DOES LOCATION MATTER?
Measuring Environmental Perceptions of Creeks in Two San Antonio Watersheds

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ABSTRACT: In the past, researchers in the field of environmental psychology have explained environmental perceptions primarily through socioeconomic and demographic factors. However, knowledge of and support for protecting specific natural features of the landscape should also be influenced by one's location, setting, and proximity to such features. This article focuses on residents' familiarity with and concern for two creeks passing through San Antonio, TX. Using Geographic Information Systems analytical techniques, we expand on previous studies by introducing driving distance from the creeks to identify the effects of this location-based variable on environmental perceptions. Specifically, we test the degree to which the actual driving distance respondents live from two creeks affects respondents' knowledge and perceptions of the water bodies. We show that when controlling for socioeconomic and geographic contextual variables, the residential distance variable remains a significant factor in explaining both familiarity with the creeks and views on the level of

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water pollution in them. Based on the results, we discuss the implications of incorporating proximity factors in watershed planning and policy.

Keywords: *environmental perceptions; watersheds; proximity; Geographic Information Systems; Texas*

The field of environmental psychology has a long tradition of explaining the factors influencing environmental attitudes and perceptions. These descriptive and explanatory studies usually pinpoint sociodemographic factors, such as party identification, age, income, and education as the drivers of familiarity (considered synonymous with awareness in this article) with and concern for the natural environment. However, knowledge of and support for protecting even general features of the environment can also be influenced by location, place, and space. Proximity and exposure to natural features, such as wildlife habitat or water bodies, may be important factors in forming an individual's understanding and views toward maintaining the quality of the surrounding natural environment.

This article expands on previous conceptual models stemming from the environmental psychology and behavior literatures that rely primarily on socioeconomic and demographic factors to predict how the public perceives the natural environment by adding a spatial dimension. The study focuses on residents' familiarity with and concern for two creeks passing through San Antonio, Texas. Salado and Leon Creeks stretch from Northern Bexar County southeast to the confluences of the San Antonio River and Medina River, respectively (Figure 1). Salado Creek runs for a total of 44 miles through the eastern portion of the city, whereas Leon Creek flows for approximately 57 miles through the western portions. Both watercourses traverse a variety of land uses, ranging from rural and agricultural to urban and commercial. Currently, the U.S. Environmental Protection Agency (EPA) recognizes both creeks as "impaired waters" because of their high levels of pollution.

Based on the results of a survey of residents in the two San Antonio watersheds, we empirically test the degree to which the distance that respondents

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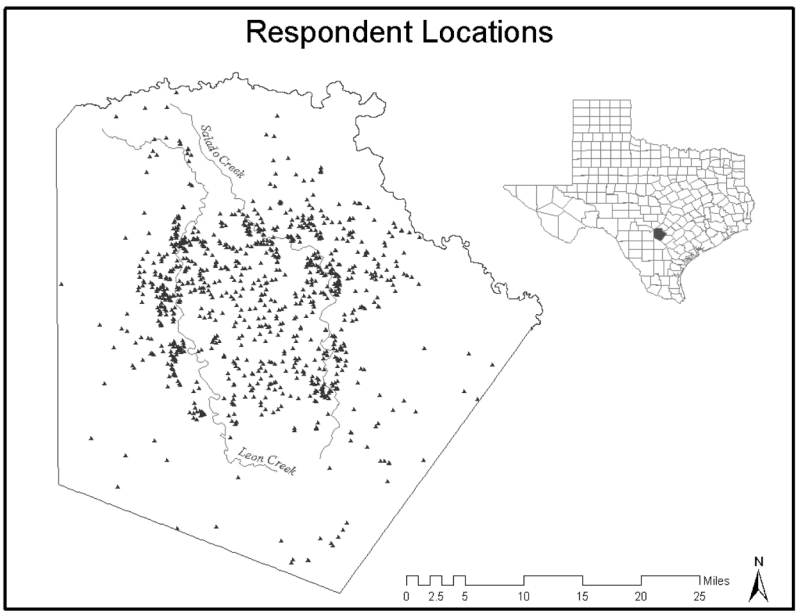

Figure 1: Respondent Location

live from the creeks affects their knowledge and perceptions of the natural resources. We draw from a variety of previous distance-based studies demonstrating a relationship between general proximity and environmental awareness. Using Geographic Information Systems (GIS) analytical techniques, we introduce geographic variables, such as driving distance, land use, and land cover, to precisely identify the effects of these location-based factors on environmental perceptions. Results indicate that when controls are introduced for socioeconomic and geographic contextual variables, driving distance of residence remains a significant factor in explaining whether respondents are familiar with Leon and Salado Creeks, as well as their views on the safety of these watercourses for drinking, swimming, and other activities.

