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The Relationship Between Water Shortage Concern and Age in Utah

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The Relationship between Water Shortage Concern and Age in Utah

by

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Abstract

It is unclear whether current water supplies in Utah will be able to accommodate the needs of the future. Population in the state is expected to double by 2050 and climate change models predict declines in water availability in the region. Public perceptions of the adequacy of the water supply (and concerns about potential shortages) are key factors that could influence water use behaviors and support for public policy interventions. This paper explores the research question: "Are young people in Utah more concerned about water shortages than older cohorts?" It was expected that young people would be more concerned about water shortages because they have the highest material stake in avoiding future water crises in the state. Data from a large public survey of representative Utah adults (n=6,800) is used in multivariate models to investigate the relationship between age and perceptions and concerns about water shortages, controlling for sociodemographic attributes and independent estimates of the biophysical adequacy of water supplies in the respondent's place of residence. Results show that adults in all age groups are somewhat concerned about future water supplies in their community, but age is positively related to the degree of concern (net the effect of other variables in the model). These findings support an emerging body of research that suggests a cohort shift in patterns of environmental concern in the United States. The paper explores implications of the findings for public officials seeking to motivate residents to conserve water and support public investments to secure future water supplies.

Keywords: *water supply, environmental concern, age, Utah*

For Juliane, Florence, and Abhay

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Introduction

Utah, like much of the arid West, is facing increasing tension between growing urban centers and water supply projections. The population is expected to double by 2060 while the Utah Division of Water Resources predicts major water shortages before 2040 (Utah Foundation 2015). This dilemma is exacerbated by the current allocation of water wherein the majority of water is used by agriculture and is rarely available for water-hungry cities that are often geographically far away.

Utah is the second driest state in the United States based on average annual precipitation levels, reports the National Oceanic and Atmospheric Administration (NOAA 2016). The precipitation serves much of Utah's current population of 3 million people and will continue to be the primary water source into the future. Despite this relative water scarcity, per capita consumption of water is at 180 gallons/day. Water demand management strategies have also been employed to curb water use in Utah. The Governor's Office has established the goal of a 25% reduction in water demand for each city by 2025 through conservation (Utah Division of Water Resources 2013).

Major development projects are underway to alleviate the relative water scarcity in Utah. The Bear River Development Project aims to divert surface water from the Bear River in Northern Utah for delivery to Cache County and beyond to Weber, Davis, and Salt Lake Counties that have population hubs in need of water. A similar project, the Lake Powell Pipeline, is in progress to bring water from Lake Powell to residents in Washington County. These high cost initiatives to provide additional water supply are driven by supply concerns

from the Division of Water Resources (Utah Division of Water Resources 2014, Utah Division of Water Resources 2013)

Initiatives that look to address water shortage problems should be informed by the public's concerns and perceptions of the water supply in Utah, and solutions to the problem are often dependent on motivating the public to either change their water use behaviors or support major public investments in new water supply infrastructure. It is therefore important to maintain an understanding of the degree to which Utahns perceive water as scarce and are concerned about future water shortages.

As water supply issues are projected to increase, the youngest in Utah are the most likely to experience them. Those currently in their younger years have the greatest stake in water shortage alleviation because of this vulnerability. Their awareness of water supply and concern about shortages is important in understanding their perception of their own vulnerability, and will influence the degree to which they will be a source of political impetus for water supply alleviation initiatives.

This study aims to understand the relationship between age and perceptions and concerns about water shortages.

Explaining variation in concerns about water shortages

The state of water availability in the West is certainly troubling to experts, but it is not clear whether the public shares their assessment, and to what extent different types of Utah adults are more or less aware of and concerned about potential water shortage problems. Guidance on which groups in Utah we might expect to be the most concerned can be taken

from the vast research literature on drivers of environmental concern, more broadly. The explanatory variables that have mattered in these studies have the greatest likelihood of being relevant in Utah. Furthermore, significant recommendations have been made in this field to measure concern about specific environmental issues, giving support for a study of water shortage concern amongst Utahns.

Environmental concern

Understanding who has environmental concern (EC) became an area of particular interest to researchers when social movements in the 60's and 70's erupted to protest the degradation of the environment and its subsequent harmful effects on human health and wellbeing and to mobilize to adopt more environmentally protective laws and regulations (Dunlap and Scarce 1991). This was in part motivated by interest in understanding if there was a general level of concern within society or if certain groups (particularly young adults) were more concerned and likely to support legislative action on the environment.

EC has been measured in several ways since then, as social scientists have aimed to capture the public's perceptions about the state of the environment. Buttel and Flinn in 1976 defined environmental concern as "awareness of environmental problems and support for environmental reform" (Buttel and Flinn 1976). Environmental concern is generally measured through survey respondent agreement with a series of statements about the relationship between society and the environment or the state of the environment as a whole. The survey items vary from awareness of environmental issues, support for environmental spending, and support for government regulation (Schaffrin 2011).

