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Drivers of intervention use to protect domestic animals from large carnivore attacks

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ABSTRACT

Large carnivores are prioritized in conservation, but their co-occurrence with humans and domestic animals can generate conflict. Interventions preventing carnivore attacks are central to carnivore conservation, but are only effective if implemented. This study investigates drivers of the intention to use interventions among animal owners in Sweden based on the Theory of Planned Behavior, extended with the emotion construct Worry. Additionally, the study includes an explorative analysis investigating the processes behind this worry based on the Appraisal Theory of Emotion. In a survey comprising 1,163 animal owners, the subjective norm is identified as an important driver in the regression model of intended intervention use. Adding Worry to the model increased the amount of explained variance. Worry, in turn was mainly explained by experienced vulnerability among animal owners. This study illustrates how emotion theory can extend TPB to enhance understanding of human behavior, important for future coexistence between humans and wildlife.

KEYWORDS

Large carnivore; conservation; conflict; theory of planned behavior; appraisal theory of emotion

Introduction

With increasing human pressure wildlife species are threatened by extinction (Barnosky et al., 2011). In addition to habitat loss due to human development, facilitating human-wildlife coexistence poses a major challenge. This is particularly evident when species impact human interests other than conservation and create conflict between stakeholders (Redpath et al., 2013; Woodroffe, Thirgood, & Rabinowitz, 2005). Carnivores represent a wildlife guild of conservation priority that co-occurs with human practices and conflicts. These social conflicts occur between people who do not share similar views on what is acceptable (Vaske, Beaman, Barreto, & Shelby, 2010), especially predation on domestic animals (Chapron et al., 2014).

Until the mid-twentieth century, carnivores were bounty hunted in Sweden to reduce predation, but the contemporary carnivore policy demands a management that allows viable populations (Bostedt & Grahn, 2008). Various "interventions" have become central to carnivore conservation (Eklund, López-Bao, Tourani, Chapron, & Frank, 2017; Shivik, 2006; van Eeden et al., 2018). These interventions include traditional techniques as well as new developments (Shivik, 2006). An extensive description of the historical use of specific interventions is beyond the scope of this article, but examples of interventions include raising livestock that are less

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prone to carnivore attacks (Landa, Gudvangen, Swenson, & Røskaft, 1999), using guard dogs to deter carnivores (e.g., Andelt, 1992; Gehring, VerCauteren, Provost, & Cellar, 2010; Palmer, Conover, & Frey, 2010), using visual/auditory deterrents to startle carnivores (e.g., Davidson-Nelson & Gehring, 2010; Musiani et al., 2003), or keeping animals confined at night (e.g., Kolowski & Holekamp, 2006; Lichtenfeld, Trout, & Kisimir, 2015; Woodroffe, Frank, Lindsey, Ole Ranah, & Romañach, 2007). Sometimes more invasive methods are used, including shock collars on carnivores (Hawley, Gehring, Schultz, Rossler, & Wydeven, 2009), sterilization of carnivores to reduce dietary needs (Bromley & Gese, 2001), and translocation or elimination of carnivores that cause problems (e.g., Bradley et al., 2015; Wagner & Conover, 1999).

The rationale is that if interventions can reduce the impact of carnivores on domestic animals, acceptance of carnivores would increase. Interventions should thereby also mitigate social conflicts over carnivore presence and increase the legitimacy of carnivore conservation in coexistence with humans (Kaplan-Hallam & Bennett, 2018). To produce these desired outcomes, interventions need to be effective in reducing attacks on domestic animals. Scientific evaluations of interventions, however, are scarce (Eklund et al., 2017; Miller et al., 2016; Treves, Krofel, & McManus, 2016; van Eeden et al., 2018). If interventions are implemented without the support of stakeholders, conflicts between social groups could also increase, and challenge human-carnivore coexistence (Eklund, 2020; Højberg, Nielsen, & Jacobsen, 2017; Riley et al., 2002).

Traditional human dimensions of wildlife (HDW) research on attitudes and values about carnivores may not sufficiently predict behavioral intensions regarding interventions and management actions (Manfredo & Dayer, 2004; Manfredo, Vaske, & Decker, 1995; Whittaker, Vaske, & Manfredo, 2006; Williams, Ericsson, & Heberlein, 2002). Animal owners could regard carnivores as a threat to domestic animals yet oppose an intervention (Eklund, 2019). Understanding the drivers of behavioral intentions to use interventions is important for avoiding misdirected assumptions about stakeholders (Enck & Decker, 1997; Miller & McGee, 2001; Redpath et al., 2013).

