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Social referents and normative standards affect perceptions of livestock management behaviors

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Wildlife Conservation Research Unit, Zoology Department, University of Oxford, Oxford, U.K

ABSTRACT

Social influence impacts individuals' behavior through norms – the perceived appropriateness of behaviors – and social referents, whose behavior is copied by others. Interventions using social influence may help promote conservation-friendly behaviors. We explored how perceptions are influenced by descriptive norms (what people do) and social referents (who does it) in relation to livestock management in Kenya. By presenting participants with vignettes describing different livestock management scenarios, we explored how two norms ('high' vs. 'low' standards of livestock management) and three social referents ('neighbor,' 'leader,' 'father') influence participants' perceptions of aspects of livestock management. More senior social referents and 'high' standard norms were associated with greater impact on perceived importance of livestock management behaviors. Age also had an effect, with higher perceived importance and greater effect of norm treatment in younger respondents. Encouraging social seniors to model desired behavior may be a possible strategy for conservation behavioral interventions.

KEYWORDS

Behavior change; human-wildlife conflict; conservation psychology; human dimensions; social norms; livestock; predators

Introduction

How people behave is influenced by the behavior of their peers (Lapinski & Rimal, 2005; Montgomery, 1989; White et al., 1994). The subconscious influence exerted by the perceptions and behavior of others shapes the behavior of individuals through 'social norms' (i.e., behaviors that are collectively approved or disapproved by society) (Cialdini & Trost, 1998; Lapinski & Rimal, 2005), and by opinion leaders, people whose behavior is copied by others (Abrahamse & Steg, 2013), who we henceforth broadly refer to as 'social referents.' In environmental science, norm-based interventions have been shown to consistently influence behavior (Farrow et al., 2017). For example, in Hawaii, individuals' efforts to control invasive species are strongly related to perceptions of social norms (Niemiec et al., 2016). Social norms also impact conservation behavioral intentions with regard to reducing light pollution for turtle hatchlings (McDonald et al., 2014), or avoiding foot traffic near ground-breeding birds (Schoenleber, 2019).

Individuals form ideas about what is socially normative by observing the behavior of others, and by judging the extent to which that behavior is endorsed by those around them (Prentice & Miller, 1993). 'Social referents' (i.e., known persons or groups with

CONTACT Laura R. Perry  laura.perry@zoo.ox.ac.uk  Wildlife Conservation Research Unit, Zoology Department, University of Oxford, Tubney House, Abingdon Rd, Oxford OX13 5QL, U.K

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whom an actor has an existing relationship) can exert a strong social influence on normative perceptions and adherence to norms (Brechtwald & Prinstein, 2011; Paluck & Shepherd, 2012). Socially proximate referents (e.g., close family or peers) have far greater influence on individual behavior than more socially distant referents (Bamberger & Biron, 2007; Brown & Reingen, 1987), as have referents in positions of authority (Carmeli & Schaubroeck, 2007; Turner, 1956).

Socially comparative feedback, norms, and social referents can be effective in changing behavior. Social referents had a significant effect on participation in soil conservation initiatives in Kenya (Willy & Holm-Müller, 2013). By providing participants with information about their peers' average energy consumption, Schultz et al. (2007) effected a significant decrease in household energy use. In a meta-analysis of the mechanisms by which social influence can impact environmental behavior, Abrahamse and Steg (2013) concluded that behavioral role models were particularly effective for promoting sustainable practices.

If social influence can modify behavior – as in public health (Albarracín et al., 2004) or environmental sustainability (Eagle et al., 2016) – then it may also be useful in a conservation context. Human behavior is thought to be a significant driver of conflict between people and predators (Van Eeden et al., 2018). Interventions that encourage people to behave in ways that are compatible with living alongside carnivores are particularly needed.

Human-predator conflict across Africa is a major threat to predator populations, and much of this conflict stems from livestock predation (Van Eeden et al., 2018), which is exacerbated by variable standards of livestock management (Hazzah et al., 2014). Livestock management practices can also contribute to ecosystem degradation through overgrazing of fragile landscapes. Land degradation is an increasing threat to rural lives and livelihoods (Boles et al., 2019). Numerous conservation interventions have been designed to help livestock owners improve their management behavior by making protection of livestock easier and land usage more sustainable (Sibanda et al., 2020), but little focus has been devoted to making such activities more desirable. A theory of planned behavior framework can explain individual variation in livestock management (Perry et al., 2020a), with social norms playing a substantial role in determining livestock management behavior across eastern and southern Africa (Perry et al., 2020b). In the Tsavo-Amboseli landscape of southern Kenya, traditional approaches to livestock management are increasingly incompatible with both land and predator conservation. Loss of traditional anti-predator management techniques and increasing livestock numbers mean that sustainable, wildlife-friendly management practices are urgently needed if significant negative impacts to grazing and to wildlife populations are to be avoided.

