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The Role of Cultural Worldviews in Willingness to Pay for Environmental Policy

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Abstract

Recent research in the social psychology literature suggests that personally held beliefs may play a pivotal role in individuals' acceptance of environmental policy. We extend previous work in this area by providing a contingent valuation method (CVM) framework that examines the interaction between cultural worldviews and willingness to pay for a policy that mitigates environmental risk. Results from a bivariate probit model indicate that individuals with communitarian and egalitarian worldviews are willing to pay significantly more for the environmental policy. We further investigate the role of cultural worldview on individuals' support for, and valuation of, environmental policies that differ by their underlying cause. Again, cultural worldview is important and point estimates of mean willingness to pay increase if the proposed policy is designed to mitigate the effects of climate change-related issues as opposed to a more local pollution threat. Finally, results indicate that cultural worldviews also influence respondents' perceived consequentiality with potentially important ramifications for eliciting stated preferences in a CVM framework.

Keywords: Contingent valuation; cultural worldview; willingness to pay; environmental policy.

1. Introduction

The degradation of numerous types vital coastal ecosystems (e.g. coral, subaquatic vegetation, wetlands) can be seen as "wicked problems" in that conditions contributing to or addressing this degradation have characteristics which are "complex, unpredictable, open ended, or intractable" (Head and Alford 2015). Calls for collective action come from the fact that most of these ecosystems represent impure public goods, often held in the public trust, and the loss or degradation of these ecosystems leads to diminished benefits to society through declines in ecosystem goods and services. The causes of these declines stem not only from localized stressors (e.g. overuse, land use change, and water quality), but also regional and global environmental change (e.g. Sea Temperature, Sea Level Rise and Ocean Acidification) (Moser et al 2012, Cloern et al 2016). The multiple spatial scales of environmental stressors and the inherent complexity of socio-ecological systems make attribution for losses convoluted. Moreover, the conflicting values and perceptions of resource stakeholders hinder finding public agreement for preferred solutions. As Head and Alford (2015) suggest "there is no 'root cause' of complexity, diversity, uncertainty, and ambiguity – hence, there is no root cause of 'wickedness' and no single best approach to tackling such problems." Look no further than the interrelated wicked problems associated with global environmental change, loss of biodiversity, and decline of coral reefs.

While the scientific evidence mounts linking various types of human activity to environmental degradation, efforts to address wicked problems through public action have led to mixed results. In addition to the ambiguity and uncertainty common to public debate over complex issues (Rittel and Webber 1973), there is clear heterogeneity in individuals' opinions and political support regarding source and magnitude for some environmental risks and preferences for corrective or adaptive policies. Moreover, as is evident from the results of recent policy referenda – such as the acceptance of California voters to ban plastic bags in 2016 to the more recent rejection by Washington State residents of a new carbon tax designed to raise the cost of fossil-fuel intensive activities in 2018 – social pluralism directly influences public support for environmental policy across different environmental challenges.

With no root cause to the decline of many coastal ecosystems, applied economics, and more specifically, ecosystem valuation provides a methodology for ranking public priorities based on the benefits and costs of environmental change and subsequent policy interventions.

When correctly designed, applied economics can provide insight into the consequence of individuals' perceptions and knowledge of biophysical complexities as well as the perceived tradeoffs associated with policy applications on individuals' economic behavior (Batie 2008). This can be especially beneficial when viewed through the lens of behavioral economics using analyses that investigate the underlying social and political factors driving conflict among stakeholders.

The behavioral economics and social psychology literature posit different theories regarding the determinants of people's acceptance or rejection of environmental challenges and corrective policies. These hypotheses include individuals' perceptions on their ability to control the risk in a protection motivation framework (Whitmarsh and O'Neill 2010; Milfont 2012), inability of the general public to comprehend the intricacies of the issue (Kallbekken et al. 2011; Irwin and Wynne 1996), or a distrust in experts' opinions or credibility (Peters, Covello, and McCallum 1997; Slovic 2000; Jenkins-Smith 2001). However, one theory that has gained traction in this literature suggests that individuals' support for environmental policy can be influenced by their own belief structure. That is, individuals tend to fit their risk perceptions to their moral evaluations and dismiss any information that is incongruent to their own personal beliefs. Kahan et al. (2011) describe this individual effect as being in direct conflict to a more collectivist perception of social welfare maximization. As a consequence, individuals' cultural worldviews may play a more significant role in dictating their support or rejection of environmental policy than the actual social virtue of any adaptive policy. Within this psychological framework, Douglas and Wildasky (1982) provided the first cultural theory of risk, in which they describe how individuals can be expected to form perceptions of risk based on their socially constructed orientation. Work by Kahan et al. (2009, 2010, 2011) on cultural cognition provides further evidence that individuals' cultural worldviews can influence their response to information on environmental risk and policy. Further still, Kahan et al. (2011) illustrate that as individuals' cultural allegiances are formed before beliefs regarding specific issues, cultural worldviews directly influence how individuals process information about environmental policies. Work by Cherry et al. (2017) in an experimental laboratory setting supports the view that cultural worldview can influence individuals' contribution toward public goods, suggesting that "policy debates may be governed more by where people argue from rather than what people argue for".