The Theory of Planned Behavior (TPB, Ajzen, 1991; Miller, 2017) and the Theory of Reasoned Action (TRA) have been applied to investigate a broad range of HDW topics such as attitudes toward wildlife introductions (Pate, Manfredo, Bright, & Tischbein, 1996), hunting intentions (e.g., Hrubes, Ajzen, & Daigle, 2010), support for hunting management (Campbell & MacKay, 2003), human behavior in protected areas (e.g., Martin & McCurdy, 2009) and intention to participate in conservation programs (e.g., Sorice & Conner, 2010). TPB describes a person's attitude, subjective norms, and perceived control as predictors of behavioral intentions to perform a behavior. In this study the behavioral intention refers to animal owners' intention to use interventions. According to TPB beliefs about positive or negative outcomes of intervention use will determine the attitude toward the behavior; subjective norms represent the social pressure from significant others to use interventions; and perceived control are beliefs about one's ability to use interventions (Ajzen, 2019a).

Unfortunately, TPB often leaves a substantial amount of variance in behavioral intention unexplained (Miller, 2017), and does not account for emotional processes (Ajzen, 2011). The attitude construct of TPB, includes affective beliefs about positive or negative feelings (Ajzen & Driver, 1991, 1992). In this article, such affective beliefs would relate to emotional outcomes of using interventions. If animal owners believe an intervention will make them feel calm then attitudes toward the intervention are likely positive. On the

other hand, if they believe that interventions will increase their stress or worry then attitudes toward interventions may be negative. Applied to animal owners' intervention use, these affective beliefs thus relate to the *use of interventions*. The use of interventions, however, is intended to facilitate human coexistence with a different attitudinal object – the *presence of large carnivores*. Worry of carnivore attacks is an important link between carnivore presence and intervention use. Worry and fear are the main emotional outcomes among owners of domestic animals in response to carnivore presence (Eklund, 2019; Frank, Johansson, & Flykt, 2015). Although emotional reactions (e.g., worry) guide human behaviors (Dolan, 2002; Tooby & Cosmides, 1990), the TPB does not include a direct measure of emotion as a driver of behavior. The concept, however, can be included in the theory (Manfredo et al., 1995; Miller, 2017).

The emotional impact is interrelated with cognitive mechanisms in predicting behavior (Scherer, 2009). For example, the Appraisal Component Process Theory (Leventhal & Scherer, 1987; Scherer, 2009; Scherer, Schorr, & Johnstone, 2001) describes an appraisal process that involves cognitive functions on various levels of processing through stimulus evaluation checks. The structure of appraisal theory resembles the structure of TPB, but predicts an emotional outcome (Moors, Ellsworth, Scherer, & Frijda, 2013) of a rapid process that does most often not require complex cognitive thought (Scherer, 2009).

Appraisal theory (Leventhal & Scherer, 1987; Scherer et al., 2001) has been used as a tool for understanding of people's fear of encountering carnivores (e.g., Johansson, Flykt, Frank, & Støen, 2019; Johansson, Frank, Støen, & Flykt, 2017; Johansson, Karlsson, Pedersen, & Flykt, 2012). The theory describes emotional outcomes animal owners use to evaluate the presence of carnivores. Animal owners appraise the relevance of carnivores as a threat to their domestic animals, the possible implications of carnivore presence to their animals, their potential to cope with these implications, and their personal and social norms in relation to carnivore presence.

This article explored the psychological antecedents of behavioral intentions to use interventions among animal owners in Sweden. The study was divided into two parts. Part one was based on TPB and evaluated the relative weight of the original TPB constructs on intervention use and the direct impact of worry on the behavioral intention. Part two was exploratory and quantitatively assessed the processes of worry in relation to carnivores using the Emotional Appraisal Theory (Scherer et al., 2001).

