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Influence of recreational activity on water quality perceptions and concerns in Utah: A replicated analysis

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ABSTRACT

Both social structural factors and direct sensory experiences can contribute to the development of environmental perceptions and concerns. We use two separate surveys of Utah adults to explore the association between sociodemographic characteristics and participation in recreational activities on water quality perceptions and concerns. We find that engaging in outdoor recreation is systematically associated with more positive water quality perceptions and higher levels of concern about impaired water quality. However, water quality perceptions appear to be shaped more by social characteristics (age, education, gender, race, religion, and income) and by generic measures of overall recreation behavior than by indicators of participation in particular forms of outdoor recreational activity. There is modest evidence that hikers, birdwatchers, and anglers are generally more likely to express concerns about impaired water quality, while boaters have more positive perceptions and lower levels of concern.

Management implications:

- The baseline results of this study can be used by water managers in Utah to track shifts in public attitudes toward water quality as the state grapples with rapid climatic and demographic changes in the coming years.
- Certain types of water recreation (e.g. hiking and birdwatching) are consistently predictive of greater concern about poor water quality. More frequent participation in these types of recreation may lead to increased receptivity to public policies aimed at addressing water quality problems.
- Some demographic groups in our sample are more likely to engage in outdoor recreation, which may have important implications for public engagement.

1. Introduction

Water quality impairment is a substantial environmental hazard which impacts a wide variety of stakeholders and interests, particularly those who participate in outdoor water-based recreational activities. Most water quality problems are also related directly or indirectly to decisions and behaviors made by human actors. To address water quality challenges effectively, it is important to understand how the public perceives and becomes concerned about water quality issues, and to use this information in the design of public programs and interventions (Artell, Ahtiainen, & Pouta, 2013; Tudor & Williams, 2003).

We know from previous research that social structural variables are systematically associated with heightened awareness of and concern about environmental problems by different social groups (Liu, Vedlitz, & Shi, 2014). Socioeconomic status, gender, race/ethnicity, and religion can shape sensitivity to environmental problems and culturally accepted views about the need to change personal behaviors that affect environmental outcomes (Abeles, 2013). It can also structure vulnerability and exposure to potential environmental risks (Chakraborty, Collins, & Grineski, 2016; Cutter, 1995). Beyond sociodemographic attributes, there remains an open debate about the degree to which direct personal experience with actual environmental conditions is essential to the development of heightened risk perceptions. Some have found that environmental experiences are important predictors of environmental concerns and changes in environmentally-relevant behaviors, although access to information and time to recreate at nearby rivers, creeks, and canals may be more available to certain social groups, such as high socio-economic status and white residents (Haeffner, Jackson-Smith, Buchert, & Risley, 2017; Larson, Whiting, & Green, 2011; Martha, Sanchez, & Gomà-i-Freixanet, 2009). At the same time, there is evidence that the public interaction with the environment can lead to inaccurate perceptions of actual threats to public health

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(Frick, Degenhardt, & Buchecker, 2007; Pendleton, Martin, & Webster, 2001; Scherer & Cho, 2003).

Because the worst water quality impairment in the western United States tends to take place around areas of mixed land use (Brown & Froemke, 2012) the densely populated Wasatch Front Region in Utah provides an interesting setting for a study of water quality perceptions and concerns. As of 2014, 7007 miles of Utah's rivers and streams and 152,691 acres of lakes, reservoirs, and ponds have been classified as impaired (Environmental Protection Agency (EPA, 2014)). At the same time, Utah is a magnet for people interested in outdoor recreation, and residents of the Wasatch Front regularly participate in water-based recreational activities like hiking, skiing, snowmobiling, boating, hunting, and fishing (Office of Outdoor Recreation (OOR, 2013)). In this paper, we explore how sociodemographic characteristics and levels of participation in outdoor recreational activities shape perceptions and concerns about water quality in Utah. We use data from two large public surveys to test the hypothesis that increased outdoor recreational experiences are associated with more negative perceptions and heightened concerns about impaired water quality in this region.

2. Drivers of water quality perceptions and concerns

2.1. Water quality perceptions

The degree to which people are aware of water quality is linked to how they interact with and experience water (e.g., drinking water from a tap, engaging in outdoor recreation, etc.). Sensory experience can shape the development of human water quality perceptions (Strang, 2005). The patterns of sensory experience as a driver of water quality perception, however, have been found to differ between perceptions of drinking water versus outdoor water quality. Drinking water perceptions are driven mainly by direct experiences with taste, color, and odor, though sociodemographic characteristics (e.g., gender and race), attitudes and concerns about health, and neighborhood satisfaction are also important predictors (de França Doria, 2010; Dupont & Krupnik, 2010). People tend to evaluate or describe perceived outdoor water quality based on a number of less immediate sensory cues: water clarity, color, objects in the water (e.g., floating debris, water plants, algae, etc.) and odor (Moser, 1984; Smith, Croker, & McFarlane, 1995; West, Nolan, & Scott, 2016). Experiential factors such as past negative experiences with water (i.e., getting sick after coming into contact with dirty water via recreational participation) have also been shown to drive water quality perceptions (Canter, Nelson, & Everett, 1993).

Different types of recreation offer opportunities for interaction with natural water bodies with varying levels of sensory focus and experience. The idea of forms of “recreational specialization” was originally developed by Bryan (1977) to capture “a continuum of behavior from the general to the particular reflected by the equipment and skills used in the sport and activity setting preferences” (p. 175). This theoretical framework has been applied in numerous research settings to explore differences among diverse outdoor recreational activities such as boating, vehicle-based camping, rock climbing, and fishing (Donnelly, Vaske, & Graefe, 1986; McIntyre & Pigram, 1992; Merrill & Graefe, 1998; Mowen, Williams, & Graefe, 1997; Salz & Loomis, 2005). Early research regarding the possible link between recreation and perceptions of water quality noted that recreationalists were more aware of quality problems than non-recreationists, and that participants in different forms of recreation preferred distinct water quality characteristics (Dinius, 1981; Ditton & Goodale, 1973).

