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Assessing the Effects of a Cognition-Based Education Program on Attitudes of Villagers Toward Asian Elephants (*Elephas maximus*) in Conflict-Prone Areas

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ABSTRACT

A vital role in mitigating human-elephant conflict (HEC) involves conservation education programs in local communities. It is therefore important to assess the types of information that make conservation education programs effective. Given the public's fascination with animal minds, the elephant being a cognitively complex species, and the high occurrence of HEC surrounding Asian elephants, the current research assessed whether using information on elephant cognition in a conservation education program increased positive attitudes toward elephants/elephant conservation in Bannerghatta National Park (BNP). BNP, located in Karnataka, India, is an area reporting high HEC. Results indicated no significant difference in adult male villagers' attitudes toward elephants/elephant conservation when exposed to one of two educational programs, one of which included information on elephant cognition. However, a significant difference in attitudes between the two programs and a control group was discovered, suggesting the importance of an educational intervention in the communities surrounding BNP.

KEYWORDS

Elephants; cognition; education; conflict; India

Education programs are playing an increasingly important role in conservation efforts, both *in situ* (in the wild) and *ex situ* (in captivity), with numerous studies reporting positive changes in attitude after implementation of these programs (Ancrenaz, Dabek, & O'Neil, 2007; Ballantyne & Packer, 2016; Burnett, Sills, Peterson, & DePerno, 2015; Espinosa & Jacobson, 2012; Hungerford & Volk, 1990). However, it is also important to measure the effectiveness of the *content* present in these programs. Strategies used to implement these programs include community-based participation, exposure to wild animals for *in situ* educational programs (Chatterjee, 2008; Kideghesho, Røskaft, & Kaltenborn, 2007; Kuhar, Bettinger, Lehnhardt, Townsend, & Cox, 2007; Mehta & Heinen, 2001), and incorporation of live animals and interactive displays for *ex situ* educational programs (Awasthy, Popovic, & Linklater, 2012; Ballantyne & Packer, 2016; Brewer, 2000; Kruse & Card, 2004). However, few studies have looked at the role that animal cognition (used interchangeably with animal minds) plays in attitude change regarding conservation (Bielick & Karns, 1998; Bowler, Buchanan-Smith, & Whiten, 2012; Harley, Fellner, & Stamper, 2010; Sickler et al., 2006).

Evidence of the public's fascination with animal cognition is everywhere, ranging from documentaries (e.g. *Ape Genius on NOVA*, Rubin, 2008, and BBC's *Inside the Animal Mind*; Barrett, 2014) to popular news and magazine articles (e.g. Time Magazine's article: *The Animal Mind: What They're Thinking and Feeling, and How to Understand Them*, Kluger, 2014) addressing the subject. Part of this fascination with animal cognition is due to the connectedness we feel with non-human

animals once we learn that many of them have similar abilities to our own. For example, higher scores on the Belief in Animal Mind scale (BAM) (Hills, 1995), a scale measuring belief in animals' mental abilities, resulted in less support for use of animals in activities such as animal experimentation, use of animals for personal decoration, etc. (Knight, Vrij, Cherryman, & Nunukoosing, 2004). This connectedness, in turn, is argued to increase empathy toward the target species, resulting in positive conservation attitudes (Bielick & Karns, 1998; Bowler et al., 2012; Harley et al., 2010; Makecha & Ghosal, 2017; Maust-Mohl, Fraser, & Morrison, 2012; Sickler et al., 2006); but not always (e.g. Richards, 1995). Although there is widespread fascination regarding animal cognition, only a few studies have *assessed* the impact of a cognition-based education program/exhibit on attitudes toward animal conservation (Bielick & Karns, 1998; Harley et al., 2010; Maust-Mohl et al., 2012; Sickler et al., 2006). Additionally, to our knowledge, no study to date has systematically isolated knowledge of animal cognition as a variable and assessed how this affects attitudes toward conservation of specific species.

The programs that have assessed some components of animal cognition on attitudes include the Think Tank at the National Zoo in Washington, D. C. (Bielick & Karns, 1998 – orangutans), the Living Links Center at the Edinburgh Zoo (Bowler et al., 2012 – brown capuchin and squirrel monkeys), the Living Seas at Disney's Epcot (Harley et al., 2010 – dolphins) and the Aquarium Think Tank at the New York Aquarium (Sickler et al., 2006 – dolphins). All of the programs reported a positive change in visitor attitudes. For example, visitors at the Think Tank at the National Zoo reported feeling more connected to the animal world and having a more positive image of animals (Bielick & Karns, 1998), while visitors to the Aquarium Think Tank reported an increased appreciation for dolphins (Sickler et al., 2006). Similarly, Harley et al. (2010) reported favorable comments from visitors who were able to watch dolphins engaging in cognitive research at the Living Seas. Additionally, visitors spent more time observing the dolphins during these sessions than when a session was not in place. The Living Links Center also reported that visitors spent more time at observation windows when given a description of the research being conducted (Bowler et al., 2012). Although these studies are few in number, their findings, along with the public's fascination of animal minds, led us to *systematically* investigate the role that knowledge on animal cognition has on conservation attitudes. This is particularly important for endangered species where human-animal conflict (HAC) is prevalent. One such species that is now the focus of considerable conflict is the Asian elephant (*Elephas maximus*).

