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Trust in Whom? Dioxin, Organizations, Risk Perception, and Fish Consumption in Michigan's Saginaw Bay Watershed

Joseph A. Hamm^{a,b,*}, J. Cox^c, G. Zwickle^{a,b}, J. Zhuang^d, S. Cruz^e, B. L. Upham^f, M. Chung^c, J.W. Dearing^c

^aSchool of Criminal Justice, Michigan State University (557 Baker Hall, 655 Auditorium Rd., East Lansing, MI 48824, USA)

^bEnvironmental Science and Policy Program, Michigan State University (274 Giltner Hall, 293 Farm Lane, East Lansing, MI 48824, USA)

^cDepartment of Communication, Michigan State University (473 Comm Arts and Sciences Building, 404 Wilson Road, East Lansing, MI 48824, USA)

^dDepartment of Communication Studies, Texas Christian University (Moudy South, 2805 South University, Fort Worth, Texas 76109, USA)

^eSpeech Communication, Oregon State University (Shepard Hall, 2001 SW Campus Way, Corvallis, OR 97331, USA)

^fDepartment of Pediatrics and Human Development, Michigan State University (B240 Life Sciences Building, 1355 Bogue St., East Lansing, MI 48824, USA)

Abstract

Trust is generally recognized as important for risk-relevant behavior but research suggests that trust in different organizations may have varying effects. This research advances the literature by testing two hypotheses which postulate that this variability can be explained by risk perception. We collected data from 351 anglers regarding their trust in nine organizations whose efforts are relevant to dioxin contamination in Michigan's Saginaw Bay Watershed, risk perceptions, and self-reports of risky behavior (i.e., consumption of local fish identified as especially likely to contain contaminants). As hypothesized (H1), the negative effect of trust in two agencies—the Michigan Department of Natural Resources (MDNR) and a Michigan Department of Health and Human Services-sponsored River Walker Program (RWP)—on risky behavior was significantly mediated by risk perception but these effects differed from each other such that trust in the MDNR was associated with increased perceptions of risk while trust in the RWP was associated with decreased perceptions of benefit. Also as hypothesized (H2), the positive effect of trust in Dow Chemical Company on risky behavior was significantly mediated by risk perception such that increased trust in Dow was associated with reduced risk perception. The current results lend credence to arguments regarding the importance of specificity in the target of trust and advance this literature by suggesting that differential effects on risk perception help explain this variability.

*Corresponding Author Information: jhamm@msu.edu.

Declaration of Interest Statement

The authors declare no conflicts of interest in this research.

Thus, organizations whose efforts focus on risk communication appear ideally situated to reduce risky behavior through a negative impact on risk perception. Other organizations, however, may run the risk of *increasing* risky behavior if their efforts result in reduced perceptions of risk.

Keywords

Dioxins; environmental contamination; remediation; risk perception; trust; state agencies; industry

Introduction

Environmental contamination is an important contemporary issue. In recognition of this, a number of organizations have taken active roles in working to protect the public from pollutants like lead, mercury, and carbon monoxide. In the U.S., organizations like the Environmental Protection Agency (EPA) and state environmental authorities are often most directly involved in assessing and directing the remediation of these threats through the removal or sequestration of contaminants, but a range of other organizations are frequently involved as well. These organizations run from international, non-governmental entities like the World Health Organization to any number of small, local, environmental groups across the country. These organizations typically play very different roles, but it is generally accepted that the public's trust in them is vital to their ability to work effectively to educate, protect, represent, and advocate for the public (Earle and Siegrist 2008; Freudenburg 1993).

Scholars have addressed a variety of constructs and operationalizations of trust (Earle 2010), but one of the most common in the risk literature focuses on the public's willingness to rely on organizations that are responsible for addressing the potential for harm from a hazard (i.e., *social trust*; Siegrist 2000). Research consistently suggests that when these organizations are able to engender the public's trust, they typically enjoy the greatest levels of support and deference for their actions (Cvetkovich and Winter 2003; Vaske, Absher, and Bright 2007). Environmental contamination, however, poses a particular challenge as protecting human health often requires individuals to personally choose to take preventive actions that reduce the probability of negative outcomes (Paton 2008). Thus what is needed is not simply passive support, but active public cooperation with the goals of these organizations, which trust has been shown to facilitate (Earle and Siegrist 2008; Hamm et al. 2016).