Assessment of trends in environmental concern also contributed to the establishment of a framework that views changes in society's relationship with their environment through the lens of a cultural shift in world view or paradigm. Support for the idea that a 'New Ecological Paradigm' (NEP) was emerging found support in survey research that used a battery of questions to identify individuals who adhered to an "ecologically sound worldview" (Dunlap, Van Liere, Mertig, and Jones, 2000). These theorists argued that the NEP represented a fundamental alternative to conventional Western cultural perceptions of the human-environment relationship, the 'Human Exemptionalism Paradigm' (HEP), which is broadly understood to view the environment primarily as a vehicle for economic growth and development.

Many studies have sought to identify important socio-demographic correlates of environmental concern, in general, and support for the New Ecological Paradigm, in particular. Age, education, income, and gender have all been extensively analyzed as drivers of variation in environmental concern across the population, with varying results.

Age

Of particular interest to social scientists was the apparent heightened levels of environmental concern, adherence to the NEP, and engagement in environmentally friendly behaviors among young people in the 1970s and 1980s. Young people represented a considerable portion of the early environmental movement of the 60s and 70s, and early studies documented a strong negative relationship between age and environmental concern as the most significant and reliable predictor of environmental concern (Buttel 1979).

However, statistical relationships between age and attitudes or behaviors are often challenged to disentangle the effects of age (how old a person is) from those driven by period (the time period in which one collects data) and cohort (traits that are characteristic of people who are born or come of age during a particular historical time) effects. Mannheim's seminal work on the problem of generations holds true for environmental concern and age: it has been very difficult to distinguish between cohort, period, and aging effects in the relationship (Mannheim 1952). Theorists have argued that resistance to the New Ecological Paradigm by older adults could be explained because it is seen as "potentially disruptive of and threatening to the existing social order" (Buttel 1979; Van Liere and Dunlap 1980). As people got older, it was believed, they would be less supportive of environmental issues, while new generations of young adults would be expected to pick up the torch of environmental concern. As these young people assumed social responsibility and grew older, their concern for the environment would be expected to diminished.

Others argued that the negative relationship between age and environmental attitudes reflected a cohort effect among a new generation of young people who grew up and came of age in the context of the rise of the environmental movement, and this cohort of citizens was expected to retain unusually high levels of environmental concern as they aged (Honnold 1984; Mohai and Twight 1987). Of course, cohort and aging theories were working in the same direction with younger groups and the ecological generation in the 1970s and 1980s, and it was difficult to disentangle which process was more at work.

This back- and- forth between assigning causality to a lack of concern on the part of older generations or to a relatively increased concern level for younger generations has been

illuminated by the passage of time. Throughout the 90's, studies of age yielded more mixed results with regard to directionality and relevance in explaining environmental concernedness. Some studies noted that society overall was becoming more environmentally aware and concerned, and that variation between demographic groups was thus decreasing (Jones and Dunlap 1992; Kanagy, Humphrey and Firebaugh 1994; Klineberg, McKeever, and Rothenbach 1998; Fransson and Gärling 1999). To some extent, this supported the idea of a 'period effect' in which late 20th century society reflected broad awareness of and strengthening social norms to address environmental problems typical of this era.

By the early 21st century, however, age began to show up in studies as being positively related to environmental concern. Recent cross-sectional studies and multi-year longitudinal studies have shown the relationship remains positive and strong. This flip from negative to positive directionality in environmental concern gives credence to proponents of the cohort effect. As those young people of the 60's, 70's, and 80's age, their concern for the environment may be staying with them. This finding provides insight as to what relationship between environmental concern and age may be at play. Those who had environmental concern in their younger, formative years, are now the older generations who have the most concern (Pampel and Hunter 2012; Marquart-Pyatt 2012; Liu, Vedlitz and Shi 2014).

It should be noted, however, that the period effect cannot be discounted completely. The younger generations of today were not alive to experience the early environmental movement and so, may not be imbued with the same environmental ethic as older generations.

Other Demographic Drivers

Besides age, important demographic drivers of environmental concern include gender, education, and income. Combined, these variables tend to consistently explain 10-15% of the variance in environmental concern (Liu, Vedlitz, and Shi 2014, Klineberg, McKeever, and Rothenbach 1998). Demographic indicators have also been tested widely through regional analysis on state, region, and national scales, with similar effects (Liu, Vedlitz, and Shi 2014, Pyatt 2012).

Over three decades of social science research have shown that educated females tend to be the most environmentally concerned adults in the US. This is also the case with specific environmental concern issues and in the risk perception literature. Theories as to why range from socialization to gender-based divisions in the home and the workforce which influence caring about the environment, which may imply support for pro-environmental policies, even when they could adversely affect the economy (Zelezny et al. 2000, Stern, Dietz and Kalof, 1993).

Education and income have been studied as separate drivers of environmental concern as well as together as independent measures of social class. Across a large number of studies, noth have generally been found to be either positive or insignificant predictors of EC. When positive effects are seen, it has been theorized that those who are educated and have high income levels are more informed about environmental issues or are able to care about the environment because their basic needs are met and these groups ascribe to a post-materialist perspective; valuing the environment and quality of life more than wealth (Liu, Vedlitz, and Shi 2014).