Methods

Sampling

Data were collected through a web-based survey developed in Qualtrics. In total, 1,163 participants (362 female and 801 male respondents, ages 18–85 years, M = 48 years) responded to the survey. Participants included hunters with dogs, pet dog owners, reindeer herders, sheep owners, and transhumance farmers who keep their animals free-roaming during summer – groups known to suffer attacks from large carnivores on their animals (Frank, Månsson, & Höglund, 2018; Pedersen et al., 1999). In relation to the total number of survey links distributed to animal owners (n = 4,016, excluding reindeer herders where the number of distributed surveys is unknown) the response rate to at least the initial question confirming animal ownership was 43% (n = 1,713). Exclusion of

Table 1. Descriptive statistics of responses.

Group	n	Response rate[a]	Gender	Mean age (years)	Age range (years)
Hunters with dogs	633	48%	15% female	45	18–84
Pet dog owners	118	13%	64% female	48	20–74
Reindeer herders	33	NA	21% female	41	22–62
Sheep owners	323	20%	50% female	53	22–85
Transhumance farmers	56	25%	38% female	53	25–76

[a]the number of complete responses without missing values in relation to the total number of distributed links

responses with missing values (n = 550) reduced the response rate to 29%. For more detail on each subsample see Table 1.

The respondents were active in areas with large carnivore presence. Pet/hunting dog owners and sheep owners were active in counties with wolf (*Canis lupus*) and lynx (*Lynx lynx*) populations (Värmland, Dalarna, Örebro, Västmanland, Gävleborg). Reindeer husbandry and transhumance farming occur in areas with populations of brown bear (*Ursus arctos*), lynx, wolverine (*Gulo gulo*), and occasional wolves.

The survey was distributed to animal owners from October 2017 to October 2018 and respondents in each group had approximately 1 month to anonymously respond to the survey. A reminder was sent approximately 2 weeks after the initial distribution. Distribution was made via e-mail obtained from the Swedish Kennel Club (pet and hunting dog owners), the Swedish Board of Agriculture and the Sheep Breeders Association (sheep owners). Transhumance farmers received a postal letter with a QR code and URL with log in details to the survey via postal addresses from the Swedish Board of Agriculture. The link to the survey was sent to the official e-mail addresses of the reindeer herding districts available on the Sami Parliament website (www.sametinget.se) and forwarded to active herders. Due to this intermediary step in distribution between the research team and the individual herders, it was not possible to record how many links were distributed to individual herders in total.

Survey Instrument

Behavioral intention to use interventions was measured with the item "What is your stand on using some intervention to prevent carnivore attacks within the coming 3 years?" with responses given on a five-point scale ranging from "Will definitely not use any intervention" to "Will absolutely use some intervention" and coded 0–4 (Table 2). The TPB latent constructs of Attitude, Subjective Norm, and Perceived Control were measured by four and three items (for more detail see Table 2) for indexing based on the TPB Questionnaire Construction (Ajzen, 2019b). Responses to the predictor variables were also given on a five-point scale, coded from 0 to 4 with reverse coding for negative statements. To expand the TPB with an emotional construct, a measure of Worry was included as an additional predictor variable. Worry was measured with the item "Do you feel worry/fear that some large carnivore (bear, wolverine, lynx, wolf) will attack your animals?" with responses on an 11 point scale between two extremes at "None at all" and "Very strongly", coded 0–10 (Table 2). This item was used by Johansson et al. (2012) and Frank et al. (2015). New items were developed to capture the latent constructs of Relevance, Implication, Coping Potential, and Norm, considered underlying worry in the emotional appraisal process. In total, three items were included for indexing of Relevance, Coping Potential, and Norm, and six items

Table 2. Items and response scales (in italics) for TPB constructs and for emotional appraisal constructs.