One of the biggest factors contributing to human-elephant conflict involving Asian elephants includes habitat loss (due to deforestation and agricultural land conversions) leading to habitat fragmentation (Barua, Bhagwat, & Jadhav, 2013; Choudhury, 2004; Gopalakrishna, Somashekar, & Anand, 2010; Leimgruber et al., 2003; Nelson, Bidwell, & Sillero, 2003). Due to a decline in resources in these fragmented landscapes, elephants often resort to crop-raiding which subsequently leads to conflict with human communities (Gopalakrishna et al., 2010; Leimgruber et al., 2003; Venkataramana, Sreenivasa, & Lingaraju, 2017), known as human-elephant conflict (HEC). Not only does HEC result in loss of income and subsequent lack of food for humans (Lenin & Sukumar, 2011; Mabeluanga, Kumar, Gayathri, & Krishnan, 2016; Sukumar, 2006), but HEC can also cause so-called "hidden" impacts such as compromised physical and mental health (Barua et al., 2013), with mental health complications going beyond mild anxiety/depression to include more severe disorders such as PTSD and substance abuse (Jadhav & Barua, 2012).

Many conservation efforts are therefore focused on involving the local community in mitigating HEC. These efforts have been multi-faceted, but success has been demonstrated by using integrated low-cost approaches (Zhang & Wang, 2003), of which conservation education programs play an important role (Ancrenaz et al., 2007; Burnett et al., 2015; Choudhury, 2004; Espinosa & Jacobson, 2012; Kwamboka, 2013). Additionally, understanding the attitudes/perspectives of the local human population is often stated as one of the most important components of conservation and an essential first step in gathering baseline data and understanding the various factors (e.g. economic, cultural) that contribute to attitudes toward wildlife (Gopalakrishna et al., 2010; Kanagavel, Raghavan, &

Verissimo, 2014; Kideghesho et al., 2007; Mabeluanga et al., 2016; Megaze, Balakrishnan, & Belay, 2017; Nath, Lahkar, Dutta, & Das, 2015; Naughton & Treves, 1999). Therefore, developing effective conservation education programs, including programs that connect people to elephants, is especially important.

Ex situ and *in situ* education programs both play an important role in conservation education. Although *ex situ* education programs do not directly involve communities exposed to HEC, participation in these programs raise awareness and funding for wild elephant conservation. For example, programs that bring visitors in close proximity to elephants (Hacker & Miller, 2016 – San Diego’s Wild Animal Park) or expose visitors to elephants through shows, reported that visitors were more likely to engage in conservation efforts after these experiences (Swanagan, 2000 – Zoo Atlanta).

Although the programs mentioned above did not directly involve exposure to elephant cognition, many zoos are engaging in elephant cognition research, such as Busch Gardens (Tampa, FL), the Lowry Park Zoo (Tampa, FL), the National Zoo (Washington, D.C.), Disney’s Animal Kingdom (Orlando, FL), the Oakland Zoo (Oakland, CA), and the Bronx Zoo (New York, NY). These studies range from investigating mirror-self recognition (self-awareness) (Plotnik, De Waal, Moore, & Reiss, 2010; Plotnik, De Waal, & Reiss, 2006) and problem-solving in elephants (Foerder, Galloway, Barthel, Moore, & Reiss, 2011; Highfill, Spencer, Fad, & Arnold, 2016) to studies on personality (Grand, Kuhar, Leighty, Bettinger, & Laudenslager, 2012; Highfill, Fad, Makecha, & Kuczaj, 2013; Horback, Miller, & Kuczaj, 2013) and communication (Günther, O’Connell-Rodwell, & Klemperer, 2004; Soltis, Leighty, Wesolek, & Savage, 2009). For example, Foerder et al.’s (2011) study on problem-solving involved a young Asian elephant using a cube to get to out-of-reach food in his habitat without being instructed to do so and without prior experience with this particular behavior. Incorporating this research into public education programs could be a powerful tool for connecting zoo-goers to elephants as well as increasing their conservation efforts.