The method for measuring environmental concern can be an important factor when determining the relevance of demographic variables. In a review of environmental concern studies from 1960 to 1980, Van Liere and Dunlap found that only age and education were consistently significant across a wide range of measures of environmental concern. This was reaffirmed in 1998 by Klineberg, McKeever, and Rothenbach, who used more refined statistical tools than had previously been available (Klineberg, McKeever, and Rothenbach 1998).

Measuring specific environmental concern

While studies of generalized environmental concern or adherence to a new ecological paradigm world view are interesting, many scholars argue that studies will be more successful to the degree that they explore drivers of attitudes toward more specific types of environmental issues. The NEP scale was developed in response to increasingly global environmental problems such as climate change, ozone depletion, and loss of biodiversity. Recommendations for refining the measurement of environmental concern also argue that citizens are likely to give more consistent and meaningful answers to survey questions about specific environmental problems that might take place in their own community.

Samdahl and Robertson (1989) noted that perceptions of and attitudes towards specific local environmental issues instead of abstract human-environment paradigms may be a better indicator of EC because individuals are more aware of the problems in their immediate surroundings than they are of global-scale environmental problems.

Measuring water shortage perceptions

Water shortages are an issue in the arid West where rainfall is low. Interestingly, water demand remains high, with western states having the highest per capita consumption of water in the United States (Neel et al., 2014).

Most information available about water perceptions comes from studies measuring willingness to conserve water. Generally, willingness to conserve water is considered a proxy for awareness about water scarcity (Po, Kaercher, and Nancarrow 2003). Studies conducted in the western United States show that concern for water supply is generally high but support for water management varies (Harlan et al., 2009, Pritchett, Bright, Shortsleeve, Thorvaldson, Bauder, and Waskom, 2009). Meta analyses of these studies have recommended studying how demographic characteristics affect perceptions of water issues.

Length of residency in a water dry state may also affect one's concern about water shortages, and therefore their attitudes towards water conserving behavior. Hilaire et al. has noted that "there is a negative relationship between length of residency in the southwestern United States and the willingness to use high desert plants" (Hilaire et al., 2010). It has also been shown that those living in the Southwest were "more likely to use desert plants in their backyard the shorter their stay in the desert" (Spinti et al., 2004).

An important subgroup in Utah are farmers and people with social or economic ties to the agricultural community. Farmers have been shown to have varied concern levels for environmental issues, but are often less willing to acknowledge environmental challenges when they perceive environmental regulation as a threat to their agricultural practices (Wilson 1996). For example, farmers have notably lower levels of concern about climate change, even though

they may be at the forefront of groups who will likely experience threats from changes in temperature and water availability (Howden et al. 2007).

Research Expectations

Over three decades of social science research have shown that educated females tend to be the most environmentally concerned adults in the US. This is also the case with specific environmental concern issues and in the risk perception literature. Conversely, the relationship between age and environmental concern has varied across time (and by the type of specific environmental issue included in a study). Because water use behaviors are often learned (Jorgensen, Graymore, and O'Toole 2009), I also wanted to explore whether being a Utah native or a person with family ties to agriculture serve as alternative drivers in variation in water supply concern and awareness in the state. Accounting for whether a respondent is a Utah native addresses the common assumptions that out-of-staters are likely to come from more water-rich areas, more likely to notice the arid climate of Utah, and may be more aware and concerned about water supply shortages. Likewise, including measures of the presence of family ties to farmers allows me to explore whether farmers or those who know farmers are also more likely to be aware of water supply issues and be concerned about them. After controlling for gender, education, Utah origins, and farm ties, because younger generations are more likely to impacted by water scarcity in their lifetimes, I expect that age will have a significant, positive effect on water shortage perceptions and concerns.

Data and Methods

Utah Water Survey

This research was conducted using data from the Utah Water Survey, which were collected as part of a statewide initiative to understand Utahn's perceptions and concerns about water scarcity and water quality. These surveys comprise one component of a range of social and natural science research projects coordinated by the National Science Foundation-funded innovative Urban Transitions and Aridregion Hydro-sustainability (iUTAH) project to understand Utah's water future (for full survey, see Appendix).

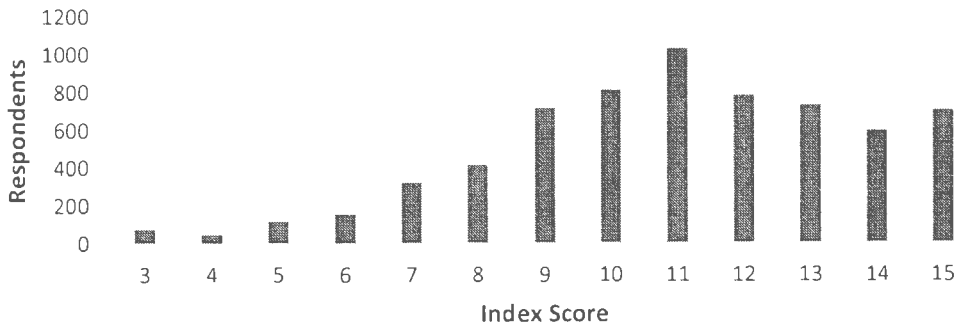
The Utah Water Survey is a 3-5-minute survey that was administered to Utahns throughout 2015. The survey covered socio-demographic characteristics, including age, gender, education, farming ties, and zipcode information, as well as perceptions and concerns about water-related issues and population growth issues. Teams of undergraduate students intercepted potential respondents at grocery stores, asking them to complete the survey on an iPad. The selected grocery stores serve a wide range of consumers, both geographically and demographic-wise. Gender composition was tracked throughout the collection period to compare to state averages.

