Received: 9 March 2023 | Revised: 28 March 2024 | Accepted: 8 April 2024

DOI: 10.1111/csp2.13152

CONTRIBUTED PAPER

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access

WILEY

A conciliatory and persuasive social campaign changes owner behavior to reduce cats' hunting

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Funding information
New Zealand Companion Animals Trust

Abstract

Solutions to the cats-hunting-wildlife environmental conflict could benefit from social science approaches. Our Theory of Planned Behavior questionnaire—informed by an elicitation survey of cat owners at veterinary clinics about their attitudes, norms, and beliefs regarding bringing their cats inside at night—surveyed 158 cat owners across 20 veterinarian clinics in four cities. It revealed that wildlife conservation was not influential on cat owner intention but veterinarians, cat safety, peers, and household members were. Thus, we designed a social marketing campaign with two treatments: (1) a veterinarian/cat safety message or (2) social/family norm message. Thirty-four veterinary clinics received one of the two campaign posters or served as the control group. Customers ($n = 510$) received a "cat welfare" survey and then a pamphlet with the advocated message, and a follow-up survey by email or telephone 3–6 weeks later (69% response rate). Campaign messaging significantly increased the number of cat owners who reported bringing their cats inside at night compared to the control group. The social/family norm message was most effective. Although rudimentary, the campaign generated measurable changes in cat owner intention and behavior. Conservation campaigns informed by co-benefits for cat owners may reduce cats' hunting and be conciliatory ways of transcending environmental conflict.

KEYWORDS

animal welfare, behavior, campaign, cat, depredation, Theory of Planned Behavior

1 | INTRODUCTION

The most difficult-to-solve environmental conflicts are those between stakeholder groups with equally principled but opposing positions (Lynn, 2006), such as the conflict between companion animal owners and wildlife conservationists (Lynn et al., 2019). They share common values with respect to animals. Many cat owners consider themselves conservationists and many conservationists own pets. But they adopt ethical positions based on the welfare and rights of the animals about which they care most. It is a nuance in their prioritization that is different. Thus, the debate concerning domestic cats' predation of wildlife is among the most divisive in conservation

research and practice (Lynn et al., 2019), particularly in countries such as New Zealand (where this study occurred), Australia, and the United States, to the extent that a compromise seems remote. The conflict is unfortunate because "both conservation biology and animal welfare are marginal human activities with relatively little power in these times. Neither can afford to become diverted by internal conflict when they share a common goal—in this case improved welfare for cats and wildlife both" (Hadidian, 2021, p. 8; see also Crowley et al., 2020).

Biodiversity science, practice, and advocacy have mostly taken a knowledge (or awareness)-deficit and "command and control" approach when engaging with other stakeholders whose participation is necessary for a solution. This approach assumes that, once enlightened with scientific (e.g., ecological) information, a stakeholder community will become sympathetic and change their behavior (Kidd et al., 2018). Or, if mandated to do so by science-informed policy and regulations, that they will comply (Trouwborst et al., 2020). However, such top-down approaches often backfire because stakeholder behavior is primarily driven by values, not knowledge (Leong et al., 2020; Manfredo et al., 2017; Schultz, 2011). Repeating information that challenges stakeholder's values may also marginalize them, leading to disengagement, entrenched behavior, noncompliance, and more conflict (Burns & Medvecky, 2018; Crowley et al., 2020; McLeod et al., 2019; Rohlf et al., 2010). A different approach is required.

The challenge for conservation science on issues about which there is deep-seated conflict is to identify the common underlying values, beliefs, and co-benefits shared by opposing stakeholder groups. These might serve as the basis for analytically building a compromise and advocating behavior change. It is an approach that has been effective in public health controversies (Ajzen, 1996; von Haeften et al., 2001) and for encouraging pro-environmental behaviors (Bain et al., 2016; Bamberg & Möser, 2007; Mancha & Yoder, 2015), but is still an emerging practice in biodiversity conservation (Clayton et al., 2013; Kidd et al., 2018; Miller, 2017). Fortuitously, the challenge of reducing domestic cats' predation on wildlife appears to be a good candidate for values-based consensus and behavior change research and practice (MacDonald, 2015; McLeod et al., 2019).

Hunting by domestic cats can pose a significant risk to prey population persistence and biodiversity (Kays et al., 2020; van Heezik et al., 2010), leading conservationists to call for greater control and regulation of cats (Legge et al., 2017; Loss et al., 2013). Cat owners are critical stakeholders central to reducing their cats' hunting (Crowley et al., 2019, 2020; Kikillus et al., 2017; MacDonald, 2015), yet most efforts to change cat owner behavior have been styled in the traditional "command and control" or knowledge-deficit approaches (McLeod et al., 2019). The result has been an increase in conflict and sometimes regulations that are difficult to enforce, resulting in poor compliance (Elliott et al., 2019; McLeod, Driver, et al., 2017; McLeod, Hine, et al., 2017; Trouwborst et al., 2020; van Eeden et al., 2021).

