The Journal of Wildlife Management 76(7):1331–1340; 2012; DOI: 10.1002/jwmg.398

Human Dimensions

Learning to Live With Black Bears: A Psychological Model of Acceptance

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ABSTRACT The reappearance and recovery of large carnivores in human-dominated landscapes creates a need to understand how people will respond to the presence of these animals. We tested a psychological model of acceptance to determine what variables most influence people's acceptance for black bears (*Ursus americanus*) in an area with an emerging black bear population (Ohio, USA). We hypothesized that people's perceptions of risk and benefit related to bears would mediate the effect of trust (in wildlife management agencies) and personal control (over interactions with and management of wildlife) on acceptance for black bears. We used a mail-back survey of Ohio residents ($n = 9{,}400$; adjusted response rate = 35%) to assess the variables of interest and test the hypothesized model. Based on multiple criteria of model fit, the hypothesized model fit the data acceptably well. The model explained approximately 62% of the variance in acceptance, and perception of risk associated with black bears had the largest impact on the level of acceptance. As large carnivore populations expand and interactions with humans increase, our results will aid managers in designing outreach materials and communications aimed at promoting acceptance for large carnivores. Our model suggests that interventions raising an individual's social trust in the managing agency, or personal control can indirectly raise stakeholders' acceptance by reducing risk perception and increasing perception of benefit from carnivores.

KEY WORDS acceptance, black bear, carnivore, control, Ohio, risk perception, trust, *Ursus americanus*.

Population increases of large terrestrial carnivores in many parts of the world increase the frequency of human–carnivore interactions and the likelihood of conflicts (Enserink and Vogel 2006). The success of carnivore populations is not limited to rural or wilderness areas. Rather, these species have proven remarkably adaptable, increasingly occupying urbanized areas (Hristienko and McDonald 2007, Gehrt et al. 2010). As with other terrestrial mammals, conflicts with large carnivores often involve agricultural damage (e.g., threats to domestic livestock and apiaries, property damage); however, large carnivores also pose an added risk—they can and sometimes do attack and kill people (Herrero et al. 2011). Yet, despite these conflicts, research suggests that large carnivores can persist alongside human populations at relatively high densities, so long as management policies classify carnivores as a protected or game species, and not as pests (Linnel et al. 2001). The extent to which policies will remain favorable to carnivores will depend, in part, upon local acceptance or tolerance of these species (Decker and Purdy 1988), raising the need to understand factors that influence people's acceptance for carnivores (Bruskotter and Shelby 2010).

An individual's judgment regarding the acceptability of a species or a management action or policy results from the complex interplay between their perceptions about the species and policies in question, and the social context within which they formulate these perceptions (Shindler et al. 2004, Decker et al. 2006). Although a number of studies have examined the various cognitive antecedents of acceptance for wildlife (e.g., Bright and Manfredo 1996, Riley and Decker 2000*a*, Lischka et al. 2008), a robust theoretical model for predicting acceptance remains elusive (see Gigliotti et al. 2000). By incorporating both existing applied research in wildlife and psychological theory on risk, we sought to address this need by developing a parsimonious model of wildlife acceptance based on psychological theory aimed at understanding the acceptance of hazards. We reviewed the relevant literature to identify psychological factors shown to affect acceptance and specified a theoretical model of acceptance. Where previous models for wildlife have focused entirely on explaining variability in acceptance (or the acceptability of a policy), we specified

Received: 6 January 2011; Accepted: 23 February 2012;
Published: 2 July 2012

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the inter-relationships among antecedent variables, which allowed us to examine both the direct and indirect effects of these variables on acceptance. Understanding what factors promote or inhibit acceptance among interested stakeholders can assist wildlife managers in formulating and implementing carnivore management policies and practices that will minimize controversies, ultimately helping to ensure the long-term viability of carnivore populations (Bruskotter et al. 2009, Don Carlos et al. 2009).

Researchers who study the acceptability of wildlife typically employ 1 of 2 approaches. The first and more common approach focuses on evaluating the acceptability of some type of wildlife management action (e.g., reintroduction, trapping, lethal control; see for example, Bright and Manfredo 1996, Bruskotter et al. 2009). Studies that use this approach are typically couched in terms of psychological theories on attitudes (e.g., Bright and Manfredo 1996, Manfredo et al. 1997) or social norms (e.g., Needham et al. 2004, Bruskotter et al. 2009). The second approach attempts to determine the acceptability of, or tolerance for, a wildlife population within some geographically or politically relevant unit (e.g., state, region, or stakeholder group; see for example, Riley and Decker 2000*b*). Studies that employ this approach generally lack explicit ties to psychological theory, and often employ inconsistent terminology, which has led to some confusion regarding what researchers mean when the use the term acceptance (see Bruskotter and Fulton 2012). Indeed, as Shindler et al. (2004:149) noted, terms such as "appropriate, preferred, desirable, supported, tolerated, or adequate" have all been used synonymously with "acceptable" in the resource management literature.