Construct	ID	Items and response options
Behavioral Intention	BI	What is your stand on using some intervention to prevent carnivore attacks within the coming 3 years?
Response	*0*	*Will definitely not use any intervention.*
	1	*Will preferably avoid using any intervention.*
	2	*Either or.*
	3	*Will preferably use some intervention.*
	4	*Will absolutely use some intervention.*
Attitude	A1	That there are interventions intended to protect *animals* from attacks by large carnivores is predominately good.
	A2	That there are interventions intended to protect *animals* from attacks by large carnivores is predominantly useless. [reverse coding]
	A3	That there are interventions intended to protect *animals* from attacks by large carnivores is predominantly desirable.
	A4	That there are interventions intended to protect *animals* from attacks by large carnivores is predominantly negative. [reverse coding]
Subjective Norm	SN1	My family thinks that I should use interventions.
	SN2	My close friends think that I should use interventions.
	SN3	People with the same lifestyle as I think that I should use interventions
	SN4	Other *animal* owners in my surrounding use interventions.
Perceived Control	PC1	I experience that I have the possibility to implement relevant interventions.
	PC2	I experience that I in my everyday life can use existing interventions.
	PC3	I experience that I have time to maintain interventions to protect my animals from carnivore attacks.
Response	*0/4*	*No, absolutely not.*
	1/3	*No, hardly.*
	2/2	*Either or.*
	3/1	*Yes, to some extent.*
	4/0	*Yes, absolutely.*
Worry	EO	Do you feel worry/fear that some large carnivore (bear, wolverine, lynx, wolf) will attack your *animals*?
Response	*0*	*None at all*
	…	…
	10	*Very strongly*
Relevance	R1	I think that my *animals* will be attacked by large carnivores …
Response	*0*	*No I do not think it will happen*.
	1	*… after more than 10 years*.
	2	*… within 6–10 years*.
	3	*… within 1–5 years*.
	4	*… within a half year.*
Relevance	R2	It is important that there are interventions to prevent carnivore attacks on *animals*.
	R3	My *animals* and my animal husbandry define who I am.
Implication	I1	Carnivore attacks on *animals* are a result of political decisions.
	I2	I would be negatively affected by an attack from large carnivores on my *animals*.
	I3	Carnivore attacks on *animals* are a result of natural processes. [reverse coding]
	I4	I think that the consequences of a carnivore attack on my *animals* would be substantial.
	I5	I would be positively affected by an attack from large carnivores on my *animals*. [reverse coding]
	I6	I experience that a carnivore attack on my *animals* would be like an attack on me and my lifestyle.
Coping Potential	C1	I experience that I can influence what the consequences are of a carnivore attack on my *animals*.
	C2	I experience that I can handle the consequences of a carnivore attack on my *animals.*
	C3	The use of preventive interventions reduces my anxiety of carnivore attacks.
Norm	N1	I experience that the use of interventions is supported by existing legislation.
	N2	The interventions that are available to prevent carnivore attacks on *animals* are in line with my view of good animal husbandry.
	N3	The County Administration Board's work with interventions to prevent carnivore attacks is predictable.
Response	*0/4*	*No, absolutely not.*
	1/3	*No, hardly.*
	2/2	*Either or.*
	3/1	*Yes, to some extent.*
	4/0	*Yes, absolutely.*

The word animal was substituted for the relevant domestic animal in each owner group. ID indicates identification for each item, and code/reverse-code value for response options. Response scales are shown below dashed lines corresponding to all items in each section separated by solid lines in the table.

for indexing of Implication (see Table 2 for a detailed description). Responses to these items were given on a five-point scale coded 0–4 (Table 2).

Analysis

R Studio 3.5.1 (R Core Team, 2018) was used to perform two multiple linear regression analyses. "Owner group" affiliation was included as a factor in the analyses as situations may vary between groups, and age and gender was controlled for. Prior to analysis, responses with missing values (n = 550) were removed. Collinearity was assessed through an analysis of the Variance Inflation Factors (VIF) for each model, and for no predictor did the VIF exceed the critical cutoff value of five (Zuur, Ieno, Walker, Sveliev, & Smith, 2009).

The first regression analysis was based on TPB, with Behavioral Intention dependent on the latent independent variables Attitude, Subjective Norm, and Perceived Control. An additional regression included the factor Worry as an independent variable to explain behavioral intention. As the original theory is well established and supported by empirical work, a confirmatory factor analysis in IBM SPSS Amos 25 Graphics was used to evaluate model fit, and to select items for indexing of the latent variables. All observed TPB variables were included in the original model; Attitude item A1-4, Subjective Norm item SN1-4, and Perceived Control PC1-3 (Table 2). Variables were stepwise removed to improve model fit. The χ^2 for the evaluated models is reported but this test of exact fit may not be useful as it leads to rejection of good models when the sample size is large, and an additional test of close fit is therefore included (MacCallum, Browne, & Sugawara, 1996). Other goodness of fit measures for model selection are also included: Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA) as recommended by Jackson, Gillaspy, and Purc-Stephenson (2009), and Schreiber, Nora, Stage, Barlow, and King (2006). For good model fit the χ^2 should preferably not be statistically significant, and cutoff values for the fit indices are $CFI \geq .95$ for acceptance, $TLI \geq .95$ but can be $0 > TLI > 1$ for acceptance, and $RMSEA < .06$ (Schreiber et al., 2006) with a statistically non-significant *PClose* to indicate close fit of the model (MacCallum et al., 1996).

