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Reducing koala roadkill: a social marketing formative study

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ABSTRACT

Context. Koalas are an Australian icon and their numbers are seriously declining. In some regions, a key threat to koalas is vehicle strikes. Therefore, understanding what might convince people to be more vigilant and willing to slow down in areas with high koala numbers is an important research undertaking. **Aims.** This study aims to use the wildlife value orientation (WVO) framework, a value-based segmentation process, to extend conservation insight. It will do this by demonstrating the application of social cognitive theory (SCT), to investigate how wildlife beliefs can help in identifying worthwhile groups to target with wildlife conservation interventions. The findings of this study can be used to benefit koalas by assisting conservation planning efforts to decrease driving speed and promote positive changes in driving behaviour. **Method.** Data collection through intercept surveys was employed by convenience sampling in 2019. A total of 661 responses were collected from residents of a koala priority conservation area in Queensland, Australia. Respondents were asked about their wildlife values, beliefs, attitudes, norms, barriers, and intentions to slow down, while driving in a koala area. Four key groups were identified based on respondents' WVO (i.e. mutualists, pluralists, traditionalists and distanced) and multigroup structural equation modelling was conducted to understand group differences. **Key results.** The analysis identified several significant psychographic factors that influenced people's intentions to protect koalas dependent on what wildlife value respondents held. Injunctive norms were important, positively influencing the intention of traditionalists and pluralists to slow down while driving in a koala area. Individual attitude positively influenced safe driving intention for pluralists, while perceived barriers negatively influenced mutualists' intention to slow down. Other groups did not show similar results. **Conclusion.** A person's WVO can influence their intention to protect koalas by modifying their driving behaviour. Various social marketing approaches can benefit conservation strategies aimed at different WVO groups with targeted messages and interventions for each group. **Implications.** This paper demonstrates the value of SCT in explaining people's intention to slow down to protect koalas. The identification of group differences demonstrates that varied approaches are required to deliver behavioural change to benefit koalas.

Keywords: behaviour, behavioural change, human dimensions, koala, segmentation, social marketing, theoretical modelling, wildlife.

Introduction

Koalas are an Australian icon and their numbers are seriously declining in the northern part of their range, specifically New South Wales (NSW) and Queensland (Gonzalez-Astudillo 2019; Lunney *et al.* 2022) Recent bushfires have halved populations in some regions (Trask 2020). Human factors such as increased urbanisation create further pressure, where vehicle strikes are a major threat to koalas (Shumway *et al.* 2015; Queensland Department of Environment and Science 2019; Department of Agriculture Water and the Environment 2022; Lunney *et al.* 2022). A recent parliamentary enquiry in NSW (NSW Parliament Enquiry 2020) found that 'a key threat to local koala populations were roads, traffic and vehicle strikes.' While natural disasters such as bushfires highly impact koala population (with 6382 koalas killed in the 2019/2020 bushfire season in NSW alone; (International Fund for Animal Welfare 2022), other factors are also considered key drivers of koala mortality (Gonzalez-Astudillo 2019). Such factors include urbanisation of coastal areas (McAlpine *et al.* 2015), domestic dog attacks (David *et al.* 2019) and vehicle strikes (Lunney *et al.* 2022). The current study focuses on koala roadkill, and strategies to positively influence safe driving behaviour in highly populated koala regions. Every year around 300 koalas are killed on South East Queensland roads, while NSW reported 3500 koalas killed by vehicles between 1980 and 2018 on its roads (Department of Environment and Science 2020; Department of Planning, Industry and Environment 2020). Local councils mitigate risks to koalas with measures including koala-safe passages, static slow-down signs and koala injury reporting systems (Redland City Council 2016). Given that human factors also contribute to koala mortality, the provision of infrastructure cannot be solely relied upon. This study responds to the call for a better understanding of human dimensions in the discipline of conservation, and factors that may enable people to be more vigilant and willing to slow down in areas with high koala numbers.