Within the contingent valuation method (CVM) literature, researchers have investigated individuals' willingness to pay (WTP) for a host of environmental challenges, from the provision of open space (Champ et al. 2002), to conserving ecosystem services (Lo and Jim 2015; and Karloseva et al 2016), to the provision of renewable energy (Claudy et al. 2011; Bollino 2009; Mozumver et al. 2011; and Lee and Heo 2016); to reducing greenhouse gas emissions (Carlsson et al. 2012 and Williams and Rolfe 2017). While much of this research has included either sociodemographic and/or policy-related determinants of WTP, some CVM studies have also examined the role of environmental attitudes on social acceptance of environmental policy (Kaheneman et al. 1993; Stern et al. 1995; and Kotchen and Reiling 2000). For example, Kotchen and Reiling (2000) combine techniques from an attitude-behavior approach with CVM and find that respondents with stronger pro-environmental attitudes have a higher probability of answering 'yes' to a hypothetical question regarding species protection. Closer to our line of research, Georgiou et al. (1998) examine determinants of WTP for reductions in environmental risk and even present a conceptual model, suggesting stated WTP values may be a function of personal worldviews, and external cultural, societal, and environmental factors. However, to our knowledge, support for environmental policy and the associated stated WTP values for an impure public good conditioned on individuals' cultural worldview has not been examined empirically.

The cultural worldview metric we use – developed by Kahan et al. (2011) – is not bound to geographic location, but to individual worldviews. As such, it is a broader metric than the socio-demographic factors and individuals' attitudes towards environmental policy used in other studies as it captures individuals' perceptions of the tension between individuals and society.

The wicked problem we examine is a degrading natural reef system in the Florida Keys with no single cause. The proposed environmental policy is an increase in state-level funding for additional artificial reef deployment. These reefs act as substitute goods by providing important ecosystem functions lost by declining natural reef coverage.

Based on previous empirical research, *ex ante*, we expect that individuals' cultural worldviews will influence support for environmental policy. Particularly along the individualist-communitarian dimension, one would strongly expect to find a correlation between whether government intervention is generally desirable and whether our specific intervention is desirable. As such, the principle elements of the study are to extend previous analyses in three ways. First,

beyond support for the policy, a bivariate probit model enables an examination of whether cultural worldviews also impact respondents' WTP measures for the impure public good. Second, we are interested in understanding whether any differences in the impact of cultural worldviews on support and WTP for additional artificial reef deployment persist based on the cause of environmental degradation. Specifically, we examine differences in behavior, conditional on cultural worldview, when the cause of natural reef degradation is either; 1) local outflow of treated sewage; or 2) climate change-related increases in sea-level temperature. Finally, building on the literature with respect to respondent perceived survey consequentiality on voting behavior and policy WTP estimates, we examine the role of cultural worldview on respondent survey consequentiality.

Results from bivariate probit models indicate that cultural worldviews play a significant role in individuals' responses to environmental policy. Specifically, communitarian and egalitarian individuals are more likely to support the environmental policy. This result is expected and supports other research. For example, in a laboratory market setting, Cherry et al. (2017) – examining support for the provision of a welfare-enhancing public good – find that egalitarian and/or communitarian individuals are more supportive of environmental policy interventions than hierarchical and/or individualistic types. More importantly, adding to previous research on worldviews and environmental policy, results indicate that communitarian and egalitarian individuals are also willing to pay more for the provision of the impure public good. Further, splitting the sample based on the cause of environmental degradation, results indicate that, across all subgroups, WTP values for the impure public good are magnified if the need for the policy is necessitated through climate change-related impacts as opposed to local treated sewage discharge. Finally, findings from a probit model indicate that cultural worldviews can also influence respondents' perceived consequentiality of the survey. This has potentially important ramifications for elicited stated preferences in a benefit-cost context.

2. Background

2.1 Cultural Worldviews

The cultural worldview instrument produces a broad metric that captures how a person views the relationship between individuals and society. The metric has helped explain perceptions and policy preferences on issues such as climate change and green energy (Cherry et al. 2018), vaccines (Kahan 2013), nuclear power (Marris et al. 1998), social preferences (Cherry et al. 2017) and genetically modified food (Sjoberg 2003). Following work by Kahan et al. (2011), respondents answer a series of worldview questions that place them on a spectrum across two dimensions – *individualism-communitarianism* and *hierarchical-egalitarian* – enabling an investigation of cultural worldview on WTP values. Kahan et al. (2011) describe the *individualism-communitarianism* dimension as relating to attitudes toward social ordering of those that expect individuals to pursue their own well-being without assistance versus those that believe that society has an obligation to defend collective welfare and quash competing individual interests. The *hierarchical-egalitarian* dimension is defined as relating to individuals' attitudes toward a social ordering that connects authority to social roles based on certain characteristics, such as race, gender, and class (Kahan et al. 2011). Following the emerging literature on the role of cultural worldview on individual preferences about varying social issues, we include eight cultural worldview questions from Kahn et al. (2011) in the survey. The first four questions relate to an *individualism-communitarian* dimension, while the remaining four questions correspond to a *hierarchy-egalitarian* dimension. For each question, respondents are provided with a five-point Likert scale, ranging from "1 = Strongly Disagree" to "5 = "Strongly Agree". Respondents are assigned to both dimensions based on their scores from these two sets of questions (with scores ranging from 4 to 20 points). Respondents that score above the median on the *individualism-communitarian* dimension are classified as individualistic types, with those then scoring at the median or below, as communitarian types. Likewise, those that score above the median on the *hierarchy-egalitarian* dimension are coded as a hierarchical type, with those at the median level or below then considered as an egalitarian type.