Probably the most common measure of the acceptability of a wildlife population is Decker and Purdy's (1988) Wildlife Acceptance Capacity (WAC). Modeled after the concept of biological carrying capacity, Decker and Purdy (1988) conceptualized WACs as reflecting the "maximum wildlife population level in an area that is acceptable." Decker and Purdy (1988) proposed WAC as a concept for explaining how human tolerance can limit the distribution and frequency of species within a given area. When an individual perceives a population of animals to have exceeded their acceptance threshold, it becomes unacceptable, and that individual is motivated to take action designed to reduce the population.

Gigliotti et al. (2000:77) asserted that WAC studies lacked "a robust theoretical framework and standard terminology," leading to confusion among managers and researchers alike. For example, researchers interested in understanding what makes wildlife acceptable have long focused on the impacts associated with wildlife as predictors of acceptance for wildlife populations; but they have measured such impacts under a variety of different names. Bright and Manfredo (1996) measured "perceptions of outcomes" associated with wolf reintroduction as a predictor of attitudes toward reintroduction, Riley and Decker (2000*a*) assessed "risk perceptions" as a factor affecting acceptance for cougars in Montana, and Lischka et al. (2008) assessed "impact perceptions" as a predictor of the acceptance for white-tailed deer. Despite differences in labeling, these measures all assess the positive and negative impacts associated with wildlife, and they consistently correlate strongly with the acceptance of wildlife and wildlife management actions. However, as Gigliotti et al. (2000) asserted, we lack a common theoretical framework for tying together these divergent studies. However, theoretical models developed in psychology to understand acceptance of hazards (i.e., Siegrist 1999, 2000; Siegrist and Cvetkovich 2000) can be readily adapted to understanding the acceptance of wildlife, especially those species that are sometimes viewed as hazards (i.e., posing a threat to human health or safety). This literature provides conceptual clarity to existing research on the acceptance of wildlife. Following this line of research, we conceptualized acceptance as an individual's judgment regarding the appropriateness of existing and future wildlife populations. Such judgments could also be described as an indication of individual's tolerance or intolerance for a species or population (see Bruskotter and Fulton 2012); thus, hereafter we use the terms tolerance and acceptance synonymously.

Siegrist (1999) proposed that an individual's acceptance of a hazard is determined primarily by their perceptions of the risks and benefits associated with that hazard. Siegrist (2000) later used this model to understand acceptance of gene technology in the use of foods. Given the conceptual and operational similarity between Siegrist's (1999, 2000) measures of perceived risks and benefits and the measures of impacts, risks, and outcomes employed in many wildlife acceptance studies, we contend that Siegrist's (1999, 2000) model, along with additional research aimed at understanding acceptance (see Siegrist et al. 2000, Siegrist and Cvetkovich 2000, Cvetkovich and Winter 2003, Poortinga and Pidgeon 2003, Vaske et al. 2007) provide a useful theoretical framework for grounding studies of wildlife acceptance in social science theory. Following this research, we specified a psychological model of wildlife acceptance that views acceptance as determined (primarily) by 5 factors: perceived risk, perceived benefit, trust, values similarity, and personal control (see Fig. 1).

Perceived risk is an intuitive evaluation, not a technical assessment, of the threat an object or activity may pose (Slovic 1987, McDaniels et al. 1996), reflecting the degree to which individuals think that they are or may be exposed to some hazard. Perceptions of risk are often heightened for hazards that are believed to be uncontrollable, involve fatal consequences, result from involuntary exposure, or are new or relatively unknown to science (Slovic 1987). Previous research demonstrates that acceptance of wildlife, and especially wildlife capable of killing human beings, is determined in part by perceptions of risk (Riley and Decker 2000*a*; Gore et al. 2006, 2007). However, wildlife also provide benefits to people in the form of aesthetic enjoyment and other recreational opportunities, and may even affect the environment in ways that people feel is beneficial. Numerous studies have recognized this and measured not just the negative outcomes (or risks) associated with a species, but also the positive outcomes (or benefits) that people perceive (e.g., Bright and Manfredo 1996, Bruskotter et al. 2009). In judgment

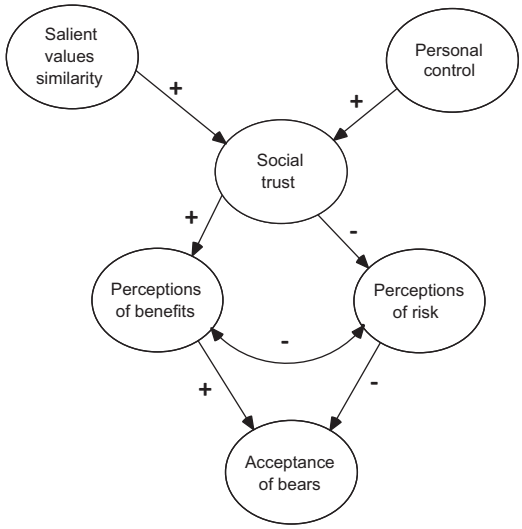

Figure 1. Conceptual model illustrating our understanding of the latent variables influencing acceptance of bears. The sign on each causal and correlative pathway indicates the expected direction of the relationship. Straight lines represent causal pathways and double-headed curved lines represent correlations.

and decision making research, perceived benefit is concerned with the gains attained from a hazard, and not the nature of the hazard or characteristics associated with the hazard itself (Finucane et al. 2000). Following this research, our model views the perceived risks and benefits associated with wildlife as the direct antecedents of acceptance (Fig. 1).