Human dimensions should be considered for biodiversity conservation to be implemented successfully (Robinson *et al.* 2019; Veríssimo and Wan 2019). While the importance of human dimensions in improving conservation has been previously discussed, the literature demonstrates a lack of understanding of how human dimensions can be employed for positive behaviour change outcomes (Bennett *et al.* 2017). This indicates a need for empirical research to extend understanding of the role of human dimensions in conservation interventions and its effect on conservation management outcomes. A field known for its focus on human behaviour change is social marketing. Social marketing has been applied to a broad range of social issues such as increasing physical activity (Kubacki *et al.* 2017*a*), minimising alcohol harm (Yousef *et al.* 2021) and encouraging positive wildlife conservation behaviour (Rundle-Thiele *et al.* 2019*a*). Use of social marketing techniques to ensure effective behaviour change interventions to benefit wildlife conservation has received increasing attention (Robinson *et al.* 2019). Examples of the successful application of social marketing to enhance wildlife conservation are emerging (David *et al.* 2019; Rundle-Thiele *et al.* 2019*a*). Common across literature reviews (Truong 2014; Kubacki *et al.* 2017*b*) is a lack of theory and segmentation use, despite the known benefits associated with the application of these two key social marketing principles (Rundle-Thiele *et al.* 2019*b*).

Heterogeneity in the human population is reflected in differences in psychographic factors proven to influence human behaviour (Dahana *et al.* 2018). Hence, segmentation (i.e. classification of people into groups based on shared characteristics) is increasingly being used by researchers to help enable a more targeted behaviour change approach to groups with different psychographic factors such as beliefs, attitudes and norms (Jones *et al.* 2019). McKenzie-Mohr *et al.* (2012) highlight that the foundation of environmental protection is human behavioural change. Understanding why people do, or do not, perform behaviours remains a key priority to ensure solutions devised to address conservation issues take human dimensions into account.

This enquiry is underpinned by two frameworks. The first, social cognitive theory (SCT) (Bandura 1989), considers behaviour as a triadic reciprocal process with personal, social/environmental factors and behavioural factors continually interacting to affect overall behaviour (Glanz 2001) The second framework is wildlife value orientation (WVO) (Teel and Manfredo 2010).

According to the cognitive hierarchy model of human behaviour (Homer and Kahle 1988), WVO is the set of beliefs relating to wildlife and human coexistence represented as clusters of interrelated fundamental values (Fulton *et al.* 1996). The WVO framework has been used to segment a target audience based on how they value wildlife. The framework captures the nuances of people's beliefs and their relationships with wildlife. These values are important as they have been proven to have a direct effect on people's daily behaviour in terms of interaction with wildlife (Teel and Manfredo 2010). WVO consists of two value orientations (domination and mutualism) and four belief dimensions: hunting and use of wildlife, and caring and social affiliation (Manfredo *et al.* 2009; Teel and Manfredo 2010). A domination WVO reflects the belief that wildlife should be managed for human benefit. Individuals with this orientation are more likely to prioritise human well-being over wildlife. A mutualism WVO reflects an egalitarian ideology that has fostered perceptions of social inclusion and equality that extend to human–animal relationships (Steel *et al.* 1994). Individuals with a mutualism orientation view wildlife as capable of relationships of trust with humans, as if wildlife were part of an extended family, and thus deserving of rights and care. These individuals are more likely to engage in welfare-enhancing behaviours for wildlife. To categorise individuals based on their WVO, Teel and Manfredo (2010) suggested individuals could be divided into four types: traditionalist (high domination–low mutualism), mutualist (low domination–high mutualism), pluralist (high domination–high mutualism) and distanced (low domination–low mutualism). These groups differ in wildlife-related attitudes and behaviours, and the WVO may offer a foundational segmentation identification tool that can be applied to manage human–wildlife conflict issues more effectively.

Segmentation, a tool used in commercial and social marketing, can deliver a nuanced understanding of human dimensions, demonstrating differences that can inform policy selection, strategy development, program delivery, and program evaluation (French 2017). Detailed segmentation modelling ensures that interventions cater to the needs of various groups exhibiting clear differences in beliefs and behaviour, allowing for more refined program delivery and evaluation (French 2017). Segmentation has been gaining popularity in the discipline of conservation research (Hinsley *et al.* 2015; Jones *et al.* 2019; Metcalf *et al.* 2019) as ecologists and conservationists realise the value of applying processes that can assist them to consider the diversity of human behaviour. For example, a recent study by Mehta and Chahal (2021) applies segmentation techniques to understand consumer groups based on their environmental attitudes; the identified segments can then be targeted and engaged differently by social marketers for more effective outcomes. Our study extends conservation insight by demonstrating the application of the WVO framework alongside a behavioural change theory to investigate how wildlife beliefs can form key segments, enabling a targeted behaviour change approach to benefit wildlife (e.g. safe driving).