This study makes several important contributions to the literature on environmental psychology and understanding environmental perceptions. First, including proximity-based variables along with socioeconomic and demographic variables highlights the importance of location in explaining environmental perceptions and improves upon past environmental psychology models. Second, using GIS analytical techniques provides a higher level of precision when measuring distance and setting that has rarely, if ever, been

used in the literature on environmental perceptions. We employ network analysis programming to determine the driving distance from a respondents' home to a creek, taking into consideration the road network for San Antonio. Third, conducting multivariate analysis along with precise proximity measurements enables us to empirically test a longstanding conception that residents living closer to a natural resource will be more familiar and possibly more concerned with its environmental quality. Using quantitative analysis enables us to go beyond simply saying that location matters by demonstrating that on average, for every unit increase in kilometers from one of the creeks, the likelihood that a person will view them as being more polluted decreases by a specific amount, while controlling for income, education, party identification, and other factors. Finally, this study increases understanding of how residents in and around San Antonio perceive key water bodies. Although the results of the study are generalizable to other regions, they provide important information on which factors cause an average resident to be familiar with or concerned about the water quality of Leon and Salado Creeks. This information has important ramifications for state or city environmental planners and policy makers focused on water management issues in the San Antonio region.

The following section reviews the past literature explaining environmental attitudes and perceptions primarily through socioeconomic variables. We then relate this research to place-based issues and the need to consider geographic factors when understanding individual views on the environment. In this section, we build on previous research using proximity to explain environmental views and preferences. Next, we describe sample selection, variable measurement using GIS, and data analysis procedures. Our findings are reported in two sections. First, we examine factors influencing familiarity with the two creeks by using logit models. Second, we test the degree to which distance from these creeks affects views on water quality through multiple regression analysis. Based on the results, we discuss the policy implications of the importance of distance and other location-based factors in understanding environmental perceptions, particularly within the context of watershed planning.

EXPLAINING ENVIRONMENTAL PERCEPTIONS THROUGH SOCIOECONOMIC VARIABLES

Traditionally, researchers in the field of environmental psychology have relied on socioeconomic and demographic variables, such as age, education,

income, political orientation, and occupation, to explain broad scale environmental perceptions such as attitudes, views, awareness, and concerns (Buttell, 1987). Generally, these studies conclude that young women with high levels of income and education and with liberal political views are the most likely to consider environmental protection a priority.

For example, in their summary of more than a decade of previous research, Van Liere and Dunlap (1980) found that

> age, education and political ideology are consistently (albeit moderately) associated with environmental concern, and thus we have confidence in concluding that younger, well-educated, and politically liberal persons tend to be more concerned about environmental quality than their older, less educated and politically conservative counterparts. (p. 192)

Jones and Dunlap (1992) and Scott and Willets (1994) found the same results: Young, highly educated, liberal-minded individuals demonstrate greater recognition of and concern for environmental problems. Other, more recent studies focusing on the role of socioeconomic factors find evidence that younger age (Fransson & Garling, 1999; Honnold, 1981; Nord, Luloff, & Bridger, 1998) and higher levels of education (Guagano & Markee, 1995; Howell & Laska, 1992; Raudsepp, 2001) are significant drivers of environmental attitudes and concern.

Although not as pronounced in the literature as other socioeconomic factors, income is another variable shown to explain environmental perceptions and attitudes (Fransson & Garling, 1999; Van Liere & Dunlap, 1980). For example, Scott and Willets (1994) found that respondents with higher income levels were more likely to demonstrate proenvironmental concerns. Gender is also a variable that receives consistent attention by environmental psychology researchers. Raudsepp (2001) found that women were "significantly more likely than men to be concerned with environmental problems" (p. 363). Most research finds slight evidence that women are more environmentally concerned (Jones & Dunlap, 1992) or possess stronger environmental attitudes than men (Foster & McBeth, 1994). However, as acknowledged by Van Liere and Dunlap (1980), gender does not appear to be as significant a predictor of environmental concerns or attitudes as other sociodemographic variables.

