Adaptive Motivations Drive Concern for Common Good Resources

by

Aleah Charlotte Bowie

Department of Evolutionary Anthropology
Duke University

Date:_____

Approved:

_____
Brian Hare, Supervisor

_____
Anne Pusey

_____
Steven Churchill

_____
Jeffrey Vincent

_____
Daniel Ariely

Dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor
of Philosophy in the Department of
Evolutionary Anthropology in the Graduate School
of Duke University

2019

ABSTRACT

Adaptive Motivations Drive Concern for Common Good Resources

by

Aleah Charlotte Bowie

Department of Evolutionary Anthropology
Duke University

Date:_____

Approved:

_____
Brian Hare, Supervisor

_____
Anne Pusey

_____
Steven Churchill

_____
Jeffrey Vincent

_____
Daniel Ariely

Dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor
of Philosophy in the Department of
Evolutionary Anthropology in the Graduate School
of Duke University

2019

Abstract

Humans universally demonstrate intrinsically motivated prosocial behavior towards kin, non-kin ingroup members, and strangers. However, humans struggle to extend the same prosocial behavior to more abstract concepts like future-others and non-human species. The Adaptive Motivation Hypothesis posits that humans evolved intrinsic motivations to act prosocially towards more tangible social partners like those within an individual's ingroup, but prosocial behavior towards more distant and abstract partners is constrained by ecological certainty. Prosocial behavior towards these more abstract concepts is more variable and more likely motivated by extrinsic reward. This dissertation aims to examine the development of motivations for prosocial behavior towards these more abstract concepts. My studies rely on common goods games as a proxy for examining behavior towards abstract recipients of prosocial behavior. Common goods are any resource like forests or fisheries that are non-excludable to a population, but rivalrous. In-demand common goods require cooperation of humans to ensure sustainable use in order to avoid depletion. Chapter Two examined how children in three populations that differed in ecological certainty behaved in a common goods game where they were asked to contribute portions of their personal endowment to the maintenance of a forest. Participants were either provided a high extrinsic motivation, a low extrinsic motivation, or no extrinsic motivation for contributing to the maintenance

of the common good. Results show that overall, children of all ages were more motivated to contribute to abstract recipients when extrinsic motivation is high. However, noticeable variation in behavior between populations was driven by ecological and cultural differences. Chapter Two examined whether aggregated extrinsic rewards increased contributions to common goods in a sample of children aged six to fourteen. Results suggest that both information about personal loss and delay in an acquiring resource together dramatically increase children's contributions to common goods within both experimental and real-world contexts. Chapter Four explores whether making a typically abstract social partner more tangible increases an individual's prosocial behavior towards said partner. Results for Chapter Four, conducted with a population in the Democratic Republic of the Congo, find that increasingly the tangibility of an abstract population marginally increases prosocial behavior in children but not in adults. Together, the results of these studies have implications for improved understanding of the development of prosocial motivations in school age children, as well as applications to understanding motivations for socially conscious behavior in the face of environmental and conservation dilemmas.

Dedication

This dissertation is dedicated to my father, Donald Bowie (1941-2018), who first inspired my curiosity about the natural world and fostered my love of science.

Rest in peace.

Contents

List of Tables

List of Figures

Acknowledgements

This project would not have been possible without the guidance and support of several incredible people and institutions. Motivation for this project stemmed from work with two of my earliest mentors Drs. Richard Wrangham and Elizabeth Ross. Dr. Wrangham provided me with the rare opportunity of traveling to his research site in Uganda where I first started my exploration of cross-cultural cognition studies. Dr. Ross inspired me to always connect my research back to the wellbeing of the surrounding communities.

Through Dr. Wrangham, I began working with Dr. Katherine McAuliffe. I had the privilege of working with Dr. McAuliffe while she was still a graduate student, and I worked with her on conducting cross-cultural samples of her studies in Uganda. She provided me with my earliest experiences conducting cross-cultural cognitive research helped me continue along this path. I could not have asked for a better mentor and teacher over the course of two years. Dr. McAuliffe's mentorship and support continues to have an impact on all aspects of my research. I look forward to collaborating with her more in future.

Dr. Wrangham also connected me with my PhD advisor, Brian Hare. Through the challenges of conducting this incredibly interdisciplinary project, Dr. Hare has been a fierce advocate of mine. His support and confidence in my potential has led to a variety of opportunities for which I will be forever grateful. I am also grateful for the

guidance and feedback from my dissertation committee members, Anne Pusey, Steve Churchill, Dan Ariely, and Jeff Vincent.

The projects in this dissertation would not have been possible without generous funding sources. I am thankful for Duke's Dean's Fellowship and the National Science Foundation Graduate Research Fellowship for providing funding throughout my tenure as a graduate student. The Duke Tropical Conservation Initiative Research Fund, The Reeder Conservation Fund, and Experiment.com provided additional funding for my research.

I have had the privilege of working with several institutions. Much of the work in this dissertation was collected with the support of staff at Lola Ya Bonobo in the Democratic Republic of the Congo. I had the immense pleasure of collaborating with Claudine André, Fanny Minesi, Raphaël Belais, and Pierrot Mbonzo. I look forward to working more with them in the future.

I have had the opportunity to create a partnership with the research and education departments at Zoo Atlanta. We now have a robust and continuing research program collecting cognitive data from zoo attendees throughout the year. The development of this program would not have possible without Jinzhi Tan, Michelle Kolar, Yetta Robinson, and Staci Weich. I look forward to developing this program and working more with this incredible team of collaborators.

I am thankful for the team of friends and collaborators I have gained while working in the Hare Group over the past six years. Christopher Krupenye and Jingzhi Tan continue to be amazing friends and mentors. Wen Zhou and Hannah Salomans are brilliant scholars and friends who I had the privilege of sharing an office with everyday. Vanessa Woods brings light and joy to the research group. Congo-Birdie and Ernie provided much-needed emotional support. Zachary White and Phillip White provided life-saving help with statistics and analysis. Our lab coordinators over the years—Kerri Rodriguez, Eliot Cohen, Ben Allen, and Kyle Smith—made everything easier.

The Department of Evolutionary Anthropology provided constant support. Lisa Jones helped with all business administration and continues to be a cheerleader and mentor. Elaina Cossin, Lisa Squires, LaMonda Sykes, and Felina Grissom provided administrative support over the years. Richard Kay and Charles Nunn offered guidance and support during their tenures of Director of Graduate Studies. The Evolutionary Anthropology Faculty provided important feedback on my work during my public talks. Emily Boehm, Joseph Feldblum, Jackson Spradley, and the other graduate students have been a great source of fun and inspiration. In particular, my cohort members Caroline Amoroso and Randi Griffin have provided friendship, compassion, and support.

None of this work would have been possible without the dedicated students who assisted with data collection. Gianna Ossello, Feruth Kidane, Julia Villegas, Aidan

Haney, Sruti Pisharody all assisted with data collection in the United States. Wen Zhou translated and collected all of the data for the Chinese sample of my studies. Blaise Mbaki assisted with translation and data collection in the DRC.

Finally, I want to thank the support network of friends and family without whom none of this would be possible. Thank you to my late father, Donald Bowie, who first inspired my love of science and the natural world. My mother, Clarissa Bowie, has always been my strongest advocate. My brother, Christopher Bowie, continues to teach me the power of discipline and focus. My cousin, Cara Michell, was my first friend and is still my best friend. My aunt, Carolyn Michell, exudes levels of grace and wit to which I aspire. My grandfather, Clinton Wallace Chapman, sets expectations for success high for all in my family.

Nyamagaga Gondwe, Janell Holloway, Rachel Karasik, and India Schneider-Crease are four of the most exceptional people I have ever met, and I am privileged to call them my closest friends. They have been my greatest source of compassion, support, and love throughout this journey. I cherish these friendships more than anything else in my life.

The work in this dissertation represents collaborations with Brian Hare (Chapters 2-4), Christopher Krupenye (Chapter 4), Jingzhi Tan (Chapters 2 and 3), Wen Zhou (Chapter 2), and Phillip White (Chapter 2-4).

1. Introduction

1.1 Theoretical Approaches to Studying Prosocial Behavior Towards Common Goods

The fields of psychology, evolutionary anthropology, and behavioral economics have all explored humans' capacity for prosocial behaviors (Tomasello, 2014; Henrich et al, 2004; Boyd and Richerson 2009; Ariely, 2009; DellaVigna 2012). Though theories, hypotheses, and methods used in these fields may differ, the research often reaches similar conclusions: prosocial behavior among humans is commonplace.

Broadly, a prosocial behavior is any behavior where one individual, the actor, performs a behavior that benefits another individual, the recipient (Hare, 2017). Among evolutionary anthropologists, the cost or benefit of a behavior is measured in terms of the behavior's effect on fitness, i.e the ability to survive and reproduce (Hamilton, 1964; Trivers, 1971). Cooperation, reciprocal altruism, and altruism all fall under this categorization. These various types of prosocial behaviors vary in terms of the cost and benefit payoffs to the actor and recipients, and they vary in terms of how they are maintained as behaviors within a population (Melis and Semmann, 2010).

Research on prosocial behavior has often focused on prosocial behavior within dyadic relationships (Warneken, 2015; Engelmann et al, 2013; Moore, 2009; Silk and House, 2011; Apicella and Barrett, 2016; Blake et al., 2015). These relationships are dyads of kin, non-kin ingroup members, or other human strangers. Less of a focus has been on

prosocial behaviors that benefit recipients that are more abstract than another human partner in a dyadic interaction. Future-selves, future-others, or the natural world are all potential recipients of prosocial behavior that are more abstract to the human mind (Steinberg et al, 2009; Atance, 2008). The aim of this dissertation is to illuminate how individuals develop prosocial behaviors that benefit abstract recipients.

In these studies, I use the concept of common goods as a proxy for examining how humans interact with abstract recipients. A common good, also known as a common-pool resource, is any resource that is non-excludable but rivalrous (Hardin, 1968). Various aspects of the natural world, like forests and fisheries, are examples of common goods. Common goods need humans to actively contribute to their maintenance so that they do not disappear (Vugt, 2009). Contributions can be seen as costs paid by humans to benefit the fitness of forests or fisheries. We can therefore examine how humans interact with common goods to better understand how humans are motivated to act prosocially towards abstract recipients.

The diversity of studies about prosocial behavior have informed this dissertation's interdisciplinary approach to understanding a poorly understood aspect of prosocial behavior in humans: the development of prosociality towards abstract recipients.

First, all studies in this dissertation use an experimental design to test the effect of a treatment on an observable behavior. Studies incorporate a range of controls so that reliable conclusions can be drawn about how hypothesis-driven treatments affect behavior change in participants.

Second, all studies include participants from a wide age range in order to conduct an ontogenetic analysis of the behaviors in question. A large cognitive skill set needed to make decisions about prosocial behaviors develops in early and middle childhood. This skill-set includes other-regarding preferences, inequality aversion, and self-control (Ferh et al 2008; Blake et al, 2014; Steinberg et al, 2009; DeRidder et al 2018). By examining how children at different ages behave, we can begin to understand which cognitive skills are being employed when they are asked to act prosocially towards an abstract recipient.

Third, the design of the studies in this dissertation are informed by phylogenetic research about prosocial behaviors. Cooperative behaviors have been observed in humans' closest genetic relatives, the chimpanzee (*Pan troglodytes)* and the bonobo (*Pan paniscus) (*Warneken et al, 2007; Mitani, 2009; Rosati et al 2018; Tan and Hare, 2013*).* Research about decision-making in these two primate species, including how ecology shapes their risk and temporal preferences (Rosati and Hare 2013; Heilbronner et al.

2011), helps to inform the underlying cognitive processes used by humans to make decisions about prosociality.

Last, these studies will discuss potential evolutionary functions of the prosocial behaviors in question. The immediate utility of the behavior might be clear, but the costs or benefits in terms of evolutionary fitness will be less apparent. To assess potential function, I conduct studies in multiple populations from around the world that vary in ecology and cultural norms. Strong similarities in behaviors will suggest universality of behaviors, while notable variation in behavior may suggest functional adaptation to local ecologies (Blake et al, 2015).

1.2 Recipients of Prosocial Behavior

1.2.1. Human Ingroups

Existing studies of prosocial behavior in humans mostly examine dyadic relationships that fall into two broad categories: ingroup members and outgroup members (Shkurko, 2012). Close kin are considered ingroup relationships because of the genetic proximity (Silk, 2006). Humans are likely to act prosocially towards those in their close kin groups (Silk, 2002). Hamilton (1964) proposed one of many hypotheses that aims to explain cooperative behavior among kin through the concept of inclusive fitness. Hamilton's Rule posits that an actor is inherently motivated to maximize his/her own fitness by reproducing and passing on genes to the next generation. The actor's genetic

relatives possess a proportion of the actor's genes. By helping genetic relatives increase their reproductive success, the actor is indirectly propagating a portion of his/her own genetic material. The closer the genetic relationship of the recipient, the more likely an actor is to act prosocially towards that recipient because doing so will contribute to the actor's inclusive fitness (Silk, 2006, Chapais, 2001; Hamilton, 1964).

Other hypotheses exist that aim to explain the evolutionary mechanism of prosocial behavior maximizing fitness in humans, including group selection, direct reciprocity, indirect reciprocity, and partner choice (Apicella and Silk 2019; Nowak, 2006). Anthropologists have studied social relationships and prosocial behaviors in contemporary hunter-gatherer societies, which are cautiously viewed as our best models for pre-agricultural societies of the Pleistocene. Studies from the Ache in Paraguay, and the Hadza in Tanzania demonstrate that the majority of prosocial behavior in small-scale communities is among close kin groups (Hill and Hurtado, 2017; Crittenden and Zes, 2015).

Ingroup membership in humans is not limited to genetic relatedness and can be determined by perceived similarities in race, ethnicity, gender, political affiliation, or age (Shkurko 2012). Even at the age of 14 months, infants show more interest in individuals who portray signs that they are part of an ingroup, such as similar accents or skin color, compared with those who do not share those traits (Butler et al, 2011; Buttelmen and

Bohm, 2014). Ingroup relationships can also be manufactured with minimal priming (Shkurko, 2012). Adults arbitrarily assigned to novel social groups demonstrate more prosocial behavior towards others in the arbitrary group (Volz et al, 2009). After being assigned to novel social groups simply designated by hat color, children as young as six dole out punishment to outgroup members who act unfairly towards their ingroup members (Jordan et al, 2015).

Prosocial behavior between non-kin members in species outside of humans is rare (Clutton-Brock, 2009). However, there is evidence in chimpanzees living in large communities that same-sex dyads show similar levels of affiliative behaviors between dyads of kin members (maternal siblings) and non-recognizable distantly related individuals (Langergraber et al, 2007; Langergraber et al, 2009). Other primate species, like callitrichids, demonstrate cooperative breeding among close genetic relatives (Bales et al, 2000).

1.2.2. Human Outgroups

Like ingroup membership, outgroups can be comprised of multiple strata based on perceived relationship to the actor. Out-group strangers are those with little to no known genetic or social relationship with an actor. Outgroup membership can also be primed using minimal priming techniques (Shkurko, 2012). Humans regularly demonstrate prosocial behavior towards outgroup members (Abrams et a, 2015; Moore,

2009; Blake and McAuliffe 2008; Meleady and Seeger, 2017; Bereczkei et al, 2010). Young children even demonstrate more prosocial behaviors towards strangers compared to prosocial behavior towards in-group members they do not like (Moore, 2009). Humans share our ability to act prosocially towards strangers with one of our closest relatives, the bonobo (*Pan paniscus)* who demonstrate xenophilic tendencies towards outgroup members in experimental settings (Tan and Hare, 2013). Given that outgroup members likely lack the genetic proximity to an actor, Hamilton's Rule would not predict prosocial behavior between an actor and an outgroup member. However, prosocial behavior towards outgroup members and strangers may serve as a costly, reputation-enhancing signal in societies where such behavior has evolved to become a cultural norm (Bereczkei et al, 2010).

1.2.3. Abstract Recipients

The above categorization of recipients of prosocial behavior is similar to how Singer (1981) describes variation in social bonds between individuals and the implications of those bonds for understanding human ethics. He deemed this concept "The Expanding Circle" (Figure 1). I propose that there is an additional category of recipients of prosocial behavior beyond human ingroups and human outgroups. This additional category is comprised of more abstract recipients, such as future-others and the natural world. The majority of research on human cooperation is based on studying

a dyadic relationship between an individual and a recipient whose relationship would exist among the inner rings of the Expanding Circle (Warneken, 2015; Engelmann et al, 2013; Moore, 2009; Silk and House, 2011; Apicella and Barrett, 2016; Blake et al., 2015). The studies that have examined prosocial behavior towards more abstract recipients have focused more on applied research. For example, climate change presents a threat to future human generations and non-human species. To combat this, behavior change is needed among current populations. Such behavior requires people paying a cost now to benefit the intangible and uncertain populations and natural world of the future. A host of behavioral research, often highlighting humans' tendency to discount the future, establishes the phenomenon that humans are less motivated to contribute to the wellbeing of future persons and environments compared to contemporary ones (Gollier, 2010; Spence et al, 2012; Van der Linden 2015). Studies also exist that explore potential interventions to solve this lack of motivation, for instance harnessing social norms to encourage individual environmentally friendly behavior change (Goldstein et al, 2008; Griskeivius et al, 2010; Costa and Kahn, 2013; Steg et al, 2014). While many of these studies investigate sociological explanations of these behaviors, there is limited exploration of evolutionary and ontogenetic theories that help us understand how and why humans think about contributing to these more abstract recipients.

1.2.4. Motivation for Prosocial Behavior

Cognitive scientists separate motivations for behaviors into two broad categories: intrinsic and extrinsic. Intrinsically motivated behaviors are those driven by internal rewards like positive emotions or sense of accomplishment to the actor. Extrinsically motivated behaviors are driven by the potential acquisition of an external reward, be it material gain, praise, reputation enhancement, or punishment avoidance (Ryan and Deci, 2000). Though not explicitly stated, the majority of aforementioned studies have investigated intrinsic motivations for prosocial behaviors for kin, non-kin in groups and strangers. Intrinsic motivation for prosocial behavior emerges early in humans (Warneken, 2007; Warneken et al, 2007; Warneken and Tomasello, 2013). For example, children as young as 14 months will help an unfamiliar adult complete a task like fetching out-of-reach objects without any material or reputation-enhancing incentives (Warneken, 2007). At the most extreme, adults donate anonymously to charities or donate kidneys to strangers (Balliet et al, 2019; Tamura, 2018).

Given early emerging intrinsic motivations for prosocial behavior, the introduction of extrinsic rewards can sometimes undermine prosocial behaviors. This is referred to as the Undermining effect or the motivation crowding effect (Warneken and Tomasello, 2008; Ariely 2009). When children as young as 20 months are first provided with an extrinsic reward as motivation to engage in prosocial behavior in a dyadic

interaction, they are less likely to perform the same prosocial behavior in a subsequent interaction (Warneken and Tomasello, 2008). Monetary incentives decrease adults' motivation to contribute to prosocial causes in certain contexts (Ariely, 2009).

Wide-spread cooperation often correlates with the existence of systems that detect and punish cheaters. (Mathew and Boyd 2011; Boyd et al, 2010; Bowles et al, 2002; Henrich et al, 2010). For example, in the small-scale society of the Turkana, wide-scale, costly cooperation among individuals engaging in warfare is maintained through harsh punishment of free riders (Mathew and Boyd, 2011). These studies suggest that for larger-scale cooperation beyond dyadic interaction, some extrinsic motivation may be necessary to encourage prosocial behavior. Cultures with norms that create extrinsic motivation for cooperation show the highest level of prosociality towards those outside of kin-groups (Henrich et al, 2006; Henrich et al, 2001).

1.2.5. Ecology's influence on prosocial behavior

Previous research has shown that individuals show cognitive plasticity in problem solving that reflects adaptations to the environments in which the individual developed (Frankenhuis et al., 2015) For instance, cognitive preferences relating to time and risk are shaped by considerations of resources within environments (Ellis et. al 2009; Bateson et al., 2014, Belsky, 2008). Frankenhuis et al. (2015) identified two ecological factors that influenced decision-making: harshness, defined as the rates of mortality and

morbidity caused by factors an individual cannot control, and unpredictability, defined as the change in mean variation in harshness over time.

Previous research using the environmental harshness framework has provided explanations of populational differences in risk and time preferences. Populations in highly harsh/unpredictable environments tend to be more vigilant, more risk prone, and steeper temporal discounters than those in less harsh/less unpredictable environment (Ellis et al., 2009; Salali et al., 2015; Mittal et al., 2014).

Variation in human prosocial behavior has previously been linked to environmental factors as well. Adolescents and adults are more willing to risk losing personal resources in exchange for benefits for themselves or kin in environments where resource acquisition is certain and predictable (Frankenhuis, 2015; Eom et al., 2015). Evidence also demonstrates that adolescents in harsher and more uncertain environments volunteer considerably less than counterparts in more resource certain environments (Lichter et al, 2002).

Chimpanzees and bonobos also show varying social preferences in response to their environments. Bonobos, living in a less competitive environment than chimpanzees, are considerably more xenophilic –they readily share food and provide help to other bonobos outside their own group (Tan and Hare, 2013; Tan, Ariely, Hare, 2017). Humans may have evolved to respond to uncertainty in analogous ways to how

species are shaped by natural selection to respond optimally to environmental uncertainty.

1.3 The Adaptive Motivation Hypothesis

Here, I propose the Adaptive Motivation Hypothesis (AMH) which posits that humans across cultures have evolved early-emerging intrinsic motivation for prosocial behavior towards kin, non-kin ingroup members, and strangers. Intrinsic motivation evolved to facilitate prosocial interactions between social partners and categories essential to survival and reproduction during human evolution. These same pressures did not shape human psychology in regard to more abstract social categories. The AMH posits that prosocial behavior towards the more abstract social categories like future-others and the natural world is more variable across cultures. This variability is a response to environmental certainty and is largely motivated by extrinsic reward or punishment reflected in cultural norms.

Under this hypothesis, the degree of resource uncertainty in an individual's environment can predict how they respond to extrinsic motivations to act prosocially towards abstract recipients like future others and the natural world. In more uncertain environments, prosocial behavior that benefits abstract recipients might be perceived as costly, so more extrinsic rewards are needed to motivate such prosocial behaviors. In

other environments where resource acquisition is more certain, less extrinsic motivation is needed because the costs of such prosocial behavior is perceived as more affordable.

This dissertation is designed to test the central predictions of the AMH using a variety of approaches. Chapter Two explores the extent of cultural variation in prosocial behavior towards abstract recipients. Chapter Three asks whether aggregated extrinsic motivations increase prosocial behavior towards abstract recipients. Chapter Four tests whether making an abstract recipient more tangible to actors increases prosocial behavior towards said recipient. Throughout these studies, common goods games are used as a way to systematically test how individuals contribute to abstract recipients.

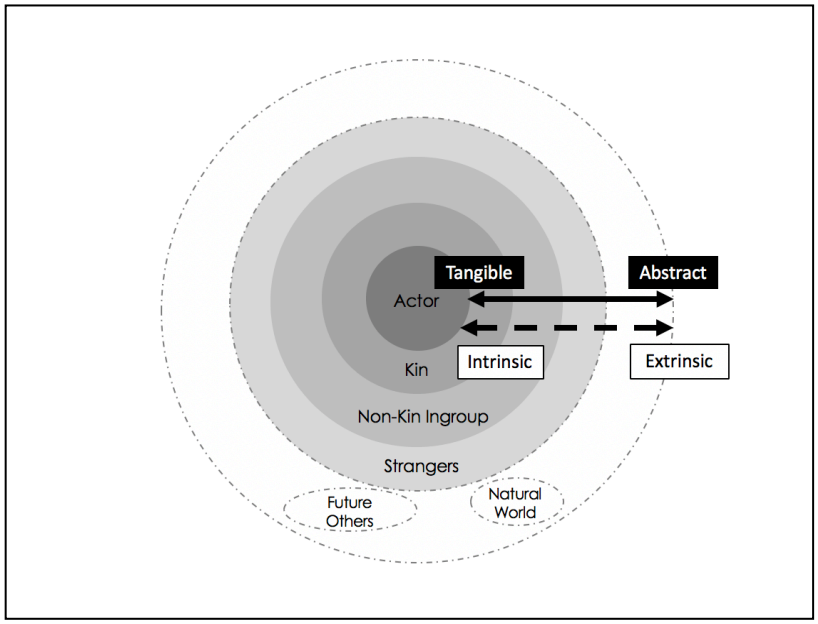


Figure 1: The Expanding Circle. Rings in shades of gray illustrate the categories of prosocial behavior recipients that have thoroughly been studied in developmental and cross-cultural psychology and anthropology. The unshaded ring represents our proposed addition to the Expanding Circle, the abstract-most potential recipients of prosocial behavior. The further from the center of the circle, the more abstract the recipient becomes to the actor. The further from the center of the circle, the more extrinsic rewards play a role in motivating prosocial behavior.

1.4 Common Goods as Abstract Recipients of Prosocial Behavior

Common goods can serve as a proxy for abstract recipients that are central to testing the AMH. Common goods are frequently—but not limited to— biological materials like lumber or fisheries that are of limited supply if overharvested by human use (Hardin, 1968). Maintenance of common goods requires costly cooperation among humans to ensure the wellbeing of common goods in the future (Kaul et al.,1999; Van Vugt, 2009). Understanding the motivations for why humans contribute to the

maintenance of common goods has been a research focus among many adult populations. Common goods games are frequently employed to experimentally examine how individuals interact with such resources. These games are variations on the more well-known public goods game. In a simple common goods game, individuals in a group are each given an endowment of a resource, such as money. Collectively, the individuals in the group are prompted to contribute some portion of personal endowment towards a collective fund that benefits a common good resource. If the target is not reached, the common good is not maintained

1.4.1 Common Goods Research in Adults

Common goods experiments typically use adults as participants. Milinksi et al (2009) used a modified common goods game to test the difference between intrinsic versus extrinsic rewards for motivating cooperative behavior to maintain a common good. The study analyzed how a group's risk of losing personal resources motivated individual contributions to a common goods goal. Results show that as risk of losing personal resources increased, individuals were more likely to contribute to help the group reach the goal (Milinski et al, 2009). Variations on this paradigm demonstrate that in addition to material extrinsic motivations, social tools like shame, honor, and other reputation management motivates individuals to contribute to the common good (Milinski et al, 2002; Jacquet et al, 2011),

Other common goods studies in adults have focused on the intergenerational nature of contributing to common goods. In some situations, like the regeneration of forests, current populations pay the cost to maintain common goods, but future generations will reap the benefits. Jacquet et al (2013) found that the further in the future the benefits of cooperation will be delivered, the less likely individuals are to contribute to the common good when there is also motivation to defect. Hauser et al (2014) employed a modified common goods game where individuals could choose to exhaust a resource for use in the present or leave some of the resource for the future. Individuals were more likely to make a decision to conserve the resource when they made a decision in a group as opposed to making a decision individually.

Common goods games like those described above have not been conducted cross-culturally in non-Western societies. However, similarly designed public goods games have been conducted cross-culturally. Henrich et al (2005) conducted a public goods game in fifteen societies that varied in terms of industrialization and cultural norms. This study found that a host of social and economic variables like anonymity, access to markets, local social norms and customs all lead to variation in how populations behave in a public goods game. No unifying theory is presented in this study as to why these populations vary in their behavior in this game.

One hypothesis that explains variation in these behaviors has been the *individualism-collectivism hypothesis (*Triandis et al., 1988; Triandis, 2001). This hypothesis, commonly cited in the cross-cultural psychological literature, posits that self-concept, well-being, cognition, and relationality can be largely explained by normative considerations of identity (Oyserman et al. 2002; Triandis, 2001). Individualists typically place higher value on personal independence and distinction within an ingroup, while collectivists place higher value on belonging and duty to an ingroup (Oyserman et al., 2002). A population's placement on the individualism-collectivism scale is based on survey data distributed to multiple individuals within the population in question. Traditionally, Western societies like the United States and Western Europe are considered individualistic cultures, and Eastern Asian are relatively more collectivistic cultures (Oyserman et al., 2002).

The individualism-collectivism hypothesis, widely used by cross-cultural psychologists, has provided several contributions to understanding variation in human behavior. However, this hypothesis often overgeneralizes normative behavior in a population (i.e. meaningful variance likely exists within both individualist and collective cultures) and does not easily allow for predictions of how human cognitive biases relate to behavior. To understand the variation in behavior in large scale environmental

common goods dilemmas, it will likely be necessary to go beyond the individualist-collectivist framework and test the Adaptive Motivation Hypothesis.

1.4.2 Common Goods Research in Children

Taken together, the common goods studies mentioned above suggest that intrinsic and extrinsic motivations, both material and social, play varying roles in how individuals make decisions about contributing to common goods. To better understand how and why these motivations exist, and how they can possibly be predicted, it is important to consider the ontogeny of these behaviors, especially using comparative, cross-cultural samples.

Few studies have explored how children perform in public goods or common goods games. Those that do exist are mostly limited to children in Western, industrialized societies. Children as young as five in Western cultures behave strategically in an iterated public goods game by initially increasing their donations to a collective pool, and then decrease their contributions in favor of free-riding after multiple iterations (Voglesang et al, 2014; Hermes et al, 2019). Despite the motivation to freeride, children as young as four demonstrate the ability to track and sanction free riders in modified public goods games (Yang et al, 2018).