2.2. Water quality concerns

While awareness of environmental problems is a necessary precondition, it is important to translate perceptions into concerns to motivate human responses. A large social science literature on environmental concern has explored the role of social psychological factors (values, beliefs), social structural characteristics (gender, age, race/ethnicity, socioeconomic status), and direct experiences with the environment in explaining variation in levels of concern across time, space, and social groups. Stern and Dietz (1994) classic article about environmental values suggests that culturally constructed norms of egoism, altruism, and biocentrism predispose some persons to respond differently to information about environmental impairments.

Social structural variables (e.g., socioeconomic status, gender, race/ethnicity, and religion) are associated with heightened awareness of and concern about environmental problems by different social groups (Hunter & Toney, 2005; Liu et al., 2014; Phillips, Cragun, Kosmin, & Keysar, 2011; Van Lier & Dunlap, 1980; Xiao & McCright, 2012). Females tend to be more environmentally concerned than males (Xiao & McCright, 2007, 2012). Age has also been linked to environmental concern. The emergence of the US environmental movement in the 1960s and 70s led to a pattern in which younger people tended to be more environmentally concerned (Van Lier & Dunlap, 1980). As the baby boom generation aged, however, this association has flipped and more recent studies find consistent positive relationships between age and environmental concern (Liu et al., 2014). Meanwhile, more extensive levels of formal education have been associated with higher level of concern (Dietz, Stern, & Guagnano, 1998; Liu et al., 2014). Religious affiliation and religiosity have also been associated environmental concern, although the strength and directionality of these relationships has varied based on the denomination and the timeframe of study, and are also closely tied with ideology (Hunter & Toney, 2005). Religion is a particularly prominent feature of social structure in our study site (Utah), where 57% of the Utah population identified as belonging to the Church of Jesus Christ of Latter Day Saints (LDS, or Mormon) as of 2008 (Phillips et al., 2011). Several recent studies have shown that LDS residents have distinctive views on environmental issues and are generally less concerned about environmental problems and less supportive of pro-environmental policies and behaviors (Olsen-Hazboun, Krannich, & Robertson, 2017).

A smaller body of research has examined the effects of direct sensory experience on perceptions and concerns about water quality in particular. Flint et al. (2017) discovered a positive association between recreation and concerns about a wide range of water issues (including water quality impairment) among Utah residents. de França Doria (2010) found that sensory experience was significant in shaping both perception and concern, but that these experiences were mediated by past health experiences, different uses of media and other information sources, and levels of trust in water suppliers. Other experiential indicators, such as household proximity to waterways, have been found to influence household water quality perceptions and concerns (Brody, Highfield, & Alston, 2004). These links can be imperfect, however. Doria (2006) found that even when people perceive their drinking water to be high quality, they still express significant concerns about water impairments in their private drinking water sources, leading many to use bottled water or treatment devices.

2.3. The role of recreational activity

Recreation may be associated with environmental concerns because of the impacts of direct sensory experience, or because of the distinctive demographic characteristics of participants in particular forms of recreational activities. Dunlap and Heffernan (1975) were among the first to explore the relationship between participation in different types of recreation and environmental concern by examining the bivariate relationships between various environmental concern items and five separate categories of recreation—camping, hiking, visiting parks, fishing, and hunting. They found that ‘appreciative,’ or low-resource utilization activities (camping, hiking, and visiting parks) were associated with higher levels of environmental concern than ‘consumptive,’ or high-resource utilization activities (fishing and hunting). The appreciative/consumptive dichotomy has since been revisited by researchers with mixed results, suggesting that the original model is incomplete. One restudy concluded that sociodemographic variables (age, educational attainment, and place of residence) were responsible for most of the observed variation in environmental concern (Geisler, Martinson, & Wilkening, 1977). Pinhey and Grimes (1979) used a multivariate model which included age, educational attainment, and residence, and found that recreational activity was one of the weakest predictors of environmental concern.

More recent research on the effects of outdoor recreation on water quality perception have shifted the focus from concern to behavior. Tarrant and Green (1999) found that outdoor recreational activities were positively associated with pro-environmental behaviors such as recycling and donating to environmental groups. They also found support for Dunlap and Heffernan (1975) appreciative/consumptive thesis, as they found hiking to be more strongly associated with pro-environmental behaviors than fishing. Researchers have also noted that participants in motorized outdoor recreation may be less environmentally concerned than non-participants (Waight & Bath, 2014). Moreover, recreation specialization has been linked to preferences for certain environmental management practices (Curtis & Stanley, 2016; Lepp & Herpy, 2015; Zajc & Berzelak, 2016).

Some of the complexity of the associations between recreation and environmental attitudes reflects the characteristics of recreationalists. Increasing age, for example, has been associated with reduced participation in outdoor recreation, but this drop in activity has been found to be less pronounced for walking and hiking as compared to other forms of recreation (Cordell, Lewis, & McDonald, 1995). A higher level of educational attainment, meanwhile, has generally been associated with a greater degree of participation in outdoor recreation, although these associations have also been found to vary among different recreational activities (Reeder & Brown, 2005).

Taken as a whole, previous work would suggest that participation in outdoor water-based recreational activities should be related to the perceptions of water quality and concern about potential water quality problems, but that these patterns may be mediated by frequency of participation in different types of recreation and/or sociodemographic factors. The present analysis is driven by two guiding research questions: (1) Is outdoor water-based recreational experience significantly associated with water quality perceptions and concerns when controlling for sociodemographic characteristics? and (2) If so, to what extent does the intensity and type of participation in recreational activities explain variation in perception and concern about environmental water quality conditions? Based on the prior literature, our hypothesis is that higher levels of recreation overall, and participation in more appreciative (vs. consumptive) forms of recreation in particular, are associated with heightened sensitivity and thus more negative perceptions about environmental water quality conditions, and with higher levels of concern about water quality as an environmental problem.