The second regression analysis investigated a model based on the appraisal theory of emotion (Scherer, 2009). In this analysis the emotional construct Worry is dependent on the latent appraisal constructs. An Exploratory Factor analysis was performed in IBM SPSS Statistics 25 prior to the regression analysis, to identify the fit of the developed items for Relevance R1-3, Implication I1-6, Coping Potential C1-3, and Norm N1-3 (Table 2). The results guided the construction of independent variable indices.

Results

Drivers of Behavioral Intention to Use Interventions

The Confirmatory Factor Analysis of TPB constructs guided model selection for the inclusion of items in the regression analysis. All models had χ^2 ($p < .001$) which indicated poor fit, but this statistic is sensitive to large sample size and instead other goodness of fit measures were relied upon for model selection. The best model fit was established for model 3 ($RMSEA$ = .03, $PClose > .05$), for which the recommended fit indices are reported

Table 3. Indices of model fit for the confirmatory factor analysis of model 1, 2, and 3.

Model	CFA (latent: observed)	χ^2 (df)	RMSEA	PClose	TLI	CFI
1	Attitude: A1, A2, A3, A4 Subjective Norm: SN1, SN2, SN3, N4 Perceived Control: PC1, PC2, PC3	342 (41)	.77	.00	.95	.96
2	Attitude: A1, A2, A4 Subjective Norm: SN1, SN2, SN3, N4 Perceived Control: PC1, PC2, PC3	178 (32)	.06	.02	.97	.98
3	Attitude: A1, A2, A4 Subjective Norm: SN1, SN2, SN3 Perceived Control: PC1, PC2, PC3	57.8 (24)	.03	.99	.99	.99

Cutoff values are provided in the Methods-section.

in Table 3. Based on the results and recommended cutoff values, means indices were created with three observed variables to represent each latent TPB construct: Attitude (α = .84), Subjective Norm (α = .92), and Perceived Control (α = .85).

Animal owners expressed a favorable intention to use interventions on average (M = 2.78, SD = 1.24, range = 0–4) though the strength of the intention varied between groups (Table 4). The regression analysis of Behavioral Intention as a dependent variable of Attitude, Subjective Norm, Perceived Control, Worry, Owner Group, Gender, and Age revealed an insignificant influence of gender and age (partial R^2 = .001, p > .05) on Behavioral Intention. These variables were thus removed from the model. For the remaining constructs, the regression analysis revealed that with TPB constructs only, 22% of the variance in Behavioral Intention was explained, adjusted R^2 = .22, F(3, 1159) = 106.80, p < .001. Including Worry in the model increased the explained variance to 27%, adjusted R^2 = .27, F (4,1158) = 105.90, p < .001, and with the addition of Owner Group the model explained 28% of the variance in Behavioral Intention, adjusted R^2 = .28, F (8, 1154) = 56.82, p < .001. The largest variance in Behavioral Intention was explained by Subjective Norm (partial R^2 = .15, p < .001), followed by Worry (partial R^2 = .05, p < .001), Owner Group (partial R^2 = .05, p < .001), and Perceived Control (partial R^2 = .02, p < .001). Attitude did not have a statistically significant effect on behavioral intention to use interventions in either model (see Table 5 for final model statistics).

Drivers of Worry

The Exploratory Factor Analysis with Varimax Rotation revealed a better correspondence of the emotional appraisal items as three constructs, instead of the original four. These deviated from the initial theoretical model, suggesting a failure to capture the original constructs of Emotional Appraisal Theory. The analysis proceeded with the three new latent constructs. The first of the new constructs included items R1, R2, I1, I3, and I6 (Table 2), but R2 was removed to improve internal consistency in the index (α = .72, M = 11.51, SD = 3.55). This new construct was named "Vulnerability" as the common theme related to carnivore presence being out of the individual owner's control and beliefs about the risk and consequences of carnivore attacks. The second new variable included items C1, C2, C3, N1, and N2 (Table 2). This new variable was labeled "Potential for Action" (α = .74, M = 8.29, SD = 4.47) as items relate to the individual's potential to take action and use interventions. A third new variable included items I2 and I4 (Table 2) but due to a low internal consistency this variable was not included in further analysis (α = .64, M = 7.38, SD = 1.18). Item I5 was removed prior to analysis due to a skewed frequency

Table 4. Descriptive statistics.