In situ conservation education programs (often in areas where HEC is high) also provide an excellent avenue for developing and testing programs with an elephant cognition component. This is especially important considering that elephants are considered a “nuisance” species or a pest in some countries (Bandara & Tisdell, 2002, 2003; Barrett, Stanton, & Benson-Amram, 2019). Barrett et al. (2019) mention that eliciting empathy toward “nuisance” species *via cognition* may foster a greater appreciation for these species and a better relationship with them.

One program that included cognition in their message was a program developed by Save the Elephants (STE) and scientists and educators from Disney’s Animal Kingdom. This elephant education program was developed for primary school children in and around Samburu National Reserve. The program included information on elephants’ contribution to the ecosystem, their adaptability to the environment, ways in which to mitigate HEC, and how to act safely around elephants. Students reported more favorable perceptions toward elephants, as well as a better understanding of *elephant behavior and its similarity to human behavior*, both components related to elephant cognition (Kwamboka, 2013).

In situ elephant cognition research (MacLean et al., 2014; Plotnik & De Waal, 2014), also provide a unique opportunity to incorporate this information into local outreach and education programs. For example, Think Elephants International (n.d.) (an organization dedicated to conducting cognition research and education) reported favorable results regarding the conservation attitudes of a local pre-college population (<http://thinkelephants.org/education/>). Although Think Elephants International has taken an important first step in using elephant cognition as an educational tool, no *ex situ* or *in situ* study has compared the effects of elephant education programs using information on elephant cognition, versus programs without this information, on attitudes toward elephants and elephant conservation.

Research purpose and question

Given the public's fascination with animal minds, as well as the elephant being a cognitively complex species, we chose to conduct an exploratory pilot project comparing the effects of a cognition-based elephant conservation education program with that of a regular elephant conservation education program (containing no information on elephant cognition) on the attitudes of villagers toward elephants in the HEC dominated landscape of Bannerghatta National Park (BNP), Karnataka, India. HEC has been on the rise in BNP, resulting from an increase in encroachment, habitat fragmentation, and habitat degradation. In spite of the HEC in BNP, Mabeluanga et al. (2016) reported that most locals in the area (85.1%) expressed that elephants needed to be conserved. However, attitudes toward elephants were mixed, with 57.4% of the sample reporting positive attitudes, while 42.6% reported negative or ambivalent attitudes. This may be due to villagers understanding that elephants may be crop-raiding more because of the decline in resources in the forest. Additionally, the prevailing religious attitudes toward elephants, who are revered in the Hindu culture (although this may be on the decline due to conflict), may have also contributed to the mixed attitudes (Mabeluanga et al., 2016). Additionally, Gopalakrishna et al. (2010) and Venkataramana et al. (2017) reported that local attitudes in BNP toward the elephant were changing from that of "gentle giant to that of a destructive animal", due to crop raiding and human casualties. The combination of wild elephants and the dense human population (for the area) involved in HEC, as well as the changing attitudes of the locals, made BNP an ideal area for testing the effectiveness of cognition-based conservation education programs.

We therefore addressed the following question for our research study:

Do participants in a cognition-based conservation education program have more positive attitudes toward elephants and elephant conservation than the participants in a regular conservation education program and individuals with no exposure to any conservation education program?

Materials and methods

Study area

BNP is a fragmented elephant habitat (see Jayaprakash & Hickey, 2019 for a map depicting land use change in BNP from 1975–2015), surrounded by approximately 120 villages located within a five-kilometer radius of the park and with a human population of 107,082. BNP is approximately 260 square kilometers and has an elephant corridor for wild elephants (Gopalakrishna et al., 2010; Mabeluanga et al., 2016; Venkataramana et al., 2017). BNP is administratively divided into four wildlife ranges (WLR) Bannerghatta, Harohalli, Anekal and Kodihalli. Only Harohalli, Anekal, and Kodihalli WLR were surveyed in our study. Bannerghatta WLR was not included in our study due to its proximity to Bangalore City and the predominance of urban and peri-urban villagers, where agriculture was not the primary source of income (see below). Refer to [Figure 1](#) for a map of BNP.

Participants

Participants consisted of 133 adult males (ages 18 and up) from villages experiencing moderate and severe levels of HEC in and around BNP, and who had a self-sustaining source of income. Five percent of the participants were between the ages of 18–30, 17% between the ages of 31–40, 16% between the ages of 41–50, and 62% over the age of 50. Conflict severity data was obtained from the Karnataka Forest Department's (Ministry of Environment, Forests, and Climate Change) compensation records over the last five years. A list of 33 villages experiencing high (11–16 cases of HEC/year) or moderate (6–10 cases of HEC/year) levels of conflict closest to the wildlife ranges of Anekal, Harohalli and Kodihalli within BNP were chosen for the study. Refer to [Figure 1](#) for a map of villages sampled in BNP.