In this article, we explored the potential of social influence to alter individuals' perceptions of livestock management behavior. Using an experimental approach, we used different illustrative vignettes to explore the role of social referents and social norms among livestock managers in the Tsavo-Amboseli landscape, in southern Kenya. We asked whether (1) 'high' vs 'low' behavioral standards or (2) different social referents influence individual perceptions of livestock management, and (3) how these influences interact with participant age in determining how different livestock management practices are perceived.

Methods

Target Behavior and Study Area

The Tsavo-Amboseli region of southern Kenya has an extensive system of protected areas, which includes internationally famous national parks (Amboseli, Tsavo West, Chyulu Hills NP), and various community-owned conservation areas. Rainfall across the region is low, and the area can be described as arid to semi-arid (Kioko & Okello, 2010; Schuette et al., 2013). Local people come into substantial conflict with large carnivores, including lion (*Panthera leo*), leopard (*Panthera pardus*), and spotted hyaena (*Crocuta crocuta*), which predate their livestock. Some livestock management behaviors reduce the risk of predation or livestock mortality: sending a trained herder out with livestock during the day; maintaining a high-quality ‘boma’ (overnight shelter); and regularly checking livestock health with a veterinary technician. As a fragile, semi-arid area with growing human and livestock populations, the region is also vulnerable to over-grazing (Boles et al., 2019), which has severe economic and subsistence consequences for local people. Behaviors that reduce the risk of overgrazing include managing grazing patterns to avoid repeated grazing, and resting of specific areas (Western et al., 2020).

The study’s focal topics were determined over a course of one-to-one semi-structured interviews with senior local people ($n = 15$) and with practitioners who have been working in the area for 10+ years ($n = 10$). These interviews were supplemented with community meetings ($n = 4$) to validate interview content. Interviewees identified sending an adult herder out with livestock, grazing management, and land resting as key components of traditional management, and boma maintenance and herding as key techniques which have been used to reduce depredation risk.

Through the qualitative interview process, both community elders and local conservation practitioners considered age a major factor affecting individuals’ livestock management practices, with younger age groups said to carry out poorer management. In Maasai culture, individuals belong to age-classes, which are more important than the exact age of individuals. Individuals above and below the age of approximately 30 years fall into two qualitatively distinct social strata: ‘elders,’ and ‘warriors’ (Hedlund, 1979). These distinctions reflect social differences in individual values: older individuals tend to value livestock management (Perry et al., 2020a; Perry et al., 2020b), whereas younger individuals are more inclined to value conventional employment (May & McCabe, 2004), or alternative sources of livelihood. Other work indicates that social influence may be moderated by age (e.g., Ghalandari, 2012; Steinberg & Monahan, 2007). We included interaction terms in our analyses to explore the hypothesis that the effect of ‘norm’ depended on respondent age.

As well as characterizing issues surrounding livestock management and human-predator conflict across eastern and southern Africa, the Tsavo-Amboseli landscape has desirable attributes: the human population exhibits a common behavior (livestock management), which varies in how effectively it is performed. There is also cultural and sociological variation, with a range of ethnicities and cultures, predominantly Maasai but with Kamba, Taita and Kikuyu minorities, present in the area.

Survey Participants and Collection Protocol

Survey protocol was approved by the University of Oxford Social Sciences and Humanities Interdivisional Research Ethics Committee (Reference No. R53944/RE001). Surveys were translated into Swahili through a discursive process, with expert discussion in cases where there was poor consensus. Swahili is commonly used, and all respondents were fluent in Swahili.

Nine survey enumerators were hired and trained. Each survey was conducted as a face-to-face interview. All enumerators were technologically literate men in their 20s. Enumerators operated in their home area to increase trust in and reduce accessibility challenges. Due to practical constraints, a convenience sample was used. Efforts were made, however, to randomly select participants. Similar convenience approaches have found no practically significant differences between convenience and probability-based samples (Luschei et al., 2009). Women are seldom involved in livestock management, and were not included in this study.

