Identifying mechanisms of environmental decision-making: How ideology and geographic proximity influence public support for regulating agricultural runoff to curb harmful algal blooms

Tian Guo [a], Erik C. Nisbet [b], Jay F. Martin [c]

a. Cooperative Institute for Great Lakes Research (CIGLR), University of Michigan, 4840 S. State Rd, Ann Arbor, Michigan 48104, USA

b. School of Communication, The Ohio State University, 3062 Derby Hall, 154 N. Oval Mall, Columbus, OH 43201, USA

c. Department of Food, Agricultural, and Biological Engineering, Ohio Sea Grant and Stone Laboratory, The Ohio State University, 230C Agricultural Engineering, 590 Woody Hayes Drive, Columbus, OH 43201, USA

Corresponding author: Tian Guo, tianguo@umich.edu, Cooperative Institute for Great Lakes Research (CIGLR), University of Michigan, 4840 S. State Rd, Ann Arbor, Michigan 48104, USA

1. Introduction

Harmful algal blooms (HABs) affect freshwater systems worldwide (Carmichael, 2008; Cheung, Liang, & Lee, 2013; Duan, Ma, Xu, Kong, Zhang, Kong, et al., 2009). Many freshwater HABs are likely to be the result of anthropogenic nutrient pollution from multiple sources, such as agricultural runoff, residential fertilizer, storm water management, ground water contamination, and septic tanks (Cheung, et al., 2013; Scavia, et al., 2014). Mitigating anthropogenic nutrient pollution requires a mix of market-based and governmental strategies, such as education programs, technical assistance, tax-based incentives, and regulations (Garnache, Swinton, Herriges, Lupi, & Stevenson, 2016). In practice, however, it is difficult to select effective, efficient, and socially acceptable strategies (Garnache, et al., 2016).

In the United States, point sources of nutrients, such as wastewater treatment plants and large Concentrated Animal Feeding Operations, are heavily regulated (McDowell, Dils, Collins, Flahive, Sharpley, & Quinn, 2016). In contrast, there are few regulations on non-point sources including runoff from agricultural fields. In fact, policy proposals to regulate agricultural runoff can be highly contested (Garnache et al., 2016). Opponents cite concerns that most farmers have already done as much as is economically feasible to reduce agricultural runoff and it is not fair to have farmers alone carry the costs to restore water quality (Smith, Wilson, King, Zwonitzer, McGrath, Harmel, Haney, & Jahnson, 2018). Meanwhile, there are concerns that without regulations, voluntary programs and other "paying-the-polluters" approaches (e.g., incentive programs for farmers to reduce agricultural runoff) are too "soft" to change current agricultural practices to reduce agricultural runoff (Garnache et al, 2016; Segerson, 2013; Shortle, Ribaudo, Horan, & Blandford, 2012).

In Ohio, there is an unfolding debate about the benefits and costs of introducing new regulations to curtail agricultural runoff entering Lake Erie. Lake Erie is one of the Laurentian Great Lakes, which supplies drinking water and recreation opportunities to more than 11 million residents in the U.S. and Canada (Lake Erie LaMP, 2011). The proliferation of HABs has impacted public water provisions, tourism, and the fishery industry (Gill, Rowe, & Joshi, 2018; Wolf, Georgic, & Klaiber, 2017). Mitigating HABs in Lake Erie requires mitigating runoff from a few specific watersheds, mostly in Ohio, that are also important agricultural areas (Kalcic, Kirchhoff, Bosch, Muenich, Murray, Gardner, & Scavia, 2016; Maccoux, Dove, Backus, & Dolan, 2016; Scavia, et al. 2014; Stumpf, Johnson, Wynne, & Baker, 2016).

The Ohio Domestic Action Plan, released in March 2018, focused on using voluntary approaches such as conservation certification and cost-sharing grants to reduce agricultural runoff (Ohio Lake Erie Commission, Ohio Department of Agriculture, Ohio Department of Natural Resources, Ohio Environmental Protection Agency, and Ohio Department of Health, 2018). However, in July 2018, the Governor of Ohio at the time issued an executive order, requiring the Ohio Department of Agriculture to consider eight watersheds in the western basin of Lake Erie for designation under state law as "Watersheds in Distress" (John R. Kasich Governor of Ohio Press Releases, 2018). The designation would require future regulations to further limit agricultural runoff. The order signaled a strong desire of this administration to change the direction of state policies from using a voluntary approach to a "more aggressive" regulatory approach. However, the executive order was stalled before the Ohio Soil and Water Conservation Commission. In October 2018, the Director of the Ohio Department of Agriculture was dismissed allegedly due to his lack of support for the executive order (Ludlow, 2018).

During this policy debate, although farmers' concerns and oppositions are widely cited, less is known about how other Ohio residents view regulations on agricultural runoff. Public support or opposition to a policy proposal affects politicians' decisions about whether to implement an environmental policy (Burstein, 2003; Kington, 1984; Wlezien, 1995). Public support can legitimize a policy proposal while public opposition will weaken its political support. Meanwhile, politicians and advocacy groups often engage in campaigns to shape public attitudes about issues on their agenda (Burden & Hillygus, 2009). These dynamics speak clearly to the importance of public opinions and policy attitudes in electoral politics as well as policy development and implementation (Gravelle & Lachapelle, 2015).

Few studies have evaluated public support for regulatory policies to reduce agricultural runoff entering Lake Erie. What studies do exist suggest some support for more regulations to protect the Great Lakes (Great Lakes Water Quality Board Public Engagement Work Group, 2018; Gud, 2017). However, regarding specific policy proposals, people appeared to indicate more support for incentives or market-based programs, than for regulatory policies or taxes (Howard, Roe, Nisbet, & Martin, 2017; Rissman, Kohl, & Wadropper, 2017). These past studies reveal a crucial knowledge gap related to public opinion towards regulatory policies. More importantly, why do members of the Ohio public support or oppose regulatory policies to reduce agricultural runoff?

In this study, we analyzed Ohio statewide and watershed specific public opinion data collected in 2013 and 2014 to examine the effects of ideology and geographic proximity to Lake Erie on public support for regulatory policies to reduce agricultural runoff. Among a list of potential psychological factors that contribute to the formation of attitudes toward environmental policies, such as perceptions about costs and benefits, social norms, environmental values,

cultural cognitions, and perceived water quality (Attari, Schoen, Davidson, DeKay, de Bruin, Dawes, & Small, 2009; de Groot & Schitema, 2012; Newman, Nisbet, & Nisbet, 2018; Rissman et al., 2017), ideology and geographic proximity are salient population attributes that could distinguish between groups in terms of their policy attitudes. In the debate about using regulatory policies to reduce agricultural runoff, do residents align their policy support with their political ideologies or their residence? If they do, which mechanisms account for such effects? Drawing upon science communication and environmental psychology literatures, we tested a serial mediation model with exposure to news of HABs and risk perception as mediators. The results are informative to resource managers and policy makers in Ohio and other regions who are interested in introducing similar policies to mitigate agricultural runoff and curb HABs.

2. Literature Review, Hypotheses and Model

2.1 Ideology and Support for Regulatory Policies

Political ideology may be defined as a set of coherent beliefs about how the world should be structured and is a key component of an individual's self-concept and identity (Ahern, Connolly-Adhern, & Hoewe, 2016; Hula, Bowers, Whitley, & Isaac, 2017; Stroud, 2008). It has long been identified as an important factor for shaping the public's policy preferences toward environmental issues (Konisky, Milyo, & Richardson, 2008). Examples of these environmental issues include climate change (e.g., Borick & Rabe, 2012; McCright & Dunlap, 2013; McCright, Dunlap, & Xiao, 2014; Nisbet, Cooper, & Ellithorpe, 2015), support for hydraulic fracturing (e.g., Boudet, Clarke, Bugden, Maibach, Roser-Renouf, & Leiserowitz, 2014; Choma, Hanoch, & Currie, 2016; Clarke, Budgen, Hart, Stedman, Jacquet, Evensen, & Boudet, 2016), and wildlife management (Bright, Manfredo, & Fulton, 2000; Manfredo, 2008). Ideology is most often conceptualized as a heuristic or informational shortcut used by individuals when

determining their attitudes about complex environmental issues (Campbell, Converse, Miller, & Stokes, 1960; Cacciatore, Cassiatore, Scheufele, Binder, & Shaw, 2012; Clark, et al., 2016; Hula et al, 2017).

