Chronic wasting disease as a model for the development of risk communication using the mental models approach

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Chronic wasting disease as a model for the development of risk communication using the mental models approach

by

Ann Jalynn Almond

A dissertation submitted to the graduate faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Sustainable Agriculture

Program of Study Committee:
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The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will insure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University
Ames, Iowa

2017

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DEDICATION

To Lynne Gardner Almond, with whom all things are possible: Thanks for being my rock and my biggest cheerleader. This one is for you.
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ABSTRACT

Using chronic wasting disease (CWD) as a model for risk communication development using the mental models approach, this dissertation examines: 1) how published CWD risk communications compare to expert recommendations; 2) whether the experts and members of relevant stakeholder groups agree upon the information that should be included in these communications; and 3) what lessons we can learn from including previously unstudied stakeholder groups in this research. We developed a theoretical expert model based upon an extensive review of the CWD literature and convened a CWD expert workshop to develop an actual expert model. We compared these models to selected CWD risk communications from both states with, and without, CWD. We administered surveys to and conducted interviews with STEM graduate students and farmers and rural landowners in North-Central Iowa to ascertain their knowledge and perspectives on CWD. Contrary to expectations, there was widespread dissimilarity between the two expert models, even though some of the reviewed literature for the theoretical model was authored by the convened experts. Also, the absence or presence of CWD in a jurisdiction seemed to have little bearing on the quality of CWD risk communications. We anticipated between-group differences in stakeholder perspectives, but were surprised by the starkness of these differences and that these differences were found regardless of which stakeholder group the participant was affiliated with so long as he or she was a hunter or regular venison consumer. Our results suggest that a centralized authority for public health related CWD risk communications might be appropriate and that future research could focus on including larger numbers of stakeholders and other previously unstudied, but relevant, stakeholder groups.
CHAPTER 1. GENERAL INTRODUCTION

An Introduction to Chronic Wasting Disease (CWD)

CWD, the disease which serves as the model for our study, was first identified in mule deer at a Colorado research facility in 1967 and was first identified in free-ranging cervids in Colorado in 1981 (Haley, et al., 2011; Spraker et al., 1997; Williams & Young, 1980). For decades, CWD was believed to be geographically limited to the endemic areas of Colorado, Wyoming, and Nebraska (Demarais et al., 2002). However CWD has since spread to 24 states and two Canadian provinces, and has also been exported to South Korea from Canada (Evans et al., 2014; Williams et al., 2002). Most recently, CWD has been identified in Norway (Dagleish, 2016). CWD prevalence rates of greater than 35% in some free-ranging cervid populations have been reported, with accompanying population declines of 30-50% (Almberg et al., 2011). In captive cervid herds, the prevalence rate can be near 100% (Haley et al., 2011) Although there has been no reported causal link between CWD and human health, CWD is a fatal, infectious prion disease affecting both captive and free-ranging cervids including, white-tailed deer, mule deer, elk, reindeer, and moose (Saunders et al., 2012). Some researchers contend that CWD is likely to be become yet another wildlife-associated zoonotic disease (Jones et al., 2008; Saunders et al., 2012). As CWD spreads geographically, and as its prevalence in cervid populations increases, the likelihood that a novel strain of CWD that infects humans, either directly or through an intermediate host, also increases (Fischer et al., 2013; Saunders et al., 2012; Jennelle et al., 2009). Given the current lack of reliable ante-mortem testing options, preventatives, treatments, or a cure, the potential devastation to public health is incalculable (Collinge, 2012; Saunders et al., 2012).
At the state level, wildlife management agencies often produce and publicize CWD risk communication (Eschenfelder & Miller, 2007). These communications primarily target hunters whose physical proximity to cervid habitat, excrement, live (or dead) cervids, and the hunters’ potential exposure to CWD via carcass processing and venison consumption make them a prime at-risk group for CWD exposure. Hunters are also targeted for these communications because their respective perceptions of the health risks associated with CWD have a direct impact on their hunting participation, and, by extension, wildlife management strategies and agency revenue (Robinson et al., 2012). We hypothesized, however, that there are many underserved, but relevant, stakeholder groups that have little, if any, information about CWD and its public health potential, in part because they may be less likely to be constituents of, or have access to, wildlife management agencies and their CWD publications. We further hypothesized that there is a divergence between the information that CWD experts believe should be communicated to the public, and the information that the stakeholders themselves deem important. Both issues are critical in designing effective CWD risk communication.

Dissertation Organization

Chapter 2

The still-evolving field of risk analysis and communication has benefitted from the development and use of theories and models from many disciplines, including, but not limited to, mathematics, science, psychology, sociology, and communication. This chapter serves as an introduction to modern risk communication and provides a brief synopsis of some of the most important developments in the field of risk communication.
to date. The chapter also provides a more thorough analysis of the mental models approach (MMA) to risk communication, the model utilized in our research, to include a discussion of some of the benefits and limitations of this approach.

Chapter 3

Using the MMA framework for risk communication, we developed two expert models for CWD risk communication. The first expert model was our theoretical model and was based upon an extensive review of the CWD literature. The second model was an actual model created by CWD experts during the course of a workshop convened for this purpose.

We then used the MMA to evaluate, compare, and contrast the content of the information about CWD provided by selected state regulatory agencies on their respective websites. We analyzed the respective states’ content for its ability to adequately and accurately convey information upon which information recipients can make an informed decision relative to the potential health risks associated with CWD. As part of our analysis, we compared each state’s communication content with both our theoretical and actual expert models, both representing variants of the ideal CWD risk communication (Morgan et al., 2002).

Chapter 4

Since we hypothesized that the primary risk communication methods currently employed relative to CWD risk communication result in a large number of relevant, but underserved, stakeholder groups, we elected to focus our research on two distinct, but previously unstudied stakeholder groups, namely Iowa State University graduate students
in STEM fields, and farmers and rural landowners in North-Central Iowa. The primary goals of this portion of our research were to: 1) determine the level of familiarity with, and knowledge about CWD by the participants; and 2) determine what the participants, both individually and as a group, felt was appropriate relative to CWD risk communication. To elicit this information, administered short written surveys with all of the individuals in both groups. The surveys were designed to obtain general demographic information, as well as information concerning the participants’ experiences, knowledge, and perceptions about wildlife and its management, wildlife-associated public health risks, fair chase hunting, venison handling and consumption, cervid farming, enclosed hunting, and published CWD-related risk information.

After completion of the surveys, we conducted, recorded, and transcribed a 90-minute focus group interview with Iowa State University graduate students; we also conducted, recorded, and transcribed individual and small-group interviews with the farmers/rural landowners. The information from both the surveys and interviews was reviewed and analyzed for content, consistency, and patterns within and between groups.

Chapter 5

This chapter looks at the current predominant information source for CWD risk communication, namely state wildlife management agency websites, in light of CWD’s uncertain potential as a zoonotic disease and any governmental obligation to communicate these types of risks to the general public. It points out some inconsistencies in the current system of CWD risk communication, and suggests a way forward that
separates the discussion of CWD risks into those that should be undertaken as part of a wildlife management strategy, and those that are better left to public health agencies.

Chapter 6

This chapter includes general conclusions and some suggestions for future research.

References


CHAPTER 2. INTRODUCTION TO RISK COMMUNICATION

The earliest documented risk communications have been traced to approximately 3200 B.C. and the “fertile crescent” of civilization (Covello & Mumpower, 1985). Like their modern counterparts, these early risk communicators, the Asipu, collected data concerning potentially risky events (Covello & Mumpower, 1985). This data was then analyzed using the Asipu version of a risk-cost-benefit analysis (RCBA) to determine the best possible alternative or outcome, which was then communicated to their audience (Covello & Mumpower, 1985). The Asipu’s “unique” ability to determine the best possible alternatives were purportedly considered “gifts from the gods” (Covello & Mumpower, 1985).

Some might contend that not much has changed in risk communication during the intervening 5,215 years since the times of the Asipu because today’s risk communicators still collect and analyze data, which is then used to develop and communicate risk information, frequently relying upon policies which use RCBA to define communication goals and frame the risk message (Thompson, 2012). Others might even go so far as to say that today’s technical and policy experts, like the Asipu, believe themselves to be “uniquely” qualified to assess and communicate the necessary risk information to their audience in order to “shape public attitudes, values, or behavior in the hope of reaching some desirable social outcome” (Weiss, & Tschirhart, 1994).

That said, modern risk analysis and communication has benefitted from the development and use of mathematical and scientific theories and models, which have been used to evaluate risk (Covello & Mumpower, 1985). This still evolving field has
more recently incorporated cognitive, psychological, behavioral, sociological, and communication-process based components with the scientific and empirical components of risk analysis and communication (Covello & Mumpower, 1985; Fischhoff, 1995; Slovic, 1987). It is some of these more modern approaches that will discussed herein.

Cognitive or Psychological Approaches to Risk Communication

How an individual perceives and responds to a risk and risk communications is governed, at least in part, by that individual’s cognitive process for evaluating that risk. Although early theories of economic risk presumed that people always processed risk information in such a way as to choose the best outcome or the most rational choice, it was not until cognitive psychological modeling was combined with analytical theory to study individual risk behavior that we learned definitively that our prior assumptions about rational choice are not always accurate. Instead, researchers found that individuals process and understand risk in two distinct ways (Slovic et al., 2004).

The first method of risk processing, referred to as the “analytic system” or “systematic processing”, is slow and methodical, and employs formal logic and probability calculations; it is the thinking way to evaluate a risk (Slovic et al., 2004). The second processing method, referred to as the “experiential system” or “affective processing” is fast, intuitive, and automatic, or the feeling way to evaluate a risk (Slovic et al., 2004). The cognitive or psychological approaches to risk communication have focused on the study of these two risk processing methods, individually and collectively, in order to gain a more complete understanding of how people process risk, the components or elements that contribute to their risk decisions, and what is required for
effective risk communication (Slovic et al., 2004). This approach may be limited, however, to the extent that it fails to include, consider, or account for the effects of social, cultural, and other outside forces on individual risk evaluations and decisions.

**Important Developments in the Cognitive or Psychological Approach to Risk**

**Prospect Theory**

One of the most oft-cited and influential of modern risk theories, known as “prospect theory” or “loss-aversion theory” was developed by two psychologists and published in an influential economic journal in 1979 (Kahneman & Tversky, 1979). Although prospect theory is considered an analytical theory, it represents one of the earlier attempts to apply psychological modeling to provide answers relative to how individuals process risk information (Slovic, et al., 2004).

Kahneman and Tversky (1979) found that when making decisions about a risk, the way the risk choice is presented, that is, whether the risk is framed positively as a gain, or negatively as a loss, has a higher explanatory power of the risk decisions actually made than the theory of expected utility or rational choice. Prospect theory also contends that, contrary to expected utility theory, the transparency of presented alternatives may impact whether or not individuals make the best choices (Kahneman & Tversky, 1979; Tversky & Kahneman, 1986). Put another way, subjective, values-based risk assessments may be more indicative of an individual’s risk decision choices than objective, probabilities-based measures (Slovic & Lichtenstein, 1983).

While significant for demonstrating that an individual’s risk decisions may not follow what appears to be the rational choice and providing some explanations therefore
(Kahneman & Tversky, 1979), prospect theory is less useful for explaining or predicting the affective, and other non-rational dimensions of risk-related behaviors or decisions.

**The Psychometric Paradigm**

Slovic (1987) proposed a “taxonomy of hazards” in his quest to gain a broader understanding of the noted discrepancy between expert and lay public evaluations and judgments about acceptable levels of risk. Specifically, he obtained quantitative ratings from individuals about specific risks or hazards and their regulation; these ratings were analyzed with other factors believed to be explanatory relative to perceptions of risk (Slovic, 1987).

Contrary to expert assumptions, Slovic (1987) found that for members of the lay public, perceptions regarding the riskiness of an event, activity, or technology are not based exclusively on considerations of the number of likely fatalities and the probability of the risk event. Instead, these perceptions are related on two dimensions to what Slovic (1987) called “dread risk” (how controllable and catastrophic the risk is perceived to be), and “unknown risk” (the perceived novelty, immediacy, and observability of the risk). A high “dread risk” hazard has been shown to be particularly useful in predicting public attitudes and behaviors relative to that risk (Peters et al., 2004; Slovic, 1987).

Like prospect theory, Slovic’s (1987) psychometric paradigm uses psychological methods and quantitative analysis to further the understanding and predictability of risk decisions made by the lay public. However, Slovic’s focus is broader and includes affective risk processing dimensions (Sandman, 1989; Slovic et al., 2004; Slovic, 1987).
The relationship between risks and rewards

Research has identified important anomalies in the relationship between the perceptions of risks and benefits in people’s minds relative to these perceptions in the real world (Finucane et al., 2000a; Fischhoff et al., 1978). Essentially, the capitalist mantra of “high risk leads to high reward” does not mirror how people think about risk. Instead, in our minds, there is a negative relationship between risk and reward such that technologies and activities perceived as low risk are also perceived to have a high reward, and vice-versa (Fischhoff et al., 1978). Moreover, this negative relationship demonstrably increases under time pressures (Finucane et al., 2000a).

The effect of affect and emotions

Slovic et al. (2004) contend that, while the manner and amount of affective processing differs by individual, our reliance upon intuitive feelings of goodness or badness relative to an object or activity predominates our risk evaluations and decisions. Gut-level emotions, including fear, anger, happiness, and worry, also play their own part in these evaluations (Slovic et al., 2004).

In fact, a link between the magnitude of an individual’s affective feelings about an object or activity and the negative relationship between the perceived risks and rewards associated with same has been identified (Alhakami, & Slovic, 1994). The implication here for risk communication is that how an individual feels about a risk is integral to how they assess the relative risks and rewards associated with that risk (Slovic et al., 2004). Thus, much as with message framing, presenting information or cues designed to shape an individual’s affective response to a risk may provide a way to predict, influence, or
dictate, an individual’s judgment and behavior relative to that risk. The caveat here is that in certain cases, namely those involving what has been termed visceral needs, including food, water, and drugs (in the case of addicts), and situations that implicate the inherent biases of our affective systems such that individuals tend to be desensitized to events that are more temporally and spatially distant or abstract (Slovic et al., 2004).

**Mental models**

The mental models approach (MMA) to risk communication was created specifically to help risk communicators choose, design, and analyze the content, structure, and organization of risk messages (Atman et al., 1994). This approach utilizes both text comprehension research and mental models theory, which is often attributed to the early efforts of the cognitive psychologist, Kenneth James Wilson Craik (Doyle & Ford, 1998).

Proponents of this approach for risk communication have defined mental models as “the pattern of knowledge gaps, overly general understandings, and outright misconceptions that can frustrate learning” (Atman et al., 1994; Jungermann et al., 1988; Lave & Lave, 1991; Maharik, & Fischhoff, 1992). Thus, the goals of this approach are to provide message recipients with sufficient information to correct or complete their mental models, such that the message recipients are able to make an informed risk decision (Atman et al., 1994).

One of the major strengths of this approach, as compared to other risk studies which are intended to further our understanding of the elements of effective risk communication, is that the MMA, because it was specifically created with the risk
communicator in mind, lays out a detailed blueprint or roadmap for the creation of risk communications (Atman et al., 1994; Morgan et al., 2002). Second, proponents of this approach specifically recognized the importance of textual aids and visual cues for effective printed risk communications (Atman et al., 1994). Ironically, in 2017, this particular strength might also be considered a limitation in today’s fast-paced, internet and social media-dominated world of blogs, facebook©, and tweets. I am not sure that anyone has adequately demonstrated that the MMA can effectively make the leap from printed risk brochures to the predominant social-based communication methods employed today. Finally, the MMA has been utilized for a wide variety of risks, including environmental, technological, occupational, and health and disease risks, in which the existence of the risk or hazard is certain, but the magnitude of risk may, or may not, be certain. However, I have not seen the MMA used in situations, such as in the case of the zoonotic potential of CWD, in which the existence of the risk or hazard is uncertain, but the magnitude or severity of those individuals who are impacted, should the risk come to fruition is certain. It remains to be seen how well the MMA will fare in this instance.

The importance of trust

In 1993, Slovic enunciated his asymmetry principle of trust, contending that risk communication fell far behind trust in terms of importance for conflict resolution. This principle which originated with the work of social psychologists, says that distrust is much easier to garner and keep than trust; essentially, distrust is the default position (Slovic, 1993). Moreover, Slovic (1993) contends that government and industry receive the bulk of the public’s distrust.
For risk communication, the significance of trust or distrust is obvious. If people do not trust the messenger, they will not trust the message (Slovic, 1993). While Slovic (1993) cast part of the blame for public distrust on the media, the legal system, and powerful interest groups, he concluded that under the U.S. democratic system, unprecedented levels of openness, transparency and power-sharing between the government and its citizens may be the only way for the public’s trust in government to be restored (Slovic, 1993).

**New Directions in the Cognitive or Psychological Approach**

**Risk information seeking and processing (RISP)**

Griffin et al. (1999, 2004) developed the RISP model to examine the interrelationship between the risk information processing path, information seeking, and long-term behavioral changes relative to risky behaviors. The 2004 version of RISP proposes that information sufficiency, that is, the amount of effort that people can or need to expend in order to feel that they have obtained enough information about a risk, operates as a predictor of an individual’s efforts to learn more about a risk (Griffin et al., 2004).

Griffin et al. (2004) further hypothesized that information sufficiency was influenced by several factors, including: 1) individual characteristics (demographics, sociocultural background, political philosophy, and experience with the risk); 2) perceptions about the risk (likelihood, perceived severity, personal control, and trust in risk managers); 3) whether or not the individual perceives a social pressure to educate themselves about the risk; and 4) whether the affect or emotion associated with the risk is
positive (heuristic processing), negative (systematic processing), or extremely negative (avoidance). They found, however, that affect and emotion, specifically worry, and the perceived social pressure to be informed were the variables most closely correlated with information sufficiency (Griffin et al., 2004).

The RISP model and its variants have also been utilized to study risk in other contexts. For example, Kahlor et al. (2006) used the sections of the RISP model related to perceived social pressures to be informed about a risk and information seeking behaviors and applied these concepts to environmental (non-direct or impersonal) risks. Their goal was to inform risk communication efforts for risks that may be perceived as “neither personal [nor] relevant for the general public” (Kahlor et al., 2006). They found that for these risks, perceived social pressures were highly correlated with information sufficiency, and information sufficiency was highly correlated with information seeking (Kahlor et al., 2006), confirming Griffin et al.’s (2004) previous results.

Clarke (2009) used and expanded on the RISP model to study the relationship between information processing and wildlife-related zoonotic disease risk. His intent was to inform wildlife managers relative to the impact of the public’s risk perceptions and behaviors vis-à-vis wildlife management policies (Clarke, 2009). Two of the additions to the RISP model added by Clarke (2009) include personal values and wildlife value orientations, which Clarke posited are factors directly related to the types of risk that individuals perceive from wildlife-related zoonotic diseases. Noting the importance of the public’s trust in wildlife managers and their decisions, Clarke (2009) also included salient value similarity (SVS) and its effect on trust and affective responses to disease risk. Lastly, Clarke (2009) included a component derived from role theory which
suggests that one’s self-identified position as a leader of a social group may result in risk information seeking because of a sense of obligation to fulfill one’s duty to the group. Clarke (2009) concluded that this expanded RISP framework could have important implications for communications between wildlife managers and their constituents, and ultimately, on wildlife management policies and practices.

**Heuristic-Systematic information processing model (HSM) adaptations**

Like Griffin et al. (1999, 2004), Trumbo (2002) examined the relationship between information processing and risk perception in the public health communication context. For his model, Trumbo (2002) novelly adapted the HSM for use with data obtained from surveys. The HSM, considered a cognitive process theory, contends that, depending upon their critical-thinking capabilities, individuals use systematic, affective, or both modes of processing to evaluate a risk (Trumbo, 2002). HSM also predicts that of the two modes, systematic processing leads to the most rational and consistent risk judgments over time (Trumbo, 2002).

To this model, Trumbo (2002) added antecedent variables for information sufficiency and motivation drawn from the RISP model (Griffin et al., 1999); he also included variables for gender and age, to allow for comparison of this model’s results to those of previous risk studies. Lastly, the model incorporates risk perception, the dependent variable, based upon the psychometric paradigm of Slovic (1987). Interestingly, unlike other previous studies, Trumbo (2002) found a link between heuristic processing and lower risk perception.
Johnson (2005) also adapted the HSM for use with surveys, by pairing it with variables of actual knowledge and the IRA model (involvement, relevance and ability) relative to risk message evaluation and information seeking. He then compared his findings to those of Trumbo (2002) and the Griffin et al. (1999, 2004) RISP model, with mixed results, and suggested several gaps in the current measures for analyzing systematic and heuristic processing (Johnson, 2005).

