflect a geographically-oriented description of the state’s water quality, such as “I would think it’s good except below Des Moines” and “Small pockets need work, the Cedar Lake, the industrial areas.” Des Moines was the most common of the locations used in this way, and though mostly used to highlight a negative area of water quality, one respondent it as ‘average,’ saying: “The whole state is really good but certain basins, like Des Moines, are average.”

Another way locations were used in the responses were as comparative assessment tools. For example, one respondent used ‘third world countries’ as a comparative mark, stating: “I would say good, much better than many third world countries, but I'm sure there is better water out there.” Another comparison that was made by several respondents was with the city of Flint, Michigan. Flint became infamous because of dangerous levels of lead in drinking water in 2014. One respondent answered the question by stating: “Well its nothing like Flint, Michigan. I think it’s pretty safe.” Finally, qualifications related to personal experience appeared in a few answers to this question. For instance, one respondent stated, “I've never been out of Iowa so I think it’s very good.” Another even more personal response was based on the water on the person’s own property, in the response: “We had our well tested and it was fine, so as far as I know it’s good.”

Media making it sound worse than it is. Another theme present among the responses to this question were related to media portrayals of Iowa’s water quality. Most of the responses that

mentioned media did so to juxtapose their perception of the reality of the water quality situation. For example, one respondent stated: “We personally don't have an issue with it but media is making it seem like a huge problem, I'm not sure it's quite as doomsday.” Another respondent seemed to use the example of negative media portrayals as a way to acknowledge that water quality in the state might not be good, but could not be as poor as the way the media was portraying it to be, in the response: “I'm sure nothing is pure but not as bad as what they [media] like to say.” Another respondent went beyond discussing water quality, answering the question by stating: “Media sensation targeted at farmers who for the most part are doing things responsibly. There is room for improvement but I wouldn't label as bad.”

Personal observation. Another interesting theme related to respondents' personal observations of physical attributes of water bodies. People seemed to judge water quality by what they could see within the general Iowa landscape or based directly on the appearance of a personally relevant waterbody. For example, one respondent states, “I think it's better than it's been in the past, looking out on our landscape - it's not black ground anymore, there is lots of no till and the manure is confined.” Several other respondents answered the question based on their observation of aquatic ecosystem species, specifically fish populations. This is illustrated through the following two responses: “I'd think good, we have excellent fish populations, we have thriving fish in small streams, so good from my natural observation” and “Pretty good, lots of fish and water fowl that weren't around when I was a kid.” This is interesting considering that fish kills and algal blooms are visual cues which indicate negative water quality, and were commonly discussed in the media products examined in the previous study (Chapter Three). Yet no respondents noted their own observation of such problems, and the only personal observations

given in the answers to this question were used to highlight the positive state of Iowa's water quality.

Uncertainty. Another theme present within the responses to this question relate to a concept salient within this dissertation—uncertainty. Considering this study's conceptualization of the term, based on Brasher's (2001) definition, many of the responses were riddled with uncertainty. For example, many responses touched on the notions of ambiguity and probability, such as "Can't be that bad because I've been drinking out of a well for 40 years," "Probably excellent," and "Probably poor." Complexity of the situation was reflected in some of the responses which posed logical qualifier statements in their answers, such as: "If you eliminate nitrate level it'd be pretty good, but we are an ag state, and we are the last to be regulated - like coal and other natural resource industries." Similarly, the notions of unavailable or inconsistent knowledge were present within responses such as: "I don't have stats to know" and "As far as I know it's good." Finally, statements such as: "I don't know it seems like it's okay," reflect the insecurity many respondents seemed to feel regarding both their own and the general state of knowledge regarding Iowa's water quality.

Negative responses. There were a small number of individual respondents who answered the question with completely negative replies. Most responses reflected some uncertainty or some optimism. This is explicated through the following example responses: "Average to poor," "Probably poor," "SLOWLY improving," "Not terrible, but could be improved." Of the few responses reflecting only negative outlooks on Iowa's water quality, one individual attributed the negative quality directly to farming practices and provided an example of human health threats from negative water quality. The respondent stated: "Terrible. We have the most altered landscape of a state and farming practices have regressed. The rivers in the Amana area are so

polluted you need to worry about going in the water with an open wound, thus even our recreation is effected by the poor water quality.”

Biggest Problem for Iowa’s Water Quality

In addition to asking respondents to describe Iowa’s water quality, participants were asked “What do you consider to be the biggest problem for Iowa’s water quality right now?” Several themes emerged from the responses to this question including: cities/urban areas, flooding, ignorance, agriculture, erosion, and animal confinements. Examples of each, plus a short discussion of several other notable responses, are provided and discussed below.

Urban areas. Cities, towns, urban development, roads, golf courses, and even “Walmart parking lots” were cited as the biggest problems for Iowa’s water quality by over one-fifth (n = 22) of the respondents. Many of these responses were specifically about fertilizer, such as “Fertilizer used in urban areas,” or “Residential areas, lawns, golf courses, commercial landscaping—they apply such higher rates. Grass doesn’t use the nutrients like crops do!” Sometimes the respondents qualified their blame of urban residents by citing lack of regulations, as in, “Urban areas because they don’t have guidelines.” Often these responses directly attributed the blame for water problems to cities and urban area residents in juxtaposition to farmers. For example, “Golf courses and people in town, they do so much more than what farmers do.”

Flooding. Many of the responses pointing to cities and urban areas were also linked to flooding and the increased potential for pollution through excess water. These responses often tied urban development directly to flooding,. For example, “Flooding is worse because of urban development of people living where fields used to be, so there is a lot more street runoff.” Another respondent answered similarly, but described the way cities responded during times of flooding as the primary driver of the issue, stating: “During flood times cities can dump sewage,

and people pollution in general, because more concrete on the ground, and then salt and sand are used on that.” Increased concrete in urban areas was also tied into some responses, such as: “Torrential downpours and rain, mother nature. Probably also we need to look at all the concrete and small town sewer systems,” and “Water gets into the rivers and streams a lot faster than it used to because of tile and concrete in towns.”

Ignorance. Tied to the notion of cities and urban areas being chiefly responsible for water quality problems, was the notion of [other] people’s “ignorance” (one respondent’s sole answer to the question) and lack of education among urban residents. Sometimes this sentiment was addressed by referencing the licenses farmer’s need to obtain each year to be legally allowed to use chemical applications on their fields. For instance, one farmer answered simply, “urban area runoff, urban people applying herbicide without license.” Several other respondents directly used the term “uneducated,” with such responses as: “Over application of products, uneducated people, greater tendency for it to happen in urban areas,” and “Uneducated people, crowding of people and them moving to the country.” Both of these previous examples demonstrate a degree of ambivalence with regard to who exactly is “uneducated.” In one sense both responses indicate these “uneducated” individuals are those who live in the cities and are not farmers. However, both responses are also vague enough that certain farmers could also fall under the “uneducated” description per these responses.

Agriculture. A few respondents cited agricultural practices and producers as contributing the most to Iowa’s water quality problems. One such respondent stated: “Misunderstanding of crop requirements for nutrients, and an entrenched view of agriculture where nutrients and intensive management are required.” However, the full extent of agricultural attribution for water quality problems varied greatly in the responses. For instance, one respondent states, “We get

ourselves in trouble when we have big natural rain events. Things are gonna go that you don't want to go, we try our best to use what we can.” This response indicates that current agricultural practices are the problem, yet qualifies this by implicating the weather and using the term “natural” to describe the problem. Another respondent qualifies his response by attributing blame to one type of farmer, saying the problem is “the threat of farmers who don't care about the environment around them.”

Other responses were centered directly on the practices, rather than who was doing them, such as, “Buffer strips being taken out due to the need for profits is a big problem.” Another respondent differentiated himself from other agricultural producers by referring to the practices of other farmers as “they,” as in: “Runoff from crop fields and using more chemicals now. Fifty years ago we used less, but did more tillage. The big problem is how many acres they are trying to farm, they don't have time to go back to every spot, so they error by doing too much the first/only time.” This farmer is attributing changing farming practices to the need for more land in production, in order to make a living. Some respondents do directly reference the broader economic sphere as a way to account for behaviors that could be negatively impacting water quality. For example, one respondent stated: “Ethanol mandates came in and corn prices increased so acres are being used that were never for row crops before, and areas that now need tiling is taking out trees, etc.”

Erosion. The term ‘erosion’ was used in 12 of the responses, or just over 10 percent of the answers. Seven of these responses stated simply the term “erosion,” or “soil erosion.” One respondent added: “from organic farming.” This qualification ensured attribution was not on conventional farmers but instead directed at the much rarer practice of organic farming (there are 612 organic farms out of 87,000 total farms in Iowa (USDA, 2015)). This type of response was

atypical, as most respondents cited soil erosion from conventional row crop farming practices. For example, the response: “There are opportunities from the farming side, with erosion, maybe because of tiling where it would be better not to grow row crops” highlights the way most farmers discussed the term erosion. Another respondent stated: “Lack of use of grasslands and set asides as a means to reduce runoff and erosion. More awareness than there has ever been about the issue [poor water quality] and more concerns about taking the necessary steps for improvement.”

Animal confinements. “Animal confinements,” one respondent’s full answer to the biggest problem question, were commonly discussed. Some individuals stated specific attributes related to animal confinements, such as manure, as in: “Manure runoff from livestock industry, confinements and big rains.” Another respondent noted the size of confinement facilities as it related to manure and waste disposal regulations, stating: “Large animal confinement facilities have rules but smaller ones don't have rules.” Several other respondents referenced one specific animal type of confinement facility as most detrimental to Iowa’s water quality— “Hog buildings.” One respondent stated his worries more specifically: “I'm worried about hog CAFOs in flat sandy areas.” Another respondent cited certain practices used by hog operations, stating: “Some hog facilities that they inject all manure on ground, but probably not everything stays in the ground.”

Other. Problematic or compromised water coming out of Des Moines was also mentioned by several respondents, which may indicate that the negative portrayal of Des Moines Water Works (DMWW) through the Farm Bureau Spokesman, may have helped shape perceptions on the issue. Media itself was mentioned as the biggest problem by three respondents. These individuals each made references to mainstream media, or as one respondent

said “negative media.” Another respondent answered “the media giving it [water quality] a bad rap!” This response seems to indicate that there are no tangible problems with Iowa’s water quality. The response mirrored several responses suggesting there were no problems with Iowa’s water quality to name. This type of response was indicated by six individuals, or slightly over 5 percent of respondents.

Conceptualizing Nutrients in Water

Nutrient levels. Respondents were asked: “In your opinion, are nutrient levels in Iowa’s waterways higher or lower than normal right now?” This question produced two main answers, as expected based on the question wording. The most common response was “higher” with 45 participants answering using that term. Twenty-four respondents answered “lower” or some variation of that term, and 17 answered either “I don’t know” or “no idea.” Other responses included statements such as “it depends” or “it depends where you’re talking about.”

Additionally, “normal” and “neutral” were also sometimes given as full or partial answers to this question, such as in the response, “I think normal, I was swimming in our creek a few weeks ago.”

There are several likely reasons for the high proportion of farmers who believe nutrients are currently high in Iowa. First, the issue of nutrients is and has been at the forefront of agricultural and mainstream media sources for several years in the state of Iowa. Thus, regardless of one’s particular interest in the topic, there likely has been exposure to the subject even if people were not motivated to investigate the issue further. This exposure (an individual seeing the words “nutrients” and “water”) may have primed people to believe the levels were higher than normal, since people may believe media are more likely to report on a problematic issue. Alternatively, because Iowa did experience heavy rainfall in the spring and summer prior to

interviews, many individuals may have been assuming levels were high due to increased nutrient runoff. Four survey participants did specifically cite rain in their response to this question. Regardless of the reason, these findings are likely to be considered promising to water quality experts in the state who assert that nutrient levels in Iowa's water are continuously increasing overtime (IDNR, 2015; Osterberg & Kline, 2014; USGS, 2017).

What is normal? Respondents were asked an additional follow-up question, "What are normal levels of nutrients?" This was helpful in establishing rapport with participants and because many participants themselves posed the question ("what is normal?") in their responses to the previous question regarding nutrient levels. Asking farmers how they defined normal nutrient levels was also intended to bolster understanding of the way farmers conceptualize nutrients in water overall.

Two-thirds of respondents answered that they did not know what normal levels of nutrients in water are. Of the responses that were offered, several referenced "safe" levels for human and animal consumption. Other respondents suggested that normal would depend on rainfall at any given time. Approximately one-tenth of the sample did mention the phrase "parts per million" in their response, though mostly to explain they could not remember well enough to name the exact number. Two individuals answered with the current acceptable maximum level of nitrates in water as determined by the EPA, 10 parts per million (EPA, 2017).

Nutrient description. To assess the second part of RQ3 regarding farmer's conceptualizations of nutrients in water, participants were asked "Can you explain to me what nutrients are and how they get in the water?" They were instructed to answer the question as if the interviewer was not from Iowa and had no knowledge of the topic whatsoever. Many respondents began by listing the chemical elements that comprise primary nutrients. These

include phosphorous, nitrogen, and potassium (EPA, 2017). Nitrogen was the most commonly cited of the three, and was mentioned in 22 responses. Phosphorus was mentioned in 15 responses and potassium was mentioned by seven respondents. Responses also commonly included a description of nutrients as “making plants grow.” For example, “Anything that we use to help plants grow. The big three are nitrogen, potassium, and phosphorus. Some are already there in the soil. We are also seeing a benefit from micronutrients and sulfur,” and “The elements that are needed by plants to grow, essentials to plant life, and to grow healthy crops.” Nutrients were referred to as “plant food” by five respondents, as in, “nutrients are what we feed crops and are like vitamins to humans, they act the same to plants, and then they can get in the water through runoff and tiles.”

Natural versus chemical. One-tenth of the respondents referred to nutrients as purely natural or coming from nature, while slightly fewer described nutrients as being man-made or completely manufactured. For example, consider the following responses: “The particles of products or chemicals not being absorbed by the soil and running off into the water supply,” and “Nutrients would be an added ingredient, man-made, they get in through poor land stewardship or conservation, no grass or buffer strips, a buffer strip can save a lot.” Several respondents described nutrients as fertilizer itself, such as, “Any extra fertilizer that isn’t used by crops and gets washed off.”

Similarly, the term “chemical,” was used by 11 farmers to describe nutrients. Chemical was most often used to describe fertilizer forms of nitrogen, phosphorus, and potassium that are different from nutrients already in soil or water. For example, responses such as: “Products both natural and chemical used in production of crops and waste products from livestock” indicate that chemicals are a man-made version of nutrients, even though all nutrients are chemical

compounds. This speaks to a broader issue related to scientific literacy and is likely not specific to Iowa farmers. This will be addressed at length in the final discussion chapter. At least one respondent indicated confusion with the term chemical, stating: “They are the particles from fertilizer and pesticides and herbicides, and nature, they are in the soil whether we measure it or not, I don't want to say chemicals, but elements, in the water.” Others added qualifying terms before the term chemical to try and refine their meaning, such as: “There’s a lot that come from nature, they are the products that we add to enhance our crops, those could be manure or commercial chemicals.”

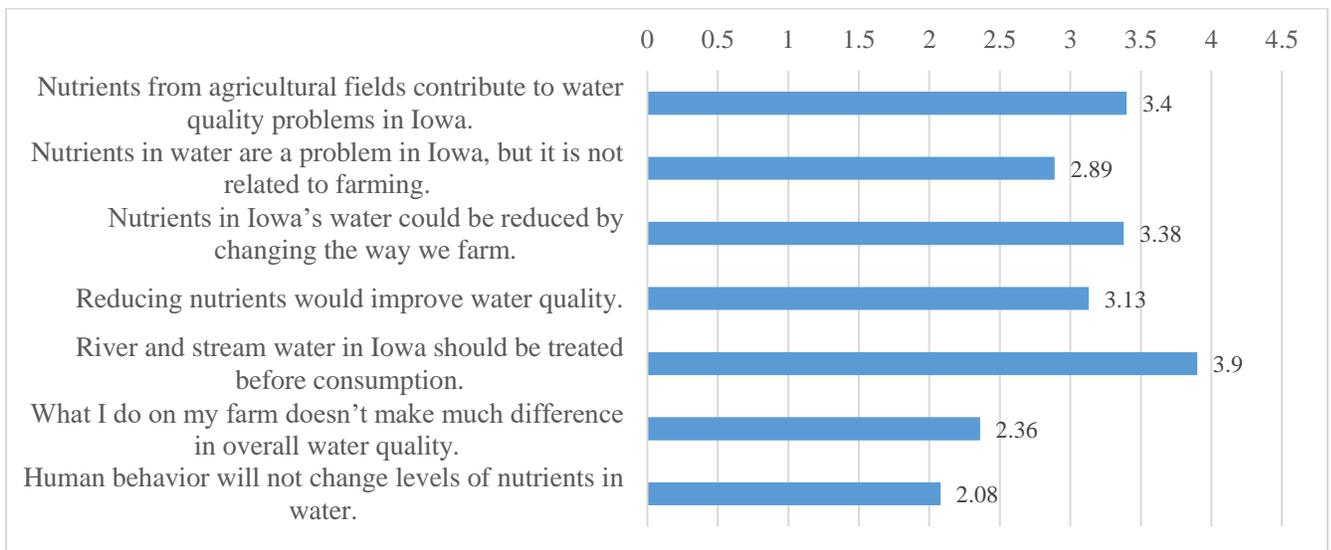
Nutrient versus pollution. Another term produced similar confusion among some participants—the term nutrient itself. Several respondents were unclear whether the term had a positive or negative valence, often asking whether they should answer from a perspective of nutrients as beneficial plant food or pollution. For example, one respondent stated: “I just came back from the Canadian glaciers and I drank the water and it was clear from pollution now... But what are the nutrients we are talking about, are they good or bad?” Another respondent was concerned by the use of the term nutrient throughout the questionnaire and repeatedly suggested it be changed to “pollutants.” This respondent stated: “Nutrients could be iron, sulfates, but the key is things coming off fields, like fertilizer, like from confinements, and uncontained pit or lagoons but I'd call it a pollutant not nutrient. If it's excessive, it's a problem.”

When asked to describe how nutrients get in our water, many respondents answered using the terms runoff or leaching. For example, responses such as “Runoff of fertilizer and anhydrous and plants don't use and it leaches off soil” and “Nutrients are food we use for plants and they get in water when they don't bind to the plant, they leach into the water” were common for this question. Runoff was mentioned in 32 responses while leaching was mentioned in 14. Other

common responses included discussions of parking lots and towns,. For example, one respondent answered: “Putting too much on house yards and washing down sewers after rain. Walmart parking lots from salt and oil in town if they don't clean it up. Farmers don't waste fertilizer; they only use what we'll need to make the crops grow this year.” Another respondent stated: “Nutrients come from a number of sources including parking lots, things like that, lawns, farm residue, golf courses, manufacturing still out of bounds, the yards and residential areas have a lot of negative input more than people really know.” Other similar responses included: “Every Tom, Dick, and Harry fertilizing their yards in town, and when rain is coming they go fertilize more,” and “Nitrogen is the main one, leaching from all the city lawns.”

Nutrient perspectives quantitatively. Seven nutrient belief statements were read to each respondent who was asked to indicate their level of agreement (i.e. Likert-scale responses from strongly disagree to strongly agree). Mean values for respondent agreement with each statement are displayed in Figure 5, below.

Figure 5. Mean Agreement for Nutrient Opinions and Belief Statements



Overall, respondents' beliefs related to nutrient issues in Iowa based on their rankings of agreement with these seven items trended towards the middle (indicating neutrality). However,

the results do indicate that farmers may believe nutrient issues in water are at least generally related to agriculture and that changes to behavioral practices on farm may impact nutrient levels.

Conceptualizing Risks

Respondents were asked one open-ended question “What are the risks, if any, related to nutrient excesses in water?” to assess the way farmers conceptualize risks associated with excess nutrients in water. The primary themes identified from this data fall into the following four categories (presented in order of prevalence): impacted water quality, ecosystem devastation, human health, and financial loss. Several subthemes within each of these themes also appeared and are discussed below. It is important to note that the themes were not necessarily mutually exclusive among participants as many respondents named two or more risk issues which fell into several of the thematic categories. For example, one response touched on all four:

Negative impacts to fauna, amphibians, fish, and some for people who eat the fish, because people who use waters for recreation are exposed to high bacteria which is harmful to humans and pets. There is a direct impact on water supplies and they are finding their way into drinking water, and that's costing much more money to remove.

The four primary themes and several subthemes are detailed below and are followed by the presentation of results from the quantitative risk assessment items in the questionnaire.

Impacted water quality. A large proportion of participants explicitly mentioned the terms “contamination” and “pollution” when answering this question. Several respondents simply made statements such as “Contaminates the water,” “Contamination for neighbors downstream,” “Water pollution,” or “Pollution of streams.” Other respondents answered only “water quality for human consumption,” “water quality – eventually we’re gonna drink it,” or

“water quality impacts for the state and country.” Each of these responses indicated some sort of threat to water quality but did not mention what mechanism this could occur through. Of the responses which did specify the source of contamination, pollution, or water quality impairment, nitrogen was the most common. For example, respondents made statements such as, “Higher levels of nitrogen,” and “Nitrates, some chemical residue.” One participant explained this further, stating: “Nitrates, anything on the table of elements basically, field spillages and stuff like that.”

Ecosystem devastation. Some participant’s responses indicate high levels of knowledge of the environmental effects of excess nutrients, such as hypoxic conditions. For instance, one participant stated: “Overgrowth of phytoplankton and fish getting starved of oxygen, also leading to proliferation of invasive species because of having so many nutrients available.” Two participants did explicitly mention the hypoxic zone, stating: “Hypoxic zone, nitrates in drinking water, PH leading to more algae, and “Dead zone in Gulf of Mexico, issue of human consumption, and wildlife issues.” Other responses illustrating concern for the potential environmental ramifications, included: “Quality of water will go down and wildlife will be effected if it gets too bad” and “Sick animals, like wildlife and fish.” Several participants referenced impacts on livestock. For instance, one participant stated: “For livestock - drinking chemicals from fields or for wildlife.”

Human health. Another theme related to negative human health impacts from drinking nutrients in water. One participant described the health risks as important to plants, animals, and human health, stating: “Depending on the nutrients there are health concerns, animal, plant, human, too much of a good thing isn't always good.” Some people explicitly used the terminology “health hazard” as in the response: “Pollution and health hazards if you drink it.”

Other participants discussed risks in terms of sickness, for example, “People could get sick if not filtered out.” Still other participants qualified their health-related responses by age. For example, one participant stated, “Sickness in elderly and children.”

References to nitrogen-induced blue baby syndrome were made by several respondents. Only one participant explicitly mentioned the syndrome by name, stating “Blue baby syndrome but that’s at 340 parts per million.” This response was surprising because the EPA asserts that 10 parts/million nitrate is the recommended standard to protect against blue baby syndrome (EPA, 2017; Knobeloch, Salna, Hogan, Postle, & Anderson, 2000) More will be discussed on blue baby syndrome in Chapter Five. Other responses indicated awareness of the syndrome without the full name, as in: “Babies can’t drink it, ecosystem, farm ponds,” and “Too much nitrates for babies.”

Financial loss. Respondents also commonly discussed financial implications related to nutrient excesses. These respondents generally described this in two ways: either as personal profit loss for farmers, or as additional costs for water treatment facilities. Demonstrating the potential for personal loss, consider the response: “It’d be money washing down the river.” This respondent viewed the risks of excess nutrients in water as resulting from a farmer over-application of nutrient-containing fertilizer. Instead of the crops utilizing this purchased source of nutrients, they are being swept into the water and wasting money. Another farmer explained: “And financial risks, if you paid to put it there then it’s gone - that’s money lost.” Descriptions of financial risks related to costs for utility companies often referenced the infamous Des Moines Water Works (DMWW) lawsuit. This respondent stated: “The Des Moines Water Works thing - the thing about it is the cost to remove them, though they still dump it back below Des Moines.”

Risk Perceptions Quantitatively

Several different measures of risk perceptions were assessed quantitatively, including financial riskiness, environmental and human health riskiness, risk likelihood, risk severity, and scientific certainty. See Table 6 below for the mean and mode values for each risk measure.

Table 6. Means and Modes for Risk Measures

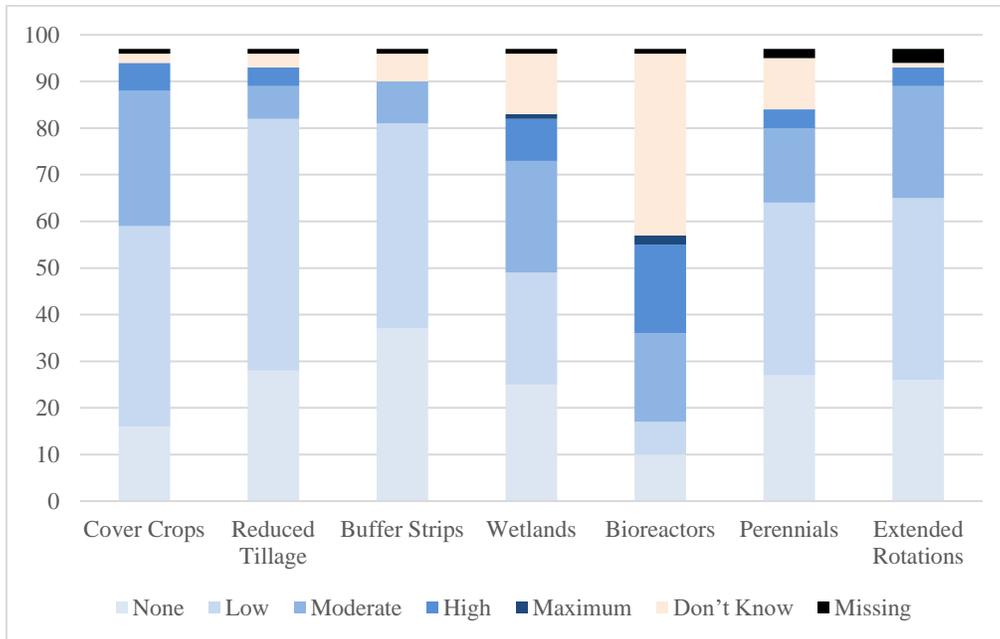
Measure of Risk Perception	Mean	Mode	Scale
Financial Riskiness	2.81	3	1-5
Environmental and Human Health Riskiness	3.35	4	1-5
Risk Likelihood	4.3	4	1-7
Risk Severity	4.09	4	1-7
Scientific Certainty	3.17	4	1-5

The resulting means from the risk-related measures trended towards the middle, indicating moderate perceptions of each risk measure. However, the mean and mode of the environmental and human health risk measure is slightly higher than that of the financial risk, indicating that farmers may view the potential threat of negative impacts to environmental and human health as slightly more threatening than lost profits. This does mirror the qualitative findings regarding risk perceptions in that slightly more respondents described the risks related to nutrient excesses in terms of ecological and health impacts than those who's answers centered on the financial implications. However, additional research is needed to comprehensively understand the way farmers view such risks and the potential relationships between different types of risk perceptions related to water quality issues in the agricultural community.

Perceived financial risk of nutrient-reducing practices. Because of previous research showing how perceived financial risk may negatively impact farmers' adoption of new practices (Marra et al., 2003), participants were asked to rank how risky they considered adoption of each

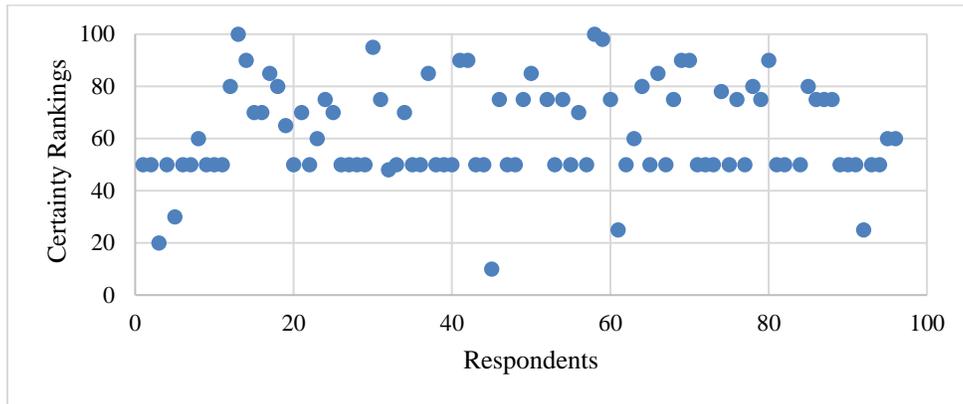
practice to be, specifically in terms of financial profit. The results indicate that farmers view reduced tillage and buffer strips (the two practices most prevalent among respondents) as the least risky, while they considered bioreactors and wetlands the riskiest. See Figure 6 below for complete risk rankings.

Figure 6. Perceived Financial Risk of Adopting Each INRS Recommended Practice



Uncertainty of financial risks of practices. Respondents were also asked to rank from 0 (completely uncertain) to 100 (completely certain) how certain they felt about their risk ratings for the practices overall (range:10 – 100, $Mdn = 50$, $M = 61.9$, $SD = 18.32$). As demonstrated by the scatterplot of responses, shown below in Figure 7, the responses trended toward the middle. Because of the distance from zero and 100 for most answers, these responses indicate low certainty overall.

Figure 7. Scatterplot of Uncertainty of Financial Risk Responses



Use of Nutrient Reduction Practices

Farmer's self-reported current use of seven different nutrient reduction practices on their farms were assessed to better understand the land management behaviors of respondents. This data was also used to answer RQ4 (*How do farmer's beliefs about nutrients and perceptions of risk, uncertainty, and norms correspond to their current use of nutrient reduction practices?*) through a summative scale which combined the dichotomous data on farmer's use of each practice into one composite measure of number of practices used.