In turn, ideologically-based opinion about policy may lead to issue polarization across ideological divides that becomes a major obstacle for both public and political consensus on policy proposals. In this context, regulatory approaches to reduce agricultural runoff including penalizing farmers for excessive nutrient runoff, can run counter to the core values held by individuals with conservative worldviews and political identities, such as individual freedom and less government control. Thus, our first hypothesis proposes a direct relationship between public support for regulatory policies.

H1. Residents with more conservative social and economic ideology will be less supportive of regulatory policies to reduce agricultural runoff.

Ideology may also indirectly affect public policy preferences. For example, one's ideology affects the amount and type of information individuals seek and receive about an environmental issue (Cacciatore et al., 2012; Nisbet, et al., 2015; Stroud, 2008, 2017). This phenomenon is commonly referred to as *selective exposure*. It is a form of motivated reasoning, describing the desire to arrive at particularly conclusions consistent with previously held beliefs (Kunda, 1990). News media plays an important role in helping members of the public to understand policy proposals and develop their opinions, especially when the issue is complicated and beyond an individuals' personal experience (Newman, et al., 2018). Climate change is an excellent example of how an individual's ideology triggers selective exposure to news media, which contributes to polarized beliefs and attitudes (Guber, 2013; McCright & Dunlap, 2013; McCright, et al., 2014; Nisbet, et al., 2015; Newman, et al., 2018).

In this context, we propose that residents who are more ideologically conservative will engage in selective exposure to avoid media information about the risk of HABs. Scientific and policy information about HABs and their links to agricultural runoff might threaten their worldviews and sense of self-identity, and they will be motivated to engage in selective exposure and/or selective judgement to avoid dissonant information or to process it in a biased manner (Nisbet, et al., 2015). Thus, we hypothesize:

H2. Residents with more conservative social and economic ideology will report less exposure to information about HABs.

This ideologically-driven selective exposure may have significant consequences for residents' risk perceptions about HABs in Lake Erie. Mitigating HABs is a complex environmental puzzle with many moving pieces (Garnache, et al., 2016). It is reasonable to assume that most residents are dependent on news media to learn about HABs and the policy proposals. Thus, from a social amplification of risk perspective, we would expect the media to amplify or mediate perceptions of risk that in turn influence public responses to risk (Kasperson et al, 1998; Hart, Nisbet, & Shanahan, 2011). For instance, Morgan, Larkins, and Adams (2011) found that media coverage about "red tide" in Florida, a type of HAB, reduced the number of people visiting local coastal parks. Likewise, Hart and his colleagues found that local media mediated the relationship between environmental values and risk perceptions about chronic wasting disease among local wildlife in upstate New York (Hart et al., 2011). We surmise that media coverage may likewise amplify the risk of HABs among Ohio residents. Thus, we propose that increased exposure to news about HABs will increase the perceived risk of HABs.

H3. Residents with greater exposure to news about HABs will perceive greater risk from HABs.

In turn, residents who consider HABs a high-risk issue may be more likely to support regulatory policies, as they may be more likely to demand aggressive approaches to solve the problem. They may also incline to punish the "polluters" who contribute to the problem, resulting in higher support for regulatory policies. Therefore, we hypothesize:

H4. Residents with greater perceived risk from HABs will express stronger support for regulatory policies to reduce agricultural runoff.

These hypotheses form the basis for the indirect effects of ideology on policy attitudes through the mediation of news exposure and risk perceptions. Thus, we hypothesize:

H5. Ideology will have a significant indirect effect on support for regulatory policies to reduce agricultural runoff, with more conservative social and economic ideology significantly reducing policy support through news exposure and perceived HABs risk.

2.2 Proximity and Support for Regulatory Policies

Beyond attitudinal and sociodemographic factors, location, place and space also greatly affect people's environmental awareness and attitudes. Many studies, for instance, have investigated the discounted intensity of environmental concerns, valuation, and risk perceptions across space, using different proximity variables such as geographic distances, travelling time, and dichotomous indicator of being close or away (Brody, Highfield, & Alston, 2004; Canter, Nelson & Everett, 1992; Hannon, 1994; Kawamura & Fukushima, 2018; Laws, Yeh, Reisner, Stone, Wang, & Brugge, 2015; Pattingson, Longley, & Kingham, 2015; Signorino, 2012). Several studies examined the link between proximity and public support for nuclear plants and unconventional oil and gas development sites. Some studies found declining project support with increasing distance from the sites (Gravelle & Lachapelle, 2015; Boudet, Zanocco, Howe, &

Clark, 2018), while other studies found positive or no relations between distance/proximity and project support (Cale & Kromer, 2015; Clarke et al., 2016). These mixed results may indicate substantial variation in community responses. Besides these mixed results, little research has examined the link between geographic proximity and public policy attitudes.

Geographic proximity is especially important when considering the problem of HABs on Lake Erie. The downstream ecological condition is caused by upstream nutrient runoff, with the agricultural runoff representing the largest source. For example, the Maumee River has been implicated as the major contributor of nutrients entering Lake Erie that caused HABs (Maccoux et al., 2016). Within the Maumee Region, residents' the proximity to Lake Erie may associate with different levels of awareness of the downstream ecological conditions, personal valuation of the water quality of Lake Erie, and social connections with those who are impacted by HABs. These differences, in turn, may result in varied policy attitudes. A deeper understanding of the variation in policy attitudes among residents of the Maumee Region will inform policy development and implementation to reduce upstream nutrients flow and fluxes and mitigate downstream ecological problems.

Moreover, the geospatial separation between those who contributed to HABs on Lake Erie and those who are directly impacted by the environmental problem determined that solving HABs requires higher-level coordination and authority, such as state, regional or federal policies. Thus, it is important to investigate whether public policy attitudes vary across the state based on residents' living distance from the lake. More importantly, which opinion-formation processes mediate the contextual factor? Quantifying the effects of proximity on policy attitudes, and identifying its mediators for residents within the Maumee Region and statewide, will advance

our understanding of the co-evaluation between upstream human behaviors and downstream ecosystem services.

For Ohio residents, Gill, Ming, and Ouyang (2017) observed charter captains who run fishing trips on Lake Erie wanted more regulation to "fix" the problem quickly. Although their study focused on one group who depend on Lake Erie for livelihood, it indicated a link between the proximity to Lake Erie and residents' support for regulatory policies (i.e., the closer, the stronger support). Hence, we examined the sixth hypothesis.

H6. Residents residing further way from Lake Erie will indicate less support for regulatory policies to reduce agricultural runoff.

In addition to the direct association between proximity and policy support, proximity may also indirectly affect the environmental policy preferences of the public through media use and risk amplification, which forms the basis of the same serial mediation model for ideology. Residents who live further way from Lake Erie may have less motivation to seek news about HABs, as HABs on the lake do not directly affect them. This is consistent with the theory of motivated reasoning, which highlighted that individual media use is impacted by personal factors including the relevancy of the topic (Kunda, 1990). Similarly, media away from Lake Erie may be less motivated to report on HABs. As a result, the amount of news of HABs that are available to residents declines with the increasing distance from Lake Erie. Thus, we hypothesize:

H7. Residents residing further way from Lake Erie will report less exposure to new of HABs.

Similar with the effects of ideology, this proximity-driven differentiation in news exposure may affect residents' support for regulatory policies through the risk amplification

mechanism hypothesized in H3 and H4. We propose proximity to Lake Erie influences residents' policy attitudes through news exposure and risk perceptions. Thus, we hypothesized:

H8. Proximity will have a significant indirect effect on support for regulatory policies to reduce agricultural runoff, with living further way from Lake Erie significantly reduce policy support through news exposure and perceived HABs risk.