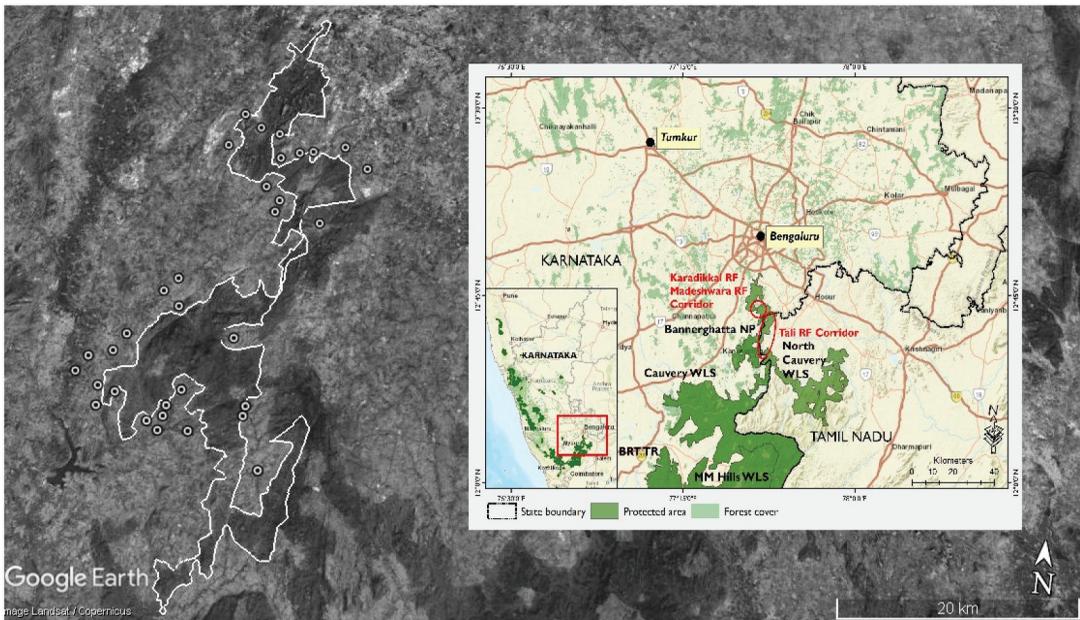


Figure 1. Map of Bannerghatta National Park (reproduced with permission from A Rocha, India and created by R. Raghunath, NCF) and villages surveyed (Bannerghatta National Park is outlined in white while the villages surveyed are depicted by the dots with the contrasting centers). The map inset depicts a map of Bannerghatta National Park in relation to Bangalore (city) and the adjoining forested landscape of Cauvery Wildlife Sanctuary, while the bottom left of the inset depicts Bannerghatta National Park in relation to southern India.

Adult male villagers were targeted due to the responsibility placed on them as the primary decision-makers during instances of HEC. Additionally, all participants' income was agricultural in nature, given that farmers are the most directly affected by HEC and have the potential to play a key role in mitigation efforts (Bandara & Tisdell, 2003; Gopalakrishna et al., 2010; Kioko, Kiringe, & Omondi, 2006; Nsonsi, Heymanns, Diamouangana, & Breuer, 2017; Van De Water & Matteson, 2018).

Conservation education programs

Participants took part in one of two elephant education programs or were part of a control group. The two types of elephant education programs that were developed and tested consisted of one that incorporated information on elephant cognition (hereafter referred to as the cognition program), and one that did not incorporate information on elephant cognition (hereafter referred to as the non-cognition program). Both programs included information on the physical features of elephants (with emphasis on the trunk), what elephants eat, where elephants can be found in India, Karnataka, and BNP, their approximate numbers, the social structure of an elephant family (e.g. gender and age class), and why elephants are important to the ecosystem. The non-cognition program placed extra emphasis on elephant social structure, with two brief videos showing a family herd (adult females, subadults, juveniles, and calves) and a solitary male elephant. Participants also participated in a brief activity where they labeled members of an elephant family herd and were able to learn about the different age classes. In contrast, the cognition program contained additional information on how elephants are like us (the cognitive component), such as information on how they protect their young, play, etc. During this part of the presentation, participants engaged in a brief activity where they had to solve a cooperation task (modified from Plotnik, Lair, Suphachoksahakun, & De Waal, 2011). After solving this task (with or without aid from the program translator – see below for

details), they were asked if they thought elephants could solve the task and then shown a brief video (BBC Earth, 2017) of elephants solving the task from the Plotnik et al. (2011) study.

