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# **Factors Associated with Behavioral Compliance to Prevent the Spread of Viral Hemorrhagic Septicemia**

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**Abstract:** This article examines the relationship between awareness, knowledge, and motivations in adopting behaviors that prevent the spread of Aquatic Invasive Species (AIS) such as Viral Hemorrhagic Septicemia (VHS) among boaters and anglers who are a primary mechanism by which VHS can spread degrading water quality and fisheries. Although previous Extension efforts have focused on imparting knowledge to change environmental behaviors, results of the study reported in this article suggest that awareness and intrinsic motivation to protect the environment play a stronger role in adopting behaviors to prevent the spread of VHS. Implications for Extension professionals outreach efforts are discussed.

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Protecting water quality has long been viewed as an important goal to pursue for Extension educators (Vaughn, 1989). The spread of Aquatic Invasive Species (AIS) such as Viral Hemorrhagic Septicemia (VHS) in particular represents a significant threat to water quality and the health of fisheries in large areas of the United States, including all five of the Great Lakes—as well as the connecting waterways and several inland lakes in the states of New York, Michigan, Ohio, and Wisconsin. VHS affects multiple fish species, causing bleeding in flesh and internal organs and has been associated with major mortality events involving many families of freshwater fish including at least 25 different species (Bowser, Casey, Winton, & Goodwin, 2009).

Boaters and anglers who move between bodies of water are thought to be one of the primary mechanisms by which VHS can spread degrading fisheries. According to Bowser (2003), some of the specific ways VHS may spread via transient anglers include: 1) moving infected fish through human intervention such as transferring an infected fish for the purpose of "ad hoc stocking"; 2) moving infected bait; and, 3) moving infected water in the course of recreational boating such as water in the live well.

Because of these potential mechanisms by which VHS can spread, researchers have suggested that engaging with anglers to encourage preventive behaviors is a crucial strategy for preventing the spread of aquatic invasive species (Kolar & Lodge, 2000) such as VHS. Such an approach is consistent with recent research asserting that Extension programs are increasingly being challenged by the land-grant system and grant-funding agencies to produce measurable outcomes and behavior change (Pratt & Bowman, 2008). In support of the assertion is the fact that regardless of changes in awareness, knowledge, and motivations, at the end of the day, behavior is truly the only dependent variable that will produce positive, measurable effects on the environment (Shaw, 2010).

Given this reality, it is important that Extension natural resource professionals understand how variables such as awareness, knowledge, and motivations are likely to contribute to behavior change because these can be addressed through strategic outreach programs. Therefore, the aim of this article is to explore how these intrapersonal variables can be addressed by Extension to most effectively produce behavior change to prevent the spread of VHS to protect water quality and fisheries. To contribute to the literature exploring what factors contribute to people adopting behaviors that will protect natural resources, we examine how awareness, knowledge, and individual motivations are related to compliance with recommended behaviors to prevent the spread VHS once the effects of demographic variables such as age, level of education, and gender are controlled for.

## Literature Review

### Awareness

In the research reported here, awareness is presumed to be a precursor to knowledge. Awareness refers to people being alert to a particular issue (Krueger, 1989). If individuals are unaware about the consequences of their existing behaviors, it is unlikely that they will perceive a need to pursue any form of behavior change (Shaw, 2010). However, research indicates there is often a gap between the possession of environmental awareness and displaying pro-environmental behavior (Kollmus &

Agyeman, 2002). This set of mixed findings related to the influence of environmental awareness on behavior change leads to the first research question.

Research Question 1: What is the relationship between awareness about VHS and practicing VHS-preventative behaviors?