Enumerators recruited participants using door-to-door surveying or through opportunistic meetings at communal spaces (e.g., markets). Before starting an interview, enumerators administered three participant suitability questions: “*Have you been involved in livestock management in the past three weeks?*”; “*Do you live in [the local area]?*,” and “*Do you or anyone in your immediate family work for [local conservation NGOs]?*.” Individuals who were not involved in livestock management, did not live locally, or worked in conservation were excluded. Enumerators also checked for linguistic fluency; no candidates failed this test. Participants were then allocated to a treatment group at random using Qualtrics randomization software. Surveys were collected January to March 2020.

Study Design

We used six treatments, in a 2×3 between-subjects factorial design (see Table 1). One independent variable was the standard of livestock care (i.e., low vs. high standards). The ‘high standards’ treatment involved a more demanding set of behaviors which are desirable from a conservation perspective (e.g., greater effort regarding anti-predator behavior, sustainable grazing). The other independent variable was the social referent (i.e., ‘your father,’ ‘your community leader,’ ‘your neighbor’), which explored differences in social influence. Typically, socially proximate referents (e.g., ‘father’) or leadership figures (‘community leader’) perform best as social influences. Community members (‘neighbor’) are generally less proximate, typical actors (Brown & Reingen, 1987; Carmeli & Schaubroeck, 2007). We also stratified by age based on existing cultural age segregation, and grouped participants into 18–30, and 31+ age classes.

The interviewer read all survey components aloud to each participant. First, each participant was read a brief introductory segment to explain the survey process, and the response scales. The interviewer confirmed with example questions that the respondent understood the use of scales, and recorded the interviewee’s age category. Participants were then read the experimental vignette assigned to their treatment group (Table 2). Each participant then answered a series of follow-up questions, five relating to each of the specific vignette topics, and two relating to overall perceptions of the importance of livestock management. The only aspect of the survey that varied between treatments was the exact

phrasing of the experimental vignette. Enumerators were trained to check respondent attentiveness, and where there were concerns regarding comprehension, the interview was terminated, and data excluded from analysis ($n = 9$).

The use of vignettes to study perceptions in non-Western societies is considered effective in minimizing assumptions or misunderstandings (Jeffries & Maeder, 2006), and vignette-based experiments have previously been used to study local norms (Knutson et al., 2010; Krumhuber et al., 2018). The two vignettes were designed to reflect ‘high’ and ‘low’ standards of livestock management and were paired sentence for sentence covering each of the five key management behaviors, e.g., low standard: “[REFERENT GROUP] sometimes sends a herder out with the animals, and has a boma which they can sometimes use at night.” versus high standard: “[REFERENT GROUP] always sends a trained and experienced herder with the livestock; he has a very strong boma for them to use every night.” The vignettes were designed to be simple to understand, and easy to administer. They were piloted in training sessions with enumerators to ensure that they were clear and made sense in a local context, and where necessary adjusted to reflect the desired meaning (Table 2).

In total, each participant was asked seven follow-up questions regarding their perception of the importance of various livestock management practices. Respondents rated the importance of five management variables (boma use, herding, veterinary care, grazing management, resting grazing land, Table 2); higher rankings indicated higher perceived importance regarding standards of livestock management. The two additional follow-up questions concerned overall perceptions of the livestock management of self and others, which were used in the manipulation check. All questions were answered on a 10-point scale to capture subtle differences in response (Boone & Boone, 2012).

We performed a manipulation check to confirm that the vignettes were interpreted appropriately by respondents. This check was necessary to confirm that the ‘high standards’ vignette was perceived to reflect better, more intensive management than the behaviors described in the ‘low standards’ vignette. We tested this in both a pretest and in the survey itself. In the pretest, the vignettes were read to 20 community members, who were then asked open-ended follow-up questions about their perceptions of the behavior described; these individuals were not included in the sample. This was a strict test of meaning and local perception, and responses showed the vignettes were suitable. To test the manipulation under the survey conditions, we compared answers to one of the overall, follow-up questions “how well do you think [REFERENT GROUP] takes care of their livestock” between both treatments. This follow-up check was designed to confirm that there was no context-specific loss of meaning.

Table 1. Study design and number of participants. Participants ($n = 996$) were randomly allocated to one of 6 groups, in a 2×3 design. Factors: 1) high or low livestock management standard; 2) referent group (father, leader, or neighbor).