More than 2 decades of research using socioeconomic and demographic variables to explain environmental perceptions have advanced our understanding of how people view, think about, and are aware of the natural environment (Samdahl & Robertson, 1989). However, the authors of these studies are quick to point out that sociodemographic variables alone are

insufficient in their explanatory capabilities (Samdahl & Robertson, 1989). As stated by Van Liere and Dunlap (1980) in reference to years of research on the topic, "The foregoing review indicates that researchers have had limited success in explaining the social bases of environmental concern" (p. 193). In a review of the sociodemographic correlates of environmentalism, Cantrill and Senecah (2001) concluded, "Contradictory findings such as these indicate that perceptual processes beyond the mitigating influences of sociodemographic factors may drive perceptions of the environment" (p. 188). Statistical evidence of the difficulty in thoroughly explaining environmental perceptions can be found in the relative size of R^2 values and the overall amount of unexplained variances in models. Lowe and Pinhey's (1982) research covering 16 separate years of support for spending to protect the environment (categorized here as environmental attitudes), reports R^2 values ranging from 0.067 to 0.130 (all significant to $p < 0.001$). Although it is certain that sociodemographic variables play an important role in shaping attitudes toward the environment, it is also clear that other factors must be considered to more fully understand what shapes environmental perceptions, attitudes, and concerns.

CONSIDERING PROXIMITY, LOCATION, AND PLACE

A second stream of literature measures location, proximity, and setting to examine environmental perceptions. Work that emerged in the 1920s under the heading of human ecology was extremely varied in approach and emphasis but consistently argued that human behavior was significantly influenced by spatial and geographic factors (Hawley, 1944; McKenzie, 1925). Research that emerged from this approach mapped phenomena such as crime (Duffala, 1976; Farley & Hansel, 1981; Longmoor & Young, 1936), mental disorders (Queen, 1940), and family disruption (Lind, 1930), correlating these with the proximity to amenities such as recreational facilities and good housing and to declining city centers. Increasing sensitivity to environmental issues and the emergence of environmental sociology in the 1970s continued a line of research that focused on the correlates of environmental attitudes and values (Buttell, 1987). Proximity has played a small role in this research. However, the idea that living in a place or near particular environmental features influences knowledge and perception is central to the current emphasis on local knowledge as a legitimate source of useable information in the development of policy and solutions to environmental problems.

Recently, researchers have begun to consider geographic factors to explain the underpinnings of environmental perceptions in addition to the traditional sociodemographic variables. The environmental psychology literature lays a strong foundation for understanding place-based perceptions by examining the difference in views among urban and rural residents, for example. Tremblay and Dunlap (1978) found that rural residents were less concerned with environmental problems than those living in urban settings and that rural farmers were particularly uninterested in protecting the environment. Lowe and Pinhey (1982) confirmed these rural-antienvironmental conclusions in a national study focusing on a respondent's place of socialization. These findings are consistent with other research indicating that those whose livelihood is based on extractive activities are less likely to be concerned with environmental conservation (Freudenburg, 1991). More recent empirical research disputes the rural-antienvironment hypothesis and instead suggests increasing environmental concern in nonmetropolitan areas (Alm & Witt, 1994; Fortmann & Kusel, 1990). For example, Foster and McBeth (1994) demonstrate that rural residents are more likely to be concerned with local environmental issues when they are defined in terms of quality of life features. In addition to general place of residence, the length of stay, or "tenure," has also been linked to building value-based awareness and connections with the physical environment (Cantrill, 1998).

Hannon (1994) and Norton and Hannon (1997) are among the first to directly link environmental attitudes to location and distance. These authors propose that the intensity of environmental valuation is discounted across time and space. In other words, proximity factors play a critical role in determining how individuals view physical place. Similarly, in a government survey of resident's environmental views of the South Shore of Long Island, it was found that general proximity to the waterfront is associated with greater interest in and support for protecting the estuary. Respondents living closer to the water assigned greater importance to the quality of the South Shore natural environment (Cornell Local Government Program, 1998). Gobster (1998) found that neighborhood residents living near the Chicago River were generally more aware of the water body and chiefly concerned with its water quality.

Brown, Harris, and Reed (2002) used straight-line distance to test a place-based theory of environmental evaluation. These authors admitted their measures of distance could be confounded by physical barriers between points of study, but their results showed "moderate support for the theory that community place attachment is related to distance and intensity of environmental valuation" (p. 70). Examinations of the importance of proximity also include research into attitudes toward and decisions about environmental risk. For

example, Gawande and Jenkins-Smith (2001) found that distance from transportation routes for nuclear waste drove perception of risk and influenced property values. Elliot, Cole, Kreuger, Voorberg, and Wakefield (1999) found that proximity to adverse air quality locations affected community cohesiveness over air pollution issues, and Bush, Moffatt, and Dunn (2001) found that in their study sample, residents of communities closest to industrial facilities expressed the strongest need for adequate information on air quality. In addition, literature on recreational site choice includes various studies focusing on the relationship between general proximity and awareness of metropolitan trails (Gobster, 1995), park use (Gobster, 2002), urban wildlife (Gilbert, 1982), and riparian landscapes (Zube, Simcox, & Friedman, 1998).