Specifically, this study applies four social marketing principles: consumer orientation, use of behavioural theory, insights and segmentation (French and Russell-Bennett 2015). The study hence employs a consumer-oriented and theoretically guided empirical enquiry, delivering segmented insights to inform the design of campaigns to reduce koala roadkill.

Literature review and hypothesis formation

A focus of SCT is self-regulation, in which individuals drive their self-conceptions, revise behaviour, adjust their environment, and act to bring about outcomes that match with their own goals and self-perceptions (Plotnikoff *et al.* 2013; Sawitri *et al.* 2015). The SCT has been employed and validated in contexts including pro-environmental behaviours (Tabernero and Hernández 2011; Tang *et al.* 2011) and conservation (Sawitri *et al.* 2015). SCT focuses on the interaction of personal, environmental, and behavioural factors. Personal factors include attitude and outcome expectations (Bandura 1989). Environmental factors focus on the influence of others and/or the environment (Bandura 1989) and are considered by many as social and situational. SCT considers the relationships between these constructs as reciprocal and dynamic. To date, there has been minimal empirical application of SCT to ascertain the extent to which it offers explanatory potential that can be reliably used to inform program and campaign planning as well as intervention design (Rakotonirainy *et al.* 2014; Chin *et al.* 2017). SCT was applied in this study to identify determinants of behaviour.

In driving and road safety contexts, the application of SCT is limited and focuses predominantly on social norms as a method to influence driving behaviour (Chin *et al.* 2017). In this study, four constructs of the SCT (outcome expectation, attitudes, social norms and perceived barriers) were used to explain the context.

Outcome expectation is a social cognitive variable that refers to the anticipatory (positive or negative) consequences of engaging in a behaviour (Hatchett *et al.* 2013; Lent *et al.* 2017). The second construct within the SCT is attitudes, referring to an individual's consistent tendency to respond favourably or unfavourably toward an object (Vaske and Donnelly 1999). Generally, behaviour follows a reasoned action approach, which assumes behaviour is a result of one's perceptions including beliefs, attitudes and social norms (Ajzen and Fishbein 2005). Research suggests that an individual's intention to perform a behaviour is based on having a positive attitude towards it (Hrubes *et al.* 2001). Hence, we hypothesise:

H1: Outcome expectation has a positive effect on the intention to slow down when driving in a koala populated area.

H2: A favourable attitude towards wildlife has a positive effect on the intention to slow down when driving in a koala populated area.

Social norms refer to a person's perceptions of social pressure placed upon them to perform (or not) a particular behaviour (Beedell and Rehman 2000; Wauters *et al.* 2010). Injunctive social norms reflect 'what is approved or disapproved by society', while descriptive social norms capture 'how most important others behave in a given situation' (Reid and Aiken 2013). We hypothesise:

H3: Social norms have a positive effect on the intention to slow down when driving in a koala populated area.

Perceived barriers are another important construct in SCT frameworks. There are two types of barriers: environmental and personal. Environmental barriers are those that are beyond one's direct control. In our study, perceived barriers refer to an individual's perceptions of the perceived hassle and/or inconvenience experienced when required to slow down at wildlife warning road signs. Within social marketing, perceived barriers are akin to negative attitudes toward an object or behaviour (Rundle-Thiele *et al.* 2016). For example, perceived barriers are significantly linked to road accidents among motorcyclists (Özkan *et al.* 2012). Therefore, we argue that strong perceived barriers will have a negative effect on behavioural intention. The hypothesis is as below:

H4: Perceived barriers have a negative effect on the intention to slow down when driving in a koala populated area.

WVO has been found to play an important role in explaining individual variation in wildlife-related behaviour and/or behavioural intention (Teel and Manfredo 2010). Studies have shown that WVO can influence attitude, behaviour and/or behavioural intention (Fulton *et al.* 1996;

Vaske and Donnelly 1999). Miller *et al.* (2018), for example, found that WVO increased the effectiveness of conservation messages. In another context, Gamborg *et al.* (2019) applied the framework to predict landowners' hunting management practices in rural landscapes. A model mapping the different WVO groups based on the SCT constructs may help identify differences in groups' perceptions, enabling a more targeted approach to interventions and thus increasing their effectiveness (Miller *et al.* 2018). Therefore, this study proposes the following.

H5: WVO influences each of the effects between variables of the SCT model.

See Fig. 1 for the proposed model to be tested in this study.