2.3 Serial Mediation Model

Collectively, our hypotheses form the basis of the theorized serial mediation model depicted in Figure 1. Ideology and geographic proximity influence the level of exposure to news of HABs, thereby impacting people's risk perception, and eventually their support for regulatory policies to reduce agricultural runoff. This represents a full serial mediation model that includes 1) direct paths between the antecedent variables (i.e., ideology and proximity) and both mediators, and 2) control variables in regression equations predicting each mediator and the ultimate consequent variable (i.e., support for regulatory policies). The hypotheses we proposed did not cover all the possible paths in the serial mediation model, but they were of the most interest to this study. This model differed from studies testing the interaction between ideology and proximity through conceptualizing proximity as a moderator (Clarke et al., 2016; Zanocco, Boudet, Nilson, Satein, Whitley, & Flora, 2018). In this study, by simultaneously testing the direct and indirect effects of ideology and proximity on support for regulatory policies, we contribute to the inquiry of how the combinations of personal and contextual factors affect public policy attitudes.

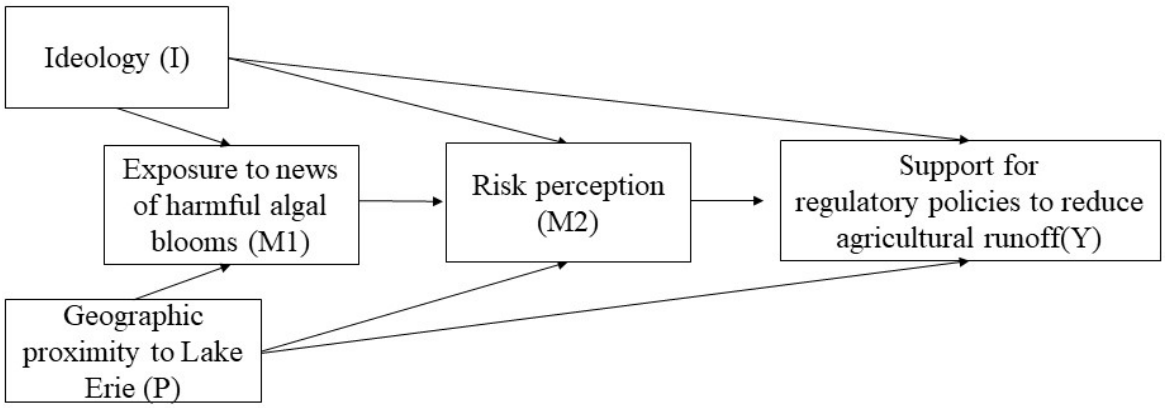

Figure 1. Conceptual graph of the serial mediation model. Control variables emitted from the model illustration.

3. Methods

We tested the serial mediation model using data from a statewide survey within Ohio and a regional survey within the Maumee River watershed (Figure 2). HABs most frequently occur along Lake Erie shoreline in Ohio from Toledo to Sandusky. The Maumee River flows into the Western Lake Erie Basin at Toledo, Ohio, with the watershed spanning across three states Ohio, Indiana, and Michigan. This tributary is the greatest source of phosphorus to Lake Erie (Scavia et al. 2017), and the Ohio Domestic Action Plan has identified Maumee River watershed as the priority region to reduce nutrient runoff. Understanding the public support for regulatory policies within this specific region is important. Moreover, testing the model with two datasets helped establish the convergent validity of the model at different geospatial scales.

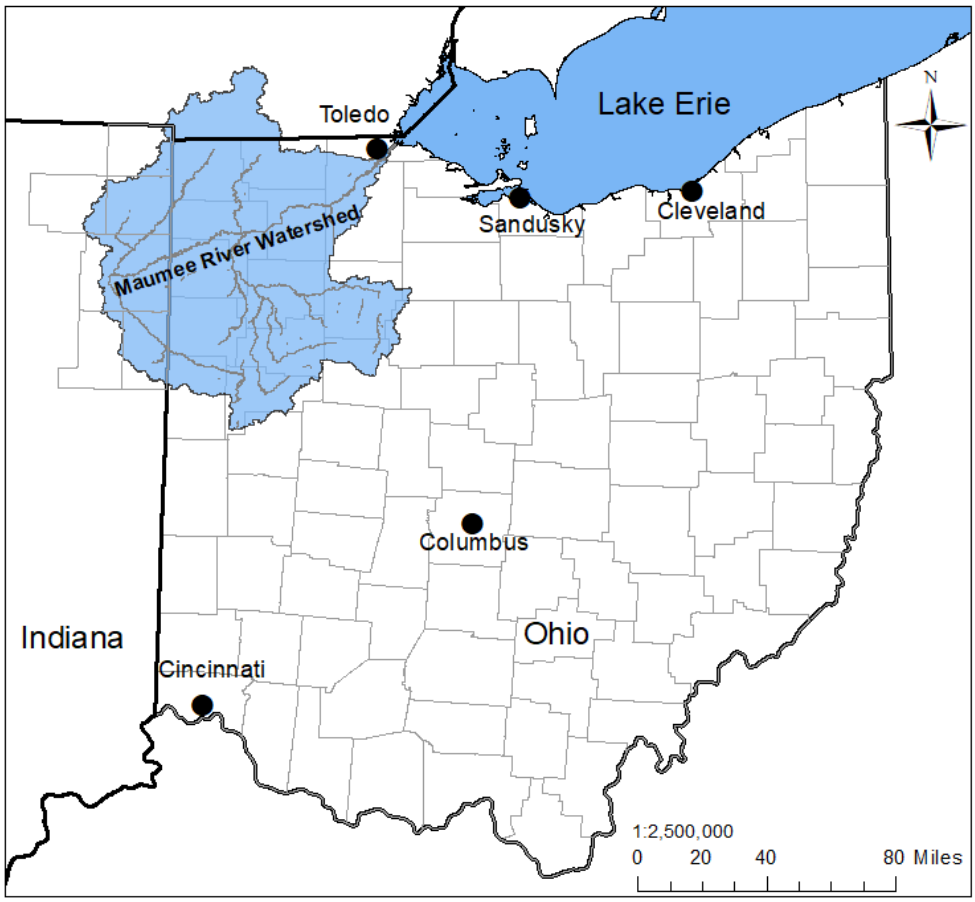

Figure 2. Map of Maumee River watershed, Lake Erie, and Ohio

3.1 Sampling

The statewide survey was a representative, random-digit dial telephone survey of 801 adults. The survey was managed and administered by Strategic Research Group, fielded from October, 2013 to January, 2014, and used Computer Assisted Telephone Interviewing software. The sampling was stratified by regions. Six thousand and twenty residents were contacted, and 801 completed the survey, resulting a response rate of 13%. The sample demographics were as follows: 80.3% age 18-64 (Mean = 48 years, median = 47 years, S.D. = 19 years), 52.8% female, 85.0% white, 41.9% having income $50,000 or above, and 24.1% with a 4-year college degree or above.

The Maumee Regional survey, administered by the same company, was a three wave multi-mode survey. A sample of addresses stratified by groups of census tracks within the Ohio and Indiana portion of the Maumee Watershed was purchased from Marketing Systems Groups. All respondents were initially sent an invitation in the mail to complete the survey online. Respondents who had not completed the web survey were sent a reminder postcard with the survey URL one week after the initial mailing. In the third stage, respondents who did not complete the web survey were contacted through phone calls, if a telephone number was available, or through mailed survey packages. Ten thousand one hundred and nine residents within the Maumee Region were contacted, and 1,268 residents completed the survey, resulting in a response rate of 12.5%. The sample demographics were as follows: 66.6% age 18-64 (Mean = 57.17 years, median = 58.5 years, S.D. = 16 years), 42.8% female, 91.8% white, 50.9% having income over $50,000 and 35.9% with a 4-year college degree or above. Sixty seven percent of the sample was from Ohio (n=850), with the rest of the sample from Indiana (N=418).