The response rate and gender composition of the approached potential respondents was collected for comparison against state records. Refusals and disqualifications were also recorded in order to calculate an accurate response rate (40.6% with 6,891 surveys collected).

Dependent Variables

This analysis focused on explaining perceptions of water availability and concerns about future water shortages in Utah communities. The survey included three questions that addressed these perceptions and concerns. First, a question asked "To what extent do you agree or disagree that there is enough water to meet the current needs of all the people and businesses in your community," with a second parallel question asked that focused on the adequacy of water to meet the future needs in their community. The answer categories for both questions ranged from 1- 'disagree strongly' to 5- 'agree strongly.' For the present analysis, responses were recoded such that higher values indicated stronger disagreement with statements that we have enough water (or greater perceptions of water scarcity). Another block of questions asked respondents "Thinking about the next ten years in your community, how concerned are you about each of the following issues?" with one issue option being "water shortages." Answers were coded with another 5-point Likert-type scale scale, with the concern measured on a scale ranging from 1- 'not at all concerned' to 5- 'very concerned.'

The water supply perception (flipped) and concern items were then combined into a composite index variable that was generated by summing the values of responses from the three questions. The resulting index variable ranges in value from 3 to 15 and captures a



synthetic measure of both awareness and concern about the state of the water supply in Utah. The additive index had a Chronbach's alpha value of 0.719, which suggests strong internal consistency and reliability. The Combined Water Availability and Concern Index exhibited a frequency distribution much like a truncated normal distribution (See figure 3). 43% ranked highly on the index variable, scoring between 12 and 15 (averaging between a 4 and 5 on each individual item).

Independent Variables

Independent variables included in my analysis included measures of relevant respondent sociodemographic characteristics. These included binary variables for gender (female), Utah nativity (originally from Utah) and farm ties (you or any of your relatives currently farm). Educational attainment was measured by asking respondents to indicate the highest level of formal education they have using 4 answer categories ('some high school or HS diploma/GED', 'some college and/or vocational/tech degree', '4-year college degree' and 'graduate degree'). Age was measured using a question with 5-answer categories ('18-29', '30-39', '40-49', '50-59', and '60 and over').

Analysis Strategy

Data analysis took place using IBM's statistical software package SPSS. Descriptive statistics for the independent and dependent variables were used to provide a profile of respondent characteristics (See Table 1). Spearman's rank correlation coefficients (bivariate measures of strength and directionality appropriate for categorical variables) were used to provide a preliminary assessment of the relationship of age and the four dependent variables,

and to identify possible combinations of variables which might pose problems with multicollinarity in the multivariate models (See Table 2).

Because the dependent variables were captured measured using ordinal categorical measures, and because the combined index variable did not meet the assumptions of normality required for ordinary least-squares regression, I utilized a type of generalized linear model, ordered logistic regression method, to explore the relationships among the independent and dependent variables. Ordered logistic regression models provide estimates of how changes in values for independent variables increase or decrease the odds that they will have a higher value on the dependent variable. When independent variables had multiple ordered answer categories (e.g., education and age), I excluded one category and estimated the log-odds associated with being in a higher category compared to the reference category. Multivariate methods allow one to explore the impacts of each variable while holding the other independent variables constant (See Table 3 for β-coefficients). Four sets of models were estimated – one for each of the separate measures of water supply perceptions and concerns about water shortages, and a final model estimating values for the combined additive index. Within each set, I estimated a base model using all sociodemographic variables excluding age, then examined the impacts of including variables that captured the respondent age to see if (a) age was a significant predictor of the outcome, and (b) age significantly improved the model fit relative to the base model. By comparing results between these four models, I was also able to assess the robustness of the results linking age to perceptions and concern about water shortages.

Findings

Descriptive Statistics

Descriptive statistics for key variables are reported in Table 1 alongside corresponding U.S. Census data when applicable. Overall, 47.1% of the respondents were female, 58.3% were originally from Utah, and 28.2% reported having farm ties. Compared to census estimates for the adult Utah population, the Utah Water Survey respondents are fairly representative in terms of gender and age, though those with higher levels of education (4-year degrees and graduate degrees) are overrepresented.

Among the nearly 7,000 respondents to the survey, nearly equal numbers agreed or disagreed that there is enough water currently to meet the needs of all the people and businesses in their community (Figure 2a). Looking ten years into the future, nearly two thirds disagreed with the statement that there will be enough water to meet the future needs of all the people and businesses in their community. Future water shortages were also a concern for over 70% of the respondents (Figure 2b).

