

## Enhancing Aquatic Invasive Species Outreach Through Values-framed Messages

Elizabeth J. Golebie & Carena J. van Riper

To cite this article: Elizabeth J. Golebie & Carena J. van Riper (2022): Enhancing Aquatic Invasive Species Outreach Through Values-framed Messages, Environmental Communication, DOI: [10.1080/17524032.2022.2156574](https://doi.org/10.1080/17524032.2022.2156574)

To link to this article: <https://doi.org/10.1080/17524032.2022.2156574>



Published online: 13 Dec 2022.



Submit your article to this journal [↗](#)



View related articles [↗](#)




View Crossmark data [↗](#)

RESEARCH ARTICLE



# Enhancing Aquatic Invasive Species Outreach Through Values-framed Messages

Elizabeth J. Golebie and Carena J. van Riper 

Department of Natural Resources and Environmental Sciences, University of Illinois Urbana-Champaign, Urbana, IL, USA

## ABSTRACT

Aquatic invasive species (AIS) pose negative threats to ecosystems and society on a global scale. The unintentional transport of AIS by recreationists who move between waterbodies has prompted outreach campaigns that encourage changes in human behavior. These campaigns have been widely disseminated, however the risks of AIS transport remain high. Thus, evaluations of how these campaigns are being processed by stakeholders are urgently needed. In this study, we tested the persuasive capacity of values-framed messages among recreational water users throughout the U.S. state of Illinois. Results indicated that messages framed to reflect biospheric and altruistic values were most likely to resonate with recreationists. Specifically, participants with strong biospheric values tended to review the message closely when it was aligned with their values, resulting in stronger beliefs about their ability to take action. Implementing values-framing in AIS outreach may ultimately increase support for AIS prevention and lower the risk of spread.

## ARTICLE HISTORY

Received 4 May 2022  
Accepted 3 December 2022

## KEYWORDS

Message framing;  
elaboration likelihood  
model; protection  
motivation theory; aquatic  
invasive species prevention

## Introduction

Aquatic invasive species (AIS) are organisms that have established populations outside of their native range and caused negative impacts (Blackburn et al., 2011) such as altered habitat and interference with human activity (Gallardo et al., 2016). Removal of AIS is nearly impossible, underscoring the critical role of prevention in management of biological invasions (Vander Zanden & Olden, 2008). Recreational water users are at risk of spreading AIS by accidentally carrying these organisms via boats and equipment and depositing them in new locations (Rothlisberger et al., 2010). Thus, informing aquatic recreationists of ways they can prevent AIS transport has become a priority for environmental education and outreach (Pradhananga et al., 2015; Seekamp, Mayer, et al., 2016).

Numerous informational campaigns have been developed to raise awareness of the risks posed by AIS (Cole et al., 2016; Kemp et al., 2017; Seekamp, McCreary, et al., 2016). Knowledge of how recreational water users are processing these campaigns is needed to inform strategies for improvement (Cole et al., 2019). Values-framing has been proposed as one of these strategies, given that it could leverage an individual's core principles to convey the relevance of a message (van Riper et al., 2018; Marquina et al., 2022). This research approach can be theoretically guided by the Value-Belief-Norm Theory of Environmentalism, which holds that values are long-term drivers of environmental beliefs and behaviors (Stern et al., 1999). Responses to values-framed messages can be understood through Protection Motivation Theory, which holds that risk perceptions and

efficacy are necessary factors for risk communication campaigns to have a desired impact (Rogers, 1975). Additionally, research on message processing, including elaboration (Petty & Cacioppo, 1986), reactance (Brehm & Brehm, 1981), and message effectiveness (Dillard & Ye, 2008), has provided insight on the mechanisms that influence responsiveness in environmental communication. The combination of these conceptual frameworks shows promise to better understand and enhance communication about how best to minimize the spread of AIS.

## Literature review

### *Protection motivation theory*

Communication theories, such as Protection Motivation Theory, have been used to understand message responses. Originally developed to explain responses to fear-based messages (Rogers, 1975), Protection Motivation Theory addresses the role of risk perceptions, self-efficacy, and response-efficacy in risk communication (Milne et al., 2000). Risk perceptions are beliefs about the severity of threats, self-efficacy is defined as beliefs about one's ability to effectively complete an activity, and response-efficacy is defined as beliefs that the activity itself will have a positive impact (Kothe et al., 2019). Previous research guided by Protection Motivation Theory has demonstrated that both efficacy and risk perceptions must be activated for people to engage in protective action in response to a threat (Floyd et al., 2000). When risk perceptions are low, people do not view the threat as important, and are thus not motivated to act (Mongeau, 2012). When efficacy is lacking, people feel unable to engage in the behaviors recommended by a message and instead reject the message outright – a response known as reactance (Maddux & Rogers, 1983). Thus, for a message to effectively communicate about risk mitigation, it should raise both risk perceptions and efficacy.

### *Message framing*

Risk communication can be enhanced by drawing on message framing research. Message framing, defined as “the process by which people develop a particular conceptualization of an issue” (Chong & Druckman, 2007, p. 104), encompasses a broad area of study related to the way information is communicated and understood (Lakoff, 2010). Normative framing, which highlights how desired behaviors are performed by one's peers, has been effective for communicating about multiple environmental topics (Cialdini, 2003; Lede & Meleady, 2019). However, there are mixed results on the persuasiveness of normative framing for AIS (Niemic et al., 2021; Wallen & Kyle, 2018). Likewise, the framing strategy of metaphors (e.g. comparing AIS management to a battle or war) has faced mixed success for AIS communication (Shaw et al., 2021). Although metaphorical frames have bolstered support for AIS policy (Kohl et al., 2020), they have been criticized as biased and xenophobic (Mando & Stack, 2019; Verbrugge et al., 2016). To move past these limitations, other framing techniques, such as values-based framing, should be considered (van Riper et al., 2018).

### *Value concepts*

Values, defined as broad goals that serve as guiding principles in life (Rokeach, 1973), have been conceptualized through numerous theoretical frameworks, including Value-Belief-Norm Theory of Environmentalism (Stern et al., 1999), The Theory of Basic Human Values (Schwartz, 1992), and Social Values (Kenter et al., 2019). For example, Schwartz (1992) posited that self-transcendence pertained to concern for entities outside the self, including altruistic (i.e. equality, justice, and peace) and biospheric values (i.e. environmental protection that aids in finding unity with nature), whereas self-enhancement values are focused on pursuing benefits to the self, including egoism (i.e. power and influence). People are guided by multiple values, but the relative importance of each value varies across cultures and individuals (Schwartz, 2012).

Values motivate environmental actions when the behavior is relevant to the underlying value (Sagiv & Schwartz, 2022). The Value-Belief-Norm Theory of Environmentalism (Stern et al., 1999) holds that three key values inform environmental beliefs: biospheric, altruistic, and egoistic values. A large body of research has supported this tripartite conceptualization and provided evidence for their relevance in influencing environmental beliefs and behavior (Stern et al., 1999; van Riper & Kyle, 2014; Steg et al., 2005; de Groot & Steg, 2008). These three values are distinct, as evidenced by the different relationships each has with environmental beliefs and behaviors. Biospheric and altruistic values lead individuals to support practices such as cleaning boats to prevent the spread of AIS (Golebie et al., 2021). Some researchers (e.g. Pradhananga et al., 2015; van Riper & Kyle, 2014) have suggested that altruistic and biospheric values should be collapsed into one dimension, whereas other researchers have distinguished between the two. Egoistic values are a distinct third value, given that they are negatively correlated with environmental beliefs (de Groot & Steg, 2008; Stern et al., 1998). Despite robust evidence that values are direct predictors of beliefs (Schultz et al., 2005), and the recognition of the need for values-framed messages (Lakoff, 2010), few past studies have empirically tested values-framing as a strategy for environmental campaigns.

The limited body of research on values-framing for environmental issues has provided mixed evidence for the ways that values affect message processing. For instance, Nilsson et al. (2014) indicated that people with strong self-transcendence values experienced positive emotions when thinking about purchasing green energy and negative emotions when thinking about rejecting green energy. The reverse relationship was observed for people with self-enhancement values. Other studies indicated that value alignment affected ability to discern argument strength (von Borgstede et al., 2014) and attitudes (Arp, 2018). In response to the aforementioned bodies of research informed by message framing and values, we hypothesized that values would predict elaboration when aligned with a message frame (H1-H3). Specifically, for a frame that reflected self-transcendence, we believed biospheric and altruistic values would positively predict elaboration whereas egoistic values would positively predict elaboration for a self-enhancement message frame.

Research on the outcomes of values-framing has provided mixed evidence. In contrast to work indicating that values framing influences message responses, Dean et al. (2019) showed that political orientation played a larger role than values. Additionally, several studies have argued that biospheric framing is perceived as more logical for environmental topics than other value frames, regardless of value-alignment. Specifically, one study indicated that biospheric framing improved message evaluations among individuals with strong biospheric values, whereas hedonic framing did not impact individuals with strong hedonic values (Judge et al., 2021). Biospheric messages in another study were also perceived as more effective than altruistic and egoistic messages for sharing information about environmental topics (Hansla, 2011). Given the limited and mixed research on value-alignment, more work is needed regarding its role on beliefs like risk perceptions and efficacy, and the resulting relevance for AIS-related environmental outreach programs.

### **Message evaluations**

Messages can be evaluated by assessments of elaboration, reactance, and perceived message effectiveness. The elaboration likelihood model positions message processing along a continuum that ranges from low to high elaboration (Petty & Cacioppo, 1986). When engaging in high elaboration, people think systematically about information relevant to the message, in contrast to low elaboration whereby people use mental shortcuts and heuristics to form opinions. High elaboration is sought after in communication campaigns because it tends to create stronger attitudes and longer-lasting effects (O’Keefe, 2013). In the context of fisheries management, anglers who have carefully read and reflected on AIS brochures would be expected to form longer-term beliefs that AIS are a problem, as compared to anglers who skim content or only look at images. Assuming a trustworthy message is employed, it is likely that high elaboration would induce increases in beliefs about the risks of AIS and one’s ability to take action (Petty et al., 2009). Examining the

explanatory relationships among elaboration, risk, and efficacy will provide insights into the utility of values-framed messaging campaigns. Thus, we hypothesize that elaboration will positively predict risk perceptions and efficacy (H4-H8).

