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Perceived and Desired Outcomes of Suburban Deer Management Methods (Manuscript c)

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Abstract

Disparity among natural resource agencies and the public often arises when white-tailed deer (*Odocoileus virginianus*) must be managed in suburban areas. Managers require information as to why methods are acceptable to public constituents to resolve conflicts. We surveyed 660 residents in a suburban Illinois county to evaluate attitudes towards 5 deer management methods (archery hunts, gun hunts, sharpshooting, fertility control, none). We obtained predictive models for accepting each method using respondents' beliefs and evaluations of 9 possible management outcomes. Many reasons to accept methods involved tangible beliefs or desires that could be addressed by managers (e.g., low management costs and public participation). Alternatively, some reasons to reject methods included core beliefs (e.g., killing deer is inhumane or unnatural) which cannot be easily swayed. We recommend managers conduct surveys that incorporate perceived and desired outcomes of deer management methods to gain information that may guide management decisions and minimize disputes.

Keywords: expectancy-value model, management, *Odocoileus virginianus*, survey, white-tailed deer

Introduction

White-tailed deer (*Odocoileus virginianus*) management is often controversial and difficult to employ in urban and suburban areas (Kilpatrick & Walter, 1997; Green, Askins, & West, 1997; Messmer, Cornicelli, Decker, & Hewitt, 1997; Urbanek, Allen, & Nielsen, 2011). Although natural resource agencies and the public often agree as to why to manage deer, there is often a disparity in which deer management method is most acceptable (Urbanek et al., 2011). Lethal management such as sharpshooting and public hunts appear to be methods that both parties may agree upon when deer densities are high enough to incur damage to landowner property (Urbanek et al., 2011). Alternatively, the public often approve of non-lethal methods such as fertility control (Green et al. 1997; Stout, Knuth, & Curtis, 1997; Kilpatrick, LaBonte, & Barclay, 2007) and trap-and-relocation (Ishmael, Katsma, Isaac, & Bryant, 1995; Green et al., 1997, Messmer et al., 1997; Stout et al., 1997) which are less supported by agencies (Urbanek et al., 2011). To resolve these disparities, managers require information as to why a deer management method is acceptable/unacceptable by public constituents.

Few studies have investigated public perceptions or expectations of different deer management techniques beyond whether the method was acceptable or unacceptable (Kilpatrick & Walter, 1997; Stout et al., 1997; Dougherty, Fulton, & Anderson, 2003; Kilpatrick et al., 2007). Kilpatrick and Walter (1997) only summarized reasons to accept or reject methods using percent responses. Kilpatrick et al. (2007) compared reasons to accept and not accept a deer management method but only among archery hunters; analyses related to homeowner acceptance of methods were based on cost. Stout et al. (1997) examined Pearson correlations between the acceptability of several management techniques and possible considerations (e.g., maintaining a healthy deer population, minimize deer suffering, maximize recreational opportunities for

hunters) about each deer management technique but only found weak correlations (only 7% had correlations with $\rho > 30$). Although their study was informative, correlations do not identify causative reasons to accept or reject a method (Sokal & Rohlf, 1995), thus a more rigorous multivariate analysis is warranted. Dougherty et al. (2003) compared management beliefs and perceived outcomes between male and female respondents, but the study failed to examine specific deer management methods (e.g., archery hunts, gun hunts, sharpshooting). Gathering information as to why a technique is acceptable or unacceptable may help resolve disparities between the opinions of agencies and those of citizens and will be an invaluable aid in future management decisions.

One technique to obtain information as to why a deer management method is acceptable is to use the expectancy-value model (Fishbein & Ajzen, 1975; Ajzen, 1991). The model, $A_B = \sum b_i e_i$, suggests people's attitudes towards certain behaviors (A_B) is proportional to the sum of people's beliefs that certain outcomes associated with the behavior will occur (b_i) multiplied by their evaluations of those outcomes (e_i). This model is often used in predicting social behavior relating to recreational activities (Ajzen & Driver, 1991; Ajzen & Driver, 1992; Rossi & Armstrong, 1999; Hrubes, Ajzen, & Daigle, 2001; Daigle, Hrubes, & Ajzen, 2002), but can be easily employed for understanding attitudes towards wildlife management methods (Manfredo, Pierce, Fulton, Pate, & Gill, 1999; Dougherty et al., 2003). Dougherty et al. (2003) is the only study to our knowledge that used the expectancy-value model to assess the acceptability of deer management. These authors found female respondents held negative attitudes towards outcomes such as the reduction of deer-vehicle collisions (DVCs), maintaining a healthy deer population, and upsetting local visitors to the national park where deer were to be managed. Although important knowledge was gained, the authors could not determine the cause of the negative