3. Data and methods

3.1. Survey instruments

In order to evaluate the relationship between recreational experience and water quality perception and concern, this study incorporates data from two surveys: The Utah Water Survey (UWS) and the Utah's Water Future Survey (UWFS), both of which were conducted as part of an NSF-funded interdisciplinary study of urban water systems in Utah.[1] The primary survey instrument used in this study, the UWS, is a short questionnaire that was administered on iPads to the general public at grocery stores in major population centers across the state of Utah from fall of 2014 through the summer of 2016. Grocery stores were selected to represent a range of different store types and community locations within the most urbanized areas in Utah. Teams of university students were recruited and trained to randomly approach adult shoppers as they entered each selected store to ask them to complete a brief survey. The survey included questions about a respondent's perceptions about the quality of four kinds of water (groundwater, drinking water, upstream water, and downstream water), concern about poor water quality problems, levels of participation in outdoor water-based recreation, and measures of the sociodemographic characteristics of respondents (gender, Utah nativity, age, and educational attainment).

To address sampling and response bias, team members also tracked the gender composition of all shoppers entering the store, and found similar gender profiles among the shopping population and the respondent pool (55.2% versus 53.2%, respectively). The dataset reflects field survey work at 31 different stores from across most urban areas in Utah. Of the more than 35,000 shoppers encountered, we approached 18,908 shoppers (approximately 54% of the total shopping adults), 926 were disqualified for being under 18 or because they were not Utah residents, and we received responses from 7364 individuals (producing an overall response rate of 41%).

In order to assess the robustness of the results from the UWS sample, we use data from a much more detailed survey of Utah households conducted around the same time. The UWFS used a drop-off/pick-up method to administer questionnaires in 23 selected neighborhoods in three northern Utah counties: Cache, Salt Lake, and Wasatch. Neighborhoods were purposively chosen to represent the full range of sociodemographic and built environments found in this region (Jackson-Smith et al., 2016a). Because it targeted residents in specific types of urban neighborhoods, the respondents in the UWFS study were not intended to be representative of the overall population of the state. While the sample size was smaller (n = 2343), it boasted a higher response rate (62%) than the UWS, and was much more detailed with over 200 questions in the 16-page instrument. As such, the UWFS allows us to both validate patterns seen in the UWS data, but also to explore the role of additional sociodemographic variables not included the UWS, including income, race, and religion. It also included more extensive measures of water quality perception and additional categories of water-based recreation (Jackson-Smith et al., 2016b).

3.2. Study variables

For both the UWS and the UWFS data, two blocks of questions were used to measure the water quality perceptions and concerns of respondents. In the UWS, perceptions of water quality were measured using items asking survey participants to rate the quality of four types of water in or near their community: groundwater, drinking water, water in nearby mountain rivers and lakes (upstream), and water in streams and rivers located downstream of the respondent's community. Responses were measured using five-point Likert-type scales where answers ranged from ‘very bad’ (1) to ‘very good’ (5) (‘not sure’ was also included as a response option). Respondents were most likely to say they were ‘not sure’ with respect to groundwater quality (where 28% chose this option, compared to 2–16% for the other items). In the analyses below, ‘not sure’ responses were recoded to the neutral scale midpoint of ‘neither good nor bad.’ Since answers on these four items were highly correlated, the four water quality perception items in the UWS data were combined into a single additive index which had a Cronbach's alpha coefficient of .734. Because the commonly-cited threshold of acceptability for Cronbach's alpha values is 0.7 or higher, we elected to include this summative index variable for water quality perception in the analyses reported below (Santos, 1999).

The UWFS data included identical questions about water quality perceptions, except that respondents asked to assess more types of water. Specifically, perceptions of downstream water quality were asked in more detail by disaggregating downstream streams and rivers from downstream reservoirs and lakes, and new items were added to

[1] The iUTAH (innovative Urban Transitions and Aridregion Hydro-sustainability) project. See www.iutahepscor.org.

Table 1
Descriptive statistics for dependent variables.

	Utah Water Survey			Utah's Water Future Survey		
	%	M	SD	%	M	SD
How would you rate the water quality of the following types of water?						
My current drinking water supply						
Very bad (1)	4.1			4.0		
(2)	9.2			8.0		
Neither good nor bad (3)	14.2			14.3		
(4)	24.8			22.0		
Very good (5)	44.5			48.3		
Not sure (6)	3.2			3.4		
Groundwater beneath my neighborhood						
Very bad (1)	3.0			1.9		
(2)	8.6			5.1		
Neither good nor bad (3)	24.1			33.0		
(4)	20.2			12.3		
Very good (5)	16.6			8.8		
Not sure (6)	27.5			39.0		
Water in rivers and lakes downstream[1]						
Very bad (1)	5.2			1.3		
(2)	16.9			6.2		
Neither good nor bad (3)	21.3			47.3		
(4)	23.5			32.2		
Very good (5)	16.8			13.1		
Not sure (6)	16.2					
Water in rivers and lakes upstream						
Very bad (1)	2.6			1.4		
(2)	10.8			6.1		
Neither good nor bad (3)	16.7			23.5		
(4)	28.5			30.2		
Very good (5)	31.2			19.1		
Not sure (6)	10.2			19.8		
Water in nearby irrigation canals and ditches						
Very bad (1)				3.9		
(2)				11.9		
Neither good nor bad (3)				32.3		
(4)				17.1		
Very good (5)				11.2		
Not sure (6)				23.6		
Water in streams and creeks in my neighborhood						
Very bad (1)				2.8		
(2)				8.4		
Neither good nor bad (3)				29.1		
(4)				23.4		
Very good (5)				18.2		
Not sure (6)				17.9		
Combined WQ Perception Index (4 item version)		14.4	3.2		14.3	2.8
Combined WQ Perception Index (6 item version)					21.0	4.1
Over the next 10 years in your valley, how concerned are you about poor water quality?						
Very concerned (1)	24.0			28.0		
(4)	27.0			27.1		
(3)	27.1			23.7		
(2)	15.2			13.4		
Not at all concerned (1)	6.8			7.8		