MODELING ENVIRONMENTAL PERCEPTIONS THROUGH DISTANCE

In most cases, measures of nearness or proximity in the literature have lacked precision. To test the importance of proximity, consistent and reliable measures of the variable are required. We draw on geographic methods of analyzing distance variables to expand on past studies of association between distance from environmental elements and environmental perceptions (i.e., attitudes and concerns). Specifically, we build on previous findings to test the hypothesis that the driving distance from a respondent's residence to either Salado or Leon Creeks impacts the level of awareness of the creek's existence and perceptions of its water quality.

We use two suites of variables to control for the effects of driving distance on (a) the familiarity (or awareness) with the creeks and (b) the degree to which respondents believe the watercourses are polluted or unsafe to use (environmental concern). First, we employ a series of socioeconomic contextual control variables selected on the basis of previous studies that modeled environmental perception. These include party identification (PID), age, education, income, gender, population density, and environmental views. Second, we add geographic variables to better account for place and setting when isolating the influence of distance on the dependent variable. Because residency variables are meant to capture place and setting issues, we advance this approach by directly measuring land cover and land use using GIS analysis of remote sensing data. Land cover types include forest, rangeland, agriculture, and built-out. Land use is defined as urban, rural, and residential. This conceptual model not only helps explain the influence of place-based

factors on environmental awareness and concern but also provides a more complete approach to understanding environmental perceptions in general.

RESEARCH METHOD AND DATA ANALYSIS

SAMPLE SELECTION

We selected the sample of respondents from a random household telephone survey of residents in San Antonio, Texas, that oversampled the area within the two major watersheds for Salado and Leon Creeks. The sample was stratified into three groups: Salado Creek watershed, Leon Creek watershed, and Bexar County as a whole. To make sure the households were in the targeted areas, we used only listed numbers that have addresses. This approach made certain that the correct strata could be determined for every household. A random selection of 4,000 listed households within each stratum was conducted. A sample of 2,400 households was sampled from the Bexar County and 800 from each of the oversampled areas. Telephone interviews took an average of 19.5 minutes; the shortest took 10 minutes, and four took over an hour. Of the initial sample, 7.3% required return phone calls. The overall response rate was 25.4%, which generated a sample of 1,017 for analysis. Of the 1,017 respondents selected, 1,005 were geocoded (placed in their true locations on earth using X and Y coordinates) by tying their reported addresses to a 2000 U.S. Census Bureau TIGER line file. Once each respondent was located in space, we could effectively employ geographic factors to examine environmental perceptions within the study area.

MEASUREMENT OF VARIABLES

Respondents' perceptions of the environment, the dependent variable for the study, were measured through the survey in two formats (see Appendix). First, familiarity with Salado and Leon Creeks was measured as a dichotomous "yes" or "no" variable. Second, environmental concern was measured based on views of the creeks' safety for drinking, swimming, consumption of fish, and drinking for livestock were measured on a scale from 1 to 4, where 1 is *very safe* and 4 *very unsafe*.[1] These two measures of environmental perception enabled us to be systematic in our investigation by examining the dependent variable in increasing levels of detail.

Socioeconomic contextual variables were measured primarily through the survey instrument. PID, age, income, education, and gender were

registered based on the methods used most widely throughout the environmental psychology the literature (see Appendix for more detail). Environmental views were measured based on questions initially used by Van Liere and Dunlap (1980). Responses were summed and ranged from 1 (*strongly agreeing* that humans are abusing the natural environment) to 16 (*strongly disagreeing* that humans are abusing the environment).[2] Finally, population density was measured using GIS along with census data to determine the population per square mile.

The majority of geographic variables in the model were measured through GIS analysis techniques. Using GIS to analyze the data enabled us to derive more accurate measurements of geographic factors than rough approximations of distance or general land use settings. Driving distance was measured by tying the geocoded survey respondents to a 2000 U.S. Census Bureau TIGER line file product, which contains the road network for San Antonio.[3] Through the program Network Analysis, we determined the shortest driving distance in meters from a respondent's residence to the nearest intersection with Salado and Leon Creeks. In other words, based on the street network of San Antonio, the computer program was able to find the driving distance from each geocoded resident to the closest intersection of each creek.