Participants were asked whether they currently used seven INRS recommended nutrient reducing practices, including: cover crops, reduced tillage, buffer strips, wetlands, bioreactors, perennials, and extended rotations. Reduced tillage was the most common practiced utilized among respondents, with 88.7% (n = 86) of participants reporting use of the practice. Bioreactors were the least prevalent practice used with only one participant reporting use. See Figure 8 below for all descriptive data on current practice use and see Figure 9 for descriptive data on the number of practices participants used based on the sum scale created for the correlation analysis. Please note, four respondents did not have any farm land in production and thus were marked as 'not applicable' for each practice, so the total number of respondents potentially answering this section was 93.

Figure 8. Current INRS Recommended Practices Used

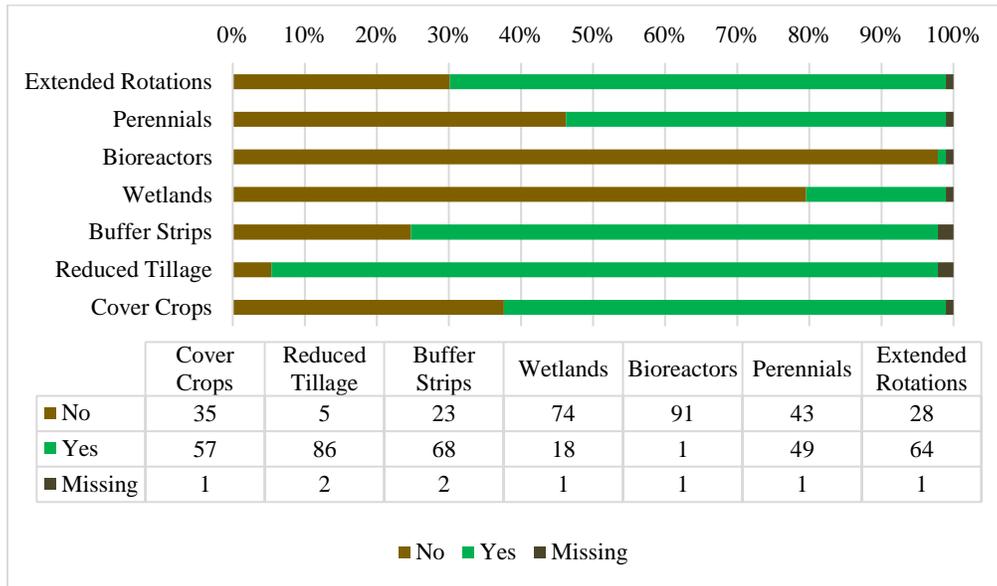
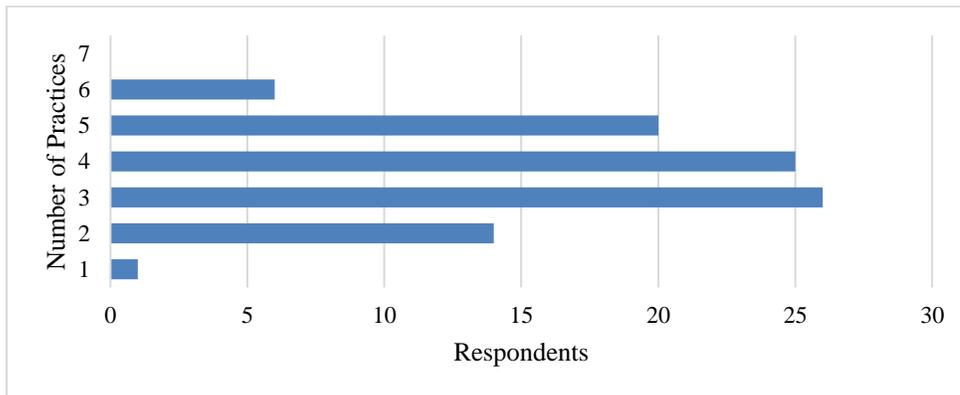


Figure 9. Number of Practices Reported



Number of practices and perception variables. Pearson’s product-moment coefficients of correlation were computed to assess and compare the strength of association between the number of practices a farmer currently uses on their land and each of the other the perception based composite measures (i.e. financial risk, environmental and human health risk, risk likelihood, and risk severity, uncertainty, and norms). The method allowed for the quantification of both the direction and strength of the linear relationships (Hayes, 2010) between respondents’

perceptions a, only the correlation between norms and number of practices was significant ($r = -.228, p < 0.05$).

These findings suggest that the more INRS recommended practices a farmer currently uses, the lower the farmer's agreement with the normative influence statements. In other words, the more practices a farmer uses the less likely he is to believe many other farmers also use the practices. In some sense, these results lend support to the findings of Ritter (2012) that subjective norms were the best predictor of conservation behaviors among farmer in Ohio—though this relationship is not so straightforward in this study. This finding is interesting because it may indicate that perception of what other farmers are doing on their fields is working against the diffusion process, in that nutrient reducing practices have not yet hit critical mass levels. Or, this indicates that farmers may not feel the pressure of normative behaviors related to INRS recommended practices, indicating their motivation for adopting such behaviors is not prompted by normative influences.

Number of practices and perceived financial risk. One post-hoc correlation analysis was conducted due to the extensive literature documenting the relationship between perception of financial risk and reduced adoption of conservation agriculture practices (Marra et al., 2003). The number of practices scale and perceived financial risk of each of the seven practices were assessed. Bioreactors ($r = 0.232, p < 0.01$) and extended rotations ($r = -0.320, p < 0.05$) were significantly correlated. These findings indicate that perceptions of higher financial risks of using bioreactors are associated with adoption of more nutrient reduction practices, whereas low risk perceptions for extended rotations are associated with adoption of more nutrient reduction practices. Both results indicate the potential for a knowledge-based effect moderating the relationships between perceived risks and adoption of practices.

Barriers to Adoption of INRS Practices

Correspondingly, to answer RQ4a (*What do farmers believe are the primary barriers to the adoption of nutrient reduction practices among more Iowa farmers?*), farmers were asked to describe what they believe are the primary reasons other farmers in Iowa might *not* want to try any nutrient reduction land management practices on their farm. Most responses were related to a) cost/financial implications of trying new field practices and b) aversion to change/loyalty to tradition among farmers, or c) both.

Cost. Costs related to one practice in particular, cover crops, were discussed by many respondents. This is highlighted in the response: “Cost. I’m doing the numbers for cover crops right now and it’s a lot of money for establishment. And extermination is a bigger deal for corn, whereas beans can thrive on them.” This statement brings up a potentially unintended consequence of using cover crops to reduce nutrient losses—the need to eventually exterminate them before planting corn or soybeans. Due to the popularity of cover crops within articles assessed in the previous study (Chapter Three), and their prominence among farmer responses in this study, cover crops will be discussed further in the final discussion chapter.

Another topic that appeared among some of the cost-related responses was the amount of farmable land that is lost by using certain nutrient reduction practices. For example, one respondent stated, “Cost, and takes more of the farmland up.” This participant is referencing the way certain practices, such as buffer strips, require farmers leave areas of land surrounding waterways unfarmed. The purpose of this is to provide greater natural filter area for nutrients running off fields before they make it into the water ways. Additionally, restoring wetland areas—one of the most effective nutrient reducing practices based on percent of nitrogen reduction potential (INRS, 2015), also requires farmers to give up producible land.

Another respondent's answer touches on this theme in a slightly different way, stating: "Cost of production is up, prices are lower, so harder to get ROI. Certain farmers believe they need to farm every acre they have, so they give it a bad name." This type of response echoes sentiments from responses to earlier questions which attribute responsibility only to certain types of farmers. Several other respondents' answers express similar sentiments. For example, one participant stated: "Greed. Some people want to farm every last inch. We make our waterways 100 feet." Another respondent answered: "Inputs and return on yields, a lot don't care as much about water quality as much as how it is going to pay off for them financially."

Aversion to change. Another important theme relates to "Change, farmers don't like change." Responses included sentiments such as "fear of change" and "[farmers are] stuck in their ways." One respondent described the reluctance to change land-practices as an inherent personality trait of farmers, stating "Financial investment, change is hard - and not in farmer's nature, historic practices because we've always done it this way or it's how our neighbors do it." Respondents also highlighted tradition as a concern, with several farmers using the word "tradition" as their sole response and several other farmers alluding to it through statements such as "Because their dad didn't and they haven't before." Several respondents described this notion of aversion to change as stubbornness, with one farmer answering simply, "Stubbornness. Ya know, Iowa stubborn."

Another respondent related farming tradition with one particular agricultural corporation. The respondent stated: "Monsanto makes things pretty clear cut to do it their way... The transition to these practices can be costly, tradition is important to farmers, uncertainty about risks or yield losses, lack of awareness of environmental effects." This is important to highlight from the standpoint of Monsanto, the company, and their personal connection to this farmer.

This response indicates that Monsanto represents this notion of “farming tradition.”

Correspondingly, this response highlights the way Monsanto has been able to offer products and protocols which have become the path of least resistance for farmers’ land management decisions.

Several farmers described this type of change aversion as being related to age, as in the response, “Old timers set in their ways.” Another explained that age might work against farmers’ willingness to try new practices in a different way, stating: “Older people farming and they want to quit, so maybe they have only 5 years to go and they don't want to spend money for only a short time more.” Some participants mentioned age in the opposite way, expressing optimism about the future generations’ likelihood of adopting nutrient reducing farming practices, for example, “They don't like change. But I do think the younger farmers will adapt.”

Other answers. Another interesting notion that was expressed regarding farmer’s unwillingness to change, was related to the types of people advocating for these changes. For example, one respondent stated: “Outsiders coming in and giving advice to people who have been doing it and they are set in their ways and it’s hard to get your head wrapped around change.” A different respondent described the ‘outsiders’ referenced in the above response in more detail, stating:

Iowa farmers tend to stick with what is yielding results now. Change being advocated by more educated people/academics makes them really skeptical, and really anti-government, so it feels like interference. It’s also more work, planning, and a little more money, and many don't look at it as farming for the next generation anymore.

This respondent touched on an anti-government theme that resounded in several responses, mostly related to the difficulties of adopting new practices which provide government subsidies.

For example, one participant described his experience working with governmental subsidy programs, stating: “Red tape from government programs, lots of strings attached, so you have to answer to FSA to do anything, it’s like permit to farm, which everyone is afraid of.” This response demonstrates a similar ‘fear of regulation’ perspective to messages uncovered in the previous textual analysis study (Chapter Three).

Social pressures related to implementing practices was mentioned by one participant, though not in the way it might be expected. The participant stated: “Cost of implementation, and some social pressure against the practices - doing most of these is still like being the weird kid in class.” This response is interesting considering the wealth of information about these practices which appeared in the two agricultural media sources from the previous study (Chapter Three), and the general familiarity most participants had with each of these practices. However, considering the low proportion of adoption of several specific practices (i.e. wetland restoration, bioreactors) further specification as to which practices the respondent was referring to in his response would be helpful to understanding this notion.

Renter status among farmers was also mentioned by at least one participant. This participant stated, “Depends on how long they plan to rent or farm where they are, and whether they care about the land. If they are paying rent they need every last inch to get back with the low commodity prices and especially with high rent.” Considering the concerns relating to cost that were expressed by a high proportion of responses, it does follow that financial concerns would be paramount among farmers who also have the burden of paying rent for their field.

Finally, a few farmers referenced their own uncertainty via inconsistencies in the information they have received about different practices. For example, one farmer stated, “Well, like cover crops can reduce yield and can kinda pack the soil. They [farmers] are getting

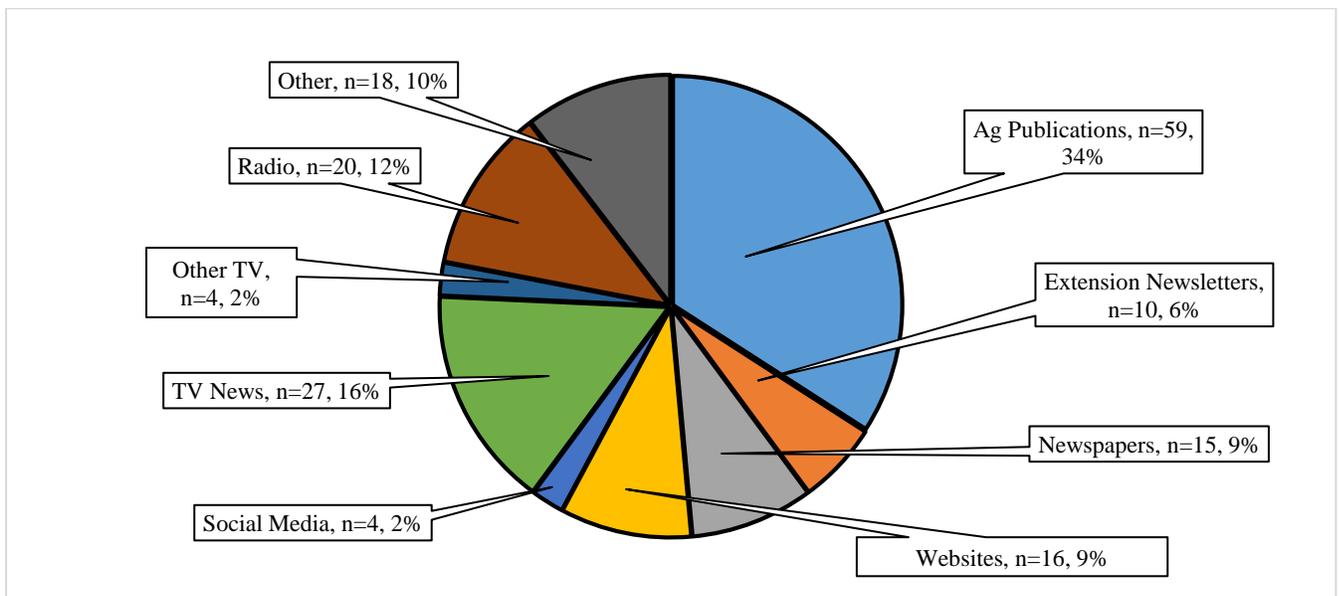
contradictory advice. You can't use less fertilizer and less tillage.” The notion of receiving contradictory advice does indicate the participant’s level of uncertainty related to information he has received about these practices.

Information Sources

To answer RQ5 (*Who do farmers identify as influential individuals and mediated sources for water quality related information and land management practices?*), farmers were asked what sources of media they consume to gain information about water quality issues in Iowa, what organizations in Iowa have been important sources of water-quality information for them, and who they talk to in general about land management practices. Next, they were asked to name the one person who was most important to their own water related land management practices. The findings from each of these questions are presented below.

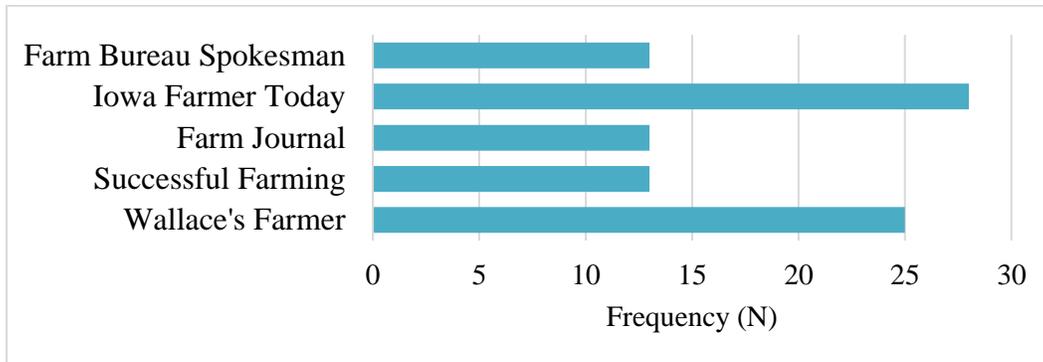
Mass media. The media sources respondents named as most important for water quality related information are shown in Figure 10, below.

Figure 10. Media Cited by Respondents as Most Important Information Source



By far, agricultural journal publications were the most commonly cited source of information for farmers, echoing Chiu et al.'s (2015) recent research on Iowa farmer communication preferences. The frequencies (N) of the top five agricultural journal publications are displayed in Figure 11, below.

Figure 11. Top Five Agricultural Publications Cited as Primary Information Source



This figure lends support to the sources explored in the previous textual analysis study (Chapter Three) by demonstrating the high readership of Iowa Farmer Today and the Farm Bureau Spokesman. While agricultural journals were the most prevalent source, many other information sources were also listed as important by respondents. See Table 7, below, which details all other media respondents mentioned.

Table 7. Water Quality Information Sources (Excluding above Agricultural Publications)

Type	Detail	Number
Handouts/ Newsletters	Agricultural Consulting Services (ACS)/ (FSA)	3
	Stutsman's Inc.	1
	Department of Natural Resources (DNR)	5
	Trade/commodity organizations	9
	“WMAs”	1
	Clear Creek WMA	2
	English River WMA	2
	Natural Resources Conservation Service (NRCS)	5
Newspapers	Cedar Rapids Gazette	6
	Iowa City Press-Citizen	2

Table 7—continued

	Des Moines Register	5
Local TV News	KCRG	15
	KWWL	2
	WQAD	1
	Fox	2
Other TV	RFD-TV	3
	AgDay	1
	Market to Market (PBS)	5
	CNN	1
Websites	"Internet"	1
	"Ag websites"	1
	DNR	1
	Facebook	4
	Twitter	1
	UI Hygienic Lab	1
University	Brownfield Ag	1
	University of Iowa (UI)	1
	Iowa State University (ISU)	1
	"my professors at ISU"	2
Radio	WMT	9
	KCII	1
	KBOE	1
	WHO	3
	PRI	1
	NPR	1
Other Ag Journals	CropLife	1
	Hoard's Dairyman	1
	Angus Journal	1
	Forage	1
	Soybean Digest	3

Organizations. The organizations farmers named as the most important sources of water quality information are listed in Table 8 below. Farmers often mentioned more than one source in their responses and the organizations which were mentioned frequently by participants did mirror the most frequently cited organizations found through the textual analysis (Chapter Three). For example, both ISU and the Farm Bureau were mentioned frequently by participants and news articles.

Table 8. Most Important Organizations for Water Quality Information

Organization	Number of mentions
Iowa State University (ISU) Extension	19
None	18
Farm Bureau (FB)	17
Natural Resources Conservation Services (NRCS)	15
Iowa Soybean Association (ISA)	13
Iowa Corn Growers Association (ICGA)	8
United States Department of Agriculture (USDA) Office	7
Farm Service Agency (FSA or ACS)	5
Iowa Cattleman's Association (ICA)	4
Department of Natural Resources (DNR)	3
Iowa Heritage Foundation	2
I don't know	2
Washington County Conservation	2
Washington County Extension	2
Iowa Institute for Hydraulic Research (IIHR)	1
Iowa Flood Center (IFC)	1
Agribusiness Association of Iowa (AAI)	1
Pheasants Forever	1
Watershed Management Authorities (WMAs)	1
Practical Farmers of Iowa (PFI)	1
Future Farmers of America (FFA)	1
Nebraska University Extension	1
Eastern Central Iowa Council of Governments (ECICG)	1
Monsanto	1
Dupont	1
University of Iowa (UI)	1
Total	129

Interpersonal influencers. When asked about who farmers generally talk to regarding their land management decisions, the majority reported talking to either: a) other farmers/neighboring farmers, and/or b) the individuals they buy agricultural products from. See Table 9 for the complete list of responses, below.

Table 9. Important Interpersonal Information Sources

People	N
Neighbors and other farmers (around me, near me, that we trust, with bigger operations, Amish, organic)	41
Sales associates/dealers (chemical (9), feed (1), seed (15), fertilizer (12), equipment (1))	38
Family (Son (3), Dad (4), Grandpa (1), wife (2))	20
Agronomist	15
Local co-op	7
Farm Service Agency (Also called ASC or USDA)	5
Banker	3
Friends	3

The finding regarding other farmers/neighboring farmers is expected following the robust body of scholarship on agricultural decision-making which highlights the influential role of neighboring farmers (Conley & Udry, 2001, 2010; Feder & Slade, 1984; Lapple et al., 2015; Nowak, 1992; Padel, 2015). However, the findings regarding agri-industry sales associates is interesting and important to consider when taken in combination with the results from the first study (Chapter Three) regarding the pro-agriculture perspectives on the origin of nutrient problems and risks related to Iowa’s water quality. Correspondingly, it is important to consider that these sales associate individuals are also making their own livelihoods based on the sales of current conventional agricultural products, which correspond to conventional practices. For example, a fertilizer sales person may have a higher incentive to oversell a farmer fertilizer, rather than spend time discussing alternative fertilizer application rate schedules which would decrease the total amount of fertilizer the farmer needs. Or, a seed dealer may be less enthusiastic about promoting the adoption of buffer strips or wetland restoration due to their own financial bottom line benefiting more from farmers planning to seed more area of their field and thus buying more seed. However, these potential explanations cannot be confirmed without additional research directly with agri-industry sales associates to investigate their perspectives and

motivations. Two such agri-business representatives are interviewed in the subsequent study (discussed in the following chapter).

Respondents were also asked to name the one person who was most important to their water-quality related land management decisions. Table 10, below, shows entities and descriptions of individuals named by respondents. The names of individuals who were mentioned were not listed due to privacy considerations as instructed by the IRB (ID #: 201403809).

Table 10. Influential People and Their Associated Descriptions

Entity	Details	N
<i>Entity-associated individuals</i>		
NRCS	"Iowa Co office", Head of Iowa Co. NRCS office, Johnson County office, Washington County office	8
Stutzman Inc.	Owner, Head of agronomy, Precision Ag Specialist, "people"	8
ISU	"extension workers," "Professors"	5
DNR	"people", a former director	3
Farm Service Agency	"people"	2
Hertz Farm Management		1
WHO Radio		1
<i>Non-entity associated individuals</i>		
	"No one specific"	27
	Farmer/Friend/Family	13
	Spokesman for cover crops/no-till (one person)	6
	Neighboring farmer	4
	Iowa's Agriculture Secretary	3
	"My agronomist"	3
	"Amish Farmer"	2
	"Big Farmer"	2
	Feed salesman	2
	Ag Instructor in FFA chapter	1
	Chemical salesman	1

Table 10—continued

	Clear Creek WMA member	1
	Internship supervisor	1
	Local Ag Store Employee	1
	Owner, Gingrich Wells	1
	Vice President for Cattleman's Association	1
Total		97

More will be discussed regarding these individuals, including the method for selecting influentials to be interviewed, in the subsequent study (Chapter Five).

Discussion

The purpose of this study was to better understand how farmers conceptualize risks related to nutrients in water; who and what are influential information sources about nutrients in water; and the potential connections between farmer’s perceptions of the key variables and their current nutrient management practices. The overall focus of this study was not generalizability, but rather to produce findings that helped illuminate nuanced conceptualizations of understudied phenomena within the farming community. Several key findings emerged through the analysis of the data from the face-to-face surveys of 97 Iowa farmers.

The confounding use of the term ‘chemical’ was notable within responses to open-ended questions, and highlight the need to consider the role of scientific literacy in shaping risk perceptions related to nutrients in water, and ultimately the diffusion process related to environmental risk information. The findings aligned with what Losch (2014), a biochemist and chemistry blogger, writes about regarding the colloquial use of the term “chemical” to indicate something is manmade and not natural. This also corresponds to the confusion noted by some participants at the term “nutrient.” This was particularly prominent among the women participants and non-row crop farmers. These individuals found it difficult to answer questions

related to negative outcomes from nutrients and often asked why the term “pollutant” was not being used in lieu of nutrient.

In a similar vein, the number of participants who answered the open-ended questions related to nutrients with nearly identical messages to those found in the previous study (Chapter Three) was striking. Particularly interesting were the responses related to attribution of nutrient runoff to urban areas and people. Numerous participants suggested that cities, towns, golf courses, and individual home owners were primarily to blame for the water quality problems in Iowa. Other respondents made statements that seemed to indicate their own internal struggle between the two perspectives (pro-agriculture and pro-environment) by qualifying any answers which might implicate farmers with statements about nutrients being natural or weather being the ultimate culprit. Overall, the findings regarding the way respondents’ answers directly echoed key messages promulgated through agricultural media indicates that both selective exposure to media (perhaps as a mechanism of uncertainty management), and media literacy, may be influencing risk perceptions and potentially acting as barriers to the diffusion of environmental risk information.

Finally, the discussion of key barriers to adopting nutrient reduction practices yielded important findings related to social influence. While financial considerations were expected because farmers, just like other business owners, depend on profit, the volume of respondents who noted “aversion to change” and “tradition” was unexpected. However, farmers have long been considered change-averse, with scholarship documenting this dating back to Ryan and Gross’s (1943) seminal study of hybrid corn seed (Rogers, 2010). Ryan and Gross (1943) found that most farmers would not adopt the seed until they had spent several years experimenting with it on their own farms. The need to heed tradition by respondents in this study reflects a notion of

incompatibility, or the opposite of what Roger's (2010) means by compatibility, "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (p. 266) related to INRS recommended practices. This, taken in combination with the significant, negative correlation found between number of practices and social norms, may also indicate that observability, "the degree to which the results of an innovation are visible to others" (p. 266), is also currently low.

Each of these findings help provide a foundation for the subsequent study (Chapter Five), which explores the role of interpersonal influence within farming networks and the diffusion of risk information. The practical and theoretical findings from this study will be discussed in the final chapter (Chapter Six) in the dissertation, as well as study design strengths and limitations.

CHAPTER FIVE: UNDERSTANDING THE INFLUENCERS: WHO THEY ARE, WHAT THEY KNOW, AND WHO THEY KNOW

The importance of certain individuals within a social system has been recognized since Lazarfeld, Katz, and others (1948; 1955) early work on the flow of information throughout social systems. While these individuals, often deemed opinion leaders in diffusion research, are considered vital mechanisms in the diffusion process because other people look to them for information and advice (Rogers, 2010), various nuanced conceptualizations of interpersonal influencers abound (Keller & Berry, 2003; Nisbet & Kotcher, 2009). Greenhalgh et al. (2007) emphasize the role of champions as enthusiastic supporters of a new idea—which is distinct from opinion leaders who do not necessarily support or endorse all new ideas (Rogers, 2010). Correspondingly, innovators, who are generally less integrated within local social systems, are also the least risk-averse individuals who launch new ideas into social networks from the outside (Rogers, 2010). These alternative but parallel influential forces are important to consider because as Locock et al. (2007) suggest, the co-existence of several key, but oppositional, influential powers could act to stall important community changes. Considering the promotion of so-called ‘champion farmers’ by some groups in Iowa, it is important to investigate influential agricultural networks. This also provides a useful case study to assess whether influencers in modern agricultural communities align with traditional conceptualizations of influencers.

Research Questions

Based on the literature reviewed in Chapter Two related to interpersonal communication’s role in shaping risk perceptions; the way interpersonal influencers within social networks drive the diffusion process; and the ambiguity of current conceptualizations of the various types of influencers within this process, the following research questions are posed:

RQ6: How do influential individuals within the agricultural community (i.e. individuals who were identified as influential in Studies One and Two) conceptualize the state's water quality problems and risks related to these problems?

RQ6a: How do influentials' conceptualizations conflict or align with farmers' conceptualizations of water quality and risk (in Chapter Four) and with dominant themes emerging from the textual analysis (in Chapter Three) related to water quality and risk?

RQ7: How do these individuals conceptualize their role as a source of information/influence?

RQ7a: How do the individual's perceptions of their role compare with their networks' perceptions of their influential power; and how does this compare to theoretical conceptualizations of influentials?

To answer these research questions, in-depth interviews were conducted with the individuals who emerged as most important to farmer's water quality related land management decisions in the previous study (Chapter Four). Interview transcripts were analyzed for emergent themes in order to compare definitions of influence from the level of the individual (i.e., self-identification as an influential), community (i.e., identification of an influential by their fellow farmers), and media narratives (i.e., identification of an influential in an article), in addition to definitions of influentials from scholarship on network influencers. The remainder of this chapter is organized as follows. First, justification for the use of in-depth interviews and description of the sampling and data analysis procedures are provided. Next, findings are presented and discussed related to the way interviewees conceptualize water issues and nutrient risks in Iowa, how they conceptualize interpersonal influence in the realm of agriculture in Iowa. The chapter concludes

with a brief final discussion to synthesize key findings and highlight several theoretical and practical implications which will also be discussed further in Chapter Six, along with the study's strengths and limitations.

Method: In-depth Interviews

Justification

In order to answer these research questions, and understand how influential individuals within the agricultural community conceptualize the state's water quality problems and their role in communicating about the problems and potential solutions, in-depth interviews were conducted. The interview is a "face-to-face interpersonal role situation in which one person (the interviewer) asks a person being interviewed (the respondent) questions designed to obtain answers pertinent to the research problem" (Kerlinger & Lee, 2000, p. 693). The process of conducting in-depth interviews is described as "flexible, iterative, and continuous" as opposed to the "locked in stone" structure of a survey questionnaire (Rubin & Rubin, 1995, p. 43). Kerlinger and Lee (2000) describe interviewing "as an art" (2000, p. 694), while Babbie (2013) describes the process of interviewing as analogous to an aikido master redirecting an opponent's blow: "instead of trying to halt your respondent's line of discussion, learn to take what he or she has just said and branch that comment back in the direction appropriate to your purposes" (p. 318).

The method of in-depth interviews was selected because it is best suited to answer the research questions, which inquire about the way respondents conceptualize study variables and their own role as influencers in the agricultural community. Correspondingly, in-depth interviews are the only method which allowed for the discovery and evaluation of nuanced differences between respondents' own conceptualization of their role as influencers, other farmer's conceptualizations of the influentials' roles as influencers, mediated conceptualizations

of the roles of agricultural influencers, and theoretically derived notions of what it means to be an influencer within a social system.