**Trust**

A recent cognitive model on the issue of trust in risk managers, known as the intuitive detection theorists model, contends that members of the lay public factor multidimensional evaluations of risk managers’ performance into trust judgments (White & Johnson, 2010). More specifically, the public looks at: 1) how well or poorly risk managers discern safe from dangerous items or events; 2) whether risk managers are more or less cautious; and 3) their level of candidness with the public (White & Johnson, 2010). All three dimensions were found important for trust in both experiments and surveys (White & Johnson, 2010). However, the authors suggest that incorporating social or behavioral aspects of trust, including, the effects of group influences and dynamics on trust, may be beneficial (White & Johnson, 2010).

**Stigma**

The stigma susceptibility model was proposed as a way to account for how differences in individual worldviews and affective reactivity (the relationship between affect and behavior as measured by an individual’s reaction or lack thereof to threats of punishment or other negative results) inform individual emotional, and thus, stigma,
responses to technology (negative emotions were posited to yield object stigmatization responses) (Peters et al., 2004). Peters et al. (2004) defined technological stigma as “risk objects generally regarded as disgraceful and unacceptable.”

Based upon their analysis of survey data from participants recruited from a local university, Peters et al. (2004) concluded that the results supported their hypothesis, and that the strength of the stigma response was associated with individual differences in the antecedent variables. The researchers suggested that the results could have important implications for risk communication about stigmatized objects and future research and efforts to reframe or repackage risk information that impacts emotional appraisals (Peters et al., 2004). However, it is important to note that this study looked at technological and not social stigma.

**Media-related impacts on risk**

In a study on the factors impacting women’s responses to a video about breast cancer, Morton and Duck (2003) found both consistencies and differences from previous research. While the personal relevance of breast cancer was a consistent factor for increased personal risk perception in this and other studies, this study exclusively found that personal relevance was a factor only for women who had negative attitudes toward media content (Morton, & Duck, 2003). Moreover, these particular women tended to pursue additional information from interpersonal channels that they regarded more positively (Morton & Duck, 2003). These researchers contend that these results have implications which should be considered for other mediated health risk communication campaigns (Morton & Duck, 2003).
So (2012) proposed a new theoretical model (the model of motivated media exposure (MME)), which combines the uses and gratification theory with media effects research, to explain the effects of the media on an individual’s perceptions of social and personal-level risks. More specifically, the MME proposes that a surveillance motivation to partake in media programs, is driven by a desire to know what is happening with others or one’s greater environment (So, 2012). Thus, individuals primarily or exclusively driven to utilize media by a surveillance motivation will process any risk-related content as applicable to others and not self. Conversely, the MME posits that those using media content primarily for enjoyment will personalize the media content (So, 2012).

While noting the inherent limitations and assumptions in the model, including: 1) its application only to intentional media consumption; and 2) its assumption that the consumers have the capacity to be cognizant of and articulate their motivations, So (2012) contends that the MME has both theoretical and practical implications for future research and current risk communication needs.

**Social Dimensions of Risk**

In the latter part of the 1980s, Johnson (1987) contended that the risk communication field’s emphasis on communicating technical information from experts to members of the lay public, while important, missed the mark. Johnson (1987) went on to suggest that while understudied and ill-defined, social context factors, including social networks, economic resources, political rights and responsibilities, and histories and ideologies, impact how individuals receive, process, and utilize technical risk
information. Thus, he concluded, they should be included in the risk communication process (Johnson, 1987). Similar observations and specific suggestions for social science research needs were made nearly contemporaneously by at least one other researcher (Freudenburg, 1988).

Social amplification of risk (SARF)

Following closely on the heels of Johnson (1987) and Freudenberg (1988), Kasperson et al. (1988) also examined the social and behavioral aspects of risk. However, these researchers were proposing a comprehensive theory, one that also included cognitive or psychological and cultural factors, in their attempt to answer the questions that so perplexed the technical experts, namely: Why and how could the lay public’s assessment of a risk be so disparate from that of the experts (Kasperson et al., 1988)?

Using the 1979 Three Mile Island nuclear reactor accident as a model, Kasperson, et al. (1988) contended that the technical experts conveyed risk estimates of likely direct impacts, such as, expected lives lost, using a risk cost-benefit analysis (RCBA). However, these RCBA estimates did not capture the likely indirect impacts, including, social and technological stigmatization, decreased trust in institutions and government, and other socioeconomic costs. Further, it is these indirect impacts that inform the value judgments that are a part of individual risk assessments (Kasperson et al., 1988), hence the dissonance between the experts and the lay public.

Kasperson et al. (1988) proposed SARF as a way to explain, model, measure, and predict the complex cognitive, psychological, social, behavioral, and cultural factors that
are part of individual risk assessments and decisions (Kasperson et al., 1988). In creating SARF, they borrowed the concept of “signal amplification” from communications theory (Kasperson et al., 1988).

Communications theory describes signal amplification much like the old children’s game whereby one person tells a second person in a group a secret which is then passed person-to-person, finally returning to the original secret-teller who then compares the original version to the final version of the secret to see how much the message has changed through the communications process. In the language of communications theory, the contents (signals) of the original secret are amplified (increased) or attenuated (decreased) from person-to-person in the group (Kasperson et al., 1988). Each person in the group becomes both a receiver and a transmitter of the signal, and the signal changes from the original message are a result of the differing sociocultural and values contexts that each group member uses to receive, process, and transmit the signal to the next group member (Kasperson et al., 1988).

Kasperson et al. (1988) posits that these same factors enunciated by communications theory, along with social, behavioral and group dynamic processes influence the social experience of risk and the resultant risk consequences. Thus, SARF suggests that with sufficient information flow, these social influences may spawn secondary and tertiary risk impacts, or “ripples”, that radiate far outside the original locus of the risk (Kasperson et al., 1988).

The media is most frequently implicated as the information conduit via which SARF occurs (Kasperson et al., 1988). Certainly the advent and rise in the use of the
internet and social media to communicate instantaneously on a global platform since SARF was originally proposed seemingly lends support to this theory, although some research indicates that media coverage alone is insufficient to provoke secondary effects (Kasperson et al., 2003).

In response to a call by the researchers for the use of SARF to study and anticipate new risks likely to be highly amplified or attenuated (Kasperson et al., 2003), SARF has been used to study Americans’ risk perceptions and trust in scientists relative to climate change (Leiserowitz et al., 2013); as support for the use of social media to communicate disaster information during California’s wildfires (Sutton et al., 2008); the implications relative to the potential for volcanic eruptions and tourism in Iceland (Bird et al., 2010); and evaluating SARF’s usefulness in understanding the media’s role in risk communication using the very public standoff between Greenpeace and Shell Oil as a model (Bakir, 2005), to name but a few examples. The diversity of research questions to which SARF has been applied suggests the broad utility of this framework.

**A test of the Social Network Contagion (SNC) theory of risk perception**

SNC, which emanates from organizational and community social network studies, suggests that a limitation of cognitive or psychological theories of risk perception, and communications based thereon, are their failure to account for the influences of interpersonal communication between members of social networks or groups on individual risk perceptions (Scherer, & Cho, 2003). Scherer and Cho (2003) proposed the existence of “risk perception networks” and used a rural community facing an environmental risk to its water supply as the test population.
Using interviews and surveys, Scherer and Cho (2003) collected data regarding the frequency of interactions between two individuals (independent variable); perceived risk from the hazard and belief in science (dependent variables); and education level, dominant group affiliation, and age (control variables). As expected, they found that individuals who regularly interacted with each other were more likely to have comparable risk perceptions regarding the environmental hazard (Scherer & Cho, 2003). However, the researchers did note that the results left unresolved a chicken-and-egg question, namely: whether the results are attributable to individuals seeking like individuals with whom to associate, or whether what may once have been disparate opinions and perceptions between group members evolved into a group opinion over time as a result of the social network interactions (Scherer & Cho, 2003). The researchers suggest that previous organizational studies point to the group opinion hypothesis as the most likely (Scherer & Cho, 2003).

**Salient Value Similarity (SVS) and trust**

Siegrist et al. (2000) conducted a study on German college students designed to test the SVS theory of social trust. SVS posits that individuals are more trusting of other people, including institutional managers and government officials, if they perceive that they all share the same values (Siegrist et al., 2000). The results of the study supported their hypothesis, thus they concluded that people will accept the risk and benefit judgments of experts with whom there is social trust and a perception of shared values (Siegrist et al., 2000). Siegrist et al. (2000) further suggested that framing an issue in a manner that reflects the audience’s salient values may be a way to increase social trust,
but notes that the theory would need to be tested on various other groups to determine whether or not similar results are obtained (Siegrist et al., 2000).

More recently, Earle & Siegrist (2008) tied SVS to the perceived performance of risk managers and the trust, confidence, and cooperation (TCC) model. This cognitive-social hybrid model of trust suggests that both cognitive and social factors play a role in the public trust of, and response to, risk managers (Earle, & Siegrist, 2008).

**Crisis Communications**

Crisis communications, often said to originate from the public relations field, historically tended to take the top-down approach to communication, much like earlier risk communication approaches (Lundgren, & McMakin, 2013). Additionally, institutional crisis communications frequently “spin” or “frame” the risk message in order to portray their organization in the best possible light (Lundgren & McMakin, 2013; Reynolds & Seeger, 2005).

Lundgren and McMakin (2013) suggest that simply telling the lay public what you want them to know, even in a crisis situation, is insufficient to motivate citizens to engage in the desired behaviors. Holmes et al. (2009) concur. However, in a study they conducted with health communication professionals, public health officials, and scientists and researchers, the overwhelming majority of participants, by a greater than two to one margin, were of the opinion that effective crisis communication was best demonstrated, not by public empowerment, but by public compliance (Holmes et al., 2009). Some of these participants went so far as to suggest that providing the public with information, or responding to their questions and concerns, was counterproductive (Holmes, et al., 2009).
At the very least, there seems to be a difference of opinion among crisis communicators regarding communication goals and strategies. This difference is highlighted by recent crisis communication models.

**The Crisis and Emergency Risk Communication (CERC) model**

The CERC model is a hybrid model which combines a more measured, longer-term, pre-crisis risk communication strategy, a crisis communication strategy for risk situations of an emergent nature, and a post-crisis assessment and revision phase (Reynolds & Seeger, 2005). While I believe that there are many benefits to the CERC approach, my biggest objection, and where I think the model strays from contemporary notions of a “public-centered” risk communication process (Fischhoff, 1995), is CERC’s endorsement of persuasive and “do as I say” risk communication strategies in lieu of participatory models.

**Blending communication strategies to address disease risks**

In their study of public health crisis risk communication relative to emerging infectious diseases (EIDs), Holmes, et al. (2009) suggested that this emerging field was a hybrid, entailing risk communication strategies from health, environmental, and technological fields, as well as communications ethics disciplines, for which the applicable literature is sparse or not easily accessible. In their quest to develop communications and research suggestions, Holmes et al. (2009) conducted interviews with communications, public health, and EID experts focusing on three key communication areas: 1) the media; 2) ethics; and 3) the role of institutional or agency trust by the public.
Like the CERC model (Reynolds & Seeger, 2005), Holmes et al. (2009) concluded that effective EID communication strategies must be all-inclusive, i.e., include pre, during, and post-crisis communication strategies. Where the two strategies diverged most significantly was that Holmes, et al. (2009) suggested that ethical frameworks be specifically considered in communication design and implementation, and in their conclusion that public outreach and participation was crucial in all communication stages.

**Hybrid Approaches to the Study and Communication of Risk**

Hybrid approaches to the study and communication of risk, a few of which I have mentioned, are not uncommon, and seem to be gaining in popularity. Moreover, as specific risks take on increased local, regional, national, or global significance, or become more widely known via mediated-channels, there may be calls for new risk communication models to address that particular risk (Larson et al., 2012). In some cases, I suspect that different hybrid models may be more effective than others in particular situations or for particular audiences, especially when there are distinctly different sociocultural groups to which the same risk may apply.

As a general proposition, hybrid models that incorporate knowledge gleaned from research conducted in various disciplines relevant to risk communication can lead to more effective risk communication than those approaches that are more narrowly focused in one discipline, to the exclusion of others. For example, models that incorporate pre-crisis, crisis, and post-crisis communication strategies are likely to be more effective than those that only focus on pre-crisis communication alone. Likewise, risk communications that include elements drawn from communications, cognitive, psychological, social, and
behavioral theories are more likely to effectively reach a broader audience, than those that are more limited in scope.

The Mental Models Approach (MMA) to Risk Communication

Late 19th century and early 20th century physicists and philosophers espoused what amounted to the pre-cursors to the mental models theory (Johnson-Laird, 2004), however, the theories’ genesis was the result of work published in *The Nature of Explanation* (1943) by the psychologist Kenneth James Wilson Craik (Doyle & Ford, 1998; Johnson-Laird, 2004). Craik proposed a connection between our internalized symbolization of external stimuli (“mental models”), and the impact of these mental models on human thought, reasoning and our power to predict events (Doyle and Ford, 1998; Johnson-Laird, 2004). Although not widely embraced by the field of psychology, mental models have been widely utilized and studied in systems dynamics and cognitive science-related fields, including, risk perception and communication (Doyle and Ford, 1998).

How the MMA works

This approach to risk communication requires that recipients be provided with the information necessary for them to make an informed decision, and that the information provided corrects recipients’ misinformation about the particular risk (Atman et al., 1994). More specifically, the MMA seeks to systematically determine: 1) what information the audience knows (their existing “mental model”); 2) what information the audience needs; 3) how best to communicate the needed information to the target
audience; and 4) whether or not the communication accurately conveyed the risk information as intended (Morgan et al., 2002).

Another way to conceptualize the process by which this approach works to create a risk communication is to think of a three-legged stool. The first leg of this stool represents the pool of expert knowledge about a particular risk. Although some of this information may be highly technical and essentially unusable by the target audience, the information and the uncertainties are prioritized to reflect what the experts believe is critical and should be included in a risk communication. The second leg of the stool is represented by the information or misinformation that the target audience already has or feels that they need about a risk. The third leg of this conceptual stool pools the important concepts or informational needs from both of the other two legs to determine the information that belongs in the risk communication.

The process of designing a risk communication using the MMA begins with the creation or selection of an expert model which details all of the decisions possible for recipients of the information (Atman et al., 1994). Another way to describe the expert model is that it represents the “pooled beliefs of technical specialists about a phenomenon” (Morgan et al., 2002). This expert information is presented in a hierarchical-structured influence diagram which uses both text and figures to convey the information, including a depiction of the relationships between different concepts or events (Morgan et al., 2002). Although there are numerous methods which may be used to obtain, assemble, and depict the expert information, there is no single best way to accomplish these tasks, and thus, multiple or hybrid methods to do so are often employed (Morgan et al., 2002).
The expert model is then used to structure the second phase of this approach, namely, the open-ended interviews of members of the target audience(s) to elicit their beliefs and knowledge relative to the risk (Morgan et al., 2002). Previous research has demonstrated that because information and data gathered through the use of self-reporting involves an active intellectual process, respondents’ answers to questions may be skewed by their attempts to glean information and utilize clues about how they should answer from the interviewer or the instrument (Morgan et al., 2002; Schwarz, 1999). In an attempt to counteract this effect, these open-ended interviews begin with very general questions and become progressively more pointed and specific at each subsequent stage of the interview process (Morgan et al., 2002). Although expensive, proponents of the mental models approach contend that these open-ended interviews are crucial because they unearth “surprising beliefs and formulations [which beg for] treatment in risk communications” and because the “discipline of looking at the details of what people say provides much of the utility of this approach” and distinguishes it from other forms of analyses (Morgan et al., 2002). However, because of the small sample size utilized in this phase, the results obtained from these interviews are not widely generalizable to either the target audience or the lay public generally (Morgan et al., 2002).

The third phase of this approach attempts to answer the questions relative to the target audiences’ mental models on the risk through the administration of a comprehensive questionnaire to a larger sample of people (Morgan et al., 2002). The questionnaire utilizes the expert model to design questions about important beliefs and facts about the risk; it also uses the open-ended interview results to identify and design questions concerning significant misconceptions and information needs held by members
of the target audience (Morgan et al., 2002). Moreover, the questions are subjected to
the iterative process to ensure that they “will be understood by the respondents as
intended” (Morgan et al., 2002). Creating functionally equivalent, but different, forms of
the questionnaire, and of the subsequently produced risk communication, for different
audiences is considered a viable alternative by the proponents of this approach (Morgan
et al., 2002).

The next phase is the creation of the communication itself, the content of which,
proponents contend, should be essentially determined by this stage in the process
(Morgan et al., 2002). Text comprehension and utility research suggests that the text
structure, content, and overall communication design must be written, organized,
depicted, and formatted in ways which highlight the most salient points of the risk
communication while still making the information accessible and interesting to the target
audience (Atman, et al., 1994; Bull et al., 2001; Lipkus, & Hollands, 1999; Lorch, 1989;
Marino & Gerlach, 1999; Noar et al., 2007; Reder & Anderson, 1982). Although model
proponents generally favor a neutral stance in risk communications, they acknowledge
that in communications concerning public health, a persuasive tone may be appropriate
(Morgan et al., 2002).

The fifth, and last, phase of the mental models approach is an ongoing one. It is
the process of iteration, which involves the systematic testing, and re-testing of the
communication (Morgan et al., 2002). The importance of the iterative process has been
widely acknowledged as a necessary component of successful risk assessment,
management, and communication ((The Presidential/Congressional Commission on Risk
Management and Risk Assessment, 1997). According to the Commission (1997), the
iterative process “accommodates changing or new information…and may clarify or re-
define the problem, change the focus to a different problem, or identify other risks in a
broader context.” The iterative process ensures that the risk communication can change
to reflect new information, and thus remain relevant.

**The MMA in action**

The MMA has been used to design and evaluate risk communications and public
perceptions of risk on issues as diverse as climate change, HIV/AIDS, radon, wildland
fire, and occupational chemical risk protection (Morgan et al., 2002; Niewöhner et al.,
2004; Zaksek & Arvai, 2004). For example, mental models research relative to climate
change conducted with an educated lay audience in 1992 showed that although this group
had a good grasp of many of the likely impacts of climate change, they were less clear on
the underlying physical mechanisms, tended to confuse climate with weather and climate
change with ozone depletion, and thus did not make the connection between fossil fuel
use and climate change (Bostrom et al., 1994; Morgan, et al., 2002). In a follow-up study
conducted in 2009 with another group of educated citizens, researchers found that while
many of the prior misconceptions relative to climate change causes and effects were no
longer evident, problematic misconceptions, including the failure to link fossil fuel use
with increased carbon dioxide emissions and global warming, still remained (Reynolds et
al., 2010). The researchers suggested that the existence of misconceptions in 2009,
despite the extensive political and media coverage on the issue and near-unanimous
acceptance of the climate change phenomena in the scientific community in the
intervening years between these studies, is a function of the complexity of the issue,
unclear verbiage in messages to the lay public by politicians and the mass media, and
recent research indicating that the lay public in wealthier countries tend to view climate change as a lower life priority relative to the lay public in poorer countries (Reynolds et al., 2010). These results prompted the researchers to call for “simple [risk communication] steps…which would better inform lay beliefs surrounding what human activities influence climate change and what policies might plausibly mitigate it” (Reynolds et al., 2010).

In using this approach to evaluate the relative success of public information campaigns intended to inform adolescents about behaviors which increase the likelihood of contracting HIV/AIDS, researchers concluded that “the cumulative impact of [previous HIV/AIDS-related] communications [had] …succeeded in teaching teens a lot…[and, thus] it would be a mistake for health-risk communications to provide the big picture of HIV/AIDS [because] teens already have it” (Morgan et al., 2002). Instead, the researchers suggested that subsequent risk communications should focus on filling information gaps and correcting misconceptions (Morgan et al., 2002). The researchers went on to develop and test an information brochure that both targeted a diverse segment of the adolescent population, and that included risk information relevant to all modes of HIV/AIDS transmission (unprotected sex, IV drug use, blood transfusions, and maternal transmission) (Morgan et al., 2002). The researchers specifically sought to create a risk communication applicable and relevant to males and females, different races and ethnicities, and those from populations considered both high and low risk.

Although the researchers believed that the created communication provided the necessary information, they were disappointed with what they characterized as “relatively small improvements in knowledge”, and suggested that the lack of significant
improvement might reflect a limit on the effectiveness of written communication (Morgan et al., 2002). The results of this HIV/AIDS study did, however, lead the researchers to conclude that, particularly as it relates to infectious disease, stigma may play an important role in shaping how, or if, messages concerning risk are received or processed, and should thus be addressed in risk communications. (Morgan et al., 2002).