Notes: [1] = Reflects this wording in Utah Water Survey; combines responses to two separate questions about downstream water for Utah Water Future Survey (see text).

ask about perceptions of streams and creeks in the respondent's neighborhood and nearby irrigation canals and ditches. Two additive indices for water quality perception were calculated for the UWFS respondents: one that replicated the 4-item UWS index (in which the two downstream water items were averaged before adding to the index; Cronbach's alpha = .739), and a more elaborate version that included the full set of items (with a Cronbach's alpha of .833).[2]

To measure concern about poor water quality, we relied on responses to a single question that asked respondents ‘how concerned they were about impaired water quality in their community over the next ten years’. Identical in both the UWS and the UWFS, this item was part of a larger block of ten questions that also captured levels of concern about various water issues (water supply, water costs, flooding, water infrastructure) and other environmental issues (e.g. air quality, traffic, population growth, loss of open space, and climate change). Answers were captured using a five-point Likert-type scale ranging from ‘not at all concerned’ (1) to ‘very concerned’ (5). Descriptive statistics for the measures of water quality perception and concern for each of the two surveys are provided in Table 1.

The independent variables used in the present analyses include measures of several sociodemographic characteristics and frequency of

[2] Strictly speaking, we combined the two UWFS items on downstream water quality into a single 5-point indicator by averaging the answers on the two items and rounding to the nearest integer (see Table 1).

Table 2
Descriptive statistics for independent variables.

Utah Water Survey				Utah's Water Future Survey			
	%	M	SD		%	M	SD
Female	52.7			Female	53.1		
Utah Native	59.1			Utah Native	56.7		
Educational Attainment				Educational Attainment			
Graduate Degree	18.0			*Graduate Degree*	21.2		
4-year College Degree	27.1			*4-year College Degree*	27.2		
Some College/Vo-Tech	39.5			*Some College/Vo-Tech*	35.9		
HS Diploma/GED or Less	15.4			*HS Diploma/GED or Less*	15.8		
Age				Age		48.1	17.2
60+	20.2						
50–59	16.0			LDS	51.5		
40–49	17.7			Nonwhite	15.1		
30–39	21.4			Income			
18–29	24.7			*Over $100,000*	20.1		
				$75,000-$99,999	16.3		
				$50,000-$74,999	24.1		
				$25,000-$49,999	23.1		
				Under 25,000	16.4		
Recreation Index		9.3	3.0	Recreation Index		13.5	3.91
Walking/hiking				Walking/hiking			
Often	40.3			*Often*	34.5		
Sometimes	38.5			*Sometimes*	40.5		
Rarely	11.7			*Rarely*	14.4		
Never	9.5			*Never*	10.5		
Snowsports				Skiing/Snowboarding			
Often	13.5			*Often*	15.7		
Sometimes	20.4			*Sometimes*	18.1		
Rarely	24.9			*Rarely*	17.2		
Never	41.1			*Never*	49.0		
				Snowmobiling			
				Often	2.1		
				Sometimes	6.4		
				Rarely	17.9		
				Never	73.6		
Fishing				Fishing			
Often	14.6			*Often*	12.6		
Sometimes	24.5			*Sometimes*	24.5		
Rarely	25.0			*Rarely*	24.3		
Never	35.9			*Never*	38.5		
Boating				Boating			
Often	9.0			*Often*	8.1		
Sometimes	19.8			*Sometimes*	23.1		
Rarely	29.8			*Rarely*	31.6		
Never	41.5			*Never*	37.2		
				Birdwatching			
				Often	5.5		
				Sometimes	17.6		
				Rarely	21.4		
				Never	55.5		
				Hunting Waterfowl			
				Often	3.0		
				Sometimes	4.7		
				Rarely	8.4		
				Never	83.9		

participation in water-based outdoor recreation (See Table 2). For the UWS data, these included categorical measures for age, gender, Utah nativity, and education. Participation in water-based recreation was measured by asking how often respondents participated in boating, fishing, walking or hiking near water, and snowsports. Answers were captured using a 4-point scale ranging from ‘never’ (1) to ‘often’ (4). To assess water-based outdoor recreation overall, answers to all four recreation items were combined into an additive index (Cronbach's alpha = .708).

The UWFS data contains all of the independent variables found in the UWS data, but provided additional detail and depth (Table 2). Age in the UWFS was measured by asking for the respondent's year of birth and thus can be used as an interval-ratio measure. The UWFS also included categorical questions about ethnic/racial identity, religion, and household income. In the analysis below, we collapsed answers to the race and religion questions into dichotomous variables indicating whether respondents were LDS/non-LDS and white/nonwhite. The UWFS provided more options on the question block measuring participation in water-based recreational activities. Participation in snowsports was represented by two separate items: skiing/snowboarding and snowmobiling, and the survey also included two additional types of recreation: birdwatching near water and hunting waterfowl. A recreation index was constructed which consisted of the sum of all seven of the recreation items included in the UWFS data (Cronbach's alpha = .704).

Table 3
Odds ratios for The Utah Water Survey.