Considerations of validity and reliability. There are many advantages to the use of interviews. The interview is “adaptable, capable of being used with all kinds of respondents in many kinds of research, and uniquely suited to exploration in depth” (Kerlinger & Lee, 2000, p.699). Through this potential for greater depth of exploration, interviews results can yield more valid results than many other social science research methods. Babbie (2013) states that interviews allow for a researcher to “tap a depth of meaning in concepts” (p.325) that is generally unavailable in other forms of data collection, and this depth of meaning can significantly bolster the internal validity of the research.

However, there are also disadvantages of interviews including their cost in time, energy, and the degree of skill required for the construction of interview items and successful interview procedure (Jäckle et al., 2013; Kerlinger & Lee, 2000). Interviews also produce data that may not be reliable to a broader population of study. However, as suggested in the previous studies, involving other researchers, individuals, and even the participants themselves in the analytic process; and carefully attending to the detailed and transparent description of methodology, data collection, and analysis; helps alleviate some of the validity and reliability related concerns in this type of research.

Sampling

In Chapter Four, farmers surveyed throughout the Middle and Lower Iowa River Watersheds were asked to identify the people whom they consider most influential to making their water-related land management decisions. This method, called ‘sample sociometric,’ has been greatly utilized and is recommended by many scholars for its high validity in identifying

opinion leaders and influentials within social systems (for overview see, Hossain, 1995; Long et al., 2015; Rogers & Cartano, 1962; see Valente and Pumpuang, 2007). The method entails interviewing a sample of the community and soliciting names of the individuals considered influential by the community members. This type of strategic sampling methodology is not meant to produce a generalizable sample. Instead, the goal is to facilitate a highly specific, nuanced evaluation of a particular network by identifying certain individuals having unique positions of influence within the community.

The sample of individuals for this study came directly from the data collected in the previous study (Chapter Four). Individuals named by two or more survey participants were considered potential interviewees. Additionally, data analysis from the thematic analysis study (Chapter Three) yielded a list of individuals who emerged as important spokespeople within the agriculture/water nexus. This list was compared to the list of individuals named by farmers and used to identify individuals mentioned by survey respondents. Two individuals appearing in the thematic analysis data as key spokespeople were also mentioned by one participant (each) in the survey data, and were added to the sample. This strategy is similar to the ‘positional’ approach described in Valente and Pumpuang’s (2007) review of opinion leader identification methods (the method relies on recruiting people who hold leadership positions within certain communities).

In general, sample sizes for qualitative studies follow the concept of saturation, or when “the collection of new data does not shed any further light on the issue under investigation” (Mason, 2010). Based on previous literature indicating a consensus in recommended sample sizes for research of this type, a goal of 10 to 14 participants was set forth (Guest, Bunce, Johnson, 2006; Creswell, 1998; Morse, 1994; Mason, 2010; Pearsall, 2014). However, because

the sample was dependent on the previous survey data which yielded few individuals named by multiple respondents, inclusion criteria was relaxed to include individuals named by two participants and individuals named by one participant if they were among the list of key spokespeople identified in the thematic analysis. This process yielded nine individuals who were recruited for participation in the present study. Six individuals were able and willing to participate. All participants provided informed consent per IRB protocol (ID #: 201403809), and provided consent for the use of their real names and titles in this dissertation.

Procedure

Potential interviewees were contacted by telephone or email and were informed about the research purpose and objectives. Informed consent was obtained during this phase. All interviews were conducted during Spring 2016. All interviews were recorded via digital voice recorder, following participant consent. Total interview length varied between 45 minutes to five hours, with the average being 95 minutes and a median of 50 minutes. No compensation was provided. All participants were offered an email copy of all reports and subsequent publications from the study.

All interviews were conducted in-person. They followed a semi-structured format, comprising of a series of open-ended questions as a starting point. Open-ended questions for in-depth interviews are “flexible; they have the possibilities of depth; they enable the interviewer to clear up misunderstandings (through probing), to ascertain a respondent’s lack of knowledge, to detect ambiguity, to encourage cooperation and achieve rapport, and to make better estimates of respondents’ true intentions, beliefs, and attitudes” (Kerlinger & Lee, 2000, p. 696). If a respondent seemed most interested in talking about one question more expansively, the semi-structured format allowed for this process to continuously and organically unfold. All interview

questions were designed to be neutral and non-leading (Long et al., 2015). Please see Appendix C for full interview guide.

The objective of the research was twofold: first, to uncover the way the respondents conceptualize Iowa's water quality and nutrient issues, with special attention to their perceptions of risks, uncertainty, and norms associated with nutrients in water and nutrient reduction practices. These questions aligned with the open-ended questions about these topics used in the survey research for this dissertation (Chapter Four). The second objective of the research was to comprehensively cover the topic of personal influence, specifically regarding the agricultural realm. The three dimensions of opinion leader qualities, per Katz and Lazarsfeld's (1955) foundational work, appear consistently within Diffusion of Innovations and other literature on influencers (Nisbet & Kotcher, 2009; Rogers, 2010; Weimann et al., 2007). These dimensions include personal values ("who one is"); competence, expertise, and knowledge ("what one knows"); and social position, such as number of contacts/friends/acquaintances ("whom one knows") (Katz, 1957, p. 10; Nisbet & Kotcher, 2009). Correspondingly, literature also consistently points to the information seeking, information providing, and social embeddedness functions of opinion leadership (Burt, 1999; Nibset, 2006). These interrelated personal and behavioral dimensions helped guide the types of questions posed to interviewees. Discussion with interviewees regarding these dimensions were prompted by questions regarding their own personality traits, personal values, education, credibility, expertise, and social and career related positions (sometimes called accessibility) within agricultural networks, based largely on Weimann et al.'s (2007) Personality Strength Scale. Additionally, several questions in the interview were adapted from Keller and Berry's (2003) self-identification scale (Nisbet (2009) calls this the 'Engagement Model of Opinion Leadership'). These questions included items such

as the amount of daily contact the interviewees have with farmers; their degree of political and community activism; whether they consider themselves to be influential; and why they believe others would have named them as influential.

Analysis

Transcription of recorded interviews (through Rev.com) and typing all notes occurred as soon as possible following each interview (Kvale, 2009). Interview transcripts were analyzed according to Glaser's (1965) constant comparative methodology. This method is an "iterative and inductive" process involving continual coding, comparison, and recoding of the data (Fram, 2013). Tesch (1990) describes the goal of constant comparative analysis as being "to discern conceptual similarities, to refine the discriminative power of categories, and to discover patterns" (p.90). This technique was well suited for the analysis because conceptual comparison and comparison across levels was a primary objective of the study.

The analysis procedure began by open coding the data to develop categories, as with the thematic analysis in Chapter Three. The following five stages of comparison were performed based on a list of interview comparison types, adapted from Boeiji (2002). First, comparison occurred within each interview. This involved replaying the digital recording of the interview and using the written transcripts to begin attaining a general understanding and summary of interview, followed by open-coding and developing categories. Next, comparison occurred between interviews. Building on the codes from individual interviews, typologies or clusters of interviews with similar, relevant themes were produced. Also, concepts relevant to the research questions (such as how the influentials conceptualized risk related to water quality in Iowa) began to emerge based on the identification of patterns across interviews. Careful attention was paid to inconsistencies and differences between the interviews at this stage, and subsequent re-

categorization occurred. Subsequently, the next two stages of comparisons involved comparing the emergent themes to the findings from the thematic analysis and survey research in Chapters Three and Four. Finally, the dominant themes emerging related to influence within this dissertation context were compared with conceptualizations of opinion leaders and other terms used to describe influentials (i.e. champions, mavens, innovators, positive deviants, etc.) within the literature. One other person who was not a participant within this study but was knowledgeable on the topic helped review the codes and themes as they emerged for consistency and strength of validity (Babbie, 2013; Denizen & Lincoln, 1998; Long et al., 2015).

Findings

This analysis provides the third investigation in this dissertation into the flow of environmental risk information and influence within the agricultural realm, this time by focusing on influential individuals. In addition to describing the way these individuals conceptualize key variables related to risk and water quality, the analysis also compared conceptualizations of influence across interviewees, findings from the previous two studies, and theory. The findings presented in this final case study are presented in the following three sections. First, a brief description of demographic information of interviewees is provided. Next, findings regarding interviewee conceptualizations of Iowa's water quality and nutrient risks are presented. Lastly, findings related to conceptualizations of influence are presented.

Influential Demographics

The final sample included one farmer widely-known for his use and promotion of cover crops and no-till practices, two local government employees working in the realm of natural resource conservation, two executives within one local agricultural business entity, and the Secretary of Agriculture for the state of Iowa. See Table 11 (below) for names and details. The

six respondents ranged in age from 48 to 77 and have all lived in Iowa for at least the past 30 years. Five of the six are employed as farmers or their livelihoods are directly related to the agricultural realm. Five of the six live in Eastern Iowa, within Washington, Johnson, and Cedar Counties.

Table 11. Final Sample of Influentials

Influential Name	Occupation	Number of individuals naming as influential (%)	Number of articles mentioning influential (%)
Steve Berger	Row Crop Farmer; Cover Crop/No-Till Advocate/Spokesperson NRCS District	6 (6.19)	4 (1.31)
Wendell Jones	Conservationist; Hay Farmer	4 (4.12)	0
Ron Stutsman	Chairman of the Board, Stutsman Inc.	4 (4.12)	0
Bill Northey	Iowa Secretary of Agriculture; Row Crop Farmer	3 (3.09)	40 (13.11)
Steve Meyerholtz	Vice President of Retail Agronomy, Inc.	2 (2.06)	0
Jennifer Fencel	Environmental and Solid Waste Director for the East Central Iowa Council of Governments	1(1.03%)	2 (0.66)

Conceptualizing Water Quality and Risks

To address the underlying investigation of the flow of agricultural information central to this dissertation research, it was important to assess the way key interpersonal communication sources conceptualized the key concepts uncovered through the textual analysis and discussed with the surveyed farmers, in the two previous studies. Thus, to answer RQ6 (*How do influential individuals within the agricultural community conceptualize the state's water quality problems and risks related to these problems?*) and RQ6a (*How do influentials' conceptualizations*

compare to thematic analysis and survey findings (Chapter's Three and Four)?) all of the participants were asked several of the same open-ended questions posed to the survey respondents (Chapter Four). Specifically, interviewees were asked what they considered the biggest problem for Iowa's water quality, what they considered to be the risks related to nutrients in water, and what the primary barriers are preventing Iowa farmers from adopting Iowa Nutrient Reduction Strategy (INRS) recommended practices. Table 12, below, provides brief summaries of the respondents' answers to these questions. (Interviewees are listed in the order they were interviewed.)

Table 12. Conceptualizations of Biggest Water Problem, Risks, and Adoption Barriers

Interviewee	Biggest Problem	Risk	Barriers to Adoption
Steve Berger	Iowa's soil	Economic losses for farmers; threats to the livelihoods of fishermen in the Gulf of Mexico; human health	Fear of failure; yield losses
Wendell Jones	Sediment	Sediment losses; increasing phosphorous and nitrate leading to algal blooms	Lack of knowledge; reluctance to change when comfortable; amount of paperwork to receive government assistance
Steve Meyerholtz	The media	Livestock waste getting into waterways	Maybe they don't think there is a problem; old age of many farmers makes change difficult
Bill Northey	Phosphorous and nitrates issues	Political ramifications from having to tell public that nitrate levels exceeded drinking water standards; blue-green algae blooms in lakes and ponds	"the sense that they're being accused of something they don't feel like they're guilty of"; lack of understanding their contribution to the problem; fear of financial impact; concern for what neighbors or landlord will think if they fail

Table 12—continued

Jennifer Fencel	Large-scale row cropping	Health issues especially in children, pregnant women, and babies; cost issues related to treating water; and bacteria issues from CAFOs.	Cost; lack of technical assistance; and amount of paperwork needed to receive government assistance
Ron Stutsman	Lack of terracing and filter strips.	Not sure there are real risks.	Practices won't work for particular field (for example, all land is flat); do not want to pay for changes to a system that has always worked; old age increases resistance to change.

Biggest water problems. Overall, the influentials' responses tended to align with the survey respondent's answers as well as the themes found in the thematic analysis. For example, Berger and Jones both highlighted the role of Iowa's soil in their responses, which mirrors the frequent use of the term "erosion" by surveyed farmers as well as the primary way water quality problems were framed within many news articles. Fencel, Environmental and Solid Waste Director for the East Central Iowa Council of Governments (ECICG), who is also the only woman and non-farmer in the final sample, offered a discussion of her personal experience dealing with the effects of Iowa's impaired water quality with her own family. She explained that this would help providing a foundation for her perspective on Iowa's water quality and the rest of her responses to the interview questions. Fencel explained:

Last year I went boating on the res with my brother, and his family, and our kids, and we all hopped in the water. And you can't see your hand one foot under the surface. "Kids! Don't drink the water! Don't open your mouths! We'll shower when we get home!" That's normal to us. But it is not normal. It should not be normal. ...If you knew what was in that water!

Fencel went on to explain that she believes this comes down to “a big communication problem with water quality.” She explains that she’s hopeful the situation will begin improving because of the high number of beach closures in recent years. She also points out that these closures are significant forces bringing attention to the state’s water problems because of the outrage it produces in the public. Though she did not mention Sandman (1987; 2012) and his risk equation, her response indicates her pro-environmental worldview, as well as her inherent risk communication mentality. As Sandman (1987; 2012) might recommend, communicators seeking to raise support for increased water quality legislation would bode well to highlight the number of beach closures in the state. Fencel went on to cite “large-scale row-cropping” as the leading cause of the water problems, though her explanation highlights not only her knowledge of the divide between rural and urban Iowa’s, but also how uncomfortable she was to place attribution on farmers. She stated:

I don't know how you cannot say that large scale row-cropping is ... I don't want to play the blame game... I don't believe it gets us anywhere, but based on the science I don't know how you could conclude anything but. Sure, the communities and everyone plays a role, and it is complex, and everyone does have some culpability, but I think large scale row-cropping is probably the primary.

It is interesting to consider that she was the only one of the influentials to directly cite conventional agriculture for Iowa’s water quality problems—yet she also directly acknowledges her desire not to “play the blame game.” She is also the only non-farmer of the influentials and the one whose job position is least directly tied to agriculture. Correspondingly, her viewpoints throughout the interview often seemed to reflect the position of a highly informed public official working in the environmental sector, rather than someone situated within the agricultural realm.

Meyerholtz's response to this question also referenced the notion of a communication problem related to Iowa's water, though his conceptualization differed starkly from Fencel's.

Meyerholtz explains:

The biggest problem for Iowa's water quality is...the media is a lot of it. That isn't what you wanted to hear, but that is a lot of it. Farmers are very conscientious people, and I think back to when the atrazine laws came and we had atrazine in the ground water and stuff. Farmers were very receptive to the findings and stuff. They were very interested as far as getting the way their farming practices changed, and you're seeing the same thing right here. Farmers don't want to be tagged for polluters or anything else. They're stewards of the land and a lot of the land has been passed down to them and they intend to pass it down.

Meyerholtz' response echoed the sentiments of several of the surveyed farmers in the previous study who also critiqued media within their answers to the question of Iowa's primary water problem. It is important to consider the potential that this tendency for distrust of mainstream media among some respondents is reflective of the current anti-media rhetoric disseminated by the political establishment in power in the US. This distrust in media does seem to align with findings from Arbuckle et al. (2015) which demonstrate that farmers in Iowa who believed farm industry groups were the most trustworthy sources of information on climate change also believed mainstream media to be the least trustworthy source.

Secretary Northey's answer to the question of primary water problem was unique among the interviewees in its positive frame. His effusive response began by describing the primary water quality improvements occurring in Iowa over the last few years. Even when he did go on

to describe the challenging nitrate issues, the optimism in his response was front and center. He stated:

But publicly we'd love to be able to really make progress on nitrate, both because of drinking water issues, Gulf of Mexico issues, and it is a challenge. I do still believe that we are now at the place where we have more tools to address that than we did five years ago. It's way easier for me now to be able to say that this is something that can be done, versus 15 years ago it would have been hard to argue that we could impact it like we think that we can now.

Interesting also was his use of the term “publicly,” which immediately underscores his unique position as a politician within this sample. It also indicates an inherent awareness of the role that public opinion plays on the issue of water quality.

Risk and uncertainties related to nutrients. Overall, the influentials conceptualized the risks related to nutrient excesses in water similarly to the farmer survey respondents (Chapter Four), touching on most of the primary risk themes found through the analysis of the open-ended risk question. For example, both Northey and Jones discussed the increased potential for algal blooms, though neither directly cited the adverse ecosystem or human health effects such blooms may cause. Berger and Fencel both discussed health-related impacts, as well as the potential economic risks in their answers. Economic losses were the primary focus of Berger’s answer and he described this threat in terms of several different levels of susceptibility. Locally, he described financial implications for Iowa farmers due to the loss of something they spent money running off their fields, and nationally/globally, the potential negative impacts to livelihoods of fisherman in the Gulf of Mexico.

While Berger did mention potential human health effects, these threats were presented as more of an after-thought. Alternatively, Fencel began her response by naming specific threats to human health. Fencel stated: “High nitrates, and I’m not a doctor, health professional, but high nitrates have certain known health risks... for children, and pregnant women.” Fencel went on to point out that despite these human health risks being known, they are not prominent within the collective public agenda because “not very many people know somebody who’s had blue babies.” Fencel concludes by highlighting the role water utility companies play in decreasing such risks. She states: “So there’s a couple things that are going on. Our communities are taking this source water, whatever it is, testing it and making it safe for us. That insulates everyone from the true risk. But comes at a cost.”

Northey offered another unique response to the question of nutrient risks, which was not explicitly mentioned by other influentials or survey respondents. He explained that the risks related to drinking water and nutrients are rife with political ramifications. Speaking about the Des Moines Water Works (DMWW) case specifically, he stated:

It’s about compliance with federal requirements, so even if at 11 parts per million they’re unlikely to have a health problem anywhere, extremely limited, but legally they have to be ten parts per million. They cannot sell water at 11 parts per million. They’ve got to announce to people, and so politically there is a big problem, a concern there.

Northey’s response once again accentuates his differing role of prominence within the state political system. Yet, his response does include several latent allusions to common themes within the pro-agriculture perspective media messages, such as framing the problem as being caused by federal regulations. It also speaks to the politicization of science and risk communication overall (to be discussed more in the following chapter).

Other responses mirrored some of the less common answers from the survey, including Meyerholtz's assertion about nutrient risks being related to livestock waste and Stutsman's assertion that there may not be real risks. This is important to highlight based on risk perception research which consistently demonstrates interpersonal communication's function as a force acting to heighten personal risk perceptions (Dunwoody & Neuwirth, 1992; Morton & Duck, 2001). Similarly, interpersonal communication is often credited in helping increase risk mitigation behaviors, especially when particular individuals (influentials) are disseminating the information (Kelly et al., 1992; Welch Cline et al., 1992). Given Stutsman's prominence and credibility among farmers (discussed in the following section) this indicates a potential for the reversal of such effects—as in his belief that there are no real risks of nutrient excesses leading to decreased mitigation behaviors.

Though Stutsman was the only influential other than FencI to mention blue-baby syndrome, he mentioned it to provide evidence for his argument against nutrient risks, explaining:

I had breakfast with a retired doctor this morning. He's asking me about water and I told him some of the same things I just told you. He said, "Well, I spent 40 years as a doctor and I never treated a blue-baby and don't know of anybody that ever has." And the last blue-baby death was something like 1936 in North or South Dakota. Why wouldn't we have some research on it ... is that 10 parts right?

Checking Stutsman's assertion following the interview revealed that evidence regarding blue-baby syndrome (methemoglobinemia) prevalence within the US and globally, is inconclusive (see reviews by Avery, 1999; Fewtrell, 2004). There does seem to be some evidence indicating ingestion of high nitrate water and methemoglobinemia may not be directly causal, based on a

areas around the world where drinking water quality monitoring data shows nitrate spikes without any corresponding increases in blue-baby syndrome prevalence. However, challenges related to global health monitoring are rife in this context. Recent research does consistently demonstrate that persistently high levels of nitrate ingestion is “correlated with carcinomas, hypertension, and thyroid dysfunction in adults and with brain tumors, nasopharyngeal tumors, and leukemia in children” (Richard, Diaz, & Kaye, 2014, p. 395; WHO, 2015). These nitrate related health effects were notably absent from the responses of all the influential individuals, as well as the vast majority of survey respondents, and news articles analyzed in the thematic analysis.

Interviewees were also asked to discuss their confidence in current science related to nutrients in water and Iowa’s water quality. Stutsman’s response for this topic aligned with his doubts regarding risks from nutrients in water, as he asserted he does “have to question the science.” Expounding on his discussion related to the low mortality rates of blue-baby syndrome, he offered additional anecdotal evidence meant to explicate his belief that the 10 part per million threshold for nitrates in the US is less related to science than it is an elitist, liberal agenda. "It's my impression from somebody I really trust who's spent time in Israel who says the biggest nitrate problem in the world is Israel. And they say 120 parts is the threshold." (The actual level is 70 parts per million in Israel (Younos and Grady, 2014)). Stutsman explains that despite how striking this disparity in threshold levels is, and what a relief relaxing the US nitrate standards would be for the agricultural sector, it would never be possible. He states, “if we go there, they’ll [university researchers] take it to eight parts [per million].” The culminating point Stutsman was making is that he believes if all waters in Iowa were tested and monitored for nutrients, this “might prove we don't have as big a problem as we think and funds to research it could dry up.”

To clarify, he also stated, “That's why a lot of these university projects never end. Because then where are we going to get the funds to do it?”

Stutsman’s suspicions regarding nutrient levels in water, which piqued following the DMWW legal suit, lead him to take the action himself and gave him the unique experience of testing multiple water sources in several areas around Hills and Iowa City. Stutsman’s personal quest testing local waterbodies was first mentioned by several of the survey respondents who named Stutsman as an influential and was later described by Meyerholtz during his interview. Meyerholtz, who is himself employed by Stutsman Inc., explains the impetus for Stutsman’s personal investigation of nitrate loads, stating:

He was questioning the facts. He was questioning facts. He said if there's a problem out there and we're going about it the wrong way, we need to know it so we can change our ways of doing it. If we're getting blamed for it, we need to change our practices if that's what the problem is. And we did. We went around and took all those samples and stuff. I know they weren't scientific, but we took them just for our own knowledge, more than anything. Ron has grown up in agriculture. He's 76, 77 years old. He spent his whole career, his whole life in this business and stuff. To protect it and see it go on, that's his passion. That's his passion. Like I say, he has his sons and now there's grandsons in the business, he's looking out for the future.

Meyerholtz laudatory portrayal of Stutsman was reminiscent of the FBS’s descriptions of Farm Bureau President, Craig Hill, in the way he situates Stutsman as a protector of agriculture. The descriptions of Stutsman’s character by Meyerholtz (and others) will be discussed further in the following section.

Much like Arbuckle et al.'s (2013) assertion of heterogeneity among farmers in terms of who they trust on climate change, these interviewees demonstrated a similar distribution regarding scientific certainty related to water quality. Contrary to Stutsman's low confidence in current water quality science, Berger, Jones, and Northey all expressed generally high levels of scientific certainty. Northey's explanation was unique in that he pivoted his response to focus on the problems related to monitoring and documenting nutrient loads in water without attributing blame to any one cause. He explained:

It's a rare challenge because we have 70,000 miles of streams in Iowa. The challenge is where do we measure, when do we measure, and how do we measure? Everybody wants to have one number, you know?... We could have nutrient levels of 25 parts per million, of nitrate, in some areas, that would average with a whole bulk of the state that's less than five, and on average we have no problem. It is a combination of both figuring out what the problems are, and when, and how. We had more monitoring than any other state when you look at real-time nitrate samplers, and flow sampling as well. We have load sampling in addition to concentrate sampling, but it still is a challenge to be able to get a summary of water quality.

This type of tactful response not only demonstrated his political skill, but likely helps support his position as an influential on this issue among people across the spectrum of perspectives. Meyerholtz took another route in his response, by first lauding scientists but immediately attributing blame to once again to "the media." Meyerholtz explains, "I think the scientists are very credible, they are the experts. The problem of it is, is a lot of the media take, as far as on the output, did not have the scientists involved. That's where I question as far as when I say the media. It's kind of hard to really come out with something unless you have the

scientific data to back it up.” Meyerholtz’s response seemed to echo the sentiments of several of the farmer survey respondents who vitriolically blamed media directly for Iowa’s water problems. This type of response does seem to beg the question of convenience, as in blaming the media for poor reporting on the issue may offers a simple solution which may alleviate personal dissonance related to the situation, or one’s potential role in contributing to it. Meyerholtz’s response again seemed to parallel the current US political administration’s preferred tactic in dealing with any potentially negative mediated information.

Fencl expressed displeasure in the misleading use of “science” and discussed difficulties related to science communication. Her response touches on one of the curious findings from the thematic analysis study (Chapter Three) related to the use of “science” to support all perspectives (no matter how contrary) on the issue. Fencl stated: “I am not [certain about current science] when it is used in a misleading way—to shoot down the idea that we should care about water quality.” She goes on to explain she is referring to, “the argument, which infuriated me, is this whole idea it's the lawns and it's the golf courses.” Fencl continues:

The nitrogen cycle is complex and you can't just say, "There's nitrates in the water, bad. Nitrates, bad!" Nitrates are good. It provides nutrients for things that grow. It's food in the water for things that grow. But when you use the complexity to argue that you're not doing anything wrong and no one else understands it enough to argue with you... No, I'm not confident in the science, because it isn't clearly articulating what the problem is. And it is adding to us and them.

Fencl’s explanation helped to illuminate the way the complexity of the issue of nutrients in water was used discrepantly to back up both sides, though both sides were attributing evidence to “science.” At one point during this discussion, Fencl pointed out:

And God knows, what my six years in watershed planning has taught me that we are not good at explaining the science. And it is rooted in the fact that the science is complicated. And the scientists can't bear to boil it down into those talking point because they know, in their heart, it isn't that simple.

This finding regarding the misleading use of “science” to justify two opposing sides of the water quality debates, runs throughout all three dissertation studies, and parallels the climate change debates currently dominating environmental policy in the US. More will be discussed on this in the following discussion chapter (Chapter Six).

Barriers to adoption. Respondents were asked to name and discuss what they believed were the primary barriers working against increased adoption of nutrient reduction practices among farmers. As displayed in Table 12, most of the influential responses echoed those of the farmers surveyed in the previous study, as well as touching on some of the themes found in the thematic analysis study. Particularly interesting was the way that each influential's response did reflect sentiments expressed by surveyed farmers and reflected their own unique positions within the agricultural realm. For example, both Jones and Fencl, the two local governmental employees who deal daily with subsidy paperwork available to farmers for using certain practices, discuss the amount of paperwork needed to receive such subsidies as a primary barrier to adoption. Similarly, Meyerholtz and Stutsman, two of the oldest influentials in the sample who also work for the same agricultural company, both named old age as a reason for the resistance to change barrier to adoption.

Berger, arguably the most personally innovative of the influentials, names fear of failure and yield losses as the two primary barriers. Yield and profit benefits were consistently a key part of Berger's explanations throughout the interview and are also the primary factors which he

believes motivates farmers to eventually adopt new practices. The fear of failure response was interesting to consider given that Berger himself inherited his land from his father who began using no-till and cover crops when Berger was a child. Perhaps this led to less chance of failure for Berger personally, or created a heightened need for success to uphold his father's legacy.

Northey's response to this question touches on several key findings uncovered throughout this dissertation and highlights many challenging issues within the nexus of agriculture, water, media, and influence. His response also emphasizes concepts such as blame, norms, and uncertainty, among others. Northey stated:

Well, there's several. One would be the sense that they're being accused of something they don't feel like they're guilty of. Part of it is whether they have an understanding of how they may or may not be a part of both the problem and the solution, and/or feel like it is potentially legal liability or financial impact. There are lots of different reasons, as well as, they're even just concerned about whether doing one of those practices, like cover crops, if they don't do it well what's their neighbor, what's their potential landlord, or existing landlord, think of them? The uncertainty, as well as with most of these things, cost, money. It's very tight financial times, and money is real just like for everybody, and so those are challenges that they all have to overcome.

Northey was not the only influential to highlight the potential role that lack of adequate knowledge and/or understanding of agricultural contributions to Iowa's water quality problems may play in use of INRS practices. In fact, half of the interviewee's alluded to some sort of knowledge-based shortcoming. As with findings from the two previous studies (Chapters Three and Four), this highlights the need to consider both science and media literacy within this context, and will be discussed further in the following chapter.

Additionally, the barrier of cost discussed by Northey, was noted by several other interviewees, as well as being the most prevalent as the barrier discussed by the survey respondents in the previous study (Chapter Four). As Roger's (2010) notes, "economic factors are undoubtedly very important for certain types of innovations" (p.115), though he suggests that other factors, such as prestige, are often more important to eventual adoption. This notion is highlighted through Berger's status as a "cover crop champion," per several media accounts, as well as his own desire to be innovative like he believed his father to be. However, the consistency of cost cited as a barrier (throughout this study and the previous study of farmer's perceptions) does indicate a lack of knowledge related to governmental incentive programs currently available to farmers, as well as the potential lack of other motivational factors—such as status or prestige associated with using conservation practices—in driving adoption of nutrient reducing practices.

Conceptualizing Influence

To address RQ7 (*How do these individuals conceptualize their role as a source of information/influence?*) and RQ7a (*How do the individual's perceptions of influentials compare with their networks' perceptions of their influential power; and how does this compare to theoretical conceptualizations of influentials?*) interviewees were asked questions directly about their definitions of influentials/characteristics of influencers and their own role as an agricultural influential. Some questions were framed in a way to elicit their own conceptualizations and opinions, while subsequent questions were based on previous opinion leader identification scale questions. These findings are presented based on the three dimensions (who one is, what one knows, and whom one knows) and functions (information giving, seeking, and social relations) identified in previous literature on influential individuals (Burt, 1999; Katz, 1957; Keller &

Berry, 2003; Nisbet, 2006; Watts & Dodds, 2007; Weimann et al., 2007). First, personal characteristics are discussed, followed by information-related behaviors, and lastly findings related to social embeddedness are presented. Whenever possible, the influentials' answers are compared with the characterizations of the influentials given by survey participants in the previous study.