## **Knowledge**

There is an intellectual tradition within Extension that the role of the land-grant university and Extension in particular should be disseminating the knowledge of the university to address problems of concern to people (Barrows, 1984). Knowledge within this lens of understanding is often described as "research based" and "unbiased" (Blaine & Patton, 2000) and is typically based on scientific facts generated by university-based scientists. However, to the extent that behavior change is the goal of Extension programming to protect natural resources, studies indicate that knowledge has not been shown to consistently transfer to pro-environmental behavior (De Oliver, 1999). Nevertheless, while information alone may not be able to produce behavior change by itself (McKenzie-Mohr & Smith, 1999), providing relevant information may precipitate behavior change, particularly when lack of knowledge may be a barrier to action (Stern, 2002). The prospective role of knowledge in influencing behavior change leads to our second research question.

Research Question 2: What is the relationship between knowledge about VHS and practicing VHS-preventative behaviors?

## **Motivations**

This article examines two primary forms of human motivation—*intrinsic* and *extrinsic* motivations (Lavergne, Sharp, Pelletier, & Holtby, 2010). The first is *intrinsic* motivation, referring to the internal satisfaction and sense of autonomy obtained through performance of a particular behavior or set of behaviors that is meaningful to members of the target audience. Inversely, *extrinsic* motivation—as the name suggests—is externally driven such as to please others or in an effort to avoid repercussions from strong controlling influences by others (Mata et al., 2009). Of course, people can be motivated both *intrinsicly* and *extrinsicly* to adopt a new behavior. For example, in the research reported here, *intrinsic* motivation is conceptualized as a personal desire to protect the environment. *Extrinsic* motivations may include a desire to look good in front of friends or family (i.e., social norms) or to avoid getting a citation as a result of enforcement by wardens. These various possibilities lead to the third and final research question of the study reported on in this article.

Research Question 3: What is the relationship between *intrinsic* and *extrinsic* motivations about VHS and practicing VHS-preventative behaviors?

## **Methods**

Data for the research reported here were collected as part of the 2009 University of Wisconsin Survey Center Badger Poll, a representative biannual omnibus survey of Wisconsin residents. All questions related to the issue of aquatic invasive species and VHS in Wisconsin were developed by

the authors in partnership with UW-Extension and the Wisconsin Department of Natural Resources specifically for the study. More specifically, we compiled a number of questions regarding public awareness of the problem of VHS in Wisconsin, knowledge of legal and illegal VHS behaviors, personal motivations that may explain behavioral compliance, and questions regarding self-reported compliance with VHS-preventative behaviors. These questions were then used to create a number of indices reflecting more comprehensive assessments of the constructs discussed in our research questions (see below for explicit descriptions of the scale creation process).

The results are based upon data collected between October 29 and November 20, 2009, during the interim period between the summer and winter fishing seasons. The sample consisted of a cross-section of 507 Wisconsin adults, who completed a statewide random-digit-dial (RDD) telephone survey. The final response rate was 38.3% (calculated based on AAPOR Formula 3; please note that previous survey research has supported that response rates at this level are both common and representative of population parameters, see Groves, 2006). In order to better understand the opinions of those people who have the greatest chance of spreading VHS, our analyses are based upon the segment of the Badger Poll sample that identified themselves as either boaters or anglers ( $N=377$ ).

## Dependent Variable

VHS behavioral compliance was measured by creating a mean index of behaviors based on how often respondents (1="never", to 5="always") indicated they engaged in five activities related to preventing the spread of VHS. Means ( $M$ ) and standard deviations ( $SD$ ) for these individual behaviors and the behavioral index score are listed below. Specifically, respondents were asked the question, "for each of the following actions, please indicate whether you take that action never, rarely, sometimes, often or always when you are boating or when you are fishing": (1) "drain water from the boat before leaving the landing" ( $M=3.88$ ,  $SD=1.70$ ), (2) "drain water from the motor before leaving the landing" ( $M=3.12$ ,  $SD=1.88$ ), (3) "drain water from the livewell before leaving the landing" ( $M=3.18$ ,  $SD=1.86$ ), (4) "drain water from a bucket or other container holding your daily catch before leaving the landing" ( $M=3.03$ ,  $SD=1.75$ ), (5) "limit use of leftover minnows to same body of water" ( $M=4.66$ ,  $SD=.74$ ). Responses to these questions were combined and divided by 5 in order to create our dependent variable compliance with VHS behavioral compliance ( $M=3.61$ ,  $SD=1.39$ ).