	WQ Perception Index Models				WQ Concern Models					
	WQP-M1	WQP-M2	WQP-M3	WQP-M3R	C-M1	C-M2	C-M3	C-M4	C-M5	C-M5R
Female	**0.662** ***	**0.686** ***	**0.684** ***	**0.839** *	**1.405** ***	**1.435** ***	**1.423** ***	**1.282** ***	**1.269** ***	**1.260** ***
Utah Native	**1.318** ***	**1.282** ***	**1.267** ***	**1.359** ***	**0.752** ***	**0.740** ***	**0.752** ***	**0.801** ***	**0.813** ***	**0.929** **
Age[1]										
60+	**1.345** ***	**1.485** ***	**1.505** ***	**1.797** ***	0.984	1.045	1.038	**1.217** **	**1.217** **	**1.737** ***
50–59	**1.383** ***	**1.437** ***	**1.440** ***	**1.475** **	1.067	1.091	1.090	**1.254** **	**1.254** **	**1.987** ***
40–49	**1.196** **	**1.213** **	**1.208** **	1.082	**1.184** *	**1.194** **	**1.207** **	**1.304** ***	**1.318** ***	**2.033** ***
30–39	1.043	1.059	1.058	1.161	1.050	1.058	1.060	1.073	1.076	1.153
Educational Attainment[2]										
Graduate Degree	**1.588** ***	**1.546** ***	**1.546** ***	**2.347** ***	**0.730** ***	**0.719** ***	**0.699** ***	**0.844** *	**0.813** **	**0.675** **
4-Year College Degree	**1.714** ***	**1.663** ***	**1.651** ***	**1.896** ***	**0.682** ***	**0.670** ***	**0.661** ***	**0.803** **	**0.785** ***	**0.638** ***
Some College/Vo-Tech	**1.232** ***	**1.215** **	**1.205** **	**1.228** †	**0.820** **	**0.813** *	**0.812** **	**0.869** *	**0.861** *	0.838
Recreation Index		**1.044** ***				**1.027** ***		**1.045** ***		
Walking/Hiking[3]										
Often			**1.207** *	**1.485** *			**1.264** **		**1.391** ***	**1.547** *
Sometimes			**1.271** **	1.211			0.979		1.080	1.320
Rarely			1.106	1.104			0.976		1.013	1.128
Snowsports										
Often			0.942	1.199			1.106		1.096	1.080
Sometimes			1.061	1.065			1.107		**1.155** *	0.861
Rarely			0.997	1.196			1.005		1.014	0.951
Fishing										
Often			0.944	1.168			**1.202** **		**1.167** †	1.238
Sometimes			0.975	1.099			1.082		1.061	**1.227** †
Rarely			0.986	0.969			1.030		1.030	0.975
Boating										
Often			**1.492** ***	0.985			**0.829** *		0.957	1.006
Sometimes			**1.405** ***	**1.348** *			**0.811** **		0.897	0.821
Rarely			**1.208** **	**1.220** †			0.912		0.960	**0.807** *
WQ Perception Index								**0.803** ***	**0.804** ***	**0.832** ***
Model Fit:										
(n)	6870	6870	6870	2025	6813	6813	6813	6813	6813	2013
Model χ^2 (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
−2LL	28,207	28,173	28,141	8839	19,791	19,780	19,738	18,895	18,865	5798
AIC	28,256	28,225	28,215	8913	19,817	19,808	19,788	18,925	18,917	5850
BIC	28,427	28,403	28,468	9121	19,906	19,903	19,959	19,028	19,094	5996

Notes: [1] = Reference category for age is '18–29'; [2] = Reference category for educational attainment is 'HS diploma/GED or less'; [3] = Reference category for all recreation items is 'never'.
† = $p < 0.10$.
* = $p < 0.05$.
** = $p < 0.01$.
*** = $p < 0.001$.

3.3. Analytical strategy

Version 24 of IBM's Statistical Package for the Social Sciences (SPSS) was used to facilitate the present analyses. First, we calculated descriptive statistics for the variables to gain a better understanding of the levels of perception and concern about water quality among Utah's adult population. Next, correlation coefficients were computed to explore the bivariate relationships between our dependent and independent variables. Because the relevant variables in our data are a combination of dichotomous nominal variables, nonparametric ranked variables, and scale variables, Spearman's rank correlation coefficients were used for all bivariate analyses.

We used a generalized linear modeling (GLM) approach to assess the proportional odds that participation in water-based outdoor recreation is associated with perception of water quality and levels of concern about impaired water quality. This approach allows one to control for the effects of sociodemographic characteristics prior to introducing the measures of recreational activity. For the UWS data, three ordered logit models were created for each of the two dependent variables. In both cases, the first model represented a control model to illustrate the degree to which variation in the dependent variables could be explained by respondent sociodemographic characteristics. The second and third models tested whether adding indicators for participation in water-based outdoor recreation were related and significantly improved the ability to explain variation in water quality perception and concern. Model 2 (M2) used the aggregated recreation index, while Model 3 (M3) dropped the recreation index and incorporated the four measures of participation in separate types of water-based outdoor recreation. For the models predicting water quality concern, two additional models (M4 and M5) were estimated that included water quality perceptions as an additional independent variable.

An identical modeling approach was used for the UWFS data. Initially, we estimated ordered logit models using replicated measures to test the robustness of the findings based on the UWS dataset (see M3-R and M5-R in Table 3). Next, we took advantage of the availability of more refined measures of sociodemographic characteristics and recreation to estimate more complex models to see if including additional measures improved our ability to predict respondents' perception and concern about water quality. Model fit was assessed using the Wald statistic for overall model fit, and Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) for comparative model fit (Burnham & Anderson, 2004).

4. Results

4.1. Descriptive statistics

Overall, Utah's adults report a generally positive perception of water quality in the state (Table 1). Nearly 70% of UWS respondents indicated a rating of four or higher for drinking water, and water bodies located upstream from a respondent's community were rated as having better quality than downstream rivers and lakes. A majority (about 52%) of respondents rated groundwater quality in their community as 'neither good nor bad' or 'not sure'. Respondents also reported a moderately high level of concern about poor water quality in Utah, with 51% indicating a score of four or above on the five-point scale. It is worth noting that concerns about poor water quality were generally lower than concerns expressed about other issues included on the survey like air pollution, traffic, water shortages, and water prices. Only flooding ranked lower overall on the list of concerns, with around 10% of the sample indicating that they were 'very concerned' about flooding. Meanwhile, as expected, respondents with more negative perceptions of water quality tend to express higher levels of concern about water quality issues (Spearman's rank correlation coefficient $r_s = -.343$, $p < 0.001$).