Who they are. Following the discussion of key variables related to the nutrients in water context of this study, each interviewee was asked to talk about interpersonal influence within the realm of agriculture. The conversations with all six respondents yielded a substantial set of personal characteristics distinguishing influential individuals in the agricultural realm. These characteristics include financial success, credibility, experience, humility, and passion, among others. See Table 13, below, for a list of all personal characteristics and terms used to describe agricultural influencers provided by the interviewees, and a corresponding list of terms used to describe the interviewee provide by survey respondents in the previous study (Chapter Four).

Table 13. Influencer Descriptions by and About Influential Interviewees

Interviewee	Personal Characteristics of Influencers Provided by Influentials	Personal Characteristics of Influentials Described by Survey Respondents
Steve Berger	Financial success; leadership; credibility; ability to positively represent home area/county	Passionate; media exposure; willingness to share; willingness to discuss failures; advocate of agriculture; experience; successful; down-to-earth; relatable; good at explaining; motivational
Wendell Jones	Financial success; leadership role; involved in community; respected, decent; not quiet; charismatic; willingness to be wrong; humble	Excellent guy; truly cares; everything he recommended worked; trust him; his experience; needed his help with cost-share program

Table 13—continued

Steve Meyerholtz	Number of years in business; involved in local organizations/community; being from a farming family	Extremely knowledgeable; level-headed
Bill Northey	Being able to see the bigger picture; experience; apparent success; credibility; ability to admit failure; being vulnerable; being open; able to get people excited	Passionate about agriculture; good guy; heard him speak; secretary of agriculture
Jennifer Fencil	Natural gifted as a communicator; respectful of others; value others opinions	Associated with WMA's
Ron Stutsman	Reputation of honesty and trust; years being in business; family representation in agricultural community; church attendance; success	Inquisitive; passionate about agriculture; trustworthy; information provider; experience; made lots of good decisions

Jones's response to the question of "what makes someone an influential individual in the agricultural realm?" addresses the gamut of characteristics discussed by the influentials and sets the stage for the following presentation of findings. Jones stated:

Success for one thing. Financial success. I think, like any profession, those people that have leadership and are involved in a community and are respected. Not just from a farming standpoint, but it might be a church ... They're just decent. They're not quiet and they tend to have leadership qualities. They're charismatic. And willing to be wrong. If people are too in your face with stuff, that's kind of not good. Kind of humble at the same time. I think goes well in the ag setting. Good, but not too in your face about it.

Financially successful. As Jones's response emphasizes, financial success was a common response among influential individuals interviewed in this study. However, very few farmer survey respondents mentioned this attribute in their descriptions of the influentials they

named. This may be a result of social response bias, as the participants were asked face-to-face by the surveyor to explain why they named the particular individual as influential. Discussions related to money or wealth may have been considered in poor taste by the respondents.

Berger and Stutsman readily discussed financial matters and monetary motivations throughout their interviews, seeming to underscore the importance of this characteristic. Berger gave several responses which highlighted both his inherent value system based on economic profit, as well as his awareness of the negative way that might be interpreted. For example, he stated simply “Economic profit,” when asked what he believed motivated farmers to implement no-till and cover crop practices based on his experiences at seminars and on speaking tours. In describing his own influence on other farmers, the conversation centered on the economics of the two practices he champions. Though he does not explicitly attribute financial success to his own influential position, Berger emphasizes the importance of capitalistic structures and how those drive modern agricultural production, stating:

If I can find a corn hybrid that is five percent above the average before my neighbor does for two or three years, that helps me. If I can put tile in the subsurface tile drainage in before my neighbor does ... We're really, we're good friends, but we're competing. My competition is right next door because we're all competitive. That's why we have such cheap food, is because we compete ... Competition makes for very cheap food.

Competition would make very cheap health care too. That's another story. That's why we have such cheap food, is because the competition. As I was gonna say earlier ... In some selfish ways, I almost wish nobody would adopt this cover crop thing because it's a way to get ahead.

Stutsman also discusses the profit potential from cover crops, yet, perhaps due to his role as a business owner, makes no attempt to cover up his financial motivations for promoting them for profit. His response also illuminates his own desire to be a leader in adoption of agricultural technology, his perception of the benefits of early adoption, and his inherent entrepreneurial mindset, stating:

Well, I thought I saw an opportunity to make money with cover crops. I want to be an early adopter of technology because the profit window is very narrow, very short. If I was a farmer, I would be growing my own cover crop seed or I would be working with a neighbor ... you could probably make 40 to 50 bushels an acre so between two or three neighbors they put 20 acres out and they combine it in a bin, put it and dry it and everything. It would be pretty easy. If I was a farmer, I would be using that as an opportunity to maybe grow some and sell it. And make some money off it.

His response also underscores concerns related to the potential for innovation diffusion to widen socioeconomic gaps. As Rogers (2010) states, “more progressive farmers are eager to adopt new ideas and the economic means to do so.” Stutsman’s response correspondingly highlights the potential knowledge gap (Tichenor, Donohue, & Olien, 1970) present in this context related to farmers’ understanding of governmental subsidies which are available to help offset the start-up costs of cover crop implementation. When Jones is asked about using potential profit increases as a motivator to increase farmers’ adoption of nutrient reducing practices, his response discloses a different mindset than both Berger and Stutsman. Jones states:

The economics are there, and I know that's a tactic we use, but I personally don't like it as the main tactic, because it kind of downplays the importance of the other points you're trying to make, and I think we get away from that really easily. We, as an agency become

wrapped up in we only see that, and I see that as a fault over the years that has basically watered down our efforts to address anything, because we always have to have it attached to something economic or it has to be something dramatic before people get the point, and I don't like that.

Jones' dislike for the use of economic tactics to motivate farmers highlights his underlying dedication to natural resource sustainability—which is fundamental to his personal perspective/ideology related to the nutrient in water issues in Iowa. This also underscores the inherent differences within this small sample of influentials, in that Berger and Stutsman do ultimately situate their perspective from the basis of agricultural production, whereas Jones and Fencil seem to place more value on environmental protection. Regardless of the different value schemes apparent within this sample of interviewees, these responses overall indicate the need for influential individuals in the agricultural realm to recognize the importance of financial success among farmers.

Credible and honest. Jones's earlier response regarding personal characteristics of influentials was complimented by the laudatory description of Jones's own credibility and honesty by one survey respondent. The respondent stated Jones is: "an excellent guy, and truly cares, and everything he's done for us has worked. You know you get that feeling, I trust him, and he has experience." Correspondingly, Jones explained the difference between his perceptions of success and credibility, positing that this distinction is largely based on integrity:

There's some people that are successful that are not very credible, because I don't think the others see them as honest. Good yields, whatever they're producing, be it livestock or crops, they have to kind of be in that upper echelon of producers, but they have to be seen as being honest as well, because a lot of people are considered shysters.

Berger also described the number of “shysters” who have positions of power in the agricultural realm, describing their lack of honesty by stating, “They're getting paid a couple of thousand bucks to speak. They'll say anything, take the money and run.” Berger also described the care he takes in being honest personally when talking with other farmers or media, saying, “The one thing I want to make damn sure is I represent myself and say the yields I put on there are government FSA approved yields. This is what we do.” Stutsman also highlighted the importance of an honest reputation, and the inherent fragility of it, stating:

You can spend 80 years building a reputation of being honest and everything else. You make one screw up and it's over. If they would read tomorrow in the Des Moines Register that I frauded the federal government out of \$750,000 worth of, or lied about ... it's off.

My sons that are here, three grandsons, I don't know if they'd live long enough to recover from that.

Stutsman was described as having a combination of qualities, including trust, experience, and as being an information provider. One participant explains that he considers Stutsman most important for his own land management decisions because of “his experience and business they're [Stutsman and brother] in and they always try to do the right thing. And we trust them.” Stutsman echoes this conceptualization, stating at one point during his interview, “I believe to be an influencer you have to come from a reputation of honesty and trust.” He explained further, “If we're an influencer it has something to do with being in business for 87 years. If we're an influencer, it's something that we've been working on for all those 80 years.” It's interesting to note the way that Stutsman conceptualizes his own influence as tied into his family business, demonstrated through his statements of “we're an influencer,” indicating his family business as the influencer entity.

Northey also talks about credibility as an important factor in persuasion related to nutrient reduction strategy practices and specifically, the lack of credibility he believes that government has and how this can be remedied. Northey states, “We've consciously said we have to partner with people that are more credible than government to be able to be, to help deliver, to help learn.” Northey goes on to talk about Berger to explicate his point, even directly attributing cover crop adoption rates in Washington County to Berger’s influence, stating: “Obviously, the Steve Bergers of the world have been doing it for a long time, showing how it's done. Washington County's our number one cover crop county in part because of the Steve Bergers and Rob Stouts, and folks like that.” Similarly, tied into the influencers’ conceptualizations of credibility often seemed to be the notion of passion. For example, Northey again effusively highlights Berger, saying:

Steve Berger believes in what he's doing. He doesn't just do it. He doesn't just know it. He can't just share it. He gets you excited about being able to build your solar panel, about controlling erosion off of things, about seeing the health of your soil improve, and someday being able to actually measure what healthier soil is.

Northey explains that Berger and a few other farmers in Iowa who actively promote conservation practices are influentials because (a) they are credible information sources for other farmers because they are farmers themselves, and (b) because their influential status is a product of their passion for the practices they promote. Northey says, “That passion piece comes through in those folks too. It's not because they've thought about it. It's because that's who they are and that's why they keep getting calls to come into field days and do.”

Correspondingly, it was apparent that natural resource conservation is an inherent passion for both Fencel and Jones. For example, Fencel explained her motivations for working in the realm of water quality in Iowa, stating:

I fundamentally believe in resource conservation, wise use. I understand there's a need to use resources, that it's all a part of our society. We all want to eat. I get all that. But I think that there's a way ... I've always felt strongly that there's a way to do all of this without blowing it for the here and now and long term.

Experienced and humble. Experience, another key characteristic described as fundamental to influencer status by the influentials, was conceptualized in a number of different ways. For example, Meyerholz described this as “number of years in the business” while Berger described it as distance from home, saying, “Any time you get 100 miles from home, you're an expert. You know? You can say anything and who's going to vet you?” Jones echoed Berger’s sentiment about expertise based on distance, though he goes on to describe the nuances of this perspective by detailing Berger’s own rise to expert status. Jones stated:

Being so many miles away from home. I truly believe that. I truly believe that. I say that all the time, but I'll hear people talk about Berger from that particular area, although I think he's beginning to really get that expert label, but initially it took him a long time to break into that. I just think farmers are hard to give that out. They're hard to accept that expert label for someone who is in the same business. It's almost like it has to be kind of totally removed from what they do every day, and so different, before they really consider them truly an expert.

Northey also touched on Berger’s experience in his own response, focusing in on how Berger is able to utilize his experience to connect with farmers. Northey described Berger, stating:

He's so down to earth and he'll just share his experience, and the first thing he'll always say to a group, "Hey. These are my experiences. You're in a different part of the state. Your soil is different. You're not using hog manure. You're going to do it differently, but let me tell you what I did that didn't work, and what I did that I think works well."

Several of the exact sentiments Northey expresses towards Berger were shared by the farmers surveyed in the previous study who named Berger as influential. As the most frequently named influential (n = 6), Berger's success and experience were the most common reasons farmers gave for naming him—mirroring Berger's own conceptualization of influentials. For example, one respondent stated simply, "Seems to do a damn good job!" Another participant describes Berger's influence nearly identically to Secretary Northey's description, stating that he named Berger because he is "down to earth and relatable, has practical experience, experience with those practices, and really good at explaining and motivation."

Northey's conceptualization of Berger as an influential also highlights the concept of humility, which was discussed by several other influentials. As in Jones's conceptualization of influentials (at the beginning of this section), Northey also suggests that humility is inherent among agricultural sector influencers. Northey states:

I think to some degree, you know, Steve Berger knows he gets a lot of phone calls. Tim Smith out of Humboldt knows that he's on half the panels that are out there, half the field days. They know that, but one of the things that makes them influential is they don't consider themselves any more important than anybody else. They're humble. That's kind of a farmer style. One of the things that helps that influence as well, is passion enough to cause people to feel like this is something they believe in.

Fencl also describes this notion, although she does not use the term humility, rather she calls it ‘respect for others.’ Fencl states:

I'll call it a respect for others. I don't know how else to term it, it's hard to define I think.

But if you're in this business and you approach any of this with, "I know exactly how this needs to go!" You're going to be shut down and have nothing else of value to say. Ever. If you approach it as, "I really value your input and will you please talk to me." Which is how I've tried to approach a lot of this.

Fencl’s above response, as well as her position as sole female within this sample, highlights the need for future agricultural communication research to explore differences between gender roles, gendered communication patterns, and conceptualizations of influence among women farmers.

What they know. All interviewees were asked to provide their educational history and farming experience, because these are two items comprising the ‘what one knows’ function of opinion leadership per Katz (1957). See Table 14 (below) for descriptions of these two items for each participant. (Interviewees are listed in the order they were interviewed.)

Table 14. Education and Agricultural Experience

Influential Name	Education	Experience in Iowa and/or Farming
Steve Berger	BA, Agricultural Business, ISU;	Born and raised on Iowa farm; 30+ years farming
Wendell Jones	BS, Ag Education, Alcorn State University (Mississippi)	Born in MS; 35+ years in Iowa working at NRCS

Table 14—continued

Steve Meyerholtz	AA; Agricultural Business and Management, Kirkwood Community College	Grew up on Iowa farm (since age 5); Working in ag at Stutsman's for 35+ years
Bill Northey	BA, Agricultural Business, ISU; MBA, Southwest MN State University	Born and raised on Iowa farm; 30+ years farming
Jennifer Fencel	BS, Geography, UI MS Urban & Regional Planning; UI	Born and raised in Iowa; no years farming
Ron Stutsman	BA, Agricultural Business, Minor in Economics, ISU	Born and raised on Iowa farm; 50+ years farming

Education. While not explicitly mentioned by any of the influentials interviewed, education and intelligence did seem to be important characteristics of agricultural influentials for several farmer survey respondents. For example, one survey participant attributes Berger’s influence to both his experience and his intelligence. This participant stated “Got a lot more upstairs than most people, been a leader in conservation for at least 10 years longer than anyone else.” Another participant echoed this by replying simply that Berger was influential because he (and his dad) were “leaders and educated.” These responses indicate that along with the perception of intelligence, the longevity of success and success prior to others are important components of influence. Meyerholtz was described primarily based on his knowledge, with one participant describing him as “extremely knowledgeable” and the second participant stating, “he is very level-headed and knowledgeable.” Considering he is not a farmer, yet holds a high-level position in an agricultural business industry, these assertions of knowledge are important in understanding his influencer status.

Information providing. Several survey respondents described Stutsman's information-seeking as key to his influential status, one of which stated, "He did well testing because he wanted to know the truth for himself. I've always looked up to him, and I've worked for him for 30 years, he's made lots of good decisions." This also highlights Stutsman's role as an employer within the agricultural realm, which again situates him in a different social position than others in the sample. Another respondent highlights Stutsman's role as an information provider, stating "They [Stutsman family] go to classes and keep us informed."

During his own interview, Berger described the notion of information sharing as central to farmer mentality. When asked about his motivation for becoming a cover crop and no-till spokesman, he stated:

I don't know. I guess it's the right thing to do. I'm not sure. Farmers in general like to help each other. The first thing we do is we discover something that really works and then we go blab it to everybody else. When I told you earlier, we're really in competition with the guy across the fence. It's perfect competition. That's why we have such cheap food, is because we'll work for nothing. We finally find a way to get ahead and then we go blab it to everybody.

Messaging and communication. Correspondingly, the importance of communication efforts and ability were underscored throughout several interviews. For example, Northey emphasized that one strategy for cultivating credibility among farmers was to use a specific type of messaging, stating:

The type of messaging is really about an engagement type of messaging, a humility in there is not one answer. This isn't the only way. What would you do? We always say, when I get out and somebody says, "What should I do?" I don't tell them what they

should do. I say, "You should find one of these things that you should try on your farm."

I'm not telling you which one, you know?

Fencel was the interviewee most explicitly focused on the importance of effective communication within the realm of interpersonal influence in agriculture. Through her description of the critical nature of effective communication, she criticized the communication ability of scientists and experts associated with several Iowa water quality information sources. For example, she stated:

And, bless their hearts, I love water people, I love watershed people. People from USGS and from the Flood Center and from IDAL [Iowa Department of Agricultural and Land Stewardship] and all the watershed people. Oh my favorite's the Army Corps! They're brilliant. But they aren't able to articulate what they know to people in a way that inspires them to give a shit.

Fencel believes that communication ability is both an inherent characteristic of influentials and a necessary characteristic for people who want to gain credibility in the agricultural community. This echoes Northey's comments related to appropriate "engagement" messaging. Fencel also stated, "I think it's somebody who is able to communicate well, who is respectful of all of the different sources, maybe, or threads of information."

Increased information access. The topics of media and information sources were addressed directly with each influential through discussion of their own media preferences per Keller and Berry's (2001) influence scale questions. The majority of respondents noted using numerous mediated and interpersonal forms of information and numerous sources within these, which is consistent with previous conceptualizations of influencers (Nisbet & Kotcher, 2009; Rogers, 2010). Berger directly acknowledged that his media consumption behaviors differentiated him from others, stating:

A lot of sources. That's one thing that differentiates me, probably, from a lot of ... I attend a lot of meetings, I read a lot of publications. We carry, probably, I'll bet you 15 to 20 different farm magazines, several daily papers. Not so many papers anymore. I'm reading online. A lot of internet, blogs, Agtalk is one that is popular with the farmers.

Northey also indicates his knowledge of his own exclusive access to numerous, credible sources, often before other individuals might be exposed to such information. For example, he has direct access to high-level academics, scientists, and policy makers, providing him a uniquely knowledgeable array of interpersonal sources. He described this, stating:

Yeah, I would be unique just because I get around more of it more of the time. I probably spend, you know, I don't know if it's two-thirds, of my time, on water quality types of things, you know? Some of those is not necessarily learning. It's sharing things that I'm doing, or sharing other things- I get around watershed coordinators, that have experience in their own watershed. For me, I get to talk to the Flood Center and IIHR, and I get to talk to the Iowa State Researchers that are a part of this, and part of that science scene. I get to talk to colleagues and friends from other states that have some things going, and are doing sometimes things different because they've had different focus, fertility management and other kinds of things in their state. Lots of different pieces, certainly publications too, but I ended up more, talking to those folks, sharing things that I'm hearing. I'm still learning lots of things in all of it too.

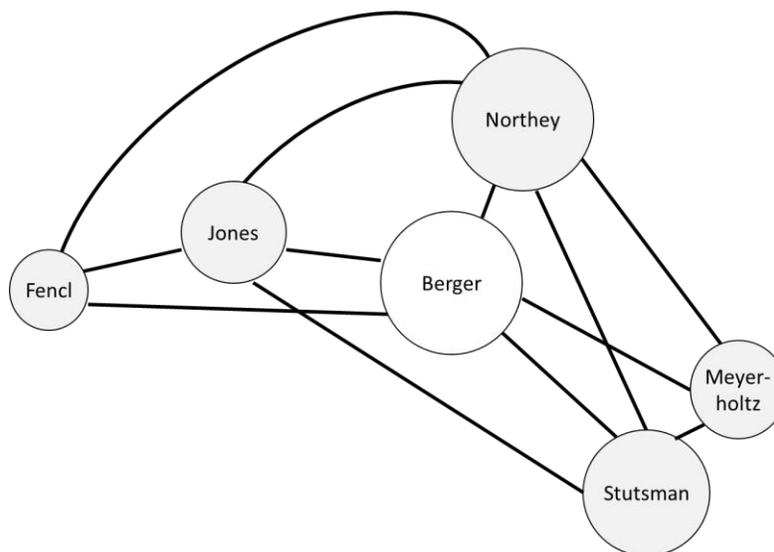
Through this explanation Northey documents both his information sharing and seeking behaviors, aligning with the conceptualization of opinion leader Burt (1999) deems an information broker.

Who they know. To address the third dimension of opinion leadership per Katz and Lazarsfeld (1955) and others, related to “their strategic location within the social network” (Weimann et al., 2007, p. 176), the social relationships between influentials were documented throughout the interviews. Thus, to answer the question of who they know directly, the most apparent answer from this analysis is: each other. Prior to the interviews the degree to which they all knew each other (other than Secretary Northey as his prominent political position likely yielded him a unique level of notoriety among the interviewees) was unknown. However, following Berger’s five-hour interview, where each of the other individuals became topics of conversation discussed by Berger, it became apparent that these individuals were generally interconnected. For example, consider Berger’s description of Secretary Northey:

Bill's a very good friend of mine. We were in the same fraternity. Yep. I know his sister, Nancy. His mom and dad, Wayne and Margaret, they live up here at Okoboji. They have a rich history in the Farm Bureau. Margaret's dad was Howard Hill that lived down here in Minburn, Iowa. So a very rich history.

This documentation of the influentials own relationships with each other enabled the production of a sociogram depiction to illustrate the connections and closeness of the individuals. Because Berger is the first person interviewed, the influential who was mentioned by the most survey participants, and was the individual who was personally connected to all subsequent interviewees, he represents the ego of this influential network sociogram. See Figure 12, below.

Figure 12. Influential Network Sociogram Based on Steve Berger



This sociogram also helps illustrate the forces of homophily, and strong and weak ties, within this small network. For example, both Berger and Northey are the two influentials who were most well-know, garnered the most media exposure, and have significantly connected family and personal histories. Similarly, Jones and Fencl, the two who work in the realm of conservation and prioritize environmental protection most outwardly, are least connected to the two agricultural business entity representatives who prioritize agricultural production (not necessarily in opposition to environmental protection, simply above it). Jones and Northey, whom Berger is most intimately familiar with based on their overlapping experiences and personal histories, seem the most well adept at navigating the tensions between agricultural production and environmental protection (along with Berger) through their own diplomatic rhetoric related to water quality issues in Iowa.

Employment/career based positions. Interviewees were asked whether there were certain careers or employment positions which inherently yielded influence in the agricultural realm, per the positional approach to identifying opinion leaders (Weimann et al., 2007).

Employment/career roles were mentioned latently in media explored in Chapter Three as

indications of positions of authority, expertise, or access—although most of the interviewees believed that there were not certain professions (other than Northey’s) that inherently gave someone power in agriculture. One survey participant referenced Jones’s job at NRCS indirectly, as well as identifying Jones’s unique position as his landlord, stating: “I’m renting a house from him and heard about what he does.” Another survey participant directly stated the importance of Jones’s NRCS position, stating: “He works for the government and they’re cost sharing so we really have to use what he says.” This is an interesting response in that it does provide some evidence both for and against Northey’s statements related to the lack of credibility in the government—who stated: “I bet you get very few people that say, “Government said, we should be a part of this, that’s why we should be.”” Despite being a governmental official himself, Northey demonstrates an acknowledgement, if not his own perspective, regarding governmental distrust. This aligns with the conservative rhetoric found prominent within messages related to the dangers of governmental regulation for water quality in the thematic analysis (Chapter Three).

Fencl also describes the NRCS’s role, lamenting, “Could we make it a little easier? And could the NRCS who do the design and oversee it and approve stuff like that. I mean, they’re so overworked. They’re so few of them that if we’re honestly gonna say we expect farmers to implement this stuff, then we have to give them access to the expertise they need to do it.” Fencl herself was described as influential based on her participation in and role working with WMA’s. The participant who named Fencl stated that she was most important because she is “associated with WMAs.” Both media articles mentioning Fencl also do so in terms of her position with ECICOG and her role in helping WMAs become established. This does align with Fencl’s own

conceptualization of herself as not so much an influential, but as “an important actor in the watershed realm.”

Community involvement. Interviewees were also asked about their own involvement in community groups and references to involvement in such groups were noted throughout their responses. Jones’s statement at the beginning of this section mentioned the potential of church membership as one characteristic of agricultural influencers. Stutsman’s conceptualization of influencers corroborated and added to this notion, through his explanation:

To be an influencer, I think you better go to church on Sunday. That better be some part of your life to be an influencer. I think about that a lot. I go to church in Arizona the three months I'm down there and knowing some of these people that go there from before, I really don't know if I know any really successful business people that that isn't part of their personality.

Overall, Berger, Stutsman, and Fencil all did acknowledgement membership to a number of various informal and formal groups, including 4-H, FFA, neighborhood coalitions, and watershed groups; rendering the notion of heterophilic communication within the diffusion process potentially bolstered by these individuals.

Political activism. Berger did not directly discuss political aspirations or political activism, though he did make several statements which highlighted his personal political affiliations and experience working in the political realm. For example, he stated, “Our Governor, Branstad, is from Winnebago County, right over here, and his farmland is also up there in the northern border of Iowa. My first two years out of college, I worked for him.” Fencil and Wendell both begrudgingly admitted personal political activism although both stressed the importance of keeping this aspect of their personal life separate from their career positions.

Northey represents the primary example of this characteristic within the sample, and as already discussed, much of his information access and conceptualizations demonstrate his position as politician—which does seem to significantly differentiate the type of influential he is. However, it should be noted that the prominence of his particular political position goes beyond what is typically meant by “political activism” in conceptualizations of opinion leadership.

Discussion

This study explored influentials’ conceptualizations of key contextual variables and conceptualizations of influence within the agricultural realm. In-depth interviews with six individuals identified as influential by Iowa farmers were conducted as this methodology allowed for the depth of exploration needed to answer the research questions. Several questions were asked of interviewees for the purpose of confronting certain aspects of conceptualizations of influence from previous literature. This enabled the comparison of data across the different levels of data collected (mass media and aggregate farmer) throughout the previous studies in this dissertation, and with theoretical definitions of influencers.

The findings demonstrate that these six individuals’ conceptualizations of water quality in Iowa were similar to the main narratives identified through the media analysis (Chapter Three) and the survey of local farmers (Chapter Four). However, these individuals did seem to have more comprehensive understanding of the issues, often attempting to breach the divides between the pro-agriculture and pro-environment perspectives within their responses. Influentials’ perceptions of risks related to nutrients in water varied greatly within this sample and reflected nearly all of the different risk perspectives presented by farmers in Chapter Four.

The findings also demonstrate that these six individuals’ conceptualizations to do generally align with many of the previous conceptualizations of opinion leaders set forth by the

vast body of scholarship on the topic—though Berger, Jones, and Stutsman seem to each represent the gamut of dimensions and functions of opinion leaders, though in differing ways and for different social networks. However, these individuals also seem to fit together in concert, suggesting a strength lies in the differing types of influencer they each align with most, which will be addressed more comprehensively in the theoretical implications section of following chapter.

Overall, data revealed that conceptualizations of influencers are not only amorphous and in need of refinement, but that the process of interpersonal influence within networks is not as simple as the notion of media being transmitted to a group of opinion leaders, who then pass the information on to their followers. This data helps lend support for Weimann et al.'s (2007) argument that “instead, people who influence others are themselves influenced *by* others in the same topic area, resulting in an exchange. Opinion leaders are, thereby, both disseminators and recipients of influence” (p.175). For example, Northey, Berger, and Fencel explicitly discussed their roles as both information providers and receivers.

Similarly, Burt (1999) argues that opinion leaders function more as information brokers, not only because of their high density of social relationships, but also because they act as information exchangers through their own seeking and providing behaviors. The key, however in Burt's (1999) argument is that this exchange occurs across social contexts, rather than within them, which is what enables these individuals to drive the entire diffusion process. From this perspective, the way that Northey and Jones could transcend beyond their own internal affiliation (Northey as pro-agriculture, Jones as pro-environment) and be able to fully integrate—and be influential—within both the networks of individuals ascribing to the two perspectives.

This adeptness with which Northey, Jones, Berger, and Fencel were able to traverse the barriers created by the divisive representation of the pro-environment or pro-agriculture perspectives was one of the most interesting and important findings from this analysis. Despite the fact that each of the interviewees did seem to demonstrate affiliations more strongly with one side or the other, they were ultimately able to communicate in a way which represented a third, middle-ground perspective that privileged both sides. This is extremely important to consider regarding these influentials' potential roles in the diffusion process, which, as Roger's (2010) emphasizes "is an uncertainty reduction process" (p.232). These individuals not only have the potential to help alleviate uncertainty and promote subsequent necessary action, but they may even be able to help encourage more productive rhetoric to be disseminated from both sides.

No participant exemplified the ability to traverse the two perspectives more than Berger, who could arguably be the only interviewee who truly represented dual-group identification based on his presentation of both pro-agriculture and pro-environment messages in tandem. For example, consider his statement regarding his motivation for promoting cover crops and no-till practices:

Well, how did my dad get interested? We wanted to do the right thing. We're not greedy capitalists out there just trying to make a profit, and we don't care what's in the rivers and streams. Our soil is our number one resource. In the long term ... The people that cut trees down, if they want to be in business forever, they're not gonna cut every tree down, they've got to make it renewable. Soil is the same way, so soil is our number one resource, and I guess you could argue that, I would say it's ... It can regenerate, but it can be a finite resource in the short term. I think most farmers recognize that real easily.

Nobody loves to see erosion. Nobody. A lot of farmers will complain about it and continue to do the same thing over and over again.