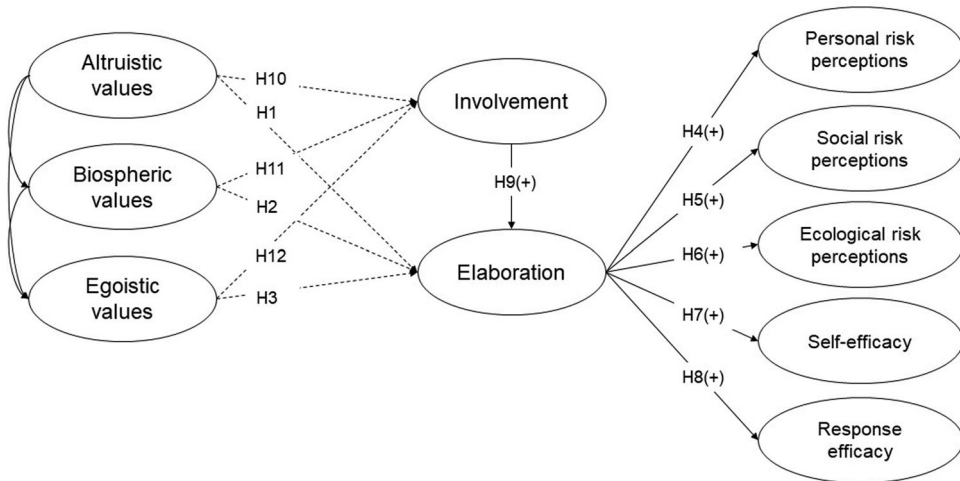
Elaboration depends on issue-involvement, defined as personal relevance of an issue to one's life (Petty & Cacioppo, 1979). When someone has high issue-involvement, they recognize the relevance of the message and are thus motivated to read it closely and think deeply about its contents. There is also evidence that messages tailored to individual characteristics increase elaboration (Kroeze et al., 2006). Thus, values may have a similar effect; relevance to one's guiding principles in life may increase perceived issue-involvement, as well as directly increase motivation to engage with a message more closely (von Borgstede et al., 2014; Arp, 2018). We therefore hypothesized that involvement would positively predict elaboration (H9) and that values would predict issue-involvement (H10-H12).

In contrast to elaboration, reactance is typically an undesirable message response. We define reactance as "the motivational state that is hypothesized to occur when a freedom is eliminated or threatened with elimination" (Brehm & Brehm, 1981, p. 37). If a message is too forceful, readers may perceive it to be a threat to their own choices and resist the message (Quick et al., 2013). For instance, if a boater believes an AIS awareness sign is aggressive and intrudes on their post-boating routine, they may respond by refusing to follow the boat cleaning guidelines on the sign in order to assert their own autonomy. Likewise, people tend to reject a message when they lack the ability to respond (Maddux & Rogers, 1983). Therefore, reactance can be averted by imbuing messages with statements that activate self-efficacy and empower individuals to take responsibility for their actions (Chang, 2021). Additionally, given that people are more likely to experience reactance in response to an identity threat (Hansen et al., 2010), it is important to consider whether reactance is elicited among people who read a message imbued with values that do not align with their own.

Perceived message effectiveness has also received attention in previous research, given its capacity to predict attitudinal or behavioral outcomes promoted by the message (Dillard et al., 2007). We define message effectiveness as "an estimate of the degree to which a persuasive message will be favorably evaluated by recipients of that message" (Dillard & Ye, 2008, p. 150). Message effectiveness is influenced by several factors, including message features (Andsager et al., 2006) and characteristics of the recipient (Bigsby et al., 2013). Given that alignment between a recipient's value system and the values reflected in a message may also increase perceived message effectiveness (Noar et al., 2010), this area of research shows promise to help understand responses to values-framed messages.

### **Study purpose**

Given that values are fundamental drivers of behavior (van Riper et al., 2018), including AIS-prevention (Golebie et al., 2021; Shin et al., 2022), framing outreach messages in line with values may encourage more recreationists to take action. However, the effects of alignment between the values portrayed within a message and the values of the message recipient have yet to be empirically tested. Therefore, this study assessed the effectiveness of AIS outreach messaging framed according to self-transcendent (i.e. biospheric and altruistic) and self-enhancement (i.e. egoistic) values. The following three research questions were addressed: (1) What responses do values-framed messages evoke among recreational water users? (2) How are relationships among values, involvement, elaboration, and beliefs influenced by messages framed in line with different values? (3) How does reading a message aligned with one's values affect their processing of that message? In response to these questions, we tested 12 hypotheses using a latent variable path model (Figure 1).



**Figure 1.** Hypothesized model of relationships among values, involvement, elaboration, and beliefs relevant to aquatic invasive species. Twelve hypothesized paths were tested between values and elaboration (H1-H3), elaboration and beliefs (H4-H8), involvement and elaboration (H9), and values and involvement (H10-H12). Plus signs (+) indicate positive hypothesized relationships. Dotted lines indicate hypothesized relationships dependent on message treatment. Values were hypothesized to positively correlate with elaboration if there was message alignment (i.e. biospheric and altruistic values were hypothesized to positively correlate with elaboration when presented with the self-transcendent message; egoistic values were hypothesized to positively correlate with elaboration when presented with the self-enhancement message).

## Methods

### Study context

This research was conducted across the U.S. state of Illinois (IL) where AIS are of great concern due to the interconnectedness of waterbodies (Cole et al., 2019). We evaluated the *Be a Hero* campaign developed by the IL Department of Natural Resources; its tagline “Be a Hero, Transport Zero” encourages recreational water users to minimize risks of transporting AIS (See for details: <https://www.transportzero.org/>). In 2013, approximately 25% of IL boaters recognized the *Be a Hero* campaign (Cole et al., 2016).

### Sampling methods

This message experiment was implemented through a survey administered from May-June 2021. Our protocol (#20679) was approved by University of Illinois at Urbana Champaign Office for the Protection of Research Subjects (OPRS). Participants provided informed consent appropriate for an online survey and had the ability to withdraw at any time. Participants were recruited from a Qualtrics panel of IL residents and deemed eligible if they were at least 18 years old and had gone fishing or participated in a recreational water activity (e.g. sailing, kayaking, canoeing, boating, jetskiing) on at least one occasion since 2018. All participants were compensated by Qualtrics for their participation. Responses were recorded only when the entire survey was completed and when two “attention check” questions were answered correctly (Kung et al., 2018). Invalid responses were discarded when patterns indicated extreme inattention or possible use of bots, defined as selecting the first response option for every question (i.e. “straightlining”), or completing the survey in less than five minutes. The final sample size was 507.

Participants were majority female (59.1%), White (86%), and held a bachelor’s degree or higher (53%), with an average age of 45.36 ( $SD = 17.72$ ). Participants had spent an average of 9.71 ( $SD = 15.96$ ) days boating and 11.60 ( $SD = 19.97$ ) days fishing over the past year. They also had 14.97 ( $SD$

= 14.77) years of boating experience and 21.46 ( $SD = 19.09$ ) years of fishing experience. Reported experience and avidity levels were lower than studies of licensed anglers (e.g. van Riper et al., 2020; days fished:  $t(765) = 7.58, p < .001$ ; years fished:  $t(765) = 12.87, p < .001$ ), indicating messages were tested among people who were less likely to have been heavily exposed to AIS messaging (Seekamp, McCreary, et al., 2016). We did not control for demographics or recreational experience in our analysis.

### Survey measures

Survey measures were drawn from past work and evaluated through confirmatory factor analysis. Reliability was tested using Cronbach's alpha ( $\alpha$ ) and McDonald's omega ( $\Omega$ ) and considered acceptable when coefficients were greater than 0.60 (Cortina, 1993; Bagozzi & Yi, 1988). Convergent validity was considered acceptable with average variance extracted (AVE) values that exceeded .50 (Hair et al., 2011).

Three scales were used to measure how participants evaluated messages. We used a six-item message effectiveness scale developed in past work (Davis et al., 2013), and found it to be reliable and valid ( $\alpha = .908$ ;  $\Omega = .910$ ;  $AVE = .629$ ). We used a seven-item reactance scale drawn from past work (Nisbet et al., 2015) and dropped all reverse coded items due to low reliability, resulting in a three-item scale ( $\alpha = .697$ ;  $\Omega = .700$ ;  $AVE = .442$ ). To measure elaboration, we selected six items from an established scale (Reynolds, 1997); three items were dropped given standardized factor loading scores below 0.40 (Hair et al., 2011), which resulted in a three-item scale ( $\alpha = .714$ ;  $\Omega = .727$ ;  $AVE = .479$ ).

In line with Protection Motivation Theory (Rogers, 1975), risk perceptions and efficacy were measured after message exposure. Risk perceptions were assessed by asking participants to report the perceived severity of environmental, social, and personal impacts. Building on previous research that has measured both social and personal dimensions of risk (van Riper et al., 2016), we added an environmental dimension to reflect the direct threats faced by aquatic ecosystems that may be processed differently than threats that directly impact humans. To measure self-efficacy, three items were drawn from past work (Bandura, 1977), and adapted to the context of AIS management. Three items measuring response-efficacy were developed during earlier qualitative phases of this project and were refined in response to past research (Landon et al., 2018). All risk perception and efficacy scales were reliable (Table 2).