attitudes towards these outcomes (i.e., whether the attitude stemmed from females thinking an outcome was likely to occur but undesirable or unlikely to occur but desirable).

Our objective was to explore attitudes toward 5 deer management methods (archery hunts, gun hunts, sharpshooting, fertility control, and no deer management) and determine beliefs and desires that cause a respondent to accept or reject a management method. Our goal was to identify specific beliefs and desires in which managers may address to resolve or minimize management disputes.

Methods

Study Area

McHenry County, Illinois is located approximately 60 km northwest of Chicago and 70 km southwest of Milwaukee, Wisconsin. It is considered 1 of the 6 counties that make up the Chicago Metropolitan Area and encompasses 1,562 km² of land and had 308,760 residents in 2010 (U.S. Census Bureau, 2010). The McHenry County Conservation District (hereafter, District) consists of >10,036 ha in 17 state nature preserves and 29 other sites throughout McHenry County that provide a combination of natural, recreational, education, and cultural resources for county residents and tourists. District biologists conduct sharpshooting, gun hunting, and archery hunting on 24 of the District areas as a proactive deer management strategy and to reduce the spread of chronic wasting disease which has been confirmed in 10 District areas since 2003. The District biologists' decision-making process regarding which deer management technique to use relates to safety, cost, recreation potential, and site-user conflicts. Similar to many natural resources agencies, District biologists are interested in understanding public beliefs regarding deer management methods and public desires in a management regime.

Site Distribution

We assessed the attitudes of McHenry County residents regarding deer management methods using a stratified, random sampling design focused on surveying residents living in closest proximity to District areas. We chose 22 District areas which had a broad range of deer densities (2-36 deer/km²), area (58-1,233 ha), and represented areas along an urban-rural gradient. Sites included a range of proactive deer management activities including archery hunts ($n = 11$); gun hunts ($n = 3$); combination of archery and gun hunts ($n = 3$); and sharpshooting ($n = 1$); no deer management was conducted on 4 sites.

Survey

We collected 100 names and mailing addresses of residents (2,200 names total) living in closest proximity to and surrounding each District area from public property tax data (McHenry County, Illinois, 2011). We selected residents living in closest proximity to District areas so their attitudes toward management could be associated with the density of deer on the nearest District area. Additionally, we believed these residents would be the most affected by management decisions (e.g., sights and sounds of gunfire) and thus we hoped targeting this group would provide a large response rate. Names of residents living directly adjacent to District borders were collected first and then names were systematically chosen at increasing distances from the borders (all <1.5 km) until 100 names were collected. Areas that included residents that were in close proximity to >1 District preserves were not selected to avoid ambiguity. All names and addresses were verified as valid using the United States Postal Service certified software CASS by the Southern Illinois University Carbondale mail center prior to sampling. A random sample of 30 residents was then chosen from each District area sample pool using sampling without replacement. We then mailed a self-administered, mail-back booklet-format survey to each

recipient to examine beliefs and attitudes about deer management methods and deer population trends.

We followed a modified version of Dillman's (1978) total design method, similar to most public surveys of wildlife in the literature (West & Parkhurst, 2002; Sullivan & Messmer, 2003; Lauber & Knuth, 2004; Storm, Nielsen, Schaubert, & Wolf, 2007; Davenport, Nielsen, & Magnun, 2010). A pre-test of the survey ($n = 15$) instrument was conducted to determine if the average citizen can competently complete and understand all aspects of the survey; syntax was changed accordingly prior to the actual survey launch. Survey methods and questions were approved by the Human Subjects Committee at Southern Illinois University Carbondale. Each recipient was mailed a cover letter explaining the interests of this study and seeking cooperation, and a questionnaire that took <25 minutes to complete. Surveys were mailed in February 2011 and were followed with 2 additional contacts to non-respondents. A new cover letter and replacement questionnaire was sent to non-respondents 6 weeks after the initial mailing. The new cover letter indicated that we had not received the resident's survey and made another appeal for participation. We telephoned a sample of non-respondents from each District area (13% of all non-respondents; 10-18% of non-respondents from each site) 11 weeks after the original communication. Phone numbers of non-respondents were found via yellowpages.com and yellowbook.com.