3.2 Measures

In the statewide survey, geographic proximity was measured through a dichotomous variable, with one indicating that the respondent was from one of seven coastal counties of Lake Erie within Ohio, and with zero indicating that the respondent was from other counties within Ohio. Ideology related to economic issues was measured using a sequence of questions. Respondents were first asked “When considering economic issue, how would you best describe your views. Do you consider yourself liberal, conservative or moderate/middle of the road?” For those who identified with being liberal or conservative, they were asked if they would say themselves as somewhat liberal [conservative], or very liberal [conservative]. For those who identified with being moderate/middle of road, they were asked if their views were more similar

to conservatives, liberals, or neither. Answers to these questions were combined using a seven point scale from *very liberal* (= 1), to *neither liberal or conservative* (= 4), and *very conservative* (= 7). The same question were used for ideology related to social issues. We then calculated the mean of these two scores and used it in the models as the composite ideology score.

To measure support for regulatory policies respondents were asked to rate their level of agreement with three statements, 1) "The Ohio State legislature should change state law to allow the Ohio Department of Natural Resources to penalize farmers who allow too much fertilizer and nutrients to flow into local streams, rivers, and lakes", 2) "All farmers should receive certification in fertilizer and nutrient management, similar to current pesticide use standards, before being allowed to apply commercial fertilizer to their fields", and 3) "Ohio Department of Natural Resources should designate the Lake Erie watershed as being 'in distress', and this designation would trigger additional state oversight of the way farmers use manure and fertilizer". These three policy proposals were selected because they were prominent options under discussion at the time of survey design. The policy support was measured using seven-point scales, with seven indicating *strongly agree*. We used the mean of the three items scores as the composite score for support for regulatory policies to reduce agricultural runoff.

We measured the rest of the concepts in the model with single items. To measure exposure to news of HABs, respondents were asked "In the last few months, how much have you heard or read in the news about Algal blooms in Lake Erie?" using a seven-point scale with seven indicating *a great deal*. To measure risk perception, respondents were asked "In your opinion, how much risk do algal blooms in Lake Erie pose to Human health in Ohio" using a eleven-point scale with zero indicating *no risk at all* and ten indicating *extreme amount of risk*.

In the Maumee Regional survey, we were able to include more questions compared to the statewide survey, allowing us to measure proximity and risk perception more comprehensively. The Maumee Regional survey included census track information for each respondent. Using this information, we calculated how far away the respondent lived from the Lake Erie. As suggested by Hart et al. (2015), we took the log of the distance and used it in the model to account for the potential non-linear relationship between proximity and respondents' policy attitudes. For risk perception, the Maumee Regional survey used seven items instead of one. These items asked respondents to report how much risk algal blooms in Lake Erie pose to fish in Lake Erie, human health, the economy, plant and animal species, the respondent and the respondents' family, the respondents' local community, and people in the state generally. Reliability and confirmatory factor analysis revealed these items cohesively measured respondents' risk perception (Crobach's alpha = .937; *Chi-square* = 388.35, *df* = 14, *CFI* = .94, *NFI*=.94, *SRMR*=.0386, *RMSEA* =.01617)[1]. We used the mean of these seven variables as the composite score for risk perception. Social and economic ideologies were also measured with the same sequence of questions. However, when asked to specify their liberal or conservative leaning, respondents were given three levels (extremely, fairly, somewhat), rather than the two levels given in the state-level survey. As a result, the combined scale for ideology has nine points. The rest of concepts (exposure to news about HABs, and support for regulatory policies to reduce agricultural runoff) in the model were measured in the same way as the statewide survey.

3.3 Modelling

[1] We noted the RMSEA exceeded recommended cut-off value of 0.08 for good fit. However, all other fit statistics indicates good fit. The RMSEA is a parsimony-adjusted index. The high value of RMSEA may relate to the large number of items measuring the concept suggesting some level of redundancy among items. Since our major interest was to test whether the seven items measured a uniform construct or multiple constructs, we consider the seven-item scale uniformly measured the construct of risk perception.

We used the PROCESS macro for SPSS (Hayes, 2017) to run three OLS regression models with exposure to news of HABs, risk perception, and support for regulatory policies as the dependent variable, respectively. For each model, predicators included the concepts in the conceptual graph that having an arrow pointing to the dependent variable, and covariates. For the statewide data, the covariates include 1) gender (1= *female*, 0=*male*), 2) age (continuous), 3) education level (1=*some high school or less*, 5=*post-graduate degree*, treated as a ordinal predictor), 4) race (variable name white, 1=*white*, 0=*other racial groups*), 5) income (1=*below $14,999*, 6=*$100,000 or more*, treated as a ordinal predictor), and 6) whether respondent currently work in or had worked in agriculture (variable name agriculture, 1= *yes, current or previously employed in agricultural industry*, 0=*no*). The PROCESS macro also estimated the indirect effect of predictors on support for regulatory policies and its confidential interval using bootstrapping.

We noted that our final sample size for the statewide survey was 505 rather than the original sample size of 801. The majority of the omitted cases were individuals who reported "don't know" when asked how much risk algal blooms in Lake Erie posed to human health in Ohio (n=245). We rerun the analysis with a mean substitution on the missing risk perception data with the sample size increased to 677. Neither the significance nor magnitude of any direct or indirect effects of ideology and proximity changed, suggesting missing values in risk perceptions did not affect the results. We decided to report modelling results without missing data substitution.

For the Maumee Regional data, we tested the serial mediation model with all covariates specified earlier and added three covariates: 1) whether the respondent worked or had worked on or near the lake (=1, variable name lake occupation), and 3) when the last time was the

respondents visited Lake Erie or one of the Lake Erie's island (variable name last visit, 1 = within the past year, 5= never visited lake Erie, treated as a ordinal predictor). By adding covariates, we expect the model testing results to be more robust. The final sample size for the model was 992. Most variables had less than ten percent missing values, except for income (13.8%). However, the large number of predictors in the model resulted in the reduced sample size.

4. Results

4.1 Statewide

The mean support for regulatory policies to reduce agricultural runoff was 5.04 on a seven-point scale, with *a standard deviation (S. D.)* of 1.66, suggesting a slightly positive public attitude toward regulatory policy proposals. Specifically, 59.7% of sampled Ohio residents somewhat to strongly agreed that the Ohio State legislature should change state law to allow Ohio Department of Natural Resources to penalize farmers who allow too much fertilizer and nutrients to flow into local streams, rivers, and lakes. About sixty seven percent (67.2%) of sampled Ohio residents somewhat to strongly agreed that all farmers should receive certification in fertilizer and nutrient management, similar to current pesticide use standards, before being allowed to apply commercial fertilizer to their fields. About fifty three percent (53.4%) of sampled Ohio residents somewhat to strongly agreed that the Ohio Department of Natural Resources should designate the Lake Erie watershed as being "in distress", and this designation would trigger additional state oversight of the way farmers use manure and fertilizer.

Residents in the sample tended to be conservative (*mean* = 4.64, *S.D.* = 1.92), read or saw news of HABs in the past few months less than a moderate amount (*mean* = 2.45, *S.D.* = 1.94),

and considered HABs posed moderate amount of risk to human health in Ohio (*mean* = 5.00, *S.D.* = 2.33). About 14.8% of the sample was from coastal counties adjacent to Lake Erie (*n* =119).