Measure	Mean	Standard Deviation	Range
Worry			
Hunting dog owners	8.04	2.420	0.00–10.0
Pet dog owners	4.69	3.268	0.00–10.0
Reindeer herders	9.73	1.008	5.00–10.0
Sheep owners	6.66	2.903	0.00–10.0
Transhumance farmers	8.25	2.193	2.00–10.0
Vulnerability			
Hunting dog owners	3.22	0.604	0.00–4.00
Pet dog owners	1.92	1.035	0.25–4.00
Reindeer herders	3.14	0.508	2.00–4.00
Sheep owners	2.51	0.955	0.00–4.00
Transhumance farmers	2.93	0.748	1.00–4.00
Potential for action			
Hunting dog owners	1.29	0.764	0.00–3.80
Pet dog owners	1.81	0.723	0.00–3.60
Reindeer herders	1.35	0.716	0.00–2.40
Sheep owners	2.31	0.832	0.00–4.00
Transhumance farmers	2.02	0.805	0.40–3.60
Behavioral intention			
Hunting dog owners	2.82	1.231	0.00–4.00
Pet dog owners	2.04	1.317	0.00–4.00
Reindeer herders	3.70	0.637	2.00–4.00
Sheep owners	2.85	1.179	0.00–4.00
Transhumance farmers	2.89	1.171	0.00–4.00
Attitude			
Hunting dog owners	2.25	1.193	0.00–4.00
Pet dog owners	2.65	1.245	0.00–4.00
Reindeer herders	2.44	1.183	0.00–4.00
Sheep owners	3.16	0.943	0.00–4.00
Transhumance farmers	3.05	0.936	1.00–4.00
Subjective norm			
Hunting dog owners	3.14	0.938	0.00–4.00
Pet dog owners	2.49	1.062	0.00–4.00
Reindeer herders	3.13	0.946	1.00–4.00
Sheep owners	3.19	0.907	0.00–4.00
Transhumance farmers	3.07	1.006	0.00–4.00
Perceived control			
Hunting dog owners	1.82	1.038	0.00–4.00
Pet dog owners	2.39	1.022	0.00–4.00
Reindeer herders	1.46	0.924	0.00–3.33
Sheep owners	2.48	0.965	0.00–4.00
Transhumance farmers	2.20	0.921	0.00–3.33

distribution and items R3 and N3 (Table 2) were removed as the analysis revealed they did not clearly belong in any of the new constructs.

On average, animal owners expressed strong levels of worry that their animals would be attacked by a large carnivore (M = 7.38, SD = 2.86, range = 0–10). Descriptive statistics for separate owner groups are presented in Table 4. The regression analysis including means indices of "Vulnerability" and "Potential for Action," "Owner Group," "Gender," and "Age" revealed a negligible influence of gender and age (partial R^2 = .003, p < .05) on the dependent variable Worry. Gender and age were thus removed from further analyses of Worry. Together Vulnerability, Potential for Action, and Owner Group explained 44% of the variance in Worry, adjusted R^2 = .44, $F(6, 1156)$ = 152.30, p < .001. The largest variance is explained by Vulnerability (partial R^2 = .41, p < .001), followed by the Owner group (partial R^2 = .03, p < .001), and Potential for Action (partial R^2 = .01, p < .001). See Table 6 for final model statistics.

Table 5. Model estimates for regression of the behavioral intention to use interventions.

Factor	B	SE	t-value	p-value
Attitude	0.002	0.028	0.060	.952
Perceived Control	0.194	0.033	5.808	< .001
Subjective Norm	0.461	0.035	13.075	< .001
Worry	0.096	0.013	7.576	< .001
Owner Group Affiliation:	**Intercept**			
Pet dog owner (reference)	-0.020	0.163	−0.121	.904
Hunting dog owner	0.269	0.115	2.342	< .05
Reindeer owner	1.057	0.218	4.860	< .001
Sheep owner	0.275	0.118	2.327	< .05
Transhumance farmer	0.280	0.178	1.577	.115

The intention to use interventions is described by TPB constructs extended with the emotional factor worry and group affiliation. For the categorical variable "Owner group affiliation" intercepts and test of statistical significance are in relation to the reference group "Pet dog owners."