Both programs were approximately equal in length (~10 minutes) to control for time. The videos that were used in each program (the social structure videos for the non-cognition program and the elephant cooperation video for the cognition-program) were also approximately the same length to control for exposure to videos in both groups. A third group of participants were included in the study as a control group and were not exposed to any educational programs, but instead, only given the survey (see below). *Survey Instrument*

The 9-item Attitudes Toward Elephants Scale (AE) and the 9-item Attitudes Toward Elephant Conservation Scale (AEC) were developed for this study based on the tripartite model of attitudes (i.e. Rosenberg, Hovland, McGuire, Abelson, & Brehm, 1960). The model identifies three components of attitudes (affect, cognition, and behavior) and has received empirical support (Breckler, 1984; Crites, Fabrigar, & Petty, 1994). Following recommendations suggested by Hinkin (1998), we developed two attitude scales by generating items based on the literature review and pilot tested the scales' psychometric properties. Three subject matter experts who are familiar with the elephant conservation research reviewed the initial items (23 AEC items and 17 AE items), and we retained items that the subject matter experts deemed essential for the respective scales. Using a college student sample in the U.S. ($N = 291$), we also tested these initial items with correlational analysis and exploratory factor analysis. We removed items with poor inter-item correlations and items with cross-loadings onto multiple factors. We further revised item wording for better clarity and relevance to each scale. The final AEC Scale and the AE Scale each had 9 items. For both scales, participants were asked to respond to each question using a four-point scale (Yes, Maybe yes, Maybe no, No). Mean score was calculated for each subscale. A higher score indicates that participants reported more positive affect, behavior, and judgment toward elephant conservation (AEC) or elephants in general (AE). Both scales were developed in English, translated into Kannada, and back-translated into English by an independent translator to ensure the quality of translation. In the current study, Cronbach's alphas were .76 for the AEC and .69 for the AE.

Procedure

Data collection took place from June 1st, 2018 to June 13th, 2018. This was also an ideal time to collect data because it did not overlap with the high HEC season in BNP, which could have had a potential effect on villager attitudes. Data collection took place with the aid of a local translator.

Of the 133 participants in the study, 43 were in the non-cognition group, 45 were in the cognition group, and 45 were in the control group. The non-cognition group contained two less participants due to the first few participants being part of an unsuccessful group presentation (see Discussion section for a full explanation), after which our sampling strategy changed to sampling individual participants in most cases (see below). Sampling for the non-cognition group occurred first, followed by sampling of the cognition group and then the control group. To secure participants, the research team conducted vehicular surveys opportunistically in each of the villages and farmers were either interviewed in their homes or in their fields. Participants were asked if they were willing to participate in a brief educational presentation and survey. Participants in the control group were asked if they would be willing to participate in a survey study. All participants were told that participation was voluntary and that they could withdraw at any point. Participants in the cognition and non-cognition groups were given the presentation individually (in four cases, we gave the presentation to pairs of individuals, and in one case, we gave the presentation to a group of three individuals; however, all participants were surveyed individually) via PowerPoint on a laptop, where the translator narrated the presentation in Kannada (along with the words on the PowerPoints also being in Kannada). All presentations were given by the same translator.

After the presentations, the AE and AEC scales were orally administered (to account for any illiteracy) by the translator and the participant's response was translated back into English for

the research team to record. In addition to four response options (Yes, Maybe yes, Maybe no, No), participants could elaborate on their response to each item. In addition to the two scales, demographic and supplemental information was also collected (date, time, weather, village, GPS location, whether recent conflict with elephants had occurred and approximately when this had occurred, and age). The participants in the control group only provided responses to the AEC and AE scales and demographic questions and were not given an educational intervention. All participants received a small food-based token (non-monetary) after participating in the study (information on these tokens was not disclosed to the participants until after their participation to account for any biases in attitudes that may have been caused from prior knowledge of the token).

Analyses

The data analyses were conducted using IBM SPSS Statistics version 22. A one-way between-subjects multivariate analysis of variance (MANOVA) was conducted on two dependent variables: attitudes toward elephant conservation (AEC) and attitudes toward elephants (AE). The independent variable was conservation education programs (cognition, non-cognition, and control). With a statistically significant multivariate test, we inspected the univariate tests for AEC and AE ($p < .025$ with the Bonferroni correction). A Tukey HSD test was conducted as a post-hoc test when the univariate test was statistically significant ($p < .0083$ with the Bonferroni correction).

Results

A one-way MANOVA revealed an overall effect (Wilks' $\lambda = 0.75$, $F_{(4, 258)} = 10.22$, $p < .001$, partial $\eta^2 = 0.14$), with significant differences between the control group and the two education groups (cognition and non-cognition), but not between the two education groups. Univariate tests showed that intervention groups differ on the AEC scores ($F_{(2, 130)} = 13.34$, $p < .001$, partial $\eta^2 = .17$) and on the AE scores ($F_{(2, 130)} = 19.46$, $p < .001$, partial $\eta^2 = .23$). More specifically, participants in the elephant cognition education group ($M = 2.57$, $SE = 0.08$) and participants in the regular elephant education group ($M = 2.46$, $SE = 0.08$) reported more positive attitudes toward elephant conservation (AEC) than those in the control group ($M = 1.92$, $SE = .08$, $p < .001$). A similar pattern was found in attitudes toward elephants (AE), with participants in the elephant cognition education group ($M = 2.79$, $SE = 0.10$, $p < .001$) and the regular elephant education group ($M = 2.86$, $SE = 0.11$, $p < .001$) reporting more positive attitudes toward elephants than those in the control group ($M = 2.18$, $SE = 0.10$). However, there was no difference in the attitudes between cognition and non-cognition programs.