Regarding the multiple, nuanced influencer conceptualizations, Berger seems to fit not only the general definition of opinion leader, but also an ‘issue-specific opinion leader’ in the realm of conservation (Nisbet & Kotcher’s, 2009). However, Berger also uniquely fits the conceptualization of champion, described by both Rogers (2010) and Greenhalgh (2004)—as well as being described as a “cover crop champion” of Iowa within several agricultural newspaper articles. Alternatively, Berger (and especially his father) could also be described as positive deviants, based on an approach to social change which rests on the identification of individuals who have achieved better outcomes than the rest of their community, despite having access to the very same resources (Singhal, Shirley, & Marston, 2010).

Regardless of the various terms used to describe influencer status, they do not all necessarily apply consistently to this group of influential individuals. This analysis helps provide evidence for the need to continue expanding definitions of interpersonal influencers, ultimately perhaps to produce a comprehensive typology of influencers. Though these distinct types of influentials function as influencers in different ways; i.e. Secretary Northey yields a different power, reach, and relevancy to a different audience than that of Berger, whose own influence works differently and for different individuals than Jones, and so on—they are all people who hold some sort of distinguished importance among Iowa farmers in terms of water quality related agricultural practices. Please see the following chapter for further theoretical and practical implications from this study, as well as study design strengths and limitations.

CHAPTER SIX: OVERALL DISCUSSION AND CONCLUSIONS

This dissertation project offers an in-depth investigation into the flow of environmental information through influential media and interpersonal sources within the agricultural community in Iowa. The diffusion of risk information and risk perceptions related to nutrient excesses in water has been of paramount interest throughout the three studies conducted. The important, prominent concepts of uncertainty, normative information, and opinion leadership have also been investigated throughout the studies. On a practical level, one impetus for this research was the disconnect between the Iowa Nutrient Reduction Strategy's (INRS) clear documentation of nutrient reduction benefits achievable via the strategy's recommended practices and the lack of wide-spread land-management decisions to implement these practices on Iowa farm fields.

The mass media are a key source for disseminating environmental and risk information for the public (Ho et al., 2013; McCallum et al., 1991; Morton & Duck, 2001) and because of this the first study (Chapter Three) examined several mediated sources to empirically document the various, and often contradictory, messages farmers are receiving related to the controversial topic of Iowa's water quality. The second study (Chapter Four) was a natural extension of this preliminary exploration and intended to document the way that the environmental issues, risks, and potential solutions were being perceived by one group of key actors within this controversy—farmers. Additionally, because of the significant role interpersonal communication plays in both the flow of information and the persuasion of behavioral change (Katz & Lazarsfeld, 1955; Lazarsfeld et al., 1948; Rogers, 2010), especially among farmers (Conley & Udry, 2001, 2010; Lapple et al., 2015; Nowak, 1992; Padel, 2015), the second study also sought to identify key interpersonal information sources. The third and final study (Chapter Five)

focused on the individuals identified by respondents from the second study and investigated their perspectives of the environmental issues, as well as their conceptualizations of influence within the agricultural community.

Results from these three studies help illuminate the differing conceptualizations of risk and uncertainties related to water quality in Iowa currently being promoted by mainstream and agricultural media entities, agricultural and environmental industry sources, influential individuals in the agricultural sector, and agricultural producers themselves. Both farmers and influential individuals generally did view nutrients in water as potentially risky, though risk conceptualizations were mixed between environmental degradation, human health impacts, and economic losses. A clear distinction between pro-agriculture and pro-environment worldviews was represented in media examined in the first study. Several specific messages reflected through these two seemingly contradictory worldviews were reemphasized by farmers' and influentials' own perspectives on nutrient issues in Iowa. However, most farmers who were interviewed throughout the course of this dissertation demonstrated a range of perspectives on the issues, indicating that many people situated in the agricultural realm hold opinions and beliefs which reflect strong environmental values. Thus, the reality of individual perspectives do not seem to reflect the same dichotomous pro-agriculture versus pro-environment perspectives portrayed by media, rather they reflect a continuum where agriculture and environmental values are not necessarily at odds with one another.

Taken together the results of these three independent, yet intertwined and successive, studies help emphasize the significant, yet nuanced, connections between mass media representation, audience perception, and the exceptional power of personal influence held by a select few individuals. Special consideration is given to the role that risk information, and risk

perceptions, play within the flow of environmental information. This culminating chapter will be organized into two main parts. First, a discussion of the primary strengths and limitations from each study will be presented; and second, a comprehensive discussion of theoretical and practical implications derived from this research are provided. Recommendations for future research are identified throughout the chapter based on both methodological limitations and theoretical implications.

Methodological Strengths and Limitations

Strengths of Study Design

Overall, the triangulation of methods to investigate risk information flows and influence in the agricultural community in Iowa, aligns with key principles of mixed-methods research and follows the suggestions of many scholars (Collins, Onwuegbuzie, Jiao; 2007; Creswell, 2011; Creswell, Shope, Plano Clark, & Green, 2006; Johnson, Onwuegbuzie, Turner, 2007; Rogers 2000). Rogers (2000) specifically calls for more diffusion of information-based research to use a similar triangulation of methods as was conducted in this dissertation research. The use of multiple, complementary methods are necessary for research seeking to identify, document, investigate, and understand complicated social phenomena (Creswell, 2011).

In terms of research efficiency, the progression of methods was also useful considering the exploratory nature of this research and the way investigating media texts helps provide a foundational understanding of the various perspectives on an issue (Philo, 2007). Beginning with media texts also helped inform the creation of more relevant survey and interview protocols. The complementary use of quantitative and qualitative questions within the survey instrument helped rectify some of the criticisms of quantitative-only methods relating to the loss the human dimension and oversimplification of complicated phenomena (Guba & Lincoln, 1994; Howe,

1992). Correspondingly, the use of quantitative methods helped bolster the qualitative data by using pre-determined questions based on previous scholarship and rectified some limitations of qualitative only research, such as subjectivity of findings based on researcher interpretation.

While there were several key strengths from the overall research design of this dissertation, several important limitations should also be emphasized for each study. The remainder of this section will identify and discuss these primary limitations from each of the three studies independently.

Limitations of Each Study

Thematic analysis. In the first study, utilizing thematic textual analysis, the primary limitation was the inclusion of only three sources. Two of the sources, IFT and FBS, represented agricultural industry media and only one source, the DMR represented the mainstream news media perspective. Only looking at these three different sources cannot provide a complete sample of all important viewpoints on the issues central to this study. Similarly, the dichotomy between the two agricultural industry publications and one mainstream news media source was muddled by the high number of op-ed articles published in the DMR. Thus, some of the comparisons made between the sources are based more on the type of publication, rather than the context of the dissertation or the study phenomena. The inclusion of several more publication types to represent additional viewpoints would have been helpful. Correspondingly, given the representation of the narratives related to pro-agriculture and pro-environment perspectives identified in this study, future research should include a pro-environmental publication. Perhaps this would illuminate dichotomy between perspectives, or could have introduced a third, middle-ground perspective.

Additionally, because this preliminary study laid the foundation and identified key themes and narrative, the concepts could subsequently be re-organized into concretely defined categories allowing for the subsequent quantitative examination of the same or similar media texts. This would bolster the reliability and generalizability of this study, and complement this original exploratory work significantly.

Intercept interviews. In the second study, a face-to-face questionnaire was conducted with farmers across several counties in Eastern Iowa. Face-to-face data collection has several important disadvantages, including time, cost, and increased social desirability bias (Bowling, 2005; Dillman, 2009). While time and cost were not significant concerns in this research situation, social desirability bias is important to consider. Respondents' desire to present themselves in the best possible light may potentially have influenced answers to certain questions. Additionally, given the topic of water quality is highly contentious in Iowa currently, great care was taken to develop the questions and questionnaire to reflect neutrality on each topic covered. Such concerns also rendered the wording of the introductory research statement, the informed consent document, and the overall design and tone of the questions very important.¹

¹ Likewise, interviewer experience, attitude, personality, and skill have been shown to affect respondent cooperation in face-to-face surveying (Jäckle, Lynn, Sinibaldi, & Tipping, 2013). As the sole interviewer for this study my experience conducting interviews is important to consider. I have worked in a Denver primary care clinic conducting patient health interviews, conducted field interviews for research projects in India and Haiti, and interviewed farmers at farming events across the Midwest while employed by the Great Plains Center for Agricultural Health. In addition to this interviewing experience, I also grew up in Iowa attending and participating in many fairs and farm-related events. This has given me appreciation for and insight into the unique position of farmers in this state. Therefore, I was an ideal person to

There was a general wariness to speak about water quality issues with someone from the University of Iowa which became apparent among farmers being recruited for the survey.

It is difficult to assess the extent social desirability bias may have played in the responses. Even though conscientious effort was made by the interviewer to assure participants that choosing this study topic was based on increased media attention on Iowa's water quality issues—not based on a liberal, environmentalist agenda promoted by University of Iowa professors (as several participants expressed concern for), social desirability bias likely still occurred. No matter one's politics or private behaviors, our society generally condemns the notion of knowingly polluting the environment. Concern regarding this sentiment, which became apparent through the some of the pro-environmental media artifacts examined in the first study and through discussions with farmer participants in this study, is likely at the heart of many findings from this study overall.

Another important limitation in this study is the lack of validity of several of the quantitative question scales. As Babbie (2013) argues, scale-based survey items can suffer from an artificiality that occurs through the respondent's own inaccurate or unrepresentative responses, or can occur because the predetermined response categories did not accurately reflect

conduct this research and well-equipped to represent my research in a way that accurately reflected the dissertation goals, inspired interest among participants, and minimized potential biases resulting from interviewer error. However, all of this experience also highlights the personal lens with which I conduct and interpret this research, and is an important caveat to recognize.

the respondent's true answer. Part of this had to do with the fact that these contextual topics (such as risks of nutrient excesses) have rarely been studied in previous perception-based survey research, thus the adaptation of scales that were based on measuring concepts more broadly (risk perception for instance) may have shifted the meaning of scaled questions just enough to decrease the measurement validity. Krosnick and Preser (2010) argue that scale-based questions rely on strong prior research and comprehensive researcher understanding of a given topic to ensure a complete list of appropriate answers for each respondent. In cases lacking such extensive previous empirical work, creating a completely standardized, valid instrument would entail a preliminary research agenda based solely on the creation of such scales—which was beyond the scope of research possible for this dissertation.

Fortunately, the combination of qualitative data collected regarding most of the variables did help improve the overall understanding of the key phenomena investigated in this study. This complementary qualitative and quantitative data also enabled comprehensive answers to most of the research questions. However, the collection of both types of data for nearly all variables, and especially the number of quantitative scales and items per scale included in this survey, did result in an overly long questionnaire which hindered the participation of some respondents. The length of the survey overall, in combination with factors related to the locations where the surveys were conducted (i.e. outdoors, on foot, in Iowa summer heat), yielded the completion of questionnaires as exhausting to some participants. Finally, the type of quantitative items included in the questionnaires were not intended to be used to create a predictive statistical model, thus, the descriptive and correlation based results only show proportions and relationships between farmers' perspectives on key variables.

Future research could refine the questionnaire in a way that media use, for example, combined with nutrient beliefs, could be analyzed with hierarchical linear regression to potentially illuminate important predictions. Though it was outside the scope of the present study, additional research should also assess differences between farmer perspectives and demographic characteristics, such as farm size. Similarly, the findings from this study would be better situated if there was additional data from across different geographic groups of Iowa farmers, enabling comparisons of key concepts. For example, the location of farmers being within the Iowa Cedar River Watershed, rather than the Raccoon River Watershed (around Des Moines), or other areas in the state, may have important influences on the responses.

In-depth interviews. The third study, in-depth interviews with the individuals identified as influential by respondents in the second study, was limited most ostensibly by size. The original goal was to include individuals who were cited by three or more survey respondents in the interviewee sample. However, because of the lack of consistency and few number of people ($n=4$) for which these criteria applied, several more individuals who were named by fewer than three survey respondents were included. This was intended to bring the interviewee sample up to ten, however several invited individuals did not respond to the request for research participation. Overall, given the purpose of this final study to provide in-depth analysis of farmer influencer networks, this small sample did provide the necessary data to fulfil this goal. Correspondingly, given that several of the influentials (e.g. Berger, Stutsman, and Jones) were consistently named by the sample of nearly 100 farmers in eastern Iowa, the resulting numbers of repeat mentions does indicate acceptable validity for this modified sociometric methodology.

Theoretical Implications: Influence and the Flow of Risk Information

With the consideration of each study's limitations in mind, there are a number of theoretical and practical implications derived from these three studies. While diffusion of innovations laid a foundation for this research, risk communication and interpersonal influence were explored within the context of environmental and agricultural communication in Iowa. Specifically, the following areas are in need of further theoretical attention and are discussed subsequently: the politicization of environmental risks, literacy challenges related to science and media, and ambiguous conceptualizations of interpersonal influencers.

Politicization of environmental risks. The polarizing pro-agriculture and pro-environment media narratives identified in the first study were continually reinforced by survey respondents' and influencer perceptions of the issues in the two subsequent studies. Despite there being multiple issues and sub-themes resounding within these two worldviews, political ideology seemed to be the most prevalent force driving these perspectives. Much like the debate on global warming, which is "often conducted along party lines, with political ideology determining much of what political leaders, pundits, and members of the public have to say on the issue" (Zhao et al., 2011). It seems that much in the same way global warming, gun control, or taxes define conservatives and liberals (Nisbet, 2009), the water quality debate in Iowa aligns with these distinctions. Water quality itself has become a hotly-contested and highly politically-charged issue in the state of Iowa. This was not only evidenced by the rhetorical battles occurring via the Des Moines Register op-eds written by prominent state politicians, but also by the reluctance of farmers in the second study to participate in a survey about water quality.

This also aligns with past research on climate change communication. For example, McCright and colleagues have produced a substantial body of scholarship in this realm (see,

McCright & Dunlap, 2003; 2011; McCright, Xiao, & Dunlap; 2014) investigating issues ranging from the effects of political polarization on support for government funding of environmental protection, to the race and gender based patterns related to the denial of climate change—which do typically align with the demographics of conservative individuals in the United States. This notion of demographic division was particularly interesting based on the individuals who participated in the second and third studies in this dissertation. While interview participants were overwhelmingly male, the racial disparity was even more significant—though it was not officially documented or explored in either study. All participants but one were white. Though, considering Iowa’s low diversity levels and traditional demographics of US agricultural populations, this was not surprising.

Laird (1989) argues that “to understand how risk communication can influence risk perception, we must see the former as, in part, a political dialogue, not simply a channel for information” (p. 548). This notion of risk communication as political discourse was evidenced in all three studies of this dissertation. Initially the thematic analysis illuminated the differing ways that risks were being conveyed between the two sides, and more specifically the way that the pro-agriculture perspective promoted the sentiment of the ‘risk of regulation’ from the problem of nutrients in water. In one sense, this risk was portrayed as financial. The agricultural sector itself is resistant to the potential monetary penalties or taxes imposed by environmental regulation proposals, and/or the agricultural sector is resistant to economic constraints placed on their farmer customer base as that might disrupt current budgetary allotments for spending in the agricultural sector. However, in another sense, descriptions of nutrient risks in this way were often rife with conservative rhetoric related to impacts on personal liberties and the negative ramifications of increased governmental control. These threats were cloaked within narratives

promoted in news articles and among respondents, warning that such regulations would result in government inspectors traipsing around their fields, or in an increased burden of paperwork for required land-management plans.

However, Fencl's responses related to nutrient in water risks highlighted another side of the risk representations and perceptions appearing within these studies. Fencl optimistically suggests that the increased number of beach closures in recent years should help increase awareness of Iowa's impaired water quality because of the public outrage these closures prompt. Her assertion not only affirms her pro-environmental worldview but also her inherent risk communication mentality. Just as Sandman (1987; 2012) might recommend, risk communicators should utilize examples such as these to strategically increase public outrage and potentially increase support for water quality regulations. Correspondingly, the environmental and health risks were generally portrayed by media and described by respondents with low to moderate severity. This was also slightly more prominent among the discussions of health-related threats than environmental threats. One reason for this may be related to the prominence of national news narratives related to the 'dead-zone' in the Gulf of Mexico. Thus, farmers may have been exposed to more messages related to the ecosystem effects of nutrient excesses in water, yet, they may not feel as susceptible to the negative consequences of this threat given its geographic distance.

Conversely, only very few individuals or media discussed specific health effects related to nutrients, and the most prominent of these was blue-baby syndrome. However, as Fencl points out, nobody knows someone who had a baby die from blue-baby syndrome. And, as Stutsman pointed out, there is some debate on the exact conditions which induce this disease. Yet, recent research into the health effects of nitrates does show persistently high levels of nitrate

consumption is “correlated with carcinomas, hypertension, and thyroid dysfunction in adults and with brain tumors, nasopharyngeal tumors, and leukemia in children” (Richard, Diaz, & Kaye, 2014, p. 395; WHO, 2015). These other health effects associated with high nitrate consumption were notably absent from the responses of all the influential individuals, as well as the majority of interview respondents and news articles analyzed in the thematic analysis. This may indicate low levels of both severity and susceptibility of health-related effects.

Public relations power and risk perceptions. Nowak (1992, p. 16) states “Instead of using the sophisticated communication campaigns and marketing strategies commonplace in agriculture’s private sector, the public sector continues to rely on crude educate, regulate, or bribe tactics.” This apt description from a quarter century ago still seems to resonate today. As became apparent through the texts examined in the first study, and was reconfirmed throughout the subsequent studies, the Iowa Farm Bureau operated with impressive public relations power. Not only were the textual materials well designed, including a number of attractive infographics created by the Farm Bureau to highlight farmer’s progress in adoption of conservation practices, but the content of the articles that came from the FBS were laudatory of farmers above all else. This complimentary coverage was supplemented through an overall reflection of important farmer values—arguably a demonstration of the Farm Bureau’s notable understanding of their audience base. While one farmer did note that he does not turn to the Farm Bureau as the first source of information on water quality issues because he knows that the source is “on the farmer’s side,” and one interviewee asked me to stop recording when discussing the perception of Farm Bureau credibility among farmers, overwhelmingly the interviewees and the influentials praised the organization during our discussions.

However, the public relations power the Farm Bureau has garnered may be working in some less productive ways for Iowa's environmental health. For example, Arbuckle et al.'s (2015) research shows farmers who express higher levels of trust in agricultural interest groups (the Farm Bureau Federation being the primary organization discussed) "are less likely to believe in climate change, much less anthropogenic causes" (p. 226). Correspondingly, the FBS vilifying coverage of Bill Stowe, the Des Moines Water Works (DMWW) CEO, in juxtaposition to the laudatory coverage of Craig Hill, the IFB president and outspoken opponent of the DMWW lawsuit, also seems to highlight the notion that Zhao et al. (2003, p. 716) discuss, in that "competing political and economic arguments and dueling public figures may still provide fodder for public uncertainty." These results also provide evidence that the "manufacturing of uncertainty" and that so-called "denial machine" tactics that have played a role in shaping the general public's beliefs about climate change (Dunlap & McCright, 2010; Stuart et al. 2012) may also be working in Iowa's agriculture realm. The strategic placement of information questioning Bill Stowe, or the environmentalist agenda, in prominent media sources used by farmers may parallel what Zhao et al. (2011) describe as 'manufacturing of uncertainty,' in that the "portrayal of scientific uncertainty in the news is a carefully plotted maneuver by those whose political and economic interests are at stake" (p. 715). Discussing this notion, Freudenburg, Gramling, & Davidson (2008) state:

Given that most scientific findings are inherently probabilistic and ambiguous, if agencies can be prevented from imposing any regulations until they are unambiguously "justified," most regulations can be defeated or postponed, often for decades, allowing profitable but potentially risky activities to continue unabated (p. 2).

Conversely, it is also important to consider the way that the Farm Bureau continually emphasized the potential threats to farmers in their negative coverage of the DMWW lawsuit. Recall that one Farm Bureau writer likened the lawsuit to giving up on his own two-year old daughter. Sensational information in media coverage of risk is generally “thought to elicit fear and inhibit the ability of media users to consider an issue’s genuine risks” (Dahlstrom et al., 2012, p. 156), though this relationship is strongest when sensational information is presented in conjunction with *imprecise* risk information. For example, consider the variety of ways the FBS presented the nutrient issues in Iowa, such as being totally natural, or too difficult to accurately measure, or constantly changing based on weather. If audiences are reading this ambiguous information in tandem with highly negative, sensational coverage suggesting the DMWW lawsuit is threatening the vary profession which has supported their family for generations, it seems likely that fear-based cognitive processes will be primed.

Overall, this study underscores the need to continue to examine the roles that risk portrayals by these trusted information sources may be playing in shaping risk perceptions—and the way these perceptions may ultimately influence behavioral decisions. Consider the way that Fitchen, Heath, Fessenden-Raden (1987) define risk perception as a continually changing process that interacts with attributes of the community, and argue that “the collective perception then acts as a filter through which individual members of the community perceive the risk” (p. 50). Thus, this underscores how useful it may be to consider how environmental risk can fit into a framework of behavior change.

The theory of planned behavior (Ajzen & Fishbein, 1980) is an important social science theory which draws on several of the concepts addressed in this dissertation. The theory suggests that behavior is a product of intention, which is directly influenced by the three key variables:

attitude, subjective norms, and perceived behavioral control. The study in Chapter Four did ultimately address elements of these three components and showed that subjective norms were significantly related to farmers' current nutrient reducing practices. While nutrient beliefs or attitudes toward nutrients were directly assessed, and risk perceptions were directly assessed, no items directly measured attitudes toward the environmental risk reduction potential of INRS practices. Correspondingly, behavioral control, or self-efficacy, was the least explicitly studied of the three variables within this study, though the concept was addressed indirectly in many of the respondents' answers to the question regarding barriers to adopting the INRS practices. Another type of efficacy highlighted by Witte's EPPM model, response efficacy, is related to the perceived effectiveness of taking a particular action. Thus, considering the potential role of efficacy, this suggests that a follow up study might seek to more directly explore self-efficacy and response efficacy related to the practices, in addition to the relationship between environmental risk perception and types of efficacy.

Media and science literacy. The presence of these divergent and competing narratives in the news coverage of Iowa water quality, should serve as an ominous reminder of the dangers of selective exposure of media enabled by today's mass media landscape. The divisive rhetoric promoted by some individuals and some media sources in the agricultural sector parallels current divisions in the U.S. political landscape, where divisive media portrayals of issues (and what the facts really are) contributes to a divided general public. For Iowa, these contradictory narratives are likely to continue to divide the "city slickers" and farmers, which will do little to positively impact our state's water quality.

Despite the ample research conducted by multiple Iowa entities showing nutrients excesses are due to agriculture, and are a threat to public health, this issue is still being covered

by highly circulated, influential media in a way that contradicts this. The discrepancy in coverage of these issues, combined with the results from the survey of farmer's perspectives on the issues, highlights the troubling notion that public perception of water issues is not reflective of current scientific understanding (Ewing & Mills, 1994; Kahan et al., 2012). This is similar to Weathers and Kendall (2015) findings about climate change news coverage, in that there may be “a serious disconnect between what the public health community knows about the health threats associated with climate change and what the public knows” (p. 606). This same disconnect can be presumed for water quality knowledge, however, subsequent research is crucial in this important realm—both in the US and around the world.

As some scholars suggest, part of the problem may be related to principles of good journalism which are centered on the provision of unbiased and equal coverage to both sides of any issue—despite scientific consensus of the facts (Boykoff, 2007; Boykoff & Boykoff 2004; 2007; Zhao et al., 2011). If individuals, such as Iowa farmers, consume some agricultural media and some mainstream media related to water issues, the individuals may perceive the mainstream's media equal reporting on both perspectives as evidence that a scientific consensus does not exist. Or, it may serve to increase their own uncertainty which may drive these individuals to seek more media that presents the topic from one, uniform perspective—that also does not attribute blame for the problem onto them.

Ashe (2013) suggests that the way to combat this challenge is to improve journalism education related to science, health, and the environment to enable a better foundation of understanding among new journalists. Journalists are gatekeepers and agenda-setters, and most often are the first individuals responsible for the introduction of new information within the diffusion process (Dahlstrom, 2014). Focusing more on the education of these crucial

information brokers may be one step towards affecting positive change in the verity of environmental risk information in mass media. Correspondingly, perhaps emphasizing media literacy education at the primary school level would be an even more foundational shift which could eventually result in a more scientifically literate general population.

Refining influencer conceptualizations. In addition to the “curious blind spot” regarding the effects of negative messages on the diffusion process, Weenig and Midden (1991) argue that too little is known about how exactly social influence takes place and “how it is affected by existing communication networks” (p. 734). Additionally, within the context of such a hotly contested, emotionally and politically charged issue, the individuals who are most important in influencing farmer land management decisions may represent or promote a variety of perspectives, and thus may or may not fit within previous theoretically-derived definitions of opinion leaders. The third study in this dissertation sought to examine how theoretical representations of influentials aligned with agricultural media and interpersonal representations, and how these perspectives aligned with the influentials’ perceptions of their own roles as influencers.

Katz and Lazarsfeld (1955) original conceptualization of opinion leader defined these people as “the individuals who were likely to influence other persons in their immediate environment” (p.3). Since that time, literature from the fields of sociology, psychology, communication, public health, marketing, and business has offered slight revisions and expanded terminology used to describe these people. However, the basic conceptualization of influential individual remains largely consistent with Katz and Lazarsfeld’s (1955) original definition (Watts & Dodds, 2007). Correspondingly, while the broad sweeping characteristics of opinion

leader or influentials do align across terms, these definitions are generally amorphous and in need of contextually and theoretically based refinements.

For instance, Northey's position as a prominent governmental official goes against Keller and Berry's (2003) description of an influential. Keller and Berry (2003) state: "It's not about the first names that come to mind when you think about the people with influence in this country—the leaders of government, the CEO's of larger corporations, the wealthy" (p.1). Watts and Dodds' (2007) echo this assertion, arguing that "opinion leaders are not 'leaders' in the usual sense—they do not head formal organizations nor are they public figures such as newspaper columnists, critics, or media personalities whose influence is exerted indirectly via organized media or authority structures" (p. 442). Yet, Northey was referenced within 40 articles included in the thematic analysis (Chapter Three) and named as the most important person to three different farmers' water quality related decisions. While he did represent a unique position of formal power within the case study, he did personally influence several farmers in Iowa making it difficult to suggest he should not be considered an influential.

Along these lines, Burt (1999) argued that opinion leaders are not individuals who are more powerful or of any sort of elevated status within a group, rather that they are information brokers. These brokers, not only have a high density of social relations but also act as information exchangers through their seeking and providing behaviors (Burt, 1999). The key, according to Burt (1999), is that this exchange occurs across social contexts, rather than within them, which is the mechanism enabling these individuals to drive the entire diffusion process. From this perspective, the way that Berger and Jones were able to transcend beyond their own internal affiliation (Berger as pro-agriculture, Jones as pro-environment) and be able to fully

integrate—and be influential—within for individuals holding both perspectives, demonstrates Burt's (1999) conceptualization.

However, this ability to connect and belong within differing factions also depends on another influencer type as described by Greenhalgh et al. (2004)—the boundary spanner. This type of influential who seemed to be represented by both Fencil and Northey, can affect broader institutional and organizational changes through their significant social ties both inside and outside their organizations. Essentially Jones's influence is supported and bolstered by his relationship with Fencil (and vice versa, though her position gives her broader and higher level governmental access), while the same is true for Berger with Northey.

In some sense, both Stutsman and Meyerholtz represent the more traditional opinion leader roles, especially because they are less directly involved in water quality issues, and rather have a more general credibility on the scope of agriculture and technologies. Yet, in terms of water quality related practices, Stutsman especially seems to represent more of the negative opinion leader role (Leonard-Barton, 1985), given his disbelief in risks associated with nutrients in water and primarily monetary motivations for cover crop usage. Midgley (1977) states, “unfavorable communicated experience is always more effective in making favorables neutral than is favorable communicated experience in making passives into favorable” (p. 145). Considering Stutsman's broad influence, negative perspectives, and proclivity for voicing these opinions, he may be fulfilling Midgley's notion and helping to stall practice adoption.

Similarly, both Stutsman and Northey seem to fit Weimann et al.'s (2007) conceptualization of opinion leaders as distinguished by their level of personality strength, or the ‘influence as personality strength’ category of opinion leader per Nisbet and Kotcher, 2009. According to Weimann et al. (2007) these individuals exude a unique level of confidence,

leadership, and persuasiveness. Berger also seems to fit not only the general definition of opinion leader, though more on the side of Nisbet and Kotcher's (2009) description as an 'issue-specific opinion leader.' However, Berger also uniquely fits the conceptualization of champion, described by both Rogers (2010) and Greenhalgh (2004) as especially important for boosting a new idea in an organization, such as the way Berger and his father did for cover crops while working for Monsanto. Alternatively, the positive deviance approach, which relies on the identification of individuals who have achieved better outcomes than the rest of their community despite having access to the very same resources (Singhal, Shirley, & Marston, 2010), also seems to describe Berger (and maybe his father even more so).

Opinion leaders, negative opinion leaders, information brokers, champions, boundary spanners, positive deviants, all represent slightly differing types of the same general person—the influential individual. However, these various terms and their corresponding definitions do not necessarily comprehensively or accurately represent the gamut of those influential individuals—as evidenced by the case study of six influentials in the third study of this dissertation. Perhaps the next wave of diffusion research should focus on expanding definitions of the opinion leader to offer a comprehensive typology of influencers, based in part on the vast literature already documenting diffusion through various social networks and contexts. This research demonstrates that despite all six individuals being influential, Secretary Bill Northey is a very different type of influencer than is Steve Berger, who is different than Wendell Jones, and so on.

Practical Implications: Attribution, Agri-business, and Cover Crops

In addition to these important theoretical implications, several additional implications are important for environmental communication practitioners, farm media entities, and watershed advocacy groups, among others. The three practical implications—related to attribution of blame

for impaired water quality, agri-businesses as potential change agents, and cautions related to cover crops—are discussed subsequently.