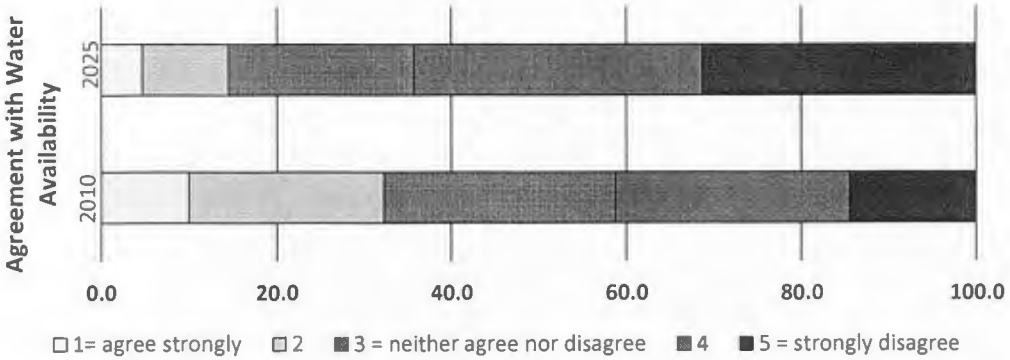


Figure 2a. Reported agreement levels for current and future water availability.

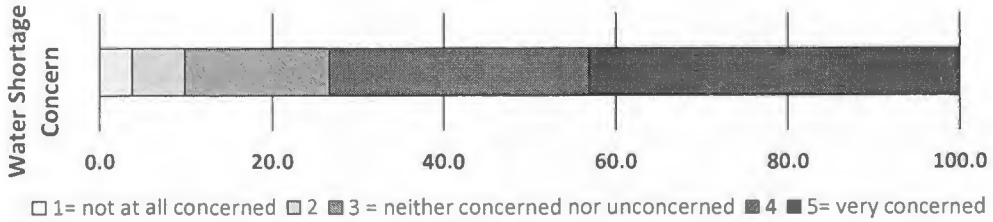


Figure 2b. Reported level of concern over the next ten years.

TABLE 1: Descriptive Variables for Dependent and Independent Variables

VARIABLE	CODING/DESCRIPTION	VALID SURVEY PERCENTAGE	CENSUS[1]
Female	0 = No	47.1%	50.2%
	1 = Yes	52.9%	49.8%
Utah nativity	0 = No	41.7%	
	1 = Yes	58.3%	
Age	1 = 18-29	25.4%	28.9%
	2 = 30-39	22.3%	20.8%
	3 = 40-49	17.6%	8.1%
	4 = 50-59	15.8%	15.1%
	5 = 60 and over	18.9%	18.8%
Farm Ties[2]	1 = Yes	28.2%	
	2 = No	71.8%	
Educational attainment	1 = Some high school or HS diploma/GED	14.7%	33.9%
	2 = Some college and/or vocational/tech degree	38.8%	36.8%
	3 = 4 year college degree	28.4%	19.9%
	4 = Graduate degree	18.1%	9.4%
Water Shortage Concern[3]	1 = Not at all concerned	3.7%	
	2	6.1%	
	3 = Neither concerned nor unconcerned	16.8%	
	4	30.3%	
	5 = Very concerned	43.0%	
Agreement with Current Water Availability[4]	1 = Agree Strongly	10.0%	
	2	22.2%	
	3 = Neither Agree nor Disagree	26.6%	
	4	26.7%	
	5 = Disagree Strongly	14.5%	
Agreement with Future Water Availability[5]	1 = Agree Strongly	4.7%	
	2	9.8%	
	3 = Neither Agree nor Disagree	21.2%	
	4	33.0%	
	5 = Disagree Strongly	31.3%	
Combined Water Availability Agreement and Concern Index[6]	3-15 = Composite variable for all water availability categories		

Bivariate Examination

A full bivariate correlation matrix for all variables used in the analysis is presented in Table 2. Age is significantly and positively correlated with all three measures of water shortage concern and awareness as well as with the combined index. Gender is also consistently correlated with the dependent variables. While the four dependent variables are highly correlated with one another, none of the independent variables are correlated to a degree that suggests potential problems with multicollinearity.

TABLE 2. Spearman Rank Correlation Matrix for all Variables

	F	UN	A	FT	E	WSC	ACWA	AFWA	CWAACI
Female	–								
Utah nativity	0.020	–							
Age	0.023	-0.083 **	–						
Farming Ties	-0.031 *	0.108 **	0.019	–					
Educational attainment	-0.075 **	-0.136 **	0.180 **	0.007	–				
Water Shortage Concern	-0.118 **	0.037 *	0.166 **	-0.006	0.070 **	–			
Agreement with Current Water Availability	-0.106 **	-0.032 **	0.092 **	-0.026 *	-0.007	**0.338** **	–		
Agreement with Future Water Availability	-0.091 **	-0.006	0.145 **	-0.024	0.062 **	**0.469** **	**0.584** **	–	
Combined Water Availability Agreement and Concern Index	-0.132 **	-0.006	0.168 **	0.028 *	0.059 **	**0.710** **	**0.819** **	**0.851** **	–

Multivariate Model Results

I estimated four sets of ordered logit models using sociodemographic variables gathered from the Utah Water Survey for each of the four dependent variables. For each dependent variable, two nested models are tested. The first 'base' model tests the significance of gender, farm ties, Utah nativity, and education in predicting the likelihood of a high rank for the dependent variable. The second 'full' model comprises the former explanatory variables as well as age. In each full model, the effect of age is positive and significant, and effects of moving up each age category has a consistent and linear impact on the probability of perceiving and being concerned about water shortages. Furthermore, the goodness of fit for these "full" models was tested, each model showing a greater fit than the initial "base" model.