Post-hoc qualitative analysis

To gain further understanding of how the three groups (cognition, non-cognition, and control) differ, we conducted a content analysis of the additional comments that the participants provided while they elaborated on their response to the AEC and AE scales. The analysis was conducted using the qualitative software program QSR NVivo. We identified emerging themes and developed an initial code list. One author coded the comments, and another author checked the coding accuracy. The results of the content analysis are summarized in Table 1. Overall 128 out of 133 participants (96.24%) provided additional comments. The comment return rates were similar across the conditions (97.78% for cognition, 95.35% for non-cognition, and 95.56% for control). There were four recurrent themes in the participants' comments. The first, most frequently commented on theme was the danger or potential danger associated with elephants. Participants in the elephant cognition education program more often cited the danger of elephants in their open response compared to the other two groups. The second theme was elephant cognition. For example, participants talked about

Table 1. Content analysis of participant comments on the AE and AEC scales.

Emerg ed themes	Frequency, <i>n</i>	Non-			Example quote
		Cognition	Cognition	Control	
Danger associated with elephants	33	16	8	9	“Can’t go close to them.” (Cognition) “If the elephants hear a bike sound, they come attack.” (Control)
Elephant cognition	10	3	3	4	“Elephants are like us, same life styles and societies.” (Cognition) “Elephants are very intelligent.” (Control)
Solitary elephant vs. elephants in groups	15	2	8	5	“Groups don’t do anything but solitary bulls do.” (Non-cognition) “Have to be careful with solitary males.” (Cognition)
Support for killing elephants	13	1	1	11	“If government gives permission to shoot, I shoot.” (Control)
Do not support killing elephants	11	5	5	1	“When you kill an elephant, you will be cursed because elephant is God.” (Non-cognition)

elephants’ intelligence and lifestyles. There was no difference among the three groups in this area. The third theme was centered on the difference between solitary elephants and elephants in groups. For instance, participants recognized that the solitary bulls could be especially aggressive. Finally, we identified the fourth theme as saving the lives of elephants. While some participants supported killing elephants when necessary, the others were more hesitant to take an elephants’ life. Participants in the control group provided more comments about killing elephants when they have permissions (from the government). This result is consistent with participants’ responses to the AEC item, “Do you feel upset when deadly actions such as poisoning and electrocution are taken against elephants in crop-raiding?” While 51% of the participants in the control group responded no to this question, fewer participants in two conservation education programs (11% for cognition, 0% for non-cognition) indicated no. The majority of the participants in the two education programs (82% for cognition, 98% for non-cognition) chose “yes” response option for this question.

Discussion

Overall, our study demonstrated that an educational intervention induced more favorable attitudes by adult males toward elephants and elephant conservation in high HEC villages in and around BNP. These results support other studies demonstrating the positive impact that educational interventions have on attitudes/behavioral intentions toward wildlife in human-wildlife conflict areas (e.g., Andean bear (*Tremarctos ornatus*) – Espinosa and Jacobson (2012); African elephants (*Loxodonta africana*) – Kwamboka (2013); forest elephants (*Loxodonta cyclotis* – Nsonsi et al. (2017)). However, knowledge on elephant cognition did not result in a significant difference in attitudes toward elephants and elephant conservation over an educational program without this information.

One reason for the lack of a significant difference in attitudes toward both elephants and elephant conservation between the cognition and non-cognition programs may have been due to the participants’ preexisting local and contextual knowledge of elephant cognition. Elephants in many high-conflict areas have been reported to change their behavioral strategies to find new solutions for getting around barriers. For example, in areas with electric fences, elephants have been reported to use trees or their tusks to get through without shocking themselves (Barrett et al., 2019; Sukumar, 2003). Choudhury (2004) reports one such incident with an Asian elephant in North India: “When the fencing was erected, the elephants innovated an intelligent method of breaking fencing posts by holding the top of the wooden posts by their trunk and breaking at the middle by gently pushing their foot, thus avoiding live wires (p. 267).” Bandara and Tisdell (2003) also report that crop-raiding elephants adapt to crop-raiding mitigation strategies (e.g. “scaring and chasing” methods of farmers), stating that they, “... have developed no fear of such control measures and continue to raid the

cultivated fields for easy fodder (p. 336).” Finally, individual differences (personality) may play a role in which elephants are more likely to crop-raid (Mumby & Plotnik, 2018), with certain individuals recognized by locals as the “troublemakers”.