Generating more information that casts cats as a threat to biodiversity and using that negative framing to convince cat owners to manage their cats differently is counter-intuitive and ultimately leads to ineffective campaigns. Instead, we could attempt to understand and work with the beliefs, values, and perceptions of cat owners to arrive at a mutually beneficial compromise (McLeod et al., 2019). Recent studies have taken this more inclusive and conciliatory route by, for example, investigating how changing the care of cats (e.g., human-initiated play and higher protein diets) in ways aligned with cat owner's values (i.e., fostering their relationship and cat welfare) reduces cats' propensity to hunt (Cecchetti et al., 2020, 2021); a cat and conservation win-win (see also MacDonald, 2015; McLeod, Hine, et al., 2017). The possibility that cat owners might also be motivated to confine their cats, thus limiting their hunting, has also been considered as a means of reducing cats' impact on biodiversity (van Eeden et al., 2021).

New Zealand is an interesting case study in the cat-wildlife conservation debate because rates of cat ownership and the proportion of cat owners who allow their cats to roam are high (summarized in Linklater et al., 2019), even though biodiversity conservation and the cat-wildlife debate have had a high public profile (Kikillus et al., 2017). In a previous cat owner behavior-change prioritization study there, we identified keeping cats inside at night as the cat owner behavior most likely to be adopted and which limits the time during which cats can hunt (Linklater et al., 2019). In this article, we apply the Theory of Planned Behavior (TPB) (Ajzen, 1991; Ajzen & Fishbein, 1980) to identify an array of co-benefits for cat owners of keeping their cats inside at night. We then use those to design and undertake a simple advocacy campaign and evaluate its influence on cat owners' behavior. Our aim was to test the effectiveness of a stakeholder-values-based approach, grounded in psychological theory, to diffuse the conflict between wildlife conservation and cat ownership and achieve incremental progress toward a mutually beneficial solution. Our approach is to make conservation science not just a source of conservation-aligned information but also a pathway to conflict resolution and progress.

2 | ETHICS STATEMENTS

The study was approved by the Victoria University of Wellington's Human Ethics Committee (#23123). Acknowledging that our scientific topic and practice are values-based and the emerging need for reflexivity in applied conservation science (Boyce et al., 2021), the authors provide a position statement (Supporting Information S1).

3 | METHODS

The development and evaluation of our behavior change campaign for cat owners had three parts. In Study 1, after recruiting veterinary clinics to the study, we used elicitation surveying to detect the most commonly held attitudes, norms and beliefs of their cat-owning customers. In Study 2, we applied the TPB to identify which attitudes and beliefs were most salient because they might facilitate co-benefits and inform an advocacy campaign. Finally, in Study 3, we implemented an elementary campaign to "bring cats inside at night," designed as a treatment-control experiment, to measure its influence on cat owner intentions and behavior.

3.1 | Clinic and customer recruitment

We contacted all small-animal veterinarian clinics ($n = 44$) in four New Zealand city centers (Auckland, Wellington, Palmerston North, and Dunedin) to recruit veterinary clinics for the three studies. A preliminary letter was sent to each clinic introducing the research project and seeking permission to survey their customers. We telephoned each clinic to confirm participation. In the absence of a response, we telephoned again and emailed the clinic.

To recruit veterinary clinic customers to our study, we stationed a research assistant in each participating clinic's waiting room. Cat-owning customers were identified as they checked in to the clinic's reception for their appointments. While each cat owner waited for their appointment, and following a protocol and introductory script, the assistant asked them to participate in a study on cat welfare and ownership. Customers who agreed were handed materials depending on which study they were recruited for: elicitation, TPB, or advocacy campaign.

3.2 | Study 1: Elicitation

We used an elicitation survey (Ajzen, 1991; Fishbein & Ajzen, 2010; Middlestadt et al., 1996) to identify salient attitudes, normative beliefs, and perceptions about control for keeping cats inside at night among participating cat owners. Participants completed a written survey (Supporting Information S2) with three open-ended questions: (1) what are the advantages and disadvantages of keeping a cat inside at night? (attitudes); (2) which individuals or groups would be supportive or not supportive of keeping a cat inside at night? (normative beliefs); and (3) what factors would enable or make it impossible to keep a cat inside at night? (owners' beliefs about their control). The questionnaire took no more than 5 min to complete, was confidential, and was administered in March 2015.

Respondent answers were categorized based on a coding frame (Saldana, 2015). The lead author and a research assistant independently read and categorized the responses using the same coding frame.

3.3 | Study 2: TPB questionnaire

General attitudes do not predict behavior (Ajzen, 2005; Manfredo, 2008). Instead, according to the TPB, the principal predictor of a specific behavior is the intention to engage in the behavior during a given time frame, which is influenced by attitudes, subjective norms, and perceptions about behavioral control of that specific behavior (Ajzen, 1991; Ajzen & Driver, 1992; Fishbein & Ajzen, 2010) (Figure 1).

Following Ajzen's (1991) recommendation, we developed statements in the TPB questionnaire based on our elicitation study (Supporting Information S3, Table 1) (e.g., Downs & Hausenblas, 2005). For a more detailed description of statement development, refer to Ajzen (2019). Six beliefs emerged from the elicitation study (i.e., responses to the question "what are the advantages and disadvantages of keeping a cat inside at night?") and were developed into statements for the TPB questionnaire (Supporting Information S3, Table 1). Five normative beliefs (i.e., responses to "which individuals or groups would be supportive or not supportive of keeping a cat inside at night?") and four perceived-control beliefs (i.e., responses to "what factors would enable or make it impossible to keep my cat inside at night?") were also translated into statements for the TPB questionnaire. In addition to the questions that were based on the elicitations study, following Ajzen's (2019) recommendation, questions that assessed direct beliefs were also incorporated into the TPB questionnaire. Five direct attitudinal beliefs (e.g., "overall I think that keeping my cat inside all night is enjoyable"), four direct normative beliefs (e.g., "people who are important to me keep their cats inside at night"), and three direct control beliefs (e.g., "I