A considerable body of work has investigated the role of trust in facilitating this cooperation by impacting risk perception. This risk communication work has been conducted in the U.S. (Burger 2004; Jardine 2003) and abroad (de Vos and Bush 2011; Ser and Watanabe 2012) and suggests that trust is critical for this process, especially because of its effect on the perceived credibility of the message (Renn and Levine 1991; Verbeke et al. 2008). Problematically however, research consistently shows that trust is not always associated with increases in cooperative behavior and, in some cases, is actually inversely related such that increased trust is actually associated with increased risky behavior (Sjöberg 1999; see also Chryssochoidis, Strada, and Krystallis 2009; Feng et al. 2013; Siegrist, Cvetkovich, and Roth 2000; Watson, Zizzo, and Fleming 2017). In the current research, we present data that

contributes to this body of scholarship by addressing the role of trust in reducing risky behavior among a sample of anglers in a dioxin-contaminated watershed.¹ Specifically, we test the effect of trust on self-reported consumption of fish species from two Michigan rivers, where some of the world's highest levels of dioxins have been recorded. Thus, this research—like a significant portion of the previous literature—investigates the importance of the relationships between the public and organizations for reducing risky behavior. We seek to advance this literature, however, by investigating these relationships in light of an especially complex community and inter-organizational context (see Table 1). We expect that, as in much of the previous literature, the link between trust in these organizations and risky behavior will vary, especially in the direction of the effect. We, however, contribute to this literature by presenting a first empirical test of two hypotheses regarding the mechanisms of these differential effects. We expect that for organizations whose efforts increase the perception of risk, greater trust will lead to fewer risky behaviors *because* of the positive relationship with risk perception. For organizations whose efforts decrease the perception of risk, however, increased trust will lead to increased risky behavior *because* of the negative effect on risk perception.

Study Context

Dioxin contamination in Michigan's Saginaw Bay Watershed has been an important issue since the mid-1980s (Peterson 1983; Reinhold 1983; Sinclair 1983; Zhuang et al. 2016).

Some of the anthropogenic dioxins and particularly the furans that have been found in this watershed have been linked to manufacturing activities at *Dow Chemical Company's* facility in Midland, Michigan. After the discovery of abnormally high levels in the 1980's, Dow began working with the US EPA to reduce the risk of exposure through information campaigns and direct remediation for which Dow remains the principal funder (McKenna 2009). Today, Dow Chemical Company has a multi-faceted relationship with the communities in the area. Most notably, Dow Chemical (along with Dow Corning Company) is the area's largest employer, directly employing thousands of residents, especially in Midland, and indirectly effecting the employment of many more in supply, support, and ancillary companies. Dow is also an active sponsor of community development projects and local philanthropy, including major public infrastructure investments such as parks, schools, and community centers. As a result, Midland is often referred to as a "company town" (McKenna 2009, p. 42).

The *U.S. Environmental Protection Agency's* (EPA) role in the watershed has primarily been its oversight of the risk management efforts but it has also communicated directly with local stakeholders and community residents through public meetings, notices and mailings, and other forms of community engagement. The primary avenue by which the EPA communicates with the public is via its *Community Advisory Group* (CAG). CAG's are comprised of residents who are elected to represent their community in discussions with the EPA, especially where there is a particular need to integrate community views (Laurian

¹The term dioxin is often used to refer to a family of 75 different dioxin compounds and 135 related furans that share a similar molecular structure. In this paper, we use the term to refer generally to the isomers of dioxin and furans, a subset of which induce harm through the same receptor-based mechanism (Fernandez-Gonzalez et al. 2015).

2007). Thus, their purpose is to facilitate sustained and deliberative discussions between affected communities and the federal, state, and corporate stakeholders involved in the environmental response. The primary community engagement vector of the Saginaw-Tittabawassee Rivers CAG is its meetings, which are held every two months and are open to the public. Community attendance at these meetings has varied, but is now relatively minimal. Instead, the CAG's primary interactions with the community are through its members' interpersonal discussions with coworkers, customers, friends, and family members. The CAG also provides information to the public through its website, which often explicitly funnels visitors to the EPA website for updates, remediation plans, background, and technical reports.

Several state agencies are also involved in addressing the risk of exposure in the area. The *Michigan Department of Environmental Quality's* (MDEQ) primary mission is to assess and protect the state's natural environment through direct testing and regulation of individual and corporate action (Habron, Barbier, and Kinnunen 2008). The MDEQ has also been jointly responsible for oversight of the remediation efforts and, as a result, much of its involvement with this community centers on its work with the EPA and Dow. Notably, however, the department does conduct and oversee new testing regarding the potential health effects of dioxins as needed. Information from MDEQ is primarily distributed through its website, which contains original content as well as links to EPA resources, but the department also directly distributes flyers and other print materials.

The mission of the *Michigan Department of Health and Human Services* (MDHHS) highlights understanding and improving public health with a specific focus on collecting and distributing information about environmental impacts to residents (Habron et al. 2008). As a result, the department has a particularly strong information pipeline to a number of communities in Michigan, including those within the Saginaw Bay Watershed. Most relevantly, the department is responsible for the Eat Safe Fish guide, a resource that presents waterbody-specific recommendations about which and how much of specific fish species are safe to eat as well as optimal techniques for cleaning and preparation (Michigan Department of Health and Human Services 2013). The guide is updated annually and is available online and in a number of locations including sports stores, restaurants, and health clinics.

The MDHHS also operates a small *River Walker Program* (RWP), to which the EPA contributes funding. The River Walker Program is staffed by anglers who are retired members of a local community center. They walk along the lower Tittabawassee River (southeast of the city of Midland) and upper Saginaw River (north of the city of Saginaw) to talk with anglers and distribute information about fish advisories and safe practices.