2.2 Provision of an Impure Public Good

The environmental risk, or challenge, in this study is the degradation of the natural reef system in the Florida Keys region.[1] The natural reef system contributes a wide variety of important ecosystem services such as supporting services (providing an essential resources for many fish species), cultural services (recreation), and regulating services (storm protection for coastal communities). The largest stressors to corals include increased seawater temperatures, high coastal population levels, overfishing, and nutrient enrichment (Halpern et al 2008), threatening the availability of ecosystem services. A recent study analyzing maps of the Florida Keys dating to the 18th century noted the locations of coral reefs and found that more than half the area formerly occupied by corals has been lost over the past 250 years (McClenachan et al. 2017). For some nearshore reefs, estimates indicate a loss in live coral cover exceeding 90 percent, suggesting that human influences are playing a major role. The natural reef system has also suffered from an increasing number of bleaching events with corals turning white as a result of a loss in their symbiotic algae. A study by the U.S. Geological Survey indicates that over the last 100 years, late-summer water temperatures near the Florida Keys have increased by nearly 2 degrees Fahrenheit (Kuffner et al. 2014). Researchers indicate that the warmer water temperatures are stressing corals and contributing to the rising number of bleaching events. Experimental evidence shows nutrient enrichment increases both coral disease and coral bleaching in the Keys (Vega Thurber et al 2014). Additionally, human pathogens linked to sewage contribute to coral declines in the Keys (Sutherland et al 2011). Millions of gallons of nitrogen-rich effluent (treated domestic sewage) are discharged daily out of South Florida's coastal cities via outfall pipes that extend a mile or more out to sea.[2] Nutrients and pathogens also enter waters via storm water runoff and groundwater flow from in ground receptacles.

The environmental policy in question is one designed to increase funding for artificial reef development in the Florida Keys region. The Florida Keys region has the most active and diverse reef system in the United States attracting thousands of recreational divers every year to dive on the natural and artificial reef system. While the deployment of artificial reefs (such as deliberately sunk ships, reef balls, bridge rubble, etc.) creates more diving opportunities, research has shown that this process can also help mitigate the impact of a degrading natural reef system

[1] The Florida Keys have long been the main focus for reef diving in the U.S. as its warm waters and coral reefs serve as a major draw. From Key Biscayne, located just south of Miami, stretching comma-like to Key West and beyond to the Dry Tortugas is the Florida Keys National Marine Sanctuary.

[2] The state of Florida passed a law to ban outfall pipes by 2025.

by providing substantial ecosystem benefits (Macreadie et al. 2011). In essence, artificial reef and natural reef systems are substitute goods that provide essential ecosystem benefits, such as habitat and biomass for fish species and storm protection. They are therefore impure public goods that can enhance private use values for divers and play an important environmental role for society in general.[3]

2.3 The Underlying Cause for Environmental Policy

Previous work has demonstrated that the underlying cause for environmental policy – and the provision of public or impure public goods – has a significant impact on WTP (Baron and Ritov 1990; Kahneman et al. 1993; Walker et al. 1999; and Brown et al. 2005). Results from this body of work are mixed. For example, Kahneman et al. (1993) provide respondents with descriptions of various environmental issues (like fish species extinction) that were caused by either human activity or occurred naturally. They find that losses created by humans were more upsetting than losses from natural events. As a result, the anthropocentric-losses generated greater support and WTP for policy intervention. They refer to this behavior as an "outrage effect" although the effect was marginal. Brown et al. (2005) also examine this issue and find that individuals considered environmental losses to be more serious when they were caused by human actions rather than by natural events. Conversely, Walker et al. (1999) find that willingness to pay for the provision of a public good was less if the need for the good was caused by humans than if it was caused naturally. In our application, we are unable to completely separate attribution (anthropogentic vs natural causes) for the sources of coral degradation, but there is scientific consensus that both environmental risks (rising sea temperatures and nutrient/pathogens) degrade corals and that human activity plays an important role in this degradation. Furthermore, we hypothesize that among our targeted population, there is a higher level of disagreement over the role of rising sea temperatures as compared to nutrient inflow on coral degradation.

Assuming differences in disagreement over attribution of environmental risk factors does exist among users, we wish to test the role of cultural worldviews on the choices of respondents. Kahan et al (2011) find cultural worldviews drive differences in the interpretation of scientific

[3] While non-users will likely value further artificial reef deployment, the focus of this research is to capture use values from the diving population.

evidence. They find the divergence in the perceptions of risk to be larger for politically polarizing topics such as Global Environmental Change. Our approach expands upon this finding by testing it within a stated preference study in the Florida Keys. In our CVM survey design, we examine individuals' support and WTP for environmental policy based on two underlying causes: (1) the local outflow of treated domestic sewage discharge (termed the sewage treatment); and (2) climate change-related rising water temperatures (termed the climate change treatment). Our design enables some interesting insights to be tested regarding the interaction of individuals' value for funding an impure public good to help mitigate environmental risk, cultural worldview, and the cause of the environmental problem.

3. Survey Design and Descriptive Statistics

To examine the impact of cultural worldview on individuals' WTP for an environmental policy and interaction with the cause of the environmental problem, we develop a survey of reef divers. We are explicitly interested in the Florida reef diving population as they constitute direct users of the reefing system. The sample population is drawn from fishing license holders' email addresses gathered from the Florida saltwater fishing license database (provided to us by the Florida Fish and Wildlife Conservation Commission). The survey design is developed in the Qualtrics, Inc. software and administered via email. A pilot test was sent to 500 respondents. Feedback from 94 completed responses to the pilot survey aided survey design and proposed fee structures to be refined. A follow-up survey was sent to 1,737 respondents. Follow-up survey reminders, as suggested by Dillman (2000) were also sent to respondents. After deleting any incomplete responses, the full sample was 470 divers (providing an overall response rate of 21.9 percent).

The survey was created to elicit respondents' reef diving behavior, attitudes and preferences toward artificial reef deployment, cultural worldviews, sociodemographic details, and responses to a hypothetical referendum on additional funding for artificial reef development in the Florida Keys area. In our design, the payment vehicle for funding additional reef development is via an increase in divers' annual fishing license fee.