Drawing on the Value-Belief-Norm Theory of Environmentalism (Stern et al., 1999), values were measured using survey items associated with three dimensions: biospheric, altruistic, and egoistic. A six-item issue scale was adapted from past work (Quick & Stephenson, 2007) to measure AIS issue involvement. Two items from the involvement scale were dropped due to low factor loadings; the resultant four-item scale was reliable ( $\alpha = .832$ ;  $\Omega = .777$ ;  $AVE = .522$ ).

### Experimental design

In consultation with Illinois-Indiana Sea Grant, three treatments were developed to test the effects of value-framing (Table 1) by modifying a brochure that was in use by *Be a Hero*. First, a self-transcendent message incorporated principles of altruism and environmentalism. Second, a self-enhancement message incorporated principles of self-interest and goal attainment. Finally, a third group received the original message contained in the brochure, which simply read: "Don't dump bait." Each participant was randomly assigned one of these three messages. Each experimental message was embedded within the brochure (see Appendix 1), meaning that participants were exposed to a broad suite of information consistent across all three groups, as well as the treatment information reflected in Table 1.

During the survey, participants first responded to questions about their recreational experience. Next, they were presented with one of the three experimental messages. Immediately following

**Table 1.** Message content for three treatments that reflected self-transcendent values, self-enhancement values, and a baseline message.

Treatment	Message content
Self-transcendent	<p>PROTECT THE ENVIRONMENT</p> <p>Aquatic invaders can dramatically change the ecosystem and harm native fish species. By completing remove-drain-dry, you can ...</p> <ul style="list-style-type: none"> <li>• Protect the quality of habitats and natural environments</li> <li>• Preserve recreational opportunities for future generations</li> <li>• Build a sense of community among anglers and water users</li> <li>• Ensure the economic benefits provided by the resource will continue to benefit the region</li> </ul>
Self-enhancement	<p>YOUR WATERWAYS ARE BEING IMPACTED</p> <p>Aquatic invaders can block access to waterbodies and prevent you from enjoying your favorite activities. By completing remove-drain-dry, you can ...</p> <ul style="list-style-type: none"> <li>• Protect the waterbodies that you value the most</li> <li>• Ensure you'll be able to enjoy the resource for years to come</li> <li>• Know you have done the right thing to be a responsible angler or boater</li> <li>• Influence other recreationists to take responsibility for the ecosystem</li> </ul>
Baseline	Don't dump bait

message exposure, they responded to items measuring elaboration, reactance, and message effectiveness. Next, they reported beliefs about AIS, including risk perceptions, self-efficacy, and response-efficacy. Message responses and beliefs were asked after message exposure to test hypothesized differences between these constructs due to differences in message framing. Participants were asked about their values at the end of the survey, because these questions were least related to AIS or outdoor recreation. Given that values are psychologically stable (van Riper et al., 2018), we did not expect the message experiment to impact reported values, and indeed, our results showed there were no differences in average values across the three treatment groups (See Appendix 2).

### Analysis

Mean values of message evaluations (i.e. perceived effectiveness, elaboration, and reactance) were estimated and compared against the baseline message using an ANOVA. To assess relationships among values, elaboration, and beliefs, we used structural equation modeling (Kline, 2015). First, we assessed the measurement properties for each scale using confirmatory factor analysis; the measurement model demonstrated good fit ( $\chi^2 = 622.125$ ,  $df = 329$ ,  $p < .001$ ; CFI = .961; RMSEA = .042; SRMR = .042). Next, a structural regression model was estimated to test the 12 hypotheses (see Figure 1). The full information maximum likelihood method was used to account for missing data (Von Hippel, 2016). Model fit was considered acceptable given Root Mean Square Error Approximation (RMSEA)  $\leq 0.07$  (Steiger, 2007), Comparative Fit Index (CFI)  $\geq 0.90$  (Bentler, 1990), and Standardized Root Mean Square residual (SRMR)  $\leq 0.10$  (Kline, 2015). Using multi-group SEM analyses, three separate models were estimated for the three groups of participants that received distinctly framed messages. After establishing measurement invariance between the models, differences in path coefficients were assessed. Specifically, we used a chi-square difference test to compare a model that was allowed to vary across the three groups against a model that constrained all betas to be equal. Indirect effects were estimated by multiplying path coefficients. All analyses were conducted in R version 3.6.1.

### Results

Participants responded favorably to the messages, reporting high effectiveness ( $M = 4.12$ ,  $SD = 0.67$ ), moderately high elaboration ( $M = 3.73$ ,  $SD = 0.73$ ), and low reactance ( $M = 2.63$ ,  $SD = 0.87$ ) across all three messages (Table 3). Likewise, there were no significant differences in post-message beliefs (i.e. efficacy and risk perceptions) among the three messages. Rather, all participants



**Table 2.** Factor loading scores, means, and standard deviation for survey items evaluated by recreational water users in the pooled sample. Measures of internal consistency for each construct include Cronbach's alpha ( $\alpha$ ) McDonald's omega ( $\Omega$ ), and average variance explained (AVE).

	Factor loading	M (SD)
<b>Biospheric values<sup>1</sup> (<math>\alpha = .798</math>; <math>\Omega = .800</math>; AVE = .572)</b>		<b>4.27 (0.67)</b>
Protecting the environment: preserving nature	.741	4.37 (0.75)
Unity with nature: fitting into nature	.760	4.12 (0.86)
A world of beauty: beauty of nature and the arts	.766	4.33 (0.78)
<b>Altruistic values<sup>1</sup> (<math>\alpha = .816</math>; <math>\Omega = .831</math>; AVE = .627)</b>		<b>4.25 (0.78)</b>
Equality: equal opportunity for all	.802	4.28 (0.86)
Social justice: correcting injustice, care for others	.843	4.08 (1.04)
A world at peace: free of war and conflict	.693	4.38 (0.83)
<b>Egoistic values<sup>1</sup> (Spearman-Brown Coefficient =0.768)*</b>		<b>3.38 (1.02)</b>
Authority: the right to lead or command	.754	3.35 (1.17)
Influential: having an impact on people and events	.773	3.41 (1.11)
<b>Self-efficacy<sup>2</sup> (<math>\alpha = .865</math>; <math>\Omega = .865</math>; AVE = .682)</b>		<b>4.12 (0.75)</b>
I understand what I need to do in order to remove AIS from my boat or equipment	.840	4.11 (0.85)
I am capable of performing the tasks required to remove possible AIS from my boat and equipment	.826	4.18 (0.84)
I feel confident in performing procedures necessary to prevent AIS from spreading	.810	4.08 (0.83)
<b>Response-efficacy<sup>2</sup> (<math>\alpha = .846</math>; <math>\Omega = .846</math>; AVE = .647)</b>		<b>4.35 (0.66)</b>
Cleaning my boat and equipment helps to prevent AIS from spreading	.838	4.36 (0.73)
My own actions to remove, drain, dry will protect fishing waters from AIS	.818	4.30 (0.77)
If everyone remembered to "remove, drain, dry", we could significantly lower the risk of spreading AIS	.759	4.38 (0.77)
<b>Environmental risk perceptions<sup>3</sup> (<math>\alpha = .823</math>; <math>\Omega = .823</math>; AVE = .609)</b>		<b>3.56 (0.79)</b>
Quality of habitat and natural environments	.809	3.52 (0.88)
Environmental processes (e.g. water cycle)	.807	3.46 (0.95)
Survival of plants and animals	.723	3.69 (0.92)
<b>Personal risk perceptions<sup>3</sup> (<math>\alpha = .815</math>; <math>\Omega = .816</math>; AVE = .598)</b>		<b>3.32 (0.94)</b>
Your appreciation of the beauty of the landscape	.736	3.33 (1.10)
Your own enjoyment of recreational activities	.774	3.40 (1.05)
Your own access to the waterbody	.805	3.22 (1.14)
<b>Social risk perceptions<sup>3</sup> (<math>\alpha = .843</math>; <math>\Omega = .860</math>; AVE = .677)</b>		<b>3.32 (0.94)</b>
The local economy	.851	3.14 (1.12)
The community in the region	.895	3.16 (1.11)
Recreational opportunities for future generations	.687	3.66 (1.02)
<b>Involvement<sup>2</sup> (<math>\alpha = .832</math>; <math>\Omega = .777</math>; AVE = .523)</b>		<b>3.04 (0.89)</b>
The spread of aquatic invasive species is a personally relevant topic for me	.702	3.41 (0.95)
I think about aquatic invasive species a great deal	.772	2.85 (1.11)
I find myself bringing up aquatic invasive species in casual conversation	.680	2.54 (1.18)
When aquatic invasive species come up in conversation I "tune in"	.732	3.35 (1.11)
<b>Elaboration<sup>2</sup> (<math>\alpha = .714</math>; <math>\Omega = .727</math>; AVE = .479)</b>		<b>3.73 (0.73)</b>
Deep in thought about the message	.854	3.71 (0.90)
Extending a good deal of cognitive effort	.636	3.64 (0.98)
Reflecting on the implications of the arguments	.553	3.83 (0.88)

Note: measurement model indicated good model fit ( $\chi^2 = 769.600$ ,  $df = 359$ ,  $p < .001$ ; CFI = .948; RMSEA = .047; SRMR = .046).

<sup>1</sup>Measured on a 5-point scale from "unimportant" (1) to "very important" (5)

<sup>2</sup>Measured on a 5-point scale from "strongly disagree" (1) to "strongly agree" (5)

<sup>3</sup>Measured on a 5-point scale from "no impacts" (1) to "very severe impacts" (5)

\*One survey item was dropped from this construct due to poor model fit

reported moderate risk perceptions (Personal:  $M = 3.32$ ,  $SD = 0.94$ ; Social:  $M = 3.32$ ;  $SD = 0.94$ ; Environmental:  $M = 3.56$ ;  $SD = 0.79$ ) and moderately high efficacy (Self:  $M = 4.12$ ,  $SD = 0.75$ ; Response:  $M = 4.35$ ,  $SD = 0.66$ ) after reading the message.