A growing body of research indicates that one's social trust in those responsible for managing a hazard influences perception of risks and benefits associated with the hazard (e.g., Siegrist 1999, 2000; Siegrist et al. 2000). Social trust (hereafter, trust) is conceptualized as one's willingness to rely on those who have the responsibility for making decisions and taking management actions in the realms of public health and safety (Siegrist and Cvetkovich 2000). Following Siegrist (1999, Siegrist and Cvetkovich 2000), we view trust as affecting the acceptance of wildlife indirectly, that is via its influence on the perceived risks and benefits associated with a hazard (Fig. 1).

Additional research indicates that trust is determined, in part, by the degree to which one perceives value similarity between themselves and a relevant other (i.e., a management agency; Earle and Cvetkovich 1995, Siegrist et al. 2000, Vaske et al. 2007). In the context of wildlife management, salient values similarity (hereafter, values similarity) represents the degree to which one perceives a wildlife management agency as sharing one's own values. Our model hypothesizes that an increased perception that wildlife management agencies share their values will lead to increased trust in the agency as the manager of wildlife populations (Fig. 1).

Locus of control is the final component of our model. Generally, one's locus of control is the degree to which one believes s/he has control over his/her life (Bjerke et al. 2000). A high internal locus of control reflects the belief that one has personal control over his/her life, whereas a high external locus of control reflects the belief that external forces such as chance or powerful others produce outcomes, not one's own personal actions (Levenson and Mahler 1981, Lefcourt 1991). We postulated that beliefs about internal (hereafter, personal control) versus external control would help managers understand acceptance of wildlife, especially given wildlife conflicts are controlled by personal actions and wildlife populations are controlled and regulated by external forces (i.e., management agencies; Gore et al. 2006). Social trust again appears relevant when considering individual's beliefs towards an agency. In fact, social trust and personal control are found to be highly correlated (Huurne and Gutteling 2009). Specifically, we hypothesized that increased personal control would lead individuals to exhibit greater trust in management agencies (Levenson and Mahler 1975; Fig. 1).

In summary, we hypothesized that values similarity and personal control are positively related to trust; and trust is negatively related to perceived risk and positively related to perceived benefit. Thus, our model views perceptions of risk and benefit as the direct antecedents of judgments regarding the acceptability of wildlife populations, whereas trust, values similarity, and personal control are viewed as affecting acceptance indirectly, via their relationships with other variables. In our model (Fig. 1), each of the directional paths (i.e., straight arrows) represents a hypothesis regarding the expected relationship between variables.

A recovering black bear (*Ursus americanus*) population in Ohio presented an opportunity to examine acceptance in a human population with little previous direct experience with bears. The relative novelty of bears was ideal for this study, as research indicates that attitudes become more resistant to persuasive appeals with direct experience (Wu and Shaffer 1987); thus, interventions designed to increase acceptance are likely to be more effective in populations that lack direct experience. This study had 2 general aims: 1) to quantify the acceptance for black bears and specific management policies among residents of Ohio, and 2) to identify a parsimonious model of the variables influencing acceptance for black bears. Ultimately, identifying factors that affect acceptance is the first step in designing interventions that promote acceptance for a species.

STUDY AREA

We designed this study to assist with black bear management planning in Ohio, and developed it in conjunction with wildlife managers and scientists at the Ohio Division of Wildlife (ODOW). The state of Ohio is currently experiencing an unassisted recolonization of black bears. Black bears were assumed to be extirpated from the state by 1850 due to over logging, loss of habitat, and excessive hunting. However, since the 1980s, a trend of increasing forested acreage resulted in the reestablishment of suitable habitat for black bears, and an increase in black bear sightings over the last few decades (Ohio Department of Natural Resources [ODNR] Strategic plan for management of Ohio's black bear population, unpublished report). The forested region of Ohio (eastern third of the state) has typically reported the

majority of all black bear sightings in Ohio (ODNR Strategic plan for management of Ohio's black bear population, unpublished report). Current population estimates indicate that roughly 100 black bears reside within Ohio; and most are likely young males dispersing from Pennsylvania and West Virginia (ODNR Strategic plan for management of Ohio's black bear population, unpublished report). Both Pennsylvania and West Virginia report large breeding populations of black bears (15,000 and 11,000 bears, respectively; Spencer et al. 2007). Increasing habitat and nearby source black bear populations will likely result in a continued expansion of the current Ohio black bear population.

METHODS

Study Design, Sampling, and Data Collection

Adult residents in the state of Ohio were the target population for this research. We used a cross-sectional mail survey to collect data from a stratified random sample of Ohio households, as it allowed us to simultaneously assess numerous variables in the population of interest, while providing a robust sample to test the hypothesized theoretical model. A private sampling firm (Survey Sampling, Inc., Shelton, CT) drew a random sample of Ohio households, stratified across 8 Bear Management Units (BMU) with approximately 1,100 households selected from each BMU (n = 9,400). The 8 BMUs were geographically distinct and the ODOW established them based on black bear habitat requirements and human population densities. To randomize selection within each household, the cover letter stipulated that the questionnaire be completed by the adult (18 years or older) with the most recent birthday.