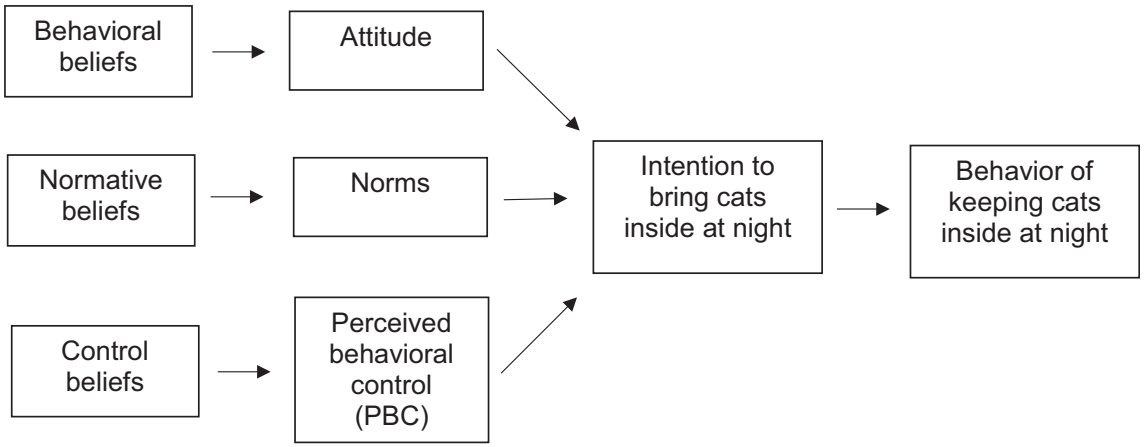

FIGURE 1 Theory of Planned Behavior (Ajzen, 1991) as applied to keeping cats inside at night.

can control keeping my cat inside all night") were included in the TPB questionnaire.

All statements were randomly dispersed in the questionnaire following recommendations by Ajzen (1996, 2005). Respondents assessed each statement based on a unipolar scale (i.e., 1 *strongly agree* to 7 *strongly disagree*) with the endpoints consistent throughout the questionnaire, that is, 1 *always on the left-hand side* and 7 *on the right-hand side* (Dilman, 2007).

Each cat owner's future intention was measured by three questions (TPB Questionnaire: Supporting Information S3). Also, participants were asked to indicate the night-time husbandry of their cats over the preceding month (i.e., their past behavior). Thus, we could compare the influence of respondents' past behavior with future intentions.

Participants also provided information on their age, gender, and education level to describe our responding population. The questionnaire was piloted with five individuals and changes made based on feedback. The TPB questionnaire was administered between July and November 2015.

Analysis of the TPB questionnaire was conducted in three stages. First, we validated the measures used. The reliability of the constructs was assessed using Cronbach's alpha (Nunnally, 1978). The assumptions of normality and sphericity were tested using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity. A confirmatory factor analysis (CFA) was conducted to test the construct validity for each measure. Second, we tested the TPB model using structural equation modeling (SEM) to assess the relationships between attitude, normative, and perceived behavioral control (PBC) beliefs, and with intention. Finally, we used a multiple indicators and multiple causes model (Kline, 2015) to explore the individual beliefs, rather than the composites, that were significantly predictive of intention (de Leeuw et al., 2015) as it will be the individual beliefs that would become the foundation of the behavior-change campaign (von Haeften et al., 2001).

3.4 | Study 3: Advocacy campaign

Based on the nine salient beliefs identified as significantly linked to intention from our TPB questionnaire, we developed two treatments for a behavior change campaign, implemented an experimental campaign at veterinarian clinics, and measured the impact on cat owners intentions and behavior by surveying them before and after they were recruited to the campaign treatments or control (von Haeften et al., 2001).

Each treatment was presented in the form of a different poster and pamphlet. Building upon Kahneman's (2011) observation that two decision-making processes are used by people to make decisions, one side of the pamphlet was a simple, largely pictorial, message based on the salient and normative beliefs. On the second side, we included more facts that aligned with those salient beliefs (Figure 2a,b).

The first treatment illustrated a child and cat enjoying being with each other to bring to mind and integrate the belief and social norm that "overall I think keeping my cat inside at night is the right thing to do" with the attitude that "having my cat inside at night is extremely desirable," and the PBC belief that "I am more likely to keep my cat inside all night if they liked staying inside," with the normative belief "people in my household think keeping my cat inside all night is a good thing." (Figure 2a). Its illustrated message: "I love it when Fluffy sleeps on my bed" was supported in the pamphlet with

TABLE 1 Questionnaire based on the Theory of Planned Behavior. Statements assessed the impact of attitude, norms, and perceived control on keeping cats inside at night.