Both Model 1a and 1b illustrate the predicted impact of each independent variable on the odds of disagreeing that there is sufficient water to meet current needs in the respondent's community. Model 1a includes only base measures of respondent sociodemographic characteristics (gender, education, Utah nativity, and farm ties). The model is statistically significant, and the coefficients for gender, Utah origins, and farm ties are all significantly associated with perceptions of current water availability. Women are roughly 50% more likely to perceive current water shortages in their community, and those originally from Utah and with family farming ties were also more likely to see their city's water supply as insufficient. There is no significant relationship between a respondent's education and their perceptions of current water shortages.

Model 1b includes a measure for the age of the respondent. Compared to 18-29 year-olds, respondents who are in the 30-39 and 40-49-year-old age groups are 43-46% more likely

to perceive current water availability to be inadequate. Respondents in the oldest age groups (50-59 years olds and 60 and over) are 69% and 68% more likely to perceive water supply to be inadequate than 18-29 year olds, respectively. The full model including a measure for age was a significantly better fit to for the data than the base model, and once age is controlled for, a new coefficient becomes significant for education: there is evidence that people with more college degrees are less likely to see water as relatively scarce than those with high-school or lower educational attainment.

Models 2a and 2b of show the effects of demographic attributes on perceptions that the local water supply in their community will be inadequate in the *future*. The base model (2a) shows that women and those with farm ties are more likely to perceive future shortages, and persons with graduate degrees are more likely to see future supplies as inadequate (compared to those with just high school education). There is no longer a relationship between being a Utah native and future water supply perceptions. Model 2b introduces the age variables. Results again suggest that compared to 18-29 year-olds, older adults are more likely to perceive the water supply to be inadequate. Those in the 30-39 or 40-49 year old group were 49% and 50% more likely to say they disagreed that future water supplies were adequate in their community. Those in the 50-59 year olds were 86% more likely, and those 60 and above were 209% (more than 2x) more likely to perceive future shortages than 18-29 year olds. Again, adding measures for respondent age significantly improves the fit of the model.

The third set of models (3a and 3b) predict the likelihood that a respondent was more *concerned* about future water shortages in their community. In the base model, women were 60% more likely to select a higher level of concern, while Utah natives were 10% less likely to be

concerned. The effects of education are more pronounced; those with 4-year college degrees were 25% more likely and those with graduate degrees were over 50% more likely to be concerned than those with high school education. There is no statistically meaningful association between having farm ties and concern about future water shortages. Model 3b shows the effect of introducing measures for respondent age. Consistent with the water availability perception models, we can see that older adults are much more likely to be concerned than 18-29 year olds. Those in the 30-39 and 40-49 year old groups were 46% and 69% more likely to be concerned, respectively. Those in the 50-59 year old and 60 and over categories were more than twice as likely to be concerned.

The final set of models predict the likelihood of having a higher value on the combined Water Perception and Concern Index. In the base model 4a, females and those with farm ties were likely to be aware about water availability and concerned about it. Those with graduate degrees were more likely to score highly on the index than those with little schooling. There was no significant statistical relationship between being a Utah Native and scores on the combined water availability and concern index. Model 4b introduces age to the base model. Older adults are significantly more likely to rank highly on the index. 30-39 year olds are 60% more likely to be concerned about water shortages then 18-29 year olds, 40-49 year olds are 79% more likely, 50-59 year olds and those 60 and over were both twice as likely to concerned than 18-29 year olds, respectively.

Table 3: Ordered logistic regression models for perceived water availability and concerns about future water shortages.

Factor	Perceives Current Water Availability to be Inadequate		Perceives Future Water Availability to be Inadequate		Concerned about Water Shortages		Combined Index of Water Supply Perceptions and Concern	
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b
	Odds Ratio - Exp (β)							
Female	**1.483****	**1.460****	**1.420****	**1.397****	**1.606****	**1.579****	**1.638****	**1.606****
Utah Nativity	**1.116***	**1.144****	1.044	1.082	**0.896***	0.933	1.036	1.085
Farm Ties	**1.114***	**1.124****	**1.114***	**1.125***	1.060	1.069	**1.138***	**1.156***
Education[1]								
Some college	0.917	0.880	1.048	1.004	1.061	1.006	1.040	0.983
4-year degree	0.867	**0.803***	1.230	1.133	**1.249***	**1.150****	1.174	1.058
Graduate Degree	1.064	0.931	**1.475****	**1.246****	**1.533****	**1.261****	**1.485****	**1.214***
Age[2]								
30-39		**1.460****		**1.490****		**1.460****		**1.601****
40-49		**1.430****		**1.500****		**1.689****		**1.713****
50-59		**1.694****		**1.863****		**2.091****		**2.161****
60 and over		**1.611****		**2.097****		**2.196****		**2.249****
Measures of Fit								
LR- CHI SQUARE	97.63	174.38	92.70	223.64	146.63	308.61	157.570	339.372
LOG LIKELIHOOD	-1404.12	-1365.75	-1320.84	-1255.46	-1232.70	-1151.71	-2881.118	-2789.717
AIC	2828.28	2759.50	2661.68	2538.80	2485.39	2331.48	5798.343	5623.434
BIC	2896.25	2854.70	2729.41	2647.53	2553.45	2426.70	5919.966	5772.215