Treatment	Father		Leader		Neighbor	
	High	Low	High	Low	High	Low
Men 18–30	88	77	82	76	74	97
Men 31 +	79	80	78	77	99	89

Analysis

We first constructed models predicting perceived importance of each of the individual management practices (grazing, land resting, use of a herder, veterinary care, boma use). A composite of these was then developed by aggregating each participant's responses to the five specific management questions. Asking participants for a single overall management perception response would likely be affected by the salience of different activities (e.g., more weight given to boma use in the evenings, or to herder presence if questions about herders immediately preceded the overall management question). This consideration favored use of a composite overall measure, which was used as the response variable in a further model. Given our 10-point scales and 50-point composite, we used generalized linear models (glms) (Rhemtulla et al., 2012).

In all models, explanatory variables were: vignette norm standard (categorical variable 'high'/'low'; 'low' as reference level), age (categorical variable 'older'/'younger'; 'older' as reference level), referent group (ordered categorical variable 'neighbor'/'leader'/'father'; 'neighbor' as reference level), enumerator identity (categorical with nine enumerators), and interaction terms for norm*age and referent*age. For age, 18–30 was considered the 'younger' age bracket, and 31+ 'older,' based on information regarding age classes, and input from community leaders. Likelihood ratio tests were used to test the statistical significance of model terms, meaning each variable was dropped from the model in turn to test whether model fit improved. In the individual management behavior models, there were no significant interaction terms and in the composite model, age*norms was the only significant interaction; other interactions were therefore removed from all subsequent analyses. Analysis was carried out using the statistical software R, version 4.0.0 (R Core Team, 2018).

Table 2. Key livestock management variables. Content based on unstructured interviews and discussions with community members. The high and low standards columns contain paired excerpts regarding each practice from the vignettes. Using a 10-point Likert scale, participants then responded to each statement.

Topic	High standards	Low standards	Statement
Grazing – managing grazing patterns.	<i>He is very careful about where [his livestock] graze, and takes them to the best pasture that he can access.</i>	<i>He lets [his livestock] graze wherever they want, and go wherever they want.</i>	It is important for livestock owners to decide where animals graze.
Land resting – maintaining land and grazing condition.	<i>He understands rotational grazing and land resting are important for maintaining the grass in the long-term, and preventing degradation.</i>	<i>He thinks resting grazing areas is unimportant; and knows the grass will always grow back.</i>	It is important to rest grazing areas.
Herder use – daytime tending of livestock.	<i>He always sends a trained and experienced herder with the livestock.</i>	<i>He sometimes sends a herder out with the animals</i>	It is important to send a trained, experienced herder with livestock.
Boma use – use and maintenance of overnight livestock pen.	<i>He has a very strong boma for them to use every night, which he keeps well-maintained.</i>	<i>He has a boma which is sometimes used at night. His boma is old, but he thinks it is adequate.</i>	It is important to spend time and money maintaining a boma.
Veterinary care – level and expectation of veterinary intervention	<i>He regularly gets a vet to visit his animals, and pays for vaccinations and medicine to keep his animals healthy.</i>	<i>When a vet is present, he sometimes gets livestock vaccinated if it is free, but he does not think it is very important.</i>	It is important to get veterinary care for livestock, even if expensive

Results

Overall, 996 participants were included in this study. Of these, 494 (49.6%) were young men, or warriors, according to Maasai social stratification, and 502 (50.4%) were considered elders. The mean number of years spent in school was 8.8 ($SE = 0.164$), and while this was higher for younger (10.2) than older (7.5) respondents there was no significant difference between the treatment groups. No other recorded social factors varied significantly among age groups. The average respondent had 2.29 ($SE = 0.035$) cows and 2.91 ($SE = 0.035$) shoats; there was no evidence that these differed between treatment or age groups (all treatment group comparisons, t -test $p > .05$).

A manipulation check was carried out to establish whether the vignettes had conveyed the intended meaning. Results indicated significantly higher perceptions of management standards in the 'high standards' treatment (high standards $M = 6.1$, $SE = 0.113$; low standards $M = 5.5$, $SE = 0.116$; Wald test: $F = 11.08$, $p < .001$).