Structural equation models to explain relationships among values, involvement, elaboration, and beliefs demonstrated acceptable model fit, indicating significant relationships among these constructs (self-transcendent:  $\chi^2 = 634.801$ ,  $df = 375$ ,  $p < .001$ , CFI = .904, RMSEA = .065, SRMR = .089; self-enhancement:  $\chi^2 = 585.789$ ,  $df = 375$ ,  $p < .001$ , CFI = .924, RMSEA = .057, SRMR = .071; baseline:  $\chi^2 = 647.867$ ,  $df = 375$ ,  $p < .001$ , CFI = .902, RMSEA = .065, SRMR = .090). Elaboration was positively correlated with all dimensions of risk perceptions and efficacy in all three

**Table 3.** Mean values and standard deviations for message evaluation and post-message beliefs across the three treatment groups. No significant differences were detected at  $p < 0.05$ .

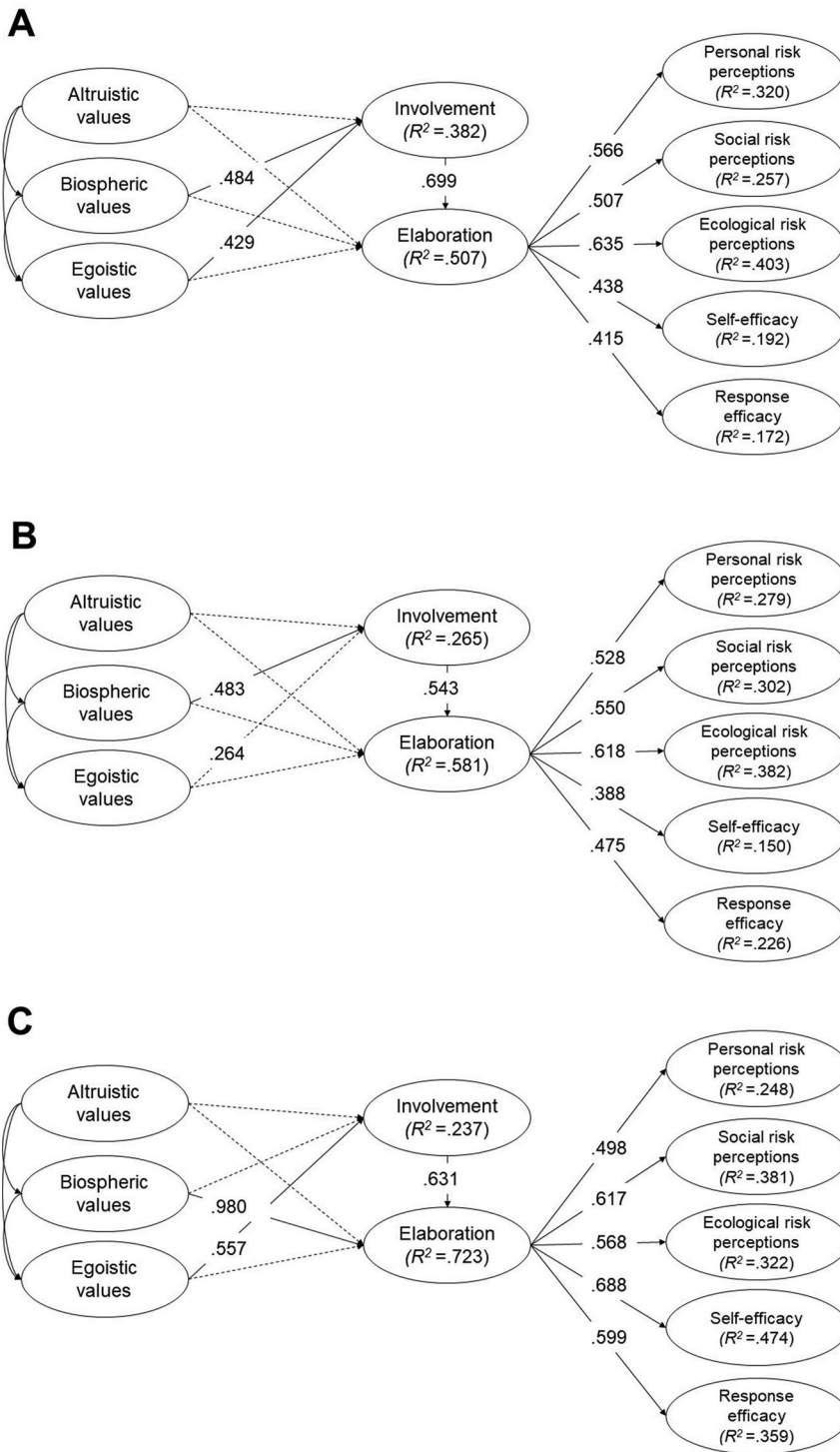
	Self-transcendent framing	Self-enhancement framing	Baseline	F	P
<b>Message evaluation</b>					
Elaboration	3.75 (0.72)	3.68 (0.77)	3.75 (0.71)	.511	.600
Perceived effectiveness	4.11 (0.69)	4.10 (0.68)	4.14 (0.64)	.220	.803
Reactance	2.61 (0.90)	2.63 (0.87)	2.64 (0.84)	.019	.981
<b>Post-message beliefs</b>					
Risk perceptions					
Personal	3.27 (0.96)	3.36 (0.90)	3.31 (0.96)	.443	.642
Social	3.28 (0.95)	3.30 (0.96)	3.38 (0.92)	.519	.595
Environmental	3.48 (0.78)	3.60 (0.76)	3.58 (0.82)	1.179	.308
Self-efficacy	4.09 (0.81)	4.09 (0.76)	4.19 (0.67)	1.195	.304
Response-efficacy	4.35 (0.67)	4.30 (0.71)	4.40 (0.60)	1.000	.369

models (Figure 2). Strong associations between elaboration and environmental risk perceptions ( $\beta = .688$ ,  $p < .001$ ) were observed in the group that received the baseline message. Likewise, for the group that received the self-enhancement message, elaboration was closely correlated with environmental risk perception ( $\beta = .618$ ,  $p < .001$ ) as well as social ( $\beta = .500$ ,  $p < .001$ ) and personal ( $\beta = .528$ ,  $p < .001$ ) risk perceptions. Similar patterns emerged in response to the self-transcendent message, in that elaboration positively correlated with self-efficacy ( $\beta = .688$ ,  $p < .001$ ) and response-efficacy ( $\beta = .599$ ,  $p < .001$ ).

Having established measurement invariance (Table 4), we compared the models to identify differences in relationships between values and elaboration. Specifically, we compared a model that allowed regression coefficients to vary across the three groups ( $\chi^2 = 2006.7$ ,  $df = 1265$ ) against a model that constrained all betas to be equal ( $\chi^2 = 2061.8$ ,  $df = 1289$ ). The constrained model did not fit the sample data as well ( $\Delta \chi^2 = 55.077$ ,  $\Delta df = 24$ ,  $p < .001$ ), indicating significant differences in regression coefficients across the three message treatments. In particular, the relationship between biospheric values and elaboration was positive and significant for participants who received the self-transcendent message ( $\beta = .980$ ;  $p = .024$ ), but non-significant for the two other experimental groups (Baseline:  $\beta = .003$ ;  $p = .985$ ; Self-enhancement:  $\beta = .173$ ;  $p = .254$ ); comparison of a model that constrained this path against a model that allowed this path to vary confirmed a significant difference ( $\Delta \chi^2 = 6.120$ ,  $\Delta df = 2$ ,  $p = .047$ ). For the self-transcendent treatment group, there were corresponding indirect effects between biospheric values and all five beliefs including self-efficacy ( $\beta = .674$ ;  $z$ -value = 2.971;  $p = .003$ ), response-efficacy ( $\beta = .587$ ;  $z$ -value = 2.858;  $p = .004$ ), ecological risk perceptions ( $\beta = .556$ ;  $z$ -value = 2.854;  $p = .004$ ), personal risk perceptions ( $\beta = .487$ ;  $z$ -value = 2.830;  $p = .005$ ), and social risk perceptions ( $\beta = .605$ ;  $z$ -value = 2.863;  $p = .004$ ). In contrast to our hypotheses, the relationship between egoistic values and elaboration was non-significant for all groups, including the self-enhancement group ( $\beta = -.009$ ;  $p = .934$ ). Finally, the relationship between elaboration and self-efficacy was the strongest for the self-transcendent treatment in contrast to the other two treatments ( $\Delta \chi^2 = 11.408$ ,  $\Delta df = 2$ ,  $p = .003$ ; Table 5).

## Discussion

Through a message experiment involving recreational water users, we quantified how values-framing affected elaboration and beliefs about AIS. Among participants who received a message that embodied self-transcendence, there was a strong relationship between biospheric values and elaboration. Further, the positive effects of elaboration on both risk perceptions and efficacy underscored the effectiveness of current AIS outreach campaigns. Thus, adopting messages with self-transcendent framing is likely to stimulate in-depth thinking, leading to stronger beliefs, and ultimately, support for AIS prevention.



**Figure 2.** Structural equation model results of relationships among values, elaboration, and beliefs for three subgroups defined by three treatment groups: (A) Baseline, Model fit:  $\chi^2 = 647.867$ ,  $df = 375$ ,  $p < .001$ , CFI = .902, RMSEA = .065, SRMR = .090; (B) Self-enhancement message, Model fit:  $\chi^2 = 585.789$ ,  $df = 375$ ,  $p < .001$ , CFI = .924, RMSEA = .057, SRMR = .071; and (C) Self-transcendent message, Model fit:  $\chi^2 = 634.801$ ,  $df = 375$ ,  $p < .001$ , CFI = .904, RMSEA = .065, SRMR = .089. Dashed lines indicate non-significant relationships.