Notes:
Significant coefficient estimates are noted in bold (* = p<0.05; ** = p<0.01; ***=p<0.001).
[1]Reference category for education: 'some high school/high school graduate'.
[2]Reference category for age: '18-29'.

Discussion and Limitations

Older females tend to be the most aware of water shortage issues and be concerned about them. Age and gender are consistently strong and positive predictors of awareness of water supply shortages and concern for them in Utah. The recent "flip" in the age-environmental concern relationship can be seen in a specific concern for water shortages in Utah, which may be a better indicator of environmental concern than any measure of abstract concernedness.

Furthermore, the positive and significant effect of age in improving each model speaks to the robustness of the independent variable in predicting water shortage awareness and concern. This, in combination with the high correlation between the dependent variables, suggests that awareness and concern for water shortages are considered similarly by Utahns and measure roughly the same thing.

Gender was also a positive and significant predictor in each of the tested models. As noted by studies of general environmental concern, females tend to be more concerned than males.

As water shortages become more of a reality in Utah, the lower levels of awareness of water supply issues and concern for them in the younger generations means that age demographic may perhaps be less of a motivator for policy changes to address water supply in Utah. The cohort effect of age in environmental concern has been documented here, meaning that younger people would not necessarily be expected to become more concerned as they age, because it is not a natural by-product of aging, so much as a function of growing up at a

specific time in history (during the 70s and 80s). This may imply a need for educational outreach to the younger generation, to increase their awareness of an issues that will affect them.

The findings give more evidence to the theory that the age-environmental concern relationship has flipped in directionality in recent years. However, limitations of the findings exist. The iPad methodology is new and may not be as reliable as other surveying techniques. The data are cross-sectional, which provides evidence of associations, but no direct proof of causal relationships. However, the findings highlight a significant positive relationship between age and water shortage awareness and concern in Utah. Further research should compare these findings to nation-wide survey data to control for any regional effects.

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Appendix: Copy of Utah Water Survey questions

UtahState University

iUTAH

Local Perspectives on Water Issues

You are being asked to complete a brief survey about water. This survey is part of a statewide project to learn more about Utahns' thoughts on water resources. Your responses are completely anonymous. Participation is entirely voluntary. You may refuse to participate at any time without consequence. In addition, you have the right to refuse to answer any specific questions if there is information you are not comfortable sharing with us. There are very minimal risks associated with participation in this survey. None of the topics are sensitive.

1. **Are you 18 or over** ◯ YES -- ***Continue*** ◯ NO (STOP HERE – you need to be 18)

2. **For each of the following statements, to what extent do you agree or disagree?**

	Strongly disagree		*Neither agree nor disagree*		*Strongly agree*
There is enough water to meet the CURRENT needs of all the people and businesses in my community.	◯	◯	◯	◯	◯
There is enough water to meet the FUTURE needs of all the people and businesses in my community.	◯	◯	◯	◯	◯

3. **How would you rate the water quality of the following types of water?**

	Very bad		*Neither good nor bad*		*Very good*	*Not sure*
a. My current drinking water supply	◯	◯	◯	◯	◯	◯
b. Groundwater beneath my community	◯	◯	◯	◯	◯	◯
c. Water in nearby mountain rivers and lakes	◯	◯	◯	◯	◯	◯
d. Water in streams or rivers downstream from my community	◯	◯	◯	◯	◯	◯

4. **Thinking about the next 10 years in your community, how concerned are you about each of the following issues?**

	Not at all concerned				*Very concerned*
a. Water shortages	◯	◯	◯	◯	◯
b. Flooding	◯	◯	◯	◯	◯
c. Poor water quality	◯	◯	◯	◯	◯
d. High cost of water	◯	◯	◯	◯	◯
e. Deteriorating water infrastructure	◯	◯	◯	◯	◯
f. Air pollution	◯	◯	◯	◯	◯
g. Traffic congestion	◯	◯	◯	◯	◯
h. Loss of open space	◯	◯	◯	◯	◯
i. Population growth	◯	◯	◯	◯	◯
j. Climate change	◯	◯	◯	◯	◯

5. **How familiar are you with how much money your household usually spends on water each month?**

Not at all familiar ○ ○ ○ ○ ○ *Very familiar*

6. **Is there a grass lawn on the property where you live?**

○ YES → ***if yes, CONTINUE*** *to question #6*

○ NO → ***If no, SKIP*** *to question #7 below*

7. **Who is mainly responsible for watering the grass lawn on your property?** *(Check the one that does most of the outdoor watering).*