. To test for the influence of the cause of the environmental policy, each respondent randomly receives one of the two treatment scenarios – either the *sewage* treatment or the *climate change* treatment. For both treatment scenarios, respondents are informed of the recent

survey analyzing maps of the Florida Keys indicating that more than half the area formerly occupied by corals has been lost over the past 250 years. Further, for some nearshore reefs, estimates reveal a loss in live coral cover exceeding 90 percent, suggesting that human influences are playing a major role. They are further told that coral reefs contribute several important ecosystem functions, such as providing an essential resource for many reef fish species and providing storm protection for coastal communities. With the ongoing degradation of natural coral reefs, artificial reefs (such as deliberately sunk ships, reef balls, bridge rubble, etc.) can play an important environmental role, mitigating the effects of a declining coral reef system by providing habitat for a variety of marine life, and improving storm protection.

For the *sewage* treatment scenario, respondents are also informed that every day, millions of gallons of nitrogen-rich effluent (treated domestic sewage) is discharged out of South Florida's coastal cities via outfall pipes that extend a mile or more out to sea. This treated sewage makes coral more susceptible to bleaching events – where corals become white as a result of a loss of their symbiotic algae. The corals can starve to death if the condition is prolonged.

For the *climate change* treatment, respondents are instead informed that a recent study by the U.S. Geological Survey indicates that over the last 100 years, late-summer water temperatures near the Florida Keys have increased by nearly 2 degrees Fahrenheit. Then they are told that researchers indicate that the warmer water temperatures are stressing corals and increasing the number of bleaching events.

Following the reef degradation information, depending on which scenario the respondent faces, respondents are asked – on a five-point Likert scale of agreement– whether they believe that sewage/climate change has contributed to the degradation of the natural reef system in the Keys area. We refer to this as the "contribute" question. Table 1 shows that 60 percent of divers either agree or strongly agree that the discharge of treated domestic sewage has contributed to the degradation of the natural reef system in the Keys area. Fewer respondents (43 percent) at least agree that climate change-related rising water temperatures have contributed to this effect.

The referendum question is then posed for either scenario. For example, under the *climate change* scenario, the question is posed as:

"Suppose that the Florida Legislature increases the funding available to Florida Fish and Wildlife to support new artificial reef development in the Florida Keys to **help mitigate the negative**

environmental impacts on the coral reef system from climate change-related rising water temperatures. This would require local areas to share in the cost of the new reefs and that cost share would take the form of an **increase** in your saltwater fishing license fee of $*x*. If a local referendum of Florida fishing license holders was held on the fee increase and if at least 50% vote for the fee it will be put into practice would you vote FOR the fee increase?"

The fee of $*x* is varied randomly across respondents and can take on a value of either $5, $25, $100, or $200. Respondents were offered the choice of voting "for", "against" or "I don't know", where "I don't know" responses were coded as "against" in the analysis. We refer to this as the "voting *yes*" question.

4. Econometric Model

We utilize the dichotomous choice, contingent valuation method (CVM) to derive WTP estimates for the development of new artificial reefs in the Florida Keys to help mitigate negative environmental impacts on the coral reef system based on one of two randomly assigned sources of degradation (sewage effluent discharge and climate-change-related increased water temperatures).

We estimate WTP using a single-bounded, closed-ended referendum. Our theoretical model is based on the Random Utility Model (Hanemann 1984). In the RUM, we specify an indirect utility function for survey research participant *j* such that

$$u_{ij} = u_i\left(y_j, \boldsymbol{z}_j, CWV_j, r^i, \varepsilon_{ij}\right) \quad (1)$$

where *i* represents the state of the world in which the artificial reef deployment program is either not implemented (*i* = 0*)* or implemented (*i* = 1*)*. Respondent *j*'s indirect utility is a function of their income, y_j, observed diver, household, and choice characteristics, $\boldsymbol{z}_j$, their cultural world view, CWV_j, their access to the new artificial reef, r^i, and the unobserved preferences of the individual, ε_{ij}. As such, respondents' indirect utility for the status quo condition would be $u_{0j} = u_0\left(y_j, \boldsymbol{z}_j, CWV_j, r^0, \varepsilon_{0j}\right)$ and the indirect utility for the artificial reef deployment would be $u_{1j} = u_1\left(y_j, \boldsymbol{z}_j, CWV_j, r^1, \varepsilon_{1j}\right)$.

Within the RUM framework, the probability of observing a yes response to the referendum at a specified fee amount, fee_j, becomes

$$\Pr(yes_j) = Pr\{u_1(y_j - fee_j, \mathbf{z}_j, CWV_j, r^1, \varepsilon_{1j}) > u_0(y_j, \mathbf{z}_j, CWV_j, r^0, \varepsilon_{0j})\}. \quad (2)$$

We specify the indirect utility function as being additively separable in the deterministic and stochastic preferences so that equation (2) can be written as

$$\Pr(yes_j) = Pr\{v_1(y_j - fee_j, \mathbf{z}_j, CWV_j, r^1) + \varepsilon_{1j} > v_0(y_j, \mathbf{z}_j, CWV_j, r^0) + \varepsilon_{0j}\} \quad (3)$$

where $v(\ )$ is the deterministic component of preferences and ε_j are stochastic preferences.

A standard probability model depicting a yes response to the referendum can be written as

$$Pr(Yes = 1) = \phi(\beta_0 + \beta_1 fee + \boldsymbol{\delta}'\boldsymbol{Z} + \varphi \text{CWV} + \varepsilon), \quad (4)$$

where a vote on the referendum is equal to 1 if the respondent votes in favor of the additional artificial reef deployment, *fee* is the randomly assigned diving fee, β_0 is a constant, β_1 is the coefficient on the fee variable, $\boldsymbol{Z}$ is a vector of explanatory variables including diver characteristics with the corresponding coefficient vector $\boldsymbol{\delta}$, CWV is a dummy variable capturing cultural worldview, and φ is the coefficient for cultural worldview.