These examples, as well as reports received in BNP (personal communication, A Rocha India, June 2018), highlight how villagers may have already had preexisting knowledge on elephant cognition. Several comments recorded during our data collection reflect this knowledge. For example, one participant from the cognition group, in response to the following survey question on the AEC scale, “do you think the government should spend more resources on elephant conservation?”, reported that “elephants used trees to break the solar fence.” Another participant in the non-cognition group commented that, “even when the department has done something (e.g. barriers), they still come”, in response to the following question on the AEC scale, “do you think it is important for people and elephants to live together without conflicts?” Although prior knowledge of elephant cognition was not assessed in this study, future studies will allow us to evaluate how this affects attitudes toward elephants and elephant conservation.

Two factors that may have influenced attitudes toward elephant and elephant conservation are rurality and age. Bandara and Tisdell (2003), in their study on rural and urban attitudes toward wildlife and elephant conservation in Sri Lanka, reported that resistance to conservation is high among rural populations in Sri Lanka, who show little interest in wildlife conservation, results that seem to be consistent with our control group attitudes. For example, in response to the following statement, “the current wild elephant population in Sri Lanka is between 3000 and 5000 animals. It does not matter if this number is reduced by 50% to provide more land for agricultural and human settlement,” the majority (94%) of the rural sample agreed. Additionally, our participants were adult males over the age of 18, with only 16.5% of our participants being under the age of 40. Van De Water and Matteson (2018) reported similar findings in their study on attitudes toward Asian elephants in and around the Salakpra Wildlife Sanctuary in western Thailand, a high-conflict area. Participants over the age of 35 (who were more likely to work in agriculture) and participants that were more likely to have experienced conflict were less likely to give importance to elephant conservation (Van De Water & Matteson, 2018). Further examination may elucidate additional age-related patterns regarding attitudes toward elephant conservation. However, it seems that both of the educational interventions in our study were able to counteract these effects and result in more favorable attitudes toward elephants and elephant conservation.

After an examination of the qualitative data, participants in both types of education groups were less likely to indicate (via comments) an inclination to kill elephants versus the control group. For example, several comments in the control group were similar to this statement made by one of our participants: “If they (the government) gives permission, then we can shoot.” These comments were recorded more frequently in the control group than in either of the education groups. Similarly, rural participants (71%) in Bandara and Tisdell (2003) study agreed with the following statement, “local farmers in the vicinity of the nature reserves should be allowed a greater freedom to control ‘problem elephants’ which cause crop and property damage,” as opposed to 81% of the urban sample opposing the statement. Zhang and Wang (2003) also reported that many high HEC locals in the Simao region of China reported that elephants “are of no use”, with some even stating, “if nobody can solve the problem for us, we will kill the elephants, and villagers can take turns to serve the penalty.” Additionally, and directly relevant, Gopalakrishna et al. (2010) reported incidents in BNP where villagers had used electrocution (and in a few cases, firearms) to kill elephants. Given that participants in our education groups were less inclined to report a desire to kill elephants than participants in our control group, an educational intervention in and around BNP may aid in reducing incidents such as the ones reported in Gopalakrishna et al. (2010).

Participants from the cognition education group were more likely to comment on how dangerous elephants were, compared to the non-cognition education group and the control group. Reasons for this pattern are unclear. Perhaps learning about elephant cognition cued participants into thinking

about how elephants change their behavioral strategies to get around mitigation efforts (e.g. fences), strategies that put villagers/economic income in danger (see examples mentioned above). Perhaps using additional scales, such as the BAM scale (Hills, 1995; Knight et al., 2004), in future studies would give us a deeper understanding of how local farmers view elephant cognition (our scales, in contrast, measured attitudes toward elephants and elephant conservation, but not specifically whether *knowledge* on elephant cognition increased).

Future directions

Two items we would like to control for in future studies are time spent with the presenter as well as randomizing the order in which we sampled our participants. The significant difference between the two educational groups (cognition and non-cognition) and the control group may have been caused by the participants' time spent with the presenter (participants in the educational groups spent roughly 10 more minutes with the presenter due to the implementation of educational presentations in these groups) rather than exposure to educational content. Therefore, future studies should include an additional control group where participants are given information (e.g. a history of BNP) unrelated to the project and then asked to answer the survey, thus controlling for time spent with the presenter. We understand that logistically, this may not always be possible with participants in an *in situ* study.