**Table 4.** Summary of measurement invariance testing between groups by values treatment.

	$\chi^2$	Df	$\Delta \chi^2$	$\Delta$ df
1. Configural fit	1868.5	1125	–	–
2. Constrained factor loadings	1908.1	1165	39.605 <sup>1</sup>	40
3. Constrained intercepts	1939.6	1205	31.516 <sup>2</sup>	40
4. Constrained residuals	2006.7	1265	67.155 <sup>3</sup>	60

<sup>1</sup>Non-significant ( $p = .488$ )<sup>2</sup>Non-significant ( $p = .829$ )<sup>3</sup>Non-significant ( $p = .245$ )

The relationship between values and elaboration was significant only for the self-transcendent message, whereas no values were related to elaboration in the baseline or self-enhancement treatment. We did not expect the baseline message to evoke a relationship between values and elaboration, given that the baseline message was not modified to present values-framed messages, but rather contained a single phrase unique from the other brochures (“Don’t dump bait”) that could be described as a regulation frame. Holding the rest of the brochure constant across the three treatments may have reduced the effects we observed. We did, however, expect the self-enhancement message to evoke a positive relationship between egoistic values and elaboration. It could be that the self-transcendent message had a more profound impact because of the predominant role of biospheric values in characterizing our sample of recreationists. Alternatively, biospheric framing may be better suited to environmental issues than other types of values, resulting in a more credible message than egoistic framing. Past research suggested that alignment between the topic (e.g. an environmental issue like AIS) and the message frame used (e.g. environmental values) can result in a stronger message than using a message frame (e.g. egoistic values) that is less related to the message topic (Hansla, 2011). Related work has argued that highlighting the personal pleasures associated with recycled products could be perceived as “confusing or disingenuous” in contrast to highlighting environmental benefits (Judge et al., 2021, p. 7). Ultimately, values-aligned message campaigns would be most successful when informed by focus group data on the target audience to ensure that the values adopted within the campaign are most relevant. When focus group consultations are not feasible, data from surveys, or known characteristics of constituents such as political affiliation (Corner et al., 2014) or gender (Dietz et al., 2002) can be used to inform value-based communication campaigns.

Without considering the effect of values, the three treatments did not evoke different responses. Specifically, there were no significant differences between the three treatments in message response (i.e. effectiveness, elaboration, and reactance) or post-message beliefs (i.e.

**Table 5.** Results from tests of significant differences in beta coefficients for each path among the three treatment groups. Values indicate the change in model fit when each regression path was allowed to vary in comparison to the model in which all regression paths were constrained.

	$\chi^2$	Df	$\Delta \chi^2$	$\Delta$ df	$p$
All regression paths constrained	2061.8	1289	–	–	
All regression paths constrained, <i>except</i> :					
Elaboration ~ Self efficacy	2050.4	1287	11.408	2	.003
Elaboration ~ Response efficacy	2060.2	1287	1.577	2	.455
Elaboration ~ Ecological risk perceptions	2057.9	1287	3.861	2	.145
Elaboration ~ Social risk perceptions	2057.0	1287	4.795	2	.091
Elaboration ~ Personal risk perceptions	2060.7	1287	1.119	2	.572
Altruistic values ~ Elaboration	2059.1	1287	2.680	2	.262
Biospheric values ~ Elaboration	2055.7	1287	6.120	2	.047
Egoistic values ~ Elaboration	2059.7	1287	2.096	2	.351
Altruistic values ~ Involvement	2053.9	1287	7.905	2	.019
Biospheric values ~ Involvement	2048.7	1287	13.129	2	.001
Egoistic values ~ Involvement	2060.9	1287	0.879	2	.644

risk perceptions and efficacy). This result indicates it was not the message alone that mattered, but alignment between values highlighted in the message and held by the individual. More broadly, the messages in this experiment were well-received; given the consistent mean values in message effectiveness and reactance across messages, no message stood out as problematic or untrustworthy. In addition to highlighting the appeal of the *Be a Hero* campaign, this finding suggests minimal risk of unintended consequences when imbuing messages with individual values. It is important to note that biospheric values were strong across our sample, as is common among recreational water users (e.g. Shin et al., 2022), and it is thus possible that within other audiences reporting stronger egoistic values, individuals would be more susceptible to reactance. Therefore, we recommend that values held by recreational water users can be highlighted by resource management agencies with minimal concern about unintended negative reactions, though caution may be necessary for other audiences.

Elaboration is integral to how messages affect beliefs about issues like AIS. In line with previous research (Brown et al., 2010), we observed that elaboration significantly predicted both risk and efficacy across all three treatments. That is, the more closely participants read and reflected on the message, the stronger their risk perceptions and efficacy beliefs. Although persuasion can occur at any end of the elaboration spectrum (Petty & Cacioppo, 1986), our results reinforce the argument that high elaboration is more likely to have long-lasting impacts due to the depth of reflection (O'Keefe, 2013). We also contend that for complex topics like the multi-step process of biological invasions (Lange & Marshall, 2016), high elaboration may be a particular asset to help the reader absorb the many facets of a detailed message. Finally, although we tested involvement as an explanatory variable, elaboration may also explain involvement, given research that has encouraged the consideration of reverse-causal relationships (Sussman & Gifford, 2019). Causality among values, elaboration, involvement, and beliefs is thus an important question for future study. In summary, high elaboration can be achieved through values-framing, and should be a key goal of environmental communication that seeks to explain how people can prevent the spread of AIS.

### **Implications and areas of future research**

From our results, we provide several implications for message campaigns related to AIS. First, the *Be a Hero* campaign messages we tested resulted in high perceived message effectiveness and low reactance regardless of the treatment. This finding contextualizes past research indicating that recreationists perceived the *Be a Hero* logo to be overly simplified (Kemp et al., 2017). Respondents in our study evaluated a brochure that contained more detailed information than the individual logo evaluated by Kemp et al. (2017); thus, efforts to communicate using signage or brochures that have logos embedded in more detailed materials to aid interpretation will likely be well-received.

Although AIS outreach campaigns are well known among recreational water users (Seekamp, McCreary, et al., 2016b), AIS have continued to threaten ecosystems and well-being in the Great Lakes region (Escobar et al., 2018). Inconsistent actions among anglers (Cole et al., 2019), coupled with inconsistent policies across the Great Lakes region (Peters & Lodge, 2009) create multiple pathways for the spread of AIS. Thus, understanding and closing the “knowledge-action gap” (Kollmuss & Agyeman, 2002) continue to be laudable goals, given that reducing the number of recreationists spreading AIS may significantly reduce propagule pressure (Drake & Mandrak, 2014). To encourage more recreationists to take action, further research on how message framing affects elaboration and beliefs will be particularly useful because these concepts mediate the relationship between knowledge and action.

Outreach professionals should build messages that foster elaboration, given its importance in conveying information regarding the threats posed by AIS and the ability of recreational water users to make a difference. In particular, campaigns imbued with biospheric values should be

prioritized in future research on recreational water users. This approach would respond to what has been learned about the powerful role of biospheric values in motivating behavior (Golebie et al., 2021; Shin et al., 2022), while acknowledging that value pluralism should be maintained to respect differences among diverse user groups (Kenter et al., 2019). Additionally, future work should examine how social norms may work in concert with values-framing, given evidence it may elicit more pronounced responses from stakeholders (Peloza & White, 2007).

The findings in this study should be considered in light of several limitations. First, this research was conducted using a Qualtrics panel, which is not randomly selected from the U.S. population. We selected this method because of declining response rates to mailback surveys (Stedman et al., 2019), and because it is increasingly used to understand environmental topics (e.g. Landon et al., 2021). There were few key differences between our study and those that used mailback surveys (e.g. van Riper et al., 2020). Most notably, recreationists with lower levels of experience were recruited in our study, which supported our aim to understand how messages are perceived by those unfamiliar with AIS. Second, our methods were adopted with guidance from a funding agency interested in testing specific messages that would enhance their outreach programs. We worked closely with the agency to design and test candidate messages that could be used in the future. Although these results provided valuable information, the evidence we generated was highly site specific. To generalize results beyond the tailored messages used for this study, future work should aim to represent values with a broader array of messages. Third, our study integrated biospheric and altruistic values within a single message in line with self-transcendence (Schwartz, 2012) whereas our path models recognized differences between the effects of these two value orientations (van Riper & Kyle, 2014). Future work should seek to disentangle the effects of these two values by testing messages that include only one value dimension, particularly given past work that has indicated combining frames in one message may be less effective than individual frames (Nilsson et al., 2016). Finally, given that none of our experimental messages resulted in a connection between egoistic values and elaboration, we are not able to provide insight on strategies that resonate with egoistic values. Alternative ways of framing egoistic values should be examined in the future, as well as other types of framing strategies that may lead to higher elaboration for individuals that value egoism.

## Conclusion

Recreational water users can unintentionally spread AIS as they travel between waterbodies and therefore threaten the health of aquatic ecosystems. Given that many of these users remain unable to take preventative measures, resource management agencies require insights on how to improve outreach campaigns that heighten awareness of risks posed by AIS and boost individuals' confidence in taking preventative measures. We confront this problem by testing the ability of values-framing to convey information in appealing and effective ways to recreational water users. This study indicates self-transcendent messages encourage participants to think more deeply and increase their perceived ability to take action against the spread of AIS. Outreach campaigns focused on AIS should therefore be informed by the values of a constituency and work to align messaging with those values. This strategy will be most likely to captivate attention and successfully communicate about AIS risks and prevention.

## Acknowledgements:

Thanks are extended to the individuals who shared their experiences and knowledge in support of this research process. Funding for this study was provided by the Great Lakes Restoration Initiative, USFWS, Illinois Department of Natural Resources Grant (# CAFWS-144A) and USDA National Institute of Food and Agriculture Hatch program (accession #: 1012211). We would like to thank Greg Hitzroth and Amanda Huegelmann for feedback during various phases of this research, and Cory Suski, Eric Larson, and Brian Quick for valuable comments on an early version of the article.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Funding

This work was supported by Great Lakes Restoration Initiative, United States Fish and Wildlife Service, Illinois Department of Natural Resources Grant [grant number CAFWS-144A]; United States Department of Agriculture National Institute of Food and Agriculture Hatch Program [grant number 1012211].