Surveys consisted of 23 multi-part questions that we analyzed in 3 different papers including this article (manuscripts *a,b*). In the first 2 studies, we examined non-response bias, sampling bias, and respondent reliability. Socio-demographic and behavioral characteristics of respondents were typical of McHenry County (manuscript *a*). Education and age were similar among mail and telephone respondents (i.e., non-respondents); however we found males were

more likely to return the survey while females answered telephone questions (manuscript *a*). Dougherty et al. (2003) forewarned that surveys focused on management should stratify samples to address gender response or sampling bias because females may hold different perceptions towards management methods than males. Countywide, the male to female respondent sex ratio was 1:.75 (manuscript *a*) which was more evenly distributed than that of Dougherty et al. (1:.38; 2003). Although respondents who returned the survey were slightly male-biased, their acceptability scores related to each deer management method were similar to non-respondents who were slightly female-biased (manuscript *b*). Given this similarity, we did not feel that gender played a contributing role to accepting any of these management techniques. Thus, we chose not to compare male and female respondents in this study because it was not our focus and we believed female opinions were well represented. Lastly, all respondents were found reliable and consistent in their answers regarding the acceptability of each deer management method (manuscript *b*).

In this paper, we evaluated components of the expectancy-value model (Fishbein & Ajzen, 1975; Ajzen, 1991). Survey questions explored the respondent's views on 9 possible outcomes of each deer management method (Table 1). Respondents were asked to rate how likely they thought each outcome was for each deer management method based on a 7-point scale (extremely unlikely-extremely likely). Respondents were then asked to rate the desirability of each of the outcomes, regardless of a deer management method, on a 7-point scale (extremely undesirable-extremely desirable).

We used responses in manuscript *b* that asked each respondent how acceptable each management method was based on a bipolar adjective scale (strongly unacceptable-strongly acceptable) for modeling. We also asked the respondent whether they were interested in

receiving educational information regarding each of the deer management methods and offered an opportunity to request summary results of the study.

Data Analyses

Scores were converted to a -3 (extremely unlikely/undesirable) to +3 (extremely likely/unlikely) scale. We then calculated the mean attitude (A) for each deer management method (B) for 2 groups: respondents who felt the management method was acceptable and respondents who reported the management method was unacceptable. Respondents who responded with a neutral or no opinion were left out of this analysis. We compared the attitudes (A_B) that these 2 groups held toward each deer management method using 1-way ANOVAs (PROC GLM, SAS 9.1, Cary, North Carolina) (Manfredo et al. 1999; Dougherty et al., 2003).

We also compared the beliefs (b_i) and evaluations for each outcome (e_i) that these 2 groups had for each deer management method. Most studies using the expectancy-value model assess differences between groups using 1-way ANOVAs on the belief x evaluation score of each outcome (Manfredo et al., 1999; Hrubes et al., 2001; Daigle et al., 2002; Dougherty et al., 2003). Although this type of analysis provides insight to which outcomes contribute the most strongly to a respondent's attitude, it does not infer clear results about the direction of the respondent's feelings (i.e., desirability) or perceptions of the likelihood of the outcome. In this study, we were interested in determining which beliefs, evaluations, and belief x evaluation scores contributed the most to the acceptance of each deer management method. Thus, we used logistic regression analysis (PROC LOGISTIC; SAS 9.1, Cary, North Carolina) with AIC_c model selection (Burnham & Anderson, 2002) and forward step-wise regression (Stout, Stedman, Decker, & Knuth, 1993; Riley & Decker, 2000) to regress acceptance for each deer management

method (i.e., for 5 logistic regression models) on outcome beliefs, evaluations, and belief x evaluation interactions.