When multiple statements or attitude items are combined to represent a respondent's evaluation of an attitude object, certain statistical methods can indicate how well the multiple statements or items measure what they are purported to measure, i.e., do they all measure the same basic concept? These statistics are known as internal consistency or reliability statistics (Eagly & Chaiken 1993), the most appropriate measure for Likert scales being Cronbach's alpha coefficient (Cronbach 1951). Cronbach's alpha coefficient is essentially the average correlation between the items in a particular scale; correlations can range from 0.0 (non-existent correlation) to 1.0 (perfect correlation). Nunnally (1978) argued 0.7 is an acceptable reliability coefficient—though lower thresholds are sometimes used in research literature (Santos, 1999). Reliability statistics measured with Cronbach's alpha were conducted on any items that were compiled of multiple Likert scales. Cronbach's alpha for the *VHS behavioral compliance* index was .73.

## Control Variables

In order to control for differences between social groups, we included three demographic controls in our hierarchical regression model: age, gender, and education. Age was a continuous variable measured in years ( $M=56.20$ ,  $SD=15.76$ ). Respondent education ( $M=4.90$ ,  $SD=1.78$ ), was based on responses to a scale that ranged from 1="never attended school or only attended kindergarten", 2="grades 1 through 8", 3="grades 9 through 11", 4="grade 12 or GED", 5="college 1 to 3 years", 6="4 year college graduate", 7="graduate work", or 8="completed graduate degree," indicating that the average respondent had graduated from high school or attended some college. Additionally, the sample was 54 percent female and 46 male (based on a dichotomous measure where 0=male and 1=female).

## Awareness

VHS awareness was measured using a single question asking respondents how much they had heard about the subject of viral hemorrhagic septicemia on a five-point scale (1="none at all", to 5="an extremely large amount"). Specifically respondents were asked the question, "since October 2008, how much have you heard, read, or seen about viral hemorrhagic septicemia or VHS." The measure had a mean of 1.82 and a standard deviation of 1.06, indicating that Wisconsin residents had a relatively low awareness of the issue of VHS at the time of the survey reported on in this article.

## Knowledge of Prevention Laws

In order to assess understanding of the subject of VHS, we created an additive index of six dichotomous items asking respondents to correctly identify the legality of specific behaviors regarding the spread of VHS specifically in Wisconsin. Respondents were first prompted by the statement, "Wisconsin has several laws and regulations related to aquatic invasive species and the fish disease VHS. Please tell me whether you believe each of the following behaviors is legal or not legal right now." Respondents were then given the following six laws: (1) "launch a boat or trailer with plants or animals attached," (2) "leave a boat landing with any water onboard a boat or in equipment with the exception of bait buckets and drinking water," (3) "leave a boat landing with plants or animals attached to a boat or trailer," (4) "release minnows in waterways in Wisconsin," (5) "leave a boat landing with any live fish other than bait," and (6) "use leftover minnows on another water body if they have had contact with lake or river water." Incorrect answers were then coded as zero, and correct responses were coded as 1.

Knowledge of these laws is essential because they specify the actions necessary to prevent the spread of invasive species and diseases like VHS. Currently, the Wisconsin Department of Natural Resources promotes these general behaviors as a method of preventing the spread of VHS. Although the rules also help stop the continued spread of other aquatic invasive species, the WI-DNR does not differentiate between VHS and AIS prevention behaviors. Knowledge of VHS laws ( $M=3.64$ ,  $SD=1.14$ ), therefore, was a summative index of the six scores ranging from 0 to 6.