Construct	Question	Mean (SD)	Correlation to intention
Attitude	My cat is safer if it spends the night inside[a]	5.51 (0.152)	.561
	Keeping my cat inside all night will protect native wildlife[a]	4.70 (0.178)	.374
	Keeping my cat inside at night reduces its injuries from cat fights[a]	5.62 (0.149)	.485
	My cat likes to come inside at night for shelter[a]	5.58 (0.151)	.249
	Keeping my cat inside at night reduces its injuries from cars[a]	5.33 (0.161)	.514
	My cat hunts at night to follow natural instincts[a]	3.24 (0.159)	−.261
	Overall, I think that keeping my cat inside all night is pleasant	5.49 (0.132)	.553
	Overall, I think that keeping my cat inside all night is beneficial	5.78 (0.132)	.563
	Overall, I think that keeping my cat inside all night is the right thing to do	5.42 (0.151)	.638
	Overall, I think that keeping my cat inside all night is enjoyable	5.30 (0.139)	.541
	Having my cat inside at night is extremely desirable	5.49 (0.140)	.634
Norms	Conservation organizations[a]	4.47 (0.155)	.317
	The SPCA[a]	4.48 (0.151)	.418
	Gareth Morgan[a]	1.47 (0.111)	−.029
	My veterinarian[a]		.439
	NZ's Department of Conservation[a]	4.09 (0.166)	.225
	People who are important to me keep their cats inside at night	4.07 (0.141)	.439
	People like me keep their cats inside all night	4.77 (0.235)	.482
	I will talk to people who are important to me about keeping cats inside at night over the next month	3.82 (0.167)	.455
	People in my household think keeping my cat inside all night is a good thing	5.23 (0.151)	.632
Perceived Behavioral Control	I am more likely to keep my cat inside all night if it uses a litter box[a]	3.66 (0.206)	.480
	I am more likely to keep my cat inside if my house is set up for it[a]	4.45 (0.508)	.286
	I am more likely to keep my cat inside all night if they liked staying inside[a]	4.06 (0.184)	.550
	I am more likely to keep my cat inside all night if I could get my cat inside[a]	2.21 (0.148)	−.041
	Keeping my cat inside all night is up to me	5.66 (0.145)	.144
	I can control keeping my cat inside all night	5.34 (0.161)	.410
	I am confident I could keep my cat inside all night	5.79 (1.47)	.470

Note: Questions were either beliefs based on responses from the elicitation survey (marked with an "a" superscript) or direct beliefs as suggested by Ajzen (2019).

[a]Statements based on elicitation study.

normative messaging such as: "75% of cat owners agree, having their cats in at night is beneficial" and the factoid "A cat's company at night is great for reducing stress."

The second treatment illustrated a veterinarian's care for a cat to bring to mind and integrate the normative belief that "my veterinarian would approve of me keeping my cat inside all night" with two safety beliefs that "my cat is safer if it spends the night inside" and "keeping my cat inside at night reduces its injuries from cars" (Figure 2b). Its illustrated message: "Keep Fluffy safe from cars" was supported in the pamphlet using normative messaging such as "74% of veterinarians treat a cat that was hit by a car at least once a month. A quarter of veterinarians see car-injured cats every week" and the factoid "Cats have a greater risk of being hit by a car at night when they are less visible to drivers."

We also included a poster and pamphlet to represent an experimental control. They were existing materials from the New Zealand Veterinary Association and advocated de-sexing of cats. Cat de-sexing was a cat owner behavior advocated by the NZVA, also advocated for cats' welfare but different from the one we were advocating.

FIGURE 2 The campaign pamphlet's front and back sides (4.0 in. × 8.5 in.) developed based on Theory of Planned Behavior surveying. The (a) veterinarian/cat safety treatment and (b) child/cat likes it treatments are illustrated. The posters (23.4 in. × 33.1 in. or 16.5 in. × 23.4 in.) hung on the veterinary clinic walls illustrated only the image on each pamphlet's left-hand side.

Veterinary clinics were randomly allocated to treatment and control groups. Each participating veterinary clinic was provided with two large posters to be hung in the waiting room and pamphlets and surveys at reception to be handed to customers. On the days of the study, after each customer checked in with reception and was seated,

our research assistant asked them if they would fill out a self-completed survey on cat welfare. Upon completion, they were handed one of the pamphlets about keeping cats in at night or the control condition.

The survey asked 10 questions about the owners' cats and took less than 5 min to complete (Supporting Information S4). Respondents were asked how many cats they owned, the breed, whether it is microchipped, and/or de-sexed, if they wore a collar, how often they were fed and what type of food was provided. Respondents were also asked what they did with their cats at night (i.e., cat stayed inside all night, cat could come and go via a cat flap or door, or the cat was locked outside) and the frequency of that action on an ordinal scale (1: "it varies from night to night"; to 7: "we do the same thing every night"). Basic demographics of age, gender, and education of the cat owner were also collected. Respondents were asked at the end of the survey if they would like to participate in a follow-up survey on cat welfare and if so, to provide their preferred method of contact (telephone or email). Data were collected between June and August 2016.

Three to six weeks after their visit to the veterinarian, we made two attempts to contact each respondent who assented to a follow-up. The follow-up survey asked if they had ever owned a cat that had been hit by a car and if so did the cat survive; had they ever owned a cat that had been attacked by a dog and if so did the cat survive; what they did with their cats at night (answer options the same as in the first survey) and how often they did this; and which of the following animals had their cats caught in the last month (i.e., rat, mouse, reptile, insect, or bird).

We applied a simple General Linear Model (IBM Corporation, 2016) to the analysis of campaign outcomes. The response variable was the difference in the self-reported consistency (on an ordinal scale, 1–7) with which individual cat owners brought or kept their cats inside at night. Post hoc Bonferroni tests for pairwise comparisons between the two treatments and experimental control were applied.