We randomly selected 75% of the received surveys to develop the model and retained 25% for model testing for each analysis (Geisser, 1975). Respondents who deemed a method acceptable were coded as 1 and respondents who deemed a method unacceptable were coded as 0 for all management methods except for “no deer management.” For the no deer management method, 1 was used for respondents who thought conducting no deer management was unacceptable and 0 for respondents who believed conducting no deer management was acceptable. Variables selected for the model were tested using the forward stepwise procedure based on Wald χ^2 values (Sokal & Rohlf, 1995; Stout et al., 1993), AIC_c values (Burnham & Anderson, 2002; Lischka, Riley, & Rudolph, 2008), and Hosmer and Lemeshow goodness-of-fit tests (Sokal & Rohlf, 1995). Beliefs, evaluations, and the interaction (belief x evaluation) of each outcome were tested independently first and variables with an AIC_c value less than the null model and which had a significant χ^2 *p*-value ($p \leq .05$) were retained. The variable with the lowest AIC_c value was used to start building the more complex model. Additional variables were added individually to the model using these methods until AIC_c was minimized and the remaining variables did not contribute to the prediction (i.e., >0.05 χ^2 *p*-value). The final model was then tested using the withheld data where a predicted probability >0.50 was considered a “1” and a predicted probability ≤ 0.50 was considered a “0.”

Results

Survey response rate was 34% ($n = 222$; 20-60% per District site). Requests for information were highest for fertility control (43%), followed by gun hunts (40%), sharpshooting (39%),

archery hunts (37%), and no deer management (31%). Forty-nine percent of respondents also requested summary results.

Attitudes (A_B) of respondents who accepted and rejected each deer management method differed ($F_{1,178-201} = 5.91-34.68$; $.001 \leq p \leq .016$). The number of usable surveys (i.e., no neutral answers for method acceptability) ranged from 185-202 for each method. Each model was validated using withheld data ($n = 45-52$ surveys) and all models exhibited high levels of predictive power (Table 2).

Respondents who deemed archery hunts as an acceptable method of deer management ($n = 112$) believed it would result in a decrease in DVCs ($\chi^2_1 = 12.22$, $p < .001$) and also desired public participation in the management process ($\chi^2_1 = 7.44$, $p = .006$; Fig. 1A). Alternatively, respondents who thought archery hunting was unacceptable ($n = 38$) believed deer would die an inhumane death if this method was employed ($\chi^2_1 = 25.99$, $p < .001$).

Respondents who thought gun hunts were an acceptable method of deer management ($n = 109$) and respondents who judged gun hunts as unacceptable ($n = 43$) both did not desire a high cost of management (Fig. 1B). However, only respondents who rejected gun hunts believed that a high cost of management would be incurred using this method ($\chi^2_1 = 4.26$, $p = .039$).

Similarly, all respondents did not desire an unnatural death for deer. Yet, respondents who deemed gun hunts as unacceptable believed deer would die an unnatural death due to gun hunts more than respondents who accepted gun hunts ($\chi^2_1 = 6.82$, $p = .009$). Respondents who deemed gun hunts as unacceptable also believed this method would lead to an inhumane death for deer while respondents who accepted gun hunts did not hold this belief ($\chi^2_1 = 9.93$, $p = .002$).

There were 3 competing models for the acceptance of sharpshooting (Table 2).

Respondents who thought sharpshooting was acceptable ($n = 79$) held both stronger beliefs that

this method would not cause an inhumane death to deer and perceived this outcome less desirable than respondents who deemed sharpshooting unacceptable ($n = 55$; $\chi^2_1 = 11.23-11.59$, $p < .001$; Fig. 1C). Respondents who judged sharpshooting as acceptable also believed damage to vegetation on their personal property ($\chi^2_1 = 14.64$, $p = .001$), damage to District vegetation ($\chi^2_1 = 13.76$, $p < .001$), and DVCs ($\chi^2_1 = 13.57$, $p = .001$) would decrease whereas respondents who deemed this method unacceptable did not believe these outcomes would occur as a result of this method.