Table 6. Model estimates for regression of worry.

Factor	B	SE	t-value	p – value
Potential for Action	−0.444	0.091	−4.866	< .001
Vulnerability	1.717	0.092	18.604	< .001
Owner Group Affiliation:	**Intercept**			
Pet dog owner (reference)	2.195	0.353	6.213	< .001
Hunting dog owner	0.886	0.240	3.697	< .001
Reindeer owner	2.749	0.433	6.344	< .001
Sheep owner	1.182	0.246	4.806	< .001
Transhumance farmer	1.917	0.363	5.288	< .001

Worry is described by the modified Emotional Appraisal constructs extended with group affiliation. For the categorical variable "Owner group affiliation" the intercept and test of statistical significance are reported in relation to the reference group "Pet dog owners."

Discussion

Research on human behavior and behavioral intentions has long been dominated by TPB and TRA (Miller, 2017). In this article, TPB alone explained 22% of the variance in behavioral intention, which is slightly lower than the findings in the meta-analysis of TPB by Armitage and Conner (2001). In this study the TPB is combined with a direct measure of worry to expand the overall understanding of what drives animal owners' intention to use interventions to prevent carnivore attacks on their animals. The need for theoretical development in the HDW field is thereby addressed by investigating the possibility of using direct emotional constructs to explain an increased amount of variance in behavioral intentions relating to wildlife management (Manfredo et al., 1995; Miller, 2017). This approach was shown to be fruitful as the explained variance in intention increased through the inclusion of the Worry construct, just as an emotional construct increased the explained variance in the study by Brosch, Patel, and Sander (2014). Additionally, the study explores ways to quantitatively evaluate the antecedents of emotion, in this case worry for carnivore attacks, based in the Appraisal Component Process Theory (Leventhal & Scherer, 1987; Scherer, 2009; Scherer et al., 2001). The results from this exploratory part of the study provides the HDW research community and practitioners with a greater understanding for the psychological processes that generate worry for carnivore attacks.

The relative importance of each construct to predict a behavioral intention will vary in different situations and settings (Ajzen, 1991), and it is possible that the relative weights

transfer to observed behavior at varying degrees, as observed behavior is not always entirely explained by behavioral intention (Armitage & Conner, 2001). Still, the influence of Worry on behavioral intention in this study indicates that the inclusion of emotional constructs can provide additional insights to the understandings of human behavior in wildlife management. Therefore, this study supports the development of new predictors of TPB in the field of HDW to get a deeper understanding of wildlife-related behaviors (Miller, 2017).

The largest variance in animal owners' behavioral intention to use interventions was explained by subjective norms. This construct reflects the owners' perception of how "significant others" think they should act. For a greater uptake of interventions, there may be implications for how communication is targeted as it is not merely the owners' own view of intervention use that determine the intention to use interventions, but also the views of people around them. The influence of norms could hinder behaviors toward which an individual animal owner is otherwise positive (Ellis-Iversen et al., 2010). Speculatively, the weighted influence of normative beliefs could vary in other systems, cultures, and countries as a result of the strength of social organization within included owner groups. In cases when peers and family are important in the recruitment to animal ownership, norms could be expected to have a big influence also on the views of best husbandry practices. Such influences of family and role models as well as community networks and organizations have been highlighted as important for recruitment to at least the hunter community (Larson, Stedman, Decker, Siemer, & Baumer, 2014). Researchers in the HDW field should be aware of the impact that norms may have when communicating for instance levels of acceptance of interventions (Eklund, Johansson, Flykt, Andrén, & Frank, 2020; Frank et al., 2015) which could lead to cascading effects that further increase the strength of acceptance or opposition tendency in a target population (Schultz, Khazian, & Zalenski, 2008). Investigations of causes and drivers for acceptance, for instance, relevance or implications of interventions, are important to provide an understanding of "why" and not simply "that" interventions are accepted or opposed (Eklund, 2019; Eklund et al., 2020). Combining quantitative and qualitative surveys in a mixed methods approach could provide depth as well as breadth to the understanding of intervention use (Austin, Smart, Yearly, Irvine, & White, 2010).