4 | RESULTS

4.1 | Study 1: Elicitation

Twenty-six visitors to four veterinarian clinics in three cities were recruited for the elicitation survey. None refused to participate. Three or more (>10%) respondents reported six attitudes with respect to "keeping a cat inside at night" (i.e., about cat safety, behavior, and welfare, native wildlife, and owner's benefit), five normative beliefs (i.e., reflecting expectations about the opinions of conservationists and conservation agencies, animal welfare organizations, veterinarians, members of their household, and peers), and three PBC beliefs (i.e., regarding providing for cats' toileting indoors, cats preferences, and owner control). Reliability between the two coders was 99%.

4.2 | Study 2: TPB questionnaire

Twenty-five small-animal veterinary clinics (out of 44 contacted) across the four cities (Auckland, Wellington, Palmerston North, and Dunedin) took part in the TPB questionnaire. We collected 160 TPB questionnaires, although four were discarded due to incompleteness (less than 50% of questions were answered), for a total of 158 included in the analysis.

Fifty-six (36%) respondents stated that they kept their cats inside every night and 6% kept their cats outside exclusively every night. Eighty-one percent of respondents were female, 12% were aged between 18 and 24 years, 46% were 25 and 49 years old, 29% were 50 and 64 years old, and 9% were over 65 years old. Basic demographics are reported in Table 2a.

TABLE 2 Demographics of participants in the (a) Theory of Planned Behavior questionnaire (Study 2) and (b) across the two treatments and control of the experimental campaign.

(a)

	Percentage ($n = 158$)
Female	80%
Male	20%
18–24 years	12%
25–49 years	46%
50–64 years	29%
Over 65 years	9%

(b)

	Child/like it ($n = 188$)	**Vet/cat safety ($n = 200$)**	**Control ($n = 122$)**
Female	83%	75%	80%
Male	15%	22%	19%
18–24 years	10%	7%	14%
25–49 years	52%	49%	39%
50–64 years	30%	31%	31%
Over 65 years	7%	11%	11%

Missing values accounted for 1.5% of the data matrix and a missing values analysis revealed data to be missing at random ($\chi^2_{1693} = 1608$, $i = 0.929$). Thus, we imputed missing values using the expectation–maximization (EM) algorithm in SPSS (Cunningham, 2008) for data analysis (see Table 1 and Supporting Information S5 for the mean answer and standard deviations for each question and correlations among them and with intention).

The initial CFA did not have adequate fit and the following changes were made based on theory (Schreiber et al., 2006). High modification indices (>20) indicated that residuals among q1 and q3, q12 and q31, and q19 and q29 had a high correlation and were co-varied in the subsequent analysis. Three normative items (q20, q43, and q44), and one PBC item (q15), were also removed as they did not fit the CFA well. We re-ran the CFA and the new analysis revealed an adequate fit $\chi^2_{202} = 320.9$, $p < .001$, df = 1.59, CFI = 0.92, TLI = 0.91, root mean square error of approximation (RMSEA) = 0.06. Final constructs of attitude (Cronbach's $\alpha = .83$), subjective norm (Cronbach's $\alpha = .77$), PBC items (Cronbach's $\alpha = .77$), and intention (Cronbach's $\alpha = .79$) statements showed good reliability.

The structural model showed an adequate fit ($\chi^2_{289} = 436.7$, $p < .001$, df = 1.51, CFI = 0.93, TLI = 0.92, RMSEA = 0.06). The effects of attitude ($\beta = .46$, SE = 0.10, $p < .05$), norms ($\beta = .30$, SE = 0.09, $p < .05$), and PBC ($\beta = .27$, SE = 0.07, $p < .05$) on intentions were significant. Past behavior had a significant relationship with intention ($\beta = .26$, SE = 0.09, $p < .05$).

Finally, we examined the individual beliefs that had a significant impact on the TPB model. Five of the attitude beliefs, that together explained 54% of variance, were statistically significant with intention: "overall I think keeping my cat inside at night is the right thing to do" ($\beta = .66$, SE = 0.06, $p < .05$); "having my cat inside at night is extremely desirable" ($\beta = .39$, SE = 0.09, $p < .05$); "keeping my cat inside at night reduces its injuries from cars" ($\beta = .15$, SE = 0.07, $p < .05$); "my cat is safer if it spends the night inside" ($\beta = .15$, SE = 0.07, $p < .05$); "my cat likes to come inside at night for shelter" ($\beta = .12$, SE = 0.06, $p < .05$).

The six normative beliefs explained 42% of the variance in intention. Two normative beliefs were statistically significant with intention: "people in my household think keeping my cat inside all night is a good thing" ($\beta = .63$, SE = 0.07, $p < .05$); "my veterinarian would approve of me keeping my cat inside all night" ($\beta = .30$, SE = 0.06, $p < .05$).

The six PBC beliefs explained 23% of the variation in intention. Two PBC beliefs were significant with intention: "I am more likely to keep my cat inside all night if they liked staying inside" ($\beta = .51$, SE = 0.06, $p < .05$); "I am confident I can keep my cat inside all night" ($\beta = .32$, SE = 0.08, $p < .05$).