Among older children aged nine to sixteen in a Western culture, an anonymous computerized public goods game found that individuals adapted their behavior to

match other players, suggesting the influence of social norms on prosocial behavior in this paradigm (Kiel et al, 2017). Children as young as six are also capable of making decisions that benefit a common good, especially when their decisions are public (Koomen and Hermann, 2018).

The existing studies of public and common goods games suggest influence of age and social norms on how children behave in these economic games. What is missing is the understanding of whether ecology has any influence on behavior as it relates to this particular prosocial behavior. The studies in this dissertation add to existing knowledge of how children think about common goods by using developmental samples of children. Testing predictions using the AMH, my studies aim to better illuminate why children of different ages and in different populations make decisions about contributing to common goods.

1.5 Research Goals

In Chapter Two, we explore whether intrinsic or extrinsic rewards more effectively encourage prosocial behavior towards an abstract recipient. To do so we employ a common goods game to assess how groups respond to a forest usage dilemma (Milinski et al, 2009). In this paradigm, individuals in a group are each given an endowment. Collectively, the group has to give enough from their personal endowment towards a collective fund that benefits the maintenance of a forest.

To test the Adaptive Motivation Hypothesis, I conducted the common goods game in three populations that varied in terms of their ecological certainty and cultural norms: The United States, The Democratic Republic of the Congo, and China. Various demographic factors, including life expectancy and average gross domestic income (GDI) per capita were used to classify the populations as either high ecological uncertainty or low ecological uncertainty. The average life expectancy in the DRC is 59/62 years (male/female) and average GDI per capita is $680 USD per year (WHO, 2019). Average life expectancy in China is 75/78 years (male/female) and average GDI per capita is approximately $11,850 USD per year (WHO, 2019). Life expectancy in the United States is 76/81 years (male/female) and GDI per capita is approximately $53,960 per year (WHO, 2019). Given these demographics, the United States sample represents populations of low economic uncertainty, the Congolese population represents high ecological uncertainty and the Chinese population falls in between.

In addition to differences in ecological uncertainty, these three populations varied in terms of a variety of cultural norms. The Individualism-Collectivism Scale classifies populations in terms of how an individual identifies and acts towards their in-group. In populations that are considered more individualistic like the United States, culture encourages individuals to stand out from the group. In more Collectivist populations like China, culture encourages more loyalty and identity to the group

(Oysterman et al, 2002). Populations in the DRC have not been thoroughly examined enough to be classified as more individualistic or collectivist. Limited behavioral data from the region suggests it falls between USA and China on the scale.

In addition to just having a cross cultural sample, it was essential to our hypothesis that we also collected a developmental sample. We conducted the study with children ages six to fifteen to explore whether there are any developmental trajectories in how populations think about common goods.

Chapter Two contains a unique data set that explores the development of behaviors towards common goods in three distinct populations. Analysis of these three populations allows us to explore how children develop behaviors about common goods given varying ecological and cultural contexts.

In Chapter Three, I explore whether aggregating extrinsic rewards increases motivation to act prosocially towards abstract recipients. We also explore whether participation in this common goods experiment can lead to pro-social behavior towards common goods in more generalized contexts. The series of three studies in Chapter Three focus only on a population of American children in order to explore variation of extrinsic rewards on a single population.

Whereas Chapter Two focused exclusively on material gain as an extrinsic reward for participants, Chapter Three explores whether a time delay as a penalty is an

effective motivator for people to contribute to the maintenance of a common good. Additionally, this study incorporated greater costs and benefits based on whether the group successfully manages to maintain a common good. When the group collectively demonstrates enough prosocial behavior to keep a common good thriving, everyone benefits and receives an increase in their endowment for the next round of the game. If they do not collectively maintain the common good, everyone receives a decreased endowment and a time penalty until they can play the game again. These penalties aim to simulate the delay needed to wait for an ecosystem to regrow after unsustainable harvest, and also the reduction of resources from which a community can profit.

Together the series of studies conducted in Chapters 2 and 3 suggest that children are more motivated by extrinsic rewards when asked to act prosocially towards abstract recipients. Additionally, children who participate in the common good simulation in Chapter 3 express increased pro-conservation behaviors in a non-related activity. This lays the foundation for further exploration of interventions in conservation education.

Chapter Four explores whether making a typically abstract population more tangible increases prosocial behavior towards said population. To test this, we conducted a series of studies with children and adults in Kinshasa, DRC. The abstract population in question were bonobos (*Pan paniscus),* a species native to the DRC, but not

present in Kinshasa. We tested whether adults and children who had no previous exposure to bonobos displayed more prosocial behaviors towards them after a guided tour that emphasized bonobos' names, personalities, anecdotes, and similarities to humans.

To conduct this study, we worked closely with Lola Ya Bonobo, a sanctuary outside of Kinshasa that rescues and rehabilitates bonobos who have been orphaned by the bushmeat trade in the Congo Forest. Each year, over 15,000 visitors come through the sanctuary to participate in an hour-long guided tour. The majority of individuals are visiting the sanctuary for the first time. The scripted tour provides background about the bushmeat trade, the similarities between humans and bonobos, and descriptions of bonobos socioecology, and anecdotes about individuals.

The AMH predicts that the hour-long tour of the sanctuary tour turns the abstract recipient into a tangible recipient that resemble group mates. This perceptual transformation facilitates greater intrinsic motivation to act prosocially towards bonobos. We examine this by using a novel approach to pre-experience and post-experience surveys that examine implicit expressions of pro-conservation attitudes towards bonobos and their habitat as opposed to the more conventional educational assessments that assess explicit attitudes towards wildlife.

Finally, I will tie together the results from Chapters Two, Three, and Four to discuss how to apply the findings of this dissertation for use in real world applications. We will focus mostly on the emerging field of Conservation Psychology which aims to draw from studies of psychology and behavioral economics to inform how we can more effectively motivate populations around the world to invest in strategies to slow or halt the effects of climate change and biodiversity loss.

All conservation dilemmas are ultimately a product of human cognition. All solutions to conservation dilemmas will be the result of cooperative human behavior. Examining conservation dilemmas through the lens of abstract recipients of prosocial behavior allows us to better understand the motivations of diverse population's behaviors towards these recipients. Ultimately, this interdisciplinary approach to understanding these complex relationships will lead to improved conservation efforts for a variety of wildlife species and ecosystems worldwide.

2. Extrinsic motivation drives common goods contributions in children from three continents

2.1 Introduction

Humans are characterized as an ultra-prosocial species (Tomasello, 2014). We regularly exhibit a range of cooperative and altruistic behaviors among kin, non-kin group members, and even strangers. Our prosocial response to different social interactants has been characterized as an expanding circle of prosocial behavior (Singer, 1981; Figure 1). Much research on human cooperation is based on studying a dyadic relationship between an individual and a recipient whose relationship would exist within the inner layers of the Expanding Circle. Cross-cultural comparative experiments demonstrate that humans are often intrinsically motivated to act prosocially toward a range of social partners (Warneken, 2015; Engelmann et al., 2013; Moore, 2009; Silk and House, 2011; Apicella and Barrett, 2016; Blake et al., 2015).

Humans are not indiscriminately prosocial towards recipients from the outer rings of the expanding circle of concern. Intrinsic motivations for prosociality towards more abstract recipients are more constrained (Strayer et al., 1979; Fray et al., 1994). These more abstract recipients represent another layer of social interactants more distant to the self than kin, non-kin ingroup, outgroups, and strangers. Examples of abstract recipients include future-selves and non-human species. Humans are capable of acting prosocially towards these outer rings, but it remains unclear what motivates this prosociality (Reeson et al., 2008).

While there is strong evidence that humans possess unique and early-emerging intrinsic motivation for cooperation as young as 14 months (Warneken, 2015), beyond dyadic interactions with kin and group members there is little evidence that humans are consistently intrinsically motivated to act prosocially. Children three years and older are more motivated to act prosocially towards peers with whom they expect a reciprocal relationship, compared to younger children who will act prosocially towards strangers (Warneken and Tomasello, 2013). Without a way to detect and punish cheaters, large scale cooperation quickly breaks down (Henrich et al., 2010). Cooperation is best facilitated when individuals are either rewarded or punished for not contributing to the group (Henrich et al, 2010). Cultures with norms that create extrinsic motivation for cooperation show the highest level of prosociality (Henrich et al., 2006).

Variation in human behavior has been linked to environmental factors. Adolescents and adults are more willing to risk losing personal resources in exchange for benefits for themselves or kin in environments where resource acquisition is certain and predictable (Frankenhuis, 2015; Eom et al., 2015). In contrast, adolescents and adults in harsher and more uncertain environments volunteer considerably less than counterparts in more resource certain environments (Lichter et al., 2002). This plasticity is mirrored in comparative studies of decision-making where animals' preference for social and non-social risk-taking shifts depending on environmental certainty (Rosati, 2017). Chimpanzees and bonobos, humans' closest genetic relatives, respond differently

to acquisition of non-social rewards. Chimpanzees and other species who live in environments with more niche competition (more resource uncertain) have adapted to become more willing to take risks to acquire resources. On the other hand, bonobos and other species that live in less niche competitive environment have adapted to become risk averse when acquiring resources (Rosati and Hare ,2013; Heilbronner et al., 2011, Zarrato et al., 2018). Chimpanzees and bonobos also show varying social preferences in response to their environments. Bonobos, living in a less competitive environment than chimpanzees are considerably more xenophilic (Tan and Hare, 2013). Human cultures may have evolved to respond to uncertainty in analogous ways to how species are shaped by natural selection to respond optimally to environmental uncertainty.

The Adaptive Motivation Hypothesis (AMH) posits that while humans across cultures have evolved early-emerging intrinsic motivation for prosocial behavior towards the inner circles of social concern our prosocial behavior toward more abstract social categories is more variable across cultures. Prosociality toward abstract social categories such as future selves or the natural world is instead largely motivated by extrinsic reward and punishment. Cross cultural variability toward these more abstract social categories is produced as an adaptive response to environmental certainty. Children of cultures from unpredictable or unproductive environments cannot afford to behave prosocially toward more abstract social categories. Children from these contexts will need more extrinsic reward or punishment to motivate their prosocial behaviors.

The AMH predicts that 1) children across cultures will show limited intrinsic motivation toward abstract social categories and 2) children across populations will not develop preferences uniformly because resource uncertainty shapes cultural norms and individual responses to extrinsic motivators for prosocial acts toward abstract social categories. To test the predictions of the AMH, we employed a cross-cultural, modified version of a common goods game. The concept of a common good serves as a proxy for the abstract recipients like non-human species. A common goods game focuses on maintenance of resources that are non-excludable but rivalrous, whereas the more well-known public goods game focuses on maintenance of resources that are non-excludable and non-rivalrous (Ostrom, 2003). A pertinent example of a common goods dilemma is the interaction between human populations and biological resources in a forest. Theoretically, forest resources like wildlife and lumber can be accessed and exploited by a given human population. However, if these biological resources are not allowed to regenerate in accordance to their reproductive rates, the resources will diminish to a point of no return (Hardin, 1968). The key to maintaining sustainable numbers of common goods is through sustainable cooperative behaviors among the human populations accessing these resources (Vugt, 2009).

Public goods games have been used to assess the factors that shape adult preferences when cooperating to maintain group resources. Milinksi et al (2009) analyzed how a group's risk of losing personal resources motivated individual

contributions to a common goods goal. Participants were assigned to a group in which each member received an endowment. They could either keep the endowment or contribute a part toward the maintenance of a common good. Each group participated in one of three conditions that varied the risk to each participants' personal endowment if the group did not meet a donation goal to support the public good. The study found that as risk of losing personal resources increased, individuals were more likely to contribute to help the group reach the goal.

To test the AMH we used Milinski et al (2009) paradigm but had groups contribute toward the maintenance of a hypothetical forest. We also adapted the paradigm for use with a cross-cultural and developmental sample of school age children between 6-15 years old. Examining children's preferences allows a powerful test of the two core predictions of the AMH. While experiments suggest that infants universally show intrinsic motivation to help others and become increasingly prosocial during infancy, these motivations may become more constrained during childhood and especially when directed at more abstract social categories. The prosocial predispositions of school age children are beginning to be shaped by ecological and cultural pressures and can powerfully reveal the degree that the environment shapes the initial preferences human infants display (Myers et al., 2003; Smith, 1978). Alternatively, it may be that children maintain and expand their preferences from infancy and will universally show increased motivation to cooperate as they get older regardless of the

uncertainty they encounter during development. To test the effect of uncertainty on the development of preferences we included school age children from the United States, the Republic of China and the Democratic Republic of the Congo (DRC)— with children in DRC who live in a more harsh environment in terms of life expectancy, health outcomes, and GPD per capita (WHO, 2019).

The AMH predicts that participants will contribute more to the common good when the risk of losing their endowment is highest when their group fails to cooperate (i.e. the extrinsic motivations are highest). The AMH also predicts divergent developmental patterns of contributions across cultures with children from DRC, in particular, needing more extrinsic motivation to contribute to common goods.

2.2 Methods

2.1.1 Subjects

570 participants took part in the current study (Beijing, China: 216; Atlanta, USA: 198; Kinshasa, DRC: 156) (Table 1).

Table 1: Demographics for participants in each country

	Total Individuals	Female	Male	Age ± std. dev.
China	216	108	108	9.60 ± 1.84
USA	198	82	116	8.15 ± 1.64
DRC	156	89	66	12.47 ± 2.71

American participants (N = 198) were recruited from summer camps at Zoo Atlanta in the suburban area of Atlanta, Georgia in 2016. Each camp was week-long, and any child between ages four and fifteen from across the Atlanta area could sign up (mean age= 8.15 ± 1.64, F/M ratio = .71). The participants were mostly public school attendees from middle income families in the Atlanta Metro-area.

Chinese participants (N = 216) were recruited from a primary school in a suburb of Beijing in 2015. (mean age= 9.60 ± 1.84; F/M ratio =1.00).

Congolese participants (N = 156) were children from local primary and secondary schools in and around Kinshasa, the capital city of the DRC. Children from four different schools were included in the study. Two of the schools served more rural, low income populations on the outskirts of Kinshasa, while the other two schools served more mid-income families in downtown Kinshasa. Children were tested at their school or during school trips to Lola ya Bonobo sanctuary in 2015 (mean age= 12.47±2.71; F/M ratio =1.35).

Participants were tested in groups of six (see Design). Groups consisted of children from the same camp or classroom. To the best of our abilities, participants in a group were matched by age and balanced by gender within groups (see Table 2 for group composition information).

Table 2: Group composition and demographics in each country. Age gap is the average difference between the oldest and youngest individuals within a group.

	Total Number of Groups	Groups in 100% risk	Groups in 50% risk	Groups in 0% risk	Age gap ± std. dev. per group	Female/ Male Ratio
China	36	13	11	12	1.08 ± 0.81	1.00
USA	33	11	11	11	1.00 ± 0.90	.71
DRC	26	10	7	9	2.77 ± 1.73	1.35

16 groups (i.e. a total of 96 participants) were excluded from the final analysis due to testing being interfered with by instructions from a teacher or communications among participants (USA: N = 3; China: N = 4; DRC: N = 9). One group was excluded from the DRC sample due to lack of age information.

2.1.2 Set-Up and Apparatus

At the beginning of the game, each participant was given a bowl that contained 24 tokens, a pen, and a stack of 9 small pieces of pre-printed paper that served as their response sheets. All participants had a clear view of the experimenter and the *Connect Four*® boards (Figure 2).

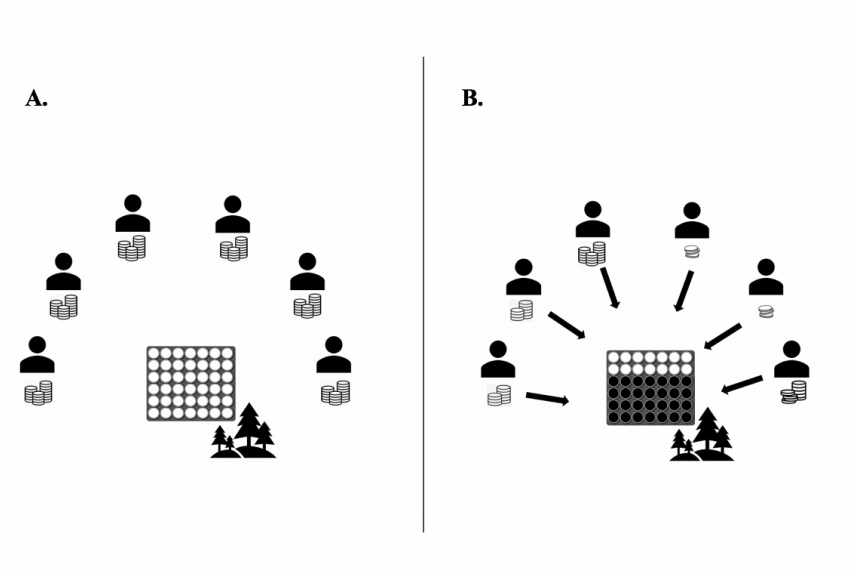


Figure 2: The general procedure for the common goods game is designed to mimic decisions around conserving a public forest. Groups of six children decide whether to keep or "donate" tokens they have been endowed. Kept tokens can be used to buy prizes. A) Each participant is initially given 24 tokens. Donated tokens are displayed in the "Forest Bank", or two Connect Four boards. This allowed the group to monitor whether they meet the goal of donating 72 tokens within 6 trials. B) In each trial each participant can anonymously give 0, 2, or 4 of their tokens to the Forest Bank. To meet the donation threshold each participant needs to donate two tokens per trial on average, but they can choose to donate as few or as many of their tokens to support the forest. Groups were assigned to one of three conditions that varied their risk of losing all their tokens if they did not meet the donation goal by the end of the sixth trial (0%, 50%, 100% risk).

Two *Connect Four*® boards (22 x 22 cm each) and game pieces (3 cm in diameter) were used to facilitate the game. The boards were used as the "Forest Bank" and the game pieces as tokens. Each board has 42 slots to place game pieces, although tape covered one column of slots so only 36 slots were visible to participants on each board (72 slots total were visible to participants). This allowed the experimenter to conspicuously add tokens to the bank so participants could easily monitor how many

tokens were in at any time. Variations in location, room set up, and recruitment for each of the three countries are listed below:

USA: A.B. conducted all data collection in the USA. Participants were tested at Zoo Atlanta in a classroom located in the education programs' building separate from the animal exhibit. The classroom was large (approximately 15 x 15 m) and was separate from the rest of the camp activities. Experiments were run between 10-12 am or 1-3pm Tuesday through Thursday each week while the camp was running. Camp-goers conducted all their activities in same-age groups of 8-12 individuals that consistently had the same instructor and group name for the entire summer. Groups had the same schedule from week to week. Our research games were one of several activities built into the schedule for these groups, so we therefore saw the same groups at the same-time from week to week, albeit with different participants. Because we were built into the camp's schedule, we therefore never disrupted the camp's other activities that included viewing animals in the zoo, attending behind the scenes tours and demonstrations by zoo-keepers and educators, and making nature related art projects. When a group arrived at the testing classroom, six individuals were chosen at random from a list to participate in the study. The remaining individuals participated in a separate activity led by the instructor outside of the testing classroom. Participants sat in a semicircle around a table in front of the experimenter. Participants were positioned with at least one foot between each other.

DRC: A.B. conducted all data collection in the DRC. All studies were conducted in French. Data in the DRC were collected at four schools in Kinshasa. We worked with Lola Ya Bonobo Sanctuary to recruit participants for this study. The sanctuary, located on the outskirts of Kinshasa, rescues and rehabilitates orphaned bonobos from the bushmeat trade. The sanctuary also has a dedicated outreach and education department. The Education Team at the sanctuary already had planned visits to each of these schools as part of their regular outreach program, and the experimenters accompanied them to the schools to conduct this study. The headmaster for each school was provided with information about the research a week in advance and had the option of providing teacher consent for students (see Ethics). If consent was provided, the headmaster provided a schedule of which classrooms could participate based on the time of our visit and class availability. If a class was chosen to participate, the experimenter would choose 6 students at random from a list, bring them into a separate room for testing, and bring them back to the classroom after the study was complete. The experimenter then chose another six participants at random from a different class. At each school, a quiet classroom or outdoor space was selected where there would be limited distraction from other students. The study either took place around a table or sitting on the ground, always with a minimum of one foot between each participant. Participants in the study received their prizes after all testing for the day was complete in order to avoid distraction when they returned to the classroom.

China: Wen Zhou conducted all data collection in China. All studies were conducted in Mandarin. Data in China were collected at an elementary school in outskirts of Beijing. Participants were tested in a 5 x 6 m room in the school. The headmaster was provided information about the research three weeks in advance and provided teacher consent for students. The headmaster provided a schedule of which classes could participate based on the time of our visit and class availability. When a class was chosen to participate, the experimenter would choose 6 students (3 boys and 3 girls) at random and bring them into the room for testing. The study took place around a table, with one foot between each participant. After the study was completed, participants received their prizes and were brought back to their classroom.

2.1.3 Procedure

Participants in a group of six were instructed to sit in a semi-circle around the experimenter with some distance between each other. Participants were instructed to only respond to the experimenter but not to talk to each other during the game. The experimenter then introduced the rules (full experiment script in Appendix A).

2.1.3.1 Introduction Phase

Participants learned they would receive tokens at the start of the game which they could either keep or "give away" (i.e. donate). Tokens they kept for themselves could be exchanged for prizes at the end of each game. Tokens they gave away would be used to fund the conservation of a national park. Critically, if they failed to meet a

donation threshold by the end of the game, all the donated tokens would be lost, and the national forest would not receive any donations. The group would be able to track the donation level across trials because the experimenter placed donated tokens into a public bank, or "Forest Bank", that was visible to the group. Participants could then adjust their donations across trials based on how close the group was to meeting or exceeding the minimum donation criteria to support the national forest.

In the USA and China, participants were shown the prizes they could purchase at the end of the game with tokens they kept (i.e. animal themed notepads, erasers, fidget spinners, kazoos, slinkies, yoyos, pencils embossed with animals, etc.). They were informed they could purchase as many prizes as they wanted but they cost two tokens each. They were also told they could not exchange tokens they earned for prizes during the game. In the DRC, locally available candies were used as the prizes instead of toys.

The experimenter then explained that it takes money to pay for the maintenance of national parks and if the group donated enough of their tokens, a monetary donation would be made to support a local national park. A national or state park familiar to the participants was chosen as the recipient (i.e. USA: Chatahoochee River, Smoky Mountains, Sweetwater Creek, Stone Mountain Park; DRC: Salonga, Virunga, Garumba, Equateur Forest; China: Sanjiangyuan National Nature Reserve, Shenongjia National Geopark, and Badaling National Forest Park).

After completing the introduction, the experimenter asked the group a set of predetermined questions to make sure participants understood the game. (See Appendix A for the experimental script and set of questions designed to test participants comprehension of the rules.) After the group responded correctly to a set of comprehension questions the group completed two practice trials.

In each practice trial the experimenter asks "How many tokens would you like to donate to the Forest Bank? Circle your answer and hand me the piece of paper." To demonstrate the procedure, the experimenter would take the piece of paper from each participant, announce out loud how many tokens each participant gave, take the tokens from the bowl and put them into the collection bank. This way each subject could experience making donation decisions, giving different amounts from trial to trial as well as observing their donated tokens being placed in the Forest Bank by the experimenter. If subjects did not understand the procedure or all participants gave the same donation amounts for both practice trials, additional practice trials were given until the experimenter felt confident the group understood the procedure.

2.1.3.2 Test Phase

The experimenter announced that the real game was beginning and reminded participants that there was no talking or sharing information throughout the game. Test trials followed the same procedure as the practice trials except: groups learned about the consequences for not meeting the donation threshold based on the condition to which

they were assigned (Table 3). At the beginning of every trial, the experimenter asked "How many tokens would you like to donate to the Forest Bank? Circle your answer and hand me the piece of paper."

After each trial, the experimenter announced how many people gave each token choice option (e.g. "one person gave 0 tokens, 3 people gave 2 tokens, 2 people gave 4 tokens") before putting tokens into the Forest Bank and moving on to the next trial.

Condition 1 (100% Loss, High Extrinsic Condition): Failure to fill the collection bank results in all participants losing all their tokens. No prizes can be purchased as a result.

Condition 2 (50% Loss, Low Extrinsic Condition): Failure to fill the collection bank results in a coin toss to decide whether or not participants' keep their remaining tokens. Participants have a 50% chance they will lose or keep their tokens depending on the outcome of the coin flip. Loss of tokens means no prizes could be purchased.

Condition 3: (0% Loss, Intrinsic Condition): Success or failure to fill the collection bank does not affect whether participants can keep their tokens. Participants can purchase prizes with their remaining token regardless of whether the bank is filled or not.

Table 3: Outcomes for Risk Conditions. Group Success indicates if the group collectively gives enough to the collection bank to meet the conservation goal (72 tokens). Reward indicates that individuals in the group can exchange the remaining tokens they did not give away for tokens.

	0% Risk (Intrinsic)	50% Risk (Low Extrinsic)	100% Risk (High Extrinsic)
Group Success	Reward	Reward	Reward
Group Failure	Reward	50% chance of getting reward, 50% chance of no reward	No reward

If, by the end, the bank is filled, the experimenter notified the participants that they can keep all the tokens that remains in their bowl to exchange the tokens for prizes. If they did not reach the goal, the experimenter will explain whether or not they lose their coins based on the group's condition.

At the end of the game, the experimenter would thank them for playing and encourage them not to share how the game works with other children in the class.

2.1.4 Design

Participants were told they had six opportunities (trials) in the game to meet the donation threshold. In each trial the experimenter asked the subjects whether or not they wanted to donate to the Forest Bank, and participants could indicate whether they would give away 0, 2 or 4 tokens. The minimum donation threshold was 72 tokens for the game to be scored as "successful." To meet the minimum donation threshold

participants on average had to donate at least 2 tokens per trial (6 participants X 2 tokens x 6 trials).

Conditions were assigned using a between subjects' design with one third of all groups in each condition. Groups were initially counterbalanced between conditions. Towards the end of data collection, groups were assigned to one of the three conditions in order to balance out age and gender.

2.1.5 Ethics

All participants in this study provided consent in order to participate. In both the China and the DRC, a waiver was granted to allow teacher consent to be given from classrooms. In the United States, an opt-out parental permission form was provided to all children's parents at the beginning of the summer camp. *(Duke Human Research IRB Protocol C0080).*

2.1.6 Scoring

For each trial, each participant marked on a pre-printed answer sheet whether they wanted to give 0, 2 or 4 tokens to the Forest Bank. After each trial, the experimenter took each paper from all six individuals, marked on the data collection sheet how many tokens each individual contributed. The experimenter ensured all individuals handed a paper each trial, so there were not any missing data within a group. If by the end of the six trials the group has collectively given 72 tokens the game is scored as "successful". If

the group does not collectively give 72 by the end of the 6 trials, the game is scored as "failed".

2.1.7 Analysis

First, we used a linear model (ANOVA) to examine the total number of tokens donated by the group (continuous: range 0-144) as the outcome variable. This group-level analysis included the categorical variables country, risk, and grade as predictor variables. We did not include any age or gender predictors for the group level analyses (e.g. mean age or female percentage of a group), because preliminary analyses suggested considerable variances across countries.

Second, we conducted an analysis using each participant as a data point. For this individual-level analysis, we focused on individual donation in total (continuous: range 0-24) as the outcome variable. We used a LaPlace Approximation for this analysis to account for the actions of the rest of the group while analyzing the behavior of the individual. This model assumed a Poisson distribution model because the data does not fall on a continuous domain. Predictors in this model included risk condition, country, age, sex, a risk condition/country interaction, risk-condition/age interaction, and a risk condition/sex interaction.

Third, we conducted an additional analysis with the individual-level data. This model was specifically asking if we could predict how many tokens individuals would donate once the group had already reached the conservation goal of 72 tokens. In the

50% and 100% risk conditions, a decrease in donations after the goal is met would provide more evidence of extrinsic motivation for supporting the conservation cause. To conduct this analysis, we included a dummy variable for whether the group has collectively donated 72 tokens. This predictor variable was in addition to country, condition, age, gender, and interaction terms. Like the previous analysis, a LaPlace Approximation was used with the assumption of a Poisson distribution to account for group effects and non-continuous data.

2.2 Results

The results of the group level analysis using an ANOVA suggest significant effects of the predictor variables on the total donation sums of the groups: $F(6,95)=3.52$, $p=.003$.

In this model there was a significant difference between the total number of donations given by populations in different countries. Compared to China, the reference group, DRC gave significantly fewer donations (estimate=-20.64, p=.00). There were no significant differences between donations in the USA and China (estimate=-10.30, p=.12). Across all countries, groups gave more in the 50% risk condition than the 0% risk condition (estimate=13.99=, p=.04), and more in the 100% risk condition compared to the 0% risk condition (estimate=14.43, p=.03) (Figure 3).