Our mail survey protocol followed a modified version of Dillman's Tailored Design method to structure the contacts with the sample (Dillman 2000). We made our initial contact with the sample in May of 2009, which consisted of a packet including a cover letter, survey instrument, and a prepaid return envelope. We sent 3 full mailings of the survey packet to selected households. Additionally, an abbreviated version of the questionnaire, including only key variables of interest and demographic questions, was mailed to a random sample of the non-respondents to assess non-response bias (n = 345). All survey materials and procedures met the approval of The Ohio State University's Office of Responsible Research Practices (Protocol # 2009E0391).

Survey Development and Operationalization of Variables

We measured all variables using multi-item scales (i.e., the multiple questions for each of the variables to which people responded in the survey instrument). The use of multiple-item scales allows researchers to assess reliability (consistency) of measures, and is the standard methodology employed when assessing latent psychological variables (a latent variable is not directly observable; see Devellis 2003 and Noar 2003 for reviews of psychological measurement). Prior to implementation, we conducted a pilot study of the instrument on a select population (n = 9) of graduate students and faculty in the Ohio State University School of Environment and Natural Resources familiar with survey research. Additionally, a panel of outside experts (n = 3) assessed the relevancy and face validity of proposed questions and multi-item measures. Review of the instrument by previous researchers was crucial in establishing content validity. Most of the items included in this survey instrument replicate past work done by other researchers (Riley 1998, Bjerke et al. 2000, Gore et al. 2006, Vaske et al. 2007, Don Carlos et al. 2009). Finally, following standard survey research practices, confirmatory factor analysis described scale dimensionality and Cronbach's α defined the internal consistency and reliability of multi-item measures (Cortina 1993; Table 1).

We used 4 statements addressing respondents' preferences for black bear population levels in Ohio to identify their acceptance for black bears in the state (see Riley 1998). The first 2 items identified respondents' perception of current bear populations in Ohio and near their home (5-point scale ranging from "much too high" to "much too low"). The next 2 items isolated respondents' preference for future bear populations in Ohio and near their home (5-point scale ranging from "decrease greatly" to "increase greatly"). We used 7 statements designed to isolate the components of dread and unknown risk as described by the psychometric paradigm (Slovic 1987) to measure risk perception. Items included 7 response options that ranged from: −3 (strongly disagree) to 3 (strongly agree). Four statements concerning the potential benefits of bears comprised the perceived benefit measure. Again, response scales provided 7 options that ranged from −3 (strongly disagree) to 3 (strongly agree). Following Vaske et al. (2007), we used a series of 5 statements to measure the extent to which respondents viewed the Ohio Division of Wildlife as sharing their values (e.g., "When it comes to wildlife management, I feel that the Ohio Division of Wildlife . . ."). Response scales provided 7 options that ranged from: −3 (strongly disagree) to 3 (strongly agree). We used an additional 4 items to measure more traditional components of trust, such as competency and reliability. We measured these 4 items on the same scales as the values similarity items. We used a series of 6 statements to measure the variability in respondents' perceived control over wildlife management decisions and human–black bear interactions (Levenson and Mahler 1981, Bjerke et al. 2000). Response scales provided 7-point options that ranged from −3 strongly disagree to 3 strongly agree.

Statistical Analysis

We used SPSS 17.0 and AMOS 17.0 for Windows (SPSS, Inc., Chicago, IL) for the analyses presented herein. We used structural equation modeling (SEM) to estimate the relationships between latent variables and maximum likelihood estimation for the analysis of covariance matrices in SEM. We assessed model fit with the Comparative Fit Index (CFI) and a parsimony-adjusted measure, the Root Mean Squared Error of Approximation (RMSEA). We considered CFI values exceeding 0.90 indicative of an acceptable fit (Hu and Bentler 1999), and RMSEA values a good fit if less than 0.05 and acceptable if less than 0.08 (Hu and Bentler 1999, Diamantopoulos and Siguaw 2000).

Table 1. Item factor loadings, scale reliability, and scale model fit for each of the 5 latent variables assessed in our hypothesized model of bear acceptance by a random sample of Ohio residents. Cronbach's α describes the internal consistency and reliability of items used to measure each latent variable (scores closer to 1 represent items more consistently measuring the latent variable). The factor loadings can be interpreted as β from multiple regression output. The Comparative Fit Index (CFI) results present the model fit for the confirmatory factor analysis of each latent variable. The factor analysis results provide the test of unidimensionality in the scales (when CFI scores are closer to 1 the model fits better).