Our empirical model expands on the standard probability model in equation (4) by accounting for the potential correlation between 1) the probability an individual believes a randomly assigned factor (sewage vs climate change) has contributed to coral reef degradation and 2) the probability of voting yes on the referendum meant to reduce pressure on coral reefs through the deployment of artificial reefs. We utilize a bivariate probit model in order to control for the potential unobserved correlation between contribution to reef degradation (sewage or climate change) and voting for the referendum. We develop this bivariate probability model, such that

$$\begin{aligned} &Pr(Contribute = 1) = \phi(\alpha_0 + \boldsymbol{\lambda}'\boldsymbol{Z} + \gamma \text{CWV} + \varepsilon_1) \quad (5)\\ &Pr(Yes = 1) = \phi(\beta_0 + \beta_1 fee + \boldsymbol{\delta}'\boldsymbol{Z} + \varphi \text{CWV} + \varepsilon_2)\\ &\Phi_2(\varepsilon_1, \varepsilon_2; \rho) \end{aligned}$$

where in the first equation, *Contribute* is equal to 1 if the respondent believes the factor (sewage or climate change) degrades coral, α_0 is a constant, $\boldsymbol{Z}$ is a vector of observed diver, household, and choice characteristics, $\boldsymbol{\lambda}$ is a vector of coefficients for those characteristics, and CWV is a dummy variable representing the cultural worldview of a respondent with a corresponding coefficient γ. In the second equation, *Yes* is equal to 1 if the respondent votes in favor of the referendum, β_0 is a constant, β_1 is the coefficient on the *fee* variable, *fee* is a randomly assigned fee added to the saltwater fishing license, $\boldsymbol{Z}$ is a vector of observed diver, household, and choice characteristics, $\boldsymbol{\delta}$ is a vector of coefficients for those characteristics, and CWV is a dummy

variable representing the cultural worldview of a respondent with a corresponding coefficient γ.. The bivariate probit model draws $(\varepsilon_1, \varepsilon_2)$ from a standard bivariate normal distribution with zero means. The correlation coefficient, ρ, captures the relationship between the unobserved characteristics captured by the error terms in the two models. We expect a positive value for ρ, indicating a positive relationship between belief that the randomly assigned factor contributes toward coral degradation and support for the artificial reef program.

5. Results

5.1 Cultural Worldview and Voting Behavior

Tables 2 and 3 provide a breakdown of some key user characteristics from both treatment samples from our 470 responses. As is typical of samples from other diver-related studies, our sample diving population is a well-educated, high income-earning cohort (see Morgan et al. 2009 and Huth et al. 2015). For example, respondents from both samples earn an average annual salary of over $120,000 with approximately 75 percent earning at least a bachelor's degree. Approximately 60 percent of respondents have an open water diving certification with between 32 and 41 percent indicating that they prefer to dive on both natural and artificial reefs. The majority of respondents are male with an average age of about 56 years.

Results from the bivariate probit models for both the *sewage* and *climate change* treatments are shown in Tables 4 and 5. Comparing both the "contribute" and "voting *yes*" equations across treatments provides some interesting insights. The first important result for this research is that all individualist and hierarchical dummy variables are negative and statistically significant in both the contribute and voting *yes* equations. In terms of the contribution equation, results suggest differing individual beliefs regarding the contributing role of the sewage outflow and climate change-related events on environmental risk dependent on cultural worldview. Specifically, individualists (as opposed to communitarians) and hierarchicals (as opposed to egalitarians) are less likely to believe that either underlying cause is contributing to natural reef degradation. This result adds weight to the work by Kahan et al. (2011) and Cherry et al. (2017) on the cultural cognition of risk such that individuals tend to shape their individual beliefs about the scientific consensus of environmental issues based on their personally held values.

From the voting *yes* equation, individualistic and hierarchical individuals are less likely to vote in favor of additional funding for an impure public good to help mitigate environmental risk. Again, this result supports findings from the experimental lab research of Cherry et al. (2017) who find that communitarian and egalitarian individuals are more likely to be supportive of environmental policy interventions.

Results also indicate that individual perceptions and voting behavior differ as a function of the underlying cause of environmental risk. We observe this in different ways. First, under the *sewage* treatment, the coefficient on the rho parameter is positive and statistically significant at the 1 percent and 14 percent confidence level across the two models, respectively. This indicates that those agreeing that local sewage pollution has contributed to the degradation of the reef system are more likely to support an artificial reef policy that aids in mitigating the negative effects of a declining natural reef system. However, under the *climate change* treatment, the rho coefficient is not statistically significant, so we do not observe the same behavior. One explanation for this could be that those receiving the *sewage* treatment see this issue as something that can be addressed at the local, state, or even national level. As such, there's a positive correlation between the two perceptions. In contrast, the *climate change* treatment presents more of a global challenge and while people may believe that it is contributing to the degradation issue, they may further believe that it requires an international level of cooperation. As such, there is not a significant level of correlation.

Further, by comparing results across treatments, we observe some diver-specific and sociodemographic differences driving policy response. Under the sewage treatment, we observe diving behavior, demographic, and education effects. Better educated, older, female divers that take more trips to the area are more likely to support an environmental policy that is necessitated by local pollution issues. Under the climate change scenario, we do not observe the same demographic effects, but positive income effects are revealed, with those earning greater income levels more likely to support the reef development policy. Similar education effects are also prevalent. Finally, differences in behavior due to the underlying cause are also evident when examining the worldview coefficients across treatments. Specifically, the effect of cultural worldview on behavior is more pronounced if the policy is driven by climate change forces

rather than domestic sewage outflow. In this sense, it appears that a more global underlying cause has a greater impact on behavior than a local event.