The *Michigan Department of Natural Resources'* (MDNR) primary responsibility is the management of hunting and fishing activities in the state through direct assessment, species management, and regulatory activities like issuing licenses (Habron et al. 2008). The MDNR also distributes MDHHS guidelines regarding the fish and game that are safe to eat, which most notably include signs posted regularly along the rivers in the watershed that inform the public which fish pose the highest risk of dioxin exposure. The department is also

responsible for managing fish cleaning stations in many of the most popular fishing spots along the rivers within the watershed.

A final important type of organization in the watershed is local environmental groups. These organizations vary significantly in the size and consistency of their membership and whether they hold formal meetings or simply serve as an information repository. Their primary contact with the community typically occurs via their websites, which compile information from other sources. Some, however, have occasionally been more actively engaged, especially via membership on the CAG and attendance at its meetings. The two primary environmental organizations in this watershed are the *Tittabawassee River Watch* (TRW) and the *Lone Tree Council* (LTC).

Current Study

The current research advances existing work evaluating the relationship between trust and risk-relevant behavior by testing two hypotheses regarding the mechanisms of the influence of trust in a specific target. As noted above, the situation in the watershed involves a wide variety of organizations that have different missions and public images, if not fundamentally competing roles. Its culture of corporate citizenship notwithstanding, Dow Chemical is a publicly traded business with responsibilities to its stakeholders, both internal and external, while the EPA and state authorities like the MDEQ, MDHHS, and MDNR are charged with working to protect their constituencies more generally. Local environmental groups, although certainly heterogeneous, are similarly interested in protecting environmental health, but they are likely to work directly against the interests of these larger organizations when they are believed to be failing at their responsibilities.

These varied interests create a context in which the perceived similarity of values between these organizations and the public are likely to vary. In some cases, this may mean that environmental groups have a relatively closer perceived relationship with the public, but it may be that the explicit responsibility of state and federal agencies to protect their constituencies results in a more salient public perception of shared values. It may also be that when a single corporate entity is recognized as being critical to the well-being of a town—as is the case in Midland, Michigan—corporate and public interests become most closely aligned. The well-established implications of this perceived value similarity for trust (e.g., Earle, Siegrist, and Gutscher 2010) suggest that the level of trust in these organizations will differ, but it may also be that the *impact* of that trust on risk-relevant behavior will itself be inconsistent. Indeed, research regularly suggests that trust in actors relevant to a variety of risks are inconsistently related to each other and, as a result, to risk-relevant behavior (Chrysoschoidis, Strada, and Krystallis 2009; Feng et al. 2013; Siegrist, Cvetkovich, and Roth 2000; Sjöberg 1999; Watson, Zizzo, and Fleming 2017).

What remains unclear, however, is precisely how these differential relationships operate but evaluation of the literature suggests that risk perception may be at the heart of this mechanism. When organizational efforts are focused on reducing risky behavior, research suggests that increases in trust may lead to reductions in risky behavior via an increase in risk perception (Hovland and Weiss 1951, Pornpitakpan 2004, Renn and Levine 1991). In the Saginaw Bay Watershed, the state's lead environmental, health, and natural resource

authorities, the MDEQ, MDHHS, and MDNR, have long worked closely with the community, providing information on everything from contaminant levels to fish cleaning practices. The TRW and LTC have similarly worked to increase risk awareness, typically by redistributing these and other materials. Although some of these efforts have sought to clarify where risks are not present, the majority focuses explicitly on increasing risk perception via awareness of avenues for exposure and strategies for mitigating the risk. We therefore hypothesize:

H1: (a) Trust in the state agencies and environmental groups will be negatively associated with risky behavior, (b) and this relationship will be mediated by risk perception such that an increase in trust will be associated with an increase in risk perception, which will, in turn, be associated with a decrease in risky behavior.

A second argument regarding the trust-behavior relationship suggests that the public generally views its potential for harm less negatively when organizations with some level of responsibility for managing the risk are more trusted (Slovic 1993). This argument has been well supported in this literature (see Earle 2010) and, when extended to risky behavior, actually suggests that individuals who trust these management organizations more may be *more* likely to engage in risky behaviors because of a reduction in the perceived risk. In the Saginaw Bay Watershed, the two organizations that have been primarily responsible for the remediation are the EPA, which directs these efforts, and Dow Chemical Company, which both funds the remediation efforts and is a salient partner in their execution.² We therefore offer our second hypothesis:

H2: (a) Trust in the EPA and Dow Chemical will be positively associated with risky behavior, (b) and this relationship will be mediated by risk perception such that an increase in trust will be associated with a decrease in risk perception, which in turn will be associated with an increase in risky behavior.