Land cover for each respondent's location was measured using the Texas Natural Resource Conservation Commission (TNRCC) Land Use/Land Cover GIS coverage.[4] From this data layer, we formed the following four major land cover categories: forest, agriculture, built, and rangeland (the baseline category). Using actual zoning and land-use information, we were also able to interpret land use for each respondent using three categories: urban, rural, and residential (the baseline category). Each respondent fell into only one land-cover and land-class category. All land-use and land-cover categories were entered into the model as dichotomous variables.

DATA ANALYSIS

Analysis of the data proceeded in two phases. First, the dichotomous familiarity variable was examined using a logit model for each creek. From these results, we calculated predicted probabilities of minimum and maximum distance on familiarity to understand the effect of distance in more detail (see Table 3). Second, the water safety variable was analyzed for each creek using ordinary least squares (OLS) multiple regression to explain the impact of driving distance on environmental perceptions. We paid close attention to adjusted *R*-squared values to see if the addition of geographic variables improved model fit over previous research relying on socioeconomic and demographic factors alone. Several statistical tests for reliability

TABLE 1
Explaining Familiarity of Salado Creek

Variable	*Coefficient*	*Standard Error*	*z-value*	*Significance*
Driving Distance to Salado	0.537	0.112	–4.78	0.000
Socioeconomic variables				
Population density	0.000	0.000	–1.06	0.288
Political identification	0.007	0.066	0.12	0.908
Education	0.083	0.027	3.07	0.002
Tenure	0.003	0.000	8.04	0.000
Age	0.001	0.004	0.40	0.692
Income	0.077	0.019	3.93	0.000
Gender	–0.371	0.160	–2.31	0.021
Environmental views	–0.021	0.019	–1.10	0.273
Geographic variables				
Forest	–0.241	0.376	–0.64	0.521
Agriculture	0.348	0.389	0.89	0.371
Built	–0.077	0.497	–0.16	0.876
Urban	–0.048	0.320	–0.15	0.879
Rural	0.252	0.607	0.42	0.677
Constant	–0.690	0.801	–0.86	0.389
$N = 1005$				
$LR\,\chi^2\,(14) = 156.50$				
Prob. > $\chi^2 = 0.000$				
Log likelihood = –500.476				
Pseudo $R^2 = 0.135$				

were conducted to ensure the OLS estimators were Best Linear Unbiased Estimates. Tests for model specification, multicollinearity (particularly between built and urban variables), heteroskedasticity, and autocorrelation revealed no violation of regression assumptions.

RESULTS AND ANALYSIS

The first phase of analysis used logit models to examine the relationship between respondent distance from creeks and familiarity with the creeks in question. We used familiarity or recognition that a natural resource exists as an initial step in investigating overall environmental perceptions. As illustrated in Table 1, driving distance to Salado Creek is a significant factor in explaining whether residents are familiar with its existence ($p < .01$). As the residential distance from Salado Creek increases, familiarity with the creek

decreases. That is, respondents are significantly more likely to be aware of the creek the closer they live to it. Education is also a significant factor in explaining familiarity with Salado Creek ($p < .01$). Respondents with higher levels of education (based on the amount of formal schooling they have completed) are more likely to be familiar with the creek. A higher level of income is another socioeconomic factor associated with increased familiarity with the creek ($p < .01$). In terms of gender effects, our study found that males are significantly more likely to be familiar with the creek ($p < .05$).

Overall, tenure, or length of residence, is the most powerful predictor of a respondent's awareness of the creek's presence. The longer a resident lives in San Antonio, the more familiar that person is likely to be with the creek. Although there is little research or data on the long-term effects of tenure on environmental perceptions, this finding may support the argument that environmental familiarity is enhanced when individuals have the opportunity (through either time or location) of increasing their knowledge of the place and the natural surroundings (Cantrill, 1998). Land use or land cover does not play a significant role in predicting familiarity with Salado Creek. We believe that these geographic variables are dictated largely by increasing distance from the city center where the creeks are situated. The presence of human constructed or built elements, forested tracts, or agricultural lands are functions of distance. As one moves away from the urban core into the surrounding suburbs and less populated areas, forested and agricultural areas become more common.

Results regarding familiarity with Leon Creek are, for the most part, identical to the results for Salado Creek, with the exception that education is not a statistically significant factor (Table 2). On average, men with higher incomes living close to Leon Creek for longer periods are more familiar with the water body. It is important to note, however, that the effect of driving distance from Leon Creek is almost double that of Salado Creek. Residents living farther away from Leon Creek are far less likely to be aware of its presence. This result may be due in part to the higher profile of Salado Creek throughout the San Antonio region, but more likely, it is because residents in the sample live farther away from Leon Creek and therefore are less likely to be familiar with it. The average driving distance from Leon is approximately 12.5 kilometers compared with 9.6 km for Salado Creek. Most residents live to the west of the Leon Creek in suburban neighborhoods. This contrast in proximity and location seems to account for the difference in the effect of driving distance on the dependent variable for Leon and Salado Creeks.