The high standard vignettes predicted greater perceived importance of three management variables: livestock grazing ($p = .025$, parameter estimate difference compared to 'low' treatment = 0.26; Table 3); resting grazing land ($p = .041$, p.e.d. = 0.25; Table 3); use of veterinary treatments ($p = .046$, p.e.d. = 0.22; Table 3). There was no evidence for an effect for norm treatment on perception of herding or boma use (see Table 3). The higher authority referent groups predicted greater perceived importance of all management variables apart from herding norms: livestock grazing ($p < .001$; Table 3); resting grazing land ($p < .001$; Table 3); use of veterinary treatments ($p < .001$; Table 3); and boma use ($p = .001$; Table 3). The neighbor treatment led to the lowest parameter estimates of perceived importance, followed by leader and father respectively: grazing (parameter estimate difference compared to 'neighbor' treatment: leader = 0.47; father = 0.8;), resting (leader = 0.34; father = 0.65), veterinary care (leader = 0.47; father = 0.70), and boma use (leader = 0.24; father = 0.44).

In the composite model, which integrated all management behaviors, the 'high' standard treatment also predicted greater perceived importance of livestock management overall (p.e.d. compared to 'low' treatment = 0.22; see Figure 1, Table 4). Enumerator was a significant model predictor (9 categories, all $p < .001$). The effect of the referent treatment in this composite model followed the same pattern as in the individual management practice models: 'father' and 'leader' treatments predicted greater perceived importance of livestock compared with the neighbor treatment ($p < .001$; Figure 1, Table 4). The 'father' and 'leader' treatments increased the parameter estimates by 0.92 and 0.61 respectively compared with the 'neighbor' reference level (Table 4).

Age significantly moderated the effect of treatment: younger participants showed greater differences in their perception of livestock management based on their norm treatment than older participants ($LR = 4.38$, $df = 1$, $p = .021$, see Figure 1). For the younger participants, the norms treatment had an effect size of 2.03; for the older group the effect size of norm treatment was only 0.05.