## Motivations to Practice Prevention Behaviors

The motivation measures were constructed to reflect three types of personal motivations. Environmental motivations ( $M=4.06$ ,  $SD=.77$ ), conceptualized as intrinsic motivations, were measured by combining two related measures of motivational topics, "protecting Wisconsin fisheries" (1="not at all motivating" to 5="extremely motivating") and "preserving the natural beauty of Wisconsin lakes." The environmental motivation variable had a Cronbach's  $\alpha$  of .71. The following variables were conceptualized as extrinsic motivations. Social motivation ( $M=4.11$ ,  $SD=.67$ ) was measured by combining three related measures of motivations related to social norms. Specifically, we combined the following three items, "keeping lakes healthy for future generations," "doing what family and friends think is the right thing to do," and "modeling responsible behavior for family and friends." This measure of social motivations had a Cronbach's  $\alpha$  of .62. Last, legal motivations ( $M=3.91$ ,  $SD=1.16$ ) were measured by a single item asking respondents how motivational "avoiding a ticket and fine for disobeying the law" would be in encouraging positive AIS behaviors.

Additionally, hierarchical ordinary least squares (OLS) regression was used to address the three research questions posed in the study. This analytical method allowed us to assess the relative influence of each variable block on our dependent variable, above and beyond previously entered blocks (Kaplan, 2004). These changes are determined by examining the incremental R-square change between blocks—a statistic indicating the amount of variance explained in the dependent variable by each block of independent variables. Demographic variables were entered initially, followed by our measure of awareness. The knowledge of VHS laws variable was entered in the third block, and our three motivation variables were entered in the final block. Statistical significance for the regression analyses was determined for  $p < .05$ .

## Results

All statistical analysis was conducted using Statistics Package for the Social Sciences (SPSS) software v. 18. In the regression model, demographic variables accounted for about 14% of the variance in our dependent variable, VHS behavior compliance (Table 1). Younger respondents and males were both more likely to comply with positive VHS behaviors.

**Table 1.**  
Predictors of VHS Behavior Compliance

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>
<b>Block 1: Demographics</b>	$\beta$	$\beta$	$\beta$	$\beta$
Gender	-.20*	-.17*	-.17*	-.19*
Age	-.29*	-.29*	-.29*	-.30*
Education	-.05	-.06	-.06	-.07
Incremental $R^2$ (in %)	13.6			

<b>Block 2: VHS Awareness</b>		.20*	.20*	.16*
Incremental R <sup>2</sup> (in %)		3.9		
<b>Block 3: Knowledge of VHS Laws</b>			.00	-.03
Incremental R <sup>2</sup> (in %)			.00	
<b>Block 4: Motivations</b>				
Environmental Motivation				.18*
Social Motivation				.01
Legal Motivation				-.08
Incremental R <sup>2</sup> (in %)				3.1
Total R-Square				20.6
Note: * p ≤ .01				

Adding our measure of awareness to the model explained an additional 3.9% of the variance in VHS behavior compliance. This was the largest incremental increase in the explanation of the variance in our dependent variable in the entire model. In the final model, awareness of VHS ( $\beta=.16$ ,  $p\leq.01$ ) was a positive and significant predictor of VHS behavior compliance. Interestingly, knowledge was not significantly related to behavior compliance and, therefore, explained no additional variance in the dependent variable.

Last, entering the motivation variables into the model accounted for an additional 3.1% of the variance in our dependent variable. Although the legal and social extrinsic motivation variables were not significant predictors of VHS behavior compliance, intrinsic environmental motivations ( $\beta=.18$ ,  $p\leq.01$ ) positively predicted respondents' compliance with VHS behaviors.