Materials and Methods

Data Collection

Data were collected from 351 anglers by eight research assistants who walked popular fishing sites along the Tittabawassee (19% of the final sample) and Saginaw Rivers (81%), during May and June of 2016. Research assistants were local to the area and recruited with the assistance of a nearby college. After training, interviewers walked the river in tandem, primarily for reasons of safety. All encountered anglers who were ostensibly eligible to participate (i.e., adults) were approached and offered an opportunity to complete the survey in return for an entry into a raffle for one of ten \$100 gift cards. Research assistants used iPads to read aloud the survey to participants, thus enabling anglers to continue fishing while verbally completing the survey. When anglers were fishing in groups, participants were interviewed independently, out of ear-shot of each other. In order to survey the greatest diversity of anglers, research assistants walked the river on weekdays (80% of the sample) as

²It is worthy of note that the MDEQ has also played a major role and that both the MDNR and MDHHS have been engaged by the EPA and Dow for support in these efforts, but EPA and Dow are clearly perceived by the community to be the primary partners.

well as weekends (20%) and in the morning (i.e., before noon, 27%), afternoon (i.e., noon to before 5:00pm, 35%), and evening (i.e., 5:00pm and on, 38%).

Participants

Participants were mostly White (83% of the sample; 12% Black); did not identify as Spanish, Hispanic, or Latino (92%); male (82%); and had an average age of 43 years (Median=42; Min=18; Max=86; $SD=15.9$). Most discontinued their education before completing a four-year degree (88%; 3% had a graduate degree) and a small minority were unemployed (13%). Although the majority of participants elected not to give salary information (52%), 11% of those who did were living below the 2015 poverty level.

Measurement and Univariate Statistics

The survey included measures of our independent (X), dependent (Y), and hypothesized mediating variables (M), and demographics. Our primary dependent variables (DVs) addressed behaviors that increase the likelihood of exposure to dioxins. Although a number of factors affect this likelihood, food vectors are especially important (Domingo and Bocio 2007) and a major concern in this area is eating particular species of locally caught fish. Consumption guidelines posted along the rivers classify local fish into levels, such that Level 1 species are generally safest, while Level 2 species are listed as somewhat more dangerous. Most relevantly and because of the increased risk, anglers are encouraged never to eat Level 3 species (i.e., catfish, carp, and white/silver bass). Our survey asked participants how many meals of these Level 3 fish species they have eaten per year over the last few years. To compute our DV, we recoded responses such that “fewer than six meals per year” was coded 0, “six to twenty-four meals per year” was coded 1, and “more than twenty-four meals per year” was coded 2. We then added these values to create our first consumption variable (*Consumption-L3*; $M=0.32$, $SD=0.86$, Min=0, Max=6).

As a second indicator of risky behavior, participants were also asked to report the percentage of the fish they have eaten from the Saginaw and Tittabawassee Rivers that are bottom-feeding fish (e.g., carp and catfish; *Consumption-BFF*). Because dioxins typically accumulate in the sediment of riverbeds, these fish species pose an increased risk of exposure (Wan et al. 2010). Percentages were generally low: the average response was 8%, and approximately 80% of the sample reported that they do not eat any bottom-feeding fish.

Both DVs, therefore, address overlapping but somewhat distinct risky behaviors. As noted above, eating bottom-feeding fish presents an increased risk of exposure because dioxins tend to accumulate in riverbed sediment. Level 3 fish species include these bottom-feeding fish, but also include some predatory species that pose an increased risk of exposure because of the bio-accumulative nature of dioxins (Wan et al. 2010). We present analyses investigating both DVs to provide evidence regarding the robustness of our findings. Given their focus in risk communication in the area, organizational efforts are likely to be most strongly linked with *Consumption-L3*, but individuals who comply with the full spectrum of risk information in the watershed should report lower values on both variables. Note however, that the correlation between these items was only moderate (Kendall’s Tau-b=.59, $p<.001$).

Regarding our independent variable, trust was measured using nine items that asked participants to indicate the extent to which they trusted the efforts of each of the nine organizations involved in protecting the public from environmental contamination in the area. These responses were scored on a five-point Likert-type scale (1=*strongly disagree*, 5=*strongly agree*) and participants were given the option to say that they did not know enough to select a response (these responses were coded as missing). Although multi-item measures may have been preferable for a variety of statistical and conceptual reasons, they would have created an excessively long survey. Additionally, unspecified, single-item trust measures such as these are both common in research and consistently yield high correlations with more nuanced measures in cross-sectional survey research (PytlikZillig et al. 2016). As reported in Table 2, mean levels of trust were generally above the response scale mid-point (3). Only Dow Chemical received an average value below the midpoint, but evaluation of the frequencies suggested a somewhat bimodal distribution with 42% (strongly) disagreeing and 36% (strongly) agreeing regarding their trust. Notably, the percentage of participants that reported that they did not know enough to report their trust in the organizations by endorsing the “I Don’t Know” option varied from 2% (MDNR) to 81% (LTC), suggesting that community awareness of the nine organizations was not consistent.

The survey also included a measure of risk perception which included evaluations of both risks and benefits. Regarding risks, participants were asked to report their agreement with three statements addressing the likelihood that fish in the rivers contain contaminants, that eating fish with contaminants would lead to health problems, and that those health problems would be severe. These items were also scored on a five-point Likert-type scale and were averaged to create a measure of risk perception (*perceived risk*; $\alpha=.76$; $M=3.94$; $SD=0.74$). Because eating fish is likely to provide salient benefits which may be distinct from the perceived risks (Chan, et al. 1999), we also asked participants to indicate their agreement with the statement, “the health benefits of eating fish can outweigh the potential risk of contaminants” (*perceived benefits*; $M=2.78$; $SD=1.08$).