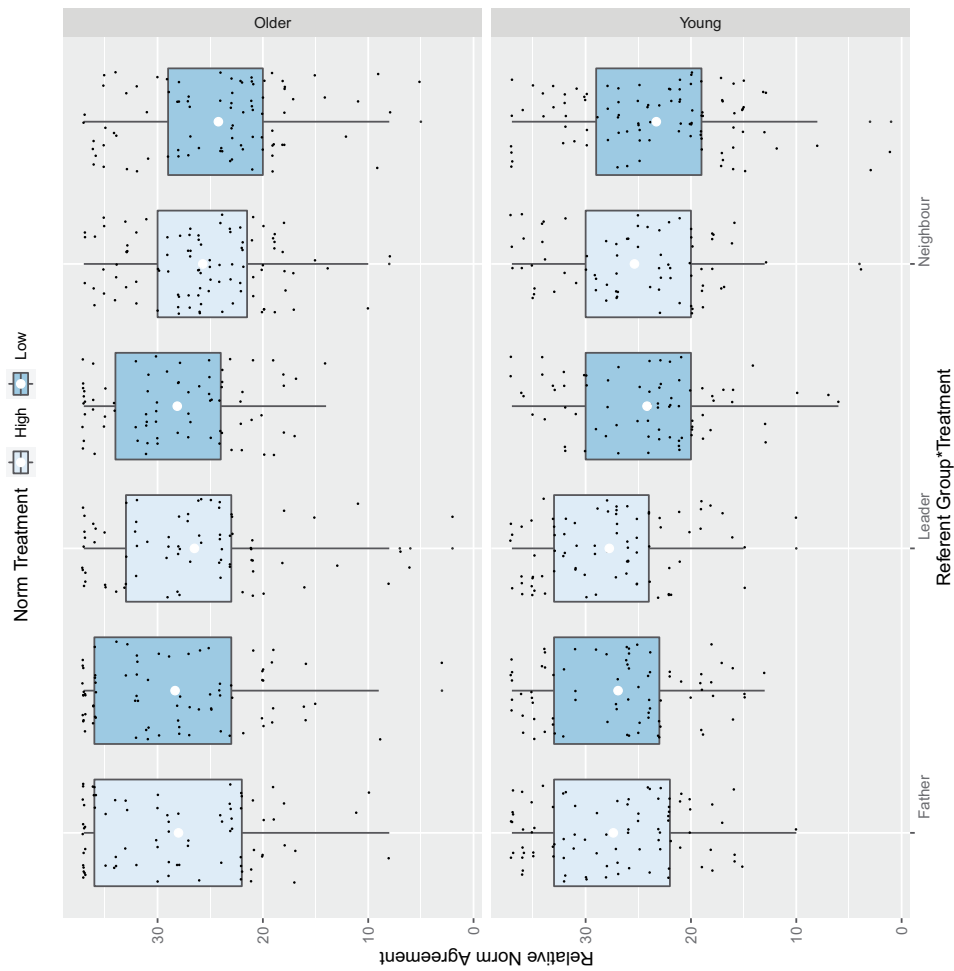


Figure 1. Composite response to vignettes with different named social referents. All five management variables had responses on the same 10-point Likert scale, so responses were added to create a general management composite (Y-axis). Referent groups (X-axis) were 'father,' 'community leader,' and 'neighbor.' Dark blue represents the low norms treatment, and light blue the high norms treatment. Larger white dots represent group means. Plot split by age: upper panel for the older age group, and lower for the younger group.

Table 3. Main effects in generalized linear models of separate livestock management variables. Models A-E show the effect of vignette treatment on respondent's perception of the importance of each management activity (see Table 2 for details of individual management parameters). Reference levels were neighbor, low norms treatment, and older respondents. An enumerator was chosen at random as the reference level; * individual enumerator estimates ($n = 8$) and SE not shown for brevity, please contact the lead author to see the full table. [†] SE for all individual parameter estimates all as shown to 3 s. f.

	Variable	d.f	Likelihood Ratio Test		Estimate	SE
			Statistic	P		
A. Grazing norms ($n = 994$)	Norm	1	5.020	.025	0.263	0.118
	Age	1	5.066	.024	-0.264	0.118
	Referent	2	31.524	$p < .001$	0.798 (father)	0.143
					0.465 (leader)	0.143
	Enumerator	6	132.362	$p < .001$	*	*
B. Resting land norms ($n = 995$)	Norm	1	4.145	.042	0.247	0.112
	Age	1	2.778	.096	-0.202	0.112
	Referent	2	18.021	$p < .001$	0.625 (father); 0.344 (leader)	0.148
	Enumerator	6	191.823	$p < .001$	*	0.149 [†]
	Norm	1	0.090	.764	0.032	0.108
C. Herding norms ($n = 996$)	Age	1	4.066	.044	-0.217	0.108
	Referent	2	8.503	.014	0.359 (father); 0.284 (leader)	0.131
	Enumerator	6	308.501	$p < .001$	*	0.132 [†]
	Norm	1	3.970	.046	0.219	0.110
	Age	1	1.842	.175	-0.149	0.110
D. Vet care norms ($n = 995$)	Referent	2	28.353	6.54e-07	0.696 (father); 0.470 (leader)	0.134
	Enumerator	6	286.710	$p < .001$	*	0.136 [†]
	Norm	1	0.238	.626	0.049	0.100
	Age	1	5.083	.024	-0.225	0.100
	Referent	2	13.400	.001	0.442 (father); 0.244 (leader)	0.122
E. Boma norms ($n = 996$)	Enumerator	6	226.030	$p < .001$	*	0.112 [†]

Table 4. Main effects of the overall generalized linear model of livestock management perceptions. Effect of treatment on respondent perception of importance of management activities ($n = 993$). Reference levels were neighbor, low norms treatment, older respondents, and low norm*older. An enumerator was chosen at random as the reference level; * individual enumerator estimates ($n = 8$) and SE not shown for brevity, please contact the lead author to see the full table.

Variable	d.f	Likelihood Ratio Test statistic	P	Estimate	SE
Norm	1	4.200	.040	0.225	0.264
Referent	2	48.03	$p < .001$	0.918 (father); 0.608 (leader)	0.442; 0.444
Age	1	13.51	$p < .001$	-0.404	0.364
Enumerator	6	425.7	$p < .001$	*	*
Norm*age	1	4.38	.021	2.056	0.890

Discussion

In this study, we found that our experimental manipulation of social influence had significant impacts on participants' perception of appropriate livestock management behavior. We found that the high versus low standards norm treatments and the choice of referent group had significant effects on participants' responses, and that there was a significant interaction between age and norms. These results suggest that appropriate social influence messaging may be an avenue worthy of further exploration with regard to encouraging behavior change in applied conservation contexts (see also Cialdini, 2003).