Respondents who thought fertility control of deer was acceptable ($n = 74$) believed that deer would not die an unnatural death if this method were employed more than respondents who deemed fertility control unacceptable ($n = 71$; $\chi^2_1 = 10.38$, $p = .001$; Fig. 1D). Respondents who accepted fertility control also believed deer-related zoonotic diseases would decrease whereas respondents who did not accept fertility control did not believe deer-related zoonotic diseases would decrease ($\chi^2_1 = 13.30$, $p < .001$). All respondents believed public participation was unlikely with this method; however, respondents who did not accept fertility control as a deer management method desired public participation in deer management more than respondents who thought this method was acceptable ($\chi^2_1 = 5.22$, $p = .022$). All respondents also believed deer numbers would decrease using fertility control; yet, respondents who believed this method was unacceptable did not desire a decrease in deer numbers ($\chi^2_1 = 4.87$, $p = .027$).

Respondents who thought conducting no deer management was an acceptable option ($n = 29$) did not desire a decrease in the deer population ($\chi^2_1 = 20.63$, $p < .001$; Fig. 1E). Alternatively, respondents who deemed conducting no deer management as unacceptable ($n = 110$) thought high costs of management ($\chi^2_1 = 10.26$, $p = .001$) and inhumane deaths to deer ($\chi^2_1 = 9.53$, $p = .002$) were strongly undesirable.

Discussion

Many reasons to accept or reject deer management methods involved tangible beliefs or desires that could be addressed by managers. The desire for public participation in the management process among many citizens drove respondents to accept archery hunts and reject fertility control methods. This ready and willing group of respondents to participate in the management process via hunting may alleviate high costs of deer management which is often undesired by citizens (Kilpatrick & Walter, 1997; Stout et al., 1997; Kipatrick et al., 2007). A pricey management policy was also not desired by most respondents in this study and contributed to a respondent accepting or rejecting several management methods. Given that public participation and a low cost of management were strong public desires, District managers can discard options such as fertility control, sharpshooting, and no deer management in their decision-making process.

Educational materials can also be directed to inform respondents about misconstrued beliefs with specific deer management methods (Green et al., 1997; Loker, Shanahan, & Decker, 1997; Lauber & Knuth, 2004). Many respondents who were against sharpshooting believed that if this method was utilized, damage to personal and District property by deer would not decrease. Similarly, respondents against sharpshooting and archery hunts believed DVCs would not decrease if these methods were employed. Property damage and DVCs are the top reasons to reduce suburban deer populations and thus are a cause for great concern (Kilpatrick & Walter, 1997; Stout et al., 1993; Storm et al., 2007, Urbanek et al., 2011, manuscript *a*). Managers can address these concerns and beliefs by providing examples (Kilpatrick & Walter, 1997; Doerr, McAninch, & Wiggers, 2001; Kilpatrick & LaBonte, 2003) of how a reduction in deer numbers via lethal methods have decreased damage and DVCs in other suburban and urban communities.

Respondents also were mistaken about several fertility control outcomes which contributed to whether they accepted or rejected the method. Many respondents believed fertility control would result in a decrease in deer numbers, regardless of whether they accepted the method. Respondents who held this belief are probably not aware that most fertility control methods are ineffective at quickly decreasing deer populations (Turner, Liu, & Kirkpatrick, 1992; Merrill, Cooch, & Curtis, 2006; Miller, Gionfriddo, Fagerstone, Rhyan, & Killian, 2008). Managers should utilize mass media, brochures, and other education outlets to educate citizens about known outcomes (e.g., high cost, long wait to see a decrease in deer numbers) of fertility control (Green et al., 1997; Lauber & Knuth, 2004). Some respondents who accepted fertility control also believed that zoonotic diseases related to deer (e.g., Lyme disease) would decrease. Prevalence of Lyme disease has been positively correlated to deer density (Kilpatrick & LaBonte, 2003), thus this belief may be associated with the belief that deer numbers would decrease if fertility methods were employed. Hence, managers could address beliefs regarding deer numbers and zoonotic diseases at the same time.

Respondents who believed that decreasing the local deer population was undesirable thought conducting no deer management was acceptable. This belief may stem from a core value that wildlife populations should be allowed to fluctuate naturally without the aid of humans (Kilpatrick, Spohr & Chasko, 1997; Stout et al., 1997). In this case, educational materials can be directed towards the negative impacts overabundant deer populations can have on themselves and their environment such as disrupting plant and animal community functions through increased herbivory, an increase in DVCs, and possible spread of diseases (Russell, Zippin, & Fowler, 2001; Rooney & Waller, 2003). Alternatively, if respondents did not desire a decrease because they thought deer numbers were acceptable, education could focus on irruptive patterns

and high growth rates of unlimited deer populations (Ozoga & Verme, 1982; Kilpatrick et al., 1997; McCullough, 1997), which may result in future problems.