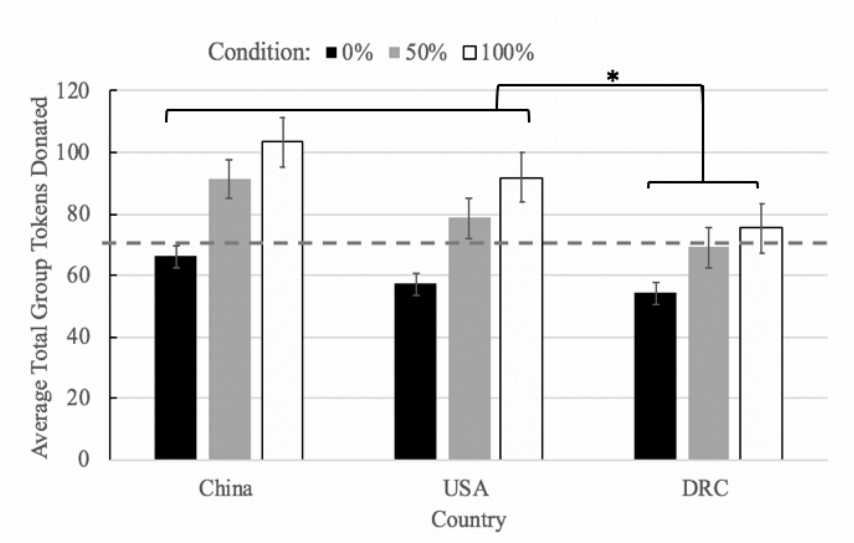


Figure 3: Average total group donations by condition and country. This group level analysis demonstrates that overall, groups give more in the half risk condition than the no risk condition (estimate=13.99, p=.04), and more in the full risk condition compared to the no risk condition (estimate=14.43, p=.03). Across all risk conditions, participants from China and the USA do not differ significantly, whereas the DRC is less likely to reach the donation threshold across conditions (estimate=-20.64, p=.00). The horizontal dashed line represents the number of tokens (72) needed to reach the conservation threshold. p<.05

The individual level analysis shows the same main effect of condition as the group level analysis, but provides age, and gender. Like the group level analysis, China was the reference group for the country variable, and the 0% risk condition was the reference group for risk variable.

Across countries, individuals gave more in the 50% risk condition compared to the 0% risk condition (estimate=.43, p=.02), and more in the 100% condition compared to the 0% risk condition (estimate=.55, p<.00) (Figure 4).

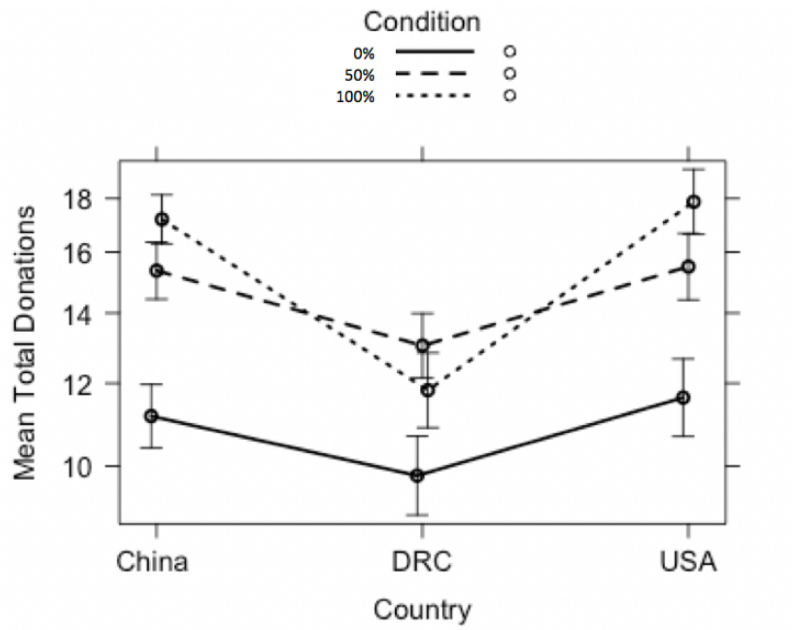


Figure 4: Mean total individual donations in all three risk conditions across all countries. Despite differences, participants in China and USA followed the same pattern of donating the most tokens in the 100% risk condition, the second most in the 50% risk condition, and the least in the 0% risk condition. Participants in DRC not only donated significantly fewer tokens than participants in the other two countries, the donations followed a different pattern across conditions. Participants in DRC on average gave the most tokens in the 50% risk condition, the second most in the 100% risk condition, and the least in 0% risk condition.

There is a significant difference in mean age across the countries ($F(2,638)=239.13$, $p>.000$). Compared to China, participants in DRC gave fewer tokens in the older age groups (estimate=. -06, p=.04). Older participants in the USA gave significantly more tokens than younger participants (estimate=.11, p<.00) (Figure 5).

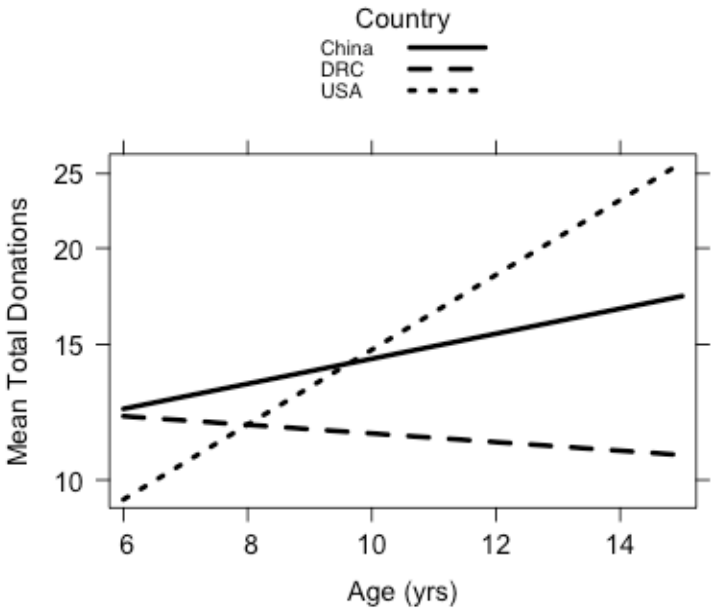


Figure 5: Mean total donations of individuals ages 6-15 across all conditions, separated by country. Individuals increase their donations to the collection bank as they age in both China and the USA (estimate=.11, p<.00). DRC is significantly different than China and USA, with individuals donating fewer tokens as they increase in age (estimate=-.06, p=.04).

In both the DRC and China, male and female participants donate similar amounts of tokens. In the United States, men donated significantly more than women (estimate=.25, p<.000) (Figure 6).

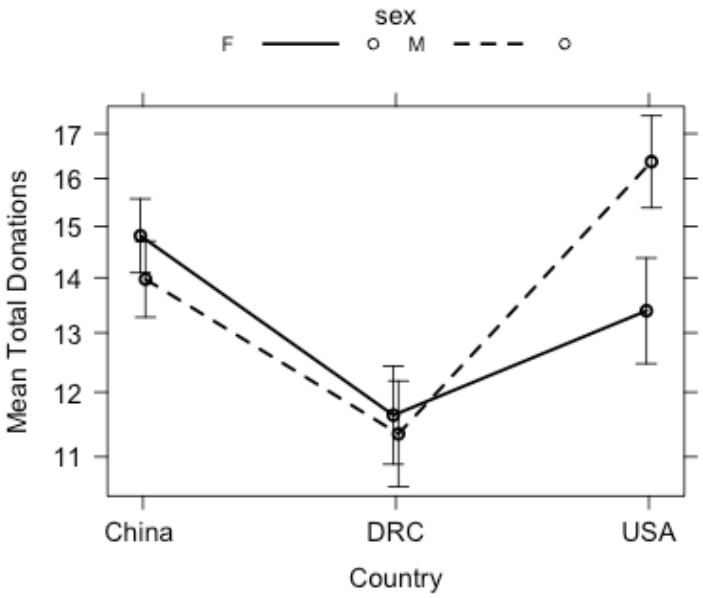


Figure 6: Mean individual donations by sex and by country across all conditions. In both the DRC and China, males and females donate similar amounts of tokens. In the United States, men donated significantly more than women (estimate=.25, p>.000).

The third analysis aimed to predict how many tokens individuals would donate once the group had already reached the conservation goal of 72 tokens. Results of this analysis found all the same main effects and interactions as the previous model that analyzed the individual-level data. This analysis also found that across conditions, individual donations to the forest bank dropped significantly in subsequent trials once the goal was reached in both the DRC (estimate=-.26, p=.01) and in the USA (estimate=-.53, p<.000), but not in China.

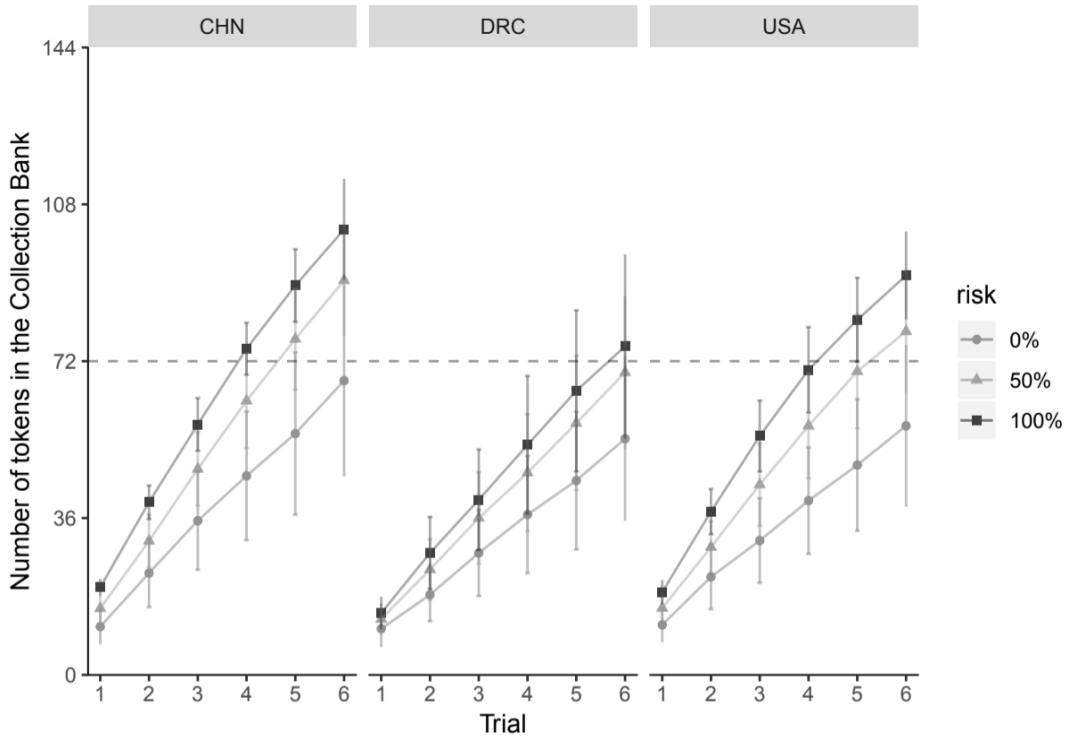


Figure 7: Collective number of tokens in the collection bank by trial for each risk condition in each population.

2.3 Discussion

Our results support the predictions of the Adaptive Motivation Hypothesis. No group met the donation goal based on intrinsic motivation alone. Children from all three countries required extrinsic risk to their own selfish rewards to motivate sufficient support of an abstract common good. However, responses to extrinsic motivators were not uniform across cultures. Participants from DRC, the location with the highest resource uncertainty, were least likely to meet the donation goals. School age children across the three cultures did not demonstrate the same intrinsic motivation for more

abstract social categories that they already show toward family, friends and group members as infants. Early emerging prosocial motivation may be limited in humans to social categories that were critical to survival during human evolution. Prosociality directed at more abstract types of social partners likely requires explicit extrinsic motivators across the human lifespan to assure group level cooperation.

All three populations, at the individual and group level, were more likely to reach the donation goal when there was a 100% chance of losing their personal resources, and least likely to reach the goal if risk of losing personal resources was 50% or 0%, respectively. This pattern is maintained even after controlling for country, age and sex. However, both individual and group level analysis revealed differences in average absolute donation across the three populations. This effect was largely driven by children from the DRC being significantly different from Chinese and American children. DRC participants gave lower average donations in all three conditions compared to the other two populations. On average, groups of Congolese children barely met the donation goal by trial six in the 100% and 50% conditions. In contrast, the average donations of Chinese and American children already surpassed the donation goal in these same conditions by trial four.

Individual-level analysis provides additional support for the role of extrinsic motivators in two cultures. Although participants had six opportunities to contribute, groups often met the donation goal before the sixth trial. If donations were mainly

motivated intrinsically, donations should be maintained after the goal is reach. Responses differed markedly across cultures. Chinese children did maintain their donation levels across all six trials regardless of whether their group had already met the donation goal. However, the donations of American children decreased significantly after their group met the goal, while Congolese children showed a nonsignificant decrease. The donation preferences of American and Congolese children are again consistent with a need to meet the goal and protect their own endowments. The continued donations of Chinese children may represent a level of intrinsic motivations not observed in the other groups. Alternatively, it may be that the group norms of more collectively focused cultures provide another type of extrinsic motivator not present in the other cultures. Stronger norms for collective action in China may have been particularly salient since the game was played publicly. While each individual donation was anonymous, everyone in the group knew its members and whether the group met the donation goal.

Analysis of donations across age and country provides further support for the AMH. Cross-sectional analysis did not reveal a uniform developmental pattern of donation behavior across cultures. While donations increased with age in American and Chinese children, participants from the DRC displayed the opposite pattern. Donations to the common good decreased with age in participants from DRC. This pattern is maintained after controlling for condition and gender. This finding supports the idea

that norms more than intrinsic motivation shape collective action in support of more abstract social categories. As children age, they mimic the norms in the cultures in which they grow up. In DRC's more resource uncertain environment norms that promote more self-interested investments may express themselves in response to calls for collective action to maintain common goods. Cultures existing within more resource certain environments may be more likely to have stronger norms to encourage charity or communal welfare.

The differences we observed between children from different countries are unlikely the result of methodological differences between testing sites. We carefully translated our instructions into the different languages with the aid of native speakers and were confident during piloting that children from each country understood the goals and rules of the game before starting data collection in each country. The uniform pattern of results across cultures in the different risk conditions supports the idea that children understood the central conflict we created between meeting the donation goal and keeping their endowments. While we did use different rewards across the three countries, rewards were chosen to maximize motivation based on cultural preferences (i.e. children of some cultures valued candy more than toys and vice versa). The similar donation rates in the first trials of all conditions in all three countries suggests children were similarly motivated. The similar donation rates across all trials of the no risk condition also suggest that children across countries were equally motivated.

While none of the populations met the donation goal in the no risk condition, it is noteworthy they children from all of the countries donated significant amounts of their endowments. This behavior differs from Milinski et a/ (2009) in which adult participants made minimal donations in the no risk condition and were not even close to the donation goal. One possibility is that we have underestimated the intrinsic motivation that children might show to support common goods and this motivation may decrease in adulthood. Alternatively, this difference may be produced by the fact that our experiments were not fully anonymous. Children may have been influenced by the presence of the adult experimenter that are not present in conventional economic games run with adults such as Milinski et al (2009). Although unconventional, the children still did not meet the donation goal in the no risk condition and the validity of the current experiment is likely high since few behaviors in the real world are truly anonymous.

The results of this study highlight the need for two main areas of further exploration. First, future studies should aim to disentangle universal aspects of human behavior from the influence of cultural norms. The AMH is predicated on understanding how local environmental differences and cultural norms contribute to how humans think and behave toward more abstract recipients. In the present study, we established the phenomenon that variation in contributions to abstract recipients exists across populations. The next step is to better understand why the differences exist. Second, it will be important to further explore how children's environments influence

how they think about abstract recipients. We see distinct developmental trends when comparing China and the USA against the DRC. Further studies can explore how education, access to media, and market integration influence children's views of more abstract social categories. The ultimate question is how these childhood preferences then shape adult behavior.

Overall, the results of this study reinforce the notion that extrinsic rewards motivate contributions to a common good more so than intrinsic rewards. This is the first study of its kind to examine motivations to give to common goods using a cross-cultural and developmental sample. Variation in contribution behavior is impacted by demographic, ecological, and cultural factors. Behavior that might at first seem at odds with one's interest make sense in light of the AMH. Congolese children donated less and stopped donating after meeting the donation goals in the risk conditions. This meant they failed to meet the donation goal more often than children from the other countries, but it also meant that they more frequently took home a larger endowment. In this way the Congolese children outperformed the other groups of children. Within the context of resource uncertainty that these children grow up with, the strategy of risking the future of the common good for immediate reward is likely highly adaptive. Understanding differences like these in the underlying motivations across a variety of populations will be vital if conservation organizations and educators are to succeed at

implementing policies that lead to behavior change and positive environmental outcomes.

3. Time delays and resource loss motivate conservation contributions in American children

3.1 Introduction

Developmental and cross-cultural studies have established that humans are highly prosocial. Children as young as 14 months demonstrate intrinsic motivations to cooperate with others (Warneken, 2015). Cross-cultural studies show intrinsic motivation to help kin, in-group members and even strangers is universal (Silk and House, 2011; Apicella and Barrett, 2016; Blake et al., 2015). Singer (1981) refers to these different social categories as The Expanding Circle (Figure 1).

While humans are intrinsically motivated to act prosocially towards recipients within the Expanding Circle, we struggle to extend prosocial behaviors towards more abstract recipients like future-others and the natural world. The Adaptive Motivation Hypothesis (AMH) provides a framework for exploring when and why humans act prosocially towards more abstract recipients and how these behaviors may vary across diverse populations.

The AMH posits that humans across cultures have evolved early-emerging intrinsic motivation for prosocial behavior towards kin, non-kin ingroup members, outgroup members and strangers. Prosocial behavior towards the more abstract social categories like future others and non-human species is more variable across cultures. This variability is a response to environmental certainty and is largely motivated by extrinsic reward or punishment reflected in cultural norms.

Chapter 2 explored whether children ages six to fifteen were more motivated by intrinsic or extrinsic rewards to contribute to a common good resource, an operationalized economic concept that serves as a proxy for abstract recipients. A common good is any resource that is non-excludable but rivalrous, like a forest or wildlife (Ostrom, 2003). To test the AMH, we conducted the study with comparable samples of children the United States, China, and the Democratic Republic of the Congo. These three populations were chosen because they varied in their environmental certainty and cultural norms. The study found that overall, children in all three populations are more motivated to contribute to common goods in response to extrinsic than intrinsic motivators. Variation in prosocial behavior across the three populations aligns with ecological predictions under the AMH.

These findings raise the question of what types of extrinsic motivators might be most successful at maximizing children's contributions to the common good. Bowie et al, (Chapter 2) demonstrated that children are motivated to contribute to common goods when the risk of losing personal resources is high. However, time delays have also been shown to be a powerful extrinsic motivator (Rosati et al., 2007). Here we also included a type of extrinsic motivation that mirrors the actual consequence of failing to maintain a common good. When common good resources in the natural world are not sustainably managed, it takes time for them to regenerate. Those who fail to invest in the maintenance of the common good must wait longer for resources to regenerate in order

to continue using them. This type of reasoning about the future and delaying gratification increases with age and is shaped by culture (Steinberg et al, 2009). Temporal discounting, or the strength of preference for smaller immediate rewards over larger future rewards, is correlated with uncertainty avoidance and is also shaped by culture (Wang et al., 2016). All of these time perception skills are often recruited to make decisions about the public good.

The AMH predicts that the threat of a delay in acquiring rewards when the common good is not sustainably managed will also motivate more contributions from children than intrinsic motivators alone. The AMH predicts that prosocial behavior should increase with increasing extrinsic rewards and punishments. To test these predictions, we manipulated two types of extrinsic rewards: time delays and loss of personal resources. We conducted three studies with a population of American children ages six to fifteen. Study 1 tested whether the threat of a time delay served as an extrinsic motivation to contribute to the common good pool. Study 2 aggregated loss of personal resources and time delays in an effort to bolster extrinsic motivation for participants. Study 3 assessed whether participation in a common goods game with multiple extrinsic motivations translated to prosocial behavior towards abstract recipients in a context separate from the experimental paradigm.

3.2 Study 1: Time Delay as an Extrinsic Motivation

Study 1 tested whether or not a time delay provided extrinsic motivation for participants to contribute some of their personal endowment to a collection bank that funded a common good. The common good was a forest with which all the participants were familiar. The AMH predicts that participants who are provided with the extrinsic time motivation will contribute more to the common good compared to participants who are not provided with any extrinsic motivation.

3.2.1 Study 1: Methods

3.2.1.1 Subjects

Participants (N=156) were recruited during the 2016 summer camps at Zoo Atlanta in the suburban area of Atlanta. Each camp was a week-long, and any child between ages six and fifteen could sign up (mean age= 8.23 ± 2.0, F/M ratio = .95). The majority of participants attend public school and are from middle income families in the Atlanta metro-area.

3.2.1.2 Set-up and Apparatus

Participants were tested at Zoo Atlanta in a space known as the "tree house". It is an approximately 10 X 10 m room situated above one of the small primate exhibits. Children had to pass through the zoo and into the small primate exhibit where they could climb up a set of stairs into the testing space. There was minimal distraction from the zoo animals since the room had no windows that viewed any of the exhibits.

Experiments were run between 10-12 am or 1-3pm Tuesday through Friday each week while the camp was running. Camp-goers conducted all their activities in same-age groups of 8-12 individual that consistently had the same instructor and identifying animal name for the entire summer. These "animal groups" had the same schedule from week to week. Our research games were one of several activities built into the schedule for these animal groups, so we therefore saw the same groups at the same-time from week to week, albeit with different participants. Because we were built into the camp's schedule, we never disrupted the camp's other activities that included viewing animals in the zoo, attending behind the scenes tours and demonstrations by zoo-keepers and educators, and making nature related art projects. When a group arrived at the treehouse, six individuals were chosen at random from a list to participate in the study. The remaining individuals participated in a separate activity in a different area of the treehouse. The group's instructor was asked to not watch those playing the game in order to avoid any influence.

The same female experimenter carried out the piloting and conducted the experimental testing (A.B.). Participants sat in a semicircle on foam pads on the floor in front of the experimenter with at least one foot between each participant. At the beginning of the game, each participant was given a bowl that contained 12 tokens, a pen, and a stack of 12 small pieces of pre-printed paper that served as their response

sheet. All participants had clear view of the experimenter and the Connect Four® board (Figure 8).

A *Connect Four*® board (22 x 22 cm) and game pieces (3 cm in diameter) were used to facilitate cooperation. The board was used as a public bank and the game pieces as tokens. The board has 42 slots to place game pieces, although tape covered one column of slots so only 36 slots were visible to participants. This allowed the experimenter to conspicuously add tokens to the bank so that they remained visible to all participants throughout the experiment. Participants could easily monitor how many tokens were in the public bank at any time.

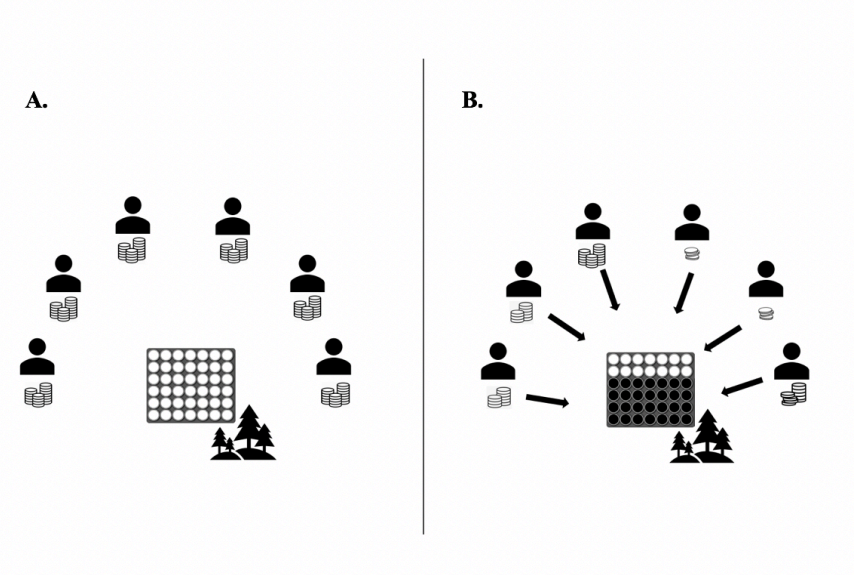


Figure 8: Set up for Study 1 and Study 2. Six same-aged individuals sit in a semicircle around the Forest Bank. Participants are sitting on the floor with minimum 1 foot between each of them. All participants can easily see the Forest Bank, which is a Connect Four board displaying 36 token slots. A) Each participant is initially given 12 tokens and told they can donate as few or as many as they want to the Forest Bank during the game. Tokens donated to the Forest Bank will be exchanged for money that supports a National Park with which the participants are familiar. Participants are told the details of their group's risk condition before starting the game. B) Each trial, participants can anonymously give 0, 2, or 4 of their tokens to the Forest Bank. 3 trials make a round. They play for a total of 3 rounds, and the tokens collect in the bank cumulatively.

3.2.1.3 Procedure

Participants in a group of six were instructed to sit in a semi-circle around the experimenter with some distance between each other. Participants were instructed to only respond to the experimenter but not to talk to each other during the game. The experimenter then introduced the rules (full experiment script in Appendix B).

For the Introduction Phase, participants learned they would receive tokens at the start of the game which they could either keep or "give away" (i.e. donate). Tokens they

kept could be exchanged for prizes at the end of each game. Tokens they gave away would be used to fund the conservation of a national park if the groups combined donations exceeded a minimum donation threshold. Critically, if they failed to meet the threshold by the end of the game all the donated tokens would be lost, and the national forest would receive no support. The group would be able to track the donation level across trials since the experimenter placed donated tokens into a public bank, or "Forest Bank", that was visible to the group. Participants could then adjust their donations across trials based on how close the group was to meeting or exceeding the minimum donation criteria to support the national forest.

Participants were shown the prizes they could purchase at the end of the game with tokens they kept (i.e. animal themed notepads, erasers, fidget spinners, kazoos, slinkies, yoyos, pencils embossed with animals, etc.). They were informed they could purchase as many prizes as they wanted but they cost two tokens each. They were also told they could not exchange tokens they earned for prizes during the game.

The experimenter then explained that it takes money to pay for the maintenance of national parks and if the group donated enough of their tokens a monetary donation would be made to support a local national park. A national or state park familiar to the participants was chosen as the recipient (i.e. Chatahoochee River, Smoky Mountains, Sweetwater Creek, Stone Mountain Park).

After completing the introduction, the experimenter asked the group a set of predetermined questions to make sure participants understood the game. See Appendix B for the experimental script and set of questions designed to test participants comprehension of the rules. After the group responded correctly to a set of comprehension questions the group completed two practice trials.

In each practice trial the experimenter asks "How many tokens would you like to donate to the Forest Bank? Circle your answer and hand me the piece of paper." To demonstrate the procedure the experimenter would take the piece of paper from each participant, announce out loud how many tokens they gave, take the tokens from the bowl and put them into the collection bank. This way each subject could experience making donation decisions, giving different amounts from trial to trial as well as observing their donated tokens being placed in the Forest Bank by the experimenter. If subjects did not understand the procedure or all participants gave the same donation amounts for both practice trials, additional practice trials were given until the experimenter felt confident the group understood.

For the test phase, the experimenter announced that the real game was beginning and reminded participants that there was no talking or sharing information throughout the game. Test trials followed the same procedure as the practice trials except:

Participants were told they would play rounds consisting of three trials each, they needed to meet the minimum donation threshold by the end of each round, they

could exchange their remaining tokens for prizes at the end of each round, and they would then receive a new endowment before the next round of three trials. They were not told how many total rounds of the game would be played.

Groups also learned there may be an additional consequence for not meeting the donation threshold based on the experimental condition they were assigned (Table 4).

Delay Condition: If the group did not contribute enough tokens during the round to meet the donation goal, all members of the group were required to wait for 90 seconds in silence before they receive their new endowment and were allowed to start a new round.

No Delay Condition: There is no direct cost to the participants if the group doesn't fill the Forest Bank in this condition. Regardless of whether the group makes the donation goal they receive their new endowment and can immediately begin the next round of the game without delay.

Table 4: Differential outcomes for each experimental condition for Study 1 based on participants donations in 1st round of three trials. Success in a round required the group to collectively donate minimum of 36 tokens.

Condition	**# of tokens each subject received at the beginning of a round**		
	1st round	*Didn't make the goal in the previous round*	*Made the goal in the previous round*
Delay	12	12 + 90 sec timeout before moving to round two	12
No delay	12	12	12

While participants could track the level of donations in the public bank, unlike the practice trials, subjects were informed that all individual donation decisions were anonymous. In each trial, all participants were instructed to circle on pre-printed strips of paper how many tokens they wanted to give to the Forest Bank and then hand the sheet of paper to the experimenter. Individuals' answers were hidden from the other participants, so only the experimenter knew how many tokens each participant gave. After each trial, the experimenter would take the pieces of paper from each of the participants, tally the total, and place the total number of tokens given by the group into the Forest Bank. All participants could therefore see how many were collectively given to the forest, but not how many their peers gave.

3.2.1.4 Design

The minimum donation threshold was 36 tokens per round. Before every round each participant was gifted an endowment of 12 tokens. In each trial the experimenter asked the subjects whether or not they wanted to donate to the Forest Bank. For each trial participants could indicate whether they would give away 0, 2 or 4 tokens. Each group participated in three rounds of three trials for a total of nine trials. This means an individual could donate 0-12 tokens per round and 0-36 tokens over the nine trials. Groups could donate between 0-72 tokens per round and 0-216 tokens over the entire

nine trials. To meet the minimum donation threshold participants on average had to donate at least 6 tokens, or half of their endowment, in each round.