4.3 | Study 3: Advocacy campaign

Thirty-four clinics agreed to participate in the experimental campaign. Ten clinics received the "child/cat likes it" treatment and distributed it to 188 of their cat-owning clients; 12 clinics and 200 of their clients received the "veterinarian/cat safety" treatment, and 12 clinics and 122 of their clients received the "control," for a total of 510 participating cat owners. Participant demographics are reported in Table 2b. The frequency of cat owners keeping their cats in at night was not different in the three groups prior to the application of treatments ($\chi^2_{135} = 0.72$, $p > .05$).

A total of 353 follow-up surveys were completed (69% return rate) with 135 for the "child/cat likes it" condition (68% return rate); 127 for the "veterinarian/cat safety" condition (63% return rate) and 91 for the "control" (75% return rate).

To normalize the data, we calculated the z-score for the distribution of pre- and post-frequency of cat owner behavior at night (Moore et al., 2013). Next, we calculated the change in frequency of keeping cats inside at night for each treatment and the control. There were significant differences in the consistency with which owners brought or kept their cats inside at night across the two treatments and control groups ($F_{2,160} = 3.34$, $p = .04$). Post hoc comparison using the Bonferroni test showed the cat owners that received the "child/cat likes it" condition and "veterinarian/cat safety" condition were significantly more likely to keep their cats inside at night compared to those in the control group ($F_{2,7} = 0.19$, $p = .04$; Figure 3). We also calculated the effect size using Cohen's d to allow for comparison to other behavior change campaigns (Steinmetz et al., 2016). We found a moderate effect size of 0.27.

Context influenced outcomes. One hundred and five (31%) participants had a cat previously hit by a car with 16% ($n = 57$) reporting it as fatal. There was no significant difference in behavior across the three treatments for cat owners whose cat was involved in a car accident ($F_{2,54} = 2.25$, $p = .12$). Twenty-nine percent of respondents ($n = 105$) had a child under 18 living in the household. For households with children under 18, there was a significant difference across the three treatments ($F_{2,99} = 4.67$, $p = .01$). The "child/cat likes it" condition had greater influence on participants with a child in the household (21% increase in frequency of restricting cat inside at night) but not the "veterinarian/cat safety" condition nor the "control" (Table 3). Finally, our campaign

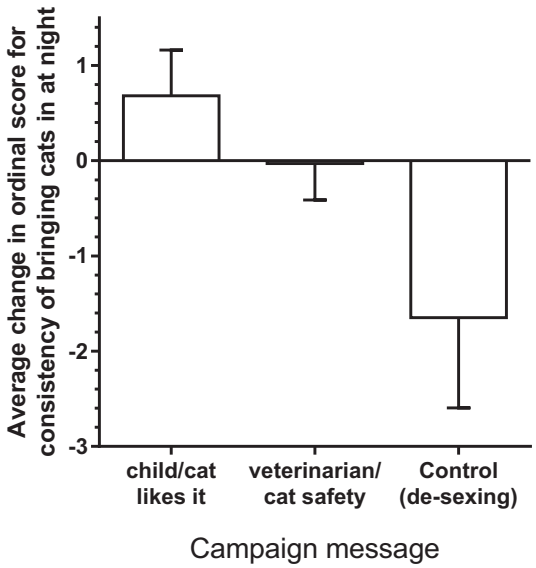

FIGURE 3 The average shift in the consistency with which respondents brought or kept their cats inside at night after visiting their veterinary clinic and receiving campaign messages. Pre- and post-visit consistency was measured on a 7-point ordinal scale (1: "it varies from night to night"; to 7: "we do the same thing every night").

TABLE 3 Change in frequency of keeping cats inside at night based on presence of children in the household and previously having a cat fatally hit by car.

	Child under 18 living in household	Previously had a cat fatally hit by car
Child/like it	20.6%	0.0%
Veterinarian/safety	−13.0%	0.0%
Control	0.0%	−3.2%

was more influential among cat owners who sometimes confined their cats at night. After our campaign, they reported confining their cats more frequently. It was not, however, successful at motivating the same behavior in the small number (9) of cat owners who never confined their cats at night.

5 | DISCUSSION

Elicitation divulged a diversity of cat owner attitudes and beliefs about keeping cats inside at night. Of the 26 attitudes and beliefs represented in our TPB questionnaire, a model including nine was significantly associated with owners keeping cats inside at night (see also Foreman-Worsley et al., 2021). Seven of the nine were attitudes about their or their family's relationship with their cat(s), normative expectations, and cat safety, especially from traffic. Owners keeping cats inside at night to protect native wildlife was not supported, consistent with previous research about cat owner's motivations (MacDonald, 2015; McLeod, Driver, et al., 2017; McLeod, Hine, et al., 2017). Thus, messages about owner's relationships, norms, and cat safety, rather than protecting native wildlife, were developed for our experimental campaign.

Both behavior-change campaign treatments significantly improved the rate cats were brought inside at night compared to owners in the control group. The campaign, including a socially normative and family–cat relationship message, was the most successful, with the treatment's effect being strongest in households with children. The statistical difference between treatment and control groups was mostly driven by a large decrease in the number of control-group owners who brought their cats inside at night. In other words, the cat safety message prevented a decline in the number of cats brought inside at night, while the family–cat relationship message reversed the decline.

The decline in the rate at which cats were brought in at night in the control group may be a result of the study conducted from winter into spring. Campaign surveying occurred from July through early September and post-campaign follow-up 3–6 weeks later. Longer and later daylight hours at southern latitudes (36°S–47°S) and warmer evenings mean that cats were more likely to be outside during the early evening and less likely to be bought in from the dark or cold.