The open-ended interview portion of a study on radon highlighted misconceptions held by members of the lay public regarding radon’s source of origin, permanence, and health impacts (Morgan et al., 2002). Respondents also incorrectly believed that radon, once present in the home, could not be remediated (Morgan et al., 2002). Based on the expert model and open-ended interview results, the researchers created two differently structured text-based risk communication brochures regarding radon (Morgan et al., 2002).

The content of these two brochures, along with an EPA radon brochure, and the relevant portion of a junior high school text, were analyzed by comparing them all to the expert model and to each other (Atman et al., 1994). The textbook information was found lacking (Atman et al., 1994). In their analysis of the brochures, however, the researchers determined that all three of the brochures covered all of the general and about one-half of the detailed or technical concepts found in the expert model, although the particular detailed concepts covered differed by brochure (Morgan et al., 2002). Both brochures developed by the researchers included the widest variety of text comprehension aids (Morgan et al., 2002). As might be expected, the brochure created directly from the expert model was found to be the most complete, best structured and
organized, shortest, and the one which directly contradicted the most lay public misconceptions (Morgan et al., 2002).

In a subsequent structured evaluation process, subjects who were given any one of the three brochures to review performed better, with less misconceptions and more correct information, on an EPA radon test than did the control group which was not given any brochure (Morgan et al., 2002). However, analysis comparing the test subjects’ test performance by brochure showed statistically significant differences between the researcher-created brochures and the EPA brochure relative to questions concerning radon decay, mitigation, detection, and health effects (Morgan et al., 2002). In short, the researchers concluded that the brochures created using the mental models approach performed better at “filling knowledge gaps, restructuring knowledge for decision making, [and] contradicting misconceptions” (Morgan et al., 2002).

**Some limitations and advantages of the MMA**

There are several criticisms of the mental models theory between and amongst the systems dynamics and cognitive-science related disciplines. The first of these criticisms is that there is no universal or consensus definition of the concept of “mental models” (Doyle & Ford, 1998; Johnson-Laird, 2004). This lack of consensus manifests as general and vague definitions that may vary significantly between or within disciplines (Doyle & Ford, 1998). These definitional differences may also result in reduced applicability or utility of mental models research and collaboration between and amongst disciplines (Doyle & Ford, 1998). Notwithstanding the differing definitions, there is
broad agreement that an individuals’ mental model represents the individuals’ perception of the external system upon which that mental model is based (Doyle and Ford, 1998).

Some have criticized mental models as overly simplified, ill-equipped to handle the complexities of reality, and limited by “bounded rationality” and experience, even while acknowledging the dynamic nature of an individual’s mental models (Doyle & Ford, 1998). More recent research, however, supports Craik’s assertion that “mental models underlie all sorts of thinking” (Johnson-Laird, 2004).

In the field of risk perception and communication specifically, some studies indicate that in their mental models, individuals may: 1) confuse important concepts or terms with others; 2) include risks not supported by the facts; and 3) fail to include mitigating factors, any or all of which will negatively impact the resultant analysis of the risk (Doyle & Ford, 1998). Thus, these factors are purported to make mental models more “error-prone” in the risk communication field relative to other disciplines (Doyle & Ford, 1998). Despite its shortcomings, proponents of the MMA suggest that this systematic approach helps lay the foundation for a “public-centered approach to developing risk messages” (Morgan et al., 2002).

**The MMA and chronic wasting disease (CWD)**

When applied to CWD, the MMA offers a systematic methodology to: 1) create the theoretical ideal standard for text-based CWD risk communication through the creation of an expert model; 2) analytically and empirically evaluate the CWD risk communication content, structure and format from state websites or other fora to determine which communication(s) most closely meet the theoretical ideal or expert
model; 3) select relevant target audiences and determine, via individual interviews and surveys or focus groups, what specific informational and other needs exist for these target groups; 4) create CWD risk communication(s) that address the key issues in the expert model and the specific needs of the target audience(s); and 5) test and revise, as necessary, the created CWD risk communication(s) through an ongoing iterative process with both experts and members of the target audience (Morgan et al., 2002).

The use of the MMA to design CWD risk communication should provide the target audience(s) with the information necessary for the members to make an informed decision relative to the potential risks and benefits associated with activities in which they engage which may put them into contact with infected cervid parts and CWD prions. The created communications should also satisfy the experts by providing the information that they deem critical. Lastly, involving the target audience in the risk communication development process could help to foster a relationship and sense of trust between the public and the relevant government agencies over time (Fischhoff, 1995).

A comparison of the MMA and RISP

However, as Morgan et al. (2002) acknowledge, the MMA as applied to risk communications falls in the mid-level of the process-related hierarchy articulated by Fischhoff (1995). This means that although the MMA may be designed and applied with an eye toward the “creation of a socially acceptable decision-making process” (Morgan et al., 2002), the MMA is not equipped to fully realize this goal.

Clarke’s (2009) adaptation and application of the risk information seeking and processing (RISP) model (Griffin et al., 1999) to zoonotic disease risk from wildlife is
applicable to CWD and seems better-suited to the task of creating a more participatory decision-making process. Specifically, Clarke (2009) distinguishes the application of his RISP framework between risk communications intended to persuade, and those intended to engage stakeholders in the risk communication and risk management strategy development process. Clarke (2009) also includes personal values, wildlife value orientation, and salient value similarity (SVS) in his RISP framework, which Clarke contends are predictors of how a zoonotic disease risk is perceived, the affective response thereto, the motivation to seek and process information, and the level of trust accorded to agency wildlife management decisions. Finally, Clarke (2009) includes the concept of “opinion leadership” in his framework. Clarke (2009) contends that the social pressure on an individual to be informed (Kahlor et al., 2006) and the social validation that accompanies being informed, results in a positive feedback loop such that these opinion leaders exert significant influence on the opinions of their social peers.

While I think that Clark’s (2009) RISP framework is further along Fischhoff’s (1995) risk communication hierarchy than the MMA, particularly as it relates to participatory risk communication strategies, I am not convinced that, as it relates to CWD risk communication specifically, Clarke’s (2009) framework is as valuable outside of the hunter-wildlife management agency risk communication paradigm. Specifically, I don’t think this framework is particularly applicable to other relevant stakeholder groups unless they are also hunters, or primarily get their CWD risk information from wildlife management agency websites.
The MMA and “one size fits all” risk communications

Another potential limitation of the MMA is its aim to create a “one-size-fits-all” risk communication. The relative lack of success in the HIV/AIDS risk communication effort undertaken by Morgan et al. (2002) provides what I believe is an illustrative example. Specifically, in this communication, the researchers intentionally attempted to create a communication that addressed the informational needs of a diverse population of teens and that also addressed the risk factors associated with four different modes of HIV/AIDS transmission in one risk communication document.

The lackluster results achieved in this study (Morgan et al., 2002) supports my hypothesis that effective risk communication efforts are not “one-size-fits-all”, but instead, these efforts must be specifically tailored to the intended audience and the specific risk factor or discrete focus of the risk problem. For CWD risk communication, I suspect, for example, that this means that communications directed at hunters will need to differ, in at least some respects, from those directed at chefs/restauranteurs, or from those directed specifically at taxidermists because these groups all have some different informational needs and values relative to their respective “risky” behaviors.

Moreover, the race, cultural, and gender make-up of the different target groups will also be important factors in the development of effective risk communications (Finucane et al., 2000b; Murray-Johnson, Witte, & Liu, 2001). For example target groups that have a higher percentage of non-white females will likely be more risk averse than other groups, and thus, risk communications will need to account for and address these differences (Finucane et al., 2000b).
The MMA in a crisis

Although the MMA provides a framework for developing pre-crisis risk communications on a wide variety of topics, and allows for the targeting of specific audiences, it is not designed for use with risks of an immediate nature (Morgan et al., 2002). Thus, while the MMA is useful for developing informational risk communications about CWD and other EIDs that have not reached the public health crisis stage, should a status change occur (from pre-crisis to crisis), the MMA is likely to be less effective as a communication strategy in the wake of heightened public risk perceptions (Holmes, et al., 2009; Reynolds & Seeger, 2005). Moreover, crisis or emergency risk communications, which have been compared to public relations campaigns, typically rely upon time-sensitive mass media communications to present the risk message to the public (Holmes, et al., 2009; Reynolds & Seeger, 2005). This differs from the communication channels most frequently employed under the MMA which typically utilizes printed informational brochures, booklets, and pamphlets (Morgan et al., 2002).

The Crisis and Emergency Risk Communication (CERC) model proposed by Reynolds and Seeger (2005) is a hybrid model designed for complex events which combines both crisis and non-crisis risk communication strategies. According to Reynolds and Seeger (2005), the primary differences between the two types of communication are their origins and focuses. Crisis communication is focused on the “strategic management and framing of public [risk] perceptions…to reduce harm for both the organization and the stakeholders” (Reynolds & Seeger, 2005). By contrast, the purported purpose of risk communication, rooted in science and technology, is to
repackage technical information about a risk in ways that are both informative to the lay public, and that persuade the public to behave in a less risky manner (Reynolds & Seeger, 2005).

By combining these two types of risk-related communication into one model, CERC proposes a broader, more process-centered view of risk communication, like that endorsed by the National Research Council (National Research Council, 1989; Reynolds & Seeger, 2005). CERC guides risk communication about a topic through a five-step process commencing with the pre-crisis phase (“public education campaign”), through the crisis stage, and finally through the post-crisis (“postmortem” or assessment) phase (Reynolds & Seeger, 2005). Reynolds and Seeger (2005) rightly contend that effective risk communication starts long before a crisis and continues after the crisis has abated.

To the extent that CERC provides a more comprehensive temporal model for risk communication and specifically contemplates the use of the mass media in the communication process, I think it presents a better overall model than the MMA for CWD risk communication – particularly if CWD were to be determined to be zoonotic and presented as a public health crisis at some point in the future. However, I found three areas of the CERC model to be lacking, namely: 1) although the model provided a list of tasks to be accomplished at each of the five communication stages, it did not provide specific details about how to perform these tasks; 2) the model made certain ethical assumptions about the purpose(s) of crisis and non-crisis risk communications that are not unanimously held (Thompson, 2012). These underlying ethical assumptions guided the way that risk messages are framed in this model without a discussion of the ethics thereof (Reynolds & Seeger, 2005); and 3) even in the pre-crisis phase, the provisions for
public engagement and stakeholder participation are limited (Reynolds & Seeger, 2005). Although this is likely a function of the top-down ethical frame employed in this model, as compared to Fischhoff’s (1995) hierarchy, it seems to be a regressive stance for such a progressive model.

Similarly, Holmes et al. (2009) suggest that communication about EIDs involves a hybrid communication strategy that includes communication phases of “preparedness, response, and recovery” and incorporates communication strategies borrowed from health risk, technological risk, and crisis communication. Based upon the results of their study exploring EID communication with health communication professionals, public health officials, scientists, and researchers, Holmes et al. (2009) made recommendations for five broad issues relative to effective communication about EIDs.

The first recommendation was to clearly define the purpose and goals of the communication, including considerations of the values of both the communicators and the target audience (Holmes, et al, 2009). As a corollary, the second recommendation was to keep ethical considerations at the forefront throughout the communication process (Holmes, et al., 2009). Early media engagement and defining the media’s role in communication was the third recommendation; this was followed by taking active steps to build trust with the public through “outreach and engagement” (Holmes, et al., 2009). Lastly, Holmes et al. (2009) recommend what might be appropriately called “human dimensions research” such that the communicators know their audience, including what the audience knows, what motivates them, and the groups social structure (Holmes, et al., 2009).
Although both the CERC model proposed by Reynolds and Seeger (2005) and Holmes et al. (2009) recommendations favor a hybrid communication strategy that is broader than the MMA, unlike the CERC model, both the MMA and the Holmes et al. (2009) recommendations support public engagement and participation in the communication process, “knowing the audience”, and specific consideration of potential ethical dilemmas in the communication process (Morgan et al., 2002; Holmes et al., 2009).

The MMA and uncertain risk problems

The MMA has been successfully used to evaluate, design, and test risk communication materials for the lay public about uncertain risks, namely climate change (Morgan et al., 2002). Thus, I expect that the MMA will also be successful for evaluating, designing, and testing risk communication(s) for the uncertain risk from CWD. However more recent work by Pidgeon and Fischhoff (2011) on “communicating uncertain climate risks” suggests that a more comprehensive approach may be prudent when dealing with uncertainty.

They suggest that to be effective, communicating uncertainty requires experts from both the social and decision sciences in six key ways: 1) risk estimates must be tailored to the values of the target audience; 2) explanations of the process underlying the risk must be sufficient for the audience to create mental models about what is happening; 3) risk messages need to be designed to reduce destructive emotions and reinforce positive/motivating emotions; 4) risk messages need to be designed to reinforce positive social processes relative to perceptions of risk; 5) communications must be “rigorously
implemented” and “empirically evaluated” for their effectiveness; and 6) communication efforts must be sustained, cross-disciplinary, and supported (Pidgeon, & Fischhoff, 2011). The MMA does many of these things well, but might be improved by additional focus on emotions, social processes and strategic organization in the risk communication design process.

References


CHAPTER 3. USING THE MENTAL MODELS APPROACH TO CREATE EXPERT MODELS AND TO COMPARE THEM TO SELECTED STATE CWD RISK COMMUNICATIONS

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**Abstract**

Using chronic wasting disease (CWD), a fatal wildlife disease with zoonotic potential, as the model disease, we used the mental models approach to create both a theoretical and an actual expert model to highlight concepts relevant to risk communication about CWD. We then used each of these models to evaluate state governmental risk communications about CWD published by selected states’ wildlife management agencies. We also compared and contrasted the concepts highlighted by each of the models. Although the two expert models differed relative to level of detail and emphasis, with one notable exception, the state communications fell far short of meeting expert recommendations. In all cases, we found deficiencies and inconsistencies in content, format and user-friendliness, both internally, and among the state communications. These deficiencies and inconsistencies have the potential to create distrust in and undermine all agency CWD risk communications.
Introduction

The primary goal of risk communication is to provide the intended recipients with information that they can use to make an informed decision about a particular risk; alternatively, it is to provide information that suggests to the recipients a specific course of action relative to the risk (Atman, Bostrom, Fischhoff, & Morgan, 1994). The mental models approach to risk communication recognizes the connection between human reasoning and “internal mental models of the external world” (Doyle & Ford, 1998) and uses this connection in a systematic, public-centered risk communication development process (Morgan, Fischhoff, Bostrom & Atman, 2002). This approach has been used to evaluate the lay public’s perception of risk, and to design and evaluate risk communication on issues as diverse as climate change, HIV or AIDS, radon, wildland fire, and occupational chemical risk protection (Morgan et al., 2002; Zaksek & Arvai, 2004; Niewöhner et al., 2004).

As part of the mental models approach, the content of existing risk communications on a subject are analyzed and compared to an expert model which details all of the decisions possible for the communication recipients (Atman et al., 1994). The expert model includes basic concepts considered essential for informed decision-making; it also includes specific concepts which, while important, may provide information that is superfluous, or otherwise inhibits the recipients’ decision-making process (Morgan et al., 2002). The expert model is presented as an influence diagram which uses both text and figures to display the relationships between the depicted concepts (Morgan et al., 2002).
We used the mental models approach to evaluate, compare, and contrast the content of the information about CWD provided by selected state regulatory agencies on their respective websites. We analyzed the respective states’ content for its ability to adequately and accurately convey information upon which information recipients can make an informed decision relative to the potential health risks associated with CWD. As part of our analysis, we compared each state’s communication content with both a theoretical expert model and an actual expert model, both representing variants of the ideal CWD risk communication (Morgan et al., 2002). The best CWD risk communications will include all, or most, of the basic concepts from the expert model, and few, if any of the specific, or detailed concepts as risk communication studies have concluded that the inclusion of detailed information obscures the main points of the communication, and decreases the likelihood that the reader will retain these central ideas over both short (20 minutes) and longer (6 to 12 months) time periods (Reder & Anderson, 1982).

CWD was first identified in mule deer at a Colorado research facility in 1967 and was first identified in free-ranging cervids in Colorado in 1981 (Haley, et al., 2011; Spraker et al., 1997; Williams & Young, 1980). For decades, CWD was believed to be geographically limited to the endemic areas of Colorado, Wyoming, and Nebraska (Demarais et al., 2002). However CWD has since spread to 24 states and two Canadian provinces, and has also been exported to South Korea from Canada (Evans et al., 2014; Williams et al., 2002). Most recently, CWD has been identified in Norway (Dagleish, 2016). Nearly one-half of the U.S. states identifying CWD have done so within the last decade (Figure 1). CWD prevalence rates of greater than 35% in some free-ranging
cervid populations have been reported, with accompanying population declines of 30-50% (Almberg et al., 2011). In captive cervid herds, the prevalence rate can be near 100% (Haley, et al., 2011). Although there has been no reported causal link between CWD and human health, CWD is a fatal, infectious prion disease affecting both captive and free-ranging cervids including, white-tailed deer, mule deer, elk, reindeer, and moose (Saunders et al., 2012). Some researchers contend that CWD is likely to be become yet another wildlife-associated zoonotic disease (Jones et al., 2008; Saunders et al., 2012). As CWD spreads geographically, and as its prevalence in cervid populations increases, the likelihood that a novel strain of CWD that infects humans, either directly or through an intermediate host, also increases (Fischer et al., 2013; Saunders et al., 2012; Jennelle et al., 2009). Recent research also suggests that the so-called “species barrier effect” is not a transmission barrier per se, but instead, a roadblock that makes transmission between unrelated species difficult, but not impossible (Beringue et al., 2012; Collinge, 2012). Thus, cross-species transmission of CWD to humans may first manifest with subclinical, asymptomatic human disease carriers (Collinge, 2012). In this event, given the lack of reliable ante-mortem testing options, preventatives, treatments, or a cure, the potential devastation to public health is incalculable (Collinge, 2012; Saunders et al., 2012).

Lack of certainty relative to CWD’s ultimate effect on human health leaves government agencies to walk the proverbial tightrope relative to CWD risk communication. At the state level, wildlife management agencies often produce and publicize CWD risk communication. These communications primarily target hunters whose physical proximity to cervid habitat, excrement, live (or dead) cervids, and the
hunters’ potential exposure to CWD via carcass processing and venison consumption make them a prime at-risk group for CWD exposure. Hunters are also targeted for these communications because their respective perceptions of the health risks associated with CWD have a direct impact on their hunting participation, and, by extension, wildlife management strategies and agency revenue (Robinson et al., 2012).

Methods

The initial step in mental models research requires the construction of a comprehensive expert model (Zaksek & Arvai, 2004; Morgan et al., 2002). There are a number of methods which may be utilized to create an expert model, including: 1) the assembly method; 2) the materials/energy balance methods; 3) the scenario methods; and 4) the template method (Morgan et al., 2002). These methods, which may be used either alone, or in conjunction with each other, all use slightly different thought processes to pool, sort, and link the concepts which become part of the expert model (Morgan et al., 2002). In our case, we created two expert models: the first, a theoretical model based upon a review of the CWD-related literature (Figure 2); and the second, an actual model created by a group of scientists and wildlife management professionals during the course of a focus group conducted for that purpose (Figure 3). These models, while different, each depict key concepts relevant for individuals to make decisions relative to the potential health risks from CWD.

For the theoretical expert model, we used a combination of the assembly method and the template method. The assembly method essentially entails creating a list of relevant factors and determining how these factors relate to one another (Morgan et al.,
The template method, which has been used previously to create expert models related to the transmission of infectious diseases includes nodes related to disease exposure and effects processes (Fischhoff & Downs, 1997; Morgan et al., 2002). In our theoretical model, we also included nodes for concepts related to CWD’s identification, including which species are affected, where CWD has been identified, and the symptoms which may be associated with CWD-infected individuals.

The concepts that we included in our theoretical model were obtained from a review of 57 peer-reviewed scientific journal articles on various aspects of CWD. These journal articles were published between 1980 to 2013 and were found in journals related to: wildlife management; veterinary medicine and pathology; microbiology; virology; ecology; emerging infectious diseases; physiology; immunology; prions; zoology; vaccines; chemistry; biophysics; environmental science and health; disinfection; agriculture food and policy; and food science, among others.

We specifically reviewed and selected journal articles that dealt with a broad array of CWD-related problems, or potential problems, including, but not limited to: potential effects on wildlife, domestic animals, human health, disinfection and decontamination efforts, prions research, environmental transmission, disease testing, CWD/prion identification procedures on both live and dead cervids, and food system concerns.

From our review of these journal articles, we created a list of CWD-related risk communication concepts that involved the identification of CWD, the potential risks of exposure to CWD from either direct contact with infected cervids or a CWD prion-
contaminated environment, and the possible effects of exposure to CWD (Figure 4). The concepts on our list included both basic and specific concepts. We used this compiled list of concepts and the information obtained from our review of the CWD literature to create the theoretical expert model, including the depiction of linkages between concepts on the model. Although the science regarding CWD’s modes of transmission, spread, and effective CWD control strategies is far from certain, in creating this model, we sought to comprehensively include information which could affect CWD-related risk communication decision-making (Figure. 2).