Latent variable and measurement item text	CFI	Factor loadings	SE
Acceptance (Cronbach's α = 0.95)			
Black bear populations in Ohio are . . .	0.96	0.88	0.019
I would prefer to see black bear populations in Ohio . . .	0.96	0.91	0.018
Black bear populations near where I live are . . .	0.96	0.85	0.02
I would prefer to see black bear populations near where I live . . .	0.96	0.89	0.018
Benefit (Cronbach's α = 0.79)			
The presence of black bears improves the quality of life in Ohio	1	0.84	0.039
Black bears will provide recreational opportunities for many Ohio residents	1	0.62	0.041
Black bears will improve the ecosystem health of Ohio	1	0.74	0.037
Having black bears in Ohio will be an inconvenience. (Reverse coded)	1	0.59	0.045
Personal control (Cronbach's α = 0.5)			
The average citizen can have an influence on wildlife management decisions	1	0.48	0.066
I have the ability to protect my property from wildlife	1	0.51	0.088
I have very little ability to protect my interests regarding wildlife management. (Reverse coded)	1	0.51	0.076
Whether or not I get into a conflict with a bear is mostly a matter of luck		Removed from analysis	
Black bear conflicts are not a matter of luck, rather bad personal decision making. (Reverse coded)		Removed from analysis	
I have very little ability to protect my interests regarding wildlife management		Removed from analysis	
Risk (Cronbach's α = 0.71)			
Black bears will be more of a problem for Ohio in the future	0.95	0.55	0.05
I am not familiar with the risks posed by black bears	0.95	0.38	0.056
I am vulnerable to the risks posed by black bears	0.95	0.59	0.051
I can prevent conflict with black bears by taking precautions around my home. (Reverse coded)	0.95	0.35	0.043
Conflict with black bears will be reduced as people learn to live with bears. (Reverse coded)	0.95	0.37	0.051
Encounters with black bears are likely to result in fatal consequences	0.95	0.61	0.053
I fear having an encounter with a black bear	0.95	0.66	0.058
All residents are equally exposed to conflicts with black bears in Ohio		Removed from analysis	
Social trust (Cronbach's α = 0.95)			
I am confident that the Ohio Division of Wildlife . . .			
. . . can effectively manage black bears	0.95	0.84	0.036
. . . knows how to use appropriate black bear management techniques	0.95	0.90	0.033
. . . will respond to black bear conflicts accordingly	0.95	0.93	0.033
. . . will listen to concerns about black bear management from ordinary people	0.95	0.81	0.038
Salient values similarity (Cronbach's α = 0.97)			
When it comes to wildlife management, I feel that the Ohio Division of Wildlife . . .			
. . . shares similar values as me	0.99	0.94	0.031
. . . shares similar opinions as me	0.99	0.97	0.029
. . . thinks in a similar way as me	0.99	0.91	0.031
. . . takes similar actions as I would	0.99	0.85	0.034
. . . shares similar goals as me	0.99	0.86	0.033

Because all of the measures employed in this study we derived from previously validated scales, we conducted a confirmatory factor analysis to verify that measurement items loaded only on the hypothesized latent variables. We conducted 6 separate confirmatory analyses (1 for each variable's measurement model) using SEM. Prior to any analysis, we randomly selected half of the dataset using the random number generator in SPSS 17.0 and reserved it for a cross validation of any model generation changes made to the hypothesized model (hereafter calibration and validation data, respectively; Diamantopoulos and Siguaw 2000).

The general form of the hypothesized model (Fig. 1) was a recursive hybrid structural equation model. We checked the hypothesized model for proper identification following the 2-step procedure for identification (Kline 2005). For purposes of identification, we constrained all of the loadings for the error variances on the indicator items to 1. We ran a bootstrapped sample (n = 5,000) to determine the true size of the indirect effects of independent variables on acceptance (Kline 2005). In contrast to a direct effect (e.g., A causes C), an indirect effect occurs when an independent variable influences a dependent variable via its effect on some intermediate variable (e.g., A causes B, and B causes C; see Loehlin 2004). Measurement of indirect effects assists in understanding the underlying psychological processes that ultimately result in judgments concerning the acceptability of a wildlife population. We used a 95% confidence interval to determine if an effect differed significantly from 0 (Preacher and Hayes 2004).

Following an examination of modification indices, we made some post hoc alterations to the hypothesized model. We only included alterations based upon the modification indices when they could be clearly justified based upon existing theory. When the new models were nested under the hypothesized model, we compared differences of χ^2 values between models with a likelihood ratio test for difference in fit to identify if the new model fit significantly better than the original (Kline 2005).

We used multiple regression multiple imputation to generate values for missing values in the original dataset (McKnight et al. 2007). Following the model generation phase of analysis, we constrained all parameters in the model so that all the imputation samples were equal to the original. If differences existed between the imputation groups, these differences would manifest themselves when comparing the model fit of the different groups. The $\Delta\chi^2$ values indicated the imputed values did not differ significantly from the original data ($P = 1.0$); thus, we included imputed values in the dataset ($n = 1{,}442$) in subsequent structural equation analyses.

Table 2. Model fit of both the calibration and validation datasets for both the hypothesized and best-fit model predicting bear acceptance by residents of Ohio. The validation data cross validates the changes made to the calibration data following initial analysis. Both metrics presented measure the model fit and better model fit is indicated by Comparative Fit Index (CFI) values closer to 1, and Root Mean Squared Error of Approximation (RMSEA) values closer to 0.