## ORCID

Carena J. van Riper  <http://orcid.org/0000-0002-6200-8855>

## Data availability statement

The data that support the findings of this study will be made openly available via Zenodo at <https://doi.org/10.5281/zenodo.6515939>.

## References

- Andsager, J. L., Bemker, V., Choi, H. L., & Torwel, V. (2006). Perceived similarity of exemplar traits and behavior: Effects on message evaluation. *Communication Research*, 33(1), 3–18. <https://doi.org/10.1177/0093650205283099>
- Arp, A. (2018). Using values to communicate agricultural science: An Elaboration Likelihood Model approach. *Graduate Theses and Dissertations*, 16309.
- Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74–94. <https://doi.org/10.1007/BF02723327>
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191. <https://doi.org/10.1037/0033-295X.84.2.191>
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107(2), 238. <https://doi.org/10.1037/0033-2909.107.2.238>
- Bigsby, E., Cappella, J. N., & Seitz, H. H. (2013). Efficiently and effectively evaluating public service announcements: Additional evidence for the utility of perceived effectiveness. *Communication Monographs*, 80(1), 1–23. <https://doi.org/10.1080/03637751.2012.739706>
- Blackburn, T. M., Pysek, P., Bacher, S., Carlton, J. T., Duncan, R. P., Jaroski, V., Wilson, J. R. U., & Richardson, D. M. (2011). A proposed unified framework for biological invasions. *Trends in Ecology & Evolution*, 26(7), 333–339. <https://doi.org/10.1016/j.tree.2011.03.023>
- Brehm, J. W., & Brehm, S. S. (1981). *Psychological reactance: A theory of freedom and control*. Academic Press.
- Brown, T. J., Ham, S. H., & Hughes, M. (2010). Picking up litter: An application of theory-based communication to influence tourist behaviour in protected areas. *Journal of Sustainable Tourism*, 18(7), 879–900. <https://doi.org/10.1080/09669581003721281>
- Chang, C. (2021). Effects of responsibility appeals for pro-environmental ads: When do they empower or generate reactance? *Environmental Communication*, 15(4), 546–569. <https://doi.org/10.1080/17524032.2021.1876132>
- Chong, D., & Druckman, J. N. (2007). Framing theory. *Annual Review of Political Science*, 10(1), 103–126. <https://doi.org/10.1146/annurev.polisci.10.072805.103054>
- Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science*, 12(4), 105–109. <https://doi.org/10.1111/1467-8721.01242>
- Cole, E., Keller, R. P., & Garbach, K. (2016). Assessing the success of invasive species prevention efforts at changing the behaviors of recreational boaters. *Journal of Environmental Management*, 184, 210–218. <https://doi.org/10.1016/j.jenvman.2016.09.083>
- Cole, E., Keller, R. P., & Garbach, K. (2019). Risk of invasive species spread by recreational boaters remains high despite widespread adoption of conservation behaviors. *Journal of Environmental Management*, 229, 112–119. <https://doi.org/10.1016/j.jenvman.2018.06.078>
- Corner, A., Markowitz, E., & Pidgeon, N. (2014). Public engagement with climate change: The role of human values. *WIREs Climate Change*, 5(3), 411–422. <https://doi.org/10.1002/wcc.269>

- Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology*, 78(1), 98–104. <https://doi.org/10.1037/0021-9010.78.1.98>
- Davis, K. C., Nonnemaker, J., Duke, J., & Farrelly, M. C. (2013). Perceived effectiveness of cessation advertisements: The importance of audience reactions and practical implications for media campaign planning. *Health Communication*, 28(5), 461–472. <https://doi.org/10.1080/10410236.2012.696535>
- de Groot, J. I., & Steg, L. (2008). Value orientations to explain beliefs related to environmental significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *Environment and Behavior*, 40(3), 330–354. <https://doi.org/10.1177/0013916506297831>
- Dean, A. J., Fielding, K. S., & Wilson, K. A. (2019). Building community support for coastal management — what types of messages are most effective? *Environmental Science & Policy*, 92, 161–169. <https://doi.org/10.1016/j.envsci.2018.11.026>
- Dietz, T., Kalof, L., & Stern, P. C. (2002). Gender, values, and environmentalism. *Social Science Quarterly*, 83(1), 353–364. <https://doi.org/10.1111/1540-6237.00088>
- Dillard, J. P., Shen, L., & Vail, R. G. (2007). Does perceived message effectiveness cause persuasion or vice versa? 17 consistent answers. *Human Communication Research*, 33(4), 467–488. <https://doi.org/10.1111/j.1468-2958.2007.00308.x>
- Dillard, J. P., & Ye, S. (2008). The perceived effectiveness of persuasive messages: Questions of structure, referent, and bias. *Journal of Health Communication*, 13(2), 149–168. <https://doi.org/10.1080/10810730701854060>
- Drake, D. A. R., & Mandrak, N. E. (2014). Bycatch, bait, anglers, and roads: Quantifying vector activity and propagule introduction risk across lake ecosystems. *Ecological Applications*, 24(4), 877–894. <https://doi.org/10.1890/13-0541.1>
- Escobar, L. E., Mallez, S., McCartney, M., Lee, C., Zielinski, D. P., Ghosal, R., ... Phelps, N. B. (2018). Aquatic invasive species in the great lakes region: An overview. *Reviews in Fisheries Science & Aquaculture*, 26(1), 121–138. <https://doi.org/10.1080/23308249.2017.1363715>
- Floyd, D. L., Prentice-Dunn, S., & Rogers, R. W. (2000). A meta-analysis of research on protection motivation theory. *Journal of Applied Social Psychology*, 30(2), 407–429. <https://doi.org/10.1111/j.1559-1816.2000.tb02323.x>
- Gallardo, B., Clavero, M., Sánchez, M. I., & Vilà, M. (2016). Global ecological impacts of invasive species in aquatic ecosystems. *Global Change Biology*, 22(1), 151–163. <https://doi.org/10.1111/gcb.13004>
- Golebie, E., van Riper, C. J., Suski, C., & Stedman, R. (2021). Reducing invasive species transport among recreational anglers: The importance of values and risk perceptions. *North American Journal of Fisheries Management*, 41(6), 1812–1825. <https://doi.org/10.1002/nafm.10696>
- Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, 19(2), 139–152. <https://doi.org/10.2753/MTP1069-6679190202>
- Hansen, J., Winzeler, S., & Topolinski, S. (2010). When the death makes you smoke: A terror management perspective on the effectiveness of cigarette on-pack warnings. *Journal of Experimental Social Psychology*, 46(1), 226–228. <https://doi.org/10.1016/j.jesp.2009.09.007>
- Hansla, A. (2011). Value orientation and framing as determinants of stated willingness to pay for eco-labeled electricity. *Energy Efficiency*, 4(2), 185–192. <https://doi.org/10.1007/s12053-010-9096-0>
- Judge, M., de Hoog, O., Perlaviciute, G., Contzen, N., & Steg, L. (2021). From toilet to table: Value-tailored messages influence emotional responses to wastewater products. *Biotechnology for Biofuels*, 14(1), 1–12. <https://doi.org/10.1186/s13068-021-01931-z>
- Kemp, C., van Riper, C. J., BouFajreldin, L., Stewart, W., Scheunemann, J., & van den Born, R. J. G. (2017). Connecting human-nature relationships to environmental behaviors that minimize the spread of aquatic invasive species. *Biological Invasions*, 19(7), 2059–2074.
- Kenter, J. O., Raymond, C. M., van Riper, C. J., Azzopardi, E., Brear, M. R., Calcagni, F., ... Thankappan, S. (2019). Loving the mess: Navigating diversity and conflict in social values for sustainability. *Sustainability Science*, 14(5), 1439–1461. <https://doi.org/10.1007/s11625-019-00726-4>
- Kline, R. B. (2015). *Principles and practice of structural equation modeling*.
- Kohl, P. A., Collins, S. J., & Eichholz, M. (2020). Metaphor, trust and support for non-native species control. *Environmental Communication*, 14(5), 672–685. <https://doi.org/10.1080/17524032.2019.1703779>
- Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental Education Research*, 8(3), 239–260. <https://doi.org/10.1080/13504620220145401>
- Kothe, E. J., Ling, M., North, M., Klas, A., Mullan, B. A., & Novoradovskaya, L. (2019). Protection motivation theory and pro-environmental behaviour: A systematic mapping review. *Australian Journal of Psychology*, 71(4), 411–432. <https://doi.org/10.1111/ajpy.12271>
- Kroeze, W., Werkman, A., & Brug, J. (2006). A systematic review of randomized trials on the effectiveness of computer-tailored education on physical activity and dietary behaviors. *Annals of Behavioral Medicine*, 31(3), 205–223. [https://doi.org/10.1207/s15324796abm3103\\_2](https://doi.org/10.1207/s15324796abm3103_2)
- Kung, F. Y., Kwok, N., & Brown, D. J. (2018). Are attention check questions a threat to scale validity? *Applied Psychology*, 67(2), 264–283. <https://doi.org/10.1111/apps.12108>