The actual model represented a consensus model created by the focus group participants using the assembly method. To arrive at this model, the participants created a list of five broad CWD-related categories through small group and large group discussion. The five broad categories included deer population health, economic, environmental, social/cultural, and human health consequences (or potential consequences) of CWD. Thereafter, as part of a large group discussion, the participants listed, and ranked, from most-to-least important, the factors or results that they associated with each of these broader categories relative to CWD risk communication. Finally, the participants, through group discussion, arrived at a consensus regarding the relationships and relative strengths of linkages between the broad categories.

We reduced the model created by the participants to a pictorial representation that uses directional arrows to depict the relationship(s) between categories and differentiates,
with different colored nodes associated with the level of importance (red = high, yellow = mid-level, green = low) the highest, mid-level, and lowest risk communication factors (Figure 3).

In conjunction with the creation of these expert models, in September, 2013 we obtained CWD-related public health information from 22 state websites. The search for relevant state CWD risk communications was performed using the Google query “CWD” and “[X] state”, and the specific information sought came under the headings of “CWD Information”, “Frequently Asked Questions”, or “CWD Information for Hunters”. The information obtained came primarily from state wildlife management agency websites, and in one case from the state veterinarian website. In all cases, hunters were the target audience and the web pages provided information about CWD’s potential health risks and suggested hunting-related precautions.

Eleven of these states had previously identified CWD, and the remaining eleven had not (Table 1). A brief review of the information obtained from each of the 22 states was performed, and based upon this review, information from six states (three with, and three without, CWD) were selected for inclusion in this study. Iowa, North Dakota, and Texas were selected as the states with CWD because they were all states that were bordered by states that had first identified CWD at least 11 years previously (Figure 1). Kentucky, Ohio, and Vermont were selected as the states which had not identified CWD. These states were selected because, although they were CWD-free at the time, they were bordered by states which had previously identified CWD (Figure 1). Thus, arguably, these CWD-free states had a strong incentive to prevent CWD from entering their state
and may have taken particular care to broadly inform constituents in their respective CWD risk communications.

The websites from the six states were then analyzed for content relative to potential risks from CWD. Information was categorized for each state’s pertinent web page in accordance with information identified on the theoretical expert model as either basic or specific information, and as either an identification, exposure, or effects risk (Figure 4). Using this categorized information and the outline for the theoretical expert model, we developed influence diagrams for each state’s communication by highlighting the basic and specific concepts covered in each state’s communication (see Supplementary Material). We then categorized each web page in accordance with the information identified in the actual expert model to develop a second influence diagram for each state. We also noted the factually incorrect and/or materially incomplete concepts included in each states’ communication. These errors and omissions may contribute to stakeholders’ misperceptions about the potential risks from CWD (Marino & Gerlach, 1999; McComas, 2006).

Risk communication that is short and to the point more effectively conveys the intended information than those communications which are lengthy, as lengthy communications may not be fully read by the communication recipients (Noar et al., 2007). Thus, an ideal CWD risk communication should be fairly concise, and have a concept-word-to-total-word ratio as close to 1:1 as possible. We counted and annotated the total number of words for each state’s communication, as well as the total number of
“concept words” by state. We calculated a ratio for the number of concept words to total words and compared the ratios among states.

Finally, each state’s CWD-information web page was analyzed for text comprehension aids, including a title, either (or both) beginning and ending summaries, and section heading. Presence or absence of each of these aids was annotated for each state. These text comprehension aids, also referred to as “text-signaling devices”, are structural tools used in writing to focus the reader’s attention to particular aspects of written text, without adding substantive information to the text (Lorch, 1989). There is a well-documented positive correlation between the presence of these aids and memory retention relative to the text these aids highlight (Lorch, 1989; Reder & Anderson, 1982). Moreover, the “attractiveness” of the communication layout significantly affects the likelihood that the recipients will focus on the message contained therein (Bull et al., 2001; Noar et al., 2007). All work was conducted in compliance with Iowa State University IRB Approval #14-130.

Results

Theoretical model

Our theoretical model contained 41 risk communication concepts relative to potential risks from CWD (Figure 2). Of this total, 26 met our criterion for basic, or general, concepts and the remaining 15 we considered specific, or detailed, concepts. None of the states’ selected CWD risk communications addressed all 41 of the concepts;
the total number of concepts addressed by state ranged from a low of 13 (31.71%) for Kentucky to a high of 25 (60.98%) for North Dakota and Texas (mean = 21.5 ± 1.86 (SE)) (Figure 5).

This theoretical model’s basic concepts further delineated concepts involving exposure to CWD, identification of CWD, and the effects of CWD. Here again, none of the states’ selected communications addressed all of the basic concepts from this model. The number of basic concepts addressed by the states ranged from a low of 12 (KY) to a high of 23 (ND) (mean = 19.0 ± 1.59) (Table 2).

Of the basic concepts found in the theoretical model, exposure concepts accounted for the majority with 17, followed by effect concepts (6), and identification concepts (3). The basic exposure concepts covered by state ranged from a low of 7 (41.2%) for Kentucky to a high of 14 (82.4%) for North Dakota (Table 2). Four states (IA, ND, OH, TX) covered 100% of the basic effect concepts, while Kentucky and Vermont covered 50.0% and 66.7%, respectively (Figure 5; Table 2). All states but Kentucky covered 100.0% of the basic identification concepts (Figure 5; Table 2).

The theoretical model’s 15 specific concepts include 12 exposure concepts; 3 effect concepts; and no identification concepts. The states addressed comparatively few of the specific concepts, with a range of 1 (KY) to 4 (VT) (mean = 2.5 ± 0.43) (Table 2). This range accounted for 1 (6.7%) to 4 (26.7%) of the total number of specific concepts found on this model (Table 2). Iowa was the only state to address any specific effect concepts, addressing 2 of 3 (66.67%) of the total specific effect concepts found in the
model (Table 2). Relative to the model’s specific concepts, the remaining 5 states only addressed exposure concepts.

**Actual model**

Our actual model contained a total of 37 CWD risk communication factors (including 7 sub-factors) (Figure 3). The human health and economic categories had the most associated factors with nine each (economics had five factors and four associated sub-factors), followed by social/cultural with eight factors, landscape health with six (of which three were sub-factors), and finally, deer population health with five associated factors (Figure 3).

Of the nine factors associated with human health, three factors, including: 1) the age/sex of harvested cervids; 2) whether or not the harvested animal was tested for CWD; and 3) the proximity of the harvested animal to areas where CWD has been identified were considered the most important information relative to CWD risk communications (Figure 3). Information regarding the consumption of high risk cervid parts, different processing methods, and safe handling precautions were included in the intermediate level of information that should be included in CWD risk communications (Figure 3). Three additional enumerated human health factors, namely deer density, the age of the venison consumer, and future generations’ risk, while important, were not considered necessary or appropriate for CWD risk communications.

For the economics category, factors associated with decreases in the captive cervid industry, decreased cervid hunting (and its four associated sub-factors), and the increase in the proportion of tax revenue used for CWD were considered the most
important factors for risk communication (Figure 3). Mid-level factors for economics included increased health care costs and increased livestock losses (Figure 3). There were no low-level factors associated with this category (Figure 3).

The social and cultural consequences of CWD category included three factors of primary importance for risk communication: 1) the loss of hunting culture; 2) the loss of public trust in science; and 3) the loss of the ability (of wildlife management agencies) to manage cervid populations (Figure 3). Of mid-level importance were factors associated with changes in public perception relative to cervids, public devaluation of wildlife, and increased public distrust of government/experts (Figure 3). Considered the least important for inclusion in risk communication were factors associated with increased public distance from nature, and increased conflicts between jurisdictions relative to CWD’s presence or absence and differing management actions (Figure 3).

All three factors (and the three associated sub-factors) for the landscape health category were deemed important for inclusion in CWD risk communication, including information regarding increased environmental contamination, increased cross-species infection, and changes to deer population (Figure 3).

There were no low-level factors associated with deer population health (Figure 3). The three most important factors all involved CWD’s effect on deer population numbers and its 100% mortality rate (Figure 3). Slightly less important were the factors associated with CWD’s resultant change to the age/sex structure of deer populations and the importance of CWD surveillance (Figure 3).
The linkages between categories were strongest between deer population health and landscape health, and for deer population health and economics followed by deer population health and social/cultural consequences (in both directions) and landscape health and deer population health (Figure 3). The linkage between human health and economics was very strong, but as yet unproven; likewise the links between landscape health and human health, human health and economics, and landscape health and social/cultural consequences were deemed strong but as yet not fully known (Figure 3). All other linkages between categories, both known and unknown, were deemed less strong (Figure 3).

When compared to the actual model, the CWD risk communication for Texas was the only communication of the selected states’ that addressed concepts from each of the five categories (Supplemental Materials). Iowa, North Dakota, and Vermont all addressed factors in the categories of deer population health, landscape health, and human health; likewise, all three states failed to address any factors in the economic and social and cultural categories (Supplemental Materials). The Kentucky and Ohio communications only addressed factors in the deer population and human health categories (Supplemental Materials).

As compared to the actual model, the Texas risk communication did the best job of addressing the high and mid-level factors for each category (Supplemental Materials). Texas failed to address one factor of primary importance from the actual model for the deer population health, human health, economics, and social and cultural categories and one factor and two sub-factors from the landscape health category (Supplemental
Texas also failed to address one mid-level factor under deer population health, two under economics, and three under the social and cultural category (Supplemental Materials). Texas did not address any of the low-level factors from this expert model (Supplemental Materials). Overall, Texas far out-performed the other states by addressing 51% of the total concepts included in the actual model (Figure 6).

CWD risk communications for Iowa, North Dakota, and Vermont all addressed almost exactly the same factors when compared to the actual model (Supplemental Materials). North Dakota and Vermont simply addressed one additional, low-level factor in the human health category that was not addressed by Iowa. Each of these three states failed to address two high-level factors in both the deer population and human health categories; three high-level factors in the social and cultural category; five high-level factors (including three sub-factors) in the landscape health category; and seven high-level factors (including four sub-factors) in the economics category (Supplemental Materials). With the exception of deer density, a low-level factor under the human health category which was addressed by North Dakota and Vermont, these states did not address any other low-level factors (Supplemental Materials). Iowa, North Dakota and Vermont represented the mid-range states relative to the total number of concepts covered in their communications, as compared to the actual model, with 19%, 22%, and 22%, respectively (Figure 6).

Kentucky and Ohio communications each addressed a total of five factors in the deer population and human health categories (Supplemental Materials). Kentucky addressed only one of the mid-level factors under deer population health and none of the
high-level factors (Supplemental Materials); Ohio addressed the same mid-level factor and one of the three high-level factors (Supplemental Materials). In the human health category, Kentucky and Ohio both addressed one of three high-level factors (Supplemental Materials). Ohio also addressed two of three mid-level factors and Kentucky addressed all three mid-level factors under human health (Supplemental Materials). Neither Kentucky nor Ohio addressed any of the low-level factors under any category (Supplemental Materials). The CWD risk communications of Kentucky and Ohio each covered the lowest number of concepts included in the actual model with 14% each (Figure 6).

**Additional state communication content evaluation**

The word count for the individual states’ CWD risk communications ranged from a low of 770 (KY) to a high of 2169 (ND) (mean = 1397.5 ± 221.85). Of the total words, the number of “concept words” ranged from 368 (KY) to 1167 (ND) (mean = 638.17 ± 129.58). The ratio of concept words to total words ranged from 1:1.86 (ND) to 1:3.36 (OH) (mean = 1:2.30 ± 0.22).

All of the states’ selected CWD risk communications contained factually incorrect and/or materially deficient information, ranging from a low of 4 items (ND, TX, VT) to a high of 6 items (IA, KY) (mean = 4.83 ± 0.40) (Table 3).

Text of the states’ selected CWD risk communications were analyzed for text comprehension aids, including titles, beginning summaries, ending summaries, and section headings. None of the states utilized all of these text comprehension aids. The
usage of these aids ranged from 2 (IA, KY, OH, VT) to 3 (ND, TX) (mean = 2.33 ± 0.21). Section headings and titles were used in all 6 states’ communications.

Discussion

Comparison of expert models

Our theoretical model represents a compilation of the relevant basic and specific concepts taken from the peer-reviewed literature on CWD. This model delineated these basic and specific concepts and showed their interrelationships. This information then provided the basis for analyzing the states’ selected CWD risk communications for their inclusion or exclusion of relevant content upon which stakeholders can make an informed decision regarding the potential risks and benefits associated with cervids, hunting, and spending time in environments utilized by cervids (Morgan et al., 2002). Successful risk communication will provide stakeholders with the necessary information, without providing unnecessary details (Fischhoff, 1995). Thus, ideally, the states’ CWD risk communication will include all or a majority of the basic information concepts from the theoretical expert model, and few, if any, of the specific concepts from the model.

Similarly, our actual expert model is a consensus model that includes high, mid, and low-level factors associated with five broader CWD categories. Under this model, CWD risk communications should contain all of the high-level factors, some of the mid-level factors, and none of the low-level factors to be considered successful (Fischhoff, 1995). It is important to note that while the two models have many similarities, there are also numerous differences between them, including their respective levels of detail and focus (Figure 2; Figure 3). These differences are particularly interesting when one considers
that much of the literature that was the basis of the theoretical model was written by the experts who created the actual model.

Moreover, although the small sample size used in this study is not widely generalizable to the CWD risk communications for all 50 states, the disparity between the number of concepts or factors from the expert models that were addressed by the selected states’ communications suggests that such a disparity may be pervasive. However, absent a review of all 50 states’ published CWD risk communications, we can reach no conclusion on the pervasiveness of the disparity between published state CWD risk communications.

**Comparison of models to selected states’ web content**

Broad disparity was found in this study involving the number of basic exposure concepts from the theoretical model that were addressed by each state. The basic exposure concepts not addressed by states is both interesting and, in some cases, a bit alarming. For example, while three states (ND, TX, KY) noted, or at least indirectly referenced, the fact that disinfection or decontamination of CWD prions is very difficult (Saunders et al., 2012); the remaining three states (IA, OH, VT) made no clear reference to this concept. Iowa and Kentucky also failed to mention that there is no preventative vaccine, treatment, or cure for CWD (Cullingham et al., 2011; Williams et al., 2002). Kentucky, Ohio, and Vermont failed to reference the fact that CWD prions persist long-term in the environment, and remain viable for disease transmission (Walter et al., 2011; Miller et al., 2004). Iowa, Kentucky, and Texas did not discuss the long incubation period associated with CWD (Gilch et al., 2011).
Kentucky singularly failed to address six other basic exposure concepts, all of which would arguably be considered particularly relevant for hunters. Specifically, Kentucky failed to advise its constituents that: 1) CWD prions are known to exist in various tissues and fluids in cervids, in addition to central nervous system and lymphoid tissues most commonly associated with prion diseases (Sanders et al., 2012); 2) the symptoms commonly associated with cervids infected with CWD are not CWD-specific, and may also be associated with other diseases (Saunders et al., 2012); 3) high cervid densities, often associated with feeding and baiting, are believed likely to contribute to the spread of diseases in cervid populations, including CWD (Dunkley & Cattet, 2003; Sorensen et al., 2014); 4) transmission of CWD may be through direct animal-to-animal contact (Sanders et al., 2012); 5) transmission of CWD may also be indirect through contact with environmental prion reservoirs (Sanders et al., 2012); and, perhaps the most surprising omission, 6) to date, there is no reported direct causal link between CWD and human health (Barria et al., 2014; Belay et al., 2004). Conversely, CWD risk communications from the remaining five states in this study addressed, at least indirectly, these six basic exposure concepts, although Iowa’s content relative to the “ubiquitous” nature of CWD prions in infected individuals was seemingly contradictory on this point (Sanders et al., 2012).

Kentucky’s omissions may also affect hunters and other stakeholders far outside Kentucky because a disparity in risk communication messages between and amongst states may undermine all states’ CWD risk communication, with a resultant loss of faith in the information conveyed (Fischhoff, 1995; Gilk, 2007). Hunters, the target audience of most state wildlife management agencies’ CWD risk communication, are directed to
research the CWD status and hunting protocols of other states before travelling to hunt. This suggests that disparities in message between a hunters’ home state and a proposed hunting state could trigger just such a loss of faith.

Also problematic was the factually incorrect and/or incomplete information found in all of the selected states’ risk communications. For example, none of the selected states correctly listed all places where CWD had been identified; three states (IA, OH, VT) failed to note the difficulties associated with prion decontamination; and Kentucky and Ohio failed to advise constituents that CWD prions are found in other tissues in addition to brain, central nervous system, and lymph nodes. As with Kentucky’s other material omissions, this lack of consistency and accuracy may also contribute to discounting of all states’ communication by information recipients (Fischhoff, 1995; Gilk, 2007).

While there are some commonalities between the two expert models, the actual model includes broader, more interrelated categories and associated factors than the theoretical model. Texas was the only one of the six selected states that addressed factors associated with all five of the broad categories included in the actual expert model in its CWD risk communication. The risk communications of the remaining five selected states were characterized by a lack, or near lack, of any communication relative to the landscape health, economics, and social or cultural categories included in the actual expert model. This suggests that many states may fail to include, or follow, expert recommendations when designing their CWD risk communication.
State content and the absence or presence of CWD in the state

In selecting the six states for inclusion in this study, we specifically sought to include both states which had, and states which had not, identified CWD within their borders. For the CWD-free states, we specifically included states that were bordered by states which had identified CWD because we hypothesized that this proximity would result in more robust CWD risk communication in these states, with the further expectation that the CWD risk communications from all six states would thus be fairly consistent. The results for all six states were more consistent in terms of the total number of concepts addressed for the theoretical model (Figure 5) than for the actual model (Figure 6). There was also broad disparity in both models between the state(s) which addressed the most concepts and the state(s) which addressed the least concepts (Figure 5; Figure 6). In both models, the state(s) addressing the most concepts had identified CWD and the state(s) identifying the least number of concepts had not identified CWD (Figure 5; Figure 6). However, for the states included in our study, the presence or absence of CWD was not a clear indicator of the quality and comprehensiveness of the state’s CWD risk communication. Moreover, the spatial proximity of the CWD-free states to states which had previously identified CWD does not have a clear, discernable impact on the CWD-free states’ respective CWD risk communications.

Risk communication mechanics and structure

Successful risk communication should be presented in ways that buttress the credibility of the risk communicator, by including appropriate communication mechanics and structure, and by being candid with the intended audience (Fischhoff, 1995; Morgan et al., 2002). Communications which are poorly structured, or otherwise unclear, too
advanced for the intended audience, or that are otherwise inaccessible, do not buttress the communicator’s credibility (Morgan, et al., 2002; Schwartzman et al., 2011).

An analysis of the selected states’ CWD risk communications for text comprehension aids, word count, and concept word-to-total word ratios yielded the following results: Texas, which along with North Dakota employed the most text comprehension aids, produced a “Chronic Wasting Disease Fact Sheet” that appeared “neater and cleaner” and better organized than the other states’ communications. Moreover, although four other states (IA, KY, ND, VT) had lower concept word-to-total word count ratios, Texas’s concept word-to-total word ratio was only slightly above the mean, and the total word count was well below the mean. What really set the Texas communication apart from those of the other selected states was the short, two-paragraph, beginning summary which provided both information and a “roadmap” of the communication’s content. Although not addressed elsewhere in the document, this beginning summary also included information regarding the economic impact of hunting on the Texas economy.

North Dakota’s CWD risk communication was the longest (2169 word count), and had the lowest concept word-to-total word ratio of 1:1.86. North Dakota was credited with three text comprehension aids, however, North Dakota’s beginning summary was arguably not as well-written, organized, or effective as the Texas beginning summary. North Dakota’s communication also included an incredible amount of detail relative to specific wildlife management units and counties in all states which had identified CWD. While this information could be useful to some hunters seeking to
travel to other states to hunt because it provides “one-stop shopping” for this information, the fact that the communication specifically directs hunters to obtain updated information directly from the proposed hunting jurisdiction suggests that the currency of this information is not regularly maintained. The level of detail and specificity that this information adds to North Dakota’s risk communication also implicates some of the concerns relative to the over-inclusion of specific content referenced previously.

From a successful risk communication standpoint, however, North Dakota’s communication is problematic. Although it is clear that substantial effort was made to convey the risk information at a level accessible to the intended audience, certain parts of the communication include reference, without further explanation, to “ELISA testing on lymph nodes”, “immunohistochemistry testing of obex portions of the brain stem”, “causal links”, “pathological studies”, and “maintaining epidemics”. Much of this information, which includes highly technical terminology, may be too advanced for some of the intended audience, and thereby reduce the effectiveness of the communication as a whole (Schwartzman et al., 2011).