Table 1 presented the results from testing the serial mediation model through fitting three regression models with exposure to news of HABs (first mediator), risk perception (second mediator), and policy support as response variables respectively. All coefficients reported in the table were unstandardized. The results supported H1 through H5. Ohio residents who were more conservative indicated reduced support for regulatory policies to reduce agricultural runoff (*Coeff.* = - 0.18, *S.E.* = 0.03, *p-value* <.0001). Moreover, Ohio residents who were more conservative received less news about HABs (*Coeff.* = - 0.12, *S.E.* = 0.05, *p-value*=.015), compared to their liberal counterparts. In turn, less news was associated with decreasing perceived risk (*Coeff.* = 0.31, *S.E.* = 0.05, *p-value* <.0001), and this decreasing risk perception was associated with reduced support for regulatory policies (*Coeff.* = 0.14, *S.E.* = 0.03, *p-value* <.0001; *estimated indirect effect* = - 0.0049, *C.I.*=(-0.0105, -0.0009)). These results supported ideology effects on residents' support for regulatory policies directly and indirectly through media use and risk perception. The direct effect of ideology seemed to be stronger than its indirect effect, suggesting other mechanisms might be in place that caused residents to align their policy attitudes with their ideology.

Table 1. Modeling results with statewide data.

Antecedent	Model 1: with M1 as response variable			Model 2: with M2 as response variable			Model 3: with Y as response variable		
	M1 (Exposure to news of HABs)			M2 (Risk perception)			Y (Support for regulatory policies)		
	Coeff.	*S.E.*	*p-value*	*Coeff.*	*S.E.*	*p-value*	*Coeff.*	*S.E.*	*p-value*
Direct effect									
I (Ideology)	-.12	.05	.015*	-.11	.05	.031*	-.18	.03	.000***
P (Proximity)	.22	.23	.336	.00	.25	.992	.08	.17	.630
M1	-	-	-	.31	.05	.000*	.05	.03	.120
M2	-	-	-	-	-	-	.14	.03	.000***
Indirect effect							*Effect*	*C.I.*	
I-M1-Y							-.0062	(-.0185, .0022)	
I-M2-Y							-.0153	(-.0332, -.0011)	
I-M1-M2-Y							-.0049	(-.0105, -.0009)	
P-M1-Y							.0119	(-.0124, .0561)	
P-M2-Y							.0003	(-.0753, .0690)	
P-M1-M2-Y							.0094	(-.0093, .0319)	
Control							*Coeff.*	*S.E.*	*p-value*
Agriculture	.52	.27	.052	-.04	.29	.882	-.66	.20	.001*
Gender	-.11	.19	.566	.23	.21	.275	.38	.14	.008*
Age	.02	.01	.001*	-.00	.01	.736	.00	.00	.833
Education	.07	.07	.323	.01	.08	.892	-.12	.05	.018*
White	.64	.28	.022*	.56	.30	.061	.16	.21	.427
Income	.05	.07	.445	-.00	.08	.988	-.00	.05	.930
	R^2 = .05			R^2 = .10			R^2 = .17		
	$F(8, 496)$ = 3.91			$F(9, 495)$ = 6.33			$F(10, 494)$ = 10.00		
	p-value <.0001			*p-value* <.0001			*p-value* <.0001		

* *p-value* <.05, ** *p-value* <.001, ****p-value*<.0001. M1: First mediator. M2 Second mediator.

We did not observe any direct or indirect effects of whether respondents were from a coastal county along Lake Erie on their policy support, rejecting H6 through H8. In addition to ideology and proximity, residents with higher education levels were less likely to support regulatory policies (*Coeff.* = -0.12, *S.E.* = 0.05, *p-value*=.018). Not surprisingly, Ohio residents who worked or had worked in agriculture indicated weaker support for regulatory policies (*Coeff.* = -0.66, *S.E.* = 0.20, *p-value*=.001). Females indicated stronger support for regulatory policies compared to their male counterparts (*Coeff.* = 0.38, *S.E.* = 0.14, *p-value*=.008).

4.2 Maumee Region

Residents in the Maumee Region indicated slightly lower support for regulatory policies (*mean* = 4.80, *S.D.* = 1.74). Specifically, 55.6% Maumee Region residents somewhat to strongly agreed that the Ohio State legislature should change state law to allow Ohio Department of Natural Resources to penalize farmers who allow too much fertilizer and nutrients to flow into local streams, rivers, and lakes. About sixty three percent (62.5%) of sampled Ohio residents somewhat to strongly agreed that all farmers should receive certification in fertilizer and nutrient management, similar to current pesticide use standards, before being allowed to apply commercial fertilizer to their fields. About fifty four percent (53.9%) of sampled Ohio residents somewhat to strongly agreed that the Ohio Department of Natural Resources should designate the Lake Erie watershed as being "in distress", and this designation would trigger additional state oversight of the way farmers use manure and fertilizer.

The Maumee Region sample was relatively conservative (*mean* = 5.76, *S.D.* = 2.10). On average, residents in the Maumee Region were exposed to more news of HABs (*mean* = 3.32, *S.D.* = 2.07). They considered HABs posed moderate amount of risk (*mean* = 5.44, *S.D.* = 2.34). On average, sampled residents lived 109 kilometers from the Lake Erie, with a median distance of 122 kilometers. We took the log of the distance and used it as the measurement for proximity in the model.

We tested the serial mediation model within this smaller region using three regression models (Table 2), and found the same results for the direct effect of ideology (H1), and risk amplification through media use (H3, H4). Those within the Maumee Region who were more conservative indicated weaker support for regulatory policies to reduce agricultural runoff (*Coeff.* = -0.16, *S.E.* =0.02, *p-value* <.0001; Table 2). Those who received less news of HABs indicated

lower perceived risk (*Coeff.* = 0.31, *S.E.* =0.04, *p-value* <.0001), which translated into lower support for regulatory policies (*Coeff.* = 0.24, *S.E.* =0.02, *p-value* <.0001). However, we did not observe selective exposure as ideology did not significantly predict news exposure. The indirect effect of ideology through the mediation of news exposure and risk perception was not significant either, as its confidence interval contained zero.

Proximity measured by log distance from Lake Erie did not directly affect support for regulatory policies, which was consistent with the statewide model. However, different from the statewide model, we observed residents who live further way from Lake Erie received less news of HABs (*Coeff.* = -0.62, *S.E.* =0.09, *p-value* < .0001), which translated into decreased support for regulatory policies through decreased risk perceptions (*estimated indirect effect* = - 0.0459, *C.I.*= (-0.0679, -0.0277)).

Among the covariates, residents within the Maumee Region who worked or had worked in agriculture indicated reduced support for regulatory policies (*Coeff.* = -0.96, *S.E.* =0.10, *p-value* <.0001). On the contrary, those who worked or hard worked on or near the lake indicated stronger support for regulatory policies (*Coeff.* = 0.66, *S.E.* =0.19, *p* -value=.001). Compared to statewide model, gender and education levels no longer predicted policy support.

Table 2. Modeling results with Maumee Region data.

Antecedent	Model 1: with M1 as response variable			Model 2: with M2 as response variable			Model 3: with Y as response variable		
	M1 (Exposure to news of HABs)			M2 (Risk perception)			Y (Support for regulatory policies)		
	Coeff.	*S.E.*	*p-value*	*Coeff.*	*S.E.*	*p-value*	*Coeff.*	*S.E.*	*p-value*
Direct effect									
I (Ideology)	-.01	.03	.599	-.17	.03	.000***	-.16	.02	.000***
P (Proximity)	-.62	.09	.000***	-.35	.11	.001*	-.09	.08	.260
M1	-	-	-	.31	.04	.000***	.02	.03	.432
M2	-	-	-	-	-	-	.24	.02	.000***
Indirect effect									
I-M1-Y							.0003	(-.0014, .0031)	
I-M2-Y							-.0400	(-.0577, -.0238)	
I-M1-M2-Y							-.0011	(-.0054, .0031)	
P-M1-Y							.0129	(-.0191, .0476)	
P-M2-Y							-.0829	(-.1366, -.0326)	
P-M1-M2-Y							-.0459	(-.0679, -.0277)	
Control									
Agriculture	.52	.13	.000***	-.32	.15	.030*	-.96	.10	.000***
Lake occu.	.09	.24	.702	-.16	.27	.563	.66	.19	.001*
Last visit	-.41	.05	.000***	-.11	.05	.034*	-.01	.04	.718
Gender	-.21	.12	.099	.85	.14	.000***	.00	.10	.985
Age	.03	.00	.000***	.00	.00	.778	-.00	.00	.612
Education	.05	.04	.239	-.04	.05	.379	.03	.03	.334
White	.82	.27	.002*	.12	.30	.681	-.17	.21	.422
Income	.03	.03	.349	-.04	.04	.230	-.01	.03	.771
	R^2 = .24			R^2 = .20			R^2 = .27		
	$F(10, 981)$ = 30.62			$F(11, 980)$ = 21.97			$F(12, 979)$ = 29.93		
	p-value <.0001			*p-value* <.0001			*p-value* <.0001		