Attribution of blame. Despite the EPA’s (2017) statement that “Animal manure, excess fertilizer applied to crops and fields, and soil erosion make agriculture one of the largest sources of nitrogen and phosphorus pollution in the country” and all of the scientific evidence pointing to agriculture’s prominent role in contributing to US nutrient excesses (Kirmeyer et al., 1995; Environment Canada, 2003; USEPA, 2006; Keeney & Hatfield, 2008; WHO, 2015) individuals aligning most strongly with the pro-agricultural world-view were resistant to attribute water quality problems with current agricultural practices. One of the most fascinating and surprising narratives emerging through the three studies was the belief by many farmers that nutrient excess are due to urban areas, either through practices such as over fertilizing golf courses and residential lawns, or through the increased asphalt used to pave new roads and parking lots. Such beliefs among farmers are not likely unique to this study’s participants, as an investigative report on the topic was published in the Des Moines Register and printed in several other Iowa newspapers (see Kilen, 2016). This report, like other mainstream media examples from the textual analysis, diplomatically outlines perspectives from both sides while still ultimately attempting to resolve this misperception. However, attribution was also often emphasized by the pro-environmental side, who seemed ready to blame the agricultural producers—farmers—rather than current conventional agricultural operations systems which prioritize profit above all else.

The notion of blame rampant within both the narratives reflecting pro-environmental and pro-agricultural perspectives makes it interesting to consider the psychological mechanism of blame. Per attribution theory, attributing responsibility helps individuals make sense of phenomena and perceptions of the factors responsible for causing a problem are seen as being

responsible for solving it (Heider, 1944; Young, Tully, & Ramirez, 2016). Accordingly, both the pro-environmental perspective which represents Iowa's water quality problems as due to agriculture, and the pro-agriculture side which is eager to attribute Iowa's water quality problems to anything but agriculture, are essentially in line with the basic premises of attribution theory.

Hallman and Wandersman's (1992) work on psychological coping through environmental threats, suggest that lack of human control (inherent in natural disasters) makes attribution of blame more difficult for people, while attribution for man-made disasters is facilitated as there is one particular entity to blame. Correspondingly, Hallman and Wandersman's (1992) work suggests that the more people blame a particular entity, the less psychological distress they endure. This is interesting to consider regarding several of the common communication messages resounding in Iowa's water quality debates. On the one hand, the agricultural sector supports a narrative promoting the naturalness of narratives, often subsequently suggesting that mother nature, or God should be blamed over individual behaviors.

This narrative aligns with other research on the psychology of environmental concern which shows that Americans are more likely than other nationalities to internally frame environmental issues as a conflict of "humans vs nature" (Gifford & Nilsson, 2014, p. 10), rather than other conceptualizations which lack this inherent conflict dichotomy. Essentially, this narrative may be making attribution more difficult and working in favor of the conventional agriculture industry's desire to continue the status quo of operations—which as they run currently, yield billions in profit each year. Correspondingly, the pro-environmental side which seems to blame farmers may be finding psychological comfort in doing so, and reinforcing their own subscription to the narrative that farmers are polluting our water—rather than perhaps being

willing to consider the role of the agricultural industry forces or even their own water-related behaviors.

Engagement with agri-businesses. Some researchers have recently argued that the climate change research community should attempt to engage with the farm press to help combat this “denial machine” (Arbuckle et al., 2015; Dunlap & McCright, 2010). The first study in this dissertation centered on the view that a necessary precursor to Arbuckle’s (2015) call for such engagement must be an attempt to understand and empirically document the way the farm press is representing environmental problems, the corresponding risk narratives or messages (i.e. portrayal of the threats related to nutrients in Iowa’s water) being promulgated within this community, and who the key sources are disseminating various representations of the issues. Accordingly, one relevant, yet cautionary observation regarding a major agribusiness entity discussed by media and participants is offered below.

Monsanto, a massive agribusiness corporation around the world, was discussed in a positive light by several participants. However, as indicated in the above section, their involvement in the promotion of cover crops likely rests on the additional sales this yields for their product, Roundup. However, their influence in the conventional day-to-day farming activities of farmers in Iowa likely goes far beyond this one example. For instance, one survey respondent who was discussing the notion of farming tradition and farmer’s unwillingness to change, stated: “Monsanto makes things pretty clear cut to do it their way... The transition to these practices can be costly, tradition is important to farmers, uncertainty about risks or yield losses, lack of awareness of environmental effects.” This is important to highlight from the standpoint of considering Monsanto and other agribusiness entities influence and control over Iowa farmers. As previously discussed, these agricultural giants have created the right public

relations image of themselves that they as a corporation seem to represent the very notion of “tradition” to this particular farmer. And, they have been able to essentially ensure that the status quo of using their products represents the path of least resistance for farmers making land management decisions. Thus, Arbuckle et al.’s (2015) call for engagement with such entities is certainly apt, yet ultimately may yield little impact.

Cover crops as the panacea? Cover crops were the most frequently mentioned and reported on of the nutrient reduction practices recommended through the INRS. This practice was also lauded by both media articles and individual study participants, and often were used to highlight progress in the agricultural realm in adopting INRS practices. While the notion of covering the ground at all times with plants which can continuously utilize and absorb nutrients—in addition to helping to hold soils in place during weather events—makes logical sense, the primary means of exterminating cover crops using Roundup, is concerning.

The use of the herbicide Roundup, which is essentially a brand of the chemical glyphosate is banned in many European countries and in March 2015 the International Agency for Research on Cancer (IARC) classified it as *probably carcinogenic to humans* (group 2A). This reported sparked great controversy, and as Dan Charles, National Public Radio reporter states in a recent article, “Monsanto, the company that invented glyphosate and still sells most of it, unleashed a fierce campaign to discredit the IARC's conclusions” (15 March 2017). Recently, new details of Monsanto’s strategies in this campaign have resulted in a lawsuit brought on by a group of cancer patients in California, alleging that “Monsanto executives colluded with officials at the EPA to downplay glyphosate's health risks” (Charles, 15 March 2017).

In any case, the increased use of Roundup in Iowa because of increased adoption of cover crops may ultimately yield unintended negative health effects rivaling those that could be created

by excess nutrients. Thus, perhaps more effort is needed among environmental groups, academics, and other key sources to both find and promote other means of exterminating cover crops. Or, these stakeholders may consider decreasing the current push for this particular practice until more definitive research exists documenting long-term outcomes of glyphosate use.

Conclusion

One barrier to the adoption of nutrient reducing practices highlighted within the pro-agriculture perspective, which was consistently expressed by interview participants (in Chapter Four), was that “Farmers hate change.” Even the phrase: “Iowa Stubborn” was used by some participants. Wilkening (1962, p. 42) describes this sentiment in his discussion of communication in the agricultural realm, stating:

Much of the resistance to innovations in agriculture appears to stem from a resistance to change itself rather than to resistance to specific innovations. Change is resisted by persons as well as by groups to the extent that the readjustments resulting from the change are not offset by greater perceived advantages. This resistance may take the form of pride in traditional ways of doing things and a reluctance to admit that there are "better ways. " This conservatism may be viewed as an overemphasis upon the integration of the system or an attempt to maintain its own "integrity" rather than upon instrumental-adaptive behavior which involves adjustment to and dependence upon the outside world.

Wilkening’s words from over half a century ago underscore one of the most fundamental dilemmas at play in the agricultural realm—and one which is ultimately harming Iowa’s water quality. As Wilkening points out, this likely rests on the lack of perception of a greater advantage in using practices which protect Iowa’s water.

This is a curious notion to consider—why does the protection of a vital, yet limited, resource for human life, not represent a greater perceived advantage? Perhaps it is because, for most Americans, water has become just another “on demand” resource (Cockerill, 2010). In part because North America has plentiful freshwater supplies and significant infrastructure, Americans can turn on their faucets and instantly receive unlimited amounts of clean safe water. The water supply system has been described as “invisible,” which leaves the connections between how water systems work, our use of it, and the overarching global implications of our use, largely un contemplated (Cockerill, 2010). Perhaps the silver lining exposed by this dissertation research is that the connection between a significant economic resource—agriculture, and the current deleterious effects this activity has on our most crucial natural resource—water, renders the fragility of water sustainability slightly more visible for Iowans.

REFERENCES

- Abadi Ghadim, A.K., 2000. *Risk, Uncertainty and Learning in Farmer Adoption of a Crop Innovation*. Unpublished Ph.D. Thesis, Faculty of Agriculture, University of Western Australia, Nedlands, Western Australia.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2), 179-211.
- Alessa, L., Bennett, S. M., & Kliskey, A. D. (2003). Effects of knowledge, personal attribution and perception of ecosystem health on depreciative behaviors in the intertidal zone of Pacific Rim National Park and Reserve. *Journal of Environmental Management*, 68(2), 207-218.
- Altaweel, M., & Bone, C. (2012). Applying content analysis for investigating the reporting of water issues. *Computers, Environment and Urban Systems*, 36(6), 599-613.
- Arbuckle, J. G. (2013). Farmer support for extending conservation compliance beyond soil erosion: Evidence from Iowa. *Journal of Soil and Water Conservation*, 68(2), 99-109.
- Arbuckle Jr, J. G., Morton, L. W., & Hobbs, J. (2015). Understanding farmer perspectives on climate change adaptation and mitigation: The roles of trust in sources of climate information, climate change beliefs, and perceived risk. *Environment and behavior*, 47(2), 205-234.
- Arbuckle, J. G., Morton, L. W., & Hobbs, J. (2013). Farmer beliefs and concerns about climate change and attitudes toward adaptation and mitigation: Evidence from Iowa. *Climatic Change*, 118(3-4), 551-563.
- Ashe, T. (2013). How the media report scientific risk and uncertainty: a review of the literature. *Reuters Institute for the Study of Journalism*, [https://reutersinstitute.politics.ox.ac.uk/sites/default/files/How% 20the% 20Media% 20Report% 20Risk% 20and% 20Uncertainty. pdf](https://reutersinstitute.politics.ox.ac.uk/sites/default/files/How%20the%20Media%20Report%20Risk%20and%20Uncertainty.pdf).
- Attride-Stirling, J. (2001). Thematic networks: an analytic tool for qualitative research. *Qualitative research*, 1(3), 385-405.
- Avery, A. A. (1999). Infantile methemoglobinemia: reexamining the role of drinking water nitrates. *Environmental health perspectives*, 107(7), 583.
- Babbie, E. R. (2013). *The practice of social research* (13th ed). Belmont, CA: Wadsworth publishing company.
- Baldassare, M., & Katz, C. (1992). The personal threat of environmental problems as predictor of environmental practices. *Environment and Behavior*, 24(5), 602-616.

- Baratta, B. (18 July 2016). Water quality academy showcases farmers' conservation efforts. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Water-quality-academy-showcases-farmers-conservation-efforts>
- Bard, S. K., & Barry, P. J. (2000). Developing a scale for assessing risk attitudes of agricultural decision makers. *The International Food and Agribusiness Management Review*, 3(1), 9-25.
- Basil, M. D., & Brown, W. J. (1997). Marketing AIDS prevention: The differential impact hypothesis versus identification effects. *Journal of Consumer Psychology*, 6(4), 389-411.
- Baxter, J., & Eyles, J. (1999). The utility of in-depth interviews for studying the meaning of environmental risk. *The Professional Geographer*, 51(2), 307-320.
- Beal, G. M., & Bohlen, J. M. (1955). How farm people accept new ideas (Report 15). Ames, IA: Cooperative Extension Service.
- Beal, G. M., & Bohlen, J. M. (1957). *The diffusion process*. Agricultural Experiment Station, Iowa State College.
- Beal, G. M., & Rogers, E. M. (1960). The adoption of two farm practices in a central Iowa community. *Special Report*, 26. Agricultural and Home Economics Experiment Station, Ames, Iowa.
- Beal, G. M., Rogers, E. M., & Bohlen, J. M. (1957). Validity of the concept of stages in the adoption process. *Rural Sociology*, 22(2), 166-168.
- Binswanger, H. P. (1980). Attitudes toward risk: Experimental measurement in rural India. *American journal of agricultural economics*, 62(3), 395-407.
- Block, T. (2016, February 29). Farm and city partnerships can solve water quality challenges. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Farm-and-city-partnerships-can-solve-water-quality-challenges>
- Boeije, H. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality and quantity*, 36(4), 391-409.
- Bonney, M. A. (ed.). (1983). Farmers get together. *The Goldfinch*, 5(1). Iowa City, IA: The Iowa State Historical Department.
- Bostrom, A., Fischhoff, B., & Morgan, M. G. (1992). Characterizing mental models of hazardous processes: A methodology and an application to radon. *Journal of social issues*, 48(4), 85-100.

- Bottorff, J. L., Ratner, P. A., Johnson, J. L., Lovato, C. Y., & Joab, S. A. (1998). Communicating cancer risk information: the challenges of uncertainty. *Patient education and counseling*, 33(1), 67-81.
- Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: a research note. *Qualitative research*, 8(1), 137-152.
- Bowling, A. (2005). Mode of questionnaire administration can have serious effects on data quality. *Journal of Public Health*, 27(3), 281-291. doi:10.1093/pubmed/fdi031
- Boyatzis, R. (1998). *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, CA: Sage.
- Boykoff, M. T. (2007). Flogging a dead norm? Newspaper coverage of anthropogenic climate change in the United States and United Kingdom from 2003 to 2006. *Area*, 39(4), 470-481.
- Boykoff, M. T., & Boykoff, J. M. (2004). Balance as bias: global warming and the US prestige press. *Global environmental change*, 14(2), 125-136.
- Boykoff, M. T., & Boykoff, J. M. (2007). Climate change and journalistic norms: A case-study of US mass-media coverage. *Geoforum*, 38(6), 1190-1204.
- Bradac, J. J. (2001). Theory comparison: Uncertainty reduction, problematic integration, uncertainty management, and other curious constructs. *Journal of Communication*, 51(3), 456-476.
- Brashers, D. E. (2001). Communication and uncertainty management. *Journal of communication*, 51(3), 477-497.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Brender, J. D., Weyer, P. J., Romitti, P. A., Mohanty, B. P., Shinde, M. U., Vuong, A. M., ... & Huber Jr, J. C. (2013). Prenatal nitrate intake from drinking water and selected birth defects in offspring of participants in the National Birth Defects Prevention Study. *Environmental health perspectives*, 121(9), 1083.
- Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: the example of vaccination. *Health Psychology*, 26(2), 136.
- Brickman, P., Rabinowitz, V. C., Karuza, J., Coates, D., Cohn, E., & Kidder, L. (1982). Models of helping and coping. *American psychologist*, 37(4), 368-384.

- Brown, C. & Lewis, M. (2003, November). *Cervical cancer messages in women's magazines: A content analysis grounded in the extended parallel process model*, Paper presented at the International Communication Association, San Diego, CA.
- Burt, R. S. (1999). The social capital of opinion leaders. *The Annals of the American Academy of Political and Social Science*, 566(1), 37-54.
- Burkholder, J., Libra, B., Weyer, P., Heathcote, S., Kolpin, D., Thome, P. S., & Wichman, M. (2007). Impacts of waste from concentrated animal feeding operations on water quality. *Environmental health perspectives*, 308-312.
- Byerlee, D., & De Polanco, E. H. (1986). Farmers' stepwise adoption of technological packages: Evidence from the Mexican Altiplano. *American Journal of Agricultural Economics*, 68(3), 519-527.
- Camboni, S. M., & Napier, T. L. (1993). Factors affecting use of conservation farming practices in East Central Ohio. *Agriculture, ecosystems & environment*, 45(1-2), 79-94.
- Campbell, M. C., & Goodstein, R. C. (2001). The moderating effect of perceived risk on consumers' evaluations of product incongruity: Preference for the norm. *Journal of consumer Research*, 28(3), 439-449.
- Carrel, M., Schweizer, M. L., Sarrazin, M. V., Smith, T. C., & Perencevich, E. N. (2014). Residential proximity to large numbers of swine in feeding operations is associated with increased risk of methicillin-resistant *Staphylococcus aureus* colonization at time of hospital admission in rural Iowa veterans. *Infection Control & Hospital Epidemiology*, 35(2), 190-192.
- Carter, P. M., Bingham, C. R., Zakrajsek, J. S., Shope, J. T., & Sayer, T. B. (2014). Social norms and risk perception: Predictors of distracted driving behavior among novice adolescent drivers. *Journal of Adolescent Health*, 54(5), S32-S41.
- Charles, D. (15 March 2017). Emails Reveal Monsanto's Tactics to Defend Glyphosate Against Cancer Fears. National Public Radio, The Salt: What's on Your Plate. Retrieved from <http://www.npr.org/sections/thesalt/2017/03/15/520250505/emails-reveal-monsantos-tactics-to-defend-glyphosate-against-cancer-fears>
- Chiu, S., Cheyney, M., Ramirez, M., & Gerr, F. (2015). Where do agricultural producers get safety and health information? *Journal of agromedicine*, 20(3), 265-272.
- Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. *Journal of personality and social psychology*, 58(6), 1015.
- Coleman, C. L. (1993). The influence of mass media and interpersonal communication on societal and personal risk judgments. *Communication Research*, 20(4), 611-628.

- Coleman, J. S., Katz, E., & Menzel, H. (1966). *Medical innovation: A diffusion study* (Second Edition). Indianapolis: Bobbs-Merrill.
- Collins, K. M., Onwuegbuzie, A. J., & Jiao, Q. G. (2007). A mixed methods investigation of mixed methods sampling designs in social and health science research. *Journal of mixed methods research, 1*(3), 267-294.
- Combs, B., & Slovic, P. (1979). Newspaper coverage of causes of death. *Journalism Quarterly, 56*(4), 837-849.
- Comito, J., Wolseth, J., Wright Morton, L. (2011). Water quality matters to us all. Iowa Learning Farms. Iowa State University, Ames, Iowa.
- Conley, T. G., & Udry, C. R. (2010). Learning about a new technology: Pineapple in Ghana. *The American Economic Review, 35*-69.
- Conley, T., & Udry, C. (2001). Social learning through networks: The adoption of new agricultural technologies in Ghana. *American Journal of Agricultural Economics, 668*-673.
- Contractor, N., & DeChurch, L. (2014). Integrating social networks and human social motives to achieve social influence at scale. *Proceedings of the National Academy of Sciences of the United States of America, 111*, 13650-13657. Retrieved from <http://www.jstor.org/stable/43043104>
- Copp, J. H., Sill, M. L., & Brown, E. J. (1958). The function of information-sources in the farm practice adoption process. *Rural Sociology, 23*(2), 146-157.
- Corbett, J. B., & Durfee, J. L. (2004). Testing public (un) certainty of science media representations of global warming. *Science Communication, 26*(2), 129-151.
- Covello, V. T., von Winterfeldt, D., & Slovic, P. (1987). Communicating scientific information about health and environmental risks: Problems and opportunities from a social and behavioral perspective. In *Uncertainty in risk assessment, risk management, and decision making* (pp. 221-239). Springer US.
- Covello, V., & Sandman, P. M. (2001). Risk communication: evolution and revolution. In A. Wolbarst (ed.) *Solutions for an Environment in Peril*, John Hopkins University Press (pp. 164-178).
- Covello, V.T., Slovic, P., & von Winterfeldt, D. (1986), Risk communication: A review of the literature, *Risk Abstracts, 3* (4) (1986) 172-182.
- Crampton, A., & Ragusa, A. (2008). My water's fine, isn't it? an exploration of the gendered perception of water quality and security in Australia. *Rural Society, 18*(3), 202-213.

- Creswell, J. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage.
- Creswell, J. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Upper Saddle River, NJ: Merrill Prentice Hall.
- Creswell, J. (2003). *Research design: Qualitative, quantitative and mixed methods approaches (2nd ed.)*. Thousand Oaks, CA: SAGE Publications.
- Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into practice*, 39(3), 124-130.
- Creswell, J. W., Shope, R., Plano Clark, V. L., & Green, D. O. (2006). How interpretive qualitative research extends mixed methods research. *Research in the Schools*, 13(1), 1-11.
- Creswell, J.W. (2011). Controversies in Mixed Methods Research. In. N. K. Denzin & Y. S. Lincoln (eds), *The SAGE Handbook of Qualitative Research*. Thousand Oaks, CA: Sage, pp. 269–284.
- Culbertson, H. M., & Stempel, G. H. (1985). “Media malaise”: Explaining personal optimism and societal pessimism about health care. *Journal of Communication*, 35(2), 180-190.
- Cullen, A. (2016, July 20). They’re playing a game at our expense. *The Storm Lake Times*. Retrieved from <http://www.stormlake.com/articles/2016/07/20/they%E2%80%99re-playing-game-our-expense>
- Dahlstrom, M. F. (2014). Using narratives and storytelling to communicate science with nonexpert audiences. *Proceedings of the National Academy of Sciences*, 111(Supplement 4), 13614-13620.
- Dahlstrom, M. F., Dudo, A., & Brossard, D. (2012). Precision of information, sensational information, and self-efficacy information as message-level variables affecting risk perceptions. *Risk Analysis*, 32(1), 155-166.
- Dalrymple, K. E., Shaw, B. R., & Brossard, D. (2013). Following the leader: Using opinion leaders in environmental strategic communication. *Society & Natural Resources*, 26(12), 1438-1453.
- Dalrymple, K. E., & Young, R. (2016). The promise of participatory media: Identifying the potential roles of influential content generators in prosocial strategic communication. In A. Dudo & L. Kahlor (Eds), *Strategic Communication: New Agendas in Communication* (pp. 42-65). New York: Routledge.

- Dearing, J. W., Rogers, E. M., Meyer, G., Casey, M. K., Rao, N., Campo, S., & Henderson, G. M. (1996). Social marketing and diffusion-based strategies for communicating with unique populations: HIV prevention in San Francisco. *Journal of Health Communication, 1*(4), 343.
- De Boer, M., McCarthy, M., Brennan, M., Kelly, A. L., & Ritson, C. (2005). Public understanding of food risk issues and food risk messages on the island of Ireland: the views of food safety experts. *Journal of Food Safety, 25*(4), 241-265.
- De Fleur, M. L. (1987). The growth and decline of research on the diffusion of the news, 1945-1985. *Communication Research, 14*(1), 109-130.
- de Leeuw, E. D. (1992). *Data quality in mail, telephone and face to face surveys*. TT Publikaties, Plantage Daklaan 40, 1018CN Amsterdam.
- del Río González, P. (2005). Analysing the factors influencing clean technology adoption: a study of the Spanish pulp and paper industry. *Business strategy and the environment, 14*(1), 20-37.
- Denzin, N. K., & Lincoln, Y. S. (1998). *Strategies of qualitative inquiry*. Thousand Oaks, CA: Sage.
- DeYoung, J. (2016, February 05). Producers hear water quality concerns. *Iowa Farmer Today*. Retrieved from http://www.iowafarmertoday.com/news/livestock/producers-hear-water-quality-concerns/article_a7cd9590-cab2-11e5-838a-0f1d2b4df880.html
- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: the tailored design method*. John Wiley & Sons.
- Donner, S. D., & Kucharik, C. J. (2008). Corn-based ethanol production compromises goal of reducing nitrogen export by the Mississippi River. *Proceedings of the National Academy of Sciences, 105*(11), 4513-4518.
- Dudo, A. D., Dahlstrom, M. F., & Brossard, D. (2007). Reporting a potential pandemic a risk-related assessment of avian influenza coverage in US newspapers. *Science Communication, 28*(4), 429-454.
- Dunlap, R. E., & McCright, A. M. (2010). Climate change denial: sources, actors and strategies. In C. Lever-Tracy (ed.) *Routledge handbook of climate change and society*, (pp. 240-259). Abingdon, UK: Routledge.
- Dunwoody, S. (1999). Scientists, journalists, and the meaning of uncertainty. In S. M. Friedman, S. Dunwoody, & C. L. Rogers (Eds.) *Communicating uncertainty: Media coverage of new and controversial science*, (pp. 59-79). Mahwah, NJ: Erlbaum.

- Dunwoody, S., & Neuwirth, K. (1991). Coming to terms with the impact of communication on scientific and technological risk judgments. In L. Wilkins & P. Patterson (Eds.) *Risky business: Communicating issues of science, risk, and public policy*, (pp. 11-30). Westport, CT: Greenwood Press.
- Duram, L. (1999). Factors in organic farmers' decision making: Diversity, challenge, and obstacles. *American Journal of Alternative Agriculture*, *14*(1), 2-10. doi:10.1017/S0889189300007955
- Egri, C. P. (1999). Attitudes, backgrounds and information preferences of Canadian organic and conventional farmers: Implications for organic farming advocacy and extension. *Journal of Sustainable Agriculture*, *13*(3), 45-73. doi:10.1300/J064v13n03_05
- Einsiedel, E. F., and B. Thorne. (1999). Public responses to uncertainty. In S. M. Friedman, S. Dunwoody, & C. L. Rogers (Eds.) *Communicating uncertainty: Media coverage of new and controversial science*, (pp. 59-79). Mahwah, NJ: Erlbaum.
- Eller, D. (2017, January 04). Can this 'Iowa nice' guy help fix our ailing water quality? *The Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/agriculture/2017/01/03/joe-mcgovern-iowa-water-debate-iowa-national-heritage-foundation/95432518/>
- Eller, D. (2016, February 07). Millions are spent for a drop in the bucket. *The Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/agriculture/2016/02/06/study-little-increase-two-key-conservation-practices/79656338/>
- Eller, D. (2015, November 24). Grassley: Regulations can't control what God determines, *The Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/2015/11/23/grassley-regulations-cant-control-god/76257732/>
- Eller, D. (2016, February 28). Most Iowans back water suit, split on footing the bill. *The Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/agriculture/2016/02/27/iowa-poll-iowans-support-water-lawsuit-but-split-who-should-pay/80938460/>
- Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of advanced nursing*, *62*(1), 107-115.
- Environmental Protection Agency (EPA). (2017). Nutrient Pollution. Retrieved from <https://www.epa.gov/nutrientpollution>
- Erickson, P. I., & Kaplan, C. P. (2000). Maximizing qualitative responses about smoking in structured interviews. *Qualitative Health Research*, *10*(6), 829-840.

- Ewing, M. S., & Mills, T. J. (1994). Water literacy in college freshmen: Could a cognitive imagery strategy improve understanding?. *The Journal of Environmental Education*, 25(4), 36-40.
- Fairclough, N. (2003). *Analysing discourse: Textual analysis for social research*. New York: Routledge.
- Featherman, M., & Fuller, M. (2003, January). Applying TAM to e-services adoption: the moderating role of perceived risk. In *System Sciences, 2003. Proceedings of the 36th Annual Hawaii International Conference on* (pp. 11-pp). IEEE.
- Feder, G., & Slade, R. (1984). The acquisition of information and the adoption of new technology. *American Journal of Agricultural Economics*, 66(3), 312-320.
- Feder, G., & Umali, D. L. (1993). The adoption of agricultural innovations: a review. *Technological forecasting and social change*, 43(3-4), 215-239.
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International journal of qualitative methods*, 5(1), 80-92.
- Ferrer, R. A., Portnoy, D. B., & Klein, W. M. (2013). Worry and risk perceptions as independent and interacting predictors of health protective behaviors. *Journal of health communication*, 18(4), 397-409.
- Fewtrell, L. (2004). Drinking-water nitrate, methemoglobinemia, and global burden of disease: a discussion. *Environmental health perspectives*, 1371-1374.
- Finlay, K. A., Trafimow, D., & Moroi, E. (1999). The importance of subjective norms on intentions to perform health behaviors. *Journal of Applied Social Psychology*, 29(11), 2381-2393.
- Fitchen, J. M., Heath, J. S., & Fessenden-Raden, J. (1987). Risk perception in community context: a case study. In *The social and cultural construction of risk* (pp. 31-54). Springer Netherlands.
- Flynn, L. R., Goldsmith, R. E., & Eastman, J. K. (1996). Opinion leaders and opinion seekers: Two new measurement scales. *Journal of the academy of marketing science*, 24(2), 137-147.
- Food and Agriculture Organization of the United Nations (FAO) (2011). Labour statistics document. Retrieved from <http://www.fao.org/docrep/015/i2490e/i2490e01b.pdf>
- Fram, S. M. (2013). The constant comparative analysis method outside of grounded theory. *The Qualitative Report*, 18(1), 1.

- Freudenburg, W. R., Coleman, C. L., Gonzales, J., & Helgeland, C. (1996). Media coverage of hazard events: analyzing the assumptions. *Risk Analysis*, *16*(1), 31-42.
- Freudenburg, W. R., Gramling, R., & Davidson, D. J. (2008). Scientific certainty argumentation methods (SCAMs): science and the politics of doubt. *Sociological Inquiry*, *78*(1), 2-38.
- Frewer, L. J., & Shepherd, R. (1994). Attributing information to different sources: effects on the perceived qualities of information, on the perceived relevance of information, and on attitude formation. *Public Understanding of Science*, *3*(4), 385-401.
- Friedman, S. M., Gorney, C. M., & Egolf, B. P. (1987). Reporting on radiation: A content analysis of Chernobyl coverage. *Journal of Communication*, *37*(3), 58.
- Friedricks, W. B. (2000). *Covering Iowa: The History of the Des Moines Register and Tribune Company, 1849-1985*. Iowa State Press.
- Fürsich, E. (2009). In defense of textual analysis: Restoring a challenged method for journalism and media studies. *Journalism studies*, *10*(2), 238-252.
- Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, *49*(3), 141-157.
- Gillham, B. (2000). *Case study research methods*. New York: Bloomsbury Publishing.
- Glaser, B. G. (1965). The constant comparative method of qualitative analysis. *Social problems*, *12*(4), 436-445.
- Glik, D. C. (2007). Risk communication for public health emergencies. *Annual Review of Public Health*, *28*, 33-54.
- Goodall, C. E., & Reed, P. (2013). Threat and efficacy uncertainty in news coverage about bed bugs as unique predictors of information seeking and avoidance: An extension of the EPPM. *Health communication*, *28*(1), 63-71.
- Gorney, C. (1992). Numbers versus pictures: Did network television sensationalize Chernobyl coverage? *Journalism & Mass Communication Quarterly*, *69*(2), 455-465.
- Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, *78*, 1360-1380.
- Granovetter, M. (1995). *Getting a job: A study of contacts and careers*. University of Chicago Press.