- Lakoff, G. (2010). Why it matters how we frame the environment. *Environmental Communication*, 4(1), 70–81. <https://doi.org/10.1080/17524030903529749>
- Landon, A. C., Woosnam, K. M., Kyle, G. T., & Keith, S. J. (2021). Psychological needs satisfaction and attachment to natural landscapes. *Environment and Behavior*, 53(6), 661–683. <https://doi.org/10.1177/0013916520916255>
- Landon, A. C., Kyle, G. T., van Riper, C. J., Schuett, M. A., & Park, J. (2018). Exploring the psychological dimensions of stewardship in recreational fisheries. *North American Journal of Fisheries Management*, 38(3), 579–591. <https://doi.org/10.1002/nafm.10057>
- Lange, R., & Marshall, D. J. (2016). Propagule size and dispersal costs mediate establishment success of an invasive species. *Ecology*, 97(3), 569–575. <https://doi.org/10.1890/15-1573>
- Lede, E., & Meleady, R. (2019). Applying social influence insights to encourage climate resilient domestic water behavior: Bridging the theory-practice gap. *WIREs Climate Change*, 10(1), e562. <https://doi.org/10.1002/wcc.562>
- Maddux, J. E., & Rogers, R. W. (1983). Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental Social Psychology*, 19(5), 469–479. [https://doi.org/10.1016/0022-1031\(83\)90023-9](https://doi.org/10.1016/0022-1031(83)90023-9)
- Mando, J., & Stack, G. (2019). Convincing the public to kill: Asian carp and the proximization of invasive species threat. *Environmental Communication*, 13(6), 820–833. <https://doi.org/10.1080/17524032.2018.1492949>
- Marquina, T., Hackenburg, D., Duray, H., Fisher, B., & Gould, R. K. (2022). *Lessons from an experiment with values-based messaging to support watershed conservation*. Conservation Biology.
- Milne, S., Sheeran, P., & Orbell, S. (2000). Prediction and intervention in health-related behavior: A meta-analytic review of protection motivation theory. *Journal of Applied Social Psychology*, 30(1), 106–143. <https://doi.org/10.1111/j.1559-1816.2000.tb02308.x>
- Mittal, B. (1995). A comparative analysis of four scales of consumer involvement. *Psychology and Marketing*, 12(7), 663–682. <https://doi.org/10.1002/mar.4220120708>
- Mongeau, P. (2012). Fear appeals. In J. P. Dillard, & L. Shen (Eds.), *The SAGE handbook of persuasion: Developments in theory and practice* (pp. 184–199). SAGE Publications, Inc.
- Niemiec, R., Jones, M. S., Lischka, S., & Champine, V. (2021). Efficacy-based and normative interventions for facilitating the diffusion of conservation behavior through social networks. *Conservation Biology*, 35(4), 1073–1085. <https://doi.org/10.1111/cobi.13717>
- Nilsson, A., Hansla, A., & Biel, A. (2014). Feeling the green? Value orientation as a moderator of emotional response to green electricity. *Journal of Applied Social Psychology*, 44(10), 672–680. <https://doi.org/10.1111/jasp.12258>
- Nilsson, A., Hansla, A., Heiling, J. M., Bergstad, C. J., & Martinsson, J. (2016). Public acceptability towards environmental policy measures: Value-matching appeals. *Environmental Science & Policy*, 61, 176–184. <https://doi.org/10.1016/j.envsci.2016.04.013>
- Nisbet, E. C., Cooper, K. E., & Garrett, R. K. (2015). The partisan brain: How dissonant science messages lead conservatives and liberals to (dis) trust science. *The ANNALS of the American Academy of Political and Social Science*, 658(1), 36–66. <https://doi.org/10.1177/0002716214555474>
- Noar, S. M., Palmgreen, P., Zimmerman, R. S., Lustria, M. L. A., & Lu, H. Y. (2010). Assessing the relationship between perceived message sensation value and perceived message effectiveness: Analysis of PSAs from an effective campaign. *Communication Studies*, 61(1), 21–45. <https://doi.org/10.1080/10510970903396477>
- O’Keefe, D. J. (2013). The elaboration likelihood model. In J. P. Dillard, & L. Shen (Eds.), *The SAGE handbook of persuasion: Developments in theory and practice* (2nd ed., pp. 137–149). SAGE.
- Pelozo, J., & White, K. (2007). Hey, what gives? The effects of altruistic versus egoistic charity appeals on donation intentions. In G. Fitzsimons & V. Morwitz (Eds.), *Advances in consumer research* (pp. 347–350). Association for Consumer Research.
- Peters, J. A., & Lodge, D. M. (2009). Invasive species policy at the regional level: A multiple weak links problem. *Fisheries*, 34(8), 373–380. <https://doi.org/10.1577/1548-8446-34.8.373>
- Petty, R. E., Barden, J., & Wheeler, S. C. (2009). The elaboration likelihood model of persuasion: Developing health promotions for sustained behavioral change. In R. J. DiClemente, R. A. Crosby, & M. Kegler (Eds.), *Emerging theories in health promotion practice and research* (2nd ed.). Jossey-Bass.
- Petty, R. E., & Briñol, P. (2011). The elaboration likelihood model. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (pp. 224–245). SAGE.
- Petty, R. E., & Cacioppo, J. T. (1979). Issue involvement can increase or decrease persuasion by enhancing message-relevant cognitive responses. *Journal of Personality and Social Psychology*, 37(10), 1915–1926. <https://doi.org/10.1037/0022-3514.37.10.1915>
- Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. In *Communication and persuasion: Central and peripheral routes to attitude change* (pp. 1–24). Springer New York.
- Pradhananga, A., Davenport, M. A., Seekamp, E., & Bundy, D. (2015). Preventing the spread of aquatic invasive species: Boater concerns, habits, and future behaviors. *Human Dimensions of Wildlife*, 20(5), 381–393. <https://doi.org/10.1080/10871209.2015.1030479>

- Quick, B. L., Shen, L., & Dillard, J. P. (2013). Reactance theory and persuasion. In J. P. Dillard, & L. Shen (Eds.), *The SAGE handbook of persuasion: Developments in theory and practice* (2nd ed, pp. 167–183). SAGE.
- Quick, B. L., & Stephenson, M. T. (2007). Authoritative parenting and issue involvement as indicators of ad recall: An empirical investigation of anti-drug ads for parents. *Health Communication, 22*(1), 25–35. <https://doi.org/10.1080/10410230701310273>
- Reynolds, R. A. (1997). A validation test of a message elaboration measure. *Communication Research Reports, 14*(3), 269–278. <https://doi.org/10.1080/08824099709388670>
- Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *The Journal of Psychology, 91*(1), 93–114. <https://doi.org/10.1080/00223980.1975.9915803>
- Rokeach, M. (1973). *The nature of human values*. The Free Press.
- Rothlisberger, J. D., Chadderton, W. L., McNulty, J., & Lodge, D. M. (2010). Aquatic invasive species transport via trailered boats: What is being moved, who is moving it, and what can be done. *Fisheries, 35*(3), 121–132. <https://doi.org/10.1577/1548-8446-35.3.121>
- Sagiv, L., & Schwartz, S. H. (2022). Personal values across cultures. *Annual Review of Psychology, 73*(1), 517–546. <https://doi.org/10.1146/annurev-psych-020821-125100>
- Schultz, P. W., Gouveia, V. V., Comeron, L. D., Tankha, G., Schmuck, P., & Franek, M. (2005). Values and their relationship to environmental concern and conservation behavior. *Journal of Cross-Cultural Psychology, 36*(4), 457–475. <https://doi.org/10.1177/0022022105275962>
- Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In *Advances in experimental social psychology* (Vol. 25, pp. 1–65). Academic Press.
- Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online Readings in Psychology and Culture, 2*(1), 2307–0919. <https://doi.org/10.9707/2307-0919.1116>
- Seekamp, E., Mayer, J. E., Charlebois, P., & Hitzroth, G. (2016). Effects of outreach on the prevention of aquatic invasive species spread among organism-in-trade hobbyists. *Environmental Management, 58*(5), 797–809. <https://doi.org/10.1007/s00267-016-0748-5>
- Seekamp, E., McCreary, A., Mayer, J., Zack, S., Charlebois, P., & Pasternak, L. (2016). Exploring the efficacy of an aquatic invasive species prevention campaign among water recreationists. *Biological Invasions, 18*(6), 1745–1758. <https://doi.org/10.1007/s10530-016-1117-2>
- Shaw, B., Campbell, T., & Radler, B. T. (2021). Testing emphasis message frames and metaphors on social media to engage boaters to learn about preventing the spread of zebra mussels. *Environmental Management, 68*(6), 824–834. <https://doi.org/10.1007/s00267-021-01506-6>
- Shin, S., van Riper, C. J., Stedman, R. C., & Suski, C. D. (2022). The value of eudaimonia for understanding relationships among values and pro-environmental behavior. *Journal of Environmental Psychology, 80*, 101778. <https://doi.org/10.1016/j.jenvp.2022.101778>
- Stedman, R. C., Connelly, N. A., Heberlein, T. A., Decker, D. J., & Allred, S. B. (2019). The end of the (research) world as we know it? Understanding and coping with declining response rates to mail surveys. *Society & Natural Resources, 32*(10), 1139–1154. <https://doi.org/10.1080/08941920.2019.1587127>
- Steg, L., Dreijerink, L., & Abrahamse, W. (2005). Factors influencing the acceptability of energy policies: A test of VBN theory. *Journal of Environmental Psychology, 25*(4), 415–425. <https://doi.org/10.1016/j.jenvp.2005.08.003>
- Steiger, J. H. (2007). Understanding the limitations of global fit assessment in structural equation modeling. *Personality and Individual Differences, 42*(5), 893–898. <https://doi.org/10.1016/j.paid.2006.09.017>
- Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review, 6*(2), 81–97.
- Stern, P. C., Dietz, T., & Guagnano, G. A. (1998). A brief inventory of values. *Educational and Psychological Measurement, 58*(6), 984–1001. <https://doi.org/10.1177/0013164498058006008>
- Sussman, R., & Gifford, R. (2019). Causality in the theory of planned behavior. *Personality and Social Psychology Bulletin, 45*(6), 920–933. <https://doi.org/10.1177/0146167218801363>
- van Riper, C. J., Golebie, E. J., Shin, S., Eriksson, M., Smith, A., Suski, C., & Stedman, R. (2020). *A study of angler behavior and the spread of aquatic invasive species in the great lakes region*. Cornell University, Department of Natural Resources, Center for Conservation Social Sciences, CCSS Series 20–7.
- van Riper, C. J., & Kyle, G. T. (2014). Understanding the internal processes of behavioral engagement in a national park: A latent variable path analysis of the value-belief-norm theory. *Journal of Environmental Psychology, 38*, 288–297. <https://doi.org/10.1016/j.jenvp.2014.03.002>
- van Riper, C. J., Thiel, A., Penker, M., Braitto, M., Landon, A. C., Thomsen, J. M., & Tucker, C. M. (2018). Incorporating multilevel values into the social-ecological systems framework. *Ecology and Society, 23*(3). <https://doi.org/10.5751/ES-10047-230325>
- van Riper, C. J., Wallen, K. E., Landon, A. C., Petriello, M. A., Kyle, G. T., & Absher, J. (2016). Modeling the trust-risk relationship in a wildland recreation setting: A social exchange perspective. *Journal of Outdoor Recreation and Tourism, 13*, 23–33. <https://doi.org/10.1016/j.jort.2016.03.001>