○ Me or someone else in my household

○ Landlord

○ Our homeowner or condominium association

○ A hired private company (e.g. lawn maintenance service)

○ Other (*explain*): _____

8. **How often do you participate in any of the following water-related activities in Utah?**

	Never	*Rarely*	*Sometimes*	*Often*
a. Boating	○	○	○	○
b. Fishing	○	○	○	○
c. Snow sports (skiing, snowmobiling)	○	○	○	○
d. Walking or hiking near water	○	○	○	○
e. Gardening	○	○	○	○

9. **Are you originally from Utah?** ○ YES ○ NO

10. **How satisfied are you with the overall quality of life in your community?**

Very Dissatisfied ○ ○ ○ ○ ○ *Very Satisfied*

11. **Do you currently own or rent your residence?** ○ OWN ○ RENT

12. **Do you or any of your relatives currently farm?** ○ YES ○ NO

13. **Are you female or male?** ○ FEMALE ○ MALE

14. **How old were you at your last birthday?**

○ 18-29

○ 30-39

○ 40-49

○ 50-59

○ 60 and over

15. **What is the highest level of school you have completed?**

○ Some high school or high school diploma/GED

○ Some college and/or vocational/technical degree

○ 4 year college degree

○ Graduate degree

16. **What is the zipcode where you live?** ___ ___ ___ ___ ___ *(type zipcode)*

Honors Capstone Reflection

Throughout my undergraduate experience at Utah State University, I have been able to get involved in many extraordinary projects and work with wonderful people. I started out in Biochemistry but quickly realized I enjoyed the policy and debates about the role of the environment in society more than anything else. I was able to find the Environmental and Natural Resource Economics degree and knew almost immediately that it was for me. I have always found the balance between business and the natural environment to be extremely interesting and relevant to the 21st century.

In pursuing environmental and natural resource economics research, I was able to get involved in projects such as perceptions of large-scale wind facilities, campus-wide barriers to sustainable behavior, cost benefit analysis of emissions testing programs. With such an inter-disciplinary degree, I was able to get involved in research with the College of Agriculture, College of Natural Resources, and the College of Humanities and Social Science.

I eventually accepted a summer position as an iFellow for the National Science Foundation-funded innovative Urban Transitions in Aridregion Hydro-Sustainability (iUTAH) after my junior year. The summer was filled with conducting primary research by administering a survey about water perceptions and concerns to Utahns across the northern part of the state. Between surveying trips, my faculty mentor, Dr. Doug Jackson-Smith, and his post-doctoral student, Dr. Melissa Haeffner, taught me and the other undergraduates more about the foundations of social science research and the construction of research questions. Their expertise and willingness to help us understand how to approach social science rigorously was refreshing and engaging. We were able to conduct literature reviews and discuss the

underpinnings of the study we were helping administer in a way that few undergraduates get to do.

Naturally, the undergraduates who were mentored by Dr. Jackson-Smith and Dr. Haeffner recognized the opportunity to do meaningful research for an Honors thesis. Matthew Barnett and I stayed on the project throughout the year, working to better the study and refine our own analyses. Both of our mentors were excited to help us develop our theses and teach us more about statistical analysis, which was extremely useful.

One of the most important things that students can do to complete an Honors thesis successfully is to find great faculty mentors who make time for you and are interested in helping you succeed. The oft-given advice to "start early" is there because trying to find a faculty mentor and develop a project takes time. It is vital that an expert looks at one's thesis proposal and believes that it is a good project that is feasible.

On another note, being passionate about the research one is about to undertake is key to persisting despite the difficulties of the research process. I knew I wanted to study something very practical and useful to the everyday lives of people. Studying an esoteric branch of sociology or economics, while interesting, would not have been the most engaging research for me to do at this point in my research career.

An exciting part about completing an Honors thesis is the chance to present it to various audiences. The Honors Program was gracious enough to provide financial support for many of my endeavors, especially presenting my Honors thesis. The opportunity to travel and discuss one's work with diverse audiences, including city officials, the public, and other scholars, is a great way of fine-tuning one's presentation skills and honing in on why one's work is important.

An Honors thesis is a great way of completing a project and getting recognized for the hard work it takes to conduct research. It does come with challenges due to the nature of research and scholarship. Much of this difficulty lies in the time it takes to produce a solid deliverable that has been checked and re-checked for accuracy. It is important to recognize how much time a thesis will take to complete and adjust one's schedule accordingly. Having done so, the thesis can be permanent evidence of one's initiative and drive.

Author Biography

Viviane Baji was born and raised in Logan, Utah until she was 10 years old and her family moved to Stockholm, Sweden to get familiar with her mother's family and roots. She returned to Logan to go to InTech Collegiate High School and later decided to attend Utah State University after having participated in her high school's early college program at the university. She is completing dual Bachelors of Science degrees in Environmental and Natural Resource Economics from the College of Agriculture and in Economics from the Jon M. Huntsman School of Business. Throughout her time at Utah State, she has been involved in undergraduate research, Service-Learning Scholars, Huntsman Scholars, and the Honors Program. Upon graduation, she will start work in environmental consulting. She hopes to pursue a graduate degree in Economics following some time in the private sector.