Conditions were assigned using a between subjects' design with only half of subjects receiving each condition. Groups were initially counterbalanced between conditions. Towards the end of data collection, groups were assigned to one condition or another in order to balance out age and gender

3.2.1.5 Ethics

This experiment and the subsequent experiment were approved by the Duke Human Research IRB committee *(Protocol 2017-1004)*. A permission form was sent home to all the campers' parents at the beginning of the camp session. This form explained the protocol as well as parent's right to withdraw their child at any time. Returning a signed form allowed parents to opt-out of their child's participation. Only 2% of parents opted out. To protect the privacy of participants we were not allowed to videotape the experiments.

3.2.1.6 Scoring

For each trial, each participant marked on a pre-printed answer sheet whether they wanted to give 0, 2 or 4 tokens to the Forest Bank. After each trial, the experimenter took each the paper from all six individuals, marked on the data collection sheet how many tokens each individual contributed. The experimenter ensured all individuals handed in a paper each trial, so there were not any missing data within a group. If by

the end of the three trials in a round, the group has collectively given 36 tokens, the round is scored as "successful". If the group does not collectively give 36 by the end of the 3 trials, the round is scored as "failed". This is the same for all three rounds in the game.

3.2.1.7 Analysis

Two group-level analyses were conducted. The first was a logistic regression model to examine the outcome of each of the rounds (binomial outcome: success or failure). Predictors for this model included the categorical variables condition (delay or control), age group (categorical), success of round 1 as a predictor of round 2.

Two other logistic regression models were run that included interactions between all the variables and the success of round 1 as a predictor of round 3. Neither of these alternative models did better than the simpler model without the interaction term.

The second GLM examined the total number of tokens donated in each round as the outcome variable (continuous 0-216). We used a Poisson linear model because the data does not fall on a continuous domain because the only donation options were 0, 2 or 4.

We also conducted an individual-level analysis that used each participant as a data point. This analysis allows for a more detailed understanding of age and gender as predictor variables. A poisson linear model examines the mean total aggregate donations as the continuous outcome variable. Predictors in this model included

condition (binary: Delay or No Delay condition) age (continuous variable), gender (binary: male or female). We also included a LaPlace approximation to deal with the lack of complete independence between each individual's decision in the round, and the decision of other participants in previous rounds. Predictors in this model included condition (delay or control), and age group (categorical).

3.2.2 Study 1: Results

Piloting suggested that participants understood the rules of the game based on the comprehension questions and practice trials. All participants passed the comprehension questions for Study 1 (each participant successfully repeated the correct answer to the comprehension questions and correctly completed the practice trials).

Table 5: Group Level Descriptive Statistics for Study 1.

Condition	Total Number of Groups	Mean Group Donation R1 ± SE	Mean Group Donation R2 ± SE	Mean Group Donation R3 ± SE	Total Mean Group Donations
Delay	13	46.77±5.30	47.54±5.38	38.31±4.32	133.39±15.10
No Delay	13	28.00±3.17	32.62±3.66	29.08±3.29	89.385±10.12

Table 6: Individual Descriptive Statistics for Study 1.

Condition	Subj #	F/M Ratio	Age ± SD	Mean R1 ± SE	Mean R2 ± SE	Mean R3 SE	Total Mean ± SE
Delay	78	.77	8.46±2.06	7.92±.90	7.92±.90	6.39±.90	22.33±2.53
No Delay	78	1.17	8.00 ±1.92	4.67±.42	5.39±.47	4.85±.49	14.90±1.25

For the group level logistic regression that uses the binary outcome, results are presented as odds ratios, i.e. the ratio of the success probability and the failure probability. This analysis shows that across all three rounds (9 trials), those in the 90 second delay condition were 3.91 times as likely (CI: 1.2, 13.9) to successfully cross the conservation threshold compared to those in the control condition (GLM estimate=1.36, p=.026) (Figure 9). The group-level analysis examining the aggregate number of tokens as the outcome shows the same results. Groups in the 90s-delay condition give more on average compared to groups in the control condition (GLM estimate=.319, p>.000).

Groups that succeeded in reaching the conservation threshold in the previous round were likely to succeed in the next round. The odds of succeeding in the next round were increased 6.73 times (CI: 2.2, 24.6) (GLM estimate=1.91, p=.002). (Figure 10) There were not any differences in mean donations from one round to the next for the No Delay condition.

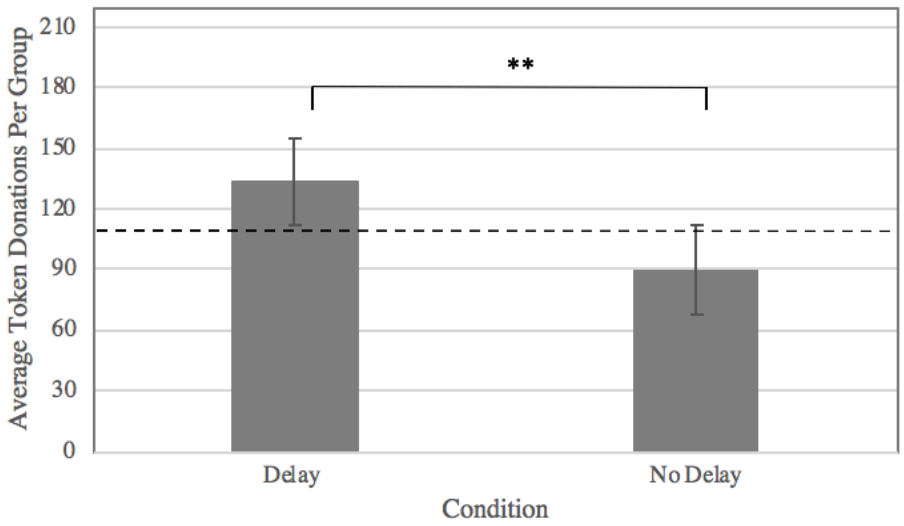


Figure 9: Study 1 average token donations per group for Delay and No-Delay Conditions. Results show mean aggregate donations after all 3 rounds. Dashed line at 108 signifies the minimum number of tokens needed to have reached the 36 token goal in each round. **p<.001.

Older kids generally had a higher success probability in all three rounds. For each additional year in the average age, the odds of success increased by 55% on average with a 95% confidence interval of (CI: 12%,127%) (GLM estimate: .44, p=.01). Also using this aggregate measure, we found that groups comprised of older children gave more than groups comprised of younger children (GLM estimate=.13, p>.000).

The results of the individual analysis are consistent with those of group level analysis while providing more detailed information about age and gender predictors. Holding all else constant, individuals in the Delay Condition give 4.63 times more tokens than those in the No Delay condition (CI: 3.38-6.33) (GLM estimate: 1.53, p>.000). Holding all else constant, older kids donated more tokens than younger kids. For every

increase in age by 1 year, donations increase by 18% (CI: 15%-22%) (GLM estimate: .17, p>.000).

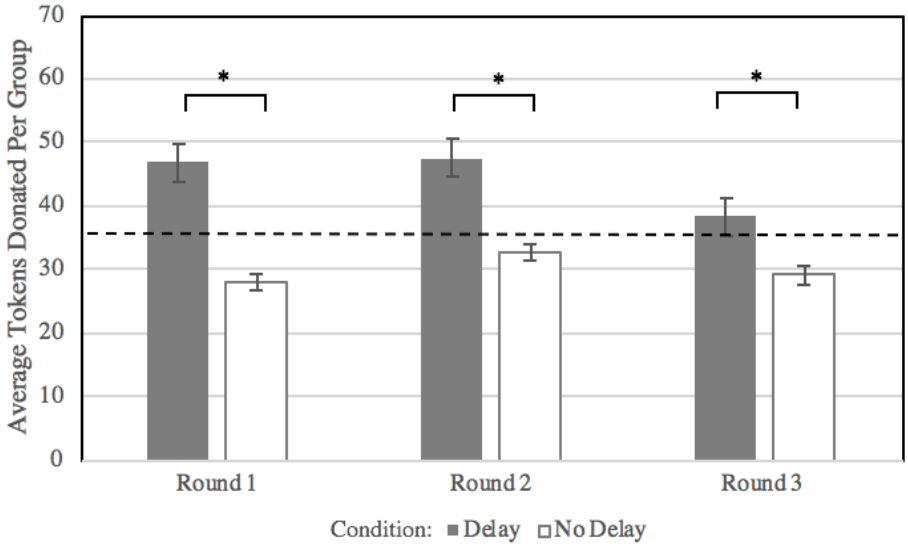


Figure 10: Study 1 Average Donations per group for each of the three rounds for the Delay and No Delay Condition. Dashed line at 36 signifies the minimum number of tokens needed to succeed in a round. *p<.05

There was an interaction between condition and age. Older individuals in the No Delay Condition tend to give slightly more than younger individuals. For every year increase in age in the No Delay condition, individuals donated an additional .87 times as many tokens as previously donated (CI: .84, .90) (GLM estimate: -.13, p>.000).(Figure 11). There was no effect of gender on individual donations.

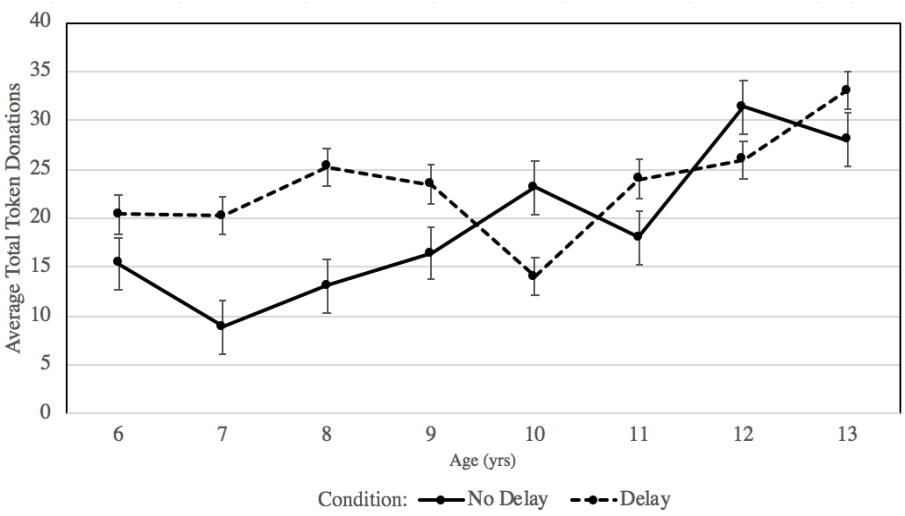


Figure 11: Study 1 average individual total token donations by participant's age and condition. As children age, they donated more tokens to the Forest bank, p<.001.

3.2.3 Study 1: Discussion

The results from Study 1 support the predictions of the AMH. Participants in the Delay Condition contributed significantly more of their endowment to the Forest Bank. Groups in the No-Delay Condition rarely even made the goal of filling the Forest Bank while those in the Delay Condition almost always made the goal. Participants in the delay condition rarely even experienced the time delay punishment. It was merely the threat of the delay that provided an effective extrinsic motivation to consistently meet and surpass the conservation goal in all three rounds of the game. While this study confirmed that time delay serves as a motivator for this population of children across all ages, the set-up of the paradigm was still rather sterile and removed from reality. Going forward, we wanted to explore whether we could make the paradigm better mirror the

real world. In doing so, we would test combining time delay and material loss as consequences if the common good goal is not reached.

3.3 Study 2: Time Delay and Resource Loss as Extrinsic Motivations

In Study 1 we relied on the fact that our subjects were attending a conservation camp as priming for forest conservation. We saw that without an incentive even these children do not donate to save a national forest. One possibility is that a reminder about the value of a forest as a public good just before the experiment might generate more donations. In this experiment we explicitly primed participants by discussing forest conservation as part of the warm-up to the experiment. The question then becomes whether incentives are still more successful at motivating higher rates of contributions toward forest conservation, or whether simply reminding children of the intrinsic value of forest is enough to motivate their donations. We also altered the incentive structure of this experiment to better simulate the risks and benefits of forest management practices. As in real life, participants were rewarded for donating to conserving forest by receiving a larger endowment (i.e. the forest became more productive), while exploiting the forest meant the endowment was smaller and was delayed in being produced (i.e. as the forest suffered reduced productivity and time to recover from overharvesting). In the experimental condition participants were also told explicitly that the endowment they received was produced by the forest. The conservation donation they made went to manage the forest so it could remain productive. This meant that participants made their

decision about donating or not knowing that their future endowment was tied to what they donated to the forest in each round as in many real-life conservation contexts.

3.3.1 Study 2: Methods

3.3.1.1 Subjects

Subjects (N=360) were naïve participants from the same population of children at Zoo Atlanta in Study 1 *(mean age±SD: 7.98 ± 1.87; F/M ratio: 1.09).* Participants were selected and distributed into groups using the same methods as in Study 1. Testing took place in the same location as in Study 1.

3.3.1.2 Procedure

One experimenter (A.B.) carried out the piloting while a research assistant, Gianna Ossello, conducted the experimental testing. Full scripts are included in Appendix B.

The set-up, apparatus, scoring, ethics, and procedure for this study was similar to Study 1 with two exceptions. This study included an extended discussion of the value of forests and also included a condition where participants paid a dual cost if the conservation goal was not met.

In this extended conversation with participants before the game began, the experimenter raised additional questions to discuss with the group that included discussions of local National Parks forest activities, and animals they may see while in a forest. The discussion also touched on everyday items that we rely on that come from

the forest and what happens to those items if too much of the forest is cut versus when the forest is used sustainably (full list of questions and answers can be found in Appendix B).

If participants did not answer these questions naturally with predetermined list of answers, the experimenter would provide the correct answers, so all groups covered the same topics about forests before the beginning of the game. Approximately 70% of groups were able to arrive at the answers to five or more of the seven questions on their own. Whether or not the group arrived at the correct answer on its own, the experimenter would repeat the predetermined answer before moving on to the next question. These group conversations lasted between 7 and 10 minutes, depending on how fast the groups arrived at the answers.

Secondly, the experimental condition was modified to explicitly tie the size and rate of the production of the endowment to the group's ability to meet the donation threshold that leads to resources to sustain the forest that produces their endowment. Participants are told that the tokens that they are donating represent money made from selling lumber from the forest. In the Cost-Benefit Condition if the group fails to collectively fill the Forest Bank with 36 tokens within the three trials of each round, the participants pay a cost. They must wait 90 seconds in silence to receive more tokens and they receive a reduced endowment of only 8 tokens in the following round. They are told this is because without donating to maintain the forest it has become less

productive and must take time to recover and will be less productive resulting in a smaller endowment for everyone. If, however, the group does meet the 36 tokens threshold the group is rewarded by a more productive forest that produces a larger endowment of 24 tokens for each participant in the following round. They also can begin the next round immediately since the forest does not need time to recover.

The control, or Neutral Condition, is the same as the *No Delay* condition from Experiment 1. In this condition, whether or not the group collectively reaches the conservation goal and gives the 36 tokens by the end of a round, each participant receives 12 tokens to immediately play the next round.

Table 7: Differential outcomes for each experimental condition for Study 2 based on participants donations in 1st round of three trials. Success in a round required the group to collectively donate minimum of 36 tokens.

Condition	**# of tokens each subject received at the beginning of a round**		
	1st round	*Didn't make the goal in the previous round*	*Made the goal in the previous round*
Cost-Benefit	12	8 + 90 sec delay	24
Neutral	12	12	12

3.3.1.3 Scoring and Analysis

Scoring for Study 2 followed the same criteria for Study 1. The same group level and individual level analyses were used for Study 2 as used in Study 1.

3.3.2 Study 2: Results

Piloting suggested that participants understood the game. 95% of participants answered all comprehension questions correctly, and therefore quantitatively passed the objective measure for comprehension. All participants passed the comprehension questions for study 1 (i.e. each participant successfully repeated the correct answer to the comprehension questions and correctly completed the practice trials).

Table 8: Group Level Descriptive Statistics for Study 2.

Condition	Total Number of Groups	Mean Group Donation R1 ± SE	Mean Group Donation R2 ± SE	Mean Group Donation R3 ± SE	Total Mean Group Donations
Cost-Benefit	36	49.90±.50	50.94±.58	50.00±.63	150.83±1.52
Neutral	24	27.70±.68	31.08±.89	31.25±1.03	90.00±2.28

Table 9: Individual Descriptive Statistics for Study 2.

Cond.	Total Subj.	F/M Ratio	Age ± SD	Mean R1 ± SE	Mean R2 ± SE	Mean R3 ± SE	Total Mean SE
Cost-Benefit	216	.94	8.24±1.80	8.32±.22	8.49±.24	8.33±.25	25.14±.61
Neutral	144	.87	7.65±1.90	4.61±.27	5.18±.32	5.20±.35	15.00±.82

For the 5% of individuals that did not pass all the comprehension questions, the experimenter subjectively determined whether an individuals' lack of comprehension in

the game influenced the behavior of the rest of the individuals, therefore invalidating the data. One group was thrown out based on these criteria.

For the group level logistic regression that uses the binary outcome, results are presented as odds ratios, i.e. the ratio of the success probability and the failure probability. The odds of succeeding in the Cost-Benefit Condition compared to Neutral condition increase by a factor of 41 (CI: 12.55, 171.72) to successfully cross the conservation threshold compared to those in the No Cost condition (GLM estimate=3.71, p<.001) (Figure 12)

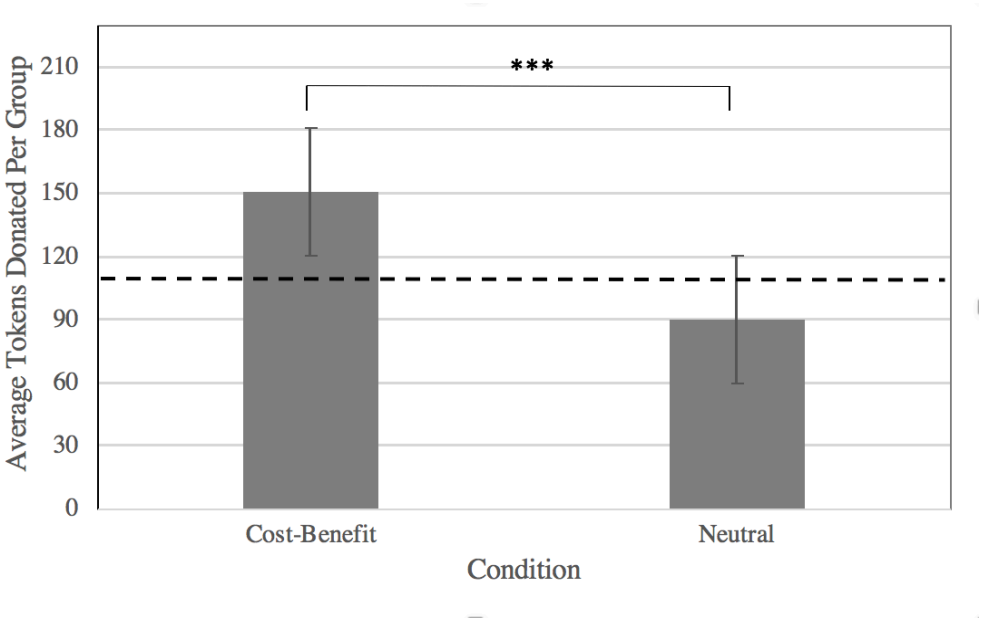


Figure 12: Study 2 average token donations per group for Cost/Benefit and Neutral Conditions in Study 2. Results show mean aggregate donations after all 3 rounds. Dashed line at 108 signifies the minimum number of tokens needed to have reached the 36 token goal in each round. ***p<.001.

Groups that succeeded in reaching the conservation threshold in the previous block were much more likely to succeed in the next. Those who succeeded in the

previous round were significantly likely to succeed in the subsequent round (GLM estimate=2.77, p=.001) (Figure 13). There were not any difference in mean donations from one round to the next within conditions.

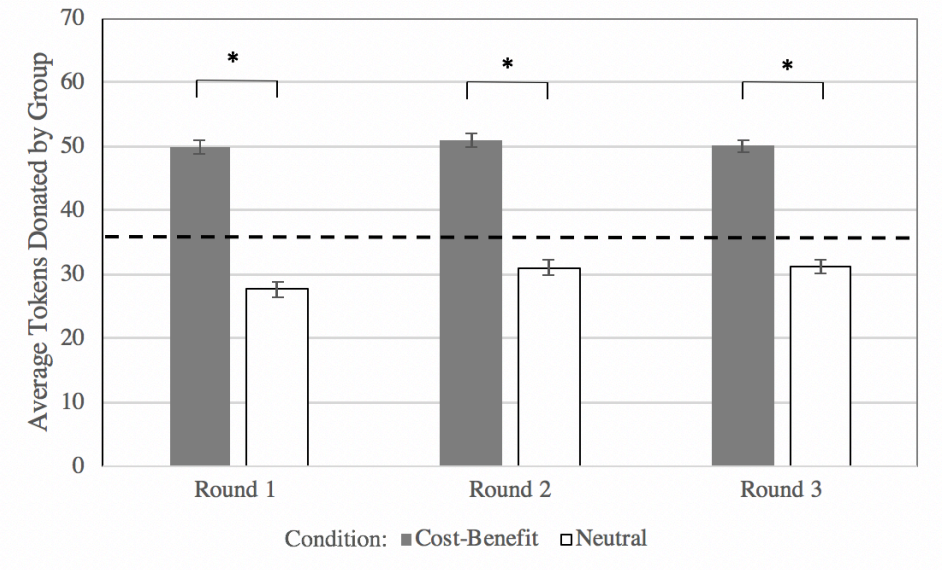


Figure 13: Study 2 average donations per group for each of the three rounds for the Cost-Benefit Condition and Neutral Condition. Dashed line at 36 signifies the minimum number of tokens needed to succeed in a round. *p<.05

Groups of older children generally had a higher success probability. For each additional age group, the odds of success increase by 71% (CI: 21%,152%) (GLM estimate: .54, p=.004).

The results of the individual analysis are consistent with those of group level analysis while providing more detailed information about age and gender predictors.

Holding all else constant, individuals in the Cost-Benefit Condition gave 1.66 times more tokens than those in the Neutral condition (CI: 1.57-1.74) (GLM estimate: .50, p<.001).

Holding all else constant, older kids donated more tokens than younger kids. For every increase in age by 1 year, donations increased by 6% (CI: 3%-9%) (GLM estimate: .05, p<.001).

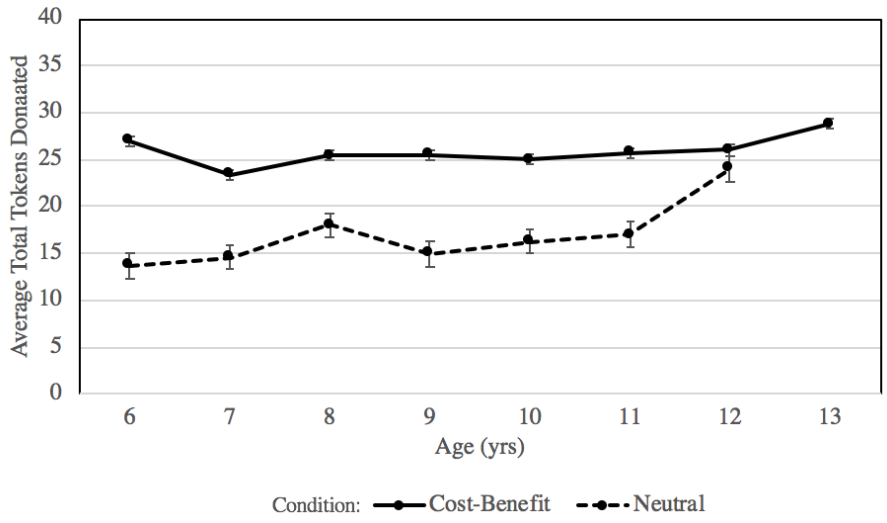


Figure 14: Average total tokens donated by individuals by participant age and experimental condition. Older children in the Neutral Condition donated more tokens to the Forest bank than those in the Cost-Benefit Condition, p>.001.

Just like in Study 1, there was an interaction between condition and age. Older individuals in the Neutral Condition gave more than younger individuals. For every year increase in age in the Neutral condition, individuals donated an additional .95 times as many tokens as previously donated (CI: .92, .97) (GLM estimate: -.06, p>.000). (Figure 14).

Holding all else constant, boys gave .95 times fewer tokens than girls across both conditions (CI: .90-.99) (GLM estimate: -.05, p=.03).

3.3.3 Study 2: Discussion

The results of Study 2 align with the predictions under the AMH. Participants in the Cost-Benefit Condition contributed significantly more to the Forest Bank than those in the Neutral Condition. Groups in Neutral condition never fill the Forest Bank in this study. Like the results in Study 1, very few groups in the Cost-Benefit Condition ever failed to fill the bank in any of the rounds. Qualitatively, participants in the Cost-Benefit condition in this study are given more tokens than those in the Time Delay condition in Study 1. This suggests that the aggregated extrinsic rewards/punishment more effectively motivate children in this population to contribute to common goods compared to no extrinsic motivation or one type of extrinsic motivation. Given the dramatic difference between the condition in this study, our next question was whether the experience of playing the cost/benefit condition in this game translated to prosocial behaviors towards common goods in a different context.

3.4 Study 3: Does experiencing the costs and benefits of a realistic conservation dilemma simulation lead to increases in pro-conservation in a novel context?

The purpose of this study is to assess whether participation in an experimental game about pay-off risks translated to decision-making about a real-life conservation dilemma. Children who had participated in the cost/benefit condition in Study 2 were tested in a simple follow-up behavioral task up to two weeks after their participation in the initial study. Their behavior in this task was compared to children of comparable age

who had never played any of our common goods games. This simple behavioral task asked children to write a postcard to the mayor of Atlanta and provide their opinion about whether she should authorize cutting down a local forest. The post cards of participants in the two groups were compared on a variety of factors. The AMH predicts that the participants who had participated in the cost/benefit experimental condition will demonstrate more pro-conservation messaging and drawings compared to the participants who had not participated in any commons good game. If the results of the study align with this prediction, we can provide evidence to Zoo Atlanta of the potential of experiential learning games that translate into important real-life behavior changes.

3.4.1 Study 3: Methods

3.4.1.1 Subjects

Participants in the experimental condition *(N=35)* were campers who had participated in the Cost/Benefit condition of Study 2. They completed this follow-up study after completing the game *(mean age: 7.71 ± 1.71, M/F ratio: 1.6)*

Participants in the control condition *(N=26)* were campers had not participated in Study 2 or any similar public goods study at the Zoo Atlanta camp *(mean age: 7.73 ± 1.93; M/F ratio: 1.3).* They were chosen because they were participants taking part in other Duke research activities run by a different experimenter than that of Study 2, and

therefore had already provided consent to participate in research. They completed this postcard activity before taking part in their other activities.

3.4.1.2 Set-Up and Apparatus

All participants were tested in the Research Treehouse. All participants were provided with white postcard (10.16 x 15.24 cm) that were blank on both sides apart from address lines. Participants were also provided with a variety of crayons, markers and colored pencils to use on the postcards.

3.4.1.3 Procedure

Participants sat in a semi-circle on the floor of the Research Treehouse around the experimenter. The experimenter handed each participant a blank postcard and drew their attention to the variety of crayons and markers available they could use during the activity. The experimenter then read from a script that detailed the activity (below). In both conditions, the participants are asked to write and/or draw a letter to the Mayor of Atlanta. The Mayor is looking for feedback about whether they should cut down part of a forest in order to make money for the city off of the lumber and wants to hear from citizens like the campers.

Experimental Condition Script: "Hey everyone, In the game we just played, you had the option of giving some of your money to help keep the forests healthy or you could keep tokens for yourself to buy prizes. The more tokens that were given to the forest, the healthier it became and the more we could benefit from the forest. The fewer

tokens were given, the less healthy the forest became overtime and the less we could benefit from the forest.

We're going to write post-cards to Keisha Bottoms, the Mayor of Atlanta. She has to make a decision about whether to cut down an entire forest right outside of Atlanta and make money for the city by turning all the trees into lumber. She hasn't made a decision about whether she will allow it to happen or not, so she wants to hear the opinions of people of all ages who live in Atlanta. Could you each write a short note to Mayor Bottoms about whether you think she should cut down the forest, and why you think she should or shouldn't? There are no right or wrong answers. She just wants to hear from you!"

Control Script: "We're going to write post-cards to Keisha Bottoms, the Mayor of Atlanta. She has to make a decision about whether to cut down an entire forest right outside of Atlanta and make money for the city by turning all the trees into lumber. She hasn't made a decision about whether she will allow it to happen or not, so she wants to hear the opinions of people of all ages who live in Atlanta. Could you each write a short note to Mayor Bottoms about whether you think she should cut down the forest, and why you think she should or shouldn't? There are no right or wrong answers. She just wants to hear from you!"

3.4.1.4 Scoring and Analysis

A coder evaluated each of the postcard on a series of 6 quantitative categories of criteria. The coder was blind to the condition to which each postcard belonged. The six included categories were 1) Presence of Writing, 2) Presence of Drawing, 3) Drawing Effort, 4) Writing Effort, 5) Drawing Content, and 6) Writing Content (see Table 11 for questions included in each of these categories).

If the coder was uncertain of the answer for any of the criteria, the postcard and criterion was flagged for follow-up and reevaluation.

For each individual, the composite score for the Writing Effort was the sum of an individual's answers to questions 5 and question 6. The composite score for Drawing Effort was a sum of an individual's answers to questions 4 and question 9. Composite scores for the Drawing Content and Writing Content categories were a sum of the binary scores for each of the included questions (Table 11). A research assistant blind to the study conditions coded all postcards according to these six categories. A second research assistant conducted reliability coding for 20% of the postcards (see Table 10 for reliability results).