Frequencies and (when appropriate) measures of central tendency and dispersion for each of the independent variables used in the analyses are shown in Table 2. Just over half (53%) of UWS respondents indicated that they were female, and the age distribution of survey respondents is largely proportionate with 2010 U.S. Census results. Meanwhile, approximately 45% of respondents had at least a 4-year degree, slightly higher than seen in the census. Over half (59.1%) were originally from Utah. The UWFS respondents had very similar characteristics on these four measures, and additional questions unique to this instrument suggest that a majority are members of the LDS faith (about 52%), most identify as white (85%), and the distribution of households across the five reported income categories roughly approximated 2010 US Census proportions.

Overall, respondents reported a moderate level of engagement in water-based recreation. The mean score of the recreation index (on a 16-point scale) was 9.26. Of all of the types of recreation activity, respondents most frequently participated in walking or hiking near water, with over 40% of UWS respondents indicating they walk or hike near water 'often'. Conversely, boating was the least common activity with only 9% of respondents indicating that they participate in boating activity 'often'. Roughly 14% of respondents indicated they often engage in snowsports or fishing. Similar patterns were seen among respondents to the UWFS household survey.

Correlation coefficients suggest that female respondents tended to view water quality less positively ($r_s = -.118$) and tended to be more slightly more concerned about water quality ($r_s = .092$), Utah natives tended to be slightly less concerned ($r_s = -0.67$) and perceived water quality slightly more positively ($r_s = .055$). Age and education were both associated with slightly more positive perceptions of water quality ($r_s = .078$, and $r_s = .107$, respectively) while education was also weakly negatively correlated with concern about poor water quality ($r_s = -.051$).

4.2. Regression results

Initially, we estimated an ordered logit model using the UWS dataset to explore how much variation in the overall water quality perception index can be explained with sociodemographic variables alone (model WQP-M1 in Table 3). The estimated odds ratios suggest that being female reduced the likelihood of rating water quality positively by about 34%, while respondents originally from Utah were about 31% more likely to evaluate water quality positively, net the effect of other variables in the model. Older respondents and those with more formal education were generally more likely to rate water quality positively. Overall, the model represents a significantly better fit than a null model (based on the Wald statistic).

We then added alternative measures of participation in water-based outdoor recreation to the base model. The addition of the recreation index improves the measures of fit and shows an increase in the odds for both a more positive water quality perception (1.044, $p < 0.001$) and a higher level of concern about poor water quality (1.027, $p < 0.001$). This indicates that for every increase of one point on the 16-point recreation index scale, the odds ratios for water quality perception and concern about poor water quality increase by roughly 4.4% and 2.7%, respectively. The model with an aggregated recreation index (WQP-M2) suggests that each additional point on the index is associated with a 4.4% increased chance of rating water quality more positively. Based on BIC statistics (which penalizes more for number of variables in the model), the model with the recreation index appears to

Table 4
Odds ratios for Utah's Water Future Survey.

	WQ Perception		WQ Concern	
	WQP-Ma	WQP-Mb	C-Ma	C-Mb
Female	0.874	0.883	**1.326** ***	**1.326** ***
Utah Native	1.104	1.123	1.154	1.150
Age	**1.010** ***	**1.011** ***	**1.092** ***	**1.087** ***
Age × Age			**0.999** ***	**0.999** ***
Educational Attainment[1]				
Graduate Degree	**2.218** ***	**2.129** ***	0.905	0.842
4-Year College Degree	**1.689** ***	**1.643** ***	0.831	0.815
Some College/Vo-Tech	1.100	1.081	0.981	0.974
LDS	**1.689** ***	**1.715** ***	**0.648** ***	**0.681** ***
Nonwhite	**0.696** **	**0.709** **	**2.123** ***	**2.206** ***
Income[2]				
Over $100,000	1.171	1.116	**0.616** **	**0.627** **
$75,000-$99,999	**1.360** *	**1.290** †	**0.721** *	**0.734** †
$50,000-$74,999	**1.321** *	**1.279** †	0.830	0.827
$25,000-$49,999	**1.279** †	**1.274** †	1.026	1.045
Recreation Index	**1.049** ***		**1.042** ***	
Walking/Hiking[3]				
Often		1.327		**1.504** *
Sometimes		1.172		**1.481** *
Rarely		1.014		1.177
Skiing/Snowboarding				
Often		**1.290** †		1.177
Sometimes		1.090		0.988
Rarely		**1.230** †		0.993
Snowmobiling				
Often		0.814		0.849
Sometimes		0.970		**0.657** *
Rarely		1.056		0.863
Boating				
Often		0.864		1.145
Sometimes		1.213		0.912
Rarely		1.098		**0.815** †
Fishing				
Often		1.197		0.993
Sometimes		1.054		1.104
Rarely		0.941		0.955
Birdwatching				
Often		1.300		**1.674** *
Sometimes		0.906		1.068
Rarely		1.144		**1.237** †
Hunting Waterfowl				
Often		1.029		1.199
Sometimes		1.097		**1.783** *
Rarely		1.136		**1.368** †
Perception Index			**0.888** ***	**0.886** ***
Model Fit:				
(n)	1883	1883	1874	1874
Model χ^2 (p-value)	0.000	0.000	0.000	0.000
−2LL	10,151	10,132	5409	5377
AIC	10,225	10,246	5447	5455
BIC	10,430	10,562	5552	5671

Notes: [1] = Reference category for educational attainment is 'HS diploma/GED or less'; [2] = Reference category for income is 'under $25,000'; [3] = Reference category for all recreation items is 'never'.
† = $p < 0.10$.
* = $p < 0.05$.
** = $p < 0.01$.
*** = $p < 0.001$.

be a slightly better overall fit than the version in which different types of recreation are broken out (WQP-M3). However, the more detailed model which includes the different types of recreation separately is preferred by the AIC statistic and suggests that the positive effects of recreation on water quality perceptions are driven mainly by participation in walking/hiking near water or boating.