The high and low standards vignettes characterized two different levels of livestock management performance, which were designed to reflect locally-meaningful differences in local livestock management practices. These differences are also meaningful from a conservation perspective, with the high standards vignette describing behaviors which are more compatible with conservation goals. In this study, across all management practices, the high standards treatment was perceived to describe substantially better livestock management behavior than the low standards treatment, demonstrating that the vignettes were constructed appropriately.

We found a significant effect of the high versus low norms livestock management vignettes on participants' perceptions of suitable livestock management behavior, with individuals in the high norms treatments perceiving various livestock management behaviors as more important than participants in the low norms treatment. This was true for the overall composite measure, and three out of five specific management behaviors. Perceptions of the importance of using a herder or a boma were not significantly affected. One explanation for this could be the extent of behavioral variability with regard to different practices: grazing, resting, and veterinary care behavior vary, whereas bomas are consistently used across the region and herding by adults is uncommon. This may mean that the intended vignette manipulations were not 'believed' by participants, and that the described distinctions between 'high' and 'low' standard behaviors were interpreted by participants as reflecting minimal real behavioral difference. Further research is needed to explore which behaviors can be impacted by social influence, and under what conditions (e.g., where there is behavioral variation in real life).

Reference to socially proximate and authority figures led to participants rating high standards of livestock management as substantially more important than when treated with the neighbor referent. As predicted from work in other fields (Brown & Reingen, 1987; Carmeli & Schaubroeck, 2007), social proximity and authority resulted in stronger social influence, with referents of 'your father' (social proximity AND authority) and 'your community leader' (authority only) increasing respondents' perceived importance of livestock management (with substantial changes of 0.92 and 0.61 for father and leader, respectively) relative to the 'neighbor' referent. Interventions aiming to increase uptake of conservation-friendly behavior may explore the use of older, senior community members as behavioral 'influencers,' to increase the impact of an intervention. Due to similar social and cultural structures, we believe that father and leader may be appropriate authority figures across much of eastern and southern Africa. Future work exploring the extent of social influence in these communities, and whether use of appropriate authority referents can shape community behavior, would be of great value.

We found a significant effect of enumerator in all models. This is unsurprising: while 'location' was not retained as a model term due to low spatial granularity, enumerators operated in their local area, so the enumerator term captured variation from spatial, social (different community leaders in each region), and individual differences. We had nine different individuals working in this study, and yet the overall significance of normative, referent, and age terms was still apparent, despite the diversity in the survey team. We therefore conclude that whilst the personality and socio-demographic attributes of enumerators are likely to have an impact on results, and enumerators should be chosen carefully, variation in the enumeration team is unlikely to create challenges in the application of social influence-based interventions.

Although the relative changes in perceptions resulting from different treatments may not appear substantial (high vs low norm livestock management vignettes changed perceptions by roughly 0.25 for grazing, land resting and vet care, and 0.22 for overall management) these changes are comparable to results in other successful social influence-based interventions. For example, in a study of self-reported willingness to maintain good hygiene in public toilets in Kampala, Uganda, the main conclusions were supported by changes in perception of between 0.17 and 0.42 (Tumwebaze & Mosler, 2015); in work on the influence of social media on perceptions of alcohol use in teenagers, changes in perception of between 0.13 and 0.39 were linked to different behavioral outcomes (Litt & Stock, 2011). The changes in reported perceptions for father (0.92) and leader (0.61) referents were greater than most reported changes in comparable studies.

We hypothesized that there would be an interaction between age and the treatment efficacy, and that younger participants would be more susceptible to social messaging. This is consistent with previous work on social stratification of pastoralist communities in the region, which suggested that younger groups have greater behavior flexibility regarding livestock management activities (Perry et al., 2020b). Similarly, other work on social influence has suggested cohort-specific effects (Keyes et al., 2012), with greater social influence on younger participants (Albarracín et al., 2004; Cestac et al., 2011). In this study, we found an interaction between age and norm treatment on perceived importance of livestock management, with a greater difference between responses to the high and low standards vignettes in younger participants. That younger participants were more influenced by messaging than older participants has practical implications for conservation practitioners. If replicated in other contexts, these results suggest that younger, behaviorally malleable groups could be prioritized as the target of social influence interventions – except in situations where it is possible to influence older, more senior community members, under which circumstances these older groups should be prioritized.