Methods

Data collection

Intercept surveys, using convenience sampling, were conducted in person from September to October in 2019. Redland City in south-east Queensland is heavily populated with koalas and has been identified by the Queensland Government as a priority koala conservation area. High foot-traffic locations in this shire such as public parks, shopping malls, bus stops, and ferry wharves were targeted for data collection. Ethics approval for the study was granted by the Griffith University Human Research Ethics committee, and a consent form was collected from each participant prior to them completing the survey (ethics number: GU Ref No: 2020/589). Two screening questions asked whether the respondent had a driving license and whether they had driven in the Ormiston and Thornlands areas in the previous 3 months. A total of 661 residents of the local area (Ormiston and Thornland suburbs) then completed a survey that gathered demographic and psychographic information on participants.

All questions in the survey required self-report answers, including demographic variables such as gender, age and educational background; and psychographic variables measuring WVO (Teel and Manfredo 2010) and SCT constructs (Bandura 1989). For the WVO scales, participants were asked about their response towards the two dimensions (mutualism and domination). SCT constructs were measured using previously validated 7 point Likert scales from Pang *et al.* (2018) for attitudes and intentions to drive more slowly in koala areas, Fielding *et al.* (2008) for both injunctive and descriptive norm, and Ayotte *et al.* (2010) for perceived barriers, namely hassle and increased travel time. Finally, four items measured outcome expectancies, which captured expectations about wildlife fatality and environmental conservation (Lent *et al.* 2017).

Data analysis

The data analysis was conducted in four steps. First, IBM SPSS ver. 26 was used to analyse descriptive statistics for the sample. Second, reliability and validity tests on WVO, attitudes and outcome expectancies were performed using Cronbach's alpha in SPSS. Confirmatory factor analysis was performed in AMOS, following the method by Hu and Bentler (1999). Frequencies and descriptive statistics were calculated for the WVO scales to segment the sample based on an ideological matrix using a cross-tabulation procedure (Fulton *et al.* 1996). Finally, following the process used in Pang *et al.* (2018), multi-group structural equation modelling was performed in AMOS, using the SCT and WVO frameworks to investigate which factors were influencing the intention to slow down when driving in a highly populated koala area across the four WVO segments.

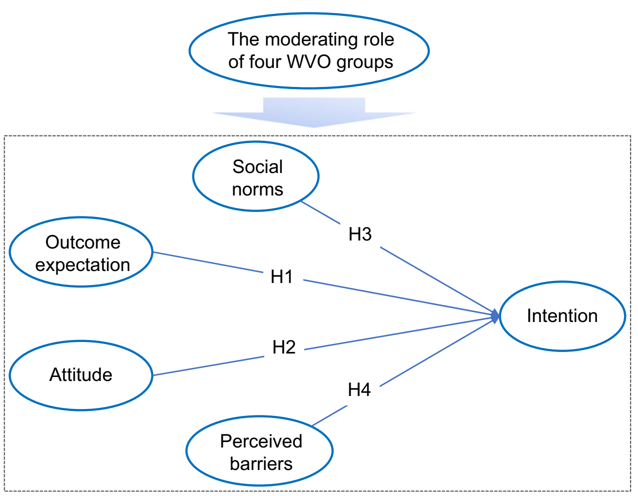

Fig. 1. The proposed research model.

Results

Sample characteristics

Table 1 shows the demographic characteristic of the respondents. The sample consisted of 37.5% male and 62.5% female. Almost all (95.6%) respondents were over 18 years of age and the numbers of respondents in each age group were very similar. Over 42% of respondents had attended university.

Measurement model

Reliability and validity analyses were conducted to assess the adequacy of the measurement model. Reliability tests indicated that all scales had acceptable or high internal consistency (Cronbach's alpha 0.68–0.92) (Nunally and Bernstein 1978). Confirmatory factor analysis of WVOs suggested an acceptable measurement model fit (chi-square

Table 1. Sample characteristic.

Variable (*N*)	Category	*n*	Valid (%)
Gender (626)			
	Male	235	37.5
	Female	388	62.5
Age (608)			
	Under 18 years old	27	4.4
	18–24 years old	114	18.8
	25–34 years old	102	16.8
	35–44 years old	100	16.4
	45–54 years old	93	15.3
	55–64 years old	93	15.3
	65 years old and over	79	13
Education (613)			
	School education level	136	22.2
	Certificate level	113	18.4
	Advanced diploma and diploma	104	17
	Bachelor's degree	146	23.8
	Graduate diploma and graduate certificate	50	8.2
	Postgraduate degree	64	10.4

The number in each variable is slightly different because of missing data.