A similar set of ordered logistic regression models were estimated to predict levels of concern about water quality (Table 3) using sociodemographic variables alone (model C-M1) and different measures of recreational activity (C-M2 and C-M3). Results suggest that women are nearly 41% more likely to be concerned about water quality, while those who grew up in Utah were about 25% less likely to be concerned. Generally speaking, the most highly educated respondents were 27–33% less likely to be in a higher concern category, when compared to those with a high school diploma or less. Interestingly, the estimated odds-ratios for age categories were only significant for those in the middle category (40–49 years old); this group was significantly more likely to be concerned about water quality than the youngest group (18–29 years old).

Greater participation in water-based recreation overall significantly increases the likelihood of greater concern about water quality (model C-M2), though this impact appears to be driven mainly by those who most frequently go hiking or fishing (model C-M3). In addition, when the different types of recreation are broken out (C-M3), those who go boating ‘sometimes’ or ‘often’ are almost 20% less likely to be concerned about water quality. Meanwhile, moderate or low levels of participation in snowsports were associated with smaller and generally insignificant estimated odds-ratios.

To test whether concern about water quality is also shaped by perceptions about water quality conditions, we estimated two more models using the UWS data that included a respondent's score on the water quality perception index as an additional independent variable (see models C-M4 and C-M5). We found that each increase of 1 point on the value of the water quality perception index reduced the chances of having a higher level of concern about water quality by roughly 20%, net the effects of other variables in the model. Moreover, these models appear to be a much better fit overall than the previous concern models, and the direction and significance of the sociodemographic variable coefficients were generally maintained or increased. For example, controlling for perceptions of water quality, the effects of age became more pronounced, with adults in the top three age categories all being more concerned than the youngest respondents. Including a measure of water quality perceptions also increased the estimated magnitude of the impacts on water quality concern of the recreation index (overall) and the role of frequent hiking and moderate snowsports (in particular). However, the apparent negative impact of boating on water quality concern was no longer significant once the perception variable was included.

The nested model results suggest that the impact of water-based outdoor recreation and sociodemographic characteristics on water quality perception and concern act largely independently of each other. After recreation is included in the model, the effect of belonging to the ‘60 and over’ age category on water quality perceptions becomes more pronounced, but the majority of the odds ratios for the sociodemographic factors remain largely unchanged. The situation is similar in regards to concern about poor water quality, as the addition of the recreation index to the model leaves the sociodemographic odds ratios largely unchanged.

4.3. Robustness of the UWS models

We tested the robustness of these results using data obtained from an entirely different sample of Utah adults—the Utah Water Future Survey. The replicated ordered logit models predicting both water quality perceptions and concerns are shown in Table 3 (WQP-M3R and C-M5R). The predicted odds ratios for nearly all variables are substantively similar to those estimated using the UWS data. However, a few differences are worth noting. The UWFS models estimated stronger effects of both age and education on both dependent variables, but more modest impacts of Utah origins. While the impacts of walking/hiking near water are more pronounced in the UWFS sample, the distinctive effects of boating on water quality perceptions are minimized in the replication model.

To explore how inclusion of additional variables affects our results, we used the UWFS dataset to estimate more elaborate models that included additional sociodemographic measures for income, race, and religion and measures of three more types of recreation. Moreover, because age is available as a scale variable in the UWFS data and had demonstrated a non-linear relationship in the analysis above, a quadratic form (age + age^2) was added as a covariate in the water quality concern models. The final models predicting both water quality perception and concern are shown in Table 4. For each dependent variable, we show results for two models with alternative specifications of the recreation variables.

The additional sociodemographic variables of race and religion both show up as highly significant in the UWFS models. LDS respondents were roughly 70% more likely to rate water quality in their area positively, and 40% less likely to indicate a higher level of concern about poor water quality. Nonwhite respondents, meanwhile, were about 30% less likely to rate water quality positively than whites, and were more than twice as likely to report a higher level of concern. Increasing age is positively associated with perceptions of water quality perception, but has a non-linear relationship to concern about poor water quality with the effects of increasing age diminishing somewhat among older respondents. The effects of income were more complex. Middle income groups rated water quality most positively (compared to households with incomes below $25,000), while the wealthiest households (over $100,000) were consistently less concerned than the middle or lower income respondents.

Once race, religion and income are added to the model, the effects of gender, education, and Utah origins on the dependent variables appear to be more complex than seen in the UWS dataset. In the full UWFS models on Table 4, gender remains a significant predictor of water quality concern (women are 33% more concerned than men), but is no longer a significant predictor of water quality perceptions. By contrast, education is much more systematically related to water quality perceptions (better educated respondents were more likely to view water quality as good), but no longer related to water quality concerns. The estimated odds-ratios associated with a respondent being originally from Utah are no longer statistically significant in these new models, suggesting that these effects may be captured by the new sociodemographic variables (particularly religion, since most long-term residents are LDS).

The effects of recreation on both dependent variables remain largely intact in the UWFS models, particularly with respect to the aggregated index of overall recreational activity which is positively related to both water quality perceptions and concerns. The addition of more types of recreation, however, does not appear to improve overall model fit and produces few statistically significant coefficients in either of the UWFS models (Table 4). In addition, only skiing/snowboarding was marginally associated (at the ‘often’ and ‘rarely’ levels) with water quality perceptions once other variables were incorporated into the model (Model WQP-Mb). In the model predicting concern about water quality, it appears that those who more frequently hike/walk, go birdwatching, or hunt waterfowl have higher levels of concern (net the effects of sociodemographic variables). Meanwhile, those who participate at moderate levels in boating or snowmobiling activities seem to have lower levels of concern, though there is not statistically significant evidence of a linear relationship.

5. Discussion and conclusions

Our study set out to explore whether participation in outdoor recreation shapes perceptions and concern about environmental quality (net the effects of sociodemographic attributes), and whether those patterns differ depending on the type of outdoor recreation. Results from two independent surveys of Utah residents suggest that both sociodemographic and experiential/behavioral factors are associated with variation in perceptions of and concern about water quality. In this sense, the findings support broader social theory that expects both social structure and individual agency to play a role in shaping patterns of attitudes and behavior (King, 2010).