- Vander Zanden, M. J., & Olden, J. D. (2008). A management framework for preventing the secondary spread of aquatic invasive species. *Canadian Journal of Fisheries and Aquatic Sciences*, 65(7), 1512–1522. <https://doi.org/10.1139/F08-099>
- Verbrugge, L. N., Leuven, R. S., & Zwart, H. A. (2016). Metaphors in invasion biology: Implications for risk assessment and management of non-native species. *Ethics, Policy & Environment*, 19(3), 273–284. <https://doi.org/10.1080/21550085.2016.1226234>
- von Borgstede, C., Andersson, M., & Hansla, A. (2014). Value-congruent information processing: The role of issue involvement and argument strength. *Basic and Applied Social Psychology*, 36(6), 461–477. <https://doi.org/10.1080/01973533.2014.958226>
- Von Hippel, P. T. (2016). New confidence intervals and bias comparisons show that maximum likelihood can beat multiple imputation in small samples. *Structural Equation Modeling: A Multidisciplinary Journal*, 23(3), 422–437. <https://doi.org/10.1080/10705511.2015.1047931>
- Wallen, K. E., & Kyle, G. T. (2018). The efficacy of message frames on recreational boaters' aquatic invasive species mitigation behavioral intentions. *Human Dimensions of Wildlife*, 23(4), 297–312. <https://doi.org/10.1080/10871209.2018.1434705>

**Table A1.** Mean values and standard deviations for reported values across the three treatment groups. No significant differences were detected at  $p < 0.05$ .

	Self-transcendent framing	Self-enhancement framing	Baseline	F	P
Biospheric values	4.30 (0.67)	4.26 (0.66)	4.26 (0.67)	.132	.876
Altruistic values	4.25 (0.77)	4.24 (0.79)	4.25 (0.79)	.015	.985
Egoistic values	3.10 (1.02)	3.15 (0.93)	3.14 (1.09)	.140	.870



A. The baseline message

**BE A HERO TRANSPORT ZERO**

Here are a few simple actions you can take to prevent aquatic invaders from spreading:

**REMOVE**

**Remove plants, animals and mud from all equipment.**

Many invaders spread by attaching to boats, trailers, and other equipment.

Plant fragments can create new populations and transport smaller invaders like zebra mussels.

**It's quick!**

A few minutes spent removing plants and animals significantly decreases the spread of invaders.

**DRAIN**

**Drain all water from your boat and gear.**

Pull drain plugs and remove water from all equipment prior to leaving a water access.

Water should be drained from all water-containing equipment, such as portable bait containers, ballast tanks, motors, bilge tanks, livewells, and baitwells.

**It's easy!**

By draining all water, you can easily prevent live plants and animals from traveling with you.

**DRY**

**Dry everything thoroughly with a towel.**

Wiping down your boat, trailer, and other equipment not only leaves you with clean gear, but also removes all the invaders you can't see, such as zebra mussel larvae and fish diseases like VHS. If possible, let your gear remain dry for at least 5 days.

**It's effective!**

Allowing your equipment to dry is a reliable way to kill off any potential invaders, especially smaller species you can't see.

DON'T DUMP BAIT

**Remember**

Dispose of all unwanted bait and hitchhikers in the trash, and never release organisms caught from one waterbody into another.

ZEBRA MUSSELS

HYDRILLA

SILVER CARP

These tips don't just apply to boaters and anglers! Other activities can easily spread invaders, such as:

JETSKIING WINDSURFING SAILING KAYAKING WATERFOWL HUNTING BODYBOARDING

PADDLEBOARDING CANOEING SHORE AND FLY FISHING SCUBA DIVING SURFING

**Report new sightings!**

If you suspect a new infestation of an invasive plant or animal, save a specimen and report it by visiting <http://www.usgs.gov/stopans> or calling the Illinois Department of Natural Resources at 217-785-6300.

B. The self-transcendent message

**BE A HERO TRANSPORT ZERO**

Here are a few simple actions you can take to prevent aquatic invaders from spreading:

**REMOVE**

**Remove plants, animals and mud from all equipment.**

Many invaders spread by attaching to boats, trailers, and other equipment.

Plant fragments can create new populations and transport smaller invaders like zebra mussels.

**It's quick!**

A few minutes spent removing plants and animals significantly decreases the spread of invaders.

**DRAIN**

**Drain all water from your boat and gear.**

Pull drain plugs and remove water from all equipment prior to leaving a water access.

Water should be drained from all water-containing equipment, such as portable bait containers, ballast tanks, motors, bilge tanks, livewells, and baitwells.

**It's easy!**

By draining all water, you can easily prevent live plants and animals from traveling with you.

**DRY**

**Dry everything thoroughly with a towel.**

Wiping down your boat, trailer, and other equipment not only leaves you with clean gear, but also removes all the invaders you can't see, such as zebra mussel larvae and fish diseases like VHS. If possible, let your gear remain dry for at least 5 days.

**It's effective!**

Allowing your equipment to dry is a reliable way to kill off any potential invaders, especially smaller species you can't see.

**PROTECT THE ENVIRONMENT**

Aquatic invaders can dramatically change the ecosystem and harm native fish species.

By completing remove-drain-dry, you can **protect the quality of habitats** and natural environments and **build a sense of community** among anglers and water users.

ZEBRA MUSSELS

HYDRILLA

SILVER CARP

These tips don't just apply to boaters and anglers! Other activities can easily spread invaders, such as:

JETSKIING WINDSURFING SAILING KAYAKING WATERFOWL HUNTING BODYBOARDING

PADDLEBOARDING CANOEING SHORE AND FLY FISHING SCUBA DIVING SURFING

**Report new sightings!**

If you suspect a new infestation of an invasive plant or animal, save a specimen and report it by visiting <http://www.usgs.gov/stopans> or calling the Illinois Department of Natural Resources at 217-785-6300.

**Figure A1.** The experimental messages that participants evaluated including: (A) the baseline message; (B) the self-transcendent message; and (C) the self-enhancement message.

C. The self-enhancement message



Here are a few simple actions you can take to prevent aquatic invaders from spreading:

<p style="background-color: #0070C0; color: white; padding: 2px; text-align: center; font-weight: bold;">REMOVE</p>  <p><b>Remove plants, animals and mud from all equipment.</b></p> <p>Many invaders spread by attaching to boats, trailers, and other equipment.</p> <p>Plant fragments can create new populations and transport smaller invaders like zebra mussels.</p> <p style="background-color: #0070C0; color: white; padding: 2px; font-weight: bold;">It's quick! A few minutes spent removing plants and animals significantly decreases the spread of invaders.</p>  <p style="text-align: center; font-size: small; color: #0070C0;">ZEBRA MUSSELS</p>	<p style="background-color: #0070C0; color: white; padding: 2px; text-align: center; font-weight: bold;">DRAIN</p>  <p><b>Drain all water from your boat and gear.</b></p> <p>Pull drain plugs and remove water from all equipment prior to leaving a water access.</p> <p>Water should be drained from all water-containing equipment, such as portable bait containers, ballast tanks, motors, bilge tanks, livewells, and baitwells.</p> <p style="background-color: #0070C0; color: white; padding: 2px; font-weight: bold;">It's easy! By draining all water, you can easily prevent live plants and animals from traveling with you.</p>  <p style="text-align: center; font-size: small; color: #0070C0;">HYDRILLA</p>	<p style="background-color: #0070C0; color: white; padding: 2px; text-align: center; font-weight: bold;">DRY</p>  <p><b>Dry everything thoroughly with a towel.</b></p> <p>Wiping down your boat, trailer, and other equipment not only leaves you with clean gear, but also removes all the invaders you can't see, such as zebra mussel larvae and fish diseases like VHS. If possible, let your gear remain dry for at least 5 days.</p> <p style="background-color: #0070C0; color: white; padding: 2px; font-weight: bold;">It's effective! Allowing your equipment to dry is a reliable way to kill off any potential invaders, especially smaller species you can't see.</p>
---	---	--

These tips don't just apply to boaters and anglers! Other activities can easily spread invaders, such as:

JETSKIING WINDSURFING SAILING KAYAKING WATERFOWL HUNTING BODYBOARDING

PADDLEBOARDING CANOEING SHORE AND FLY FISHING SCUBA DIVING SURFING

YOUR WATERWAYS ARE BEING IMPACTED

Aquatic invaders can block access to waterbodies and prevent you from enjoying your favorite activities.

By completing remove-drain-dry, you can **influence other recreationists** to get involved and **ensure you'll be able to enjoy the resource** for years to come.

Remember  
Dispose of all unwanted bait and hitchhikers in the trash, and never release organisms caught from one waterbody into another.

Report new sightings!  
If you suspect a new infestation of an invasive plant or animal, save a specimen and report it by visiting <http://www.dnr.gov/InspAMS> or calling the Illinois Department of Natural Resources at 217-782-6302.




SILVER CARP

Figure 3 Continued