State CWD risk communication and candor

Vermont and North Dakota took a more candid approach to their discussion of the zoonotic potential of CWD than did the other selected states by providing details of the potential public health threat. Conversely, while most of the other selected state communications advised caution when handling cervid carcasses, they also highlighted the fact that CWD, unlike its bovine counterpart, Bovine Spongiform Encephalopathy (BSE), has not been conclusively linked to humans. Although both Vermont and North
Dakota clearly noted that the World Health Organization and the Centers for Disease Control had found no direct link between CWD and humans, North Dakota alerted its constituents that three suspected cases of CWD in humans had been investigated; Vermont provided information implicating CWD’s potential to adapt to new species, and went on to advise Vermonters that, pending greater scientific certainty about CWD’s potential risk to humans, the best approach was to avoid eating sick appearing cervids, or those originating from areas of the country that had identified CWD. Vermont’s recommendations for caution contrasted sharply with Ohio’s communication which praised the health benefits associated with eating venison, and emphasized the lack of health warnings, illnesses, or deaths associated with its consumption.

However, even those states that did not directly reference concerns about CWD’s zoonotic potential, indirectly referenced those concerns by advising their constituents of at least some of the following: 1) not to eat meat from sick-appearing animals; 2) to take safety precautions when handling cervid central nervous system and lymphoid tissue; 3) to wear protective gloves when handling cervid carcasses; 4) to clean and disinfect equipment used on carcasses (in some cases specifically referencing soaking in a 50% bleach solution); and 5) to keep utensils used on carcass processing separate from household utensils. Their message inconsistencies regarding the potential health risks to humans from CWD, both within a specific state’s risk communication, and between and among the communications produced by different states, may create distrust within the intended audience for all governmental CWD risk communication (Stafford et al., 2006; Vaske & Lyon, 2011). Even so, given the current scientific uncertainties surrounding CWD’s zoonotic potential, providing too much information now may also unnecessarily
create a perception of risk that could have far-reaching social, public health, wildlife management, and economic ramifications which ultimately, may, or may not, be justified.

Scientific insufficiency and risk communication

The current insufficiency of scientific knowledge about the CWD-human health relationship does not suggest that we have no knowledge; however, it does have implications for risk communication because the amount and type of knowledge that we do have is deemed inadequate to clearly illuminate the risk, and thus the necessary, or appropriate, risk communication content requirements (Rogers, 2003). This inadequacy may explain the ambiguity and disparity present in the selected states’ CWD risk communications.

According to Rogers (2003), there are three different types of uncertainty: 1) uncertainty in the effect; 2) uncertainty in the cause; and 3) uncertainty in the relationship between the hazard and the harm. The link between CWD and human health suggests the third type of uncertainty. The Precautionary Principle, a rule of law adopted by Europe in 1992, and used by the United Nations Framework Convention on Climate Change in international climate change agreements, is utilized to take action in advance of scientific certainty on the exact relationship between the hazard and harm in order to avoid an undesirable danger (Osofsky & McAllister, 2012; Rogers, 2003).

Rogers (2003), among others, contend that there are different levels to the Precautionary Principle, ranging from “weak” or “modest” to “very strong” or “aggressive” (Maguire & Ellis, 2009). For Precautionary Principle proponents, the “weak” level justifies action, but does not require it; the intermediate level requires
action; and the “very strong” level shifts the burden of proof to the risk-generator to show why the potentially risky action should be permitted (Rogers, 2003).

Given the potential public health risks from CWD, and the demonstrated concern that many hunters have expressed relative to this issue, adoption of the intermediate level of precaution relative to CWD is arguably justifiable (Vaske and Lyon, 2011). To that end, communications designed utilizing the mental models approach to inform the general public about the potential risks from CWD would also arguably permit communication recipients to make better informed decisions relative to actions that they may choose to undertake, and would satisfy established Precautionary Principle aims to reduce the likelihood of risks/harms, even in the absence of scientific certainty (Sunstein, 2005; Rogers, 2003).

That said, the Precautionary Principle is not without its critics. The current scientific knowledge concerning the relative risk to the public associated with a disease like CWD does not warrant government action based upon nebulous and divergent public fears and values about the disease and its potential risks (Sunstein, 2005). Sunstein (2005) further contends that the media and social interactions exacerbate the problem by bringing relatively low-risk issues to the public consciousness, with the result that these issues are often associated with higher degrees of risk than may be warranted. Thus, CWD risk communications published by state wildlife management and other agencies that adopt a precautionary approach to CWD and include more information about the potential public health risks would, in Sunstein’s (2005) view, create a public risk perception problem where none actually exists. Moreover, under this view, the adoption
of the Precautionary Principle in response to CWD amounts to a mandate for the complete, or nearly complete, avoidance of all risks that may be associated with CWD (Sunstein, 2005). In an analogous case involving Italy’s proposed ban on GMO corn, where no evidence of a health risk to people or animals was shown, the European Court of Justice held that the potential for danger, without more, is insufficient to adopt a precautionary approach (Sunstein, 2005).

**Other CWD risk communication considerations**

Successful risk communication is tailored to address stigmatization, social amplification of risk, and the role that the media plays in risk communication (Kasperson et al., 2003). An in-depth examination of these issues, while critical for successful risk communication, was beyond the scope of this study.

The broad utility of this study is also limited because we analyzed CWD risk communications obtained primarily from state wildlife management agencies with hunters as their target audience. As a group, hunters are most typically older, white males (Adams et al., 2000). Research into 1) whether or not these agency CWD risk communications are generally accessed by, or otherwise “available” to non-hunters; 2) whether the information is useful to non-hunters; and 3) whether or not the “white male effect” in risk communication is a factor would provide useful information (Finucane et al., 2000).

A second, and somewhat related, issue involves the fact that CWD also has the potential to impact non-hunters, including hunters’ friends and family, cooks/chefs, taxidermists, meat processors, venison eaters (including low-income recipients of venison...
in state-sponsored venison donation and distribution programs), and others. Thus, a more robust study would thoroughly examine whether or not state wildlife management agency CWD risk communications, or other governmental communications, specifically and effectively target and reach non-hunter audiences.

Lastly, wildlife management agencies are caught between the proverbial “rock and hard place” with respect to CWD risk communication. On the one hand, their mission includes educating the public on wildlife-related issues (Eschenfelder & Miller, 2007). On the other hand, these agencies typically rely on hunters for both revenue and cervid population management; to the extent that CWD risk communication negatively impacts hunter participation, agencies may lack funding to manage both game and non-game species (Bishop, 2004; Decker et al., 2011).

Numerous studies which have examined the effect of CWD on hunters have concluded that there is an inverse relationship between hunters’ perceptions of the risks associated with CWD and hunting, such that as perceptions of risk increase, one can also expect a corresponding decrease in cervid hunting in many instances (Vaske & Lyon, 2011). The two factors found to contribute most significantly to hunters’ perceptions of CWD-associated risk, and thus signal accompanying changes in hunting behavior and frequency, are: 1) high CWD prevalence; and 2) human deaths from CWD (Vaske and Lyon, 2011). Thus, agency CWD risk communications which more clearly articulate the potential human health risks from CWD, such as those identified from North Dakota and Vermont, are arguably more likely to have a deleterious impact on cervid hunting in at
least some states (Decker et al., 2011). In other states, however, this does not appear to be the case (Gigliotti, 2004).

**Conclusion**

The underlying seminal issue with respect to CWD risk communication is whether, or where, to draw the line regarding informing the public about the potential risks from a disease which is not, at least yet, considered zoonotic. Although the expert models developed using the mental models approach should provide guidance on this question, experts may disagree, and the ethical, social/cultural, economic, and deer, landscape, and public health considerations – both for and against a broad and wide dissemination of information - are substantial. Moreover, this issue has implications for a host of potential emerging infectious diseases beyond CWD.

**References**


Figure 1. Map showing current (2016) North American states and provinces that have identified CWD.
Basic concept
Specific concept

Arrows used to depict interrelationships between concepts

Figure 2. Theoretical Expert Model.
important factors or sub-factors in CWD risk communication

factors of mid-level importance in CWD risk communication

factors of low-level importance in CWD risk communication

Arrows used to depict interrelationships, strength of the relationship, and relative certainty of the relationship between different factors or concepts

Figure 3. Actual Expert Model.
Figure 4. Concepts categorized as identification, exposure, and effect in theoretical model.
Table 1. List of states for which preliminary website review was conducted for content analysis.

<table>
<thead>
<tr>
<th>STATES WITH CWD</th>
<th>STATES WITHOUT CWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado</td>
<td>Alabama</td>
</tr>
<tr>
<td>Illinois</td>
<td>Arizona</td>
</tr>
<tr>
<td>Iowa*</td>
<td>Arkansas†</td>
</tr>
<tr>
<td>Kansas</td>
<td>Connecticut</td>
</tr>
<tr>
<td>Michigan</td>
<td>Idaho</td>
</tr>
<tr>
<td>Missouri</td>
<td>Kentucky*</td>
</tr>
<tr>
<td>North Dakota*</td>
<td>Nevada</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>North Carolina</td>
</tr>
<tr>
<td>South Dakota</td>
<td>Ohio†</td>
</tr>
<tr>
<td>Texas*</td>
<td>Oregon</td>
</tr>
<tr>
<td>Virginia</td>
<td>Vermont*</td>
</tr>
</tbody>
</table>

*States included in our study
†States where CWD has subsequently been identified
Figure 5. Comparison of percentage of total concepts covered (by state) to theoretical expert model.
Figure 6. Comparison of percentage of total concepts covered (by state) to actual expert model.
Table 2. State-by-state comparison of concepts utilized by each state relative to theoretical model.

<table>
<thead>
<tr>
<th></th>
<th>Iowa</th>
<th>North Dakota</th>
<th>Texas</th>
<th>Kentucky</th>
<th>Ohio</th>
<th>Vermont</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Concepts (total by state):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure</td>
<td>18</td>
<td>23</td>
<td>22</td>
<td>12</td>
<td>20</td>
<td>19</td>
<td>19 ± 3.90</td>
</tr>
<tr>
<td>Identification</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2.83 ± 0.41</td>
</tr>
<tr>
<td>Effects</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>5.17 ± 1.33</td>
</tr>
<tr>
<td><strong>Specific Concepts (total by state):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2.5 ± 1.05</td>
</tr>
<tr>
<td>Identification</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 ± 0</td>
</tr>
<tr>
<td>Effects</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.33 ± 0.82</td>
</tr>
<tr>
<td><strong>Total Concepts Covered (by state):</strong></td>
<td>20</td>
<td>25</td>
<td>25</td>
<td>13</td>
<td>23</td>
<td>23</td>
<td>21.5 ± 4.55</td>
</tr>
</tbody>
</table>
Table 3. List of factually incorrect or materially incomplete concepts referenced in the selected state communications.

<table>
<thead>
<tr>
<th>Concept</th>
<th>IA</th>
<th>ND</th>
<th>TX</th>
<th>KY</th>
<th>OH</th>
<th>VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to advise that CWD prions are found in tissues other than the brain, eyes, spinal cord, lymph nodes, tonsils and spleen</td>
<td>***</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Failure to advise that CWD prions are highly resistant to disinfection/decontamination</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Indicates that there is no “live-animal” test to detect CWD</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Failure to identify all jurisdictions where CWD has been identified</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Failure to identify all U.S. states where CWD has been identified</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X**</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Inaccurate chronology of CWD discovery in U.S.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrectly identifies known “naturally susceptible” species (fails to list all)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inaccurately identifies percentage of infected cervids in endemic areas</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to advise that no vaccine, treatment, or cure for CWD exists</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to address long-term prion viability in the environment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to advise that CWD/prion diseases are associated with long incubation periods, during which infected individual may remain asymptomatic but still transmit the disease</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Morgan et al. (2002).

**Kentucky does not specifically identify any other states except those bordering Kentucky, but, instead, provides a link to USGS.

***Iowa provided seemingly contradictory information on this point.
Figure 7. Comparison of Iowa CWD risk communication to theoretical model.
Figure 8. Comparison of Kentucky CWD risk communication to theoretical model.
Basic concept
Specific concept
or factor or concept covered in state’s CWD risk communication

Arrows used to depict interrelationships between concepts

Figure 9. Comparison of Ohio CWD risk communication to theoretical model.
Figure 10. Comparison of North Dakota CWD risk communication to theoretical model.
Basic concept
Specific concept

or concept covered in state’s CWD risk communication

Arrows used to depict interrelationships between concepts

Figure 11. Comparison of Texas CWD risk communication to theoretical model.
Figure 12. Comparison of Vermont CWD risk communication to theoretical model.
or important factors or sub-factors in CWD risk communication

factors of mid-level importance in CWD risk communication

factors of low-level importance in CWD risk communication

or factor or concept covered in state’s CWD risk communication

Arrows used to depict interrelationships, strength of the relationship, and relative certainty of the relationship between different factors or concepts

Figure 13. Comparison of Texas CWD risk communication to actual model.
or important factors or sub-factors in CWD risk communication

factors of mid-level importance in CWD risk communication

factors of low-level importance in CWD risk communication

factor or concept covered in state’s CWD risk communication

Arrows used to depict interrelationships, strength of the relationship, and relative certainty of the relationship between different factors or concepts

Figure 14. Comparison of Iowa CWD risk communication to actual model.
important factors or sub-factors in CWD risk communication

factors of mid-level importance in CWD risk communication

factors of low-level importance in CWD risk communication

factor or concept covered in state’s CWD risk communication

Arrows used to depict interrelationships, strength of the relationship, and relative certainty of the relationship between different factors or concepts

Figure 25. Comparison of North Dakota CWD risk communication to actual model.
important factors or sub-factors in CWD risk communication

factors of mid-level importance in CWD risk communication

factors of low-level importance in CWD risk communication

factor or concept covered in state’s CWD risk communication

Arrows used to depict interrelationships, strength of the relationship, and relative certainty of the relationship between different factors or concepts

Figure 16. Comparison of Vermont CWD risk communication to actual model.
or important factors or sub-factors in CWD risk communication

factors of mid-level importance in CWD risk communication

factors of low-level importance in CWD risk communication

factor or concept covered in state’s CWD risk communication

Arrows used to depict interrelationships, strength of the relationship, and relative certainty of the relationship between different factors or concepts

Figure 37. Comparison of Kentucky CWD risk communication to actual model.
important factors or sub-factors in CWD risk communication

factors of mid-level importance in CWD risk communication

factors of low-level importance in CWD risk communication

factor or concept covered in state’s CWD risk communication

Arrows used to depict interrelationships, strength of the relationship, and relative certainty of the relationship between different factors or concepts

Figure 48. Comparison of Ohio CWD risk communication to actual model.
CHAPTER 4. EVALUATING STAKEHOLDER KNOWLEDGE AND PERCEPTIONS OF CHRONIC WASTING DISEASE (CWD)

To be submitted to Human Dimensions of Wildlife.

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Abstract

We hypothesized that current CWD risk communication methods fail to reach many relevant stakeholders. Moreover, the majority of research investigating public knowledge, concerns, and informational needs about CWD is focused on hunters. We elected to evaluate two previously unstudied groups, farmers and rural landowners, and STEM graduate students, regarding their knowledge and informational needs relative to CWD using the mental models approach to risk communication. While we found widespread general familiarity with the term “CWD”, very few participants were knowledgeable about the particulars of the disease and the potential for human health risks. Both stakeholder groups were nearly evenly split in their support for and opposition to widespread dissemination of CWD risk information beyond that currently publicized by state wildlife management agencies. Those supporting widespread publication focused on the individual rights and autonomous, informed decision-making. Reasons for opposing dissemination varied, but concerns about the impact on hunters and hunting predominated.
Introduction

Risk communications concerning the transmissible spongiform encephalopathy affecting cervids (deer, elk, and moose), namely, CWD, and the potential public health consequences, are primarily disseminated by state wildlife management agencies (Eschenfelder & Miller, 2007). The target constituent of these agencies are hunters. Moreover, the majority of research investigating public knowledge, attitudes, and concerns regarding CWD, i.e., the human dimensions aspects of CWD, have focused on hunters (Vaske, 2010).

We hypothesized that the primary risk communication methods currently employed result in a large number of relevant, but underserved, stakeholder groups which may include home cooks, restauranteurs, venison consumers, meat processors, taxidermists, farmers, and rural landowners, among others. We elected to focus our research on two distinct, but previously unstudied stakeholder groups. Our first group included Iowa State University STEM graduate students, primarily from the Sustainable Agriculture and Natural Resources Ecology & Management (NREM) areas of study. We intentionally included NREM graduate students because we hypothesized that, given their field of study, they would be the students most likely to have prior information and opinions about CWD. We also hypothesized that graduate student-hunters would also be likely to have prior information and opinions about CWD. We selected Sustainable Agriculture graduate students because we anticipated that many of them will pursue post-educational careers in agriculture-related fields, which recent research indicates has CWD-related relevance.
Specifically, CWD research has determined that CWD prions, which are shed by live cervids or their carcasses, may remain in the soil or environment, and continue to be infectious for a number of years (Wyckoff, et al., 2016). These prions may also be absorbed from the soil by plants and thus be identified in, and infectious via, plant tissues (Pritzkow et al., 2015); this has clear infectivity implications for cervids grazing on agricultural crops, grasses, or forbs planted or growing in soil harboring CWD prions, and may have similar implications for other species that graze on plants, or their predators, now or in the future (Saunders et al., 2012). Given that agriculture is Iowa’s most important industry, and that farmers and rural landowners are included in what we contend are a relevant, but an underserved CWD risk information stakeholder group, we elected to include farmers and rural landowners from North-Central Iowa as our second study group.

The field of risk communication is relatively new, and in practice, if not in theory, is still evolving from the top-down approach initially employed, and arguably favored by, government officials and subject matter experts (Fischhoff, 1995). The risk communication practices of the British and Canadian governments relative to bovine spongiform encephalopathy (BSE), the cattle-infecting disease in the same class as CWD, provide valuable lessons and reminders on risk communication pitfalls (Leiss & Powell, 2004a; Leiss & Powell, 2004b).

**Risk communication: The evolution of a field**

In its infancy, the chasm that existed between the risk experts and the general public in the field of risk communication can most succinctly be described as the
difference between quantitative expert opinions and qualitative public perceptions. Frustrated experts failed to grasp how the general public could look at the same data – for example, the likelihood that one would die as the result of a nuclear accident as opposed to one dying in an automobile accident – and walk away with what experts considered an unrealistic fear of nuclear power plants, when, statistically, someone is much more likely to die in a car accident. Suffice it to say, the top-down approach to risk communication was unsuccessful (Fischhoff, 1995; Leiss, 1996).

Advances in the field came with contributions from research in the fields of psychology, sociology, and communications, among others, which showed that the public’s assessment of risk is based upon different definitions and considerations than those of the experts (Slovic, 1987). More specifically, public perceptions of risk and benefit are influenced by factors such as perceived controllability, familiarity with the risk, catastrophic potential, equity, and level of knowledge (Slovic, 1987). Thus, contrary to expert assumptions, Slovic (1987) found that for members of the lay public, perceptions regarding the riskiness of an event, activity, or technology are not based exclusively on considerations of the number of likely fatalities and the likelihood (probability) of the risk event. Instead, these perceptions are related on two dimensions to what Slovic (1987) called “dread risk” (how controllable and catastrophic the risk is perceived to be), and “unknown risk” (the perceived novelty, immediacy, and observability of the risk). A high “dread risk” hazard has been shown to be particularly useful in predicting public attitudes and behaviors relative to that risk (Peters, Burraston, & Mertz, 2004; Slovic, 1987). More recently, the field has evolved with the realization that, for the general public, risk perceptions are colored by both cognitive and affective or
emotional risk processing dimensions, as well as social and behavioral considerations, and issues of trust in government and industry officials (Johnson, 1987; Kasperson et al., 1988; Slovic, 1993; Slovic et al., 2004). Thus, successful risk communication strategies are those which, simply put: 1) seek to regularly engage with the public on an issue; 2) provide information, including uncertainties, in a way that is useful for the public; 3) understand and address public concerns, questions, and biases; and 4) create an atmosphere of credibility and trust between the public and risk communicator (Leiss & Powell, 2004a; Morgan et al., 2002).