As noted above, a number of previous studies have argued that direct sensory experience should be an important mechanism in shaping perceptions of environmental quality (Canter et al., 1993; Strang, 2005). Specifically, different forms of recreation (motorized vs. nonmotorized, consumptive vs. appreciative) were expected to generate distinctive patterns of water quality perceptions, and by implication, of concern about water quality problems (Waight & Bath, 2014). We anticipated, for example, that participants in appreciative forms of recreation would perceive water quality more negatively than those who engage in consumptive forms of recreation. Among our respondents, however, water quality perceptions appear to be shaped more by social characteristics (age, education, gender, race, religion, and income) and by the generic measures of overall recreation behavior than by the more specific measures of participation in particular forms of outdoor recreational activity. Additionally, in contrast to some previous work (de França Doria, 2010; Dupont & Krupnik, 2010), perceptions of water quality by individual respondents did not vary much depending on whether we were asking about indoor/drinking or outdoor/recreational forms of water (e.g., the four questions about perceived quality of drinking water, groundwater, upstream lakes and streams, and downstream rivers and reservoirs are very highly correlated). The lack of strong evidence that the 'type' of recreation matters in shaping water quality perceptions, and the similar patterns of associations between recreational activity and perceptions of diverse types of water quality, combine to suggest that primary sensory experience is probably not the major driver of water quality perceptions among adults living in this region.

Our interest in perceptions of water quality was linked to a broader desire to explain variation in levels of concern about impaired water quality, and thus levels of support for public policies to address water quality problems in this region. Not surprisingly, our results suggest that perceptions of water quality are negatively associated with levels of concern (e.g., those who perceive water to be cleaner tend to worry less about water quality problems). Moreover, inclusion of an indicator of water quality perceptions is a significant predictor of individual-level water quality concern. That said, it is intriguing that the effect of recreation on both indicators is positive; in other words, those who engage in more recreation activity are more likely to have positive perceptions of water quality *and* to have higher levels of concern about water quality.

Insofar as sensory experiences matter, higher levels of outdoor recreational activity (overall) in Utah are linked to beliefs that water is less impaired, which suggests that recreationalists might not be encountering more unpleasant water conditions as they recreate. At the same time, similar to earlier studies (Dinius, 1981; Ditton & Goodale, 1973), higher levels of recreational activity are associated with greater concern about water quality issues, even after controlling for water quality perceptions. Again, there is only weak support for the appreciative-consumptive hypothesis originally articulated by Dunlap and Heffernan (1975). Where we did see significant and consistent associations between frequency of participation in different types of recreation and concern about water quality—for hiking, birdwatching, and fishing—these all tended to be in the same direction as the overall recreation index. There is weak evidence that boating and snowmobiling (motorized forms of recreation) reduce levels of environmental concern, but this is largely explained by a more positive perception of water quality.

Although we did not have data to directly address the question, our findings are consistent with a growing body of literature which indicates that recreational participation is limited for certain people based on social structural factors (Shores, Scott, & Floyd, 2007). We know, for example, that certain sociographic groups in our sample (females, nonwhites, and those with a lower income and level of educational attainment) report participating in outdoor recreation less frequently. Past research has demonstrated that some sociodemographic groups—females, people of color, and low-income households—participate in outdoor recreation less frequently not because of lack of desire but because of personal safety, inadequate information and facilities, and insufficient funds (Espiner, Gidlow, & Cushman, 2011; Hughey, Reed, & Kaczynski, 2015; Johnson, Bowker, & Cordell, 2001; Shores et al., 2007; Xie, Costa, & Morais, 2008). Taken together, this suggests that the values and material interests of Utah's adults (as reflected in our sociodemographic variables) may be more important than direct experience in shaping attitudes towards water quality problems. Moreover, it is possible that the link between recreational activity and water quality concerns could be somewhat spurious, reflecting traits of respondents that are positively associated with both participation in outdoor recreation and concern about water quality.

Although the overall index of recreational activity provided the most elegant explanation of patterns of water quality perception and concern, the results do suggest that some forms of recreation—hiking, birdwatching, and angling are more consistently predictive of greater concern. Educators, public managers, and professionals within the emerging field of environmental social work may find these results useful in the development of more targeted and nuanced social development and intervention programs, education programs, and public policy initiatives (Kondrat, 2002; Park, Lee, & Peters, 2017).

Recently, there has been a substantial push in the behavioral, social, and economic sciences towards study replication in order to ensure that results are robust, reliable, and generalizable (Bollen, Cacioppo, Kaplan, Krosnick, & Olds, 2015; Ioannidis, 2012). Our findings validate the importance of replication. Overall, most of the conclusions derived from our larger (but less detailed) Utah Water Survey of randomly selected Utah adults are supported by analysis of a more comprehensive (but smaller sample size) household survey sample from targeted neighborhoods. At the same time, the inclusion of additional sociodemographic variables (religion, income, and race) in the UWFS did affect the significance of the gender and place of origin variables in the full models. This suggests that more sensitive social questions which are often omitted from short surveys to avoid provoking non-response can affect conclusions about the remaining sociodemographic drivers of attitudes about environmental issues.

There are several limitations to this study which must be acknowledged. Because we used proximal, rather than direct, measurements of recreational specialization in our analysis, future research should look carefully at the role of recreation specialization as it pertains to the development of water quality perceptions and concerns. Moreover, our surveys did not include questions about swimming, an activity that requires immersion in the water from participants, which could be a useful addition to the recreation items featured in this study as a measure of tactile experience with water. It could also be helpful in the future to include questions capable of distinguishing different forms of boating, as theory might suggest different attitudes to be present among participants in motorized (motorboating) vs. non-motorized (canoeing/kayaking) forms of recreation (Beardmore, 2015). Furthermore, it would be useful to test whether our findings are robust across different geographic regions where objective water quality, forms of recreation, and population sociodemographic attributes can be quite different.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jort.2017.12.003.

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