Welch's T-tests (two-tailed) were used to test whether the means for the control condition and the experimental condition were different for the scores for each 6 categories. All analyses were conducted in R Version 3.5.1.

Table 10: Reliability between 2 blind coders on the six dependent measures for the follow-up study. Cohen's Kappa was used to assess reliability between two coders for measures with binary outcomes (Presence of Writing, Presence of Drawing, Drawing Content and Writing Content). Pearson's correlations were calculated for categories with continuous outcomes (Drawing Effort and Writing Effort).

	Presence of Writing	Presence of Drawing	Drawing Effort	Writing Effort	Drawing Content	Writing Content
Cohen's Kappa	1	1	.	.	.85	.72
Pearson's R	.	.	0.99	0. 99		

3.4.2 Study 3: Results

Two of the six categories had significantly different means between the control condition and the experimental condition. Those in the experimental condition were more likely to draw on their postcards than those in the control condition (question 2, p=.04). Those in the experimental condition also exhibited more drawing effort than compared to those in the control condition (Drawing Effort Category, p=.019) (Table 11).

Table 11: Six categories for assessing the postcards from participants in the experimental and control conditions. Results from Welch's t-tests.

Category	Question	Control Condition Values	Experimental Condition Values	Welch's T-test (p-value)
Presence of Writing	1) Did the participant write anything? (Y/N)	1	1	NS
Presence of Drawing	2) Did the participant draw anything? (Y/N)	0.23	0.46	**0.04***

Writing Effort	5) How many sentences were written? (number)	1.15 ± .46	1.2 ± .47	NS
	6) How many words were written on the postcard? (number)	12.19 ± 9.37	11.26 ± 4.85	
Drawing Effort	4) How many colors did the participant use? (number)	2.2 ± 2.17	1.75 ± 1.44	**0.019***
	9) How many items are in the drawing? (number)	1.5 ± .84	3.4 ± 3.03	
Drawing Content	10) Did they draw trees? (Y/N)	0.15	0.23	NS
	11) Did they draw wild animals? Y/N	0	0.03	
	12) Did they draw domestic animals (Y/N)	0	0.03	
	13) Are there people in their drawings? (Y/N)	0.04	0.09	
	14) Did they draw themselves in the drawing? (Y/N)	0.04	0	

Writing Content	19) Do they mention the future in their message? (Y/N)	0.12	0.11	NS
	20) Do they mention the community in their message? (Y/N)	0.04	0.03	
	21) Do they mention animals in their message? (Y/N)	0.23	0.26	
	22) Do they mention benefits of the forest? (e.g.)water, lumber, medicine, food, supplies) (Y/N)	0.46	0.37	

3.4.2 Study 3: Discussion

The results of Study 3 align with our predictions under the AMH. In two of six coding categories, participants in the experimental condition demonstrated more prosocial behavior towards the common goods compared to those in the control condition. It could be argued that significant differences between conditions across all six coding categories would provide more robust support for the hypothesis. However, considering the average age of participants is between seven and eight years of age, most participants are more experienced expressing knowledge, attitudes, and behaviors

through drawing as opposed to writing. Participants show significance in two out of three coding categories. Further studies will aim to replicate the findings of this applied study in other populations and in other types of activities in educational settings.

3.5 General Discussion

All three of our studies support predictions under the AMH. Study 1 provided evidence that a delay in acquiring resources effectively motivates American participants ages six to fifteen to contribute more to a common good compared to participants who are not provided with an extrinsic motivation. Study 2 provided evidence that decreases in reward payoff and time delay in payoffs together motivate participants to contribute to common goods. Study 3 found that the experience of participating in an involved common goods dilemma where participations are made aware of the various opportunity costs of not maintaining a common good can lead to prosocial behavior towards common goods in other contexts.

In Study 1, participants donated fewer tokens in the Delay Condition in round 3 compared to the previous three rounds. Despite this, participants on average are still giving enough tokens in the third round to collectively meet the goal. The common explanation is that participants learn they can free ride--they give a smaller percentage of their endowment in subsequent rounds with the learned expectation that others in the group will continue to donate. In Study 1 we can assume that by the third round, having seen that the group collectively exceeds the Forest Bank goal in the previous rounds,

participants can donate fewer tokens and still meet the goal. Another possible explanation is that participants donate fewer tokens because they know there are no consequences for their actions in this round because this is the last round of the game. However, participants are not told that this round is the last round, so all participants are still behaving with the expectation that there could be negative consequences for a future round if they do not meet the conservation goal.

We do not see the same pattern of decreased contributions in round 3 in Study 2. Perhaps the combined risks of time delay and resource loss together inhibit the typical drop-off of contributions seen in public and common goods when no strong extrinsic motivations are provided. The difference in drop-off in Round 3 between the two studies may suggest that strong extrinsic punishments/rewards are needed to prevent the motivation to freeride in common goods games within this population.

In both study 1 and 2, we see an interaction between age and condition. As children get older, they donate more to the control condition (No-Delay in study 1 and Neutral in study 2). Essentially, we see less of a difference between the two conditions in older children compared to younger children. Older children in the control conditions still are not giving enough to meet the conservation goal, so these results do not suggest that older children need fewer extrinsic motivations. If anything, these results may simply suggest that a baseline intrinsic motivation to contribute to common goods increases with age in this population of children. Children may be internalizing cultural

norms related to charity or contributions to common goods. As previously discussed in Chapter 2, American school systems and social systems may encourage these specific types of behaviors more so than in other cultures. As predicted by the AMH, the ecological certainty of the American environment may facilitate the more flexibility for participants to cultivate intrinsic motivations to act prosocially toward abstract recipients like a forest.

Only one group failed to meet the goal in the cost/benefit condition in Study 3. We had originally hypothesized that the experience of failing to meet the goal in the first round and therein experiencing the delay and resource loss would compel participants to meet the goal in the following rounds. We predicted more groups would fail to meet the goal in the first round but would subsequently make the goal in the next two rounds. Unexpectedly, simply the threat of the punishment was enough to compel contributions to the Forest Bank that even exceeded the goal. It is unclear if this would be the same in other populations or in populations that might be less familiar with forests and wildlife like those outside this population of zoo-camp attendees.

Study 3 was conducted to assess whether participation in a conservation simulation where participants were allowed to experience the costs and benefits of conserving a forest led to behavior change outside of the context of the activity We attempted to make the forest bank game as realistic as possible by giving children the opportunity to talk about past experiences with forests and nature, and allowing them to

actually experience personal gains and losses based on their ability to reach a conservation goal. The results of study 3, wherein participants who had participated in this activity demonstrated noticeably different behavior compared to participants who had not participated in any similar activity suggests that behavioral economic games can in fact be designed to mirror real world behaviors and interactions. Not only that, versions of this simulation can potentially be employed by conservation-minded educators as teaching tools that lead to measurable behavior change in participants.

Study 3 assessed postcards created by children. The analysis examined the participants' writing, drawing and effort between the two conditions. Only differences in drawing content and effort were found. Drawing is perhaps the best assessment of behavior for children of this age. Given the mean age is approximately eight years old, language and writing skills are nascent, making it difficult to detect meaningful differences between groups. Expressing emotions and thoughts through drawing and images is more common for this age and is therefore an effective assessment of behavior for this particular population. The ability to evaluate behavior based on drawings and images allows for more effective evaluation of children of all ages, low-literate populations, and cross-language comparisons.

One limitation of these studies was that it examined only one American population attending a summer camp at a zoo. Such a population would be assumed to have a higher amount of intrinsic motivation to contribute to the well-being of abstract

recipients like the Natural World. Children attending this camp likely come from families wealthy enough to send their children to an expensive summer camp in a U.S. city. In alignment with the AMH, this population is therefore more likely to have intrinsic motivation for prosocial behavior towards abstract recipients because of a variety of cultural norms that encourage prosocial and charitable behaviors towards abstract recipients. Despite this assumption, we see that participants in this demographic almost never reach the goal in the condition where no extrinsic motivation is provided. These participants are heavily influenced by extrinsic motivations, both in the short term as shown in Studies 1 and 2, and potentially longer term in other contexts as demonstrated in Studies 3. These results suggest that we may potentially see more dramatic differences in results between a control condition and an experimental condition in populations that have no previous experience with common goods in the Natural World.

Future studies can examine children from different socioeconomic backgrounds. The AMH predicts that children who have not attended the camps at the zoo (or any similar immersive experience in the natural world) and who experience less resource certainty (i.e. being from lower socioeconomic strata) will demonstrate even less intrinsic motivation to contribute to the common good in control conditions. The hypothesis predicts a significant boost in prosocial behavior towards abstract recipients

once extrinsic motivations are provided for these populations, but potentially to a smaller degree as observed in resource uncertain populations in Bowie et al, (Chapter 2).

Due to cultural influences on time perception, time delays as extrinsic punishment might not be an effective motivator for all populations. Cross-cultural research shows that various populations around the world respond differently to time (Wang et al., 2016). Populations in more resource uncertain environments tend to have higher temporal discounting than populations in more stable environment (Wang et al, 2016). As a result, time as a punishment may be even more effective in populations with higher resource certainty. Future research can replicate the current approach cross culturally and also explore the effects of other extrinsic motivators (e.g. reputation consideration, etc.).

The current findings have implications for conservation education initiatives. The field of conservation education grapples with effective ways to assess whether programs effectively encourage pro-conservation behavior change in participants. These same programs vary tremendously in the type of information provided to participants. In these series of studies, children participate in a simulated conservation dilemma where their personal resources can be affected by the behavior of the group. We demonstrate in Study 3 that participation in this simulation so effectively conveys conservation dilemmas that children show pro-conservation behaviors in a separate context up to two weeks after participation. Future research can explore how to translate

this game into lesson plans that can effectively be disseminated in a variety of classroom settings. Future studies can further assess the extent to which participation in these games have short and long-term influence on pro-conservation attitudes and behaviors.

4. Implicit measures help demonstrate the value of conservation education in the Democratic Republic of the Congo

4.1 Introduction

Overwhelming scientific evidence points to the severe threats against our planet's ability to sustain high levels of biodiversity. Human population growth, climate change, industrialization and many other forces are all working in concert to drive an exponential increase in species extinction (Ceballos et al., 2015). One of the main tools utilized to combat extinction is environmental education. Many international non-profit organizations have invested tremendous time and effort into providing educational resources to encourage conservation efforts among their target populations. The *conservation education hypothesis* (CEH) suggests that people are more likely to defend conservation if they have been exposed to knowledge about endangered species and ecosystems (UNEP, 2004). This hypothesis would predict that a change in knowledge about a given species also leads to changes in attitudes towards said species. Conservation knowledge is here defined as familiarity with facts about the ecology, biology, conservation threats, and conservation status of a given species or ecosystem. Pro-conservation attitudes are ways of thinking or feeling that support the welfare and survival of a given species or ecosystem. The null hypothesis in this case suggests that most environmental education programs do little to change attitudes at a scale that can have a significant impact. In this case, priority investments should be made in policies

and actions that directly protect habitat or threatened environments over education programs. Testing the predictions of CEH is increasingly important as communities, governments and non-profits try to determine how best to allocate finite resources.

A key test of the CEH involves evaluating existing education programs. Many conservation education programs survey individuals before and after the educational experience. The prediction in these pre-experience/post-experience surveys is that the participants will show higher levels of knowledge and more positive attitudes towards conservation afterwards. The advantage of this assessment approach is that it is easy to implement in a variety of settings and is relatively inexpensive. Survey evaluations have been able to identify programs that effectively communicate their message, optimize existing programs, and detect programs that are not effective (Kruse et al., 2004). Various nonprofit organizations are increasing their use of such survey assessments to demonstrate the impact of their education programs. However, even with more assessments, there is skepticism regarding the value of small-scale education programs – particularly those implemented across cultures (Brewer, 2001; Carleton-Hug & Hug, 2010). There is concern that effective education programs cannot realistically reach the increasing population sizes in areas surrounding vulnerable wildlife populations (Struhsaker et al., 2005). Reviews of these programs have suggested that given the costs of these conservation education programs, a net positive impact of conservation

education may not exist at a more macro-level (Norris & Jacobson, 1998; Jacobson & McDuff, 1997).

The uncertainty of the impact of education programs underscores the importance of assessment and refinement. It also raises the question of which techniques are best for evaluating conservation education. Traditionally education program surveys *explicitly* ask questions about attitude towards conservation. However, decades of research on human cognition suggest that explicit questions of attitude are likely to be influenced by experimenter demand effects and answers may not be related to the actual internal preferences of the individual assessment-taker (Cunningham et al., 2004; Nosak, 2005; Kintz et al., 1965; Marino 2010). If on a tour led by a conservationist at a conservation site, participants may be inclined to answer "yes" if asked "do you think more effort should be invested in this species' conservation" even if it's not how the participant truly feels. The results of explicit questions of attitude may therefore overestimate the pro-conservation attitudes of participants in conservation education programs.

Another methodological impediment for conventional pre/post experience evaluations is that they often rely on written surveys that can only be used with literate populations. This precludes surveying large portions of the adult and child populations in many biodiversity hotspots around the world like Central Africa, Southeast Asia and the Amazon where adults have relatively low literacy rates and where childhood

education is not universal. It is with these populations, however, that NGOs are increasing their focus on sustainable development and conservation education (Jha and Bawa, 2006). Effective biodiversity conservation also often relies on changes in knowledge, attitudes and behaviors of multiple populations across several linguistic, ethnic and national lines. Language translation often makes comparing the effectiveness of conservation programs across different cultures difficult. Developing evaluation techniques that do not rely heavily on reading or writing would permit evaluations that can be more universally implemented across cultures, therein helping organizations to develop programs that have the greatest impact on larger scales.

To test the CEH, we designed a pair of surveys for use at the Lola ya Bonobo sanctuary. Located in Kinshasa, the capital of the Democratic Republic of Congo, Lola ya Bonobo is the world's only sanctuary for orphaned bonobos (*Pan paniscus*). Both bonobos and chimpanzees (*Pan troglodytes*) are humans' closest living genetic relatives. The sanctuary provides high quality life-time care to over seventy bonobos, most of whom have been rescued from the illegal pet trade, their family groups hunted for bushmeat. Once arriving at the sanctuary, young infant orphans are provided with specialized care to help them overcome the acute trauma of their capture. They are quickly integrated into peer groups where they enjoy rich social lives in large forested enclosures similar to what they would experience in the wild. Six days a week, the sanctuary's education team provides guided tours around the sanctuary for national and

international visitors. Tens of thousands of children, adults and civil servants are exposed to the natural behavior of the highly charismatic bonobos while learning about their natural history and the threats to their survival in the wild. This includes information about the importance of the Congo Basin for the health and wellbeing of the people who live there as well.

In 2009, Lola ya Bonobo conducted a survey with 400 Congolese children to assess the education program's success in transmitting conservation knowledge (Andre et al, 2009). All children took a knowledge assessment before and after participating in the education program. Half of the participants had never visited the sanctuary before, and half had done so one year earlier. In the pre-test, first-time visitors scored at or below chance on all questions whereas return children scored above chance on the majority of questions. In the post-test, children of both groups scored at ceiling on all questions. This study shows that the sanctuary's education program not only successfully teaches children key facts about conservation but also that the majority of what they learn is retained for at least a year.

This previous study also briefly assessed children's explicit attitude towards bonobos. Participants were also asked if they found bonobos amusing, scary, dangerous, or beautiful. Less than 10% of participants described bonobos as amusing before their first tour whereas nearly 90% did so after observing bonobos at the sanctuary. While this

explicit attitude assessment was limited to a single question it appears a similar pattern may also apply to the positive feeling children attribute to bonobos after their visit.

Building on this work, in the current study we test the CEH with two additional assessments of the education program at Lola ya Bonobo (Table 12). In Experiment 1, we use novel implicit methods to measure changes in children's conservation attitudes in response to the education program. These picture-based methods minimize experimenter-demand effects and do not require that participants can read or write. In Experiment 2, we investigate the education program's ability to improve conservation knowledge of adult visitors, as adults are the primary decision-makers involved in conservation policy. For all of these studies, we predicted that in accordance with the CEH, participants in our experiments will show higher levels of knowledge and more positive attitudes toward bonobo conservation after participating in an educational visit to the sanctuary.

Table 12: Rationale for the series of surveys in Study 1-3 examining conservation attitudes and knowledge in children and adults. Previous research found that the education program at Lola Ya Bonobo had a significant impact on children's knowledge relevant to bonobo conservation (André et al 2008). The current research extends this work by assessing how the same program impacts children's attitudes towards bonobos, as well as how the program impacts knowledge and attitudes of adults.

	Child	**Adult**
Knowledge	*André et al, 2008* Does the tour of the sanctuary increase children's knowledge and understanding of bonobos and their conservation status?	*Study 2: Knowledge Assessment* Does the tour of the sanctuary increase adults' knowledge and understanding of bonobos and their conservation status?
Attitude	*Study 1: Attitude Assessment* Does the tour of the sanctuary impact children's attitudes towards bonobos and their conservation?	*Study 3: Empathy Assessment* Does the tour of the sanctuary affect adults' empathic attitude towards bonobos?

Table 13: Descriptive information for participants for all studies

	Sample Size	Mean ± Std. Err	Std Dev	Mean Age ± Std Err	M/F Ratio
Study 1: Attitude Assessment					
Pre-Test	101	.68 ±.02	.15	12.05 ± .23	1.12
Post-Test	102	.73 ± .02	.15	12.73 ± .28	.92
Study 2: Knowledge Assmt.					
Pre-Test	81	.59 ± .02	.17	23.5 ± 1.24	1
Post Test	100	.59 ± .02	.16	20.58 ± 1.03	1.57
Study 3: Empathy Assessment					
Pre-Test	34	.48 ± .03	.19	30.57 ± 1.82	.81
Post Test	29	.40 ± .03	.18	34.71 ± 1.67	.36

4.2 Study 1: Attitude Assessment

In this experiment we extend the 2008 André et al. assessment of Lola ya Bonobo's conservation education program by again surveying children before and after they visit the sanctuary. However, to do so, we introduce novel implicit measures to

assess participants' conservation attitudes. The assessment was designed to appear to participants as if we were requesting their input for new designs for publicity for the sanctuary. Because participants are not made explicitly aware that they are being asked about their attitudes towards bonobos and their habitat, these measures are able to overcome experimenter demand effects and, therefore, should more honestly reflect participants' conscious or unconscious beliefs about conservation issues. Consistent with the conservation education hypothesis, we predict that educational visits to the sanctuary will improve conservation attitudes.

4.2.1 Methods

Participants were grade school students of Congolese origin attending one of four schools in Kinshasa (*N*=203, mean age = 12.39, range = 7-19 years, M/F=97/96). Two of the schools (Kimbala and Mamfufu) were in relatively rural regions outside the city and the other two schools (Nova Eligio and Ngolu) were in urban areas in the city center. None of the participants had previously visited the sanctuary. Experimental instructions were explained to the students by a familiar teacher in Lingala, the local language in Kinshasa.

The Attitude Assessment contained twelve questions that implicitly examined whether participants held pro-conservation or anti-conservation attitudes (Appendix C). Photos, instead of text, were used to control for literacy levels among participants. Each participant was given an assessment sheet that contained 12 blocks of photos, each block

containing two photo options. Each of the twelve questions had two photo options that the participants could circle: relative to the question, one option corresponded to a positive attitude towards bonobo conservation (pro-conservation option) and the other option corresponded to either a neutral or negative attitude towards bonobo conservation (non-conservation option). The questions addressed participants' attitudes towards the following categories: 1) bonobos as pets, 2) the value of Congolese forest, 3) perceptions of bonobo social behavior, and 4) tendency to objectify or humanize bonobos. This study used a between subject's design. Students in the *pre-tour* condition (*N*=101) completed the Attitude Assessment at their schools before an in-school information session conducted by the sanctuary's education staff. In the *post-tour* (*N*=102) condition, a separate group of students took the Attitude Assessment at Lola ya Bonobo immediately following the guided tour. The order of the photo blocks was determined randomly, and there were two versions of the assessment that counterbalanced the order of the photos within each of the photo blocks.

At the beginning of each week, the education team went to schools to conduct the in-school information session. Before the lesson began, a member of the education team who acted as the experimenter split the classroom into the pre and post-tour groups. The groups were determined by splitting the group in half alphabetically by first name, with the first half being in the pre-tour condition, and the second half in the post-tour condition. Those in the post-tour group were asked to temporarily leave the

room while the students took the assessment. Each of the students in the pre-tour group was then given a copy of the survey and a pen. The experimenter stood at the front of the room and first explained the instructions, emphasized that the survey should be taken individually and silently, and emphasized that there were no right or wrong answers. The survey was framed not as an evaluation of conservation attitudes, but as a request for information needed to design advertisements to help Lola ya Bonobo attract more visitors like themselves. Each question corresponded to one of the blocks of photos. While asking the question, the experimenter held enlarged versions of the two photo options to ensure all participants were on the right set of photo options. After asking the question, the experimenter instructed the participants to circle the photo that they thought best answered the posed question. At the end of the 12 questions, the experimenter instructed students to fill out the demographic questions and provided assistance for those who needed it.

The photo options were predetermined as either the "pro-conservation" or "non-conservation." Participants' responses for each question were scored as "pro-conservation" or "non-conservation" based on which option they marked, circled, dashed, fully underlined or partially underlined. The vast majority of responses unambiguously marked a single answer that could reliably be scored. In the few cases where responses were ambiguous (multiple responses circled), the question was scored as unanswered.

All analyses were conducted in R version 1.0.136. Two analyses were conducted for this study: the first compared the means of the pre-tour and post tour conditions' total number of correct answers. For this overall analysis, we used a generalized linear model (GLM) to analyze whether there was a difference between the mean number of correct responses in the pre-tour and post tour conditions. Age, gender, and school were included as covariates in this model. For the categorical variables, gender and school, a reference group was pre-determined against which the other groups within the category would be compared. Female was set as the reference group for gender, and Kimbala school was set as the reference group for school.

The second GLM examined the difference between the mean number of correct answers for the pre-tour and post-tour conditions for each individual question. Age, gender, and school were included as predictor variables in the same way they were for the previous analysis. To determine if there was a difference between the means of the pre-tour and post-tour conditions for individual questions, this GLM analysis compared the means for each question to the means of a neutral reference question. Question 4 was chosen as the reference question for this study because there was no statistical difference between the mean answers for the two conditions for question 4.

4.2.2 Results

Overall participants were above chance in their responses in both the pre and post tour responses and comparison of the pre and post-tour condition demonstrates

that participants chose more pro-conservation options in the post-tour than pre-tour condition (estimate=.27, p=.006) (Figure 15B). Participants attending the reference group school (Kimbala) answered with significantly more pro conservation responses than participants from the Ngolu school (estimate=-.432, p=.001).

Table 14 presents pre-tour and post-tour responses for each question. Participants responded above chance levels with pro-conservation responses in nine out of twelve questions in the pre-tour condition and ten out of twelve in the post-tour condition. Subjects scored particularly high (79-99% correct) in at least one condition for five questions (3, 6, 8,10 and 12) and low (<30% correct) in the pre-tour condition for question 9 (e.g. which group do you think bonobos belong to? Monkeys or humans?).

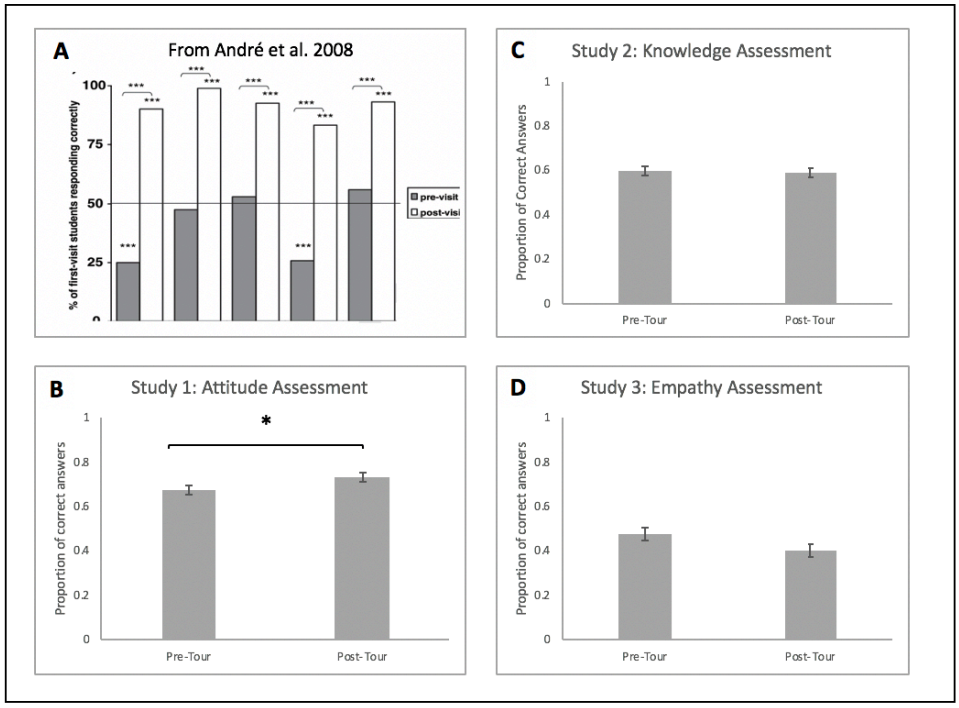


Figure 15: A) results from André et al. 2008's knowledge assessment with percentage of correct responses to the following T/F questions: 1) Bonobos do not make good pets; 2) Bonobos are not an endangered species; 3) Hunting and snares are dangerous for bonobos 4) Planting trees is something you can do to help bonobos; and 5) The bushmeat trade threatens bonobos with extinction. All participants were children visiting the sanctuary for the first time, and participants did significantly better on all five questions after the tour compared to before the tour. Figure B) displays the mean proportion of correct answers in the pre-tour and post-tour Attitude Assessment. Overall, the mean proportion of correct answers were significantly higher in the post-tour condition than in the pre-tour condition (estimate=.27, p=.006). Figure C) displays the proportion of correct answers for the pre-tour and post-tour Knowledge assessment. There was no difference between means on the two assessments, and the mean overall proportion of correct answers for both conditions were above chance. Figure D displays results for the Empathy assessment. There was no difference between overall scores and means for both assessments were below chance. Figures 1B, 1C, and 1D all display standard error.

Examining descriptive statistics in Table 14, mean pro-conservation responses increased post-tour in five questions (range: 7-24%), did not change for six and decreased in one (27%). These differences were significant for question 1, 8, 9 and 10 in which post tour correct responses were higher (Question 1: Which of these photos would you prefer to see on an advertisement for Lola ya Bonobo? Pet or Wild?; Question 8: Which photo better shows the value of the forest? Lumber or the standing uncut forest?: estimate=2.296, p=.001; Question 9: Which group do you think bonobos belong to? Monkeys or humans?: estimate=1.211, p=.017; Question 10: which photo do you think is best for an advertisement about LyB? A photo of Africa or a photo of the DRC?: estimate=2.498, p=.029) and for question 2 where correct responses significantly decreased post-tour (Which group do you think bonobos belong to? Wild Animals or Domesticated Animals: estimate=-1.309, p=.007).

Comparing questions individually across schools again shows that participants in Kimbala School, the reference school, chose more pro-conservation responses than participants from the Mamfufu School (estimate=-1.601, p=.003) and the Ngolu School (estimate=-1.932, p=.000).

Table 14: Attitude Assessment by individual question. Means for the pre-test and post-tests represent the number of individuals who correctly answered the question divided by the total number of individuals who answered the question. Asterisk (*) indicates if the proportion of individuals answering each question correctly is above chance at p<0.05.

Question	Pre-Test Mean	Post Test Mean	GLM Result
1. Which of these photos would you prefer to see on an advertisement for Lola Ya Bonobo? (Pet or Wild?)	.445	.604	NS
2. Which group do you think bonobos belong to? (Wild Animals or Domesticated Animals)	*.723	.449	Estimate=-1.356, p=.007
3. Which group do you think bonobos belong to? (Apes or Monkeys?)	*.792	*.832	NS
4.Which pictures reminds you more of bonobos? (Yogis or soldiers?)	.667	.68	NS
5. Which of these photos would you prefer to see on an advertisement for Lola Ya Bonobo? (Pet or Wild?)	.64	*.772	NS

6.Where would you prefer to find bonobos? (In a market or in a forest?)	*.98	*.98	NS
7. Which group do bonobos belong to? (Humans or pests?)	*.717	*.727	NS
8. Which photo better shows the value of the forest? (Lumber or the standing uncut forest?)	*.71	*.95	Estimate=2.296, p=.001
9. Which group do you think bonobos belong to? (Monkeys or humans?)	.198	.4	Estimate=1.211, p=.017
10. Which photo do you think is best for an advertisement about LyB? (A photo of Africa or a photo of the DRC?)	*.901	*.99	Estimate=2.496, p=.029
11. Which group do you think bonobos belong to? (Humans or objects?)	.465	.534	NS
12. Which of these photos would you prefer to see on an advertisement for Lola Ya Bonobo? (Pet or Wild?)	*.921	*.931	NS

4.2.3 Discussion

In support of the conservation education hypothesis, our attitude assessment using implicit measures suggests that interactions with bonobos on guided tours at the sanctuary increase pro-conservation attitudes among grade school age children. Overall participants in the post-tour condition selected more of the pro-conservation responses than those in the pre-tour condition with increased pro-conservation responses in five questions and a decrease in only one.