Our results demonstrate that even a basic (poster and pamphlet) campaign, informed by elicitation and TPB surveying, can shift cat owner behavior in ways that may reduce cats' opportunities to hunt.

5.1 | Which co-benefit and influencer?

Cat owners were not motivated to keep cats inside to protect wildlife, and ambivalent about the opinions of biodiversity and conservation experts (Linklater et al., 2019). In our study, therefore, generalizing cats' impact on biodiversity and calls by conservationists for ubiquitous cat controls would not be effective at shifting behavior and achieving progress on this contentious issue (see also Hall et al., 2016). Even around ecologically significant areas, where researchers might expect more affinity with biodiversity, cat owners were least concerned for wildlife (Bassett et al., 2020). Thus, the plight of biodiversity, or other species specifically, and the authority of conservationists or scientists, could not be the basis for changing

cat owners' behavior. Mandating cat controls presented to the public as measures to protect biodiversity risks poor implementation, enforcement, and compliance (Elliott et al., 2019; van Eeden et al., 2021). Instead, conservationists and conservation scientists may need to relegate their own values and prioritize the values of cat owners to reduce cats' hunting; working with cat owners to identify what is important to them (e.g., social norms and familial relationships, and cat safety) as the foundation to further research, consensus building, and compromise.

Cat safety has often been suggested as the co-benefit most likely to change cat owners' behavior (Gramza et al., 2016; McLeod, Driver, et al., 2017; McLeod, Hine, et al., 2017) and our cat-safety-from-traffic message delivered by a veterinarian significantly changed cat owner behavior. This result was expected because cat owners' experience of cat death from traffic accident is known to substantially change their behavior (Rochlitz, 2004) and veterinarians are known to be the leading source of animal care and management advice for cat owners (e.g., 79% of cat owners favored veterinary advice cf. 51% using Google search, and 44% the RSPCA, Lawson et al., 2020).

Roads are the most commonly encountered risk for free-roaming cats (Bruce et al., 2019; Fardell et al., 2021; Tan et al., 2020) leading to traffic accident as the most common form of physical trauma and death (Olsen & Allen, 2001; O'Neill et al., 2015; Rochlitz, 2004). Mortality rates from traffic can be substantial. Childs and Ross (1986) estimated that 8.7% of owned cats allowed to roam were killed each year in Baltimore, USA. In an Australian study, 34% of cat owners reported a previous cat lost to car accident, compared with 7.4% to dog attacks, 7.3% attacks by other wildlife, and 5.7% to skin cancer (van Eeden et al., 2021). In this study, we discovered similar rates (31% injured and 16% fatally).

Cat road-crossing is most strongly associated with time spent outside (Loyd et al., 2013). Although cats crossroads at similar frequency during the day and night (Bruce et al., 2019; Loyd et al., 2013), more road accidents with animals occur at night (Rochlitz, 2003) when veterinary care is also less immediate (Rochlitz, 2004). Rationally, therefore, cat owners report road traffic accidents as their leading motivation for keeping their cats indoors, especially at night (Foreman-Worsley et al., 2021; van Eeden et al., 2021).

The high mortality risk to cats from vehicles and owners' awareness of that risk reinforces previous suggestions that it may be a pertinent co-benefit and ethical message to cat owners for improving cat welfare while also reducing the time cats spend hunting. Nonetheless, in this study, the influence of veterinarian-delivered cat-safety messaging was exceeded by the socially normative, family–cat relationship messaging. The presence of children in the household accentuated its effect.

The efficacy of social and family–cat relationship messaging is consistent with the importance of normative beliefs about what friends and family like about the pet-owner relationship (Rohlf et al., 2010). Our result highlights the need for empirical work with cat owners (Crowley et al., 2019; McLeod et al., 2019). The salience of apparently intuitive co-benefits and influences like veterinarians and cat safety could be exceeded by other, more powerful, motivators of behavior change. The challenge of reducing domestic cat hunting would benefit from more research to understand households' relationships with their cats.

5.2 | The plausibility of behavior change

Despite repeated calls for social science to be better integrated into conservation practice (Bennett et al., 2017; Clayton et al., 2013; Kidd et al., 2018; McLeod et al., 2019; Reddy et al., 2017), there are still only a small number of co-benefit and behavior-change studies in which outcomes are evaluated for their efficacy (Smith et al., 2020; Veríssimo et al., 2018). Of the few published studies applying the TPB (Ajzen, 1991; Ajzen & Fishbein, 1980), to our knowledge, none have used the discovered links between beliefs and intention to develop, implement, and evaluate a behavior-change campaign (Miller, 2017). Even across all disciplines applying TPB research, only 30% of studies test for behavior change (Armitage & Conner, 2001) to bridge the research-implementation gap (Toomey et al., 2017).

Our work demonstrates the plausibility and efficacy of a behavior change campaign that integrates research and practice. It contributes to a growing literature on how to more effectively engage cat owners to reduce their cats' impact on biodiversity (McLeod et al., 2019; Roetman et al., 2018). Although our campaign was rudimentary (only poster and pamphlet communication, informed by elicitation and TPB surveying), it shifted cat owner behavior in ways that may reduce cats' opportunity to hunt.