Results

Bivariate Relationships

Before testing the hypotheses directly, we first evaluated the bivariate relationships among consumption behavior, perceived risk, perceived benefits, and trust using SPSS (Version 22). To address their count nature, we used a non-parametric test of association (Kendall’s Tau-b) for the DVs while, given their more normal distribution, Pearson’s r was used for the IVs and mediators. Regarding the relationships between trust and behavior (Table 3), risky behavior significantly correlated only with *Trust Dow*, *Trust MDEQ*, *Trust MDHHS*, *Trust MDNR*, and *Trust RWP*. The presence and strength of those relationships varied as a function of the organization but trust in the River Walker Program had the strongest relationships with consumption behavior. Most notably, and in contrast to the other organizations, consumption was positively correlated with trust in Dow such that more trust corresponded with increased risky behavior (note that only the correlation with *Consumption-BFF* reached statistical significance in the *Trust Dow* analyses). Consumption behavior was not significantly related to trust in the EPA, CAG, or either of the

environmental groups. Although this may have been due to the relatively low familiarity with the CAG, the TRW, and the LTC, the EPA was relatively well-known among participants (only 9% marked “I Don’t Know”).

The results regarding the association between trust and the proposed mediators (*perceived risk* and *perceived benefits*) were generally similar other than a reduction in the number of relationships that were significant (see Table 3). As expected, trust in three of the five organizations that had significant correlations with behavior also correlated with either perceived risk or benefits. Mirroring the results regarding consumption behavior, the significant relationship of *perceived risk* with *Trust Dow* suggested that more trust was associated with less perceived risk. *Trust MDNR* was associated with an increase in risk perception and *Trust RWP* was associated with a reduction in the perceived benefits of eating local fish. Contrary to our expectations, neither *Trust MDEQ* or *Trust MDHHS* were correlated with risk perception although both were significantly correlated with risky behavior.

Hypothesis Testing

Having identified the trust variables with significant bivariate relationships with consumption behavior and risk perception, we next tested our hypotheses. Because we were interested in the independent effects of trust and not simply the unique variance in each variable, we conducted separate tests for each organization using the PROCESS Macro in SPSS (Hayes 2012). As reported in Table 3, six of the organizations were not bivariately associated with either of the consumption variables *and* either perceived risks or benefits (*Trust EPA*, *Trust CAG*, *Trust MDEQ*, *Trust MDHHS*, *Trust TRW*, and *Trust LTC*). Given this violation of the necessary precondition for our hypothesized indirect effect, we focused only on *Trust Dow*, *Trust MDNR*, and *Trust RWP*.

Table 4 reports the models regarding Dow and suggests a significant indirect effect of *Trust Dow* on *Consumption-BFF* and *Consumption-L3* through perceived risk such that as trust in Dow increases, risk perception decreases, and risky behavior increases. Table 5 reports the same models for the MDNR. As before, perceived risk mediated the relationships with both consumption variables but unlike *Trust Dow*, increases in *Trust MDNR* were associated with decreases in risky behavior via increases in *perceived risk*. Finally, Table 6 reports the mediation analyses for *Trust RWP*. As with the previous two predictor variables, risk perception mediated the effect on *Consumption-BFF* but in place of *perceived risk*, the effect operated through *perceived benefits*. The indirect effect of *Trust RWP* on *Consumption-L3* did not reach traditional significance levels. The outcome variance accounted for in each these models was consistently significant but small.³

Discussion

These findings contribute new perspectives on the processes by which trust affects risky behavior in the environmental context. The current results suggest that when thinking about

³Robustness tests were conducted evaluating these effects in light of established predictors of risk perception and risky behavior (e.g., race, education). In most, the effect of these stronger predictors displaced the mediated and/or direct effects of trust.

the relationship between trust and risk relevant behavior, the target of that trust matters. This argument is not new to this literature, but the current research provides a first empirical test of the mechanism of this effect and finds that, for some organizations, the effects on behavior can be explained by the effect of trust on risk perception. As noted in the introduction, the roles of the organizations operating in the Saginaw Bay Watershed vary significantly, especially in terms of the aspects that are most salient to the public. These differing roles led us to pose two hypotheses which suggested that the organizations that focus on risk communication (here, the state agencies and environmental groups), would be likely to have negative impacts on risky behavior because of a positive impact on risk perception (H1). Conversely, we expected that organizations that focus on risk management (here, the EPA and Dow Chemical), would be likely to have positive impacts on risky behavior because of a negative impact on risk perception (H2). The following sections discuss each of these findings in turn before turning to their implications.