**Risk communication: Lessons from Bovine Spongiform Encephalopathy (BSE)**

Although BSE was first detected in the British cattle population in 1986, it was not until 1996, after ten deaths in Britain were deemed “most likely” attributable to consumption of BSE-infected beef, that the general public was informed of the human health risks from BSE by the British government (Leiss & Powell, 2004b). During the intervening decade, the British government had focused on eliminating BSE from their cattle herds by: 1) making BSE a reportable disease; 2) banning ruminant offal in cattle feed; and 3) destroying all cattle (and milk from cattle) suspected of having BSE (Leiss & Powell, 2004b). To that end, by November 1996, 166,380 cases of BSE had been reported at more than 32,000 British farms (Leiss & Powell, 2004b). During this same decade, and despite growing evidence to the contrary, the British government steadfastly maintained that there was “no risk” to human health posed by consuming meat and dairy products from BSE-infected cattle (Leiss & Powell, 2004b). The government’s adherence to the “no risk” message, even in the face of contradictory evidence, has been categorized as the “politicians’ [unwise choice] to exploit the unavoidable uncertainties
in the ongoing scientific detective work to justify an appalling lack of concern about the seriousness of the emerging risk factors” (Leiss & Powell, 2004b).

In addition to the public health consequences, there were significant economic costs associated with BSE in Britain and the European Union (Leiss & Powell, 2004b). These costs have been estimated to number in the billions of dollars (Leiss & Powell, 2004a; Leiss & Powell, 2004b).

Similarly, and despite the fact that the estimated small number of cases of BSE in the Canadian cattle herds arguably presented more of an economic concern than a human health concern, from 1997 to 2003, in reliance upon poor, or absent, risk evaluations from the Canadian Food Inspection Agency, the Canadian government assured the Canadian general public and beef producers, as well as its’ international beef importers, that the risk of BSE in Canadian cattle herds was “negligible” (Leiss & Powell, 2004c). Thus, when, despite the minimal surveillance efforts undertaken by the Canadian government, the first case of BSE was identified in the Canadian cattle herd in May, 2003, the market for Canadian beef fell like the proverbial “house of cards” (Leiss & Powell, 2004c). As of November, 2003, direct and indirect economic losses resulting from the first identified case of BSE in Canada were estimated at over $5 billion, and growing (Leiss & Powell, 2004c).

BSE presents as a three-pronged risk, i.e., a risk to animal health, human health, and economic health (Leiss & Powell, 2004c). Even so, the British and Canadian governments’ actions relative to communicating with the general public about the potential risks associated with BSE has aptly been described as a “risk information
vacuum” (Leiss & Powell, 2004d). In this vacuum, there was little or no effort made to regularly engage with and update the general public on the risks; thus, information “leaks” were subject to varied interpretations, if the information was received at all (Leiss & Powell, 2004d).

**Risk communications and CWD**

State wildlife management agencies’ efforts to communicate with their constituents about CWD are laudable. They are also inadequate. Infrequently revised risk information posted on a website does not equate to “engaged” public risk communication. Even wildlife management agencies in states that, like the agency in Iowa, hold “town hall” meetings when CWD is identified in yet another location in the state, are not meeting the level needed for engaged communication, particularly since there are underserved stakeholder groups with informational needs that remain unaddressed. This burden, however, should not fall squarely upon the shoulders of the wildlife management agencies.

Instead, public health risk communication about CWD, which like BSE could present as a multiple-pronged risk, should be the primary responsibility of the appropriate national agencies, including the U.S. Department of Agriculture, the U.S. Department of the Interior, and national public health agencies. Moreover, as the evolution of the field of risk communication and the BSE communication failures show, information provided to the general public should be comprehensive and frequent, despite the uncertainties relative to CWD’s zoonotic potential.
In our study, we used the mental models approach (MMA) to risk communication. This approach requires that risk communication recipients be provided with the information necessary for them to make an informed decision, and that the information provided corrects recipients’ misinformation about the particular risk (Atman et al., 1994). More specifically, the MMA seeks to systematically determine: 1) what information the audience knows (their existing “mental model”); 2) what information the audience needs; 3) how best to communicate the needed information to the target audience; and 4) whether or not the communication accurately conveyed the risk information as intended (Morgan et al., 2002).

Methods

The primary goals of this portion of our research were to: 1) determine the level of familiarity with, and knowledge about CWD by the participants; and 2) determine what the participants, both individually and as a group, felt was appropriate relative to CWD risk communication. To elicit this information, we conducted, recorded, and transcribed a 90-minute focus group interview with Iowa State University graduate students; we also conducted, recorded, and transcribed individual and small-group interviews with farmers and rural landowners from North-Central Iowa.

For the graduate student focus group, we recruited ten individuals by sending out emails to both the Sustainable Agriculture (SusAg) and Natural Resources Ecology (NREM) and Management Iowa State University graduate student list servers asking for a 1.75 hour focus group participation commitment over lunchtime. Lunch was offered as an incentive for participation. We had five graduate students from NREM who agreed to
participate in the focus group; we have four student participants from SusAg, and we also had one graduate student from another STEM discipline who volunteered to participate. These graduate students varied by age, sex, and ethnicity, and included both M.S. and Ph.D. students from Iowa and various regions of the U.S. They were all members of STEM graduate programs, and, in addition to NREM and SusAg, other represented disciplines and cross-disciplines included Ecology and Evolutionary Biology, Sociology, Rural Sociology, Environmental Science, Community and Regional Planning, and Ecology Evolution and Organismal Biology.

The farmer and rural landowner interviews were conducted either on-farm or at other places of business, at times and places convenient to the farmer or landowner. We recruited individuals by going to a local grain elevator in North-Central Iowa that has a regular group of local farmers that get together for coffee every morning. A couple of the farmers we met at the grain elevator agreed to participate; others declined to participate, but some suggested other local farmers and landowners that might be willing participants. We made telephone calls and farm visits to recruit other farmer and rural landowner participants. The seven participants that we recruited varied by age and sex, with different farming interests and backgrounds, although row-crop agriculture, primarily corn and soybeans, predominated.

Transcripts of the recorded interviews were coded, categorized, and analyzed for emergent patterns and themes (Saldaña, 2015). We also prepared and administered a brief written survey to each focus group participant immediately prior to conducting the group or individual interviews. These surveys were designed to elicit information relative to general demographic information and the participants’ experiences,
knowledge, and perceptions about wildlife, its management, and associated public health risks, “traditional” hunting, venison handling and eating, cervid farming, enclosed hunting, and published CWD-related information. We primarily used open-ended questions and a series of items that used 5-point Likert scales in the survey. Open-ended questions were condensed and categorized. Likert responses were collated and analyzed by individual question and theme. These results were then compared to demographic and other collected data. All work was conducted in compliance with Iowa State University IRB Approval #14-130.

Results

Graduate students

We conducted a focus group interview with ten graduate students. The group included both males (n = 2) and females, as well as hunters (n = 3) and non-hunters. Six of ten participants (60%) indicated that they ate venison regularly; these participants reported eating varying amounts of venison, ranging from between 5 – 75% of their respective total meat consumption. The remaining four participants (40%) reported eating little, if any, venison.

Although we hypothesized that graduate students in these fields, particularly those in NREM, as well as those graduate student-hunters in any discipline or cross-discipline, would be the most informed about CWD, as compared to the other graduate students, that was not true in many cases. While all of the NREM participants (n = 5) had heard of CWD previously, only two (40%) were well-informed about the diseases’ history, progression (temporal and spatial), and the mechanisms of infection. The NREM
participants who were most informed about CWD took undergraduate or graduate-level college courses that discussed CWD, spoke with family friends, and colleagues about CWD regularly, and/or worked for wildlife management agencies. All of the Sustainable Agriculture graduate students (n = 4) had heard of CWD previously, however, none of them were well-informed on the particulars of the disease relative to history, progression, and mechanisms of infection. The remaining participant (10%), from a different STEM discipline, had not previously heard of CWD. Only one hunter (33%) was well-informed about CWD.

The pre-focus group interview survey results showed that 80% of the graduate students did not believe that wildlife posed a serious local health issue and, of those expressing an opinion (n = 7), 86% expressed trust in the government to manage public health risks from wildlife. More problematic was that only 30% of the participants agreed or strongly agreed that information on the potential public health risks of CWD was easily accessible; only 20% agreed that published CWD risk information was consistent; and only 30% agreed or strongly agreed that the published information was truthful.

Agreement that hunting serves important cultural, economic, and ecological or wildlife management purposes was nearly unanimous among these participants. Captive deer and elk, for either farming or hunting, enjoyed significantly less support. Among those expressing an opinion (n=8), deer or elk farming received support from 50% of the respondents (n = 4), most support coming from the Sustainable Agriculture students. Of those expressing an opinion on enclosed or captive hunting (n = 7), six respondents (86%) expressed opposition or strong opposition. Four of five NREM students (40% of
total participants; 80% of NREM students) agreed or strongly agreed that captive farming and hunting facilities posed a public health threat; the remaining participants disagreed (10%) or expressed no opinion (50%). However, when asked whether wild and farmed/captive cervids posed an equal public health threat, 70% of participants disagreed or strongly disagreed, 20% agreed or strongly agreed, and one (10%) expressed no opinion.

During the focus group interview, there was a definite split between those who opposed the broader dissemination of CWD-related public health risk communications, versus those who supported a broader dissemination of information. Equal numbers of students (n = 5 for each group) opposed and favored more widespread publication of CWD risk information. The comments of those opposing broader dissemination of information included:

“There is a narrative in our society about fearing the wilderness and wildness, and I think this ties into that…industry has done a really good job of making us fearful of food safety in a certain way. I think we can get really scared about these things that potentially are risks. Giving people information is one thing, but until we have some kind of testing program, we’re getting kind of ahead of ourselves.”

“It almost becomes like restricting people’s rights to hunt and use this meat.”

“I’d be concerned [because] there are a number of people, farmers who make money for having diversified landscapes, sometimes on selling hunting leases or permits to come on their land and hunt…So I’d be concerned if [broader publication about CWD risks would] cut into their bottom line, because I know it’s been an incentive for people to manage more multifunctional landscapes.”

[Hunting] is a gateway drug for people to become caring about the environment in this part of the country [where] there aren’t big mountains and forests. I’d be concerned that [broader CWD-related publication] would further disenfranchise people from the land in a way that we don’t want to see.”

“I could see some big impacts down the road as the idea of CWD in Iowa becomes bigger [and] gets out to more people…I know that a lot of HUSH [hunter-donated] deer goes to [places where] you get free spaghetti dinners…it’s
in the spaghetti. Maybe the people that run the kitchen don’t know about CWD…but as it becomes more and more in the media, maybe some people think, “Oh, a disease that could potentially hurt people. Well, I’m just not going to take deer meat anymore.”

“It could be just in general bad for hunting overall…we’ve all seen decreases in hunting over the years…less and less kids grow up in hunting families. In Iowa especially, there’s a lot of once-a-year hunters…I think if [CWD] becomes common in conversation, they’re going to say, “Oh, I don’t want to participate in that,” [and hunting is] going to become more of an antler time than a deer hunt. And that’s going to have a negative perception with the general, non-hunting public.”

“Once it really does hit the news and once it really does become common dinner table conversation, then people will think twice about getting their deer tag and going to harvest their meat for the winter…There’s a group of people that hunt to get food and fill the freezer, and there’s a group of people that hunt to get antlers to put on their wall…the people that rely on that protein for winter are who’s going to be affected…unfortunately.”

One participant specifically opined that the current level and manner of CWD-related risk information dissemination was sufficient, saying:

“I think the Iowa DNR uses their website as a way to provide information. They’re not putting it on billboards, but it’s certainly accessible to everyone who has access to the internet. And I think that’s fair.”

The participant went on to say:

[The information about CWD is]”basically confirming to me that there’s danger in everything. Until someone says ‘this will kill you,’ I’m not going to change anything that I do, because I can’t live in fear of everything…I’m not going to stop eating deer based on what could happen. And I don’t think anyone else should either.”

Two of the hunters (67%) were among those opposed to the broad dissemination of CWD-related public health risk information. Those taking this position came from both NREM and Sustainable Agriculture programs of study, and included both men and women.
Those participants favoring a broader dissemination of information had comments which included:

“I see how much we talk about emerald ash borer right now, and that’s not a human disease potential. It’s very unfortunate and awful...[and] they’re systematically going in and doing public meetings talking about it. I think there needs to be a more public, purposeful outreach plan [about CWD] as well.”

“I feel kind of angry [because where I’m from] there has been a lot of conversation about legalizing deer farming/enclosed hunting in the news, but there was never any discussion of what this disease was. I feel like the news media obviously didn’t understand CWD and...there wasn’t anybody out there putting this information on the table...I had no idea that [my state] was one of the first states in the eastern U.S. to identify CWD.”

“The comment that wildlife knows no borders just says a lot to the management strategies – that we [need to be] proactive versus preventative versus reactive...The DNR should play a big role, not the Iowa DNR, not the [state] DNR. It has to be “The DNR”, and they need to somehow communicate risk to areas that have risk, but they need to understand at what level [the] risk is.”

“CWD can impact other people who use the outdoors or who come in contact with venison, even if they aren’t hunters, so I think [CWD risk communication] has to go beyond hunters...so that people are at least aware that it’s an issue and what are some of the potential risks.”

“Information should be more widely available to increase public awareness about what not to do, for example how not to transport the disease from one place to another.”

“It’s like pink slime – when you find out about it, you’re like, ‘Oh, why didn’t I know?’”

**Farmers and rural landowners**

The number of participants in farmer and rural landowner group totaled seven. All participants owned rural property in North-Central Iowa, and all but one (n = 6) self-identified as a farmer. The group included both men (n = 5) and women, all of whom had attended (at least some) college. Some of the participants (n = 3) were hunters; four of
the participants (57%) ate venison with varying degrees of regularity, ranging from 1 – 50% of their respective total meat consumption. The remaining three participants (43%) reported little, if any, venison consumption.

The pre-interview survey results showed that all but one participant (86%) believed that wildlife present a serious local health issue, but only two participants (29%) indicated that they trust the government to manage public health risks from wildlife. Both of those participants are hunters.

Survey questions related to whether or not the participants believed that hunting serves an important cultural, wildlife management or ecological, and economic purpose correlated exactly with hunting and venison consumption, i.e., those who hunted or ate venison with regularity believed that hunting was important culturally, ecologically, and economically, and the non-venison consumers did not. Of those with an opinion on deer and elk farming (n = 6), 50% supported deer farming and 50% opposed it; one hunter opposed deer farming. Support for enclosed hunting was considerably less with only two participants (29%) in favor. Both of those in favor of enclosed hunting were hunters. When asked whether deer farms present a public health threat, of those participants expressing an opinion (n = 6), two participants (33%), including one hunter, thought that they did, but none of the responding participants (n = 6) believed that wild and farmed cervids posed an equal public health threat.

Those expressing an opinion on the easy accessibility of CWD-related public health information (n = 4), 50% believed that the information was easily accessible, and 50% did not. Only one participant expressed an opinion regarding the truthfulness of
published CWD-related public health information and that participant agreed that published information was truthful. Three participants expressed opinions regarding the consistency of published CWD-related public health information with 67% agreeing that published information is consistent. Six of the seven participants (86%) responded to the pre-interview survey question affirmatively when asked whether people should be provided information as it becomes available.

The perspective relative to dissemination of information changed for five of seven participants (71%) during the interviews, however. These changes occurred for four of the pre-interview proponents, and for the lone pre-interview opponent, of “providing information as it becomes available”, and occurred for participants interviewed individually, or as part of a small group.

Those who, during the interview, came out opposed to a broader dissemination of CWD-related public health risk information, did so with comments such as:

“I always like to read an article that states the problem and then the solution. You feel it’s closed; you don’t have to wake up at night thinking about it. That’s the problem with the agriculture writer or a conservation writer writing an article on chronic wasting disease and there’s no solution or no happy ending…if [CWD] is not really hurting you, what good does it do?”

“Maybe it is good to be in the dark a little bit. As long as the people in the know are monitoring [CWD] and can wave the warning sign when there really is a problem that may be better.”

“Mother Nature seems to have ways of taking care of her problems.”

“As scary as it may be to wait until that first [human] case [of CWD] comes up, it might be too little, too late. However, I’m afraid that with our John Q. Public and what they think of us hunters and what they think of gun control…I think a lot of non-hunters would put it on the hunters even though [hunting] doesn’t sound to me like it has anything to do with it.”
Those who, during the interview spoke in favor of a broader dissemination of CWD risk information, did so with comments such as:

“I am a proponent of information is power...letting people make decisions for themselves. Letting people know what risks are known and what are unknown and what potential situations exist but letting people decide for themselves.”

“I’m not someone to live in the dark.”

“I’m sure you’ll find people that won’t want to think about it, but I think there should just be more information...geared toward the general public.”

“Put the info into semi-layperson kind of language without watering it down too much.”

The participants’ ultimate positions with regard to dissemination of CWD-related public health risk information also correlated exactly with hunters and regular venison consumers opposing a wider dissemination of information, and non-hunters and non-venison consumers favoring broader dissemination.

**Discussion**

Using the MMA framework to evaluate the prior knowledge and informational needs of the graduate student and farmer/rural landowner stakeholders that were a part of this study showed a wide general familiarity with the terms “CWD” or “chronic wasting disease” among the participants, but significantly less in-depth knowledge about the history, progression, and mechanics of the CWD-disease process, and its public health-related potential. Given the importance of agriculture to the Iowa economy, and the fact that all of the farmers/rural landowners, and many of the graduate students are, or are likely to be, directly or indirectly involved with agriculture (to include the impact of wildlife on agriculture), it was also telling that none of the participants were aware of the relationship between CWD prions and plants.
This lends support to claims that state wildlife management agencies are the primary purveyors of CWD-related information, and that the focus of information publicized by these agencies is on CWD as it relates to wildlife (Eschenfelder & Miller, 2007). It also suggests that state departments of agriculture, including the Iowa Department of Agriculture and Land Stewardship, are not widely publicizing information about research showing an apparent link between CWD in cervids and agricultural crops. A lack of information about CWD in agricultural publications was also specifically noted by one of the farmer participants, a self-described avid reader of row crop agriculture-related literature, who opined that “they [agricultural writers] don’t write about it because they don’t know about it.”

Despite a lack of widespread media coverage of CWD outside of state wildlife management agencies, the participants in both groups in this study were nearly evenly split on the question of whether or not CWD-related risk communications should be more broadly disseminated. In the graduate student group, there were three main themes among those participants who disfavored broader dissemination of information, namely, the perception that broader CWD risk communication dissemination would result in: 1) increased negative public perceptions of hunters and hunting; 2) decreased public interest in and participation with nature and the environment; and 3) an increased movement toward “Big Ag” and away from localized food systems and local food harvesting and processing. The farmers/rural landowners who disfavored broader CWD risk communication likewise voiced concerns on the potential effect such dissemination would have on hunters and hunting. Some also indicated that since there was not a clear solution to the problem of CWD, they would prefer not to have any more information.
Lastly, some in this group suggested that CWD was nature’s way of keeping cervid population numbers “where they should be.”

Conversely, those in both groups who favored broader dissemination of CWD-related risk communication tended to focus on the rights of the general public to be aware of the potential public health consequences of CWD, and the rights of individuals to have the information necessary to enable informed, autonomous decision-making relative to the potential risks. Some of these participants were quite angry at both government officials and the media for what they perceived as a disservice to the general public.

The divergence of opinions on the basic issue of whether or not a broader dissemination of CWD-related risk communication should occur, both within and between these two participant groups, lends support to our hypothesis that a “one-size-fits-all” risk communication on the potential public health consequences of CWD is unlikely to be successful. It also highlights some of the difficulties associated with risk communication, generally, and suggests that in cases such as this one, in which the public health-associated consequences are potential, and not yet certain, additional study with members of these stakeholder groups, and other relevant stakeholder groups, is warranted. Given the limited numbers of participants in our two study groups, while our results are suggestive of the difficulties in creating a useful and appropriate CWD risk communication, we are unable to make any broad, or sweeping, generalities given our data limitations.

Thus, at a minimum, any additional study should seek to determine whether or not the sharp divergence on the issue of broader information dissemination that we found in
our study groups holds, to include, whether or not the proportion of opponents and proponents remains roughly equal within and between stakeholder groups.

**Conclusion**

For a variety of reasons, many of the participants in our study did not support broader dissemination of CWD risk information. However, advances in the field of risk communication, and the recent history relative to the British and Canadian governments’ lack of adequate risk communication about BSE suggests that more information and frequent public engagement is a better strategy. The mental models approach to risk communication provides a detailed strategy for the development of printed risk communications, which may need to be augmented with other strategies better suited for social media communication platforms and other public speaking risk communication venues.