Model	CFI	RMSEA
Hypothesized: calibration	0.935	0.057
Hypothesized: validation	0.938	0.056
Best-fit: calibration	0.945	0.053
Best-fit: validation	0.950	0.050

RESULTS

Response Rates

After removing undeliverable and refusing members of the sample ($n = 852$), the adjusted response rate was 35%, which is equivalent to response rates reported in similar studies (Manfredo et al. 2003). Fifty-two questionnaires were returned from the non-response sample. An independent samples *t*-test revealed no differences (all *P* values were greater than 0.07) between respondents' and non-respondents' mean scores on any research variables of interest.

Measurement Model

We dropped 3 items used to assess personal control (specifically, these items were designed to assess external locus of control) and 1 of the items used to measure perceived risk from the analysis, as their inclusion reduced scale reliability (Devellis 2003). The general assumptions of SEM (i.e., variables measured on a continuous scale, and normality of item response distributions) were both met with this data (skewness ranged from −1.253 to 1.142 and kurtosis from −1.105 to 1.330) signifying no major departure from normality (Noar 2003, Byrne 2009). Simple structure was achieved in the confirmatory factor analysis with all latent variables and indicator items presented in the hypothesized model (Table 1). All latent variables had multiple items with high (>0.4) factor loadings (Noar 2003); we found no item cross loadings between variables, and all items loaded on at least 1 latent variable. Each of the scales exhibited an acceptable fit (all CFIs ≥ 0.95; see Table 1). Good model fit for each measurement model ensures that the structural analysis (i.e., the analysis examining the relationships between latent variables) provides results that reflect differences in the relationships between latent variables, and not poor fitting measurement models (Kline 2005).

Structural Model Fit

Based on multiple criteria of fit, the hypothesized model fit the data acceptably well (CFI: 0.94, RMSEA: 0.057; Table 2). As hypothesized, people who perceived more personal control and similar values with the ODOW exhibited more trust in the ODOW. People with greater trust perceived more benefit and less risk from black bears. People who perceived more risk from black bears were less accepting of them, whereas those who perceived more benefit from bears were more accepting (Fig. 2). The hypothesized model explained approximately 62% of the observed variance in acceptance.

We respecified part of the hypothesized model following an examination of modification indices (Fig. 3). The modification indices suggested including a path from personal control to both value similarity and risk. The likelihood ratio test for difference in fit resulted in a significant difference between models ($\Delta\chi^2 = 220.34$, $P \leq 0.001$). Also, the validation sample (i.e., the sample held in reserve for model verification) fit both the hypothesized and best-fit models acceptably well based on multiple criteria of fit (Table 2).

Risk perception had the largest total standardized effect of all 5 modeled variables ($\beta = -0.44$); though perception of benefit was only slightly less in magnitude ($\beta = 0.39$; Table 3). A bootstrapped sample of the indirect effects ($n = 5{,}000$) revealed the indirect effects of personal control, values similarity, and trust on acceptance to be significantly different from 0 at the 95% confidence level. The trust variable had the largest indirect effect on acceptance in the hypothesized model ($\beta = 0.25$; 95% CI: 0.20, 0.31), whereas personal control had the largest indirect effect in the best-fit model ($\beta = 0.30$; 95% CI: 0.21, 0.37; Table 3).

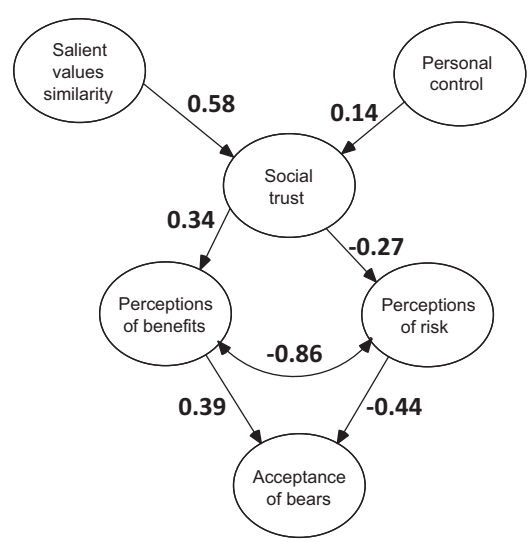

Figure 2. Our hypothesized bear acceptance model fit to questionnaires from a random sample of residents of Ohio. The coefficients on each pathway in the model can be interpreted as standardized regression weights. Straight lines represent hypothesized causal pathways and double-headed curved lines represent hypothesized correlations.

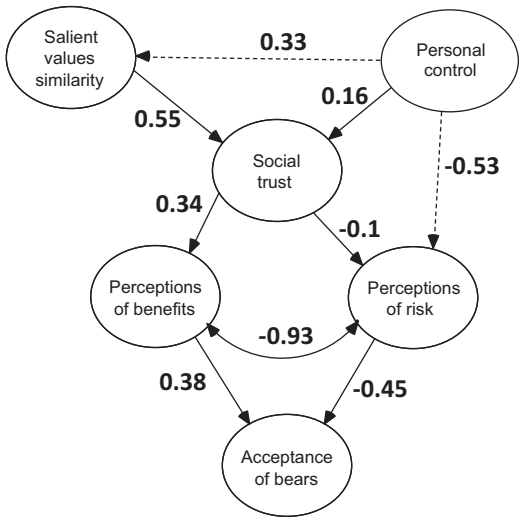

Figure 3. We obtained a better fit of our hypothesized bear acceptance model by adding 2 paths to the hypothesized model (illustrated by the dashed arrows). The coefficients on each pathway in the model can be interpreted as standardized regression weights. Straight lines represent hypothesized causal pathways and double-headed curved lines represent hypothesized correlations.