## Discussion

This article posed three primary research questions, examining the relationship between awareness, knowledge, motivations and practicing VHS-preventative behaviors. Although the research reported on here focused on a statewide survey of boaters and anglers in Wisconsin, we believe that the findings may provide valuable insights for Extension programming in other states facing VHS in their own lakes and rivers, particularly to the extent that there are demographic and geographic

similarities between them. Expanding understanding about what intrapersonal factors contribute to behavior change offers the potential to significantly improve the effectiveness of outreach campaigns designed to prevent the spread of VHS. Additionally, our findings may provide conceptual insights about variables of interest to inform other Extension programs designed to protect natural resources.

In this article, knowledge was conceptualized as being familiar with the laws created to provide guidelines about the steps required for preventing the spread of AIS in Wisconsin. As found by other researchers and shared in the introduction of this article (De Oliver, 1999; McKenzie-Mohr & Smith, 1999), knowledge is not always a significant predictor of adopting behaviors to protect the environment. However, it should be noted that respondents knew almost four of the six laws included in the scale asking respondents to correctly identify the legality of specific behaviors regarding the spread of AIS and VHS. We are not suggesting that knowledge is unimportant but rather other variables in the model, most notably awareness and intrinsic motivation to protect the environment, played a stronger role in predicting behavioral compliance for AIS-preventative behaviors.

The finding that knowledge of the laws was not a significant predictor of behavioral compliance was also consistent with the finding that the extrinsic motivation of avoiding a ticket and fine for disobeying the law also did not predict behavioral compliance. It may be that other dimensions of knowledge such as characteristics of the disease in combination with legal knowledge may offer stronger predictive power of behavioral compliance, and future research should explore this possibility. Similarly, we encourage future research to consider the possible influence that knowledge may have on observed behavioral compliance.

Due to the nature of our data (and all survey data), we were restricted to examining predictors of an individual's self-reported behavioral compliance. Although self-reported measures are often used as proxies for observational data in large cross-sectional surveys, examining the relationships between awareness, knowledge, motivations, and observed behavioral compliance may offer additional insight into how to optimize educational programs designed to prevent the spread of VHS. For instance, awareness and knowledge may serve very different purposes in informing actual behavior in comparison to self-reported data. Considering this, we urge that future research investigate these relationships further through the collection of observational data.

As pointed out in the introduction, it has been argued that Extension's central mission is to educate the public with objective, unbiased scientific knowledge (Barrows, 1993). However, in scenarios where the primary objective is to change people's environmental behavior, not just increase their knowledge about the issue, our findings suggest that Extension educators may also want to focus on awareness along with the intrinsic motivations of the target audience. Intrinsic motivations (i.e., a desire to protect the environment) were significantly related to self-reported behavioral compliance, while extrinsic motivations such as social norms and fear of enforcement were not. This suggests that Extension natural resource professionals emphasize communications that appeal to the intrinsic motivations that are most resonant with their target audience. That is not to encourage an omission of particular scientific and legal facts but rather suggests emphasizing those facts that are most consistent with the motivations of the target audience in order to influence the desired outcome of behavior change.



## Conclusions

As the identity of Extension continues to develop and evolve, it is important to consider alternative approaches to the dissemination of scientific information. Our results indicate that various target audiences are likely to react differently to information from Extension professionals based on characteristics such as demographic variables, previous understanding or awareness of a topic, and the overall frame used to discuss the issue.

Communication literature regarding the effects of framing suggests that information frames activate certain thoughts, which can direct attention towards related ideas and away from alternative trains of thought (Chong & Druckman, 2007). Considering this body of research, the finding that certain personal motivations may outweigh basic knowledge levels in regards to positive behavior change provides useful insight for Extension professionals focused on protecting natural resources. More specifically, the results suggest that Extension professionals should consider audience attitudes and predispositions, in addition to levels of knowledge, before structuring educational materials and messages (for examples see, Griskevicius, Tybur, & Van den Bergh, 2010; Hongu, Kataura, & Block, 2011). Taking these audience characteristics into account could help in making information more salient among citizens and, subsequently, influence their likelihood of adopting positive environmental behaviors.

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