P = 0.000, chi-square/d.f. = 6.653, Comparative Fit Index (CFI) = 0.918, Tucker–Lewis Index (TLI) = 0.873, Normed Fit Index (NFI) = 0.905, Root Mean Square Error (RMSEA) = 0.093). Indicator reliability was determined from loadings, which suggested an acceptable degree of individual item reliability of 0.5 (Nunally and Bernstein 1978). Convergent validity was assessed through composite reliability (CR) and average variance extracted (AVE) (Fornell and Larcker 1981; Bagozzi and Yi 1988). The use of wildlife showed reasonably low AVE (0.474), falling below the recommended value of 0.5 (Hair 2011). The CR values for use and hunting (0.394 and 0.477) also fell below recommended levels. All other variables showed good validity (see Table 2).

Wildlife value orientation types

Four WVO types were identified based on whether people scored high or low on domination and mutualism orientations (low–high, low–low, high–low, high–high) (see Table 3). They were mutualists (38.4%), distanced (14.7%), traditionalists (27.1%), and pluralists (19.8%).

Structural model

The initial hypothesised model was estimated following a theory-based approach. Each SCT construct was included as a direct factor of behavioural intention. Pathways between each construct and intention referred to a hypothesis of this study. The overall fit for the model was poor (chi-square = 0.000, chi-square/d.f. = 9.662, CFI = 0.879, TLI = 0.847, Relative Fit Index (RFI) = 0.832, NFI = 0.868, RMSEA = 0.115). Only the CFI, TLI, RFI and NFI values met criteria for acceptable fit. Using the *post hoc* modification method recommended by Byrne (2016), modification indices indicated that deleting descriptive norms and hassle would significantly improve model fit. Therefore, the model was re-estimated, and the adjusted model showed a good fit (chi-square/d.f. = 2.824, CFI = 0.982, TLI = 0.975, RFI = 0.962, NFI = 0.972, RMSEA = 0.053). See Fig. 2 for the overall model specifications.

In the final model, there were significant pathways between intention and outcome expectancies (beta = 0.694, $P < 0.001$), injunctive norms (beta = 0.070, $P < 0.05$) and perceived barriers (beta = −0.075, $P < 0.05$). Therefore, **H1** was supported, and **H3** and **H4** were partially supported. The pathway between intention and attitude was not significant (beta = 0.046, $P = 0.185$). Thus, **H2** was not supported. Finally, a significant pathway between outcome expectancies and attitude (beta = 0.512, $P < 0.001$) was identified. The entire model (including all hypotheses) accounted for 39.8% of the variance explained in terms of the intention to slow down.

Multi-group analysis

The model was then tested using multi-group analysis to examine the moderating effect of WVO on the intention to slow down when driving in koala populous areas. The effects (std. beta) of each relationship in the model are shown in Table 4. The results indicated that outcome expectations were the most significant factor influencing people's intention to protect koalas, regardless of which wildlife value they held. Outcome expectations included the expectation of protecting wildlife, reducing roadkill and keeping roads safe. Differences between groups were evident (chi-square $P = 0.017$) To be more exact, injunctive norms were important, positively and significantly influencing the intention of traditionalists and pluralists (but not mutualists or distanced individuals) to slow down. In addition, individual attitude positively influenced driving intention for pluralists, while perceived barriers (increased travel time) negatively influenced mutualists' intention to slow down. Thus, **H5** was supported.

Discussion

This study responds to the call for a better understanding of human dimensions in the discipline of conservation (Bennett *et al.* 2017). The study employed a widely used behavioural explanatory framework – the SCT – to investigate the determinants of behaviour change in the context of slowing down when driving to protect wildlife. The inclusion

Table 2. Results of the measurement model.