Four questions asked participants to choose images to use in an advertisement for Lola Ya Bonobo. All showed increases in pro-conservation responses with two being significant increases post-tour. Participants were significantly more likely in the post tour condition to prefer bonobos being depicted in the wild than in human contact as a pet (Question 10) and were more likely to choose to represent the value of a forest in its natural state rather than as lumber (Question 8).

A subset of questions examined whether participants were likely to humanize or objectify bonobos. In these questions, participants had the option of grouping bonobos with 1) humans or monkeys 2) humans or vermin, 2) humans or inanimate objects. The results for these questions are mixed since children were more likely to group bonobos with humans as opposed to with objects or pests, but they were less likely to group bonobos with humans as opposed to with monkeys. This suggests that the tour's

discussion of the genetic, physical, emotional and behavioral similarities shift attitudes in a positive direction, but within limits.

The use of implicit measures designed to reduce experimenter demand effects was a novel feature of the assessment. Results provide validation for this form of assessment since it largely replicates previous findings using explicit knowledge assessment (André et al., 2008). The use of pictures as choice options also increases the feasibility of assessing attitudes in populations where there are tremendous disparities in literacy levels.

Overall Lola ya Bonobo's educational tours have a positive impact on conservation knowledge (André et al., 2008) and attitudes in children, but what is needed next is to understand if similar effects occur in adult visitors.

4.3 Study 2: Knowledge Assessment

The majority of the efforts at Lola Ya Bonobo focus on the education of children and young adults, as they are seen as the most potentially receptive populations for conservation messaging. However, older individuals also visit the sanctuary. Adults may be less open to new ideas that might change their attitude toward conservation of endangered species. However, they are responsible for policy changes that influence the future of biodiversity in the DRC. Thus, in experiment 2, we examined whether adults also learn the core conservation messages that the sanctuary hopes to communicate. Experiment 2 was therefore designed to test how the education program affects

knowledge among visitors who are more representative of the general population of Kinshasa in age, economic and educational background.

4.3.1 Methods

Participants in the Knowledge Assessment were day visitors to Lola Ya Bonobo Sanctuary (*N*=181, mean age 21.88, age range 8-59; M/F ratio: 93/73). The majority of participants were of Congolese origin (146/181), with the remaining participants of Western European or American origin. Most participants reported being first time visitors to the sanctuary (117/181).

The Knowledge Assessment examined whether visitors to the sanctuary absorbed the main information points emphasized by the sanctuary education program. These points were identified based on observation of the education program in action, and through consultation with the education team. The knowledge assessment was designed to measure what visitors knew about bonobos and facts relating to their conservation. It included twelve true/false and multiple-choice questions, addressing bonobos' 1) habitat, 2) social organization, 3) similarities to other great apes including humans, and 4) the rehabilitation process for bonobos at the sanctuary. In addition to conservation knowledge questions, we collected demographic information about participants' age, gender, country of origin, country of residence, and whether or not they had previously visited the sanctuary (Appendix C).

In a between-subjects design, participants completed the questionnaire at the sanctuary either immediately before (pre-tour condition, *N*=81) or after a guided tour (post-tour condition, *N*=100). The sanctuary offers four scheduled guided tours each day, six days a week. While visitors were waiting for the tour to begin at the Education Center, the guide introduced the optional survey, told visitors that they would receive candy for completing the survey. Each arriving party would randomly be assigned to either the pre-tour condition or the post-tour condition. At the beginning of the tour, the guide handed the surveys, clipboards and pens to participants in the pre-tour group and instructed them to complete the survey individually and silently. He would instruct those in the pre-tour condition to not share anything about the survey with those who in the post-tour condition. The pre-tour condition participants had 10-15 minutes to complete the survey and then the hour-long tour began. Right before the end of the tour, when all participants were back in the Education Center, those in the post-tour condition were given the survey with the same instructions.

Scoring was the same as in Study 1. Like study 1, two analyses were conducted; a GLM that compared the overall number of correct answers between the pre-tour and post-tour conditions which included age group, gender, and number of visits to the sanctuary as covariates. Another GLM was also used to compare the pre-tour and post-tour responses for each individual question, with age group and gender as covariates. Question 3 was used as the reference group for this analysis because there was no

difference in mean responses between the two conditions for question 3. All analyses were conducted in R version 1.0.136.

4.3.2 Results

Overall participants were above chance in their responses in both the pre and post tour responses, but there no difference between participants in the pre-tour and post-tour conditions (Figure 15C). Table 15 presents pre-tour and post-tour responses for each question. Participants responded above chance levels with pro-conservation responses in ten out of twelve questions in the pre-tour condition and ten out of twelve in the post-tour condition. Subjects scored particularly high (79-99% correct) in both conditions for five questions (1, 3, 5, 8, and 11) and low (<30% correct) in at least one condition for three questions where chance was 25% (6, 9, 12).

Examining descriptive statistics in Table 15, mean pro-conservation responses increased post-tour in five questions (range: 6-18%), did not change for six, and decreased in six (1-24%). These differences were significant for question 1 and 4 in which subjects increased their pro-conservation responses in the post tour condition. (Question 1: In which country do bonobos live?: estimate=1.344, p=.018; Question 4: which of the following is not illegal in the DRC?: estimate=2.453, p=.005). Although not significant the post-tour group showed a 24% drop in correct responses after the tour in question six (Question 6: Which of the following describes the social organization of bonobos?)

We found no differences between the responses of first-time visitors and returning visitors within or between the two tour groups. Examining age as a variable we did find that those in the post-tour condition in age group 2 (ages 16-18) made more pro-conservation responses than other participants across conditions (estimate=1.414, p=.011).

Table 15: Knowledge Assessment by Individual Question. Means for the pre-test and post-tests represent the number of individuals who correctly answered the question divided by the total number of individuals who answered the question. Asterisk (*) indicates if the proportion of individuals answering each question correctly is above chance.

Question	Chance Level	Pre-Test Mean	Post Test Mean	GLM Result
1. In which countries do bonobos live?	.25	*.838	*.99	estimate=1.344, p=.018
2. Which of the following is NOT a threat to bonobos?	.25	*.597	.*659	NS
3. T/F: Bonobos don't suffer when they are killed.	.5	*.851	*.849	NS
4. Which of the following is NOT illegal in the DRC?	.25	*.474	*.607	(estimate=2.453, p=.005).
5. True or False: Unlike humans, bonobos don't need the care of their mothers to survive.	.5	*.885	*.826	NS

6. Which of the following describes the social organization of bonobos?	.25	*.48	.239	NS
7. Which of the following is NOT true about eating bonobos?	.25	*.532	*.5	NS
8. T/F: Bonobos feel many of the same emotions as humans.	.5	*.81	*.989	NS
9. Of the species listed below, which is the LEAST like bonobos?	.25	.197	.277	NS
10. What should you do if you see a bonobo being sold in the market?	.25	*.734	*.73	NS
11. T/F: Baby bonobos are traumatized when poachers take them from their families.	.5	*.938	*.928	NS
12. Why should we save bonobos?	.25	.342	.269	NS

4.3.3 Discussion

Comparison of the composite scores between the pre-tour assessment and post-tour assessments do not support the Conservation Education Hypothesis because the mean scores are not different from each other. However, the high mean scores in both pre-tour and post-tour assessments and analysis of responses for individual questions may provide support for the hypothesis.

Adult visitors, particularly young adults, came to the sanctuary with a high baseline level of knowledge about bonobos as reflected in their pre-tour assessment scores. There was no increase or decrease in mean scores in the post-tour condition. The high baseline scores perhaps stem from widescale efforts of programs like Lola Ya Bonobo to disseminate information about bonobos in schools and communities over the past twenty years.

Questions on this knowledge assessment fell into one of two categories: natural history of bonobos and conservation of bonobos. Participants scored well above chance in both conditions for all except three questions (6, 9, 12). Question 6 (What is the social organization of bonobos?) and Question 9 (Which of the following is least related to a bonobo?) were natural history questions. Both of these questions may have been too detailed for visitors to have known before visiting the sanctuary. Incongruity between the tour guides conveying the answers to these questions and visitors' observations of the bonobos may have led to confusion of the right answer. Question 12 (Why should

we save bonobos) was a conservation related question and may have been perceived as subjective to visitors.

Question 1 (Where are bonobos found?), a natural history question, and Question 4 (Which of the following are not a threat to bonobos), a conservation question had significantly more correct answers in the post-tour compared to the pre-tour condition. Despite having high baseline scores, the results from these two questions support the Conservation Education Hypothesis.

Given the high level of knowledge about bonobos among this population, we next explored whether high levels of conservation attitudes existed among a similar subset of adults.

4.4 Study 3: Empathy Assessment

Having established that the guided tour has little direct effect on the general population's knowledge about bonobos and their conservation, we next examined if the tour impacted visitors' empathy towards the species. We again wanted to assess the effect of the tour on empathy in the general population of Kinshasa who are representative of the current policy decision makers in the DRC. It is commonly thought that to increase support and interest in species' conservation, we must increase empathy for the species in question (Hazel et al., 2007; Shultz, 2000); however, whether or not conservation programs actually engender empathy in its visitors has not been thoroughly examined (Sivillano et al., 2007; Berenguer, 2007; Tam, 2013). This final study

examined whether the guided tour at Lola Ya Bonobo increased visitors' empathy towards bonobos. We used a novel paradigm using implicit measures to assess empathy in the general population that visited the sanctuary. Our implicit measure for this study was the use of *mentalistic language*, as opposed to *descriptive language*, as a measure of empathy. Mentalistic language describes the internal thought processes of an individual, whereas descriptive language describes the apparent actions of the individual. Evidence from developmental and social psychology suggest that attributing mentalistic language to others (e.g. she *feels* happy as opposed to she *looks* happy) is an indication of an individual's ability to understands the internal thoughts of others, and consequently is a trait commonly thought to underlie the ability to empathize with others (Symons, 2004; Ruffman et al., 2002). The use of mentalistic language as a measure of empathy has been examined among groups of humans, both adult and children (Ruffman et al., 2002). This study is the first to examine attribution of mentalistic language between humans and an endangered species.

4.4.1 Methods

Like the Knowledge Assessment, participants for the Empathy Assessment were adult day visitors to Lola Ya Bonobo (*N*=63, mean age 31.95, M/F: 27/17). The majority of the participants were of Congolese origin (39/64), with the remaining participants of European, American and Asian origin. Most participants (28/39) reported that they were first time visitors to the sanctuary.

The procedure for this study was identical to the procedure for the Knowledge Assessment.

This assessment examined whether the experience of seeing and interacting with the bonobos at the sanctuary increased visitors' empathy for the bonobos. We examined the use of *mentalistic language* as a measure of empathy. The survey consisted of six photos of bonobos doing various actions like eating, playing, pointing, or sitting. Underneath each photo were two options that described what was happening in the photos—one option used mentalistic language and the other option used descriptive language. The survey instructed participants to choose which of the two options best described what was happening in the photo. In addition to the 6 questions, we also collected information about participants' age, gender, country of origin, country of residence, and whether or not they have previously visited the sanctuary (Appendix C). There were two versions of the survey that differed in the order of the photos shown within each question block. The two different versions were randomly distributed among participants.

For this between-subject design, participants in the *Pre-Tour* condition (N=34) completed the Empathy Assessment at Lola Ya Bonobo before the start of the guided tour and those in the participants in the *Post-Tour* condition (N=29) took the assessment immediately following the guided tour.

Scoring for this study used the same criteria as those in previous studies. One challenge we encountered in this study was that not enough participants filled out the demographic information to use any of the demographics as covariates.

For the overall analysis, the same GLM was used as in the attitude and knowledge assessments. Question 1 was used as the reference question in the GLM for the analysis of individual questions. We used the available but incomplete demographic data to test for the effect of age and gender on responses.

4.4.2 Results

Overall adult participants were above chance favoring empathic responses in both the pre and post tour responses, but there was no overall significant difference between the pre and post tour groups found (Figure 15D). Table 16 presents pre-tour and post-tour responses for each question. Participants responded above chance levels with empathy responses in three out of six questions in the pre-tour condition and one out of six in the post-tour condition. Subjects did not score particularly high in any of the six questions but scored low (<30% pro-empathy) in at least one condition for three questions out of six (3, 5, 6).

Examining descriptive statistics in Table 16, mean pro-empathy responses increased post-tour in one question (8%) and decreased in five (1-29%). None of these differences were significant for individual questions. Although not significant, the post-

tour group showed a 26% and 29% drop respectively in empathic responses after the tour in question two and six.

Adding demographic information into the model did not change the results for the overall comparison between the pre and post tour condition.

Table 16: Empathy Assessment by Individual Question. Asterisks indicate questions where there was significant difference between the pre-tour and post-tour conditions. Chance level is .5 for all questions. Values represent is the number of individuals who correctly answered the question divided by the total number of individuals who answered the question. Asterisk (*) indicates if the proportion of individuals answering each question correctly is above chance value (.5).

Question	**Pre-Test Mean**	**Post Test Mean**	**GLM Result**
1. The bonobos are playing./**The bonobos are having fun.**	.424	.345	NS
2. The bonobo extends his finger./**The bonobo wants to touch.**	*.71	.448	NS
3. **The mother bonobo loves her baby.**/The mother bonobo kisses her baby.	.265	.345	NS
4. The bonobo is facing right./ **The bonobo sees something to his right.**	*.706	*.69	NS
5. The bonobo eats the food./**The bonobo is**	.206	.172	NS

hungry and wants the food.			
6. **The orphan bonobo in the corner of the box is scared./**The orphan bonobo is in the corner of the box.	.559	.269	NS

4.4.3 Discussion

Results from the Empathy Assessment do not support the Conservation Education Hypothesis. Question 4 was the only question where participants in the post-tour condition chose the mentalistic language above chance. Further research should investigate other potential implicit attitude assessments among adults, especially those that explore changes in empathy towards animals. Using mentalistic language as an implicit measure of attitude towards species is still novel. Further exploration of using mentalistic language and other implicit measures is needed to best assess changes in adults' attitudes towards bonobo conservation in this population.

4.5 General Discussion

Building upon the previous knowledge assessments conducted at Lola Ya Bonobo in 2009, the results from these three studies provide support for the Conservation Education Hypothesis among children visiting the sanctuary. There is less support for the hypothesis among adults visiting the sanctuary.

An assessment conducted in 2009 supported the prediction that the education tour at Lola Ya Bonobo sanctuary positively impacted children's conservation knowledge of bonobos. Study 1 bolsters this initial study by demonstrating that children are likely to have stronger pro-conservation attitudes towards bonobos after the sanctuary tour compared to before the tour. Specifically, results suggest that the tour bolsters children's belief that bonobos are not appropriate pets and that the forest habitat of bonobos has inherent value.

Studies 2 and 3 did not strongly support the CEH. However, these assessments did examine whether the tour influenced pro-conservation knowledge and attitudes of adults, a critical but neglected population that had not been previously been examined at this sanctuary. These two studies found that adults came into the tour with a high level of knowledge about bonobos and their conservation. There was not an overall significant change in level of knowledge after the tour. Although these results may suggest that the tour itself did not immediately impact people's knowledge about bonobos and their conservation, it is possible that the presence and extensive education outreach the sanctuary has conducted over the past twenty years has contributed to the dissemination of knowledge among the general population of Kinshasa in the Democratic Republic of the Congo. The low mean scores in both the pre-tour and post-tour conditions for the Empathy Assessment suggest that further research is needed on how to best assess conservation attitude change among this population of adults.

In addition to the support for the Conservation Education Hypothesis, the novel methods used in Study 1 highlight the importance of developing implicit attitude assessments that can be implemented with a wide variety of populations. Using implicit studies that do not heavily rely on language will allow for better comparison of results across the different stakeholder populations that play a role in the future of great apes.

Even though the analysis of the composite results for Study 2 and 3 does not strongly support the conservation education hypothesis, certain questions from across all three studies provide important feedback on how the sanctuary can refine its tour to best encourage pro-conservation attitudes. Well-intended messages conveyed by the program could have unintended effects on the audience. For instance, the tour heavily emphasizes the evolutionary relationships between bonobos and humans. Results from Question 9 (Which of the following are bonobos least related to?) in Study 2 reveals that participants perform at or below chance on a question related to this topic both before and after the tour. This might be due to religious and cultural beliefs conflicting with the sanctuary's emphasis on scientific-based messages. Given this result, the education team can experiment on whether or not decreasing the focus on bonobos' genetic and behavioral similarity to humans will lead to increased pro-conservation attitudes among adult visitors. This example highlights how results from individual questions should be scrutinized under both cultural and educational frameworks to improve the outcomes of a conservation-minded program.

These studies were not without several limitations. In Study 1, implicit attitude measures conducted with children are not concurrently compared against the results of a more conventional explicit assessment of attitude. To account for this, we relied on qualitative comparisons to the limited attitude assessment conducted among children in André (2009).

The Knowledge Assessment in Study 2 was limited to adults who voluntarily visited the sanctuary. Voluntarily coming to the sanctuary suggests pre-existing interest in learning about bonobos and their conservation. Additionally, the entrance fee ($5 USD) is higher than the average wage/day in Kinshasa ($2 USD/day), which suggests that the population visiting the sanctuary is considerably more middle-class than the average individual in the DRC. This middle-class population of Kinshasa though not fully representative of the DRC, mirrors sanctuary/zoo going visitors in other countries that have been more thoroughly studied.

The Empathy Assessment in Study 3 is limited because it may not have assessed attitudes pertinent to this Congolese population. The emphasis on empathy towards animals may be culturally dependent. In more industrialized and Western countries, animals are more likely to co-habitat with humans and are seen as part of a family (Daly & Suggs, 2010; Negra & Manning,1997). This proximity breeds stronger feelings of empathy towards animal more generally. This attitude may contrast with conventional attitudes towards animals in Central Africa, where animals are viewed in more

utilitarian ways and as belonging to a domain distinctly separate from humans. For this Congolese population, viewing bonobos in a semi-wild habitat may highlight exactly how different they are from humans. The experience of the tour may therefore counteract the sanctuary's desire to increase empathy for bonobos. Further cross-cultural research is needed to understand the different role empathy plays in cultivating pro-conservation attitudes towards this species.

As it relates to all three studies, assessments were only conducted directly after the tour. Future studies will need to develop innovative and implicit methods of assessing how the tour affects both children's and adults' changes in knowledge, attitude and behavior long-term after the initial tour.

The results from these three studies underscore the importance of sanctuaries building knowledge and changing attitudes for their visitors. In particular, this study highlights the importance of focusing on communities that have large influence on the future of endangered species. The population of the DRC drives the greatest demand for bushmeat in the Congo Basin (Carpenter and Wilke, 1999). Working further with this population by employing novel techniques to assess knowledge and attitudes among both children and adults is crucial for the continuation of great ape conservation.

5. Conclusion

5.1 Summary of Chapters

All three of the empirical chapters in this dissertation support various aspects of the Adaptive Motivation Hypothesis. This hypothesis posits that the more tangible the recipient is to the actor, the more likely intrinsic rewards motivate prosocial behavior. The more abstract the recipient is to the actor, the more likely extrinsic rewards are needed to motivate prosocial behavior.

Chapter 2 examined whether intrinsic or extrinsic motivations were more likely to encourage prosocial behavior towards abstract recipients. We used contributions to a common good resource as our measure for cooperative behavior. We conducted this study with children ages six to fifteen in the United States, China, and the Democratic Republic of the Congo. Conducting this study over a range of ages allowed us to better understand how the behavior in question develops. Conducting the study cross-culturally allowed us to explore which aspects of the behavior is universal and which aspects may be more culturally driven. Overall, we found that children across all populations were more motivated by extrinsic rewards than intrinsic rewards to cooperate to maintain a common good resource. However, some country specific differences did emerge. Most notably, children in the DRC become less likely to contribute personal resources to common goods as they get older whereas children in the United States and China becomes more likely contribute their personal resources to

common goods as they get older. Participants across all ages in China and the United States are more likely to contribute a higher percentage of their personal resources to maintain a common good compared to participants in the DRC. Participants in the United States and the DRC are more likely to stop contributing their resources to the maintenance of a common good once the extrinsic motivation is removed, whereas participants in China continue to contribute even if the extrinsic motivation is removed. Overall, this study demonstrates that even though there are general universal aspects of cooperative behavior, developmental and cross-cultural comparisons reveal important and meaningful variation.

Chapter 3 expanded on the questions in Chapter 2 by exploring whether aggregating different types of extrinsic motivations could maximize contributions to common goods. This study focused only on one population of American children but still examined the development of the behavior for children ages six to fifteen. Whereas Chapter 2 only looked at risk of losing personal resources as the extrinsic reward, this study coupled risk with a time delay as costs. Overall, the study found that by imposing a high risk of losing personal resources and a time delay in acquiring resources, individuals are highly motivated to contribute to the maintenance of a common good compared to a control where no extrinsic reward is provided. In addition, this study examined whether experiencing the opportunity costs in this simulation transferred to considerations of common goods in a more generalized context. Indeed, children who

participated in the experimental condition of the common goods game were more likely to demonstrate prosocial behavior to abstract recipients in a separate, non-experimental context compared to children who had not participated in the simulation.

Chapter 4 explored whether making an abstract recipient more tangible to the actor increased pro-conservation knowledge and attitudes towards the recipient. Actors in this series of studies were children and adults from the city of Kinshasa in the Democratic Republic of the Congo, and the recipients were bonobos (*Pan paniscus),* an animal with whom the actors had little to no previous interaction. We made bonobos more tangible to the population by conducting an hour-long guided tour of a bonobo sanctuary. Experts detailed information about habitat, social structure and similarity to humans while viewers had the chance to watch and interact with the bonobos. Overall, the guided tour increased pro-conservation attitudes towards bonobos in children but had no effect on increased knowledge of attitudes in the adult populations.

5.2. Testing Predictions Under the Adaptive Motivation Hypothesis

Together, these three chapters paint a better picture of how populations in various ecological and cultural environments develop prosocial behaviors towards common goods resources. Two important frameworks emerged from these series of studies: The Adaptive Motivation Hypothesis as a way of understanding the motivations for prosocial behavior in humans, and the importance of interdisciplinary approaches when examining cooperative behaviors.

The Adaptive Motivation Hypothesis allows for examining a wide scope of prosocial behaviors beyond those explored in this thesis. Chapter 4 explored pro-conservation attitudes towards one particular species, and Chapters 2 and 3 examined motivations for contributing personal resources towards a forest. Both prosocial behaviors and abstract recipients are broad terms that can be further explored in numerous ways. The elegance of the Adaptive Motivation Hypothesis allows for examining a variety of prosocial behaviors in terms of intrinsic or extrinsic motivations based on degree of relatedness between the actor and recipient.

Predictions stemming from this hypothesis were tested by merging methods from psychology and behavioral economics. These methods were employed all while using evolutionary theory as a guiding framework. This interdisciplinary approach led to questions and discoveries that might not have otherwise existed without merging the epistemologies of these different disciplines.

Using an interdisciplinary approach to test the Adaptive Motivation Hypothesis has a variety of future directions. As it relates to more basic research in psychology, future studies should better parse out which aspects of prosocial behaviors are universal in humans and which ones are more influenced by ecological differences and cultural norms. This type of investigation would require examining an array of communities within a population. More specifically, we would want to control for different socio-economic status, ethnic background and education levels within a population.

Additionally, the studies in this dissertation examined only a narrow scope of prosocial behaviors. Going forward, studies can and should examine other important prosocial behaviors towards abstract recipients like fairness, sharing behaviors, helping behaviors and altruism. A better understanding of these behaviors could also be bolstered by understanding motivations for their antithesis: anti-social behaviors. Exploring motivations for dehumanization of outgroups, prejudice, and aggression could provide insight into how to curtail such behaviors in favor of more prosocial behaviors.

5.3 The Adaptive Motivation Hypothesis in Application: Conservation Psychology

Another future direction is merging more basic research on the evolution and development of certain prosocial behaviors with more applied research about behavioral change to affect real-world outcomes. The resulting field of this convergence has become known as Conservation Psychology.

More specifically, this emerging field of Conservation Psychology examines how our understanding of cognitive science and behavioral economics influences how individuals make decisions about conserving the finite resources on the planet. Those resources can include forests, wildlife species, fisheries, and potable water. All of these resources can be defined as common goods. The study of prosocial behavior towards abstract recipients using the Adaptive Motivation Hypothesis can therefore easily transfer to more applied studies of sustainability behaviors.

Through the lens of conservation psychology, the choice of populations to examine can be driven by connection to commodities that have been threatened by habitat loss, poaching, or climate change. The American, Congolese and Chinese populations allowed us to test the theoretical underpinnings of the Adaptive Motivation Hypothesis, but these three populations can also be seen through their roles as stakeholders in the future of the Congo Basin. The Congo Basin is the second largest tropical forest in the world after the Amazon forest and it provides innumerable ecological services that benefit the globe (Jha and Bawa, 2006; Tyukavina et al., 2018). These three populations have varying levels of involvement in the future of the Congo basin.

Biodiversity loss is a global problem, particularly the disappearance of species in biodiversity hotspots like the Congo Basin. The Congo Basin contains several keystone species, including all species of African Great Apes: the chimpanzee (*Pan troglodytes),* the bonobo (*Pan paniscus),* and Western Gorilla (*Gorilla gorilla)* and the Eastern Gorilla (*Gorilla berengei).* All of these species serve vital roles within the ecosystem of the Congo basin as seed dispersers which contributes to the continuing biodiversity and health of the forest (Beaune et al, 2013). Conserving these species will require trans-national policy changes and behavioral changes on individual and population levels (Struhsaker et al, 2005; Wilkie and Carpenter, 1999).

According to the most recent reports by the International Union for Conservation of Nature (IUCN), both species of gorilla are classified as critically endangered and chimpanzees and bonobos are classified as endangered. Habitat destruction and vigorous poaching within the Congo Basin are threats to all of the African great ape species (Hickey et al, 2018; Maisels et al, 2018; Humle et al, 2018; Fruth et al, 2016). If all wildlife conservation dilemmas stem from human decision making, examining the psychology of the populations that have had the greatest stake in the survival of species and their habitats provides insights into potential sustainable behavioral change.

The Democratic Republic of the Congo is the only country in Africa to contain all African great ape species. Much of the international demand for great apes is for body parts used in medicine and rituals and for young individuals as pets or entertainment animals (Miles et al., 2005). Communities within the Congo are also most likely to be providing the supply of great apes, whether it is participation in hunting for sustenance or participation in the lucrative illegal wildlife trade (Nasi et al., 2011). Given the geographic and cultural proximity to these species, we are interested in how Congolese populations develop attitudes and behaviors towards great apes.

China has increasingly become a key player and stakeholder in the future of wildlife in the Congo Basin. Over the past decade, China has dramatically increased its presence within Central Africa by building a large system of railways, roads, and other infrastructure projects throughout the continent (Curtis, 2013).These efforts have

significantly improved the previously poor infrastructure within the central part of the continent, but have also significantly increased the presence of legal and illegal wildlife trade routes between Central Africa and the rest of the world, as well as further opportunities for habitat destruction. (Zafar, 2007).

More Western countries like the United States do have a history of contributing to the demand of great ape species for pet and entertainment purposes (Ross, 2014), but these countries also contribute to conservation efforts for species and the environment (Environmental Performance Index, 2016).

If we want to determine the most effective ways to encourage sustainability behaviors that benefit the conservation of the African Great Apes, it is imperative to explore cooperation behavior change with the aforementioned populations because of their proximity to the habitat, supply, and demand of these species as commodities. This exploration in conservation psychology requires the interdisciplinary synergy of research in basic psychology, education, and marketing.

Basic research in conservation psychology can and should become a field of study of more concern within Academia. It parallels many of the research questions in the more established field of environmental psychology but maintains some important differences. Environmental psychology is mostly concerned with how individuals interact with the natural and built world and applied branch of the field focusing on the consumption of more environmentally-friendly products (Griskevicius et al., 2010)

Conservation psychology, in contrast, is more concerned about interactions with finite resources in the natural world and the applied branch focuses on behavioral change that will lead to positive outcomes for humans and the natural world (Clayton and Myers, 2015).

As an interdisciplinary field of study, Conservation Psychology would rely on teaching theories from cognitive science, behavioral economics, evolutionary anthropology, environmental psychology, and ecology. The potential for new research directions is ever-expanding. The aforementioned follow-up questions from this dissertation about how populations are motivated to contribute to common goods resources is one of many broad directions. Additional research directions of interest include how the entertainment industry represents and affects pro-conservation behavior in global audiences; the impact of protected areas across the world in the health and wellbeing of humans, wildlife, and ecosystem services; and the role of empathy in the development of pro-conservation behaviors.

Outside of being an area of academic research, conservation psychology as a framework can contribute to conservation education and the missions of conservation-minded non-profits. We see a drop off of interest, pro-conservation attitudes and behaviors towards the natural world when individuals reach adulthood (Brewer, 2001). What is responsible for this drop off and how can education programs encourage the prolongation of pro-conservation attitudes and behaviors through adulthood?

Education programs are not limited to school systems. Zoos, aquaria, sanctuaries and other experience-based programming frequently focus educational programs on children but have struggled to track behavior change long-term. Conservation psychology has the potential to develop innovative methods to assess behavior tracking and behavior change within conservation education.

Several non-profits and non-governmental organizations (NGOs) exist with missions devoted to conserving endangered species and ecosystems around the world. Many of these organizations focus on encouraging behavioral change on different levels, be it persuading powerful government officials to adopt various pro-conservation laws or policies or working with communities to encourage more sustainable use of particular finite resources. Though many of these organizations are grounded in ecology research, their ultimate goal is human behavior change. Better understanding of how to communicate to populations with differing cultural norms, perceptions, and access to resources will lead to increased success of behavioral change campaigns.