Hypothesis 1

Our results provide empirical evidence that, as hypothesized, the negative effect of trust on risky behavior can be explained by risk perception which significantly—and usually, fully—mediated this relationship. Specifically, trust in the MDNR operated through an increase in perceived risk while trust in the RWP operated through a decrease in the perceived benefits. Given the MDNR's focus on communicating the risk of eating local fish, especially via the signage along the river highlighting the species that are likely to contain higher concentrations of dioxins, its effect on perceived risk likely reflects the success of these efforts in increasing risk salience and, potentially, perceptions of vulnerability. The mediation of trust in the RWP by perceived benefits, however, is somewhat more curious. The goal of the RWP is to educate anglers regarding the potential health effects of eating local fish and, although these conversations are unscripted, they generally take extensively from risk communication materials like the MDHHS' Eat Safe Fish guide. This could suggest that they would have a primary impact on perceived risk but this was not the case in our data where the primary effect was on perceived benefits. One potential explanation for this lies in the fact that these conversations occur, not as agency-to-angler interactions, but between anglers. Although beyond the data collected here, it is possible that these discussions with RWP staff actually address benefits in a way that is different from the signage. To the extent that conversations with the anglers who make up the RWP focus on helping other anglers understand alternatives that would allow them to achieve the same benefits without increasing their risk of exposure to dioxins (e.g., catch-and-release fishing), it stands to reason that the primary impact of these discussions may have been on reducing the perceived benefit of eating these locally-caught fish.

Contrary to our hypothesis, trust in two of the state agencies, MDEQ and MDHHS, was associated with risky behavior but not with risk perception. The MDEQ's primary efforts focus on understanding and protecting environmental quality, but these efforts tend to involve a relatively small focus on communicating directly with the public. Thus, while the MDEQ does engage in risk communication, these efforts are likely much less salient than those from agencies like the MDNR, RWP, and the MDHHS. This may explain the lack of association for the MDEQ but makes the lack of association between risk perception and

trust in the MDHHS, an organization whose efforts focus heavily on risk communication, all the more curious. Although it is possible that the MDHHS' efforts simply fail to impact risk perception, understanding our study context actually suggests a different explanation. Opportunities for exposure to MDHHS materials are relatively common throughout the watershed but, for anglers, the highest potential for exposure is likely connected to buying licenses. As a result, it may be that participants wrongly attribute this information to the MDNR. If so, this would be likely to increase the importance of trust in the MDNR while decreasing the importance of trust in the MDHHS.

Also contrary to this hypothesis, our results suggest that risky behavior was not significantly related to trust in either of the environmental groups. This, however, may have been a statistical artifact as, for both of those variables, more than half of the sample reported not knowing enough about the group to report a level of trust in it. For the LTC, this is compounded by the fact that of the 68 responses that were useable, most selected "Strongly Agree", thereby severely limiting the measure's variability.

Hypothesis 2

Regarding our second hypothesis, our results also provide some support. We expected that trust in Dow and the EPA would be positively related to risky behavior through a decrease in risk perception. As hypothesized, trust in Dow Chemical was negatively related to risky behavior and our mediation analyses suggest that this effect could be explained by trust's relationship with perceived risk. Dow's relationship with these communities is multifaceted, but consideration of this result suggest that its efforts regarding remediation may be most relevant for risky behavior. Thus, it may be that when organizations with some responsibility for addressing a risk are trusted, the perceived need to engage in protective behavior may decrease because of an increased belief in the organization's effectiveness.

Alternatively, however, it is possible that the positive relationship with risky behavior could be explained as arising from motivated reasoning (Kunda 1990). As addressed in the introduction, Dow's culture of corporate responsibility in Midland, Michigan has had a significant impact on residents in this community. As a result, although some have argued strongly for holding Dow responsible for the efforts to remediate the Saginaw Bay Watershed, others have argued against it, suggesting that it would harm Dow, a company that is seen as a "lifeline in a region plagued by plant closings and layoffs" (Hawthorne 2008). Thus, it is possible that the reduction in risk perception stems from a motivated desire to avoid negative impacts on Dow and subsequently, the community.

Adding some credence to this motivated reasoning argument is the fact that the hypothesized negative effect of trust on behavior was not identified for the EPA, the other major risk manager in this community and Dow's partner in the remediation efforts. As noted above, trust in the EPA was not significantly related to our DVs or risk perception, suggesting that it is generally less important. This lack of association was also true for the environmental groups but unlike them, this result regarding the EPA cannot be attributed to it being poorly known, as only 9% of the sample selected "I Don't Know" when responding regarding their trust. Similarly, trust in the EPA's CAG, which provides a primary avenue for integrating

public comments into the remediation process, was also unrelated, although it is important to note that awareness of the CAG was substantially lower (51% responded “I Don’t Know”).

Implications

Our findings add to the well-understood importance of relationships for reducing risky behavior by shedding some light on the characteristics of the targets of trust that may be most important across contexts. In the case of relatively new contamination or situations in which a single organization is clearly responsible for all communication and management efforts, it may be that only trust in that organization is relevant. In reality however, simple contexts like these are uncommon. Addressing environmental contamination typically involves a complex web of organizations of varying scales, missions, and jurisdictions. Our results suggest that, in these situations, understanding the role of trust in decreasing risky behavior requires a nuanced understanding of the organizational landscape and, most importantly, consideration of how those organizations interact with their communities. As suggested in considerable other work, organizations that are perceived as relevant risk communicators (like the MDNR and RWP) do seem likely to be well positioned to reduce risky behavior. Organizations that are more focused on risk management (like Dow Chemical Company) also appear to be important but may run a relatively greater risk of facilitating an *increase* in behavior posing health risks when this trust leads individuals to perceive less risk. One possible explanation for this phenomenon is that those with high trust in a risk manager assume that either the risk has been removed (fully remediated) or that they are otherwise protected from harm through the remediation efforts (e.g., containment) but it is also possible that motivated reasoning, stemming from a need for the relationship with the organization may create a motivation to perceive less risk.