Results supported all of the relationships hypothesized in our conceptual model (Fig. 1). Specifically, personal control and values similarity exhibit a positive impact on trust; trust consequently increases perceptions of benefit and reduces perceptions of risk. Perceptions of risk decreases acceptance for black bears, whereas perceptions of benefit increases acceptance (Table 3).

DISCUSSION

Numerous researchers have pointed out the importance of understanding the public's level of acceptance for a species if conservation efforts are to be successful (e.g., Decker and Purdy 1988, Organ and Ellingwood 2000, Riley and Decker 2000*a*). Our model moves us a step closer to understanding how individuals formulate judgments about the acceptability of wildlife populations, especially individuals with a relatively low level of exposure to the species. The model identifies perceptions of risk and benefit as having comparable effects on acceptance of wildlife populations. Together, these 2 variables account for more than half of the variance in judgments concerning the acceptability of black bears in Ohio. Lischka et al. (2008) identified perceived impacts as a key variable in acceptance decisions. Conceptually, we agree with Lischka et al., but assert that researchers will gain more information by considering how perceptions of negative (i.e., risk) and positive (i.e., benefits) impacts may influence judgments of acceptability independently (McDaniels et al. 1996, Siegrist 1999, Siegrist et al. 2000). In support of this view, we note that although the single impact score used by Lischka et al. explained 32% of the variance in acceptance for white-tailed deer (*Odocoileus virginianus*) in Michigan, separating impacts into perceived risks and benefits allowed us to account for more than 60% of the variance in the acceptance for black bears. This increase in explained variance is likely due to the fact that perceptions of risk and benefit tend to be inversely related in the minds of individuals (Alhakami and Slovic 1994); so although high perceptions of risk may explain low acceptance for some individuals, high perceptions of benefits may explain high acceptance for others. Assessing perceived risk and benefit independently allows researchers to parse out the separate effect of each variable on acceptance. Additionally, managers could misunderstand why people support or oppose the recovery of large carnivores by measuring only the perceived benefit or risk, or aggregating these into a single measure of impacts instead of assessing these constructs individually. Thus, we recommend independent measurement of both perceived risk and benefit associated with a species when attempting to understand peoples' judgments concerning that species' conservation and management.

In addition to increasing our understanding of how perceptions of risks and benefits associated with a species affect judgments of acceptance, we also sought to understand factors that affect risk and benefit perceptions, and thus, influence acceptance judgments indirectly. Consistent with our hypothesized model, an individual's trust in the agency responsible for managing a species has a moderate positive impact on their acceptance for black bears—as trust increased, perceptions of benefits increased and perceptions of risk decreased, which, in turn, led to greater acceptance for bear populations. These results add to a growing literature that emphasizes agency trust as a determinant of perceived risk and the acceptability of natural resource management actions (e.g., Cvetkovich and Winter 2003, Vaske et al. 2004, Needham and Vaske 2008). Our results further highlight the importance of maintaining good relationships with stakeholders, suggesting that an individual's trust in an agency can actually affect the acceptability of wildlife populations. The results from this analysis did not identify trust as having as substantial negative effect ($\beta \geq 0.5$; Kline 2005) on risk perception as expected from other research (e.g., Siegrist

Table 3. Standardized total and indirect variable effects of independent variables on bear acceptance by Ohio residents (equivalent to standardized regression weights).

Model	Control	Values similarity	Trust	Risk	Benefit
Standardized total effects on acceptance					
Hypothesized	0.036	0.147	0.251	−0.436	0.392
Best-fit	0.297	0.095	0.174	−0.446	0.382
Standardized indirect effects on acceptance					
Hypothesized	0.036*	0.147*	0.251*	0	0
Best-fit	0.297*	0.095*	0.174*	0	0

* Different from 0 at $P < 0.05$ (based off the bootstrapped sample).

et al. 2000). Sjoberg (2001) argued that trust does little to influence the public's risk perception when they perceive the knowledge level of the scientist managing a hazard to be insufficient to safely manage the hazard, or if they deem the hazard simply uncontrollable. Perhaps lack of familiarity with ODOW and exposure to bears prevents people from gauging ODOW's technical ability to successfully manage black bears; alternatively, individuals may perceive bear behavior to be so unpredictable that actions taken by ODOW will do nothing to ameliorate the risk posed by bears. More investigation into this risk–trust relationship with other populations (particularly those with more knowledge of wildlife or experience with wildlife agencies) will help better define the conditions under which trust impacts risk, and ultimately, the acceptability of wildlife.