In an increasingly globalized world, understanding how to encourage cooperation that benefits the diminishing resources in the natural world is imperative for determining and implementing lasting solutions. Recent reports scientists at United Nations and the Intergovernmental Panel on Climate Change estimate 10 years to work to dramatically curtail the effects of anthropogenic climate change in order to prevent further devastating global effects that will negatively affect human populations and the

natural world (IPCC, 2018). Going forward, interdisciplinary work with economists, ecologists, psychologists, and anthropologists is needed to convey the urgency of behavior change. Corporations, government officials and individuals will all need to alter behavior in order to ensure the Earth remains habitable. The theoretical approaches employed in this dissertation in addition to the more applied approaches of conservation psychology aim to bridge these interdisciplinary gaps and elucidate meaningful solutions to the increasing threats facing our biosphere.

Appendix A

Script for American Population

Note: Script below was translated into French for DRC and Mandarin for China. Minor changes to the script were made for the DRC and China to ensure cultural appropriateness.

Text in italic = action instead of speech
Text with underline = conditional speech that is not necessary in certain situations

If at any point during the experiment, subjects ask for the purpose of the experiment, the experimenter answers: "I will explain it to you after the game".

"Hello! Today we'll be playing a game where you will be making decisions with these tokens. Everybody gets a bowl of 24 tokens, which can be exchanged for prizes at the end of the game. Does everyone like these prizes?"

(*Wait for each participant to reply)*

"Great! Each prize is worth 2 tokens. At the end of the game, you can exchange the tokens for prizes."

"In this game, you will make decisions about whether you want to keep the tokens for yourself or give some of the tokens away. The tokens that you give away will be exchanged for money that will go to sustaining The National Parks Services. The tokens that you give away will go into this collection bank. The bank represents how many tokens you as a group have collectively given to support the National Park Services." (*Experimenter demonstrate how the tokens go into the bank. If subjects ask for the exchange rate for this collection bank, the experimenter answers:* "each token in the collection bank will be exchanged for the amount of money that is approximately equal to the cost of the personal rewards you receive". *i.e. in US, two tokens can be exchanged for a prize, and they can also be exchanged for about $0.10, the monetary cost of a prize, for the National Parks Services. If subjects asked how many slots are in the collection bank, we answer "72", if they didn't ask, we don't specify to keep the math simple)*

"Does everyone know what a National Parks are?" (*wait for participants to reply with answers and examples of National parks).*
"Before we continue, I have a couple questions that you each have to answer:"

Comprehension check 1:

1. "Everyone starts with how many tokens?"

Correct answer: 24

(*wait for each individual to give the correct response before moving to next question).*

2. "What you can do with the tokens that you keep for yourself after the game?"

Correct answer: exchange for prizes

(*wait for each individual to give the correct response before moving to the next question).*

3. What happens to the tokens that you give here to the collection bank?

Correct answer: the tokens in the bank will be turned into money that go to sustaining the National Parks Services?

(*wait for each individual to give the correct response before moving on).*

"It is important to remember that there are no right or wrong answers in this game. You can give or keep as many of the tokens as you want."

"Very good. When the game begins, you will have six opportunities to decide if you want to give to the collection bank. Each time I ask if you want to give to the bank, you have the option of giving 0, 2, or 4 tokens to the bank. So that no one else knows how much you're giving, you will circle how many you want to give away to the forest bank on this piece of paper and give the piece of paper to me. However, many you want to give each round is up to you. You cannot discuss your decision with others or look at other's decisions. I will collect the pieces of paper in each round, and at the end of the game I will take away from your bowl the number of tokens you have given away. Remember there are no right or wrong answers in this game. Okay, a few more comprehension questions before we move on:"

Comprehension Check 2

4. "How many opportunities do you have to give to the bank?"

Correct answer: 6

(*wait for each individual to give the correct response before moving to the next question).*

5. "How many pieces of tokens can you give to the bank each time?"

Correct answer: 0, 2, or 4

(*wait for each individual to give the correct response before moving on).*

"Great, there's one more thing before we start the trials." (*the following script depends on the condition*):

Certain Gain Condition
"Whether or not there is a token in every slot does not matter. You can exchange the tokens that remain in your bowl for donut holes at the end of the game."

Certain Loss Condition
"If the bank is full, meaning there is a token in every slot in the bank, everyone can exchange the tokens they did not give away for rewards at the end. If the bank is not full, meaning there is not a token in every single slot, everyone loses all their tokens and no one gets any rewards."

Uncertain Condition
"If the bank is full, meaning there is a token in every slot in the bank, everyone can exchange the tokens they did not give away for rewards at the end. If the bank is not full, meaning there is not a token in every single slot, I'm going to flip a coin. If it is heads, everyone can exchange the tokens they did not give away for donuts at the end. If it is tails, everyone loses all their tokens and nobody gets any rewards no donations will go to the National Park Service."

Comprehension check 3
6. "What happens if the bank is full by the end of the game?"
(*wait for each individual to give the correct response before asking next question).*
(*subjects only need to answer what happens to their personal tokens).*

7. "What happens if it is not full by the end of the game?"
(*wait for each individual to give the correct response before moving on).*

"Very good. Now we practice twice before we start the game."

"How many tokens do you want to give to the collection bank?" (2 times)

(say out loud what each person gave, take the tokens from the bowl and place them in the bank). Write down how many each person gave on the collection sheet. After both practice rounds, return the proper number of tokens to each participant).

"Great! Now we're going to start the actual game. However, two things will change in the actual game. For one, I will not say out loud how many tokens each person gave so that everyone's answers remain anonymous (*If the experimenter notices subjects*

*communicating by looking at others' piece of papers or talking to each other, the experimenter will re-iterate that "*Remember this game is individual. Make your decision independently. Please don't communicate*". If subjects are found communicating repeatedly during the experiment, the experimenter will make a note in her data entry sheet --- i.e. if a subject attempted to communicate more than once, the entire group's data will be thrown away.*). Second, I will count up and take all the tokens you decide to give away at the end of the game."

(Trials 1-6) "How many tokens do you want to give to the collection bank? Circle your answer on the paper and hand it to me."

(experimenter takes paper from each individual, (and E makes sure that she won't turn her back to the subjects when she is collecting papers -- kids talk behind her back), notes on collection sheet how much each gave, saves the papers in an opaque bag/box. Experimenter also writes down on the whiteboard the breakdown of what was given (e.g. two people gave zero tokens, three people gave two tokens and one person gave four tokens). Finally tallies the total and places the corresponding number of tokens in the collection bank.

"Well, it's the end of the game. We have accomplished our goal and everyone can take home the candy that remains in their bowl! (*OR we have not achieved our goal, so nobody can exchange their tokens for prizes (condition dependent).* Please do not share the information about this experiment with your classmate. In fact, every group plays a different game with different rules.

After the game, the kids stay in the testing room, experimenter exits the room and sets up mini-store outside the room -> kids come out one by one -> Experimenter first asked "Do you remember how many you have donated in total? if yes, how many exactly?", Experimenter then records yes/no as a binary indicator of their memory on her sheet -> Experimenter then tells subjects how many they have left, and let them exchange rewards (all rewards are of the same price, two tokens/each) -> Experimenter then put them in an opaque paper bag and gives it to the subject.

Script for Chinese Population

Note:
Text in italic = action instead of speech
Text with underline = conditional speech that is not necessary in certain situations

If at any point during the experiment, subjects ask for the purpose of the experiment, the experimenter answers: "我会在游戏结束之后解释".

大家好！今天我们会进行一个游戏，在游戏中大家要用这些代币来做出一些决定。每人将获得24个代币。游戏结束之后，这些代币可以用来换取XXXX奖品。你们每个人都喜欢XXXX么？

(*Wait for each participant to reply)*

好。每份XXXX奖品价值2个代币。在游戏之后，你们就可以来换。

在这个游戏里面，你们可以选择把代币留给自己，也可以把一些代币捐出去。你们捐出去的代币将会被换成现金，这些捐款将用来维护和建设国家自然保护区。你们捐出来的代币会被收集进这个"公共银行"里。这个"公共银行"的模型显示的是，你们整组人向国家自然保护区集体捐款了多少代币。 (*Experimenter demonstrate how the tokens go into the bank. If subjects ask for the exchange rate for this collection bank, the experimenter answers:* "在公共银行里的代币我们都会换成和XXXX奖品价值差不多的现金". *i.e. in US, each token can be exchanged for 1/2 donut hole for each subject, and thus each token can also be exchanged for about $0.05, the monetary cost of 1/2 donut hole, for the National Parks Services)*

Comprehension check 1:

1. 每个人一开始时共有几个代币?

Correct answer: 24

(*wait for each individual to give the correct response before moving to next question).*

2. 代币在游戏结束之可以用来干什么？

Correct answer: 换XXXX奖品，每2个代币可以换一个XXXX

(*wait for each individual to give the correct response before moving to the next question).*

3. 你要是把代币捐给"公共银行"之后，这些代币会怎么样呢？

Correct answer: 公共银行里面的代币会被换成现金，然后用于国家自然保护区的建设和维护。

(*wait for each individual to give the correct response before moving on).*

我需要强调的一点是，在这个游戏里没有正确和错误的决定。你们完全可以自由的选择给自己留下所有代币，或者捐出任意数量的代币。

非常好。当游戏开始的时候，你们每人都会有6轮的机会来决定是否给公共银行捐款。每一次我问你们是否愿意捐款，你们每人都有三个选择：捐0个、2个或者4个代币给公共银行。你们每一个人的选择将会是保密的，在场的其他同学不会知道你的选择是什么。你需要在这张小纸条上写下来你要捐出去代币的数量，然后把这张纸交给我。你决定捐多少完全是你自己的决定，你不能和其他人商量或者参考其他人的决定。我只负责在每一轮收集你们的纸条，然后在整个实验结束之后，我会从你的碗里取走相应数量的代币。请记住，这个游戏里没有正确或错误的答案。

Comprehension Check 2
4. 你们每人有几次机会决定是否给公共银行捐款?
Correct answer: 6
(*wait for each individual to give the correct response before moving to the next question).*

5. 在每一轮里，你们可以决定给公共银行捐多少个代币?
Correct answer: 0, 2, or 4
(*wait for each individual to give the correct response before moving on).*

好, 关于这个游戏我还有一点需要给你们说的 (the *following script depends on the condition*):

Certain Gain Condition
你们可以看到这个公共银行的模型里有很多空格，你们每捐出一个代币，就会填入一个空格。在整个游戏结束后，无论公共银行的空格是否被填满， 你们每个人可以用自己碗里剩余代币来换取个人奖品。

Certain Loss Condition
你们可以看到这个公共银行的模型里有很多空格，你们每捐出一个代币，就会填入一个空格。在整个游戏结束后，如果公共银行的空格成功被填满了， 你们每个人可以用自己碗里剩余代币来换取个人奖品。 但如果公共银行的空格没有被填满了 —— 就是说这上面还有格子是空的 —— 所有人都将失去自己碗里剩余的代币，也就是说，没有人能够换取奖品。

Uncertain Condition
你们可以看到这个公共银行的模型里有很多空格，你们每捐出一个代币，就会填入一个空格。在整个游戏结束后，如果公共银行的空格成功被填满了， 你们每个人可以用自己碗里剩余代币来换取个人奖品。但如果公共银行的空格没有被填满了 —— 就是说这上面还有格子是空的 —— 那么我将会抛一个硬币。
你们都知道硬币是有两面的，一面是图案一面是数字。如果我抛出来的结果是图案，那么和之前一样，你们每个人可以用自己碗里剩余代币来换取个人奖品；如果出来的结果是数字，所有人都将失去自己碗里剩余的代币，也就是说，没有人能够换取奖品。

Comprehension check 3 (<u>only for certain loss and uncertain conditions</u>)

6. 在实验结束之后，如果公共银行是满的，会发生什么呢?
(*wait for each individual to give the correct response before asking next question).*
(*subjects only need to answer what happens to their personal tokens).*

7. 在实验结束之后，如果公共银行不是满的，会发生什么呢?
(*wait for each individual to give the correct response before moving on).*

非常好，在我们开始正式游戏之前， 我们先来练习两轮，熟悉一下游戏的规则。

你们愿意给公共银行捐献多少代币呢? (2 times)

(say out loud what each person gave, take the tokens from the bowl and place them in the bank. Write down how many each person gave on the collection sheet. After both practice rounds, return the proper amount of tokens to each participant).

好！现在我们正式开始游戏! 请记住，正式游戏里有两点是和刚才的练习不一样的。第一，我不会在每一轮里大声说出每个人决定捐多少代币，也不会像刚才那样从你们的碗里直接取走代币。你们每人决定捐多少，彼此是不知道的，我会替你们保密。 (*If the experimenter notices subjects communicating by looking at others' piece of papers or talking to each other, the experimenter will re-iterate that "*请记住，在这个游戏里你必须自己独立做出决定，请不要和他人交流*". If subjects are found communicating repeatedly during the experiment, the experimenter will make a note in her data entry sheet*). 第二，我会在游戏结束之后才计算你们一共捐出了多少代币，并从你们的碗里一并扣除。

(Trials 1-6) 你们愿意给公共银行捐献多少代币呢? 写下你的选择，然后把纸条交给我。

(experimenter takes paper from each individual, notes on collection sheet how much each gave, tallies the total and places the corresponding number of tokens in the collection bank. Experimenter also writes down on the whiteboard the breakdown of what was given (e.g. two people gave zero tokens, three people gave two tokens and one person gave four tokens).

好, 我们的游戏结束了. 我们成功达成了我们的目标，你们每人都可以用剩余的代币来换取奖品； *OR* 我们没有达到我们的目标，所以没有人能够换取奖品 *(condition dependent).*

最后，请不要把这个游戏的内容告诉还没有参加游戏的同学。实际上，你们每一组人玩的游戏都是不一样的。

Script for Congolese Population

Bonjour. Aujourd'hui nous faisons un jeu ou vous faites des décisions avec ses 24 jetons. Ces jetons
représentent des bonbons.Chaque jeton représente un bonbon (*Show candy).*
Vous connaissez ces bonbons? Tout le monde aiment ces bonbons?.

(*Wait for each participant to reply)*

« Très Bien! Chaque bonbon vaut 2 jetons. À la fin du jeu, vous pouvez échanger les jetons pour les bonbons. »

« Dans ce jeu, vous déciderez si vous voulez garder les jetons pour vous-même ou en donner une partie. Les jetons que vous donnez seront échangés pour l'argent qui ira au soutien des Services des parcs nationaux. Les jetons que vous donnez vont dans cette banque de collection. La banque représente le nombre de jetons collectifs que vous avez collectivement apportés pour soutenir les services des parcs nationaux."

Experimenter demonstrate how the tokens go into the bank. If subjects ask for the exchange rate for this collection bank, the experimenter answers: "chaque jeton de la banque sera échangé contre une somme d'argent approximativement égale au coût des récompenses personnelles que vous recevez".

« Est-ce que tout le monde sait ce qu'est un parc national? »

«Avant de continuer, j'ai quelques questions auxquelles chacun de vous doit répondre:»

1. "Tout le monde commence avec combien de jetons?"

2. "Que pouvez-vous faire avec les jetons que vous gardez pour vous après le match?"

3. Qu'advient-il des jetons que vous donnez ici à la banque de la forêt?

« Il est important de se rappeler qu'il n'y a pas de bonne ou de mauvaise réponse dans ce jeu. Vous pouvez donner ou conserver autant de jetons que vous le souhaitez. »

« Très bien. Lorsque le jeu commencera, vous aurez six opportunités de décider si vous souhaitez donner à la banque de la forêt. Chaque fois que je vous demande si vous souhaitez donner à la banque, vous avez la possibilité de donner 0, 2 ou 4 jetons à la

banque. Pour que personne ne sache combien vous donnez, vous encerclerez le nombre que vous voulez donner à la banque forestière sur ce morceau de papier et vous me le donnerez. Cependant, le nombre que vous souhaitez donner à chaque tour dépend de vous. Vous ne pouvez pas discuter de votre décision avec d'autres ou examiner les décisions des autres. Je vais ramasser les morceaux de papier à chaque tour et, à la fin du jeu, je retirerai de votre bol le nombre de jetons que vous avez donnés. Rappelez-vous qu'il n'y a pas de bonne ou de mauvaise réponse dans ce jeu. D'accord, encore quelques questions de compréhension avant de continuer : »

Comprehension Check 2
4. "How many opportunities do you have to give to the bank?"
Correct answer: 6
(*wait for each individual to give the correct response before moving to the next question).*

5. "How many pieces of tokens can you give to the bank each time?"
Correct answer: 0, 2, or 4
(*wait for each individual to give the correct response before moving on).*

4. "Combien d'opportunités avez-vous à donner à la banque?"
(attendez que chaque personne donne la bonne réponse avant de passer à la question suivante).

5. "Combien de jetons pouvez-vous donner à la banque à chaque fois?"
(attendez que chaque personne donne la bonne réponse avant de continuer).

« Très bien, il reste encore une chose à faire avant de commencer le jeu. »

0% Condition
«Qu'il y ait ou non un jeton dans chaque emplacement n'a pas d'importance. Vous pouvez échanger les jetons qui restent dans votre bol contre des trous pour les beignes à la fin du jeu. "

100% Condition
«Si la banque est pleine, ce qui signifie qu'il y a un jeton dans chaque emplacement de la banque, tout le monde peut échanger les jetons qu'ils n'ont pas cédés pour des récompenses à la fin. Si la banque n'est pas pleine, ce qui signifie qu'il n'y a pas de jeton dans chaque emplacement, tout le monde perd tous ses jetons et personne ne reçoit de récompense. "

50% Condition
«Si la banque est pleine, ce qui signifie qu'il y a un jeton dans chaque emplacement de la banque, tout le monde peut échanger les jetons qu'ils n'ont pas cédés pour des récompenses à la fin. Si la banque n'est pas pleine, ce qui signifie qu'il n'ya pas de jeton dans chaque case, je vais lancer une pièce de monnaie. Si c'est la tête, tout le monde peut échanger les jetons qu'ils n'ont pas cédés contre des beignets à la fin. Si c'est le cas, tout le monde perd tous ses jetons et personne ne reçoit de récompense, aucun don ne sera versé au Service des parcs nationaux. "

6. "Que se passe-t-il si la banque est pleine à la fin du jeu?"

7. "Que se passe-t-il s'il n'est pas plein à la fin du jeu?"

« Très bien. Maintenant, nous pratiquons deux fois avant de commencer le jeu. »

« Combien de jetons souhaitez-vous donner à la banque de la forêt?" (2 fois)

« Très Bien! Nous allons maintenant commencer le jeu. Cependant, deux choses vont changer dans le jeu actuel. Tout d'abord, je ne dirai pas à voix haute combien de jetons chaque personne a donné pour que les réponses de chacun restent anonymes. Deuxièmement, je compte et récupère tous les jetons que vous décidez de donner à la fin du jeu. »

(Trials 1--6) «Combien de jetons voulez-vous donner à la banque de collecte? Encerclez votre réponse sur le papier et remettez-la-moi.

"Eh bien, c'est la fin du jeu. Nous avons atteint notre objectif et chacun peut rapporter à la maison le bonbon qui reste dans son bol! (OU nous n'avons pas atteint notre objectif, personne ne peut échanger ses jetons contre des bonsbons). Ne communiquez pas les informations relatives à cette expérience aux autres. En fait, chaque groupe joue un jeu différent avec des règles différentes. "

Appendix B

Chapter 3 Study 1: Delay and No Delay Condition Scripts

Note:
Text in italic = action instead of speech
Text with underline = conditional speech that is not necessary in certain situations

If at any point during the experiment, subjects ask for the purpose of the experiment, the experimenter answers: "I will explain it to you after the game".

Hello! Today we'll be playing a game where you will be making decisions with these tokens. Everybody gets a bowl of 12 tokens, which can be exchanged for prizes at the end of the game. Does everyone like these prizes?

(*Wait for each participant to reply)*

Great! Each reward is worth 2 tokens. At the end of the game, you can exchange the tokens for rewards.

In this game, you will make decisions about whether you want to keep the tokens for yourself or give some of the tokens away. The tokens that you give away will be exchanged for money that will go to sustaining The National Parks Services. The tokens that you give away will go into this Forest Bank. The bank represents how many tokens you as a group have collectively given to support the National Park Services. (*Experimenter demonstrate how the tokens go into the bank. If subjects ask for the exchange rate for this forest bank, the experimenter answers:* "each token in the collection bank will be exchanged for the amount of money that is approximately equal to the cost of the prizes you receive, so about 10 cents". *If subjects asked how many slots are in the collection bank, we answer "36", if they didn't ask, we don't specify to keep the math simple)*

"Does everyone know what a National Parks are? *(wait for participants to reply with answers and examples of National Parks).* Before we continue, I have a couple questions that you each have to answer:"

Comprehension check 1:
"Everyone starts with how many tokens?"
Correct answer: 12

(*wait for each individual to give the correct response before moving to next question).*

"What you can do with the tokens that you keep for yourself after the game?"
Correct answer: exchange for prizes

(*wait for each individual to give the correct response before moving to the next question).*

"What happens to the tokens that you give here to the forest bank?"
Correct answer: the tokens in the bank will be turned into money that go to sustaining the National Parks Services.

(*wait for each individual to give the correct response before moving on).*

"It is important to remember that there are no right or wrong answers in this game. You can give or keep as many of the tokens as you want."

Very good. When the game begins, you will have six opportunities to decide if you want to give to the forest bank. Each time I ask if you want to give to the bank, you have the option of giving 0, 2, or 4 tokens to the bank. So that no one else knows how much you're giving, you will circle how many you want to give away to the forest bank on this piece of paper and give the piece of paper to me. However many you want to give each round is up to you. You cannot discuss your decision with others or look at other's decisions. I will collect the pieces of paper in each round, and at the end of the game I will take away from your bowl the amount of tokens you have given away. Remember there are no right or wrong answers in this game. Okay, a few more comprehension questions before we move on:"

Comprehension Check 2

4. "How many opportunities do you have to give to the forest bank?"
Correct answer: 6

(*wait for each individual to give the correct response before moving to the next question).*

5. "How many pieces of tokens can you give to the bank each time?"
Correct answer: 0, 2, or 4

(*wait for each individual to give the correct response before moving on).*

Great, there's one more thing before we start the trials (the *following script depends on the condition*):

Delay Condition

"If the bank is full, meaning there is a token in every slot in the bank, everyone can exchange the tokens they did not give away for rewards at the end. If the bank is not full, meaning there is not a token in every single slot, everyone loses all their tokens and no one gets any rewards.

No Delay Condition

"Whether or not there is a token in every slot at the end of the round does not matter. After this round you will automatically get 12 more tokens to play the game again."

Comprehension check 3 (<u>answer dependent on condition</u>)

6. What happens if the bank is full by the end of the game?
(*wait for each individual to give the correct response before asking next question).*
(*subjects only need to answer what happens to their personal tokens).*

7. What happens if it is not full by the end of the game?
(*wait for each individual to give the correct response before moving on).*

Very good. Now we practice twice before we start the game.

How many tokens do you want to give to the collection bank? (2 times)

(say out loud what each person gave, take the tokens from the bowl and place them in the bank). Write down how many each person gave on the collection sheet. After both practice rounds, return the proper amount of tokens to each participant).

Great! Now we're going to start the actual game. However two things will change in the actual game. For one, I will not say out loud how many tokens each person gave so that everyone's answers remain anonymous (*If the experimenter notices subjects communicating by looking at others' piece of papers or talking to each other, the experimenter will re-iterate that "*<u>Remember this game is individual. Make your decision independently. Please don't communicate</u>*". If subjects are found communicating repeatedly during the experiment, the experimenter will make a note in her data entry sheet --- i.e. if a subject attempted to communicate more than once, the entire group's data will be throw away.*). Second, I will count up and take all the tokens you decide to give away at the end of the game.

(Trials 1-3) How many tokens do you want to give to the collection bank? Write your answer down on the paper and hand it to me.

(experimenter takes paper from each individual, notes on collection sheet how many each participant gave. Experimenter also writes down on the whiteboard the breakdown of what was given (e.g. two people gave zero tokens, three people gave two tokens and one person gave four tokens). Experimental then tallies the total and places the corresponding number of tokens in the collection bank.

No Delay Condition—Script for Round Outcomes

*If the bank is/is not full at the end of the three trials: "*You did/did not fill up the Forest Bank. The tokens you gave away will be exchanged for money and given to the National Parks. The tokens so still have in your bowl you can exchange for prizes at the end of the day. You'll now get 12 more tokens so we can play the game again.

Delay Condition-Script for Round Outcomes

If the bank is full: "You filled up the Forest Bank. The tokens you gave away will be exchanged for money and given to the National Parks. The tokens so still have in your bowl you can exchange for prizes at the end of the day. You'll now get 12 more tokens so we can play the game again.

If the bank is not full at the end of the round: "You did not fill up the forest bank. Because it's not full, you'll have to wait 90 seconds in silence until you get get 12 more tokens to play the game again. The 90 seconds begin now.

Regardless of round outcome, participants can play the game up to 3 times total.

"Well, it's the end of the game! Thank you so much for playing. You'll get the prizes from this game at the end of the week. Also, because we want to be fair to everyone, including to those who haven't played this game before, everyone is going to get the same amount of prizes on Friday"

Chapter 3 Study 2: Cost/Benefit Condition Script

Note:

Text in italic = action instead of speech

Text with underline = conditional speech that is not necessary in certain situations

If at any point during the experiment, subjects ask for the purpose of the experiment, the experimenter answers: "I will explain it to you after the game".

"Hello! Today we'll be playing a game where you will be making decisions with these tokens. Everybody gets a bowl of 12 tokens, which can be exchanged for prizes at the end of the game. Each prize is worth 2 tokens. Does everyone like the different prizes that we have here?"

(*Wait for each participant to reply--need affirmative answer from each participant)*

"In this game, you will make decisions about whether you want to keep the tokens for yourself or give some of the tokens away. The tokens that you give away will be exchanged for money that will go to sustaining nearby forests.

Can you all think of some examples of nearby forests that you have visited? (*answer: Chatahouchee River, Smoky Mountains, Sweetwater Creek, Stone Mountain Park, Appalachian Trail*)

What happens when we cut down too many trees in a forest? (answer: *when there is no lumber to sell, you have to wait for the forest to regrow before there is more lumber to sell, cutting down the forest also affects the air quality, water quality for people and wellbeing and survival of wildlife)*

What are some of the things you do when you visit a forest? (*answer: hiking, camping, self-reflection, hunting, fishing, gathering food, gathering supplies*)

What are some animals you see when you go to a forest? (*answer: squirrels, rabbits, birds, bears, deer, chipmunks, fox, insects, snakes, toads*)

What types of things that we use everyday come from forests? (*answer: lumber, paper, medicine, food, water*)

What happens when we cut down too many trees in a forest? (*answer: here is no lumber to sell and you have to wait for the forest to regrow before there is more lumber to sell,*

cutting down the forest also affects the air quality, water quality for people and wellbeing and survival of wildlife)

What happens if we instead don't cut down too many trees at once and we plant lots more trees to replace the ones we've cut down? (*answer: we'll have even more lumber to sell and we don't have to wait for the forest to regrow, air and water stay clean, animals are healthy)*

We're going to play a game about forests. The 12 tokens gifted to you represent money made from selling wood from the forest. In this game, you'll have the option of keeping the tokens for yourself to exchange for prizes at the end of the game, or you can decide to give money back to the forest to plant more trees to help the forest regrow. The tokens that you give away will go into this collection bank. The bank represents how many tokens you as a group have all together given to plant trees in the forest." (*Experimenter demonstrate how the tokens go into the bank. If subjects ask for the exchange rate for this collection bank, the experimenter answers:* "each token is worth the same as what the prizes cost, so about 10 cents each". *If subjects asked how many slots are in the collection bank, we answer "36", if they didn't ask, we don't specify to keep the math simple)*

"Before we continue, I have a couple questions that you each have to answer:"

"Everyone starts with how many tokens?"
Correct answer: 12
(wait for each individual to give the correct response before moving to next question).

"Where do these tokens come from?"
Correct answer: they come from the money from selling wood from the forest
(wait for each individual to give the correct response before moving to the next question).

"What you can do with the tokens that you keep for yourself after the game?"
Correct answer: exchange for prizes that we can take home
(wait for each individual to give the correct response before moving to the next question).

"What happens to the tokens that you give here to the forest bank?"
Correct answer: the tokens in the bank will be turned into money that go to planting more trees in the forest (wait for each individual to give the correct response before moving on).

"It is important to remember that there are no right or wrong answers in this game. You can give or keep as many of the tokens as you want."

"Very good. When the game begins, you will have three opportunities to decide if you want to give any tokens to the forest. Each time, you can give either 0, 2, or 4 tokens. To let me know how many tokens you want to give away, you will circle the number piece of paper and hand the piece of paper to me. Remember, there are no right or wrong answers in this game. You can give or keep as many of the tokens as you like. Also, this is an individual and silent game, so there's no talking to each other or looking at each other's answers. Okay, a few more questions before we move on to make sure everyone understands"

"How many opportunities do you have to give to the bank?
Correct answer: 3
(wait for each individual to give the correct response before moving to the next question).

"How many pieces of tokens can you give to the bank each time?"
Correct answer: 0, 2, or 4
(wait for each individual to give the correct response before moving on).