To better understand the impact of distance on environmental perceptions, we calculated the predicted probabilities that respondents would be familiar with the two creeks for minimum and maximum distances (Table 3). The

TABLE 2
Explaining Familiarity of Leon Creek

Variable	*Coefficient*	*Standard Error*	*z-value*	*Significance*
Driving distance to Leon	0.672	0.086	–7.78	0.000
Socioeconomic variables				
Population density	0.000	0.000	–0.53	0.594
Political identification	0.079	0.060	1.32	0.186
Education	0.031	0.024	1.29	0.197
Tenure	0.001	0.000	3.79	0.000
Age	0.002	0.004	0.56	0.577
Income	0.041	0.017	2.33	0.020
Gender	–0.585	0.138	–4.23	0.000
Environmental views	0.022	0.016	1.33	0.182
Geographic variables				
Forest	–0.146	0.3456522	–0.42	0.672
Agriculture	0.427	0.3475617	1.23	0.219
Built	–0.318	0.4545263	–0.70	0.483
Urban	0.200	0.3019675	0.66	0.508
Rural	–0.242	0.5536304	–0.44	0.662
Constant	–0.734	0.7077858	–1.04	0.299
$N = 1005$				
$LR\,\chi^2\,(14) = 123.15$				
Prob. > $\chi^2 = 0.000$				
Log likelihood = –622.725				
Pseudo $R^2 = 0.090$				

TABLE 3
Predicted Probabilities of Familiarity With Creeks Based on the Minimum or Maximum Distance (km), Holding All Other Variables Constant

	Minimum Distance	*Probability*	*Minimum Distance*	*Probability*
Leon Creek	.14	.73	38.82	.08
Salado Creek	.03	.93	43.97	.42

probability that a respondent living at the minimum distance from Salado Creek will be familiar with it, holding all other variables in the model constant, is .93 compared with .73 for Leon Creek. At the maximum driving distance, the probability of a respondent being familiar with Salado Creek is .42, whereas it is only .08 for Leon Creek. Table 3 reveals that, overall, respondents are more familiar with Salado Creek in part because they live closer to

TABLE 4
Explaining Views of Water Safety in Salado Creek

	Coefficient	*Standard Error*	t-*value*	*Significance*
Driving distance to Salado	0.147	0.024	–6.14	0.000
Socioeconomic variables				
Population density	0.000	0.000	–2.75	0.006
Political identification	0.028	0.142	0.20	0.840
Education	0.039	0.057	0.69	0.493
Tenure	0.007	0.000	8.50	0.000
Age	–0.003	0.010	–0.33	0.744
Income	0.155	0.042	3.70	0.000
Gender	–0.988	0.331	–2.98	0.003
Environmental views	–0.094	0.039	–2.38	0.017
Geographic variables				
Forest	–1.438	0.808	–1.78	0.075
Agriculture	–0.350	0.814	–0.43	0.667
Built	–0.706	1.081	–0.65	0.514
Urban	–0.026	0.719	–0.04	0.970
Rural	0.361	1.311	0.28	0.783
Constant	7.841	1.705	4.60	0.000
$N = 1005$				
$F(14, 990) = 12.67$				
Prob. > $F = 0.000$				
Adj. $R^2 = 0.140$				

the watercourse. Those living at the outreaches of the sampling area are, in contrast, unlikely to be aware of Leon Creek. The difference in the impact of distance on creek awareness appears in the size of the coefficients in the logit models (Tables 1 & 2).

Familiarity with or awareness of a natural resource is only part of understanding environmental perceptions. In the second phase of analysis, we probed further in our investigation of perception by examining residents' levels of environmental concern based on how they perceived a creek's overall state of health. The same independent variables used in the logit models were analyzed again to explain level of concern over the safety of a creek's water. Opinions on the safety of the creek's water for drinking, swimming, consuming fish from the creek's waters, and water consumption by livestock indicated the degree to which respondents believed them to be polluted.