* *p-value* <.05, ** *p-value* <.001, ***p-value<.0001

Table 3 summarized the results for hypotheses testing. The direct effect of ideology was consistently supported, while the direct effect of proximity was not supported. The indirect effect of ideology through selective exposure and risk amplification was observed at the state level but not at the watershed level. The indirect effect of proximity was supported at the watershed level

but not at the state level. It is worth noting that the measurement of proximity was more detailed for the Maumee Region data than the measurement for the statewide data. Unfortunately, we were not able to test whether the inconsistent findings were due to measurements or the geospatial scales.

Table 3. Hypotheses about effects on support for regulatory policies to reduce agricultural runoff

	Proposed Effects	Ohio Statewide	Maumee Region
H_1	Ideo → Policy	Supported	Supported
H_2	Ideo → News	Supported	Not Supported
H_3	News → Risk	Supported	Supported
H_4	Risk → Policy	Supported	Supported
H_5	Ideo → News → Risk → Policy	Supported	Not Supported
H_6	Proximity → Policy	Not supported	Not Supported
H_7	Proximity→ News	Not supported	Supported
H_8	Proximity → News → Risk → Policy	Not supported	Supported

5. Discussion

This study tested how ideology and proximity affect public support for regulatory policies to reduce excessive agricultural runoff using survey data collected in Ohio and Maumee River Watershed. Our study revealed a slightly favorable attitude toward regulatory policies. Residents seemed to align their support for regulatory policies with their political ideologies, as we observed a direct effect of ideology on policy support at the state and watershedl level. Risk perception consistently predicted policy support at the state and watershed level. News exposure played a more complicated and nuanced role in mediating the effects of ideology. At the state level, we observed an indirect effect of ideology mediated through media use and risk perception, but we did not observe this full path at the watershed level. Contrary from our hypotheses, proximity to Lake Erie did not affect support for regulatory policies directly.

5.1 Implications for Understanding Policy Support

Our study supported the proposed serial mediation model for ideology at the state level, but not at the watershed level. Such difference suggests scales are important in detecting selective exposure triggered by ideology. Explicitly, ideology affected how much news of HABs residents received at the state level, but not so at the watershed level. An explanation for this inconsistency may be that residents in the Maumee Region tend to have more at stake in reducing agricultural runoff. The literature revealed that motivated reasoning could be mitigated when the decision has direct and important consequences. For residents in the Maumee Region, reducing agricultural runoff may be such a topic with real consequences that it reduced the occurrence of selective exposure.

Although we did not detect selective exposure related to the amount of news residents reported receiving at the watershed level, other types of motivated reasoning might have occurred. For example, ideology or values may influence processes of selective attention, recall, or comprehension of media content beyond simply driving selective exposure (e.g. Newman et al., 2018). It is possible that ideology may shape how residents mentally process and interpret the media content or information to which they are exposed at the watershed level.

We did not observe a tendency of residents living close to Lake Erie to demand aggressive approaches or punishment on the "polluters" who contribute to the problem. We observed an indirect effect of proximity at the watershed level, but not at the state level. The dichotomous variable we used to measure proximity at the state level might not be sufficiently granulated to detect the effect of proximity on news exposure.

5.2 Implications for Mitigating Nutrient Pollution

We observed a difference in policy support between residents holding more conservative ideology and those who holding more liberal ideology. Meanwhile, residents in the sample received a moderate amount of news about HABs and over 30% of residents in the statewide sample indicated they did not know about the risk of HABs. Theories in science communication suggested people are more likely to use ideology as a heuristic when they know little about the issue. It suggests the difference in policy attitudes by ideologies may relate to a lack of issue salience at the time of data collection (late 2013 early 2014), rather than confirming a polarized political environmental for mitigating HABs..

The findings suggest risk perception is important in determining public support for regulatory policies. Public risk perception appeared to align with individual ideology at both the state and the watershed levels. Residents who were more conservative indicated lower perceived risk. At the state level, this reduced risk perception was preceded by reduced exposure to news of HABs, but not at the watershed level. Within the Maumee Region, risk perception had a larger effect on policy support than the direct effect of ideology, suggesting a possibility to reduce the dividing effects of ideology through developing a collective sense of risk. We recommend greater and more penetrating communication about the risk associated with HABs within the Lake Erie Basin. We also suggest natural resource managers and policy-makers account for recipients' ideology when designing messages and focus on messages that resonate across a range of different ideological viewpoints.

5.3 Limitations and Future Research

There were limitations to this study that should be acknowledged. First, the data was collected before the 2014 Toledo water crisis. In August 2014, Toledo Officials issued a two-day ban on drinking and cooking with tap water due to toxins from an algal bloom that was occurring

in Western Lake Erie. Since then, some specific policies we tested in the survey have been adopted to reduce agricultural runoff. For example, since 2015, all farmers need to receive certification in fertilizer and nutrient management before being allowed to apply commercial fertilizer to their fields. Although the levels of policy support and specific regulatory policy proposals may have changed since 2014, we propose that the mechanisms we uncovered between ideology, proximity, media use, risk perception, and policy support hold. Particularly, the serial mediation model we tested in this study predicts that the public support for regulatory policies may have increased since data collection due to more media coverage on the issue and higher perceived risks. This study set a baseline in evaluating public opinion towards regulatory policies to reduce nutrient pollutions entering Lake Erie with our findings highlighting the need for additional research in this area.

Second, this study relied upon a correlational analysis of survey data and thus we cannot make strong causal statements regarding the direction of the relationships between the concepts in the serial mediation model. Optimally, a longitudinal panel survey could be employed in the future to examine how ideology and proximity are associated with news exposure, risk perception, and support for regulatory policies. We also acknowledge the limitations of our measurement. For example, we used single item to measure exposure to news of HABs. We did not measure news channel or contents, which limited the aspects of media use that we could test. We used different measures for proximity at the state and watershed levels. Future studies should explore how the measures of proximity affect the detection of its effects, and more importantly why and when such measurement effects occur.

In this study, we simultaneously tested the effects of ideology and proximity on policy support within a serial mediation model. Hart et al. (2015) found ideology and proximity

interacted in influencing support for energy development projects through a moderation model. The next step is to test a more complicated moderated mediation model explaining the effects of ideology and proximity. In addition, residents' beliefs and values other than ideology and risk perceptions may affect public policy attitudes, such as perceived costs and benefits of policy proposals, trust in farmers, trust in state government, and environmental values. The effect of ideology on policy support may be mediated or moderated by factors that were not included in the study, such as property values, hesitancy to recreate in Lake Erie, health problems in family and friends related to water quality. We recommend future studies to examine other mechanisms of the effects of ideology on policy support. In this study, we did not distinguish news from traditional media or through social media. We recommend future research examining the role of social media as a "risk amplification" station influencing risk and policy attitudes on local environmental management issue like HABs. Lastly, our analyses on public opinion within the Maumee watershed suggested proximity to policy impacts (e.g., using penalties to reduce agricultural runoff) may be more likely to affect residents policy attitudes than the proximity to environmental impacts (e.g., risks associated with HABs). Such potential mechanism may amplify the differences in public policy attitudes, because policies to mitigate nutrient loading often target upstream while impacts of nutrient pollution often occur downstream. We suggest future studies test this hypothesis.