The acceptance of each deer management method was also based on respondent beliefs and/or evaluations that are not as easily changed via education. For example, humaneness and natural deaths of deer were common considerations of citizens when deciding whether a deer management method is acceptable (Kilpatrick & Walter, 1997; Kilpatrick et al., 1997; Stout et al., 1997). Wildlife rights and welfare are core values that are developed early in life and are embedded in a person's cognition in that they influence many of an individual's beliefs about objects or events (Fulton, Manfredo, & Lipscomb, 1996). An individual that was brought up in a home where a parent hunts may perceive archery or gun hunting as a humane and natural method of deer management while a person who was reared in a house with no hunting experiences may have the opposite values (Deruiter & Donnelly, 2002). Although most (75%; manuscript *a*) respondents were not deer hunters, they may have had other hunting experiences or friends or family that hunt. These experiences may be the reason why respondents who accepted archery and gun hunts believed these methods would not lead to an inhumane or unnatural death of deer (Deruiter & Donnelly, 2002). Correspondingly, respondents who believed these lethal methods were inhumane or unnatural may have had no experience or negative experiences (e.g., experiences with unethical hunters) with hunters or hunting (Deruiter & Donnelly, 2002). Given these deep-set values, managers will not be able to persuade all (or maybe even most) citizens to accept specific deer management methods when humanness and natural deaths are contributing factors involved in a respondent's attitude regarding many deer management methods.

Management Implications

Managers require information regarding respondent beliefs and perceptions of suburban deer management methods to make the decision-making process less controversial. We recommend managers conduct surveys that incorporate perceived and desired outcomes of deer management methods. This valuable information may guide management decisions and could minimize disputes by identifying misconstrued public beliefs about specific methods. Managers can promote the outcomes of specific deer management techniques that citizens believe and desire (e.g., low costs, public participation, decrease in property damage) to potentially increase public acceptance of a method (Green et al., 1997; Loker et al., 1997; Lauber & Knuth, 2004).

Alternatively, managers must also acknowledge that some citizens will be against any lethal methods due to their core beliefs that these are inhumane or unnatural. Thus, those people may never be appeased (Fulton et al., 1996) unless non-traditional management methods (e.g., fertility control) are employed. Nonetheless, understanding respondent beliefs and perceptions of deer management methods will ultimately allow managers to guide education, resolve some management disputes, and aid in future management decisions.

Our survey included incentives (i.e., receiving summary results) and education requests for specific deer management methods. Almost half (49%) of respondents requested summary results from our study indicating a large public interest in suburban deer management decisions in McHenry County. Providing an opportunity for respondents to receive summary results increases agency transparency which may enhance the trust the public has in future management decisions made by conservation agencies (Loker et al., 1997). Similarly, Kilpatrick et al. (1997) distributed information regarding deer management methods and decisions using news releases and personal meetings with local interest groups to counter misinformation spread by animal

rights groups. In addition, a single respondent may have had an extreme opinion (e.g., vegan animal rights activist) but may realize that he or she is in the minority after reading the summary of all respondents' opinions. Although this likely will not change that respondent's core beliefs, it may dissuade them from challenging future management decisions. In addition, at least one-third (31-43%) of respondents requested information about specific management methods which is encouraging for future education endeavors. Respondents who request information may be open to become more educated which may change or strengthen their perceptions (Green et al., 1997; Loker et al., 1997; Lauber & Knuth, 2004).

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Figure Legend

Figure 1. Mean response for variables affecting a respondent's acceptance ($n = 112, 109, 79, 74, 29$, respectively) or non-acceptance ($n = 38, 43, 55, 71, 110$, respectively) of archery hunts (Fig. A), gun hunts (Fig. B), sharpshooting (Fig. C), fertility control (Fig. D), and no deer management (Fig. E) as a deer management method in McHenry County, Illinois, 2011. Y-axis represents the range of possible responses where -3 depicted the outcome was believed to be "extremely unlikely" or evaluated as "extremely undesirable" and 3 depicted the outcome was believed to be "extremely likely" or evaluated as "extremely desirable." Error bars represent standard deviation.