Modifying our hypothesized model to include direct paths from personal control to values similarity and risk perception substantially influenced the indirect effect of personal control on acceptance (Table 3). We observed that as an individual exhibits greater personal control, their level of trust in the agency increases, their perception of risk decreases and their perception of benefit increases, all of which promote greater acceptance for bear populations. The targeted use of communication messages provides a possible mechanism for increasing personal control by using interventions designed to emphasize self-efficacy, an individual's belief that they have the ability to personally control a particular situation (e.g., conflicts with wildlife). Whether an individual has a high or low self-efficacy in a given situation (e.g., an encounter with a carnivore) depends upon the previous outcomes and frequency of similar situations the individual has experienced (Zinn et al. 2008). When managers provide information to individuals with low knowledge or little experience with a situation (the population most likely to modify their behavior based on interventions) they can indirectly raise the individual's confidence in dealing with a similar situation in the future. Thus, communicating about how the public can prevent negative encounters with bears may increase acceptance for bears by increasing perceived personal control and decreasing perceptions of risk.

Our model uses theories of trust and perceived risk to predict the general acceptability of a wildlife population. We treat acceptance as a general evaluative tendency (i.e., an attitude) rather than a specific behavior or set of behaviors. When relevant behaviors can be specified (e.g., illegal killing), other frameworks (e.g., theory of planned behavior, theory of reasoned action) may be better equipped for explaining variance in the specific behavior(s) of interest. For example, Bright and Manfredo (1996) used an adaptation of the theory of reasoned action to explain >90% of the variance in one's intention to vote in support of a hypothetical wolf reintroduction. However, the behaviors of interest to wildlife managers are diverse and may vary depending upon context; in such cases, measures of acceptance are particularly useful as a general indicator of the tolerance for a species or population in a given location (e.g., black bears in Ohio).

Though the black bear population examined for this research is quite different from black bear populations in many other parts of the world, we argue that stakeholders likely are not. Current exurbanization trends across parts of North America are placing many individuals with no previous bear experience in locations where they are more likely to interact with bears. Most of our respondents had no personal experience with wild bears (approx. 85%), and thus were likely similar to residents found in the growing North American wildland–urban interface. As carnivore populations expand and as more human–carnivore interactions occur, individuals involved are likely to become less susceptible to communication-based interventions; that is, since attitudes tend to become more stable and strongly held with exposure to consistent messages and personal experience (Wu and Shaffer 1987; see generally Eagly and Chaiken 1993, Petty and Krosnick 1995), we anticipate that the malleability of public opinion will decrease with message exposure and experience. Consequently, wildlife managers need to be proactive with their communication and outreach efforts when working with human populations living in or near areas with recovering carnivore populations.

Broader applications of the model exploring different contexts (e.g., different species, different human populations, and different levels of experience with species) are needed to assess the model's generalizability beyond the current study context (i.e., black bears in Ohio). However, this empirical test demonstrates how models developed in psychology for understanding the acceptability of hazards can be used to understand acceptance for wildlife populations. This model firmly grounds acceptance capacity studies in psychological theory, and unites applied wildlife research with the broader social science community. Ultimately, this theoretical link should provide insights into additional factors that affect the acceptability of wildlife as the related psychological research continues to develop.

MANAGEMENT IMPLICATIONS

Information gained by assessing factors that affect public acceptance for carnivores can assist agencies in more effectively communicating with stakeholders, and could help agencies promote tolerance for carnivores through direct outreach efforts, as an alternative to manipulating carnivore populations (Lischka et al. 2008). Our findings suggest that tolerance for carnivores could be influenced by outreach efforts aimed at increasing individuals' trust in management agencies and their perceptions of personal control over the risks associated with a species, which affect the perceived risks and benefits associated with a species. Additionally, a strong negative relationship between perceived risks and benefits suggests that information highlighting the social and ecological benefits of carnivores could reduce individuals' perceptions of risk associated with these species, thereby increasing acceptance. To promote greater acceptance for carnivores through the reduction of perceived risk, we emphasize the importance of managers exhibiting both their technical ability to manage carnivores and providing information aimed at helping people prevent conflicts with carnivores. Respondents in urban areas of Ohio were more trusting of ODOW than respondents in rural areas, whereas

rural respondents perceived more personal control over wildlife interactions and management than those in the more urban areas do (R. Zajac, The Ohio State University, unpublished data). These differences suggest that information interventions focused on building trust may be more useful for rural populations (where trust is lower), whereas interventions focused on increasing personal control over negative interactions with carnivores may be more useful for urban populations (where perceived control was lower). Finally, management agencies and interested organizations would benefit greatly from rigorous evaluations of communication efforts, and in particular, longitudinal research aimed at determining how such interventions affect the types and frequencies of behaviors people undertake to avoid wildlife conflicts.

ACKNOWLEDGMENTS

Funding provided by the Ohio Division of Wildlife made this research possible. Many individuals were involved in this project, but a few deserve special recognition. A. Morzillo, M. Gore, and the members of the OSU environmental social science lab provided expert feedback on the survey instrument. This manuscript benefited from the insight of the JWM editorial staff and anonymous peer reviewers. Finally, the thousands of Ohioans who took the time to complete a questionnaire about bears are the most appreciated.

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Associate Editor: Miranda Mockrin.