5.2 Cultural Worldview Willingness to Pay

This research provides the first measure in the economic literature of individuals' WTP for an environmental policy as a function of worldview type. We augment previous lab-based research by assigning dollar values to individuals' policy responses – using nonparametric, Turnbull lower bound estimates (Haab and McConnell 2002) – for each worldview type, by treatment. Turnbull lower bound estimates avoid predicting negative WTP, an issue common referendum models of contingent valuation. Haab and McConnell (1997) argue that this estimator solves the problem of estimating negative willingness to pay without resorting to ad hoc distributional assumptions. They demonstrate that the lower bound Turnbull estimate is robust across distributions while the central tendency measures of willingness to pay from parametric models are sensitive to the assumed distribution. The Turnbull estimator makes no assumptions about the shape of the underlying willingness to pay distribution. Instead, it uses the proportion of the empirical distribution falling into each price interval to calculate mean willingness to pay for the sample. This estimate is also appealing in policy-based research because it presents a more conservative estimate of WTP. Table 6 shows that across the individualistic-communitarian dimension, communitarians are willing to pay significantly more than individualists for both policies, independent of cause. If the environmental policy is necessitated by local waste outflow into coastal waters, pro-social communitarian types are willing to pay, on average, $64 annually for further artificial reef development, compared to $10 per year for individualistic types. If the same policy is presented to help mitigate the threat of climate change-related rising water temperatures, mean WTP point estimates across the individualistic-communitarian dimension increase. Again, communitarians are willing to pay significantly more than individualists ($75 compared to $28).

Results indicate a similar story when we examine WTP values across the hierarchical-egalitarian dimension. Mean WTP for environmental policy support are greater for egalitarians than hierarchical types independent of the cause. Specifically, egalitarians are willing to pay $52

for a policy to mitigate the effects of waste outflow compared to $23 for hierarchicals. When the policy helps mitigate the negative effects of climate change, again mean WTP estimates rise to $103 and $32 for the two worldview types, respectively.

5.3 Cultural Worldview and Survey Consequentiality

Recent work in the CVM literature investigated the impact of CVM survey consequentiality on voting behavior and policy WTP estimates. For example, both Herriges et al. (2010) and Vossler and Watson (2013) examine consequentiality in CVM survey responses, finding that respondents who do not believe the survey results are consequential are less likely to support the policy. Groothuis and Whitehead (2009) further suggest that a lack of perceived consequentiality in CVM surveys generates behavior similar to protest no responses. Groothuis et al. (2017) expand this work by examining a CVM tax payment on perceived consequentiality. They find that as the tax payment increases, survey respondents are less likely to find that survey instrument consequential. Our framework adds to this effort by investigating whether respondents' cultural worldview influences survey consequentiality. Immediately following the stated referendum question, we provide respondents with a consequentiality statement. Specifically, we state:

> "I think that the results of this survey could affect decisions about artificial reef policy in Florida."

Respondents are then provided with a 5-point Likert scale (1 = "Strongly Disagree"; 5 = "Strongly Agree") from which they indicate their level of agreement. Table 7 provides a breakdown of consequentiality responses by cultural worldview type. We observe that both communitarians and egalitarians are more likely to either agree or strongly agree (62% and 60%, respectively) that the survey is consequential than individualists and hierarchicals (47% and 53%, respectively).

To investigate the potential role of cultural worldview on perceived survey consequentiality, we run a probit model. In Table 8, we control for consequentiality using a dummy variable as suggested by Vossler and Watson (2013). In our set up, if a respondent answered that they either agree or strongly agree to the consequentiality question it was coded as

one, zero otherwise. The only reef or socio-demographic variable that is significant is the number of diving trips to the Keys area – with findings suggesting that those that take more trips to the Florida Keys being more likely to perceive their referendum response to be consequential. Inclusion of the worldview dummy variables is informative. First, the coefficient on the individualist dummy is negative indicating that this group are less likely than communitarians to find the survey instrument consequential ($p = 0.001$). This is also true for hierarchicals when compared to egalitarians although this is not statistically significant ($p = 0.251$). This has potentially important policy implications. First, following work by Groothuis and Whitehead (2009), our results suggest that individualists may be responding to CVM surveys by rejecting the scenario and answering with protest no votes. This greater likelihood of inconsequential responses from these groups may in turn imply that their stated preferences are understated and potentially not in line with real market behavior. As such, this may bias WTP estimates and potentially lead to inefficient policy recommendations from a benefit-cost perspective.

Conclusion and Discussion

The degradation of many coastal environments is aptly classified as a "wicked problem" due to the complex and unpredictable characteristics of their decline and the often-intractable nature of potential solutions. Coral reefs fit this classification well considering the variety of geographic scales for stressors, the scientific uncertainty associated with assigning levels of attribution to different stressors, and the complex nature of implementing management solutions. Since these threatened ecosystems typically represent impure public goods, calls for collective action to mitigate degradation are necessary to enhance individual and societal benefits. In a world of political agreement, policy solutions would be developed on a mixture of local, regional, and global scales. In reality, political agreement remains a challenge, especially on larger geographic scales with a larger collection of actors. While the scientific evidence linking various types of human activity to environmental degradation increases, the conflicting results from recent environmental policy referenda suggests a definite heterogeneity in opinions and support for adaptive policies.

The contingent valuation literature has investigated individuals' support for a range of environmental policies, designed to deal with such issues. The majority of this work has also

considered a variety of individual-level variables in an attempt to provide determinants that may induce policy support or rejection (Lo and Jim 2015; Karloseva 2016; Williams and Rolfe 2017). In the social psychology literature, recent research – in particular by Kahan et al. (2009, 2010, 2011) has indicated that personally held beliefs play a pivotal role in individuals' acceptance or rejection of environmental policy. This literature points to a tension between individuals' perceptions of social welfare maximizing actions and their personal belief structures. Work in this body of literature has indicated that when faced with decisions of whether to support environmental policy, individuals tend to form policy opinion based on their socially constructed orientation.