Construct	Measurement	Estimate	C.ratio	s.e.	C.R.	AVE	Alpha	Mean	s.d.
Dominant							0.648	−0.921	1.248
Use belief					0.394	0.474	0.677	−0.912	1.547
us1	Humans should manage wildlife populations so that humans benefit. [Strongly agree/Strongly disagree]	0.570						0.17	2.327
us2	The needs of humans should take priority over wildlife protection. [Strongly agree/Strongly disagree]	0.901	10.019	0.131				−0.93	1.928
us3	Wildlife are on earth primarily for people to use. [Strongly agree/Strongly disagree]	0.531	10.794	0.059				−1.99	1.575
Hunting belief					0.477	0.599	0.718	−0.93	1.733
ht2[A]	We should strive for a world where there is an abundance of wildlife for hunting. [Strongly agree/Strongly disagree]	0.883						−0.94	2.28
ht3[A]	Hunting is cruel and inhumane to the animals. [Strongly agree/Strongly disagree]	0.973	18.214	0.060				−0.93	2.259
ht4	Hunting does not respect the lives of animals. [Strongly agree/Strongly disagree]	0.268	6.891	0.038				−0.94	1.949
Mutualism							0.879	1.889	1.086
Social affiliation					0.692	0.555	0.822	1.86	1.20
sa1	We should strive for a world where humans and wildlife can live side by side without fear. [Strongly agree/Strongly disagree]	0.471						2.21	1.368
sa2	I view all living things as part of one big family. [Strongly agree/Strongly disagree]	0.751	11.537	0.141				1.97	1.385
sa3	Animals should have rights similar to the rights of humans. [Strongly agree/Strongly disagree]	0.807	11.867	0.185				1.45	1.741
sa4	Wildlife are like my family and I want to protect them. [Strongly agree/Strongly disagree]	0.884	12.187	0.161				1.80	1.418
Caring					0.766	0.657	0.828	1.93	1.158
cr1	I feel a strong emotional bond with animals. [Strongly agree/Strongly disagree]	0.787						1.71	1.568
cr2	I value the sense of companionship I receive from animals. [Strongly agree/Strongly disagree]	0.898	23.746	0.041				1.84	1.348
cr3	I care about animals as much as I do other people. [Strongly agree/Strongly disagree]	0.739	19.713	0.032				2.23	1.066
Attitude					0.852	0.845	0.945	1.198	1.663
att4	For me slowing down at wildlife warning and road signs is [bad/good]	0.884						1.08	1.759
att5	For me slowing down at wildlife warning and road signs is [worthless/valuable]	0.966	15.011	0.073				1.30	1.719
att6	For me slowing down at wildlife warning and road signs is [harmful/beneficial]	0.906	13.413	0.076				1.19	1.754
OE					0.736	0.556	0.782	2.126	0.983
oe2	Slowing down at a wildlife warning road sign will keep wildlife safe. [Strongly agree/Strongly disagree]	0.825						2.25	1.13
oe3	Slowing down at a wildlife warning road sign will keep the roads safe. [Strongly agree/Strongly disagree]	0.736	14.945	0.068				2.00	1.287
oe4	Ignoring wildlife warning road signs will cause wildlife fatalities. [Strongly agree/Strongly disagree]	0.667	14.436	0.056				2.35	1.125
Intention	I will slow down at a wildlife warning road sign. [Strongly agree/Strongly disagree]							2.48	1.02

(*Continued on next page*)

Table 2. (*Continued*).

Construct	Measurement	Estimate	C.ratio	s.e.	C.R.	AVE	Alpha	Mean	s.d.
INs	People in my neighbourhood think I should slow down at wildlife warning road signs. [Strongly agree/Strongly disagree]							0.53	1.837
DNs	Many people in my neighbourhood slow down at wildlife warning road signs. [Strongly agree/Strongly disagree]							0.84	1.59
Hassle	Slowing down at a wildlife warning road sign is inconvenient. [Strongly agree/Strongly disagree]							−1.06	2.006
ITT	Slowing down at a wildlife warning road sign will increase my travel time. [Strongly agree/Strongly disagree]							−0.14	1.871

Items removed: indicator loadings are below 0.5: hunting1; SA1; att1, 2, 3; oe1.
[A]Items were reversed.
C. ratio, critical ratio; s.e., standard error; C.R., composite reliability; AVE, average variance extracted; SA, social affiliation; OE, outcome expectation; ITT, increase travel time.

Table 3. Scoring of Koala value-orientation types on belief dimension and value-orientation scales.