Behaviors such as confining a cat to their property or inside from before dusk until after dawn are widely acceptable and, in some places, are supported by the majority of residents, including cat owners (Elliott et al., 2019; Toukhsati et al., 2012). However, more extreme mandates such as cat-free zones or 24-h containment, sometimes even among non-owners, are less accepted (Crowley et al., 2019; Hall et al., 2016; Linklater et al., 2019; Travaglia & Miller, 2018). Yet, where it has

been measured, cat owners who confine their cats at night are in the minority (e.g., 38% of urban cats inside at night and 27% of rural cats in Armadale, Perth (Lilith et al., 2006); 47% always confined (Elliott et al., 2019); and 36% this study). An opportunity exists, therefore, to substantially increase the number of cats confined at night by co-benefit research and advocacy, like that described here, but implemented at greater scale and intensity. A number of challenges around biodiversity conservation in peopled landscapes (e.g., dog ownership, vegetation planting, wildlife feeding, and conflict) could also be advanced by the application of co-benefit and behavior-change research.

5.3 | Limitations and opportunities

Our study population was cat owners visiting veterinary clinics. Already investing in their cats' health, they may represent more responsive and responsible cat owners than those in the wider cat-owning population whose cats are more likely to be left outside or more likely to meet the definition of being semi-owned or "strays" (Crowley et al., 2020; Farnworth et al., 2010). Consider also, at a larger scale, that cat owners' attitudes, norms, beliefs, and behaviors vary between communities and nations. An effective message and behavior in New Zealand might be ineffective, even counter-productive, in another. Thus, the messaging and behavior we advocated, while effective among some, are unlikely to represent or influence all cat owners. Wider application of the approach we have described will likely require a different elicitation, socio-psychological surveying, and campaign messaging for each demonstrably different type of cat owner in different communities. Alternatively, a larger scale study to detect co-benefits and persuasive messages that are applicable to a greater diversity of cat owners is required.

Our campaign influenced cat owners who already occasionally confined their cats at night to do it more often, but it was not successful at motivating the same behavior in nine cat owners who had never confined their cats at night. This pattern, that it was easier to increase the frequency of a behavior than to stop or start a new behavior, has been noted in other contexts where behavior change was investigated (e.g., human health; Steinmetz et al., 2016). It may be true of environmental and conservation behaviors too, thus limiting the usefulness of our approach. Future work should investigate this potential constraint with a larger sample.

We relied on participants' self-report and were not able to verify owner behavior. Nonetheless, the study included a control group, thus accommodating the influence of self-reporting bias in statistical comparisons. Moreover, to reduce the potential for participant response bias, the intent of the study was obscured from participants (i.e., it was described to respondents as a study about cat welfare across all treatment and control groups). Thus, the behavior-change result is probably robust to response bias. Nevertheless, vigilance against response-bias is critical to the evaluation of behavior-change and should motivate careful experimental design.

We used the TPB framework for our study as it has been shown to be successful in past studies with cat owners (MacDonald, 2015). There are, however, other models for behavior change (e.g., Com-B: Michie et al., 2011) that may also prove successful at engaging cat owners (McLeod et al., 2015). An opportunity exists to gauge the usefulness of the different frameworks to the problem in a variety of contexts.

The usefulness of our proposed behavior (night-time cat confinement) for biodiversity conservation will vary by context. In some environments, most cats' hunting is crepuscular or occurs at night (Seymour et al., 2020), thus rendering night-time cat confinement effective, particularly if the at-risk fauna is nocturnal (e.g., small mammals). Nonetheless, it may not, on its own, sufficiently reduce cat predation in all places all the time, especially for the most predation-vulnerable species or on islands (e.g., Hawaii and New Zealand) where at-risk species are diurnally active birds and reptiles. Nonetheless, other cat owner behaviors might be investigated and engaged concurrently to cumulatively reduce predation (e.g., changes in nutrition and behavioral enrichment) (Cecchetti et al., 2021; Crowley et al., 2019). Moreover, scaling up a campaign for night-time cat-confinement must consider its cost-effectiveness given likely return (Selinske et al., 2022). It is unlikely that any single behavior-change solutions exist for complex multi-stakeholder environmental conflicts such as that between cat owners and wildlife conservation. The benefit of behavior-change, however, is that it is progressive, fostering positive relationships among stakeholders and diverse values (instead of antagonism) and the possibility, therefore, of ongoing incremental improvement.

AUTHOR CONTRIBUTIONS

All the authors contributed to the research design, interpreting data, and writing the manuscript. W.L. wrote the application that funded the research. W.L., Y.v.H., and M.F. organized and coordinated surveying and data gathering. E.M. and W.L. collated data, conducted statistical analyses, and wrote the first draft of the manuscript.

ACKNOWLEDGMENTS

The New Zealand Companion Animals Trust funded this research. Thanks also to the New Zealand Veterinary Association and many staff at veterinary clinics for their assistance and participation in the study. Erin Willson, Julie Whitburn, Kate Irving, Kayla Griffin, Laura Harvey, Rosi Merz, Sarah Hight, Sarah Irvine, and Skyler Suhrer are thanked for their assistance in surveying.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data are available via the following link to the data repository: https://osf.io/nkug3/?view_only=a44017b956954468b0b44fa4829d2a11 (alongside related data from Linklater et al., 2019).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: MacDonald, E., Farnworth, M., van Heezik, Y., Stafford, K., & Linklater, W. (2024). A conciliatory and persuasive social campaign changes owner behavior to reduce cats' hunting. *Conservation Science and Practice*, *6*(7), e13152. https://doi.org/10.1111/csp2.13152