6. Conclusion

Our study revealed public attitudes toward regulatory policies aligned with individual political ideology, but not with geographic proximity. We demonstrated mechanisms through which individual political predispositions like ideology may influence policy attitudes about managing a local environmental problem through news exposure and risk perceptions. However,

the effect of proximity on policy support is more nuanced. Our findings highlighted the complex diversity within residents' policy attitudes, contributing to the understanding of personal and contextual factors that contribute to the difference. The ultimate goal of policy development is to find polices that are acceptable to population groups with different beliefs and backgrounds. We highlighted that policy development and environmental communication should take into account of individual differences and seek ways to promote dialogues and sympathy between groups.

Acknowledgement

The study was supported by the Grant from National Science Foundation, Directorate for Biological Sciences, Division for Environmental Biology, Dynamics of Coupled Natural-Human Systems Program titled Co-Evolution of Upstream Human Behavior and Downstream Ecosystem Services in a Changing Climate (Award number: 1114934). We wanted to acknowledge that this work is though collaboration between University of Michigan and Ohio State University, through the Cooperative Institute for Great Lakes Research (CIGLR) Research Consortium. The lead author was funded by CIGLR. This is CIGLR contribution XXX. Deanna Fyffe helped with the map of Maumee Watershed and Ohio. We thank the individuals who participated in the survey.

References

Ahern, L., Connolly-Ahern, C., & Hoewe, J. (2016). Worldviews, issue knowledge, and the pollution of a local science information environment. *Science Communication*, *38*(2), 228–250.

Attari, S. Z., Schoen, M., Davidson, C. I., DeKay, M. L., de Bruin, W. B., Dawes, R., & Small, M. J. (2009). Preferences for change: Do individuals prefer voluntary actions, soft regulations, or hard regulations to decrease fossil fuel consumption? *Ecological Economics*, *68*(6), 1701–1710.

Boudet, H., Clarke, C., Bugden, D., Maibach, E., Roser-Renouf, C., & Leiserowitz, A. (2014). "Fracking" controversy and communication: Using national survey data to understand public perceptions of hydraulic fracturing. *Energy Policy*, *65*, 57–67.

Boudet, H. S., Zanocco, C. M., Howe, P. D., & Clarke, C. E. (2018). The effect of geographic proximity to unconventional oil and gas development on public support for hydraulic fracturing. *Risk Analysis*, *38*(9), 1871-1890.

Borick, C., & Rabe, B. (2012). *Countinued rebound in American belief and policy in climate change: Spring 2012 NSAPOCC findings*. Retrieved from http://www.brookings.edu/research/papers/2012/06/11-climate-rabe-borick%5Cnhttp://www.brookings.edu/~/media/research/files/papers/2012/6/11 climate rabe borick/nsapocc_belief_spring formatted

Bright, A. D., Manfredo, M. J., & Fulton, D. C. (2000). Segmenting the public: An application of value orientations to wildlife planning in Colorado. *Wildlife Society Bulletin*, *28*(1), 218–226.

Brody, S. D., Highfield, W., & Alston, L. (2004). Does location matter?:Measuring environmental perceptions of creeks in two San Antonio watersheds. *Environment and Behavior*, *36*(2), 229–250.

Burden, B. C., & Hillygus, D. S. (2009). Polls and elections : Opinion formation, polarization , and presidential reelection. *Presidential Studies Quarterly*, *39*(3), 619–635.

Burstein, P. (2003). The impact of public opinion on public policy. *Political Research Quarterly*, *56*(1), 29–40.

Cacciatore, M. A., Cacciatore, M. A., Scheufele, D. A., Binder, A. R., & Shaw, B. R. (2012). Public attitudes toward biofuels: Effects of knowledge, political partisanship, and media use. *Politics and the Life Sciences*, *31*(1/2), 36–51.

Cale, T., & Kromer, M. (2015). Does proximity matter? Plant location, public awareness, and support for nuclear energy. *Social Science Journal*, *52*(2), 148–155.

Campbell, A., Converse, P.E., Miller, W.E., & Stokes, D.E. (1960).The American voter. Wiley, New York, NY.

Canter, L. W., Nelson, D. I., & Everett, J. W. (1992). Public perception of water quality risks-influencing factors and enhancement opportunities. *Journal of Environmental Systems*, *22*(2), 163–187.

Cheung, M. Y., Liang, S., & Lee, J. (2013). Toxin-producing cyanobacteria in freshwater: A review of the problems, impact on drinking water safety, and efforts for protecting public health. *Journal of Microbiology*, *51*(1), 1–10.

Choma, B. L., Hanoch, Y., & Currie, S. (2016). Attitudes toward hydraulic fracturing: The opposing forces of political conservatism and basic knowledge about fracking. *Global Environmental Change*, *38*, 108–117.

Clarke, C. E., Budgen, D., Hart, P. S., Stedman, R. C., Jacquet, J. B., Evensen, D. T. N., & Boudet, H. S. (2016). How geographic distance and political ideology interact to influence public perception of unconventional oil/natural gas development. *Energy Policy*, *97*, 301–309.

de Groot, J. I. M., & Schuitema, G. (2012). How to make the unpopular popular? Policy characteristics, social norms and the acceptability of environmental policies. *Environmental Science and Policy*, *19–20*, 100–107.

Duan, H., Ma, R., Xu, X., Kong, F., Zhang, S., Kong, W., … Shang, L. (2009). Two-decade reconstruction of algal blooms in China' s Lake Taihu. *Environmental Science and Technology*, *43*(10), 3522–3528.

Garnache, C., Swinton, S. M., Herriges, J. A., Lupi, F., & Stevenson, R. J. (2016). Solving the phosphorus pollution puzzle: Synthesis and directions for future research. *American Journal of Agricultural Economics*, *98*(5), 1334–1359.

Gill, D., Ming, T., & Ouyang, W. (2017). *Improving the Lake Erie HAB Tracker : A forecasting and decision support tool for harmful algal blooms*. Master's Thesis at University of Michigan.

Gill, D., Rowe, M., & Joshi, S. J. (2018). Fishing in greener waters: Understanding the impact of HABs on Lake Erie anglers and the potential for adoption of a forecast model. *Journal of Environmental Management*, *227*(September), 248–255.

Gravelle, T. B., & Lachapelle, E. (2015). Politics, proximity and the pipeline: Mapping public attitudes toward Keystone XL. *Energy Policy*, *83*, 99–108.

Great Lakes Water Quality Board Public Engagement Work Group. (2018). *Second binational Great Lakes Basin Poll*. Retrieved from International Joint Commission's website: https://legacyfiles.ijc.org/tinymce/uploaded/WQB/WQB_Second_Poll_Report.pdf

Guber, D. L. (2013). A cooling climate for change? Party polarization and the politics of global warming. *American Behavioral Scientist*, *57*(1), 93–115.

Gud. (2017). *Farming and the environment: Michigan statewide survey*. Unpublished report prepared for Michigan Department of Agricultural and Rural Development.

Hannon, B. (1994). Sense of place: geographic discounting by people, animals and plants. *Ecological Economics*, *10*(2), 157–174.

Hayes, A. (2017). Introduction to mediation, moderation, and conditional process analysis, second edition: a regression-based approach (2nd Ed). New York: Guilford Press.

Hart, P. S., Nisbet, E. C., & Shanahan, J. E. (2011). Environmental values and the social amplification of risk: An examination of how environmental values and media use influence predispositions for public engagement in wildlife management decision making. *Society and Natural Resources*, *24*(3), 276–291.

Howard, G., Roe, B. E., Nisbet, E. C., & Martin, J. (2017). Hypothetical bias mitigation in choice experiments: Effectiveness of cheap talk and honesty priming fade with repeated choices. *Journal of the Association of Environmental and Resource Economists*, *4*(2).

Hula, R. C., Bowers, M., Whitley, C., & Isaac, W. (2017). Science, politics and policy: How Michiganders think about the risks facing the Great Lakes. *Human Ecology*, *45*(6), 833–844.