Value orientation and belief dimension	Mutualist (Low domination and high mutualism)		Distanced (Low domination and low mutualism)		Traditionalist (High domination and low mutualism)		Pluralist (High domination and high mutualism)	
	Mean (s.d.)	Median	Mean (s.d.)	Median	Mean (s.d.)	Median	Mean (s.d.)	Median
Domination	−2.00 (0.71)	−2.00	−1.63 (0.57)	−1.50	0.23 (0.69)	0.17	0.13 (0.68)	0.00
Appropriate use	−1.85 (1.18)	−2.00	−1.47 (1.07)	−1.67	−0.05 (1.20)	0.00	0.14 (1.60)	0.00
Hunting	−2.15 (1.20)	−2.67	−1.80 (1.16)	−2.00	0.51 (1.22)	0.67	0.12 (1.41)	0.33
Mutualism	2.68 (0.37)	2.83	1.10 (0.66)	1.25	0.69 (0.87)	0.88	2.61 (0.36)	2.63
Social Affiliation	2.69 (0.43)	3.00	1.11 (0.84)	1.25	0.57 (1.09)	0.75	2.56 (0.48)	2.75
Caring	2.67 (0.48)	3.00	1.09 (0.98)	1.33	0.81 (1.08)	1.00	2.65 (0.46)	3.00

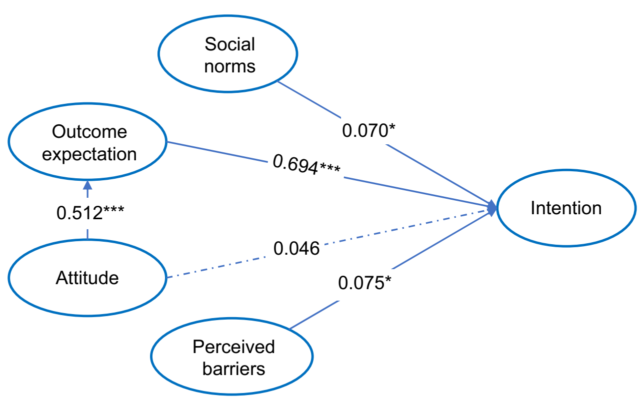

Fig. 2. The validated model – overall.

of WVO brings an additional layer of understanding, permitting group differences to be targeted based on wildlife values. This paper advances understanding in three ways. Firstly, the identification of group differences offers a practical contribution by demonstrating that different approaches are required to deliver behavioural change interventions that will benefit koalas. Secondly, this paper offers a theoretical contribution by demonstrating the value of SCT in explaining intentions to slow down to protect koalas. Finally, a methodological contribution can be offered by delivering a process that can be applied to identify values-based segments. This can guide program planning and intervention design by focussing on factors known to decrease driving speed. Each contribution is discussed in turn.

Identifying group differences to inform program planning and design

This paper combined the application of a behavioural change theoretical framework and identified group differences using the WVO framework. This has provided a comprehensive understanding of how slowing-down behaviour can be motivated in different driver groups. Segmentation challenges the fundamental mindset that a non-targeted, 'one size fits all' approach to behaviour change can reduce intervention effectiveness. The results of this study highlight the nuanced understanding that can emerge when group differences are identified and considered (see Table 4).

Table 4. Model path coefficient analysis and multigroup path analysis.

Hypothesis	Overall		Mutualists		Distanced		Traditionalists		Pluralists	
	Std. β	*P*	Std. β	*P*	Std. β	*P*	Std. β	*P*	Std. β	*P*
OE → Int	0.694	***	0.324	***	0.685	***	0.784	***	0.629	***
Att → Int	0.048	0.185	0.036	0.567	−0.070	0.433	0.010	0.883	0.167	0.021*
INs → Int	0.070	0.016*	0.038	0.523	0.011	0.890	0.100	0.044*	0.166	0.009**
PB → Int	−0.075	0.010*	−0.137	0.021*	−0.091	0.261	0.014	0.783	0.014	0.825
Att → OE	0.512	***	0.195	0.014*	0.245	0.053	0.610	***	0.353	0.004**

*$P < 0.05$, **$P < 0.005$, ***$P < 0.001$.

OE, outcome expectancies; Att, attitude; Ins, injunctive norms; PB, perceived barriers; Int, intention.