Further work is required to understand if the differences in perception identified here can be translated into actual changes to behavior, as the link between psychological factors and behavioral outcomes can be tenuous (Forward, 1997; Friese et al., 2008). In this study, we chose to focus of the effects of individuals as social referents, rather than the more typical use of norms composed of anonymous but, by implication, numerous people (i.e., ‘your community leader does X’ compared to ‘80% of people in your community do X’). We chose this approach for practical reasons, as we felt that more typical statistical norms (percentages, proportions etc.) would result in low comprehension in our semi-literate, and certainly data-illiterate, study population. Greater understanding of how best to present complex information in such populations is necessary to maximize the efficacy of not only studies such as this, but also conservation education campaigns; this is likely to vary on a site-by-site basis. Future research exploring the use of individuals vs. collectives as social referents would be valuable in determining the most appropriate messaging strategy for social-influence based interventions.

One notable study limitation is the use of a convenience sample, which introduces potential bias in the selection of participants. With a very large sample size, and specific participant inclusion criteria to restrict the sample (i.e., only those involved in livestock management, therefore a relatively more homogenous group than society at large) we believe the convenience sample is unlikely to substantially affect our results. However, future work may use a stratified approach to establish generalizability. Similarly, the lack of

geographical granularity prevented us from detecting spatial variation in responses and enumerator effects. Understanding spatial variation would facilitate a better understanding of the generalizability of these results. Exploring the effect of enumerator characteristics on results would also be of use to groups using field teams to survey local populations, which includes many conservation organizations.

In our study, levels of agreement with the survey statements were consistently high, so even participants treated with the low standards vignette mostly agreed with response statements. This may reflect a positive local perception of livestock management, acquiescence bias ('yea-saying'), or an information salience effect emerging as a product of the survey design, which detailed and therefore emphasized livestock management techniques. In this study, we chose to use behavioral vignettes and immediate follow-up questions (with a time lag of approx. 10 minutes between the primer and the end of the follow-up questions), to establish whether treatments had any significant effect on perceptions; future studies building on this result may choose to leave more time between treatment and effect measurement, to reduce any temporal exaggeration of effects. We also chose to phrase all statements positively to increase simplicity of the survey tool and reduce translation issues; it may be beneficial for future authors to examine the effect of acquiescence with reverse-scored, negatively phrased survey items. Future work should focus on understanding the use of influence campaigns *in situ*, i.e. without controlled interview protocol, to examine whether these techniques have any applied value. We suggest that a between-village design using tailored educational content, using both surveys and behavioral indicators of impact, may be a valuable way to test these initial results further.

Social norms interventions have a long history of successful application to societal concerns (Cialdini & Trost, 1998). In scenarios where behavior change is considered desirable, such as undergraduate drinking (Perkins & Berkowitz, 1986) or where a certain behavior is to be encouraged, e.g., control of invasive species (Niemiec et al., 2016), interventions using norms have provided effective mechanisms by which participants can be subtly encouraged to behave in a certain way. In this study, we found that both the specific behavior described in a vignette and the social referent group specified in the vignette had effects on the perceived importance of behavior, with high norms and socially proximate authority figures increasing the perceived importance of wildlife-friendly livestock management behavior. We also found that age interacted with the treatment, so younger participants were more susceptible to normative messaging. Against a backdrop of numerous successful norm-based interventions in other disciplines, we show that these techniques may have the potential to be applied to conservation issues. Although our study only focused on the impact of a manipulation on perceptions, and further work is needed to understand the impact on actual behavior, we believe our results are promising. In this instance, suggesting a strong social norm of conservation-compatible behavior, using an appropriate authority group referent, and targeting younger community members was sufficient to encourage significantly different perceptions of behavior. Resolving many conservation conflicts ultimately requires some form of behavior change, but relatively little work within conservation focuses on the causes of human behavior. Here, we show that by applying relatively simple social influence approaches, it may be possible to alter

individual perceptions of behavior, and we encourage practitioners to explore the applied possibilities offered by such an approach.

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ORCID

Laura R. Perry  <http://orcid.org/0000-0002-9860-4528>

Ewan A. Macdonald  <http://orcid.org/0000-0002-6420-9255>

Tom Moorhouse  <http://orcid.org/0000-0002-8889-2175>

Andrew J. Loveridge  <http://orcid.org/0000-0002-3493-6419>

David W. Macdonald  <http://orcid.org/0000-0003-0607-9373>

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