This research provides an examination of individuals' cultural worldviews in a contingent valuation study framework. We assess support for an environmental policy that's designed to improve the provision of an impure public good – coral reefs in the Florida Keys. Our design first tests the role of cultural worldviews on individuals' beliefs regarding the causes (local point source sewage outflow vs global climate change-related sea-temperature rise) of coral reef degradation, and then whether cultural worldviews influence voting behavior on a policy meant to mitigate that degradation. Our policy proposes further artificial reef development to help mitigate the loss in the natural reef system – and as such, aquatic biodiversity – in the Florida Keys region. Moreover, we estimate individuals' willingness-to-pay for this policy controlling for both cultural worldview type and the frame for the cause of degradation.

Our sample is derived from a survey of divers identified from the Florida saltwater fishing license database. In total, 470 surveys were completed and used in estimation.

Results from bivariate probit models indicate that communitarian and egalitarian types are more likely to believe that local sewage outflow or climate change-related events are a causal influence on environmental risk. This result adds weight to the work by Kahan et al. (2011) and Cherry et al. (2017) on the cultural cognition of risk such that individuals tend to shape their individual beliefs about the scientific consensus of environmental issues based on their personally held values. Results also provide strong support for previous work indicating that communitarian and egalitarian types are more likely to support an environmental policy (see Kahan 2011 and Cherry 2017), independent of the underlying cause. This is intuitive as individualistic and hierarchical types have a tendency to resist government intervention and related policy.

Further, both communitarian and egalitarian types are willing to pay significantly more for provision of an impure public good than individualists and hierarchicals, respectively. This adds to the earlier literature in experimental lab settings by specifically quantifying the effect of worldview on policy acceptance. Next, we find that all worldview types increase their WTP to help adapt to natural reef degradation if the underlying cause is climate change-related, as opposed to local treated waste outflow (although the effect is not significant at the 95% confidence level).

Finally, we examine the influence of cultural worldview on respondent survey consequentiality. Results from probit models indicates that individualists are more likely than communitarians to not perceive the survey instrument as consequential. From a policy perspective, this may imply that this cohort are more likely to reject the proposed scenario and respond with a protest no vote. Typically, respondents' protest no bids are motivated by some objection to the survey design. If so, their stated preference responses may be understated and potentially not in line with real market behavior. From a benefit-cost perspective, this may lead to spurious conclusions and ill-informed decision making.

Overall, the impact of cultural worldview clearly matters when it comes to acceptance of environmental policy interventions and the values individuals place on the provision of impure public goods, along both worldview dimensions. Future research that is interested in valuing support for an environmental policy that addresses wicked problems with no single root cause, may wish to condition the analysis on worldview dimensions. From a policy perspective, this may aid decision makers in understanding differences in individuals' voting behavior for environmental policy interventions and provide more accurate estimates for benefit-cost analyses.

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Table 1. Level of Belief Regarding Cause of Natural Reef System Degradation, by Treatment

Question	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I believe that the discharge of treated domestic sewage has contributed to the degradation of the natural reef system in the Keys area	50%	10%	12%	15%	13%
I believe that climate change-related rising water temperatures has contributed to the degradation of the natural reef system in the Keys area	30%	13%	18%	25%	14%

Table 2. Data Summary (*Sewage* Treatment – n = 200)

Variable	Mean	Std. Dev.	Min	Max
For vote = 1	0.51	0.51	0	1
Fee	58.81	71.70	5	200
Adv. Open (=1 if hold advanced open water certificate)	0.62	0.49	0	1
Natural & Artificial (=1 if dive on both reef types)	0.32	0.47	0	1
Income (in thousands of dollars)	109.4	65.6	10	200
Male = 1	0.88	0.33	0	1
Age (in Years)	56.17	10.01	26	79
Keys Trips (total number of Keys dive trips in past 5 years)	5.39	22.04	0	200
Associate's Degree = 1	0.08	0.26	0	1
Some College = 1	0.15	0.36	0	1
Bachelor's Degree = 1	0.44	0.50	0	1
Graduate Degree= 1	0.29	0.45	0	1
Communitarian = 1	0.45	0.50	0	1
Egalitarian = 1	0.49	0.50	0	1

Table 3. Data Summary (*Climate Change* Treatment – n = 270)

Variable	Mean	Std. Dev.	Min	Max
For vote = 1	0.58	0.49	0	1
Fee	53.67	69.96	5	200
Adv. Open (=1 if hold advanced open water certificate)	0.58	0.50	0	1
Natural & Artificial (=1 if dive on both reef types)	0.41	0.49	0	1
Income (in thousands of dollars)	99.15	61.52	10	200
Male = 1	0.91	0.28	0	1
Age (in Years)	57.73	10.2	32	81
Keys Trips (total number of Keys dive trips in past 5 years)	5.54	20.03	0	200
Associate's Degree = 1	0.09	0.28	0	1
Some College = 1	.012	0.32	0	1
Bachelor's Degree = 1	0.43	0.50	0	1
Graduate Degree= 1	0.27	0.44	0	1
Communitarian = 1	0.44	0.50	0	1
Egalitarian = 1	0.40	0.49	0	1