Table 1. Outcomes used to evaluate acceptance of deer management methods in McHenry County, Illinois, 2011. Respondents were asked to rate each outcome on a scale of -3 (extremely unlikely/desirable) to 3 (extremely likely/desirable). Variable codes were use for model selection.

Outcomes	Variable codes
<i>Human disease related to deer will decrease (e.g., Lyme Disease)</i>	Disease
<i>The number of deer-vehicle collisions will decrease</i>	DVC
<i>Damage to vegetation on personal property will decrease</i>	Prop
<i>Damage to vegetation on District areas will decrease</i>	District
<i>A high cost of management will be incurred</i>	Cost
<i>The public will be able to participate in management</i>	Public
<i>Deer will suffer an inhumane death</i>	Inhumane
<i>Deer will suffer an unnatural death</i>	Unnatural
<i>The number of local deer will decrease in the area</i>	Decrease

Table 2. Predictive models for respondents who accepted archery hunts, guns hunts, sharpshooting, and fertility control as deer management methods and for respondents who rejected no deer management in McHenry County, Illinois, 2011. Models were validated using withheld data; percent correct predictions are reported. Descriptions of variables are in Table 1; subscripts are B = belief; E = evaluation; BE = belief * evaluation interaction.

Method	Logit p model [β (SE)]	% correct
Archery hunt	$= 1.49(.33) + .55 * DVC_B(.16) + .40 * Public_E(.14) - .80 * Inhumane_B(.16)$	85
Gun hunt	$= 1.03(.22) + .09 * Cost_{BE}(.04) + .12 * Unnatural_{BE}(.04) - .34 * Inhumane_B(.11)$	88
Sharpshooting	$= .02(0.21) + .13 * Inhumane_{BE}(.14) + .45 * District_B(.12)$	60
Sharpshooting	$= .02(.21) + .13 * Inhumane_{BE}(.14) + .47 * Prop_B(.12)$	50
Sharpshooting	$= .02(.21) + .13 * Inhumane_{BE}(.14) + .45 * DVC_B(.12)$	43
Fertility control	$= -.10(.21) + .44 * Disease_B(.12) + .09 * Public_{BE}(.04) + .11 * Decrease_{BE}(.05) - .31 * Unnatural_B(.10)$	63
No management	$= -.93(.30) + .50 * Cost_E(.16) + .48 * Inhumane_E(.16) - .79 * Decrease_E(.17)$	72