John R. Kasich Governor of Ohio Press Releases (2018) Kasich administration takes aggressive new action to reduce nutrient runoff and improve Lake Erie water quality. Retrieved from John R. Kasich Governor of Ohio's website: https://governor.ohio.gov/Media-Room/Press-Releases/ArticleId/946/kasich-administration-takes-aggressive-new-action-to-reduce-nutrient-runoff-and-improve-lake-erie-water-quality-7-11-18.

Kalcic, M. M. C., Kirchhoff, C., Bosch, N., Muenich, R. L., Murray, M., Griffith Gardner, J., & Scavia, D. (2016). Engaging stakeholders to define feasible and desirable agricultural conservation in western Lake Erie watersheds. *Environmental Science and Technology*, *50*(15), 8135–8145.

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., … Ratick, S. (1988). The social amplification of risk: A conceptual framework. *Risk Analysis*, *8*(2), 177–187.

Kawamura, S., & Fukushima, T. (2018). Residents' concerns about lake uses and environments: a comparative study of Lakes Kasumigaura, Suwa, and Biwa in Japan. *Limnology*, *19*(1), 101–113.

Kingdon, J.W. (1984) Agendas, alternatives, and public policies. Boston, MI: Little, Brown and Company.

Konisky, D. M., Milyo, J., & Richardson, L. E. (2008). Environmental policy attitudes: Issues, geographical scale, and political trust. *Social Science Quarterly*, *89*(5), 1066–1085.

Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin*, *108*(3), 480–498.

Lake Erie LaMP (2011). Lake Erie Binational Nutrient Management Strategy: Protecting Lake Erie by Managing Phosphorus. Prepared by the Lake Erie LaMP Work Group Nutrient Management Task Group.

Laws, B. M., Yeh, Y., Reisner, E., Stone, K., Wang, T., & Brugge, D. (2015). Gender, ethnicity and environmental risk perception revisited: The importance of residential location. *Journal of Community Health*, *40*(5), 948–955.

Ludlow, R. (2018). Ohio agricultural director fired amid dispute over farms, Lake Erie algae. Retrieved from the Columbus Dispatch websites [October 31, 2018] https://www.dispatch.com/news/20181022/ohio-agriculture-director-fired-amid-dispute-over-farms-lake-erie-algae

Manfredo, M. J. (2008). Values, ideology and value orientation. In *Who cares about wildlife: Social science concepts for exploring human-wildlife relationships and conservation issues* (pp. 141–165). New York: Springer-Verlag.

Maccoux, M. J., Dove, A., Backus, S. M., & Dolan, D. M. (2016). Total and soluble reactive phosphorus loadings to Lake Erie: A detailed accounting by year, basin, country, and tributary. *Journal of Great Lakes Research*, *42*(6), 1151–1165.

McCright, A. M., & Dunlap, R. E. (2013). Bringing ideology in: The conservative white male effect on worry about environmental problems in the USA. *Journal of Risk Research*, *16*(2), 211–226.

McCright, A. M., Dunlap, R. E., & Xiao, C. (2014). Increasing influence of party identification on perceived scientific agreement and support for government action on climate change in the United States, 2006-12. *Weather, Climate and Society*, *6*, 194–201.

McDowell, R. W., Dils, R. M., Collins, A. L., Flahive, K. A., Sharpley, A. N., & Quinn, J. (2016). A review of the policies and implementation of practices to decrease water quality impairment by phosphorus in New Zealand, the UK, and the US. *Nutrient Cycling in Agroecosystems*, *104*(3), 289–305.

Morgan, K. L., Larkin, S. L., & Adams, C. M. (2011). Red tides and participation in marine-based activities: Estimating the response of Southwest Florida residents. *Harmful Algae*, *9*(3), 333–341.

Newman, T. P., Nisbet, E. C., & Nisbet, M. C. (2018). Climate change, cultural cognition, and media effects: Worldviews drive news selectivity, biased processing, and polarized attitudes. *Public Understanding of Science*, 1–18.

Nisbet, E. C., Cooper, K. E., & Ellithorpe, M. (2015). Ignorance or bias? Evaluating the ideological and informational drivers of communication gaps about climate change. *Public Understanding of Science*, *24*(3), 285–301.

Ohio Lake Erie Commission, Ohio Department of Agriculture, Ohio Department of Natural Resources, Ohio Environmental Protection Agency, & Ohio Department of Health (2018) State of Ohio's Domestic Action Plan 1.0: In accordance with the Great Lakes Water Quality Agreement. Received from Ohio Lake Erie Commission's website: https://lakeerie.ohio.gov/LakeEriePlanning/OhioDomesticActionPlan2018.aspx

Pattinson, W., Longley, I., & Kingham, S. (2015). Proximity to busy highways and local resident perceptions of air quality. *Health and Place*, *31*, 154–162.

Rissman, A. R., Kohl, P. A., & Wardropper, C. B. (2017). Public support for carrot, stick, and no-government water quality policies. *Environmental Science and Policy*, *76*, 82–89.

Scavia, D., Kalcic, M., Muenich, R.L., Read, J., Aloysius, N., Arnold, J., Boles, C., Confessor, R., Gildow, M., Martin, J., Redder, T., Sowa, S., Yen, H., (2017) Multiple models guide strategies for agricultural nutrient load reductions. *Frontier in Ecology and the Environment*. 15, 126-132.

Scavia, D., Allan, J., Arend, K. K., Bartell, S., Beletsky, D., Bosch, N. S., … Zhou, Y. (2014). Assessing and addressing the re-eutrophication of Lake Erie: Central basin hypoxia. *Journal of Great Lakes Research*, *40*(2), 226–246.

Segerson, K. (2013). Voluntary approaches to rnvironmental protection and resource management. *Annual Review of Resource Economy*. 5:161-180.

Shortle, J. S., Ribaudo, M., Horan, R. D., & Blandford, D. (2012). Reforming agricultural nonpoint pollution policy in an increasingly budget-constrained environment. *Environmental Science and Technology*, *46*(3), 1316–1325.

Signorino, G. (2012). Proximity and risk perception. Comparing risk perception profiles in two petrochemical areas of Sicily (Augusta and Milazzo). *Journal of Risk Research*, *15*(10), 1223–1243.

Smith, D. R., Wilson, R. S., King, K. W., Zwonitzer, M., McGrath, J. M., Harmel, R. D., … Johnson, L. T. (2018). Lake Erie, phosphorus, and microcystin: Is it really the farmer's fault? *Journal of Soil and Water Conservation*, *73*(1), 48–57.

Stroud, N. J. (2008). Media use and political predispositions: Revisiting the concept of selective exposure. *Political Behavior*, *30*(3), 341–366.

Stroud, N. J. (2017). Understanding and overcoming selective exposure and judgment when communicating about science. In K. H. Jamieson, D. M. Kahan, & D. A. Scheufele (Eds.), *The Oxford handbook of the science of science communication* (Vol. 1, pp. 1–21). Oxford Handbooks Inline: Oxford University Press.

Stumpf, R. P., Johnson, L. T., Wynne, T. T., & Baker, D. B. (2016). Forecasting annual cyanobacterial bloom biomass to inform management decisions in Lake Erie. *Journal of Great Lakes Research*, *42*(6), 1174–1183.

Wlezien, C. (1995). The public as thermostat : Dynamics of preferences for spending. *American Journal of Political Science*, *39*(4), 981–1000.

Wolf, D., Georgic, W., & Klaiber, H. A. (2017). Reeling in the damages: Harmful algal blooms' impact on Lake Erie's recreational fishing industry. *Journal of Environmental Management*, *199*, 148–157.

Zanocco, C., Boudet, H., Nilson, R., Satein, H., Whitley, H., & Flora, J. (2018). Place, proximity, and perceived harm: extreme weather events and views about climate change. *Climatic Change*, *149*(3–4), 349–365.