In our study, we also did not randomize the order in which we selected participants, sampling all of the participants from each group before moving on to the next group. Our rationale at the time was to conduct group (rather than individual) presentations and obtain our entire sample for a group after a few group presentations in a village and its neighboring villages. Group presentations ended up being unsuccessful (e.g. participants were distracted by the other participants and, due to the high/moderate HEC nature of the villages, were riling each other up regarding HEC in the area) and thus was the reason we moved to one to two person presentations and survey collection. Additionally, we chose not to switch to random sampling from each group at this time because preparations for the cognition group were still underway. Although a potential event in between each group's sampling (e.g. crop-raiding in one of the wildlife ranges we sampled from) may have altered attitudes, data were collected during a two-week period and the influence of external events on attitudes was therefore unlikely.

We would also like to test this study on women and children (of both sexes). Hill (1998) reported that attitudes toward wildlife can vary depending on gender and prior experience and women in Bandara and Tisdell (2003) rural sample expressed more negative attitudes toward elephants than men, due to elephants' "destructive" nature, resulting in disruption of family life and mental well-being (e.g. loss of family members, income, etc.). Especially relevant is that Mabeluanga et al. (2016) found women in BNP to have more negative opinions toward elephants than men, which they speculated to be due to socio-economic well-being. Although the women in BNP expressed more negative attitudes than men, this is likely to be area and community specific, as other studies based in different areas have reported contrasting results (e.g. Kideghesho et al., 2007; Nath et al., 2015; Van De Water & Matteson, 2018).

Due to the resistance of rural populations to wildlife conservation and farmers' viewing elephants as pests (Bandara & Tisdell, 2003; Gopalakrishna et al., 2010; Kioko et al., 2006; Nsonsi et al., 2017; Van De Water & Matteson, 2018), we also plan on testing this program with both rural and semi-rural populations (a mix of rural and urban livelihoods). Findings such as those of Bandara and Tisdell (2003), where urban attitudes toward elephant conservation were more positive and rural attitudes more mixed, and Van De Water and Matteson (2018), where individuals who work in agriculture were less likely to support elephant conservation lend support to exploring this aspect of our program.

We also would like to focus on a younger population, whose attitudes toward wildlife may be more malleable, and who have not experienced a lifetime of HEC. We acknowledge that, depending on the community and area, age may or may not have an influence (Kanagavel et al., 2014). For example, Kanagavel et al. (2014) did not find any attitude difference between age groups toward different species (e.g. tigers and elephants) in the Western Ghats-Sri Lanka Hotspot near the border of Tamil Nadu and Kerala, India, a high conflict region with significant biodiversity. Similar results were found in Heinen and Shrivastava (2009) study of attitudes in communities around Kaziranga National Park, India. However, in a study assessing villagers' attitudes toward tiger conservation living near Kalakkad Mundanthurai Tiger Reserve, India, younger participants were more likely to engage in and show stronger support for conservation (Arjunan, Holmes, Puyravaud, & Davidar, 2006). Given the mixed results from other studies and given that age is not a variable that has been tested yet regarding attitudes toward elephants/elephant conservation in BNP, we feel that this is a variable worth examining in future phases.

Lastly, we would like to investigate how direct contact with elephants, either through observation or interaction, affects attitudes toward elephants/elephant conservation. Many studies have suggested that having contact with the target species results in more positive attitudes toward that species (Bowler et al., 2012 – brown capuchin and squirrel monkeys; Espinosa & Jacobson, 2012 – Andean bear; = Harley et al., 2010 – dolphins). For example, Palash, Akash, and Islam (2018) reported that villagers in northern Bangladesh with high HEC (due to elephants crossing borders) found entertainment value in watching elephants as well as in some cases, playing with them. Palash et al. (2018) argued that this would increase the villagers' tolerance of them. Sickler et al. (2006) also reported that some visitors to their dolphin cognition exhibit would have been more engaged had there been live dolphins. In the case of BNP, the safest way to accomplish this is through the use of the semi-captive elephants housed at BNP's biological park. Viewing elephants in a *non-conflict context* may be a powerful aid in attitude change.

Conclusions

Our program demonstrated that, at the very least, an educational intervention did have a significant impact on attitudes toward elephants and elephant conservation in and around BNP. In addition to this finding, we were able to gather information on the local population's attitudes toward elephants/elephant conservation. Both of these aspects were important steps in what we plan to be a long-term multi-phase conservation project in and around BNP. We hope to continue our research into how knowledge on elephant cognition affects attitudes toward elephants and elephant conservation, including the effects of different types of cognitive information. We also hope to continue to work with the community in and around BNP, as working with humans is a key step in wildlife conservation (Gopalakrishna et al., 2010; Kanagavel et al., 2014; Mabeluanga et al., 2016; Nath et al., 2015). As Lee and Graham (2006) eloquently stated: "It is humans, not elephants, who define the problem, set the agenda for solutions, and maximize their own returns" (pp.7–8).

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