Table 4. Bivariate Probit Regression Results – *Sewage* Treatment

	Individualist-Communitarian Model		Hierarchical-Egalitarian Model	
Variable	Voting *Yes*	Contribute	Voting *Yes*	Contribute
Constant	-.299 (.624)	-.957 (.701)	-.557 (.621)	-1.016 (.693)
Fee	-.007*** (.002)	___	-.006*** (.001)	___
Adv. Open	-.423** (.222)	-.350* (.208)	-.210 (.200)	-.215 (.196)
Natural & Artificial	.584*** (.250)	.651***(.230)	.589*** (.244)	.638***(.228)
Income	.002 (.002)	.001 (.001)	.002 (.002)	.001 (.001)
Male	-.507*(.282)	-.339 (.285)	-.556**(.272)	-.389 (.298)
Age	.019* (.010)	.036*** (.011)	.018* (.010)	.034*** (.011)
Keys Trip	.082*** (.022)	-.003 (.005)	.063*** (.020)	-.003 (.004)
Associate's	.830* (.476)	.276 (.527)	.270 (.471)	.125 (.508)
Some College	.946** (.443)	-.318 (.500)	.487 (.458)	-.452 (.496)
Bachelor's degree	-.086 (.396)	-.075 (.430)	-.167 (.394)	-.036 (.444)
Graduate degree	.666* (.410)	-.318 (.449)	.695* (.399)	-.265 (.456)
Dummy for individualists	-1.262*** (.249)	-.892*** (.207)	___	___
Dummy for hierarchicals	___	___	-.333* (.203)	-.527*** (.196)
Rho	.211 (.142)		.385*** (.137)	
Log likelihood	-207.1		-224.7	
Obs	200		200	

Table 5. Bivariate Probit Regression Results – *Climate Change* Treatment

	Individualist-Communitarian Model		Hierarchical-Egalitarian Model	
Variable	Voting *Yes*	Contribute	Voting *Yes*	Contribute
Constant	-.972 (.625)[a]	1.591** (.695)	-.358 (.620)	2.028 (.611***)
Fee	-.004*** (.002)	___	-.004*** (.001)	___
Adv. Open	.326** (.174)	.279 (.184)	.424** (.182)	.295 (.186)
Natural & Artificial	-.021 (.168)	-.396**(.184)	.031 (.170)	-.242 (.178)
Income	.003*** (.001)	.002 (.001)	.003*** (.001)	.001 (.001)
Male	.111 (.321)	-1.290*** (.320)	-.104 (.348)	-1.495*** (.309)
Age	.005 (.008)	-.002 (.009)	-.003 (.008)	-.008 (.009)
Keys Trip	-.005*** (.004)	-.003 (.004)	-.009 (.007)	.002 (.003)
Associate's degree	.940** (.396)	1.231*** (.444)	.782** (.397)	.739* (.414)
Some College	.578 (.381)	-.521 (.414)	.659* (.344)	-.380 (.390)
Bachelor's degree	1.008*** (.317)	.722** (.349)	.765*** (.291)	.202 (.328)
Graduate degree	.900*** (.329)	.227 (.359)	.795*** (.303)	.155 (.345)
Dummy for individual	-.630*** (.625)	-1.554*** (.196)	___	___
Dummy for hierarchical	___	___	-.747*** (.180)	-1.281*** (.197)
Rho	.026 (.114)		.092 (.113)	
Log likelihood	-287.8		-296.2	
Obs	270		270	

[a]Standard error in parentheses.
***significant at the 99% level, significant at the 95% level, *significant at the 90% level

Table 6. Willingness to Pay Estimates (t-stats in Parentheses)

	Sewage Treatment	
	Individualist	Communitarian
Mean WTP	$10.49	$64.19
	(3.96)	(9.64)
Lower Bound	$2.73	$45.30
Upper Bound	$18.24	$83.07
	Hierarchical	Egalitarian
Mean WTP	$22.84	$51.83
	(6.26)	(9.01)
Lower Bound	$10.68	$34.18
Upper Bound	$35.10	$69.49
	Climate Change Treatment	
	Individualist	Communitarian
Mean WTP	$28.07	$75.19
	(6.55)	(10.23)
Lower Bound	$15.24	$55.14
Upper Bound	$40.90	$95.24
	Hierarchical	Egalitarian
Mean WTP	$21.10	$82.15
	(5.31)	(10.43)
Lower Bound	$10.71	$61.71
Upper Bound	$31.50	$102.60

Table 7. Consequentiality by Cultural Worldview

Cultural Worldview Type	C=1 Strongly Disagree	C=2	C=3	C=4	C=5 Strongly Agree
Individualist	3.3%	5.4%	44.6%	34.8%	12.0%
Communitarian	2.0%	5.6%	29.9%	51.4%	11.1%
Hierarchical	4.9%	6.8%	35.0%	39.8%	13.6%
Egalitarian	0.8%	4.6%	35.6%	49.2%	9.9%

Table 8. Probit Consequentiality Model

Variable	Individualist/Communitarian	Hierarchical/Egalitarian
Constant	.247 (0.418)[a]	.271 (0.422)[a]
Fee	-.000 (.001)	-.000 (.001)
Adv. Open	-.117 (.124)	-.062 (.124)
Natural & Artificial	.010 (.124)	.043 (.124)
Income	.001 (.001)	.001 (.001)
Male	.270 (.205)	.245 (.204)
Age	-.011 (.006)	-.013 (.006)
Keys Trip	-.006* (.004)	-.008* (.004)
Associate's degree	.274 (.299)	.248 (.301)
Some College	.207 (.273)	.176 (.275)
Bachelor's degree	.168 (.235)	.171 (.240)
Graduate degree	.146 (.247)	.183 (.250)
Dummy for individual	-.422*** (.125)	
Dummy for hierarchical		-.237** (.122)
χ^2	24.39***	17.39*
Sample size	470	470

[a]Standard error in parentheses.
***significant at the 99% level, significant at the 95% level, *significant at the 90% level