- Grassley, C. (2015, December 13). Grassley: Regulating ag runoff is impractical, *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/opinion/columnists/iowa-view/2015/12/12/grassley-regulating-ag-runoff-impractical/77162566/>
- Green, C. T., Bekins, B. A., Kalkhoff, S. J., Hirsch, R. M., Liao, L., & Barnes, K. K. (2014). Decadal surface water quality trends under variable climate, land use, and hydrogeochemical setting in Iowa, USA. *Water Resources Research*, *50*(3), 2425-2443.
- Greenberg, M. R., Sachsman, D. B., Sandman, P. M., & Salomone, K. L. (1989). Risk, drama and geography in coverage of environmental risk by network TV. *Journalism Quarterly*, *66*(2), 267-276.
- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Quarterly*, *82*(4), 581-629.
- Greiner, R., Patterson, L., & Miller, O. (2009). Motivations, risk perceptions and adoption of conservation practices by farmers. *Agricultural systems*, *99*(2), 86-104.
- Griffin, R. J., Dunwoody, S., & Neuwirth, K. (1999). Proposed model of the relationship of risk information seeking and processing to the development of preventive behaviors. *Environmental research*, *80*(2), S230-S245.
- Griffin, R. J., Yang, Z., ter Huurne, E., Boerner, F., Ortiz, S., & Dunwoody, S. (2008). After the flood: Anger, attribution, and the seeking of information. *Science Communication*, *29*(3), 285-315.
- Gross, A. G. (1994). The roles of rhetoric in the public understanding of science. *Public understanding of science*, *3*(1), 3-23.
- Guba, E. G. & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In: N. K. Denzin & Y. S. Lincoln (eds), *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage, pp. 105–117.
- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field methods*, *18*(1), 59-82.
- Hall, K., & Rhoades, E. (2010). Influence of subjective norms and communication preferences on grain farmers' attitudes toward organic and non-organic farming. *Journal of Applied Communications*, *94*(3-4), 51-65.
- Hallman, W. K., & Wandersman, A. (1992). Attribution of responsibility and individual and collective coping with environmental threats. *Journal of Social Issues*, *48*(4), 101-118.

- Hamilton, N. (2015, May 26). Iowa's clean water debate: What to believe? *The Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/opinion/columnists/iowa-view/2015/05/25/iowas-clean-water-debate-believe/27942213/>
- Hanson, M. J., Keller, A., Boland, M. A., & Lazarus, W. F. (2016). The Debate about Farm Nitrates and Drinking Water. *Choices*, 31(1).
- Hatch, J. (2015, December 29). State leaders must show courage on water, *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/opinion/columnists/iowa-view/2015/12/28/hatch-state-leaders-must-show-courage-water/77975056/>
- Hayes, A. F. (2005). *Statistical methods for communication science*. Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.
- Heerwegh, D., & Loosveldt, G. (2008). Face-to-face versus web surveying in a high-internet-coverage population differences in response quality. *Public Opinion Quarterly*, 72(5), 836-846.
- Heider, F. (1944). Social perception and phenomenal causality. *Psychological review*, 51(6), 358.
- Ho, S. S., Scheufele, D. A., & Corley, E. A. (2013). Factors influencing public risk–benefit considerations of nanotechnology: Assessing the effects of mass media, interpersonal communication, and elaborative processing. *Public Understanding of Science*, 22(5), 606-623.
- Hofstetter, C. R., & Dozier, D. M. (1986). Useful news, sensational news: Quality, sensationalism and local TV news. *Journalism Quarterly*, 63(4), 815-853.
- Holbrook, A. L., Green, M. C., & Krosnick, J. A. (2003). Telephone versus face-to-face interviewing of national probability samples with long questionnaires: Comparisons of respondent satisficing and social desirability response bias. *Public Opinion Quarterly*, 67(1), 79-125.
- Hossain, S. M. A. (1995). Characteristics of opinion leaders and non-leaders in differentially developed villages of Bangladesh. *Bangladesh Journal of Agricultural Economics*, 18(2).
- Howe, K. R. (1992). Getting over the quantitative-qualitative debate. *American Journal of Education*, 236-256.
- Huckfeldt, R. R., & Sprague, J. (1995). *Citizens, politics and social communication: Information and influence in an election campaign*. Cambridge University Press.
- Hurley, R. J., Kosenko, K. A., & Brashers, D. (2011). Uncertain terms: Message features of online cancer news. *Communication Monographs*, 78(3), 370-390.

- International Agency for Research on Cancer. (2010). *Ingested nitrate and nitrite, and cyanobacterial peptide toxins* (Vol. 94). IARC Press, International Agency for Research on Cancer.
- Iowa Cedar Watershed Interagency Coordination Team. (2016). Iowa-Cedar Watershed. Retrieved from <http://www.iihr.uiowa.edu/iowacedarbasin/>
- Iowa Department of Natural Resource (IDNR). (2016). Watershed management authorities. Retrieved from <http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Management-Authorities>
- Iowa Department of Natural Resources (IDNR). (2017). Environmental protection: Water quality. Retrieved from <http://www.iowadnr.gov/Environmental-Protection/Water-Quality>
- Iowa Environmental Council. (2016, September). Nitrate in drinking water: A public health concern for all Iowans. Iowa Environmental Council White Paper Report. Retrieved from http://www.iaenvironment.org/webres/File/News%20%26%20Resources/Publications/Nitrate_in_Drinking_Water_Report_Web.pdf
- Iowa Farm Bureau. (2017). About. Retrieved from <https://www.iowafarmbureau.com/About>
- Iowa Farmer Today. (2016). About. Retrieved from <http://www.iowafarmertoday.com/site/about/>
- Iowa Nutrient Reduction Strategy (INRS), (2013). A science and technology based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico. Prepared by Iowa Department of Land Stewardship, Iowa Department of Natural Resources and Iowa State University College of Agriculture and Life Sciences. Retrieved from <http://www.nutrientstrategy.iastate.edu/sites/default/files/documents/INRSfull.pdf>.
- Jäckle, A. E., Lynn, P., Sinibaldi, J., & Tipping, S. (2013). The effect of interviewer experience, attitudes, personality and skills on respondent co-operation with face-to-face surveys. In *Survey research methods* (Vol. 7, No. 1, pp. 1-15). European Survey Research Association.
- Johnson, B. B., & Slovic, P. (1995). Presenting uncertainty in health risk assessment: Initial studies of its effects on risk perception and trust. *Risk analysis*, 15(4), 485-494.
- Johnson, M. (2010). Barriers to innovation adoption: A study of e-markets. *Industrial Management & Data Systems*, 110(2), 157-174.
- Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of mixed methods research*, 1(2), 112-133.

- Jones, K. O., Denham, B. E., & Springston, J. K. (2007). Differing effects of mass and interpersonal communication on breast cancer risk estimates: An exploratory study of college students and their mothers. *Health communication, 21*(2), 165-175.
- Jones, C., Kim, S. W., & Schilling, K. (2017). Use of continuous monitoring to assess stream nitrate flux and transformation patterns. *Environmental Monitoring and Assessment, 189*(1), 35.
- Jones, C. S., Wang, B., Schilling, K. E., & Chan, K. S. (2017a). Nitrate transport and supply limitations quantified using high-frequency stream monitoring and turning point analysis. *Journal of Hydrology, 549*, 581-591.
- Jordan, E. (2017, April 2). Iowa water sensors show 2016 uptick in nitrates: State's sensor network is one of the largest in the nation. *The Gazette*. Retrieved from <http://www.thegazette.com/subject/news/government/iowa-water-sensors-show-2016-uptick-in-nitrates-states-sensor-network-is-one-of-the-largest-in-the-nation-20170402>
- Jordan, E. (2017, April 30). Farm Bureau flourishes as water quality flags: Powerhouse ag organization has millions in surplus, seven figure executive pay. *The Gazette*. Retrieved from <http://www.thegazette.com/subject/news/business/agriculture/farm-bureau-flourishes-as-water-quality-flags-20170430>
- Kahan, D. M., Peters, E., Wittlin, M., Slovic, P., Ouellette, L. L., Braman, D., & Mandel, G. (2012). The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature climate change, 2*(10), 732-735.
- Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., ... & Ratick, S. (1988). The social amplification of risk: A conceptual framework. *Risk analysis, 8*(2), 177-187.
- Kass, D. (2016, January 17). Stowe needs to get his story straight. *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/opinion/columnists/iowa-view/2016/01/15/stowe-needs-get-his-story-straight/78800340/>
- Katz, E. (1957). The two-step flow of communication: An up-to-date report on an hypothesis. *Public opinion quarterly, 21*(1), 61-78.
- Katz, E., & Lazarsfeld, P. F. (1955). *Personal influence: The part played by people in the flow of mass communication*. Glencoe, IL: Free Press.
- Keller, E. B., & Berry, J. L. (2003). *The influentials: One American in ten tells the other nine how to vote, where to eat, and what to buy*. New York: Simon & Schuster.
- Kelly, J. A., St Lawrence, J. S., Stevenson, L. Y., Hauth, A. C., Kalichman, S. C., Diaz, Y. E., ... & Morgan, M. G. (1992). Community AIDS/HIV risk reduction: the effects of endorsements by popular people in three cities. *American Journal of Public Health, 82*(11), 1483-1489.

- Kerlinger, F. N., & Lee, H. B. (2000). *Foundations of behavioral research: Educational and psychological inquiry* (Fourth Edition). New York: Holt, Rinehart and Winston.
- Kilen, M. (2016, June 20). A tug of war between farming, environment. *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/agriculture/2016/06/16/battle-between-farming-environment-plays-out-north-raccoon-river/85041518/>
- Kilen, M. (2016, July 16). Striving for the perfect lawn could be hurting Iowa. *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/agriculture/2016/07/15/your-perfect-lawn-hurting-iowas-water-quality/86870500/>
- Kim, D. K. (2007). *Identifying opinion leaders by using social network analysis: A synthesis of opinion leadership data collection methods and instruments* (Doctoral dissertation, Ohio University).
- Kline, K. N., & Mattson, M. (2000). Breast self-examination pamphlets: A content analysis grounded in fear appeal research. *Health Communication*, 12(1), 1-21.
- Knobeloch, L., Salna, B., Hogan, A., Postle, J., & Anderson, H. (2000). Blue babies and nitrate-contaminated well-water. *Environmental Health Perspectives*, 108(7), 675.
- Kort, A. (2016, March 28). Cover crops gaining momentum with farmers. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Cover-crops-gaining-momentum-with-farmers>
- Krosnick, J. A., & Presser, S. (2010). Question and questionnaire design. In *Handbook of survey research*, 2nd edition, 263-314. Emerald Group Publishing.
- Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Sage publications.
- Laird, F. N. (1989). The decline of deference: The political context of risk communication. *Risk Analysis*, 9, 543-550.
- Lapinski, M. K., & Rimal, R. N. (2005). An explication of social norms. *Communication Theory*, 15(2), 127-147.
- Läpple, D., Renwick, A., & Thorne, F. (2015). Measuring and understanding the drivers of agricultural innovation: Evidence from Ireland. *Food Policy*, 51, 1-8.
- Lazarsfeld, P. F., Berelson, B., & Gaudet, H. (1948). *The people's choice. How the voter makes up his mind in a presidential campaign*. New York: Duell, Sloan & Pierce.

- Lee, S. E. (2011). *HPV vaccine messages in news videos on YouTube: a content analysis based on Extended Parallel Process Model* (Unpublished master's thesis). Georgetown University, Washington D.C.
- Leonard-Barton, D. (1985). Experts as negative opinion leaders in the diffusion of a technological innovation. *Journal of Consumer Research*, *11*(4), 914-926.
- Licht, M., Juchems, L., Comito, J., Helmers, M., & Carlson, S. (2016). Demonstrating Cover Crop Mixtures on Iowa Farmland: Management, Soil Health, and Water Quality Benefits. *Farm Progress Reports*, *1* (82). Retrieved from <http://lib.dr.iastate.edu/farmprogressreports/vol2015/iss1/82>
- Lichtenberg, E., & Zimmerman, R. (1999). Information and farmers' attitudes about pesticides, water quality, and related environmental effects. *Agriculture, ecosystems & environment*, *73*(3), 227-236.
- Lincoln, Y.S. & Guba, E.G. (1985) *Naturalistic inquiry*. Beverly Hills, CA: Sage.
- Lo, A. Y. (2013). The role of social norms in climate adaptation: Mediating risk perception and flood insurance purchase. *Global environmental change*,*23*(5), 1249-1257.
- Locock, L., Dopson, S., Chambers, D., & Gabbay, J. (2001). Understanding the role of opinion leaders in improving clinical effectiveness. *Social science & medicine*, *53*(6), 745-757.
- Lomas, J., Enkin, M., Anderson, G. M., Hannah, W. J., Vayda, E., & Singer, J. (1991). Opinion leaders vs audit and feedback to implement practice guidelines: delivery after previous cesarean section. *Jama*, *265*(17), 2202-2207.
- Long, T. B., Blok, V., & Coninx, I. (2015). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy. *Journal of Cleaner Production*.
- Lorch, M. (2014, May 19). Manmade or natural, tasty or toxic, they're all chemicals ... The Guardian. Available online at: <https://www.theguardian.com/science/blog/2014/may/19/manmade-natural-tasty-toxic-chemicals>
- Lowe, T. D., & Lorenzoni, I. (2007). Danger is all around: Eliciting expert perceptions for managing climate change through a mental models approach. *Global Environmental Change*, *17*(1), 131-146.
- Maloney, E. K., Lapinski, M. K., & Witte, K. (2011). Fear appeals and persuasion: A review and update of the extended parallel process model. *Social and Personality Psychology Compass*, *5*(4), 206-219.

- Marra, M. C., & Carlson, G. A. (1987). The role of farm size and resource constraints in the choice between risky technologies. *Western Journal of Agricultural Economics*, 109-118.
- Marra, M., Pannell, D. J., & Ghadim, A. A. (2003). The economics of risk, uncertainty and learning in the adoption of new agricultural technologies: where are we on the learning curve? *Agricultural systems*, 75(2), 215-234.
- Mason, M. (2010). Sample size and saturation in PhD studies using qualitative interviews. In *Forum: Qualitative Social Research* (Vol. 11, No. 3).
- Masters, C. (2016, January 21). Iowa's nasty water war: Des Moines' lawsuit against farming counties is about more than just pollution. *Politico Magazine*. Retrieved from <http://www.politico.com/magazine/story/2016/01/iowas-nasty-water-war-213551>
- Mazur, A. (1981). *The dynamics of technical controversy*. Washington DC: Communication Press.
- Mazur, A., & Hall, G. S. (1990). Effects of social influence and measured exposure level on response to radon. *Sociological Inquiry*, 60(3), 274-284.
- McCallum, D. B., Hammond, S. L., & Covello, V. T. (1991). Communicating about environmental risks: how the public uses and perceives information sources. *Health Education & Behavior*, 18(3), 349-361.
- McComas, K. (2004). When even the 'best-laid' plans go wrong. *EMBO reports*, 5(1S), S61-S65.
- McCright, A. M., & Dunlap, R. E. (2000). Challenging global warming as a social problem: An analysis of the conservative movement's counter-claims. *Social problems*, 47(4), 499-522.
- McCright, A. M., & Dunlap, R. E. (2003). Defeating Kyoto: The conservative movement's impact on US climate change policy. *Social Problems*, 50(3), 348-373.
- McCright, A. M., & Dunlap, R. E. (2011). Cool dudes: The denial of climate change among conservative white males in the United States. *Global environmental change*, 21(4), 1163-1172.
- McCright, A. M., Xiao, C., & Dunlap, R. E. (2014). Political polarization on support for government spending on environmental protection in the USA, 1974–2012. *Social Science Research*, 48, 251-260.
- McGuire, J., Morton, L. W., & Cast, A. D. (2013). Reconstructing the good farmer identity: shifts in farmer identities and farm management practices to improve water quality. *Agriculture and Human Values*, 30(1), 57-69.

- McLellan, E., Robertson, D., Schilling, K., Tomer, M., Kostel, J., Smith, D., & King, K. (2015). Reducing nitrogen export from the corn belt to the Gulf of Mexico: agricultural strategies for remediating hypoxia. *JAWRA Journal of the American Water Resources Association*, 51(1), 263-289.
- McMahan, S., Witte, K., & Meyer, J. A. (1998). The perception of risk messages regarding electromagnetic fields: extending the extended parallel process model to an unknown risk. *Health communication*, 10(3), 247-259.
- Midgley, D. (1977). *Innovation and New Product Marketing*. New York: Halsted.
- Milgram, S. (1967). The small-world problem. *Psychology Today*, 1, 61-67.
- Morefield, P. E., LeDuc, S. D., Clark, C. M., & Iovanna, R. (2016). Grasslands, wetlands, and agriculture: the fate of land expiring from the Conservation Reserve Program in the Midwestern United States. *Environmental Research Letters*, 11(9), 094005.
- Morse, J. M. (1994). Designing funded qualitative research. In Norman K. Denzin & Yvonna S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp.220-35). Thousand Oaks, CA: Sage.
- Morton, T. A., & Duck, J. M. (2001). Communication and health beliefs mass and interpersonal influences on perceptions of risk to self and others. *Communication Research*, 28(5), 602-626.
- Morton, L. W., Hobbs, J., & Arbuckle, J. G. (2013). Shifts in farmer uncertainty over time about sustainable farming practices and modern farming's reliance on commercial fertilizers, insecticides, and herbicides. *Journal of soil and water conservation*, 68(1), 1-12.
- Mueller, D., & Castellano, M. (2016, March 13). Cover crop growth prior to planting provides benefits. *Iowa Farmer Today*. Retrieved from http://www.iowafarmertoday.com/news/crop/cover-crop-growth-prior-to-planting-provides-benefits/article_d16e4f66-f618-11e5-bdfd-e70eb9d321c2.html
- N. a., (2015, December 06). Don't blame God for water woes. *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/opinion/editorials/2015/12/06/editorial-dont-blame-god-water-woes/76729050/>
- N. a., (2016, January 25). Meet Iowa's poster child for farm conservation. *Iowa Farmer Today*. Retrieved from <http://www.desmoinesregister.com/story/money/2015/12/31/meet-iowas-poster-child-farm-conservation/77917296/>
- N. a., (2015, November 25). Branstad joins WOTUS legal challenge. *Iowa Farmer Today*. Retrieved from http://www.iowafarmertoday.com/news/regional/branstad-joins-wotus-legal-challenge/article_1e264e02-92ce-11e5-a17d-eb7aac4c455.html

- Nathan, K., Heath, R. L., & Douglas, W. (1992). Tolerance for potential environmental health risks: The influence of knowledge, benefits, control, involvement, and uncertainty. *Journal of Public Relations Research*, 4(4), 235-258.
- Nelson, N. M., Loomis, J. B., Jakus, P. M., Kealy, M. J., von Stackelburg, N., & Ostermiller, J. (2015). Linking ecological data and economics to estimate the total economic value of improving water quality by reducing nutrients. *Ecological Economics*, 118, 1-9.
- Neuwirth, K., Dunwoody, S., & Griffin, R. J. (2000). Protection motivation and risk communication. *Risk Analysis*, 20(5), 721-734.
- Nisbet, E. C. (2006). The engagement model of opinion leadership: Testing validity within a European context. *International Journal of Public Opinion Research*, 18(1), 3-30.
- Nisbet, M. C. (2009). Communicating climate change: Why frames matter for public engagement. *Environment: Science and Policy for Sustainable Development*, 51(2), 12-23.
- Nisbet, M. C., & Kotcher, J. E. (2009). A two-step flow of influence? Opinion-leader campaigns on climate change. *Science Communication*, 30(3), 328-354.
- North Carolina Riverkeepers & Waterkeeper Alliance. (2009, July 21). Retrieved from <http://www.riverlaw.us/realhogfacts.html>
- Northey, B. (2015, December 20). Water quality progress requires cooperation, *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/opinion/columnists/iowa-view/2015/12/19/northey-water-quality-progress-requires-cooperation/77528378/>
- Northfield, J. K., & McMahon, C. R. (2010). Crikey! Overstating the conservation influence of the Crocodile Hunter. *Science Communication*, 32(3), 412-417.
- Nowak, P. (1992). Why farmers adopt production technology: Overcoming impediments to adoption of crop residue management techniques will be crucial to implementation of conservation compliance plans. *Journal of Soil and Water Conservation*, 47(1), 14-16.
- O'Connor, R. E., Bord, R. J., & Fisher, A. (1999). Risk perceptions, general environmental beliefs, and willingness to address climate change. *Risk analysis*, 19(3), 461-471.
- O'Mara, G. (1983). The microeconomics of technique adoption by smallholding Mexican farmers. In R.D Norton, L.M Solis (Eds.) *The Book of Chac: Programming Studies for Mexican Agriculture*. Johns Hopkins University Press, Baltimore, Maryland, pp. 250-289.

- O'Neill, S., & Nicholson-Cole, S. (2009). "Fear Won't Do It" Promoting positive engagement with climate change through visual and iconic representations. *Science Communication*, 30(3), 355-379.
- Onwuegbuzie, A. J., & Collins, K. M. (2007). A typology of mixed methods sampling designs in social science research. *The qualitative report*, 12(2), 281-316.
- Osterberg, D. & Kline, A. (2014). A threat unmet: Why Iowa's nutrient strategy falls short against water pollution. Policy Brief, Iowa Policy Project. Retrieved from <http://www.iowapolicyproject.org/2014Research/140717-nutrient.html>
- Osterberg, D. (2016, May 28). Stop winking at the problem of water quality. *The Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/opinion/abetteriowa/2016/05/25/stop-winking-problem-water-quality/84815054/>
- Osterberg, D., Fetty, N., & Wong, N. (2016, June 04) Change manure application rules, *Iowa Farmer Today*. Retrieved from http://www.iowafarmertoday.com/news/opinion/change-manure-application-rules/article_d2c61882-2771-11e6-9195-c3cf46c29b6b.html
- Padel, S. (2001). Conversion to organic farming: a typical example of the diffusion of an innovation? *Sociologia ruralis*, 41(1), 40-61.
- Padel, S., Vaarst, M., & Zaralis, K. (2015). Supporting innovation in organic agriculture: A European perspective using experience from the SOLID project. *Sustainable Agriculture Research*, 4(3), p32.
- Pearsall, E. (2014). *An Exploration of the Role of Influentials in Increasing the Uptake of Evidence-Based Practice in Nursing* (Doctoral dissertation). University of Toronto.
- Petroski, W. (2016, January 04). Statehouse tepid on water plan. *Des Moines Register*. Retrieved from <https://www.newspapers.com/newspage/149000952/>
- Pew Commission on Industrial Farm Animal Production (PEW). (2008). *Putting meat on the table: Industrial farm animal production in America Report*. Retrieved from http://www.ncifap.org/_images/PCIFAPSmry.pdf.
- Pfannenstiel, B. (2016, June 17). Keeping tabs on water upgrades. *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/news/politics/2016/06/16/who-should-pay-improve-iowas-water-quality/85713430/>
- Philo, G. (2007). Can discourse analysis successfully explain the content of media and journalistic practice? *Journalism Studies*, 8(2), 175-196.
- Pilisuk, M., & Acredolo, C. (1988). Fear of technological hazards: One concern or many? *Social Behaviour*, 3(1), 17-24.

- Powell M, Dunwoody S, Griffin R, et al. (2007) Exploring lay uncertainty about an environmental health risk. *Public Understanding of Science*, 16(3): 323–343. DOI: 10.1177/0963662507074491
- Prior, M. (2005). News vs. entertainment: How increasing media choice widens gaps in political knowledge and turnout. *American Journal of Political Science*, 49(3), 577-592.
- Prokopy, L. S., Floress, K., Klotthor-Weinkauff, D., & Baumgart-Getz, A. (2008). Determinants of agricultural best management practice adoption: evidence from the literature. *Journal of Soil and Water Conservation*, 63(5), 300-311.
- Readex Research. (2015). Iowa Farmer Today 2015 Preference Study. Retrieved from http://www.iowafarmertoday.com/app/pdf/IFT_Readex_2015.pdf
- Redfearn, D., Volesky, J., & Anderson, B. (2016, January 19). What to expect from forage cover crops. *Iowa Farmer Today*. Retrieved from http://www.iowafarmertoday.com/midwest_marketer/what-to-expect-from-forage-cover-crops/article_1f598460-bed9-11e5-9bc5-ff75cf0acbb2.html Anonymous DMR, Clean water is best gift for Iowa, 20 December 2015
- Register Media. (2016). The Des Moines Register. Retrieved from <https://www.registermedia.com/advertising/the-des-moines-register/>
- Renn, O. (1992). Risk communication: Towards a rational discourse with the public. *Journal of hazardous materials*, 29(3), 465-519.
- Renn, O. (2009). Risk communication: Insights and requirements for designing successful communication programs on health communication programs on health and environmental hazards. In Heath, R. L., & O'Hair, D. H. (Eds.), *Handbook of Risk and Crisis Communication*. New York: Routledge Taylor and Francis Group.
- Retzbach, J., Otto, L., & Maier, M. (2016). Measuring the perceived uncertainty of scientific evidence and its relationship to engagement with science. *Public Understanding of Science*, 25(6), 638-655.
- Rice, P., & Ezzy, D. (1999). *Qualitative research methods: A health focus*. Melbourne: Oxford University Press.
- Richard, A. M., Diaz, J. H., & Kaye, A. D. (2014). Reexamining the risks of drinking-water nitrates on public health. *The Ochsner Journal*, 14(3), 392-398.
- Rimal, R. N., & Real, K. (2005). How behaviors are influenced by perceived norms a test of the theory of normative social behavior. *Communication Research*, 32(3), 389-414.
- Ritter, T. (2012). Exploring the Relationship between Risk Perception and Farmer Nutrient Management Decisions (Doctoral dissertation, The Ohio State University).

- Robertson, G. P., & Swinton, S. M. (2005). Reconciling agricultural productivity and environmental integrity: a grand challenge for agriculture. *Frontiers in Ecology and the Environment*, 3(1), 38-46.
- Roche, J. P., & Muskavitch, M. A. (2003). Limited precision in print media communication of West Nile virus risks. *Science Communication*, 24(3), 353-365.
- Rogers, E. M. (1962). *Diffusion of innovations*. (1st ed.). New York: The Free Press.
- Rogers, E. M. (1962a). The communication of ideas on innovation in agriculture. In *Studies in the Utilization of Behavioral Science, 2: Studies of Innovation and of Communication to the Public*, (pp. 61-98). Institute for Communication Research, Stanford University, California.
- Rogers, E. M. (2000). Reflections on news event diffusion research. *Journalism & Mass Communication Quarterly*, 77(3), 561-576.
- Rogers, E. M. (2010). *Diffusion of innovations*. (5th ed.). New York: Simon and Schuster.
- Rogers, E. M., & Cartano, D. G. (1962). Methods of measuring opinion leadership. *Public Opinion Quarterly*, 26(3), 435.
- Rogers, E. M., Medina, U. E., Rivera, M. A., & Wiley, C. J. (2005). Complex adaptive systems and the diffusion of innovations. *The Innovation Journal: The Public Sector Innovation Journal*, 10(3), 1-26.
- Rogers, E. M., & Shoemaker, F. F. (1971). *Communication of Innovations; A Cross-Cultural Approach*. New York: The Free Press.
- Rogers, E. M., & Storey, J. D. (1987). Communication campaigns. In C. Berger & S. Chaffee (Eds.). (1987). *Handbook of communication science*. (pp. 817-845). Newbury Park, CA : Sage.
- Ropeik, D. (2012). The perception gap: recognizing and managing the risks that arise when we get risk wrong. *Food and chemical toxicology*, 50(5), 1222-1225.
- Rosengren, K. E. (1973). News diffusion: An overview. *Journalism Quarterly*, 50(1), 83-91.
- Rossmann, M. (2015, September 25) Farmers can protect pond fish from runoff with careful conservation, *Iowa Farmer Today*. Retrieved from http://www.iowafarmertoday.com/feature/columnists/farm_and_ranch_life/farmers-can-protect-pond-fish-from-runoff-with-careful-conservation/article_e2dd02ae-615f-11e5-b3d2-b7b579986cb7.html
- Rubin, H. J., & Rubin, I. S. (1995). *Qualitative Interviewing: The Art of Hearing Data*. Thousand Oaks, CA: Sage.