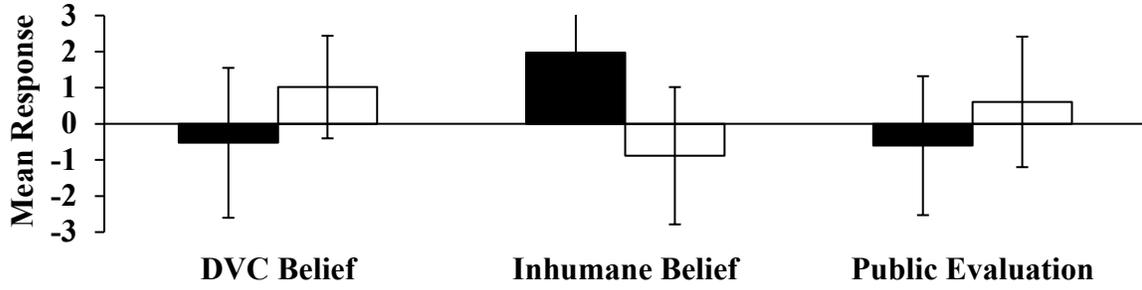


Figure 1A

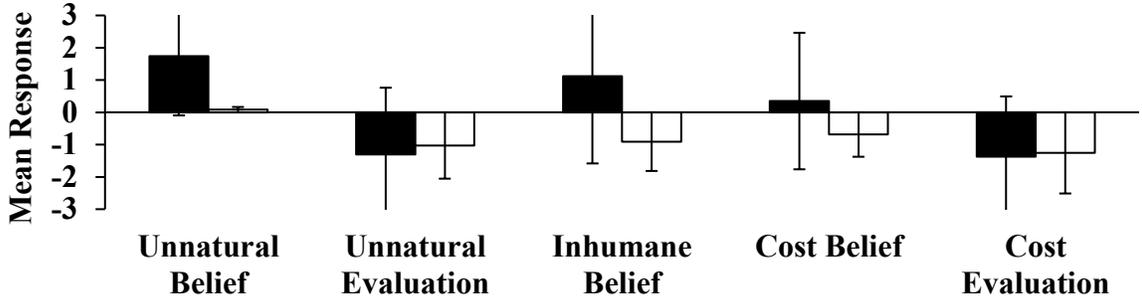


Figure 1B

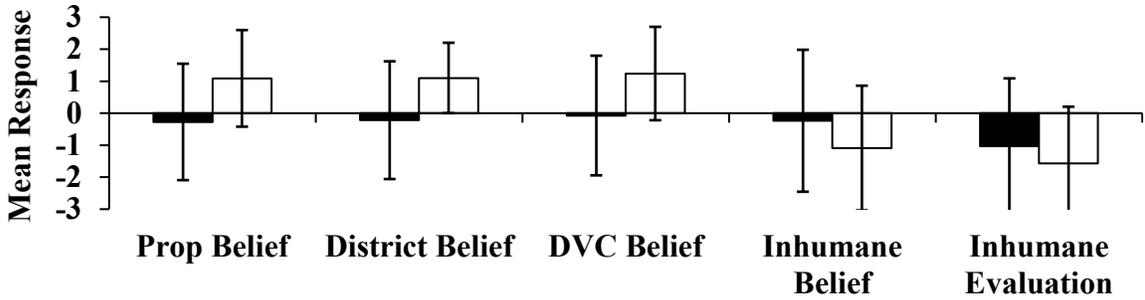


Figure 1C

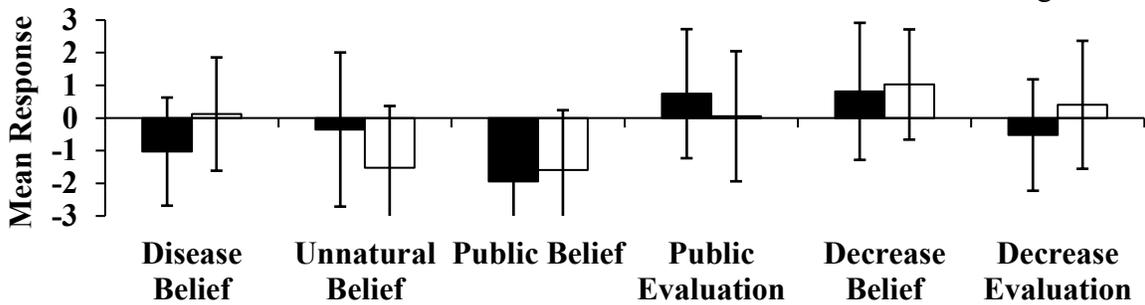


Figure 1D

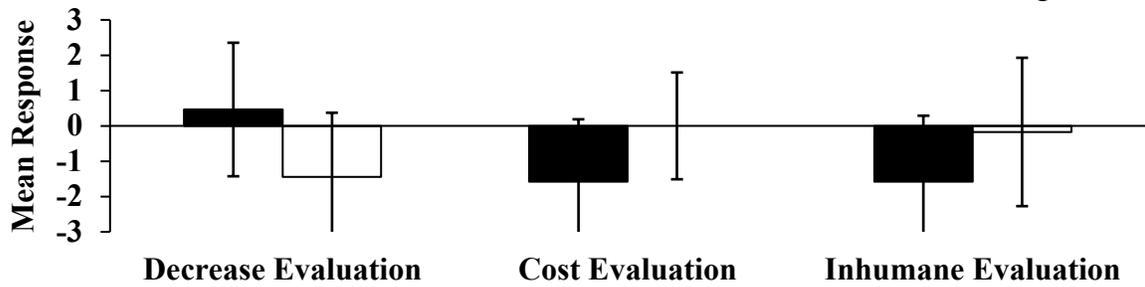


Figure 1E