The "Owner group" affiliation also explained some variance in intention to use interventions. Previous findings have indicated that the appraised relevance of using interventions will vary between different owner groups due to differences in the believed effectiveness and feasibility of interventions, but also due to differences in the perceived threat of carnivore presence (Eklund, 2019; Eklund et al., 2020). The animal owners may also find themselves in slightly different historical contexts when it comes to intervention use, and may therefore consider different interventions when responding to general questions of intervention use, based on the availability and tradition of intervention use in their practice. The study did not control for what specific interventions animal owners considered when responding, as the focus was a more general intention to use contemporary interventions. Other studies do, however, provide a more detailed context and understanding of end-user acceptance of interventions, and the reasoning behind acceptance (Eklund, 2019; Eklund et al., 2020).

Including Worry increased the explained variance of behavioral intention in the model. Worry has previously been highlighted as an important link between carnivore presence and intervention use (Eklund, 2019). The findings of this study support this link, indicating that an

increasing worry leads to an increasing intention to use interventions. From a carnivore management perspective, this emphasizes the importance of developing and providing relevant interventions to aid animal owners' coping with carnivore presence and reduce worry. Further support is provided by the analysis exploring antecedents of worry. The analysis identified a significant negative effect of "Potential for Action" on the experienced worry. This construct relates to the individual's sense of control and fulfilled preconditions for intervention use rather than to internal action tendencies (Lowe & Ziemke, 2011). The provision of relevant interventions could provide some level of control, and thereby aid owners' coping with the worry of carnivore presence (Eklund, 2019). However, interventions must be relevant for animal owners. Even few relevant interventions likely better support an experienced potential for action than a larger number of interventions that do not meet the needs of animal owners by being effective, supported by legislation, and in line with the owners' view of good animal welfare (Eklund, 2019).

The largest variation in Worry was explained by an experienced vulnerability of animal owners in relation to large carnivore presence. Whereas carnivore managing authorities, managers, and researchers can aim to increase animal owners' "Potential for Action" by evaluating and providing effective interventions within the framework of adaptive carnivore management, reducing vulnerability as such is beyond this level of carnivore management and would demand political decisions. Overall, the modified appraisal variables explained a large proportion of the variance in Worry, although the original constructs of the Appraisal Theory were not captured in this study. Further exploration and development of variables through this parsimonious and theory-driven approach is thus needed in the future (Brosch et al., 2014; Scherer, 2009) and would likely benefit future HDW research.

Using a web-based survey to reach respondents was considered a suitable method as internet use in Sweden is high with 93% of the population (62% in the 75–85 year age group) having internet access at home, and about 80% reporting to use internet on a daily basis (Statistics Sweden, 2016). Nevertheless, the response rates in this study were lower than previous mail surveys on similar topics in Sweden, but this may be expected for web-based surveys (Fan & Yan, 2010; Shih & Fan, 2008). The representativeness of the sample in relation to the entire population of animal owners is unknown. It is possible that respondents find intervention use more relevant than other animal owners. If respondents to the web-based survey are more comfortable in using technology than non-respondents this could also imply a bias toward using intervention technology. Fewer responses were received from reindeer herders than from other groups, most likely reflecting the inability to directly distribute the survey link to individual reindeer herders. Despite the small sample, including this group in the analyses was deemed important considering the relevance of the topic to reindeer herders. Slightly higher response rates were observed among hunters in comparison to other groups, a tendency also observed in previous work (Ericsson & Heberlein, 2003) and which may reflect the perceived relevance of the survey in different groups. Similarly, lower response rates of pet dog owners may reflect a lower relevance of the topic in this group (Eklund, 2019).

Acknowledging the need and possibility for the conservation of wild animals to co-occur with human practices (Chapron et al., 2014), the human dimensions of wildlife conservation and management are a research field on the increase (Bruskotter & Shelby, 2010; Manfredo, 1989). Human behaviors and behavioral intentions are to some extent explained by cognitive reasoning, and in relation to wildlife such patterns have been explored for various situations and systems (Campbell & MacKay, 2003; Hrubes et al.,

2010; Rossi & Armstrong, 1999; Shrestha, Burns, Pierskalla, & Selin, 2012; Willcox, Giuliano, & Monroe, 2012). In future research, the influence of emotion on human behavior and decision-making should be considered to enhance the understanding of human-wildlife systems for coexistence between humans and wildlife.

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