In either case, our findings suggest that, in the face of a trusting relationship, risky behavior may actually increase after remediation begins, regardless of whether exposure levels have actually changed. In the Saginaw Bay Watershed, remediation is only complete in a relatively small area, with the majority of the contaminated stretch of the Tittabawassee River and all of the Saginaw River yet to be remediated. As a result, reducing the consumption of risky species of local fish remains important for most anglers on the rivers. In situations like these, it appears to be critical that risk managers work to ensure that those who trust them continue protective behaviors, at least until the actual risk is sufficiently reduced.

Caveats and Conclusion

Trust is a critical part of managing the potential for harm to the public from risks like environmental contamination. Although somewhat limited in its predictive ability in the current analyses (and especially the robustness tests), research consistently suggests that trust in organizations responsible for managing environmental health matters. The current correlational analysis of data from a convenience sample of anglers adds to this literature by showing that the specific target of that trust can influence the perceptions of risk and benefits as well as behavior. Our results suggest that in the Saginaw Bay Watershed, the organizations whose trust is most related to the consumption of fish identified as risky are the MDNR, RWP, and Dow, but suggest that trust in them has different effects such that

while trust in the MDNR and RWP were associated with reduced consumption of risky fish, trust in Dow had a reverse effect.

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Table 1.**Organizational Roles and Major Interactions with the Public**

Organization	Most Relevant Role(s)	Major Interactions
Dow Chemical Company	Source of the contamination; funds the majority of the clean-up efforts	Major community employer
US Environmental Protection Agency (EPA)	Oversees the clean-up efforts	Hosts public comment meetings
Saginaw-Tittabawassee Rivers Community Advisory Group (CAG)	Vector for public/EPA communication	Holds public meetings and its members are community representatives
Michigan Department of Environmental Quality (MDEQ)	Conducts testing and evaluation related to environmental contaminants	Primarily through other agencies
Michigan Department of Health and Human Services (MDHHS)	Responsible for coordinating activities to keep public safe from environmental contamination	Significant and regular public information campaigns (e.g., <i>Eat Safe Fish</i> guide)
River Walker Program (RWP)	Communicates information to keep anglers safe	Staff walk along the rivers in the watershed speaking directly with anglers
Michigan Department of Natural Resources (MDNR)	Issues advisories for fish and fishing licenses	Responsible for advisories posted along waterbodies
Tittabawassee River Watch (TRW)	Environmental interest group	Maintains website
Lone Tree Council (LTC)	Environmental interest group	Maintains website

Table 2.

Frequency (Percentage) Endorsing Response Options for Trust in Each Organization

Organization	Mean [SD]	1 Strongly Disagree	2 Disagree	3 Neither Disagree or Agree	4 Agree	5 Strongly Agree	I Don't Know [†]
Dow	2.79 [1.24]	62 (17.8%)	85 (24.4%)	52 (14.9%)	106 (30.4%)	18 (5.1%)	26 (7.4%)
EPA	3.54 [0.96]	17 (4.9%)	34 (9.8%)	45 (12.9%)	200 (57.5%)	20 (5.7%)	32 (9.2%)
CAG	3.71 [0.76]	1 (0.3%)	19 (5.5%)	18 (5.2%)	123 (35.3%)	9 (2.6%)	178 (51.1%)
MDNR	3.85 [0.90]	7 (2.0%)	31 (8.9%)	33 (9.5%)	205 (58.7%)	65 (18.6%)	8 (2.3%)
MDEQ	3.61 [0.98]	15 (4.3%)	36 (10.3%)	34 (9.8%)	194 (55.7%)	30 (8.6%)	39 (11.2%)
MDHHS	3.74 [0.81]	7 (2.0%)	29 (8.3%)	32 (9.2%)	232 (66.7%)	26 (7.5%)	22 (6.3%)
RWP	3.93 [0.51]	0 (0%)	5 (1.4%)	10 (2.9%)	127 (36.4%)	10 (2.9%)	197 (56.4%)
TRW	3.81 [0.60]	1 (0.3%)	7 (2.0%)	13 (3.7%)	112 (32.2%)	4 (1.1%)	211 (60.6%)
LTC	3.79 [0.70]	0 (0%)	5 (1.4%)	10 (2.9%)	47 (13.5%)	6 (1.7%)	281 (80.5%)

Note.

[†] Responses coded as missing.

Construct Correlations

Table 3.