**References**


Graduate Student Group Comparisons:

### Table 1. Responses of hunters and venison eaters from STEM Graduate Student Group.

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<thead>
<tr>
<th>Hunters/Venison Eaters (n=6)</th>
<th>1 Strongly Agree</th>
<th>2 Agree *(Yes)</th>
<th>3 Disagree *(No)</th>
<th>4 Strongly Disagree</th>
<th>5 Not sure/ No Opinion</th>
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<td>Wildlife=serious local public health issue</td>
<td>17%</td>
<td>50%</td>
<td>33%</td>
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<tr>
<td>Trust government to manage wildlife public health risks?</td>
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<td>16.67%</td>
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<td>CWD public health risk info truthful?</td>
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<td>67%</td>
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<td>Captives=public health threat?</td>
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### Table 2. Responses of non-hunters and non-venison eaters from STEM Graduate Student Group.

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Farmer or Rural Landowner Group Comparisons:

Table 3. Responses of hunters and venison eaters from farmer or rural land owner group.

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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild and captive cervids pose an equal public health threat?</td>
<td>50%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broad dissemination of CWD risk info OK?*</td>
<td>100%</td>
<td></td>
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</tr>
</tbody>
</table>

Table 4. Responses of non-hunters and non-venison eaters from farmer or rural landowner group.

<table>
<thead>
<tr>
<th>Non-Hunters/ Non-Venison Eaters (n=3)</th>
<th>1 Strongly Agree</th>
<th>2 Agree *(Yes)</th>
<th>3 Disagree *(No)</th>
<th>4 Strongly Disagree</th>
<th>5 Not sure/ No Opinion</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Wildlife=serious local public health issue</td>
<td>67%</td>
<td></td>
<td>33%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust government to manage wildlife public health risks?</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD public health risk info easily accessible?</td>
<td>33%</td>
<td></td>
<td>67%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD public health risk info consistent?</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD public health risk info truthful?</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deer farming OK?</td>
<td>67%</td>
<td></td>
<td>33%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Captive hunting OK?</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Captives=public health threat?</td>
<td>67%</td>
<td></td>
<td>33%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunting serves important cultural purpose?</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunting serves important economic purpose?</td>
<td>67%</td>
<td></td>
<td>33%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunting serves important wildlife management or ecological purpose?</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild and captive cervids pose an equal public health threat?</td>
<td>33.33%</td>
<td>33.33%</td>
<td>33.34%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broad dissemination of CWD risk info OK?*</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Between group comparison of hunters and venison eaters vs. non-hunters and non-venison eaters from both focus groups:

Table 5. Responses of hunters and venison eaters from both focus groups.

<table>
<thead>
<tr>
<th>Hunters/Venison Eaters (n=10)</th>
<th>1 Strongly Agree</th>
<th>2 Agree *(Yes)</th>
<th>3 Disagree *(No)</th>
<th>4 Strongly Disagree</th>
<th>5 Not sure/No Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife=serious local public health issue</td>
<td>20%</td>
<td>40%</td>
<td>40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust government to manage wildlife public health risks?</td>
<td>10%</td>
<td>50%</td>
<td>30%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>CWD public health risk info easily accessible?</td>
<td>10%</td>
<td>30%</td>
<td>30%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>CWD public health risk info consistent?</td>
<td>40%</td>
<td>10%</td>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD public health risk info truthful?</td>
<td>10%</td>
<td>20%</td>
<td>70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deer farming OK?</td>
<td>20%</td>
<td>40%</td>
<td>20%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Captive hunting OK?</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Captives=public health threat?</td>
<td>10%</td>
<td>20%</td>
<td>20%</td>
<td>10%</td>
<td>40%</td>
</tr>
<tr>
<td>Hunting serves important cultural purpose?</td>
<td>80%</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunting serves important economic purpose?</td>
<td>70%</td>
<td>30%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunting serves important wildlife management or ecological purpose?</td>
<td>70%</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild and captive cervids pose an equal public health threat?</td>
<td>10%</td>
<td>10%</td>
<td>40%</td>
<td>30%</td>
<td>10%</td>
</tr>
<tr>
<td>Broad dissemination of CWD risk info OK?*</td>
<td>20%</td>
<td>80%</td>
<td></td>
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</tbody>
</table>

Table 6. Responses of non-hunters and non-venison eaters from both focus groups.

<table>
<thead>
<tr>
<th>Non-Hunters/Non-Venison Eaters (n=7)</th>
<th>1 Strongly Agree</th>
<th>2 Agree *(Yes)</th>
<th>3 Disagree *(No)</th>
<th>4 Strongly Disagree</th>
<th>5 Not sure/No Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife=serious local public health issue</td>
<td>43%</td>
<td>57%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust government to manage wildlife public health risks?</td>
<td>28.5%</td>
<td>43%</td>
<td>28.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD public health risk info easily accessible?</td>
<td>14%</td>
<td>29%</td>
<td>57%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD public health risk info consistent?</td>
<td>14%</td>
<td>86%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD public health risk info truthful?</td>
<td>14%</td>
<td>86%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deer farming OK?</td>
<td>14%</td>
<td>29%</td>
<td>43%</td>
<td>43%</td>
<td>14%</td>
</tr>
<tr>
<td>Captive hunting OK?</td>
<td>43%</td>
<td>43%</td>
<td>28.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Captives=public health threat?</td>
<td>28.5%</td>
<td>43%</td>
<td>28.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunting serves important cultural purpose?</td>
<td>57%</td>
<td>43%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunting serves important economic purpose?</td>
<td>14%</td>
<td>29%</td>
<td>43%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Hunting serves important wildlife management or ecological purpose?</td>
<td>14%</td>
<td>29%</td>
<td>43%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Wild and captive cervids pose an equal public health threat?</td>
<td>57%</td>
<td>29%</td>
<td>14%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broad dissemination of CWD risk info OK?*</td>
<td>86%</td>
<td>14%</td>
<td></td>
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</tbody>
</table>
CHAPTER 5. GOVERNMENTAL DUTY AND CHRONIC WASTING DISEASE (CWD) RISK COMMUNICATION

To be submitted to *Human Dimensions of Wildlife*.

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**Abstract**

While some might eschew a governmental political, legal, moral, or ethical duty to communicate risks considered “statistically small,” and others might point to select legal decisions as support for claims that no such duty to communicate all at exists upon the government, there is ample historical, constitutional, statutory, and regulatory support for just such a governmental obligation. In the case of CWD, which has the potential to present as both a public health and foodborne disease, it is incumbent upon the government, preferably national public health and other federal agencies, to communicate with the general public about the potential risks associated with CWD, while leaving communications about CWD surveillance, monitoring, and identification efforts to the state and national agencies responsible for implementing and monitoring these efforts, namely the state wildlife management agencies and the appropriate federal agencies.

**Introduction**

While there is ample evidence, including constitutional, statutory, regulatory, and by custom and usage, of a U.S. governmental obligation to communicate risks to its
citizens, the mechanisms and practices for communicating potential health risks, such as those posed by chronic wasting disease (CWD) and similar diseases, both in the U.S. and elsewhere, have been lacking. Here I attempt to provide background on CWD, the legal and ethical roots of public-health related risk communication in the U.S., and a proposed communication framework, to include insights from other countries where mistakes have been made in communicating with the public about similar diseases.

**What is CWD?**

CWD is a disease in the class of transmissible spongiform encephalopathies (TSEs) which affects members of the cervid family, including deer, elk, and moose (Williams et al., 2002). It is in the same class of diseases as “mad cow disease” in cattle, scrapie in sheep, and Creutzfeldt-Jakob disease in humans (Prusiner, 1997). CWD occurs in both free-ranging (non-domesticated) and farmed cervids (Williams et al., 2002); many non-cervid mammalian species, including monkeys, sheep, cattle, prairie voles, mice, and ferrets have been experimentally infected with CWD (Imran & Mahmood, 2011; Sigurdson & Miller, 2003).

As with other TSEs, infection with CWD is always fatal (Prusiner, 1997). Affected individuals may harbor CWD and be infectious, but asymptomatic, for periods ranging between 16 – 60 months, or longer, before showing symptoms of the disease (Gilch et al., 2011). Death typically follows within one year of the first appearance of clinical symptoms (Williams, 2005). Diagnosis is typically confirmed post-mortem (Mathiaison et al., 2009). There are currently no available vaccinations or treatments for CWD (Williams et al., 2002); disinfection or decontamination of areas or surfaces
exposed to CWD prions is extremely challenging, and rarely effective (Saunders et al., 2012). Although infected individuals harbor the majority of CWD prions in lymphoid, brain, and central nervous system tissues, the prions are found throughout bodily tissues and fluids (Saunders et al., 2012).

CWD, considered by some to be the most efficiently transmitted and infectious TSE, may be spread by an infected individual to others of the same species, or related species (Saunders et al., 2012). Transmission may be direct or indirect (Miller et al., 2006). Indirect transmission has been linked to contact with infected bodily tissues and fluids, as well as with contact with contaminated environments (Angers et al., 2009; Daus & Beekes, 2012; Gilch et al., 2011). Studies have demonstrated that, once in the environment, CWD prions may remain infectious for many years (Miller et al., 2004). Thus, the shedding or decomposition of bodily fluids and tissues of diseased cervids in the environment all have the potential to create CWD reservoirs, which may then result in the spread of CWD through contact, inspection, or scavenging by cervids or other TSE-susceptible species (Fischer et al., 2013; Jennelle et al., 2004).

To date, there has been no demonstrated link between CWD and disease in humans. Many scientists believe that the “species barrier”, which prevents transmission of CWD between unrelated species, is fairly robust (Sigurdson & Aguzzi, 2007). Others are less convinced of the infallibility of the so-called species barrier, and suggest that as the prevalence of CWD increases, the likelihood of direct or cross-species transmission of CWD humans may also increase (Collinge, 2012; Fischer et al., 2013; Jennelle et al., 2009; Saunders et al., 2012). Since first being identified at a Colorado research facility in
1967, CWD has since been found in 24 states, two Canadian provinces, South Korea, and most recently, Norway (Bush, 2014; Cosgrove, 2013; Dagleish, 2016).

CWD’s increasing prevalence is a concern given that wildlife represents the largest source of novel zoonotic diseases, reportedly the source of more than 43% of all emerging infectious diseases (EIDs) between 1940 and 2004 (Jones et al., 2008). More recently, 75% of all EIDs in humans are zoonotic; the majority of these have been attributed to wildlife (Rhyan & Spraker, 2010).

**Governmental Political or Legal Duty to Communicate Risks**

The government’s obligation to communicate risks to its citizens has been characterized as an undisputed, political imperative, and a fundamental duty of government (Allen, 1989; Eschenfelder & Miller, 2007; Liu & Horsley, 2007). Under our Constitution, the federal government’s responsibilities for protection of its citizens are typically limited to national and international issues, while states are responsible for protection of citizens within their respective borders, often under the authority of their police powers (Heyman, 1991). Allen (1989) points to the government’s operation of lighthouses as one of the earliest types of federal risk communication, and, by extension, a manifestation of the federal government fulfilling this duty of protection. Health and disease warnings by state and local health departments or state veterinarians are examples of state-level risk communications.

There have been some legal decisions, most notably those in *Jackson v. City of Joliet* (1983) and *DeShaney v. Winnebago Cnty. Dep’t Soc. Servs.*, (1989), that seemingly call into question whether or not a duty of protection exists upon government. In *Jackson*
(1983), a Joliet, Illinois police officer responded to an accident scene in which a car had overturned and caught fire. The police officer proceeded to direct traffic away from the scene of the accident and made no effort to ascertain whether or not there were passengers trapped within the vehicle (Currie, 1986). There were, and they died (Currie, 1986). Their heirs subsequently sued the City for a breach of duty of protection of life and liberty under the due process clause of the Fourteenth Amendment to the U.S. Constitution (Jackson, 1983; Currie, 1986).

The DeShaney (1989) case involved a young child who was repeatedly beaten by his father. Despite the local Department of Social Services’ (DSS) involvement in the matter, the child was repeatedly returned to his father’s care and custody by DSS after the beatings (Heyman, 1991). Shortly more than a year after DSS first became involved in the case, the child was beaten so severely by his father that the child suffered permanent and debilitating brain damage, and thereafter required life-long institutionalization (Heyman, 1991). A lawsuit against the local DSS for breach of duty of protection ensued (DeShaney, 1989).

In both cases, government representatives were aware of the potential for life-threatening risks to one or more citizens and knowingly failed to intervene. The appellate decisions in these cases, which affirmed the government’s decisions not to intervene, turned on the courts’ view of the U.S. Constitution as a document embodying negative, rather than positive, liberties so as to limit both state and federal governmental interference with the lives of citizens. Chief Justice Rehnquist, speaking for the U.S. Supreme Court in DeShaney, summed up the court’s position saying that the “Due Process clause must be understood as a protection against unwarranted government
interference, but not as an entitlement to government aid” (DeShaney v. Winnebago Cnty. Dep’t Soc. Servs., 1989). Similarly, Judge Posner, speaking for the Court of Appeals for the Seventh Circuit in Jackson (1983) held:

“The Constitution is a charter of negative, rather than positive liberties… The men who wrote the Bill of Rights were not concerned that government might do too little for the people, but that it might do too much to them. The Fourteenth Amendment, adopted in 1868, at the height of laissez-faire thinking, sought to protect Americans from oppression by state government, not to secure them basic governmental services.”

The argument that the U.S. Constitution was specifically designed by the Framers to protect citizens from an over-intrusive government makes some sense if one considers the historical roots of this country and the early colonists’ efforts to escape oppressive governments in Europe; however, if the purpose of government does not encompass protection of its citizens, including communicating potential public health risks, why would citizens consent to be governed at all? Where is the benefit to the citizen of the citizen-government alliance in that case? Absent a clear benefit from being governed, why would we not instead elect the “every man for himself” approach to entirely avoid the issue of undue governmental interference with our autonomy? I suggest that we would not. Moreover, the holdings in the Jackson (1983) and DeShaney (1989) cases notwithstanding, a closer look at the Framer’s comments and rationale for the enactment of the Fourteenth Amendment to the Constitution, and its predecessor, the Civil Rights Act of 1866, clearly indicates that the Due Process Clause was intended as a source of the right to protection and other positive liberties, and not merely negative liberties as claimed by Rehnquist and others (Heyman, 1991). Coming on the heels of the end of the Civil War and the resultant abolition of slavery, the Fourteenth Amendment instead sought to ensure that the federal and the state governments, including the state
governments of the south’s formerly slave-owning states, provided due process and equal protection to all “freemen and citizens”, regardless of race (Heyman, 1991).

Further, the decisions in *Jackson* (1983) and *DeShaney* (1989) fly in the face of other well-established legal doctrines whereby the government is clearly obligated to provide protection to its citizens. For example, under the doctrine of *parens patriae*, the state must protect its citizens who, by reason of age or disability, are unable to protect themselves; alternatively, *parens patriae* is applicable to extend protection to “quasi-sovereign” interests, including the public health of the state’s citizens (Kanner, 2005; Ratliff, 1999; *Missouri v. Illinois*, 1901). Accordingly, this doctrine was used to successfully force tobacco companies to settle lawsuits brought by a group of states’ attorneys general on behalf of their respective citizens (Ieyoub & Eisenberg, 1999).

Additionally, there is statutory support for the government’s political or legal duty to communicate risks to its citizens. Specifically, in response to the federal government’s increased use of the internet as a way to quickly and easily communicate information to large numbers of citizens, in 2001, Congress passed the Data Quality Act (also known as the Information Quality Act (IQA)) to ensure that information disseminated was of maximum “quality, utility, objectivity, and integrity” (Meshkin, 2010; Shapiro, 2004). Under guidelines established pursuant to the IQA, at a minimum, disseminated information must be “clear and unbiased” (Shapiro, 2004). Moreover, information concerning environmental, health, or safety risks is held to a higher standard such that it must comport with the risk disclosure provisions of the Safe Water Drinking Act (SWDA) Amendments of 1996 (Shapiro, 2004). Under these 1996 SWDA Amendments, the Environmental Protection Agency, the agency charged with ensuring the safety of the
public drinking water, is required to conduct risk assessments, using the “best available, peer-reviewed science”, and to communicate these risk assessments, including the uncertainties and studies relied upon, to the general public (Tiemann, 2014). Thus, the IQA requires that all environmental, health, and safety-related risks also be subjected to a risk assessment using the best available science, and that the results of this assessment be publicly disseminated.

The IQA, however, is only applicable to federal agency communications; few states have enacted their own versions of the IQA (Copeland & Simpson, 2004). Thus, absent another state statute relative to the quality of disseminated information to the general public, state risk communications may not be held to the same quality standards as those of federal agencies. This discrepancy may explain, at least in part, the differences between and amongst state risk communications on the same topic.

The historical and legal authority for governmental risk communications notwithstanding, for some, one must first assess whether or not the risk merits any governmental action (Sunstein, 2002). Sunstein (2002), a highly regarded legal scholar, does not believe that the government has a duty to communicate with the public about all potential health risks. Instead, he contends that for those risks considered “statistically small”, the government should not engage in any risk communication (Sunstein, 2002).

Sunstein’s (2002) position is similar to that taken by the British government after the 1986 discovery of the first case of Bovine Spongiform Encephalopathy (BSE), the cattle equivalent of CWD, in the British cattle population (Leiss & Powell, 2004a). In Britain, the government undertook no affirmative BSE-risk communication campaign
and, erroneously, we now know, responded to questions about the link between BSE and human health with adamant assurances that BSE-infected cattle posed no, or at worst, “negligible” risk to human health (Leiss & Powell, 2004a). These “no risk” responses to inquiries continued even as late as December, 1995, despite mounting contradictory scientific evidence (Leiss & Powell, 2004a). Three months later on March 20, 1996, after BSE was identified by the scientific community as the likely cause of 10 human deaths, the British Health Secretary announced the link between BSE and variant Creutzfeldt-Jakob disease in humans (Leiss & Powell, 2004a).

The government’s role as risk communicator may be further complicated when the government is also the risk generator. In that event, the government may claim that withholding risk information from the public is in the “national interests”, particularly if dissemination of the information is believed likely to create a “moral panic” (Smith & McCloskey, 1998). Some claim that the concern about a moral panic is less about public reaction to risk information and more a way to justify avoiding “explaining to the public the nuances and subtleties of risk assessments” (Leiss & Powell, 2004b). Additionally, there is evidence that one of the best ways to avoid a moral panic is to communicate potential risks to the general public early and often (Leiss et al., 2010).

**Governmental Ethical or Moral Duty to Communicate Risks**

Baram (1989) and others assert that under our system of democracy, there is also an ethical or moral obligation of government to communicate risks to its citizens. Those asserting such an obligation contend that government’s fulfillment thereof permits citizens to make informed decisions on their own behalf based upon the best information
available (Mason, 1989), and to also avoid decisions that would create undue risks of harm for others (Baram, 1989).

Pinpointing the source of such an ethical or moral obligation is often challenging, but even in the absence of a clear moral requirement, historical custom and usage suggests that informed decision-making by the public and avoidance of undue risks of harm for others are relevant factors in governmental risk communication strategies. For example, the U.S. Department of Homeland Security’s risk management protocols specify “equipping people or groups to take appropriate actions in response to an identified risk” as one of their risk communication goals for communications both inside and outside the agency (including communications with the general public) (Department of Homeland Security, 2011). For public health professionals, ethical standards are contained in a book published by the Public Health Leadership Society (2002) and contain reference to “respect for the rights of the individual” and providing communities with the information…needed for decisions” (Thomas et al., 2002).

**Constraints on or Opportunities for Governmental Risk Communication**

In creating their theoretical model for public relations oriented governmental communications, Liu and Horsley (2007) noted several factors which they contend may operate as both constraints on or opportunities for governmental communication, namely: politics, the public good, legal constraints, media scrutiny, the culture of the devaluation of communications within the government, poor perceptions of the government by citizens, decreased emphasis on professional development for government communicators, and federalism. While all of these named factors are important for
governmental risk communication, I will focus briefly on two of these factors: federalism and politics.

**Federalism**

As previously noted, there is a doctrine whereby authority for differing governmental functions is apportioned under the U.S. Constitution to different levels of government; this doctrine is known as federalism (Liu & Horsley, 2007). However, in some cases, there is an overlap in authority between the different levels of government. This overlap in authority may be by design or default, and it may create a lack of a centralized authority. In subject matter areas where there is such a lack of centralized authority, we are more likely to see differing messages on the same topic coming from different departments, agencies, or levels of government (Liu & Horsley, 2007).

**Politics**

Politics, broadly speaking, define government, and a politician’s position on an issue may include considerations of how far off the next election cycle is; how a particular issue, action, or inaction, will be received by constituents or public interest groups; whether or not an issue has exploded in the media; and the apportionment of competed-for governmental funds, among others (Liu & Horsley, 2007; Robertson & Manta, 2017). Moreover, the political response to a particular risk may bear little relationship to the assessed magnitude of the risk, such that the response to the risk is overblown in comparison to the risk assessment because of political considerations (Robertson & Manta, 2017); conversely, as previously discussed, the response to a risk
may also be politically inadequate as a result of an inaccurate risk assessment (Leiss & Powell, 2004a, 2004b), or because the public response to the risk is unanticipated.