Driving distance again is a significant factor in predicting perceptions of the safety of a creek's water. Residents living closer to Salado Creek are more likely to believe it is unsafe for human use and consumption by livestock ($p <$ .01; Table 4). The impact of contextual variables is much the same as with the

TABLE 5
Explaining Views of Water Safety in Leon Creek

	Coefficient	*Standard Error*	t-*value*	*Significance*
Driving distance to Leon	0.126	0.019	–6.52	0.000
Socioeconomic variables				
Population density	0.000	0.000	–0.61	0.545
Political identification	0.180	0.140	1.28	0.200
Education	0.055	0.056	0.98	0.326
Tenure	0.004	0.000	4.66	0.000
Age	–0.006	0.010	–0.60	0.550
Income	0.113	0.041	2.73	0.006
Gender	–1.295	0.328	–3.95	0.000
Environmental views	–0.014	0.039	0.36	0.720
Geographic variables				
Forest	–0.823	0.806	–1.02	0.308
Agriculture	0.811	0.806	1.01	0.315
Built	–1.706	1.069	–1.06	0.288
Urban	0.411	0.711	0.58	0.563
Rural	–0.746	1.294	0.58	0.564
Constant	4.182	1.671	2.50	0.012
$N = 1005$				
$F(14, 990) = 7.52$				
Prob. > $F = 0.000$				
Adj. $R^2 = 0.083$				

logit models. Men with high incomes living close to the creek for long periods were more likely to consider the watercourse to be polluted. However, in the multiple regression model, population density is statistically significant at the .05 level. Respondents in areas with higher population levels believe Salado Creek is unsafe compared to more sparsely populated locations. This result is expected because a large urban cluster of respondents lives in proximity to the creek. Finally, respondents with stronger views on protecting the environment are significantly more likely to believe the creek is polluted.

Multiple regression results for Leon Creek parallel those for Salado (Table 5). Again, males with high incomes living close to the creek for longer periods are significantly more likely to respond that the creek is polluted. However, population density is not a strong factor in this model. This result is consistent with the demographic characteristics of the San Antonio area, where most residents near Leon Creek are located to the west in suburban neighborhoods with relatively lower population densities.

When looking at the results as a whole, we find that residents who are more familiar with the creeks (i.e., those living closer to them) are

significantly more likely to believe the water is polluted. A larger percentage of respondents live near Salado Creek, and correspondingly, respondents believe that Salado Creek is more polluted than Leon Creek. These perceptions are consistent with objective indicators of the health of the creeks. Data show that, historically, both creeks have been polluted, which helps explain the strong statistical relationship between tenure and views on water safety. Based on a recent study, however, the TNRCC (1996, 1998, 1999, 2000) found significantly greater portions of Salado Creek (more than 4 times) contain high bacterial levels and other water borne pollutants compared with Leon Creek. Proximity, in this instance, not only influences environmental perceptions and general sense of place but also is associated with more accurate information on the health of the surrounding natural environment. Thus, location does not simply drive perception but may help residents of a community understand its environmental realities.

An important element of the multiple regression analysis is the issue of model fit. In both regression models, distance accounts for approximately half of the variance explained by all of the independent variables. Thus, when distance is taken out of the equations, adjusted *R*-squared values are reduced by approximately 50%. The significant improvement that distance brings to bear on model fit is one indication that proximity and location play a critical role in predicting environmental perceptions and subsequent behavior.[5] However, it is important to note that although adjusted *R*-squared values are consistent, and in most cases higher than related studies (the adjusted *R*-squared values for Salado and Leon creeks are .14 and .08, respectively), there is still a large amount of unexplained variance that needs to be addressed in future studies. Although this study demonstrates the importance of the geographic dimension, it is clear that more work is needed to improve model fit and adequately predict environmental perceptions.

CONCLUSIONS AND POLICY IMPLICATIONS

Based on the results of our study, driving distance has a significant effect on determining familiarity with and views on the safety of Salado and Leon Creeks. Respondents within closer driving distance to the watercourses are far more likely to be both familiar with the creeks and believe they are polluted. In addition, we observe a consistent profile of the San Antonio resident who is aware and knowledgeable about the creeks; generally, males with high

incomes, living for long periods in driving proximity to the creeks are more likely to be familiar with the creeks and cognizant of their pollution levels.

The significant impact of proximity when predicting how residents perceive critical natural resources has important implications for policy and public education. If residents are knowledgeable and concerned with a particular creek, they may be more likely to support watershed planning initiatives or efforts to improve water quality. For example, public sector planners who wish to start community-based watershed projects may be more effective if they can identify neighborhoods, based on location, that will take more interest in the issues and therefore be more willing to participate in a planning process. Political candidates who wish to gain support for a particular environmental issue may be more persuasive for their positions if they can use proximity to predict which constituents will be more aware of a critical natural resource or be in favor of cleaning up water pollution in a local creek.