Intervention targeting strategies

We identified group differences and presented strategies to target each group, with an aim to increase conservation intervention effectiveness in changing human behaviour. The research showed that mutualists' intentions are significantly influenced by their perceived barriers. Therefore, social marketers targeting mutualists might focus on reducing barriers to slowing down by delivering VMS indicating that travel time will not be significantly affected by slowing down at koala signs (e.g. 'A slight delay in your travel can make a big impact on koala conservation'). Traditionalists, on the other hand, are influenced by the actions and values of friends and family. Hence, messaging that highlights family approval for slowing down around koalas may be an effective tool to target this group. Another social media communication campaign may draw on one's own network of family and friends agreeing to slow down in koala populated areas. For example, a campaign on social media can encourage this group to slow down in koala areas by saying 'Your loved ones want you to slow down, so do the koalas'. A strategy focused on changing attitudes is needed when targeting pluralists, as their intentions to slow down in koala areas are much more strongly influenced by their underlying wildlife attitudes, compared with other segments in the study. Therefore, messages reinforcing beliefs that slowing down can protect koalas may be an effective strategy for this group. The differences between WVO groups may be explained by differences in psychographic and demographic variables. Research indicates each group comes from a different demographic background, which accounts for differences in influential constructs. For example, Teel and Manfredo (2010) found that traditionalists and pluralists are mostly males, and older than mutualists and those who are distanced. Conservation campaigns and interventions may benefit from approaches used in other well-established sectors such as health communication, where targeting and segmentation are applied more frequently, with evidence of effectiveness (Noar *et al.* 2007). Similarly, research evaluating road safety campaigns suggests that segmentation techniques increase campaign effectiveness in changing road-related behaviour (Batool and Carsten 2018). Identifying the different WVO groups within an audience, along with their demographic backgrounds, will help in crafting persuasive wildlife conservation messaging and designing effective interventions.

Applying a theoretical lens to environmental protection

Set within the context of koala protection by aiming to reduce roadkill, this study covers the research need to embrace human dimensions in environmental protection efforts (Robinson *et al.* 2019; Veríssimo and Wan 2019). Cognitions and associations result from lifelong learning and manifest themselves in enduring dispositions to behave (Dutta-Bergman 2003). By understanding how different people think and feel we can identify factors that can be modified to reduce negative human–wildlife interactions. This human-centred approach to conservation demonstrates the application of four social marketing principles delivering a theoretically informed understanding of SCT factors that can be modified to protect koalas through driver actions. This confirms previous findings systematically linking attitudes, intentions, and other cognitive and sociodemographic variables to driving behaviour. Road safety literature utilises attitudes, social norms, and other perceptions to predict driving behaviour and behavioural intentions (Plant *et al.* 2017; Batool and Carsten 2018; Yousef *et al.* 2021). In this study, outcome expectancies, perceived barriers and social norms interacted to influence driving speed intentions. This paper demonstrates the utility of the SCT framework, which has been deemed the most used behavioural explanatory model in social marketing (Luca and Suggs 2013). It focuses on behavioural intentions in a conservation context – slowing down on the road to protect wildlife – and demonstrates the utility of the tested framework with 40% of variance explained.

Developing a more nuanced understanding: a process to identify group differences

One major threat to koalas is vehicle strike. This study, drawing on four key social marketing principles (consumer orientation, segmentation, theory, and insight) aimed to identify modifiable factors that increase people's intention to be more vigilant in their driving behaviour in areas where koalas are present. Outcome expectations were a significant factor influencing intentions to protect koalas no matter what wildlife value a person holds, which offers one modifiable factor to target for change in a 'one-size-fits-all' approach. This paper delivers further evidence demonstrating how segmentation can be applied to identify segment level strategies for targeted program implementation.

Limitations and future research directions

The major limitation of this paper is that this study adopted a self-reporting survey mechanism to collect data, which may have resulted in social desirability biases (Nederhof 1985), comparing with other more advanced biometric methods to collect objective data on people's psychographic responses such as eye tracking, facial expression detection, and brain activities via brain recorded through EEG (electroencephalography). Furthermore, the survey did not screen participants' driving license status (Learner, Provisional, or Open licences), ownership of a vehicle, or the type of vehicle driven, to minimise the time required to complete the survey, which may have led to limited understanding of the study sample. Future research is recommended to deliver field trials to examine the effectiveness of different approaches to extend understanding of outcomes achieved and cost-effectiveness of the relative approaches.

Conclusion

In response to calls to consider human dimensions in wildlife protection, this study – set within the context of slowing down in areas where koalas are present – provides a framework that can be applied to deliver segment-level insights. This study is a first attempt to combine WVO and SCT, delivering segment-level insights to understand which modifiable factors to target in order to encourage reduction of speed in koala areas. This paper demonstrates how a nuanced understanding of human dimensions can emerge when the principle of segmentation is applied, confirming previous findings (Miller *et al.* 2018). The study has also generated new insights along with theoretical, methodological and practical implications. Practically, this study serves as a first step for the development of conservation efforts aiming to reduce driver speed in koala–human cohabitation zones. The insights from this study can be used to inform program design.

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