- Ryan, B., & Gross, N. C. (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural sociology*, 8(1), 15.
- Sandman, P. M. (1987). Risk communication: facing public outrage. *Environmental Protection Agency Journal*, 13, 21. Retrieved from <http://www.psandman.com/articles/facing.htm>
- Sandman, P. M. (2012). *Responding to Community Outrage: Strategies for Effective Risk Communication*. Creative Commons License. Retrieved from <http://psandman.com/media/RespondingtoCommunityOutrage.pdf>
- Satterfield, T. A., Mertz, C. K., & Slovic, P. (2004). Discrimination, vulnerability, and justice in the face of risk. *Risk Analysis*, 24(1), 115-129.
- Schenk, M., & Döbler, T. (2002). Towards a theory of campaigns: The role of opinion leaders. *Public information campaigns & opinion research: A handbook for the student & practitioner*, 36-51.
- Schilling, K. E., Chan, K. S., Liu, H., & Zhang, Y. K. (2010). Quantifying the effect of land use land cover change on increasing discharge in the Upper Mississippi River. *Journal of Hydrology*, 387(3), 343-345.
- Schilling, K. E., Jha, M. K., Zhang, Y. K., Gassman, P. W., & Wolter, C. F. (2008). Impact of land use and land cover change on the water balance of a large agricultural watershed: Historical effects and future directions. *Water Resources Research*, 44(7).
- Schnoor, J. L. (2010). Water sustainability in a changing world. *Iowa Research Online, Dept. of Civil and Environmental Engineering Publication, and National Water Research Institute 2010 Clarke Prize Lecture*. Cosa Mesa, California.
- Schuster, D. V., Valente, T. W., Skara, S. N., Wenten, M. R., Unger, J. B., Cruz, T. B., et al. (2006). Intermedia processes in the adoption of tobacco control activities among opinion leaders in California. *Communication Theory*, 16, 91-117.
- Shah, D. V., & Scheufele, D. A. (2006). Opinion leaders as information seekers: Communication pathways to civic participation. *Political Communication*, 23(1), 1-22.
- Sharlin, H. I. (1987). Macro-risks, micro-risks, and the media: The EDB case. In B. B. Johnson and V. T. Covello (eds), *The social and cultural construction of risk* (pp. 183-197). Netherlands: Springer.
- Shaver, K. G., & Drown, D. (1986). On causality, responsibility, and self-blame: A theoretical note. *Journal of personality and social psychology*, 50(4), 697.
- Siegrist, M., Cvetkovich, G., & Roth, C. (2000). Salient value similarity, social trust, and risk/benefit perception. *Risk analysis*, 20(3), 353-362.

- Singhal, A., Rogers, E., & Mahajan, M. (1999). The gods are drinking milk! Word-of-mouth diffusion of a major news event in India. *Asian Journal of Communication*, 9(1), 86-107.
- Singhal, A., Shirley, S., & Marston, E. H. (2010). Turning diffusion of innovation paradigm on its head: The positive deviance approach to social change. *Advances in the Study of the Diffusion of Innovation*. New York: Peter Lang.
- Singleton, R. A., & Straits, B. C. (2010). *Approaches to social research*. New York: Oxford University Press.
- Sjöberg, L. (2000). Factors in risk perception. *Risk analysis*, 20(1), 1-11.
- Slovic, P. (1987). Perception of risk. *Science*, 236(4799), 280-285.
- Slovic, P. (2001). The risk game. *Journal of hazardous materials*, 86(1), 17-24.
- Slovic, P. (1992). Perceptions of risk: Reflections on the psychometric paradigm. In S. Krimsky & D. Golding (Eds.), *Theories of Risk* (pp. 117-152). Westport, CT: Praeger.
- Slovic, P. (1997). Public perception of risk. *Journal of Environmental Health*, 59(9), 22-23.
- Slovic, P. (2010). *The feeling of risk: New perspectives on risk perception*. New York: Routledge.
- Slovic, P., Fischhoff, B., & Lichtenstein, S. (1979). Rating the risks. *Environment: Science and Policy for Sustainable Development*, 21(3), 14-39.
- Slovic, P., Fischhoff, B., & Lichtenstein, S. (1987). Behavioral decision theory perspectives on protective behavior. In N. D. Weinstein (ed.) *Taking care: Understanding and encouraging self-protective behavior*. Cambridge University Press.
- Slovic, P., Flynn, J. H., & Layman, M. (1991). Perceived risk, trust, and the politics of nuclear waste. *Science*, 254(5038), 1603.
- Smale, M., Just, R. E., & Leathers, H. D. (1994). Land allocation in HYV adoption models: An investigation of alternative explanations. *American Journal of Agricultural Economics*, 535-546.
- Smith, J. (2005). Dangerous news: Media decision making about climate change risk. *Risk Analysis*, 25(6), 1471-1482.
- Snow, J. (2000). Blue baby syndrome and nitrates: New research casts doubt on an old regulation. *Water Resources IMPACT*.

- Southwell, B. G., & Yzer, M. C. (2007). The roles of interpersonal communication in mass media campaigns. *Annals of the International Communication Association*, 31(1), 420-462.
- Stapel, D. A., & Velthuisen, A. S. (1996). "Just as if it happened to me": The impact of vivid and self-relevant information on risk judgments. *Journal of Social and Clinical Psychology*, 15(1), 102.
- Stasson, M., & Fishbein, M. (1990). The relation between perceived risk and preventive action: A within-subject analysis of perceived driving risk and intentions to wear seatbelts. *Journal of Applied Social Psychology*, 20(19), 1541-1557.
- Steimel, D. (2016, June 06). Study shows added corn acres in Raccoon River watershed did not raise nitrate delivery levels. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Study-shows-added-corn-acres-in-Raccoon-River-watershed-did-not-raise-nitrate-delivery-levels>
- Steimel, D. (2015, November 17). Is the Des Moines Water Works leader really worth a half million bucks? *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Is-the-Des-Moines-Water-Works-leader-really-worth-a-half-million-bucks>
- Steimel, D. (2016, August 22). Awards provide a look at water quality gains. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Awards-provide-a-look-at-water-quality-gains>
- Steimel, D. (2016, January 25). Others work for water quality, but Water Works sits. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Others-work-for-water-quality-but-Water-Works-sits>
- Steimel, D. (2016, August 26). Cover crop season. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Cover-crop-season>
- Steimel, D. (2016, June 27). Study shows farmers' efforts can improve water quality. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Study-shows-farmers-efforts-can-improve-water-quality>
- Steimel, D. (2015, December 07). Myths about Iowa water quality issues need to be busted. *Farm Bureau Spokesman*. Retrieved from <https://www.iowafarmbureau.com/Article/Myths-about-Iowa-water-quality-issues-need-to-be-busted>
- Sterman, J. D. (2008). Risk communication on climate: mental models and mass balance. *Science*, 322(5901), 532-533.

- Stowe, B. (2016, January 10). When water quality reached turning point. *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/opinion/columnists/iowa-view/2016/01/09/stowe-when-iowas-water-quality-reached-turning-point/78448416/>
- Sturgis, P., & Allum, N. (2004). Science in society: re-evaluating the deficit model of public attitudes. *Public understanding of science*, 13(1), 55-74.
- Sulewski, P., & Kłoczko-Gajewska, A. (2014). Farmers' risk perception, risk aversion and strategies to cope with production risk: an empirical study from Poland. *Studies in Agricultural Economics*, 116(3), 140-147.
- Sundstrom, B. (2015). Mothers "Google It Up:" Extending Communication Channel Behavior in Diffusion of Innovations Theory. *Health communication*, (ahead-of-print), 1-11.
- Tesch, R. (1990). *Qualitative Research. Analysis Types and Software*. London: Falmer press.
- Thu, K. (2010). CAFOs Are in Everyone's Backyard. In *The CAFO Reader: The Tragedy of Industrial Animal Factories*. Ed. Daniel Imhoff. (pp. 210-220). Los Angeles: Foundation for Deep Ecology.
- Tichenor, P. J., Donohue, G. A., & Olien, C. N. (1970). Mass media flow and differential growth in knowledge. *Public opinion quarterly*, 34(2), 159-170.
- Toma, L., & Mathijs, E. (2007). Environmental risk perception, environmental concern and propensity to participate in organic farming programmes. *Journal of Environmental Management*, 83(2), 145-157.
- Tonkiss, F. (1998). Analysing discourse. In C. Seale, (Ed.), *Researching society and culture*, (pp. 245-260). London: Sage.
- Trumbo, C. W. (1996). Examining Psychometrics and Polarization in a Single-Risk Case Study. *Risk Analysis*, 16(3), 429-438.
- Trumbo, C. W. (1998). Communication channels and risk information: A cost-utility model. *Science Communication*, 20(2), 190-203.
- Tsur, Y., Sternberg, M., & Hochman, E. (1990). Dynamic modelling of innovation process adoption with risk aversion and learning. *Oxford Economic Papers*, 42(2), 336-355.
- Tyler, T. R., & Cook, F. L. (1984). The mass media and judgments of risk: Distinguishing impact on personal and societal level judgments. *Journal of Personality and Social Psychology*, 47(4), 693.
- United States Department of Agriculture [USDA]. (2016). State Agriculture Overview. National Agricultural Statistics Service. Retrieved from https://www.nass.usda.gov/Statistics_by_State/Iowa/index.php

- United States Department of Agriculture [USDA]. (2015). Organic farming: Results from the 2014 organic survey. National Agricultural Statistics Service. Retrieved from https://www.nass.usda.gov/Statistics_by_State/Iowa/index.php
- United States Environmental Protection Agency (EPA). (2016). Nutrient Pollution. Retrieved from <https://www.epa.gov/nutrientpollution>
- Valente, T. W. & Pumpuang, R. (2007). Identifying opinion leaders to promote behavior change. *Health Education & Behavior*, 34, 881-896. DOI: 10.1177/1090198106297855
- Valente, T. W. (1995). *Network models of the diffusion of innovations*. Cresskill, NJ: Hampton Press, Inc.
- Valente, T. W., & Davis, R. L. (1999). Accelerating the diffusion of innovations using opinion leaders. *The Annals of the American Academy of Political and Social Science*, 566(1), 55-67.
- Valente, T. W., & Rogers, E. M. (1995). The origins and development of the diffusion of innovations paradigm as an example of scientific growth. *Science Communication*, 16(3), 242-273.
- Valente, T. W., & Saba, W. P. (1998). Mass media and interpersonal influence in a reproductive health communication campaign in Bolivia. *Communication Research*, 25(1), 96-124.
- Vitale, D. C., Armenakis, A. A., & Feild, H. S. (2008). Integrating Qualitative and Quantitative Methods for Organizational Diagnosis Possible Priming Effects? *Journal of Mixed Methods Research*, 2(1), 87-105.
- Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox—implications for governance and communication of natural hazards. *Risk analysis*, 33(6), 1049-1065.
- Wakefield, S. E., & Elliott, S. J. (2003). Constructing the news: The role of local newspapers in environmental risk communication. *The Professional Geographer*, 55(2), 216-226.
- Ward, M. H. (2009). Too Much of a Good Thing? Nitrate from Nitrogen Fertilizers and Cancer: President's Cancer Panel, October 21, 2008. In *Reviews on Environmental Health*, 24(4), 357–363. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/20384045>.
- Ward, M. H., Kilfoy, B. A., Weyer, P. J., Anderson, K. E., Folsom, A. R., & Cerhan, J. R. (2010). Nitrate intake and the risk of thyroid cancer and thyroid disease. *Epidemiology*, 21(3), 389.
- Watts, D. J., & Dodds, P. S. (2007). Influentials, networks, and public opinion formation. *Journal of consumer research*, 34(4), 441-458.

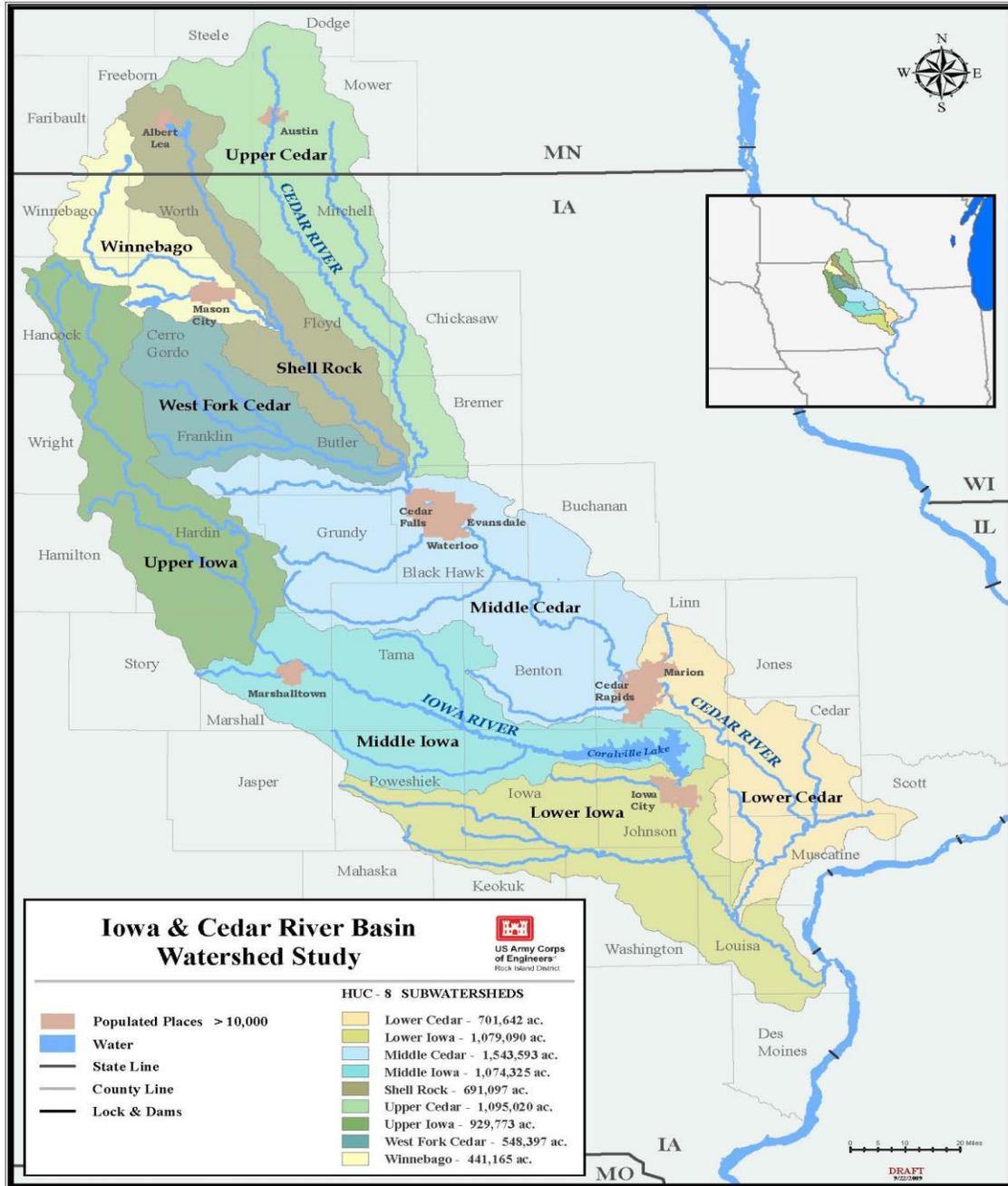
- Watzlawick, P., Bavelas, J. B., & Jackson, D. D. (2011). *Pragmatics of human communication: A study of interactional patterns, pathologies and paradoxes*. New York: W.W. Norton & Company,
- Weathers, M. R., & Kendall, B. E. (2015). Developments in the Framing of Climate Change as a Public Health Issue in US Newspapers. *Environmental Communication*, 1-19.
- Weber, E. U., & Milliman, R. A. (1997). Perceived risk attitudes: Relating risk perception to risky choice. *Management Science*, 43(2), 123-144.
- Weber, E. U., & Stern, P. C. (2011). Public understanding of climate change in the United States. *American Psychologist*, 66(4), 315.
- Weenig, M. W., & Midden, C. J. (1991). Communication network influences on information diffusion and persuasion. *Journal of Personality and Social Psychology*, 61(5), 734.
- Wei, J., Wei, Y., Western, A., Skinner, D., & Lyle, C. (2015). Evolution of newspaper coverage of water issues in Australia during 1843–2011. *Ambio*, 44(4), 319-331.
- Weimann, G. (1991). The influentials: Back to the concept of opinion leaders? *Public Opinion Quarterly*, 55(2), 267-279.
- Weimann, G. (1994). *The influentials: People who influence people*. New York: SUNY Press.
- Weimann, G., Tustin, D. H., Van Vuuren, D., & Joubert, J. P. R. (2007). Looking for opinion leaders: Traditional vs. modern measures in traditional societies. *International Journal of Public Opinion Research*, 19(2), 173-190.
- Weingart, P., Engels, A., & Pansegrau, P. (2000). Risks of communication: Discourses on climate change in science, politics, and the mass media. *Public understanding of science*, 9(3), 261-283.
- Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample. *Journal of behavioral medicine*, 10(5), 481-500.
- Weinstein, N. D., & Diefenbach, M. A. (1997). Percentage and verbal category measures of risk likelihood. *Health Education Research*, 12(1), 139-141.
- Welch Cline, R. J., Johnson, S. J., & Freeman, K. E. (1992). Talk among sexual partners about AIDS: Interpersonal communication for risk reduction or risk enhancement? *Health Communication*, 4(1), 39-56.
- Weyer, P. J., Cerhan, J. R., Kross, B. C., Hallberg, G. R., Kantamneni, J., Breuer, G., ... & Lynch, C. F. (2001). Municipal drinking water nitrate level and cancer risk in older women: the Iowa Women's Health Study. *Epidemiology*, 12(3), 327-338.

- Wilkening, E. A. (1962). The communication of ideas on innovation in agriculture. In *Studies in the Utilization of Behavioral Science, 2: Studies of Innovation and of Communication to the Public*, (pp. 37-60). Institute for Communication Research, Stanford University, California.
- Willis, H. H., & DeKay, M. L. (2007). The roles of group membership, beliefs, and norms in ecological risk perception. *Risk Analysis*, 27(5), 1365-1380.
- Wilson, R. S., Howard, G., & Burnett, E. A. (2014). Improving nutrient management practices in agriculture: The role of risk-based beliefs in understanding farmers' attitudes toward taking additional action. *Water Resources Research*, 50(8), 6735-6746.
- Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communications Monographs*, 59, 329-349.
- Witte, K. (1994). Fear control and danger control: A test of the extended parallel process model (EPPM). *Communications Monographs*, 61(2), 113-134.
- Witte, K. (1995). Generating effective risk messages: How scary should your risk communication be. *Communication Yearbook*, 18, 229-254.
- Witte, K. (1997). Preventing teen pregnancy through persuasive communications: realities, myths, and the hard-fact truths. *Journal of Community Health*, 22(2), 137-154.
- World Health Organization (WHO). (2015, March 20). IARC Monographs Volume 112: evaluation of five organophosphate insecticides and herbicides. *International Agency for Research on Cancer, World Health Organization Report*. Geneva, Switzerland. Retrieved from <http://www.iarc.fr/en/media-centre/iarcnews/pdf/MonographVolume112.pdf>
- World Health Organization (WHO). (2015). *Nitrate and nitrite in drinking-water: Draft Background document for the WHO Guidelines for Drinking Water Quality*. Geneva, Switzerland.
- Wynne, B. (1991). Knowledges in context. *Science, Technology, & Human Values*, 16(1), 111-121.
- Xiong, Y., Wei, Y., Zhang, Z., & Wei, J. (2015). Evolution of China's water issues as framed in Chinese mainstream newspaper. *Ambio*, 1-13.
- Young, D. G., & Anderson, K. (2017). Media diet homogeneity in a fragmented media landscape. *Atlantic Journal of Communication*, 25(1), 33-47.
- Young, R., Tully, M., & Ramirez, M. (2016). School administrator perceptions of cyberbullying facilitators and barriers to preventive action: A qualitative study. *Health Education & Behavior*, 1090198116673814.

- Younos, T. and Grady, C. A. (2014). *Potable water: Emerging global problems and solutions*. Switzerland, Springer International Publishing.
- Zeman, C., Beltz, L., Linda, M., Maddux, J., Depken, D., Orr, J., & Theran, P. (2011). New questions and insights into nitrate/nitrite and human health effects: a retrospective cohort study of private well users' immunological and wellness status. *Journal of environmental health*, 74(4), 8.
- Zhao, X., Leiserowitz, A. A., Maibach, E. W., & Roser-Renouf, C. (2011). Attention to science/environment news positively predicts and attention to political news negatively predicts global warming risk perceptions and policy support. *Journal of Communication*, 61(4), 713-731.
- Zohrabi, M. (2013). Mixed method research: Instruments, validity, reliability and reporting findings. *Theory and Practice in Language Studies*, 3(2), 254.

APPENDIX A. STUDY AREA WATERSHED MAP

Study area includes the Middle and Lower Iowa River Watersheds.



Available from: <http://iowacedarbasin.org/images/icrbMap.jpg>

APPENDIX B. SURVEY QUESTIONNAIRE FOR FARMERS

Nutrients in Iowa’s Water Survey Questionnaire

Survey #:_____

INTRODUCTION

I am a graduate student working on my PhD in Mass Communication, and my focus is on the way water and environmental issues are communicated. I am here at the _____ (event) today conducting a survey of farmers living in Iowa.

This survey is for my dissertation project, where I am trying to understand how different people, organizations, and the media are all discussing Iowa’s water quality. In particular, I am interested in better understanding how farmers view the issue of nutrients in Iowa’s water, and also what they think about the land management practices being recommended by the Nutrient Reduction Strategy. If you are willing to talk with me about this and answer these questions, it is important you know that your answers will be kept completely confidential, and I will not use your name or any other identifying information about you in this research. The results of these surveys I am collecting here at the fair today are only going to be used in my dissertation project—which I will happily provide you a copy of when I am finished (next year) if you are interested, so please let me know if you are. Again, my goal is just to better understand the perspective of farmers, given the large amount of government and media attention they have been given recently related to this topic. Are you interested in helping me out with this research and answering these questions?

(Circle answer) YES NO

If yes, ask: Are you at least 18 years old? (*If at all questionable.*)

(Circle answer) YES NO

(Offer to provide IRB APPROVED INFORMED CONSENT DOCUMENT/LETTER with my contact information to each participant)

BACKGROUND (*Some open-ended warm-up /demographics*)

1. How long have you been farming?
_____ years

2. What products do you farm? (*Circle and write out any additional*)

- | | | |
|----------|---------|---------|
| Corn | Hay | Oats |
| Soybeans | Alfalfa | Rye |
| Cattle | Sheep | Pasture |
| Hogs | Poultry | Produce |

IOWA'S WATER QUALITY AND NUTRIENTS (Open-ended and Likert belief/opinion questions)

Imagine I was not from Iowa, wasn't studying water, and hadn't heard anything about Iowa's water in the news. Please answer the following questions:

3. In your opinion, are nutrient levels in Iowa's waterways higher or lower than normal right now?

- 3a. What are normal levels of nutrients?

4. Can you explain to me what nutrients are and how they get in the water?

5. How would you describe Iowa's water quality overall?

6. What do you consider to be the biggest problem for Iowa's water quality right now?

6. Now I am going to read you several statements and I would like you to tell me whether you strongly disagree, disagree, feel neutral, agree, or strongly agree with each.	Strongly Disagree	Disagree	Feel Neutral	Agree	Strongly Agree
6a. Nutrients from agricultural fields contribute to water quality problems in Iowa.					
6b. Nutrients in water are a problem in Iowa, but it is not related to farming.					
6c. Nutrients in Iowa's water could be reduced by changing the way we farm.					
6d. Reducing nutrients would improve water quality.					
6e. River and stream water in Iowa should be treated before consumption.					
6f. What I do on my farm doesn't make much difference in overall water quality.					
6g. Human behavior will not change levels of nutrients in water.					

RISK PERCEPTION

13. What, if any, are the risks associated with excess nutrients in water?

14. On a scale from no risk to maximum risk, please answer:	No Risk	Low Risk	Moderate Risk	High Risk	Maximum Risk
14a. To what extent do excess nutrients in water pose a risk to farmer's yields and/or profit potential?					
14b. To what extent do excess nutrients in water pose a risk to ecosystem (environmental) health?					
14c. To what extent do excess nutrients in water pose a risk to human health?					

15. Now, how likely is it that excess nutrients in Iowa's water, from agriculture, will negatively impact:	No Chance	Very Unlikely	Unlikely	Moderate Chance	Likely	Very Likely	Certain to Happen
15a. Farming profit potential							
15b. Iowa's ecological (environmental) health							
15d. Human health							

16. Now, how serious do you feel the negative consequences of excess nutrients in water are to...	Not at all Serious	Not very Serious	Not serious	Moderately serious	Serious	Very Serious	The Most Serious
16a. You and your family							
16b. Your local community							
16c. The United States as a whole							
16d. People all over the world							
16e. The environment							

UNCERTAINTY

17. Next, I'm going to read you three last statements, please answer to what extent you disagree or agree with each.	Strongly Disagree	Disagree	Feel Neutral	Agree	Strongly Agree
17a. There is sufficient scientific evidence to know with certainty the actual nutrient loads in Iowa's water.					
17b. There is sufficient scientific evidence to know with certainty whether nutrients in Iowa's water pose a threat to the ecological health of Iowa's environment.					
17c. There is sufficient scientific evidence to know with certainty whether nutrients in Iowa's water pose a threat to human health.					

INFLUENTIAL MEDIA SOURCES

18. Now, I would like you to think about what information sources (media, organizations, and people) have been important to your knowledge of water quality and nutrient issues in the past year.

18a. What media do you use to learn about water quality and nutrient issues in Iowa? (*i.e. newspapers, websites, TV channels, ag publications, radio, etc.*) Please name as many as you think are important.

Media Source(s):

18b. When you want to *learn more* about a water quality related topic after hearing about it via [*above answer*], what media or information sources do you use?

Media Source(s):

18c. Are there any specific organizations that you think are important sources of this type of water quality information?

Organization(s):

INFLUENTIAL INDIVIDUALS

19a. In general, who are the people that you talk to most about your farming related decisions?

19b. If you had to name one specific person, who is the person who's advice has been most important to your own farming decisions and practices related to water quality?

Name: _____

Relationship: _____

Job/position: _____

19c. Can you briefly describe what it is about this person that makes their advice matter so much to you?

19d. Do you think that other farmers in your area also consider [name of person from above] to be an important source of advice regarding their water quality related farming decisions?

YES

NO

19e. Is this the same person who you would consider important to your farming related decisions in general, not only specific to water quality issues?

YES

NO

APPENDIX C. INTERVIEW QUESTIONNAIRE FOR INFLUENTIALS

Interview Protocol

Date: ____/____/2017

Interview ID#:____

INTRODUCTION (in person, not initial phone script)

As you know I am a graduate student working on my PhD in Mass Communication, and my focus is on the way water and environmental issues are communicated. I would like to interview you because you were named by several farmers in eastern Iowa as the most influential person affecting their water-related land management decisions. I would like to talk to you more about your role as an influential in the agricultural community, and about your perspectives on the state's water quality, specifically the issue of nutrients in water.

This is for my dissertation project, where I am trying to understand how different people, organizations, and the media are all discussing Iowa's water quality. I really appreciate you talking with me about these topics and it is important you know that your answers will be kept completely confidential, and I will not use your name or any other identifying information about you in this research report unless you specify that I can.

The results of these interviews are only going to be used in my dissertation project—which I will happily provide you a copy of when I am finished if you are interested—please let me know if you are. Again, my goal is to better understand the perspectives of farmers and the individuals considered influential by farmers, which I believe is especially important given the large amount of government and media attention the water related issues have recently been given.

I know you already agreed to this interview over the phone, but it's important I confirm it again, are you willing to participate in this research?

(Circle answer) YES NO

Do you mind if I audio record this survey so I don't have to scribble notes furiously as you talk?

(Circle answer) YES NO

If yes, turn on recorder and proceed with interview. If no, proceed without recording

BACKGROUND & WATER/NUTRIENT CONCEPTUALIZATIONS (*Some rapport building and demographics*)

1. How long have you lived in Iowa? (*Record answer in years*)
_____ years
2. What is your official occupation?
3. IF FARMER: what products do you farm?
4. Why did you decide to farm these items?

WATER QUALITY

5. Imagine I was not from Iowa and hadn't heard anything about Iowa's water in the news. How would you describe what nutrients are and how they get in water?
6. In your opinion, what is the biggest problem for Iowa's water quality right now?

And solutions?

Risks/Uncertainty.

7. In your opinion, what are the risks to people in Iowa from nutrients in water? What are the risks to the environment?
 8. How likely do you think it is that any of these negative consequences will actually happen because of nutrients in water?
 9. How certain are you about the risks of nutrients in Iowa's water, and the actual levels of nutrients currently in Iowa's water?
 10. How certain do you believe scientists are about this information?
- INRS.
11. Do you currently use any of the nutrient reduction practices recommended by the INRS on your farm?

12. What are the reasons farmers would not practice even one of them?
13. How many farmers do you think are currently practicing at least one nutrient reduction practice on a field?
14. Do you think farmers want their neighboring farmers to practices these behaviors?

Media.

15. Where do you get your agricultural information from?
16. What are the most credible news sources for farmers (specifically regarding topics like the environmental and farming practices?) Why are these sources more credible than others?

INFLUENTIALS

Let's talk about influential people within the farming community.

17. In your opinion, what makes someone influential in a particular farming community?
18. What do you think motivates people who are influential in this realm? (and you?)

Follow-up:

For PERSONALITY related traits mentioned:

19. What makes a person _____(name trait) in the farming world?

For JOB/POSITION related traits mentioned:

20. Are all _____(name occupation or role in community mentioned) considered influential in farming communities?

(If relevant) Can you discuss why someone in that position/job would not be considered influential to other farmers?

(Self-Identification Questions)

21. Can you talk about why you think someone named you as an important person in their land management decisions?
22. Before we started talking today, or before I called you for this interview, would you have considered yourself someone who was influential to the way other people managed their land, or farmed?
23. Now that we've been talking about influence and these characteristics that you say make someone more likely to be the type of person other farmers go to for farming advice, would you consider yourself influential within this community of farmers?
24. How often do you talk to other farmers about water quality and nutrient issues? Can you talk to me a little about who and where you talk to people about this issue?
25. Do you consider yourself politically active? Or have you ever run for any elected positions, or served on local government committees?
26. Do you attend public town meetings?
27. How about other community groups, have you or are you involved with any?
28. Are you the type of person who likes to try new farming practices or technologies right away when you hear about them? Would you consider yourself the type of person who is usually first among your friends to try new products (it doesn't have to just be related to farming).

ONLY IF NOT ALREADY COVERED:

29. How often do other people come to you for farming related advice?

30. (Follow-up if relevant) Why do you think that is?

31. In your opinion, what makes a person a credible source for farming information?

32. What makes someone an expert in the farming world?

33. What are the some of the personal values that farmers consider most important in the people they can go to for advice?