Directing watershed policy at locations that match socioeconomic and demographic profiles of known pockets of potential support, however, should not be the only planning strategy initiated by public officials. In the San Antonio case, designing campaigns for support that target high income, well-educated males in relatively stable neighborhoods could marginalize important sectors of the population. There is general evidence that lower income segments of the population are about as supportive of strong environmental controls as higher income segments (Freudenburg, 1991; Mitchell, 1979; Morrison, 1986; Van Liere & Dunlap, 1980, 1981). Specific locations may provide a starting point for initiatives, but efforts must be made to develop an inclusive socioeconomic and demographically broad-based environmental planning process that will gain support from a variety of interests.

Although this study demonstrates the importance of proximity (defined as potential for access) for awareness and information on an environmental feature, further research is needed to fully understand its impact on environmental perceptions. Case study analysis involving interviews with respondents may provide additional insight into the role of proximity in forming environmental views. Further investigation will be done to search for neighborhoods within the study area that may contain patches of similar responses. Clustered responses would indicate that environmental perceptions are not spatially independent but related to each other across watersheds or other natural landscapes. Understanding why similar responses occur in specific locations will not only enhance statistical modeling of environmental perceptions but also have implications for policy development and public participation. Examining how the mosaic of interaction among residents in specific locations or neighborhoods contributes to collective environmental awareness may further increase our ability to explain environmental perceptions in general.

APPENDIX
Concept Measurement

Name	*Type*	*Measurement*	*Scale*	*Source*	M *(Leon/Salado)*	SD *(Leon/Salado)*
Familiarity	Dependent	Awareness of creeks based on "yes" or "no" answer	Dichotomous; 0-1	Survey	1.61/1.27	.69/.48
Water safety	Dependent	Views of water pollution in creeks from *very safe* to *very unsafe*	1-16	Survey	4.01/7.00	5.31/5.55
Driving distance (km)	Independent	Distance in meters from residence to nearest intersection with creeks	Continuous	GIS Analysis	12.50/9.58	8.74/7.12
Population density	Independent	Population per square mile in study area	Continuous	U.S. Census	3,520.40	2,149.20
Party ID	Independent	Association with specific party	1-4	Survey	2.24	1.19
Education	Independent	Number of school grades completed	Continuous	Survey	14.16	3.16

Age	Independent	Reported age in years	Continuous	Survey	47.24		17.92
Income	Independent	Reported annual income	Continuous	Survey	7.4		4.19
Gender	Independent	Reported gender	Dichotomous	Survey	0.529		0.429
Environmental views	Independent	Range of views on the level of human impacts on the natural environment	1-32	Survey	15.19		4.23
Tenure	Independent	Number of months living in San Antonio area	Continuous	Survey	303.67		219.7
Land cover	Independent	Type of dominant land cover for residence	Dichotomous	GIS Analysis	Forest	.18	.39
					Range	.05	.23
					Agriculture	.16	.37
					Built	.56	.47
Land use	Independent	Type of land use for residence	Dichotomous	GIS Analysis	Urban	.09	.29
					Rural	.40	.49
					Residential	.50	.50

NOTE: GIS = Geographic Information Systems.

NOTES

1. Four separate questions regarding the safety of the Salado and Leon Creeks (for drinking, swimming, eating fish, and drinking for livestock) on a scale from 1 to 4 were combined into a single variable. This variable was thus measured on a scale of 1 to 16. Cronbach's alpha for the final scale is .91 and .95, respectively.

2. Eight separate questions regarding the degree to which humans are impacting the environment on a scale from 1 to 4 were combined into a single variable. Cronbach's alpha for the final scale is .96.

3. Previous studies correlating distance with perceptions use Euclidian (straight line) measures. We improved on these methods using the most recent Geographic Information Systems technology for the following reasons: (a) People tend to perceive distance not "as the crow flies" but how they gain access to natural resources, which is usually by automobiles. Driving distance is therefore a more accurate measure because it takes into account a respondent who lives close to a creek but must drive a comparatively long distance to gain access; (b) as noted by a recent study examining the relationship between distance and environmental values (Brown, Harris, & Reed, 2002), "barriers" are important issues when considering a person's location in relation to a natural resource. By using driving distance, we take into account urban barriers, such as buildings, watercourses, or neighborhood districts, that a respondent would need to traverse to access Salado or Leon Creeks.

4. The Commission on Environmental Quality data layer was originally generated through the EPA by interpreting a series of Landsat satellite images into a raster format. This raster-based layer was then converted to a vectors format to analyze with respondent data.

5. We used a nested model approach to test the overall impact of adding the distance variable. Distance was found to be statistically significant ($F < .01$) for both Salado and Leon Creeks.

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