Robertson and Manta (2017) point to the recent U.S. efforts to protect against terrorist bombs in laptop computers and other electronic devices by a proposal to extend the ban already in place for all such devices in the passenger cabins of all airplanes flying between the U.S. and the Middle East to all flights between the U.S. and Europe as an example of an overblown response. In their attempt to answer the question regarding whether or not the disruption and economic hardship that such a move would create is worth it or not, they note that the costs and potential effectiveness of a particular policy are frequently not the determinants of whether or not the policy is implemented (Robertson & Manta, 2017). Instead, they contend that political considerations, specifically the general public’s overestimation of the likelihood of being harmed in a terrorist attack, and the politicians’ fears of receiving a disproportionate share of the blame for failing to act, lead to measures that bear little resemblance to their billing as safety measures, and may, in fact, be just the opposite (Robertson & Manta, 2017; Slovic, 1987). Here, politics presents as an opportunity for risk communications under Liu and Horsley’s (2007) model.

The messages to be gleaned from both the discussion of the public and political responses to perceived terrorism risks (Robertson & Manta, 2017), the public responses to governmental inaction regarding BSE risks in Britain and Canada (Leiss & Powell, 2004a, 2004b), and the discussion of federalism are threefold: First, Slovic (1987) was right. Risks perceived by the general public as uncontrollable, catastrophic, novel, observable, and immediate (dread risk), regardless of how statistically unlikely the risk,
and are more likely to create fear than known risks which are perceived as controllable (Slovic, 1987). Arguably, acts of terrorism, anything nuclear, BSE, and CWD all fit within this dread risk category (Slovic, 1987). Second, governmental entities and politicians are in the unenviable position of making risk communication and mitigation decisions in these dread risk situations, with the possibility of increasing fear and inciting public panic on the one hand, or facing public backlash for failing to communicate because of uncertainty, faulty risk assessments, or unanticipated public response on the other hand. Thus, in at least some cases, politics dictates that dread risk issues, including some which Sunstein (2002) might categorize as “statistically small,” are communicated to the public. Lastly, in cases where the issue being communicated lacks a centralized authority, the risk messages are likely to differ, depending upon where, and with which entity, the communication originates (Liu & Horsley, 2007).

**Governmental Risk Communication and CWD**

CWD, like its bovine counter-part BSE, has the distinction of being a potential public health threat as both an infectious disease and as a food adulteration. From a risk communication standpoint, both are problematic, each in their own way.

**CWD as a potentially infectious disease**

First, CWD’s potential as an infectious (zoonotic) disease must be considered in conjunction with the fact that under the North American Model for Wildlife Conservation, state wildlife management agencies are primarily charged with implementing and managing state wildlife conservation programs and providing the public with wildlife-related recreational opportunities including fishing, hunting, and
wildlife viewing (Mahoney, 2009). Even so, these agencies routinely publish public health-related risk communications about CWD; at least one study has found that these agencies “maintain the most comprehensive CWD Web site [sic] in each state” (Eschenfelder & Miller, 2007). Hunters appear to rely heavily upon these agencies for information about CWD (Vaske, 2010).

Wildlife management agencies in most states rely heavily on hunter-derived revenue for their economic support, and they also rely upon hunter participation to keep deer population numbers within ecological and social carrying capacity limits (Batcheller et al., 2010). Wildlife managers are well-aware of the published studies detailing the effect that hunter concerns about CWD can have on both (Heberlein, 2004; Lyon & Vaske, 2010; Vaske, 2010). However, there is evidence to suggest that, absent a confirmed link between CWD and human health, the relationship between concerns about CWD and decreased hunting have both temporal and spatial components: those hunters in jurisdictions where CWD has been recently identified or where CWD has not yet been identified appear more likely to abstain from hunting because of CWD-related fears than are those hunters in jurisdictions where CWD was identified several years (or decades) ago (Amick et al., 2015; Gigliotti, 2004). Additionally, support for agency management (Needham & Vaske, 2008), the hunters’ status as veteran or casual hunter (Needham et al., 2007), and the prevalence rate of CWD in the jurisdiction’s cervid population (Needham, & Vaske, 2006) are all factors relevant to hunter participation. Of note, some suggest that CWD prevalence rates of 50% or more should be expected within the coming decade (Jennelle et al., 2014).
Hunting also has an economic impact in states that extends beyond wildlife management agencies, to include money spent on hunting equipment and apparel, outfitters, lodging, restaurants, gas stations and convenience stores, meat processors, and taxidermists, among others. The numbers involved are not insignificant. According to the U.S. Fish & Wildlife Service (2012), in 2011, hunters aged sixteen and older numbered 13.7 million (six percent of the U.S. population) and made hunting-related expenditures of $34 billion (an average of $2,484 per hunter). Of these hunters, 85.6% (11.6 million) hunted cervids and other big game (U.S. Fish and Wildlife Service, 2012).

Accordingly, CWD has the potential to impact not only wildlife management agency budgets by increasing expenditures for CWD-related regulation, surveillance, and enforcement, and, to the extent that the fear of risks from CWD decreases hunter participation and recruitment, it can also negatively impact agency conservation efforts for all species (Miller, 2012), as well as private businesses that rely on hunting-related revenue. Thus, the economic ramifications are likely to be felt statewide. As an example, within one year of the discovery of CWD in Wisconsin, the number of hunting licenses sold decreased by over 90,000 and the state’s wildlife management agency’s revenue decreased by over $3 million (Heberlein, 2004). The economic loss to the state from the discovery of CWD was estimated at over $50 million in the first year alone (Bishop, 2004) and was felt disproportionately by communities dependent upon hunting-associated revenue (Lyon & Vaske, 2010).
CWD and its potential as a foodborne disease

Like BSE, CWD also has the potential to be a TSE that impacts human health through food. Where CWD differs, however, is that most venison that makes it to the dinner table, does so without ever going through the regulatory and inspection processes associated with our food safety system. In fact, the test for the presence, or absence, of CWD prions in the harvested animal is not considered to be a food safety test at all, and does nothing to detect other foodborne pathogens that may be associated with venison. Testing for CWD, or any other food safety test or inspection, is typically not required for harvested venison, regardless of whether it is processed by the hunter or by a local meat processor. That said, it should be noted that when asked, CWD experts convened at a workshop to create a CWD risk communication model, responded unequivocally that they would not consume any venison, including venison that they themselves had harvested, without first having the animal test negative for CWD (personal communication, September 5, 2014).

On a positive note, we do have the Center for Disease Control’s (CDC) Pulsenet system for rapid detection and response to emerging foodborne diseases (Swaminathan et al., 2006). Despite the fact that the CDC’s PulseNet system serves as the model worldwide, and, as it has in recent years with other rapidly emerging foodborne diseases affecting spinach, strawberries, and ground beef, among others, PulseNet would likely uncover many other venison-associated foodborne pathogens (Swaminathan et al., 2006; Tauxe, 1997). However, PulseNet is a backward-looking system in that it communicates risk to the public in response to discerned clusters of disease (Swaminathan et al., 2006); it was not created or designed to forewarn the public of a disease like CWD, with its
uncertain zoonotic potential and long incubation period although it can be hoped that PulseNet would be helpful in detecting and informing the public about clusters of CWD-associated disease in humans if, or when, it becomes a known zoonotic disease. Like PulseNet, state and local health departments operate from a backward-looking perspective.

**Does CWD’s potential public health risk trigger a governmental risk communication duty?**

Setting aside for the moment the fact that wildlife management agencies in all 50 states do provide their constituents with direct, or indirect, risk information about the potential public health risks from CWD (Chapter 3), should they? Put another way, do the potential public health risk from CWD rise to the level of the health or environmental risks contemplated by the IQA and SWDA Amendments of 1996 (Meshkin, 2010; Shapiro, 2004) and other legal and moral precedents for governmental action, or are they so “statistically small” that no governmental risk communication is appropriate (Sunstein, 2002)? Alternatively, is CWD a dread risk issue that political considerations dictate should be communicated to the public? If so, who should be doing the communicating, and what should they be saying?

**CWD, legal and moral precedent, and uncertainty**

In the above discussion regarding legal precedent for risk communication, a common thread for statutory authority for risk communication for health and environmental threats under the IQA, or for bringing suit under the doctrine of *parens patriae* against the tobacco companies, was the ability to quantify, through the risk
assessment process, the likelihood, or magnitude of the risk. Similarly, the moral arguments espoused by governmental agencies in support of risk communication, namely, providing the public with the ability to make informed decisions and avoid harm to others, also imply known or identified risks. Conversely, there are arguably legal and moral arguments against governmental communication about “statistically small” risks, or risks that may never come to fruition (Leiss & Powell, 2004a; Sunstein, 2002).

From a legal and moral perspective, the problem with CWD risk communication is the uncertainty about the disease’s zoonotic potential. We do not know, and the experts do not agree, regarding when, or if, CWD will become zoonotic. Although researchers are learning new things about CWD at a fast and furious pace, we do not yet have sufficient information upon which to base a realistic risk assessment, and therefore do not have the means to provide the public with information upon which to make a truly informed decision. Add to that uncertainty the thorny reminder of BSE and Taleb’s (2007) admonitions, namely, that we do not know what we do not know, and we can begin to see the quandary in which politicians, other government officials, and even members of relevant stakeholder groups (Chapter 4) find themselves relative to CWD and its risk communication.

**Wildlife managers as purveyors of public health information**

There is an argument to be made that informing the public about wildlife-related diseases is a reasonable function for a wildlife management agency. However, even though all 50 state wildlife management agencies publish at least some information about CWD on their websites, a 2016 random search of five state agency websites (AR, ID,
MD, NH, and NM) painted a very diverse picture relative to each state’s risk communication about other zoonotic and non-zoonotic wildlife diseases. Specifically, of these five states, Idaho was the only state to provide information about multiple zoonotic and non-zoonotic wildlife diseases. Two other states (MD, NH) provided information about (zoonotic) avian influenza; Maryland also provided information about (non-zoonotic) EHD in deer and indirectly provided information about (zoonotic) rabies in a discussion about bats in Maryland. Neither Arkansas nor New Mexico provided information about rabies, EHD, or avian influenza on their sites. These differences show a lack of standardization between state wildlife management agencies relative to communication about wildlife diseases with the lay public. While, admittedly, some of these differences may be attributable to the presence, prevalence, or absence of a particular disease in that state, interestingly, CWD risk communication is part of state wildlife management agency risk communications in all 50 states, regardless of CWD’s presence, or absence in that state.

Two questions immediately come to mind. First, why do all 50 state wildlife management agencies publish risk information about CWD when they do not necessarily publish risk information about any other wildlife-related disease? Second, do all 50 states publish the same information about CWD?

The second question is easier to answer than the first. In short, state wildlife management agencies do not all publish the same CWD risk information (Chapter 3). This despite calls for standardization of the information publicized at the state level (Eschenfelder & Miller, 2007). Some states, candidly, publish information about CWD’s as-yet-unknown zoonotic potential; others omit direct reference to any zoonotic potential,
but include risk precaution strategies in their message (Chapter 3). Still others avoid
discussion of public health risks in any obvious way, and instead focus on providing
information specific to hunting and promoting hunting and venison consumption
(Chapter 3). In these latter states’ defense, since hunters, the group likely to be most at-risk from CWD as an infectious disease agent, undertake hunting as a voluntary activity,
arguably, the governmental obligation to communicate about the potential public health
risks from CWD is somewhat lessened. This lack of information uniformity and
consistency also speaks to the issue of a lack of a centralized information authority.

As to the first question, since hunters are primary constituents of wildlife
management agencies, it is logical to conclude that published information concerning
CWD is simply these agencies’ efforts to inform their respective constituents of what
they need to know given the current information. While this sounds plausible it is also
overly simplistic. It is much more likely that other considerations, including the
importance of hunting-related expenditures on agency revenue, the importance of hunting
to manage deer population numbers, the “hunting culture” and popularity of the sport
within the state, the overall economic impact of hunting on the state, whether or not the
state, or surrounding states, have identified CWD, and other considerations all combine
to impact the way that state-specific CWD risk messages are framed and presented. It
also seems plausible that political considerations dictate the way in which the primary
CWD risk communication are communicated: leaving these communications to wildlife
management agencies allow politicians to avoid a repeat of the BSE failure to
communicate and to get ahead of this issue in a way that targets the primary at-risk
stakeholder group, while avoiding CWD becoming a mainstream media issue – at least
until CWD’s uncertain zoonotic potential is more fully discerned or until it becomes clearly zoonotic.

**Conclusion**

If you believe that the government has a legal and an ethical/moral duty to communicate about risks, including potential zoonotic risks, to the general public, then you might feel that state wildlife management agencies should not be the primary source of this information for the public – for several reasons, including an actual or perceived conflict of interest between the agency mission and a full disclosure of CWD information which could negatively impact that mission, the likelihood that wildlife management agencies typically only reach a limited segment of the lay public, a lack of unified standards for information between and among states, and a lack of agency expertise in both public health or disease transmission and food adulteration. Instead, you may believe that these agencies should continue to publish information about their areas of expertise, including CWD surveillance, monitoring, and control efforts.

Conversely, you may believe that since hunters, as a group, are those most likely to be impacted by CWD, that state wildlife management agencies should remain a primary source for CWD-related information, including public health information.

If, like Sunstein (2002), you take the position that legal and ethical governmental risk communication should be based upon a risk cost-benefit analysis, you would examine the preponderance of the current peer-reviewed scientific literature on CWD, crunch the numbers, and quite possibly conclude that the government should not be publishing risk communication about CWD at all. However, that train has left the station
since state wildlife management agencies in the states publish information that at least alludes to the potential public health risks from CWD.

I submit that a more legally appropriate and ethical way forward relative to CWD risk communication is for state wildlife management agencies to continue to publish information relevant to CWD prevalence, surveillance, monitoring, and control efforts in their respective jurisdictions and that these agencies should provide a link or reference to an agency, such as the CDC, as a centralized authority for CWD-related public health information. Further, this centralized authority should publish CWD-related information in accordance with the standards under the IQA, that is as thorough and complete an assessment of the public health risks as possible, including the uncertainties, and based upon the best-available peer-reviewed science. The goals then would be to take wildlife management agencies out of the public health risk information business, and turn this task over to public health professionals; equally important would be informative, clear, and consistent CWD-related public health risk information, originating from a centralized authority, instead of the disparate messages that are currently being produced among the different state agencies.

References


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CHAPTER 6. GENERAL CONCLUSIONS

Risk Communications

Modern risk communications, a relatively new and still-evolving field, has benefitted from incorporating mathematical, cognitive, psychological, social, behavioral, and communication theories and methods. As part of this evolution, risk communications, which were once limited to top-down communications from experts to members of the general public, have been broadened to include, and in many cases rely upon, stakeholder engagement and input as part of the risk communications process.

The mental models approach (MMA) to risk communication is one such methodology that relies upon stakeholder engagement and input, in conjunction with input from experts, to create a risk communication that provides recipients with the information necessary for them to make an informed decision.

Expert Models and State Content Analysis

Using chronic wasting disease (CWD), the cervid equivalent of “mad cow” disease as our model, we used the MMA to create two expert models relative to the information that, in the opinion of experts, should be conveyed to the public relative to the risks, including potential public health risks, associated with CWD. Our theoretical expert model was based upon a review of the CWD literature; our actual expert model was created by CWD experts at a workshop convened for that purpose. While there were similarities in the two expert models, they differed in their levels of detail and emphasis.
We then used each of these models to evaluate selected states’ published CWD risk communications by comparing and contrasting the concepts found in each state communication with those concepts highlighted by the models as important information for communication to the public. With one notable exception, the state communications fell far short of meeting expert model recommendations. In all cases we found deficiencies and inconsistencies in content, format, and accessibility, both internally, and among the state communications. These deficiencies and inconsistencies have the potential to create distrust in and undermine all governmental CWD risk communications.

Although we suggest that CWD, with its uncertain zoonotic potential, is the type of problem that may lend itself to the application of the precautionary principle relative to risk communication, we also note that CWD presents as a multi-faceted problem entailing ethical, political, social, cultural, economic, wildlife, landscape health, as well as potential public health considerations. Further, this issue has implications for a host of potential emerging infectious diseases beyond CWD.

**Stakeholders and CWD**

Hunters are considered the prime at-risk group from CWD and are the target constituent of wildlife management agency CWD risk communications. Additionally, the majority of research investigating public knowledge, concerns, and informational needs about CWD has focused on hunters. We hypothesized that there are many relevant, but
underserved stakeholder groups that are also potentially at-risk from CWD, but that many of these stakeholders are not reached by current CWD risk communication methods or platforms.

Using the MMA framework, we administered surveys and conducted interviews with members of two previously unstudied groups, namely, farmers and rural landowners, and STEM graduate students regarding their knowledge of and informational needs relative to CWD. There was widespread general familiarity with the terms “CWD” and “chronic wasting disease”, but very few of the participants were knowledgeable about the particulars of the disease and the human health risk potential. While roughly one-half of the participants in both stakeholder groups strongly favored broad dissemination of CWD risk information, the remaining participants were equally strong in their opposition to broad dissemination of information, and concerns about the impact on hunting and hunters predominated. Some opposing dissemination also voiced the opinion that CWD was a problem without a solution, and thus, dissemination of information served no valuable purpose.

Despite the fact that half of our participants opposed broader dissemination of CWD risk information, the history of risk communication efforts, or more particularly the lack thereof, by the British and Canadian governments about “mad cow” disease and its potential human health and economic impacts, as well as the lessons learned during the evolution of modern risk communication suggest that more is better with regard to risk communications and engagement with members of the public.
Governmental Risk Communication and CWD

Legal, moral, and historical evidence supports a conclusion that government has a duty to its citizens to communicate risks so that said citizens can make informed judgments both concerning their behaviors individually, and as they may create a risk for others. Although the risks to human health and our food supply from CWD are uncertain, and thus make a fully informed decision difficult, if not impossible, at this stage, CWD’s potential impacts on public health and our food have the potential to create a national crisis. Thus, a centralized authority should be the lead agency for health and food risk communications, including those risks like CWD, whose zoonotic potential is as yet unknown. Communications about CWD surveillance, monitoring, and identification efforts should continue to come from the state and national agencies responsible for implementing and monitoring these efforts, namely the state wildlife management agencies and the applicable federal monitoring agencies.

Contributions from this Research

One contribution from this research was the creation of two expert models, one of both of which may be used in the development of future CWD risk communications, or the evaluation and analysis of existing CWD risk communications. This research also included two relevant, but previously unstudied stakeholder groups relative to CWD risk communication. Although the results we obtained are not widely generalizable, in part because of the small numbers of stakeholders involved, there were some interesting and potentially useful results nonetheless.
First, our results lend additional support to conclusions reached in other studies, namely, that “traditional” or fair-chase hunters as a group or sub-group, tend to behave and think differently about CWD, and its communication, than other non-hunter groups and stakeholders. Secondly, our research showed that non-hunters for whom venison consumption constitutes a regular portion of the meat in their diet have views on CWD and its risk communication that tend to mirror those of hunters. This may be worthy of further study on a larger scale with these, and other, stakeholder groups. Third, our results indicated that there was no real “middle ground” on the question of whether or not the stakeholders, regardless of group, favored or opposed broader dissemination of CWD risk information. Given that with our participants, the stakeholders within each group were relatively evenly split on this question, it may be interesting to determine whether this clear split of opinion, and the proportion of opponents and proponents, holds on a larger scale in these, and other, stakeholder groups. This stark division also suggests that developing a CWD risk communication that is tailored to a particular stakeholder group may not be feasible; alternatively, the risk communication may not be well-received, or considered trustworthy, by a significant proportion of the chosen stakeholder group.

**Other Suggestions for Future Research**

To further the risk communication development process of the MMA with the two stakeholder groups that were included in our study, a future researcher could administer comprehensive questionnaires, and iterations thereof, to larger samples of the target stakeholders. The information obtained in this phase could then be used to create the risk communication itself, and thereafter, the communication would be subjected to testing and re-testing as part of an ongoing information correction and message delivery update
process. Moreover, because there are numerous relevant stakeholder groups which have not been included in the CWD risk communication development process, future research should also include these stakeholders. Additionally, the development of a standard CWD risk message for all state wildlife management agencies would be a worthwhile endeavor, even in the absence of a centralized authority for communication of CWD’s potential public health risks.
Figure 1. IRB APPROVAL

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- You do not need to submit an application for annual continuing review.
- You must carry out the research as described in the IRB application. Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Detailed Information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. Only the IRB or designees may make the determination of exemption, even if you conduct a study in the future that is exactly like this study.

Please be aware that approval from other entities may also be needed. For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.