Role	Variable	1	2	3	4	5	6	7	8	9	10	11	12
	1. Trust Dow ^a	-											
	2. Trust EPA ^a	.35**	-										
	3. Trust CAG ^a	.28**	.45**	-									
	4. Trust MDNR ^a	.19**	.30**	.24**	-								
X	5. Trust MDEQ ^a	.33**	.56**	.29**	.55**	-							
	6. Trust MDHHS ^a	.25**	.45**	.37**	.41**	.60**	-						
	7. Trust RWP ^a	.12	.25**	.28**	.38**	.26**	.25**	-					
	8. Trust TRW ^a	.30**	.24**	.50**	.23**	.31**	.15	.61**	-				
	9. Trust LTC ^a	.29*	.33**	.57**	.24*	.37**	.42**	.38**	.18	-			
M	10. Perc. Benefits ^a	.08	.08	-.04	-.06	-.03	-.02	-.26**	-.16	-.03	-		
	11. Perc. Risks ^a	-.12*	-.09	.03	.13*	.07	.05	.13	-.06	.02	-.32**	-	
Y	12. Consumpt-BFF ^b	.12*	-.02	-.01	-.10*	-.03	-.08	-.15*	-.07	.06	.19**	-.19**	-
	13. Consumpt-L3 ^b	.08	-.02	-.07	-.12*	-.12*	-.11*	-.19*	-.09	.02	.19**	-.24**	.59**

Note.

^adenotes Pearson's *r*.^bdenotes Kendall's Tau.* *p*<.05** *p*<.01.

Table 4.

Trust in Dow Chemical Company Mediation Models

Model	Criterion	R ²	Predictor	Coefficient	SE	LLCI	ULCI
X→M	Perceived Risk	0.01*	Constant	4.14*	0.10	3.95	4.34
			Trust Dow	-0.07*	0.03	-0.13	0.005
			Constant	24.98*	6.93	11.35	38.61
X&M→ Y ₁	Cons-BFF	0.04*	Perceived Risk	-5.14*	1.54	-8.17	-2.12
			Trust Dow	1.25	0.89	-0.51	3.01
			X→M→ Y ₁ (Indirect Effect)				0.35*
X&M→Y ₂	Cons-L3	0.07*	Constant	1.50*	0.30	0.92	2.08
			Perceived Risk	-0.32*	0.07	-0.44	-0.19
			Trust Dow	0.03	0.04	-0.05	0.10
X→M→Y ₂ (Indirect Effect)				0.02*	0.01	0.003	0.06

Note. LLCI and ULCI refer to the lower and upper bounds of the 95% confidence interval around the coefficient, respectively. Confidence intervals that do not include zero are statistically significant at $p < .05$. Significant values are designated with an asterisk (*).

Table 5.

Trust in Michigan Department of Natural Resources (MDNR) Mediation Models

Model	Criterion	R ²	Predictor	Coefficient	SE	LLCI	ULCI
X→M	Perceived Risk	0.02*	Constant	3.54*	0.17	3.21	3.88
			Trust MDNR	0.11*	0.04	0.02	0.19
			Constant	35.73*	7.18	21.60	49.87
X&M→Y ₁	Cons-BFF	0.04*	Perceived Risk	-4.64*	1.52	-7.62	-1.65
			Trust MDNR	-2.38	1.22	-4.78	0.01
			X→M→Y ₁ (Indirect Effect)				-0.49*
X&M→Y ₂	Cons-L3	0.10*	Constant	2.07*	0.29	1.49	2.64
			Perceived Risk	-0.31*	0.06	-0.43	-0.19
			Trust MDNR	-0.14*	0.05	-0.24	-0.04
X→M→Y ₂ (Indirect Effect)				-0.03*	0.02	-0.09	-0.004

Note. LLCI and ULCI refer to the lower and upper bounds of the 95% confidence interval around the coefficient, respectively. Confidence intervals that do not include zero are statistically significant at $p < .05$. Significant values are designated with an asterisk (*).

Table 6.

Trust in River Walker Program (RWP) Mediation Models

Model	Criterion	R ²	Predictor	Coefficient	SE	LLCI	ULCI
X→M	Perceived Benefits	0.07*	Constant	5.00*	0.64	3.74	6.26
			Trust RWP	−0.54*	0.16	−0.85	−0.22
			Constant	24.57	14.99	−5.05	54.18
X&M→Y ₁	Cons-BFF	0.09*	Perceived Benefits	4.13*	1.62	0.93	7.33
			Trust RWP	−6.80*	3.30	−13.31	−0.28
X→M→Y ₁ (Indirect Effect)				−2.22*	1.14	−5.16	−0.48
X&M→Y ₂	Cons-L3	0.12*	Constant	1.80*	0.60	0.61	3.00
			Perceived Benefits	0.12	0.07	−0.01	0.25
			Trust RWP	−0.46*	0.13	−0.72	−0.19
X→M→Y ₂ (Indirect Effect)				−0.06	0.04	−0.16	0.01

Note. LLCI and ULCI refer to the lower and upper bounds of the 95% confidence interval around the coefficient, respectively. Confidence intervals that do not include zero are statistically significant at $p < .05$. Significant values are designated with an asterisk (*).