"Great, there's one more thing before we start the game. If you all together give enough tokens to fill up this collection bank, it means the forest is healthy and producing things we can sell. So if the bank is full by the end of the game, you'll immediately play the game again, but this time you'll play with 24 tokens instead of 12. This is because the forest is growing fast and producing a lot more than before.

However, if by the end of the game y'all have not given enough tokens to fill up the collection bank, we all have to wait 90 seconds in silence until we can play the game again. When we do start the game again, everyone will only get 8 tokens to play the game. This is because not enough money was given to keep the forest healthy. It needs to take time to regrow, and as it's regrowing it's not producing as many things that we can use or sell."

"Ok, a few more questions before we do some practice rounds:"

"What happens if the bank is full by the end of the game?"
Correct Answer: We get to play the game again, but this time we get 24 tokens.
(*wait for each individual to give the correct response before asking next question).*

"What does it mean for the forest if the bank is full at the end of the round"

Correct Answer: It means that enough money was given so the forest IS HEALTHY and can regrow and produce more things that can be sold for money.

"What happens if it is not full by the end of the game?"
Correct answer: we have to wait 90 seconds in silence before we get more tokens to play the game again. We'll only get 8 tokens to play the game this time
(wait for each individual to give the correct response before moving on).

"What does it mean for the forest if the bank is not full by the end of the round?"

Correct Answer: It means that not enough money was provided to keep the forest healthy, so it's now smaller and not producing as much wood that we can sell.

Very good. Now we will have two practice rounds before the game starts.

How many tokens do you want to give to the forest? Write your answer down on the paper and hand it to me. *(2 times)*

(say out loud what each person gave, take the tokens from the bowl and place them in the bank). Write down how many each person gave on the collection sheet. After both practice rounds, return the proper amount of tokens to each participant).

Great! If this were actually the end of the game, those tokens that are left in your bowls are the tokens you can exchange for prizes. Remember each prize is worth 2 tokens.

Great! Now we're going to start the actual game. However two things will change in the actual game. For one, I will not say out loud how many tokens each person gave so that everyone's answers remain secret. (*If the experimenter notices subjects communicating by looking at others' piece of papers or talking to each other, the experimenter will re-iterate that "*Remember this game is individual. Make your decision independently. there's no talking in this game*". If subjects are found communicating repeatedly during the experiment, the experimenter will make a note in her data entry sheet --- i.e. if a subject attempted to communicate more than once, the entire group's data will be throw away.*). Second, I will count up and take all the tokens you decide to give away at the end of the game.

(Trials 1-3) How many tokens do you want to give to the forest? *(Experimenter takes paper from each individual, notes on collection sheet how much each gave, saves the papers in an opaque bag/box. Experimenter also writes down on the whiteboard the breakdown of what*

was given (e.g. two people gave zero tokens, three people gave two tokens and one person gave four tokens). Finally, Experimenter tallies the total and places the corresponding number of tokens in the collection bank.

If the bank is full at the end of the three trials: You gave enough to meet the goal of saving the forest! That means the forest is healthy enough to produce a lot more lumber which can be sold. Because it's producing more, we're going to play the game again, but this time you'll get 24 tokens. Once I give you all your tokens, we can start playing the game all over again with the same rules.

If the bank is not full at the end of the game: You all did not together give enough to keep the forest healthy. That means it's going to take some time for it to regrow. It also means that the forest isn't producing enough lumber. So now we're going to wait here in silence for 90 seconds for the forest to regrow, and then you're only going to get 8 tokens to play the game again. Ready? 90 seconds starts now. (*Experimenter starts the 90 second timer. Once the timer ends, the experimenter distributes 8 more tokens to each participant.* "Ok, now that the 90 seconds is over, everyone is going to get 8 more tokens and we'll play the game again with the same rules."

Regardless of round outcome, participants can play the game up to 3 times total.

"Well, it's the end of the game! Thank you so much for playing. You'll get the prizes from this game at the end of the week. Also, because we want to be fair to everyone, including to those who haven't played this game before, everyone is going to get the same amount of prizes on Friday"

Chapter 3 Study 2: Control Condition Script

Note:
Text in italic = action instead of speech
Text with underline = conditional speech that is not necessary in certain situations

If at any point during the experiment, subjects ask for the purpose of the experiment, the experimenter answers: "I will explain it to you after the game".

"Hello! Today we'll be playing a game where you will be making decisions with these tokens. Everybody gets a bowl of 12 tokens, which can be exchanged for prizes at

the end of the game. Each prize is worth 2 tokens. Does everyone like the different prizes that we have here?"

(*Wait for each participant to reply--need affirmative answer from each participant)*

"In this game, you will make decisions about whether you want to keep the tokens for yourself or give some of the tokens away. The tokens that you give away will be exchanged for money that will go to sustaining nearby forests.

Can you all think of some examples of nearby forests that you have visited? (*answer: Chatahouchee River, Smoky Mountains, Sweetwater Creek, Stone Mountain Park, Appalachian Trail*)

What happens when we cut down too many trees in a forest? (answer: *when there is no lumber to sell, you have to wait for the forest to regrow before there is more lumber to sell, cutting down the forest also affects the air quality, water quality for people and wellbeing and survival of wildlife)*

What are some of the things you do when you visit a forest? (*answer: hiking, camping, self-reflection, hunting, fishing, gathering food, gathering supplies*)

What are some animals you see when you go to a forest? (*answer: squirrels, rabbits, birds, bears, deer, chipmunks, fox, insects, snakes, toads*)

What types of things that we use everyday come from forests? (*answer: lumber, paper, medicine, food, water*)

What happens when we cut down too many trees in a forest? (*answer: here is no lumber to sell and you have to wait for the forest to regrow before there is more lumber to sell, cutting down the forest also affects the air quality, water quality for people and wellbeing and survival of wildlife)*

What happens if we instead don't cut down too many trees at once and we plant lots more trees to replace the ones we've cut down? (*answer: we'll have even more lumber to sell and we don't have to wait for the forest to regrow, air and water stay clean, animals are healthy)*

We're going to play a game about forests. The 12 tokens gifted to you represent money made from selling wood from the forest. In this game, you'll have the option of keeping the tokens for yourself to exchange for prizes at the end of the game, or you can

decide to give money back to the forest to plant more trees to help the forest regrow. The tokens that you give away will go into this collection bank. The bank represents how many tokens you as a group have all together given to plant trees in the forest." (*Experimenter demonstrate how the tokens go into the bank. If subjects ask for the exchange rate for this collection bank, the experimenter answers:* "each token is worth the same as what the prizes cost, so about 10 cents each". *If subjects asked how many slots are in the collection bank, we answer "36", if they didn't ask, we don't specify to keep the math simple)*

"Before we continue, I have a couple questions that you each have to answer:"

"Everyone starts with how many tokens?"
Correct answer: 12
(wait for each individual to give the correct response before moving to next question).

"Where do these tokens come from?"
Correct answer: they come from the money from selling wood from the forest
(wait for each individual to give the correct response before moving to the next question).

"What you can do with the tokens that you keep for yourself after the game?"
Correct answer: exchange for prizes that we can take home
(wait for each individual to give the correct response before moving to the next question).

"What happens to the tokens that you give here to the forest bank?"
Correct answer: the tokens in the bank will be turned into money that go to planting more trees in the forest (wait for each individual to give the correct response before moving on).

"It is important to remember that there are no right or wrong answers in this game. You can give or keep as many of the tokens as you want."

"Very good. When the game begins, you will have three opportunities to decide if you want to give any tokens to the forest. Each time, you can give either 0, 2, or 4 tokens. To let me know how many tokens you want to give away, you will circle the number piece of paper and hand the piece of paper to me. Remember, there are no right or wrong answers in this game. You can give or keep as many of the tokens as you like. Also, this is an individual and silent game, so there's no talking to each other or looking at each others answers. Okay, a few more questions before we move on to make sure everyone understands"

"How many opportunities do you have to give to the bank?
Correct answer: 3

(wait for each individual to give the correct response before moving to the next question).

"How many tokens can you give to the bank each time?"
Correct answer: 0, 2, or 4
(wait for each individual to give the correct response before moving on).

WHETHER YOU FILL UP THE BANK IS UP TO YOU. The more tokens you give to the bank, the healthier the forest becomes. BUT OF COURSE The more tokens you keep for yourself, the more prizes you can have at the end of the game. Whatever tokens you have left at the end of the round can be exchanged for prizes. Remember, there are no right or wrong answers in this game.

Ok, Now we will have practice round before the game starts.

How many tokens do you want to give to the forest? Write your answer down on the paper and hand it to me. *(2 times)*

(say out loud what each person gave, take the tokens from the bowl and place them in the bank). Write down how many each person gave on the collection sheet. After both practice rounds, return the proper amount of tokens to each participant).

Great! If this were actually the end of the game, those tokens that are left in your bowls are the tokens you can exchange for prizes. Remember each prize is worth 2 tokens.

Great! Now we're going to start the actual game. However two things will change in the actual game. For one, I will not say out loud how many tokens each person gave so that everyone's answers remain secret. (*If the experimenter notices subjects communicating by looking at others' piece of papers or talking to each other, the experimenter will re-iterate that "*Remember this game is individual. Make your decision independently. there's no talking in this game*". If subjects are found communicating repeatedly during the experiment, the experimenter will make a note in her data entry sheet --- i.e. if a subject attempted to communicate more than once, the entire group's data will be throw away.*). Second, I will count up and take all the tokens you decide to give away at the end of the game.

(Trials 1-3) How many tokens do you want to give to the forest? *(Experimenter takes paper from each individual, notes on collection sheet how much each gave, saves the papers in an opaque bag/box. Experimenter also writes down on the whiteboard the breakdown of what*

was given (e.g. two people gave zero tokens, three people gave two tokens and one person gave four tokens). Finally, Experimenter tallies the total and places the corresponding number of tokens in the collection bank.

At the end of the three trials. Great! We're going to play the game again. Everyone is going to get 12 more tokens and you'll have the chance again to give to the forest or keep tokens to win prizes at the end. Once I give you all your new tokens, we can start playing the game all over again with the same rules.

Regardless of round outcome, participants can play the game up to 3 times total.

"Well, it's the end of the game! Thank you so much for playing. You'll get the prizes from this game at the end of the week. Also, because we want to be fair to everyone, including to those who haven't played this game before, everyone is going to get the same amount of prizes on Friday"

Appendix C

Study 1: Attitude Assessment Script and Materials

An experimenter asked participants the following questions either before or after they toured the sanctuary and participated in the education program. Experimenters read the questions, said aloud two potential answers (*in parentheses*) and then allowed subjects to indicate their answer by circling the corresponding photo on the answer sheet. The pro-conservation answer is marked with a red "1" on the answer sheet.

1. Which of these photos would you prefer to see on an advertisement for Lola Ya Bonobo?
(*Pet or Wild?)*

2. Which group do you think bonobos belong to? *(Wild Animals or Domesticated Animals)*

3. Which group do you think bonobos belong to? *(Apes or Monkeys?)*

4.Which pictures reminds you more of bonobos? *(Yogis or soldiers?)*

5. Which of these photos would you prefer to see on an advertisement for Lola Ya Bonobo?
(*Pet or Wild?)*

6. Where would you prefer to find bonobos? *(In a market or in a forest?)*

7. Which group do bonobos belong to? *(Humans or pests?)*

8. Which photo better shows the value of the forest?
(Lumber or the standing uncut forest?)

9. Which group do you think bonobos belong to? (*Monkeys or humans?)*

10.Which photo do you think is best for an advertisement about LyB?
(A photo of Africa or a photo of the DRC?)

11.Which group do you think bonobos belong to? *(Humans or objects?)*

12. Which of these photos would you prefer to see on an advertisement for Lola Ya Bonobo?
(*Pet or Wild?)*

Age: _____

Classe:_____

Sexe: _____

Combien des personnes vivent avec toi?:_____

Quand tu manges de la viande, la viande vient d'où?

- ☐ supermarché
- ☐ wenzé
- ☐ je le chasse
- ☐ mes amies/famille le chasse
- ☐ les ports

A

1. 1


2.


1

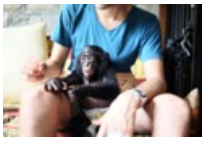
3.


1

4.


1

5. 1

6. 1


A

7.   1

1
8.  

1
9.  

1
10.  

11.   1

12.   1

Chapter 3: Study 2: Knowledge Assessment Materials (translated from original French)

Circle: Before the Tour After the Tour

Instructions: For each question, circle one response.

1. **In which country(s) do bonobos live?**
    a. The Democratic Republic of Congo
    b. All sub-Saharan African countries
    c. All countries in Africa, Indonesia and Borneo
    d. DRC, Rwanda and Uganda

2. **Which of the following is NOT a threat to bonobos?**
    a. Deforestation
    b. War
    c. Predatory Animals
    d. Poaching

3. **True or False**: Bonobos don't suffer when they are killed.

4. **Which of the following is NOT illegal in the DRC?**
    a. Eating bonobos
    b. Killing bonobos
    c. Having a bonobo as a pet
    d. Taking photos or videos of bonobos

5. **True or False:** Unlike humans, bonobos don't need the care of mothers to survive.

6. **Which of the following describes the social organization of bonobos?**
    a. Females are dominant, aggressive behavior
    b. Females are dominant, peaceful behavior
    c. Males are dominant, aggressive behavior
    d. Males are dominant, peaceful behavior

7. **Which of the following is NOT true about eating bonobos?**
    a. Ebola can be transmitted from eating contaminated bonobos.
    b. It is illegal.
    c. It is a threat to the remaining bonobos.
    d. It can cure malaria.

8. **True or False:** Bonobos feel the same emotions as human.

9. **Of the species listed below, which is the LEAST like bonobos?**
    a. Humans
    b. Chimpanzees
    c. Baboons
    d. Orangutans

10. **What should you do if you see a bonobo being sold in the market?**
    a. Buy the bonobo and bring it to Lola Ya Bonobo
    b. Call Lola Ya Bonobo
    c. Buy the Bonobo and return it to the forest
    d. Call the Ministry of Sports

11. **True or False:** Baby bonobos are traumatized when poachers take them from their families.

12. **Why should we save bonobos?**
    a. They are the pride of the Congo and they bring tourists and researchers to the country
    b. If we lose bonobos, we lose the forest.
    c. They are very intelligent, and they help us to better understand ourselves
    d. All of the above

Chapter 3: Study 3: Empathy Assessment Materials

Translation of materials are below image. The pro-empathy response is indicated with a red “1”.

Encerclez : **AVANT LE TOUR** **ou** **APRES LE TOUR** A

Instructions: Encerclez la phrase qui decrit mieux la photo

a. Les bonobos jouent
b. Les bonobos s’amusent 1

a. Le bonobo face à droit
b. Le bonobo voit quelque chose à droit 1

a. Le bonobo veut toucher 1
b. Le bonobo étend son doigt

a. Le bonobo mange la nourriture
b. Le bonobo a faim et veut la nourriture 1

6.

a. La bonobo mère aime son bebe 1
b. La bonobo mère embrasse son bebe

a. Le bonobo orphelin au coin de la boîte a peur 1
b. Le bonobo orphelin s’assied au coin de la boîte

1. The bonobos are playing./**The bonobos are having fun.**

2. The bonobo extends his finger./**The bonobo wants to touch.**

3. **The mother bonobo loves her baby.**/The mother bonobo kisses her baby.

4. The bonobo is facing right./ **The bonobo sees something to his right.**

5. The bonobo eats the food./**The bonobo is hungry and wants the food.**

6. **The orphan bonobo in the corner of the box is scared.**/The orphan bonobo is in the corner of

the box.

References

Abrams, D., Van de Vyver, J., Pelletier, J., & Cameron, L. (2015). Children's prosocial behavioural intentions towards outgroup members. *British Journal of Developmental Psychology*, *33*(3), 277-294.

Allen, M.R., O.P. Dube, W. Solecki, F. Aragón-Durand, W. Cramer, S. Humphreys, M. Kainuma, J. Kala, N. Mahowald, Y. Mulugetta, R. Perez, M. Wairiu, and K. Zickfeld, 2018: Framing and Context. *In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. In Press.

André, C., Kamate, C., Mbonzo, P., Morel, D., & Hare, B. (2008). The Conservation Value of Lola ya Bonobo Sanctuary. *The Bonobos*, 303–322.

Apicella, C. L., & Barrett, H. C. (2016). Cross-cultural evolutionary psychology. *Current Opinion in Psychology*, *7*, 92–97.

Apicella, C. L., & Barrett, H. C. (2016). Cross-cultural evolutionary psychology. *Current Opinion in Psychology*, *7*, 92-97.

Apicella, C. L., & Silk, J. B. (2019). The evolution of human cooperation. *Current Biology*, *29*(11), R447-R450.

Ariely, D., Bracha, A., & Meier, S. (2009). Doing good or doing well? Image motivation and monetary incentives in behaving prosocially. *American Economic Review*, *99*(1), 544-55.

Atance, C. M. (2008). Future thinking in young children. *Current Directions in Psychological Science*, *17*(4), 295-298.

Balliet, W., Kazley, A. S., Johnson, E., Holland-Carter, L., Maurer, S., Correll, J., ... & Baliga, P. (2019). The non-directed living kidney donor: Why donate to strangers?. *Journal of renal care*.

Bateson, P., Gluckman, P., & Hanson, M. (2014). The biology of developmental plasticity and the Predictive Adaptive Response hypothesis. *The Journal of Physiology*, *592*(Pt 11), 2357–68.

Beaune, D., Bretagnolle, F., Bollache, L., Bourson, C., Hohmann, G., & Fruth, B. (2013). Ecological services performed by the bonobo (Pan paniscus): seed dispersal effectiveness in tropical forest. *Journal of Tropical Ecology*, *29*(5), 367-380.

Bereczkei, T., Birkas, B., & Kerekes, Z. (2010). Altruism towards strangers in need: costly signaling in an industrial society. *Evolution and Human Behavior*, *31*(2), 95-103.

Berenguer, J. (2007). The effect of empathy in pro-environmental attitudes and behaviors. *Environment and Behavior*, *39*(2), 269-283.

Blair, R. J. R. (2005). Responding to the emotions of others: dissociating forms of empathy through the study of typical and psychiatric populations. *Consciousness and cognition*, *14*(4), 698-718.

Blake, P. R., McAuliffe, K., & Warneken, F. (2014). The developmental origins of fairness: The knowledge–behavior gap. *Trends in Cognitive Sciences*, *18*(11), 559-561.

Blake, P. R., McAuliffe, K., Corbit, J., Callaghan, T. C., Barry, O., Bowie, A., … Warneken, F. (2015). The ontogeny of fairness in seven societies. *Nature*, *528*(7581), 258–261.

Bowles, S., Boyd, R., Mathew, S., & Richerson, P. J. (2012). The punishment that sustains cooperation is often coordinated and costly. *Behavioral and Brain Sciences*, *35*(1), 20-21.

Boyd, R., & Richerson, P. J. (2009). Culture and the evolution of human cooperation. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1533), 3281-3288.

Boyd, R., Gintis, H., & Bowles, S. (2010). Coordinated punishment of defectors sustains cooperation and can proliferate when rare. *Science*, *328*(5978), 617-620.

Boyd, R., Richerson, P. J., Meinzen-Dick, R., De Moor, T., Jackson, M. O., Gjerde, K. M., ... & McLean, A. R. (2018). Tragedy revisited. *Science*, *362*(6420), 1236-1241.

Brewer, C. (2001). Cultivating conservation literacy:" trickle-down" education is not enough. *Conservation Biology*, *15*(5), 1203-1205.

Buttelmann, D., & Böhm, R. (2014). The ontogeny of the motivation that underlies in-group bias. *Psychological science*, *25*(4), 921-927.

Carleton-Hug, A., & Hug, J. W. (2010). Challenges and opportunities for evaluating environmental education programs. *Evaluation and program planning*, *33*(2), 159-164.

Ceballos, G., Ehrlich, P. R., Barnosky, A. D., García, A., Pringle, R. M., & Palmer, T. M. (2015). Accelerated modern human–induced species losses: Entering the sixth mass extinction. *Science advances*, *1*(5), e1400253.

Chapais, B. (2001). Primate nepotism: what is the explanatory value of kin selection?. *International Journal of Primatology*, *22*(2), 203-229.

Clayton, S., & Myers, G. (2015). *Conservation psychology: Understanding and promoting human care for nature*. John Wiley & Sons.

Clutton-Brock, T. (2009). Cooperation between non-kin in animal societies. *Nature*, *462*(7269), 51.

Costa, D. L., & Kahn, M. E. (2013). Energy conservation "nudges" and environmentalist ideology: Evidence from a randomized residential electricity field experiment. *Journal of the European Economic Association*, *11*(3), 680-702.

Cunningham, W. A., Raye, C. L., & Johnson, M. K. (2004). Implicit and explicit evaluation: fMRI correlates of valence, emotional intensity, and control in the processing of attitudes. *Journal of Cognitive Neuroscience*, *16*(10), 1717-1729.

Curtis, D. (2013). China and the Insecurity of Development in the Democratic Republic of the Congo (DRC). *International Peacekeeping*, *20*(5), 551-569.

Daly, B., & Suggs, S. (2010). Teachers' experiences with humane education and animals in the elementary classroom: implications for empathy development. *Journal of Moral Education*, *39*(1), 101-112.

De Ridder, D. T., & Lensvelt-Mulders, G. (2018). Taking stock of self-control: A meta-analysis of how trait self-control relates to a wide range of behaviors. In *Self-Regulation and Self-Control* (pp. 221-274). Routledge.

DellaVigna, S., List, J. A., & Malmendier, U. (2012). Testing for altruism and social pressure in charitable giving. *The quarterly journal of economics*, *127*(1), 1-56.

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk. *Human Nature*, *20*(2), 204-268.

Engelmann, J. M., Over, H., Herrmann, E., & Tomasello, M. (2013). Young children care more about their reputation with ingroup members and potential reciprocators. *Developmental Science*, *16*(6), 952–958.

Eom, K., Kim, H. S., Sherman, D. K., & Ishii, K. (2016). Cultural Variability in the Link Between Environmental Concern and Support for Environmental Action.

Estrada, A., Garber, P. A., Rylands, A. B., Roos, C., Fernandez-Duque, E., Di Fiore, A., ... & Rovero, F. (2017). Impending extinction crisis of the world's primates: Why primates matter. *Science advances*, *3*(1), e1600946.

Fehr, E., Bernhard, H., & Rockenbach, B. (2008). Egalitarianism in young children. *Nature*, *454*(7208), 1079.

Frankenhuis, W. E., Panchanathan, K., & Nettle, D. (2015). Cognition in harsh and unpredictable environments. *Current Opinion in Psychology*, 1–5.

Frey, B. S. (1994). How intrinsic motivation is crowded out and in. *Rationality and society*, *6*(3), 334-352.

Fruth, B., Hickey, J.R., André, C., Furuichi, T., Hart, J., Hart, T., Kuehl, H., Maisels, F., Nackoney, J., Reinartz, G., Sop, T., Thompson, J. & Williamson, E.A. 2016. *Pan paniscus* (errata version published in 2016). *The IUCN Red List of Threatened Species*2016: e.T15932A102331567. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T15932A17964305.en. Downloaded on 30 May 2019.

Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of consumer Research*, *35*(3), 472-482.

Gollier, C. (2010). Ecological discounting. *Journal of economic theory*, *145*(2), 812-829.

Griskevicius, V., Tybur, J. M., & Van den Bergh, B. (2010). Going green to be seen: status, reputation, and conspicuous conservation. *Journal of personality and social psychology*, *98*(3), 392.

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: a life history theory approach. *Journal of Personality and Social Psychology*, *100*(6), 1015–1026.

Hardin, G. (1968). The Tragedy of the Commons. *Science*, *162*(3859), 1243–1248.

Hare, B. (2017). Survival of the friendliest: Homo sapiens evolved via selection for prosociality. *Annual review of psychology*, *68*, 155-186.

Hare, B., Wobber, V., & Wrangham, R. (2012). The self-domestication hypothesis: evolution of bonobo psychology is due to selection against aggression. *Animal Behaviour*, *83*(3), 573-585.

Hauser, O. P., Rand, D. G., Peysakhovich, A., & Nowak, M. A. (2014). Cooperating with the future. *Nature*, *511*(7508), 220.

Heilbronner, S. R., Rosati, A. G., Stevens, J. R., Hare, B., & Hauser, M. D. (2008). A fruit in the hand or two in the bush? Divergent risk preferences in chimpanzees and bonobos. *Biology Letters*, *4*(3), 246–249.

Henrich, J. *et al.* Markets, religion, community size, and the evolution of fairness and punishment. *Science.* 327(201), 1480–1484.

Henrich, J. P., Boyd, R., Bowles, S., Fehr, E., Camerer, C., & Gintis, H. (Eds.). (2004). *Foundations of human sociality: Economic experiments and ethnographic evidence from fifteen small-scale societies*. Oxford University Press on Demand.

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., ... & Henrich, N. S. (2005). "Economic man" in cross-cultural perspective: Behavioral experiments in 15 small-scale societies. *Behavioral and brain sciences*, *28*(6), 795-815.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). Most people are not WEIRD. *Nature*, *466*(7302), 29.

Henrich, J., McElreath, R., Barr, A., Ensminger, J., Barrett, C., Bolyanatz, A., … Ziker, J. (2006). Costly punishment across human societies. *Science (New York, N.Y.)*, *312*(5781), 1767–1770.

Hermes, H., Hett, F., Mechtel, M., Schmidt, F., Schunk, D., & Wagner, V. (2019). Do children cooperate conditionally? Adapting the strategy method for first-graders. *Journal of Economic Behavior & Organization*.

Hickey, J.R., Basabose, A., Gilardi, K.V., Greer, D., Nampindo, S., Robbins, M.M. & Stoinski, T.S. 2018. *Gorilla beringei ssp. beringei*. *The IUCN Red List of Threatened Species* 2018: e.T39999A17989719. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T39999A17989719.en. Downloaded on 30 May 2019.

House, B. R., Silk, J. B., Henrich, J., Barrett, H. C., Scelza, B. A., Boyette, A. H., ... & Laurence, S. (2013). Ontogeny of prosocial behavior across diverse societies. *Proceedings of the National Academy of Sciences*, *110*(36), 14586-14591.

Humle, T., Maisels, F., Oates, J.F., Plumptre, A. & Williamson, E.A. 2016. *Pan troglodytes* (errata version published in 2018). *The IUCN Red List of Threatened Species* 2016: e.T15933A129038584. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T15933A17964454.en. Downloaded on 30 May 2019.

Jacobson, S. K. (1987). Conservation education programmes: Evaluate and improve them. *Environmental Conservation*, *14*(03), 201-206.

Jacobson, S. K., & McDuff, M. D. (1997). Success factors and evaluation in conservation education programmes. *International Research in Geographical & Environmental Education*, *6*(3), 204-221.

Jacquet, J., Hagel, K., Hauert, C., Marotzke, J., Röhl, T., & Milinski, M. (2013). Intra-and intergenerational discounting in the climate game. *Nature climate change*, *3*(12), 1025.

Jacquet, J., Hauert, C., Traulsen, A., & Milinski, M. (2011). Shame and honour drive cooperation. *Biology letters*, *7*(6), 899-901.

Jha, S., & Bawa, K. S. (2006). Population growth, human development, and deforestation in biodiversity hotspots. *Conservation Biology*, *20*(3), 906–912.

Johnson-Pynn, J. S., & Johnson, L. R. (2005). Successes and challenges in East African conservation education. *The Journal of Environmental Education*, *36*(2), 25-39.

Jordan, J. J., McAuliffe, K., & Warneken, F. (2014). Development of in-group favoritism in children's third-party punishment of selfishness. *Proceedings of the National Academy of Sciences*, *111*(35), 12710-12715.

Keil, J., Michel, A., Sticca, F., Leipold, K., Klein, A. M., Sierau, S., ... & White, L. O. (2017). The Pizzagame: a virtual public goods game to assess cooperative behavior in children and adolescents. *Behavior research methods*, *49*(4), 1432-1443.

Kintz, B. L., Delprato, D. J., Mettee, D. R., Persons, C. E., & Schappe, R. H. (1965). The experimenter effect. *Psychological Bulletin*, *63*(4), 223.

Koomen, R., & Herrmann, E. (2018). An investigation of children's strategies for overcoming the tragedy of the commons. *Nature Human Behaviour*, *2*(5), 348.

Kruse, C. K., & Card, J. A. (2004). Effects of a conservation education camp program on campers' self-reported knowledge, attitude, and behavior. *The Journal of Environmental Education*, *35*(4), 33-45.

Langergraber, K. E., Mitani, J. C., & Vigilant, L. (2007). The limited impact of kinship on cooperation in wild chimpanzees. *Proceedings of the National Academy of Sciences*, *104*(19), 7786-7790.

Langergraber, K., Mitani, J., & Vigilant, L. (2009). Kinship and social bonds in female chimpanzees (Pan troglodytes). *American Journal of Primatology: Official Journal of the American Society of Primatologists*, *71*(10), 840-851.

Lichter, D. T., Shanahan, M. J., & Gardner, E. L. (2002). Helping others? The effects of childhood poverty and family instability on prosocial behavior. *Youth & Society*, *34*(1), 89-119.

Maisels, F., Bergl, R.A. & Williamson, E.A. 2018. *Gorilla gorilla* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2018: e.T9404A136250858. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T9404A136250858.en. Downloaded on 30 May 2019.

Mathew, S., & Boyd, R. (2011). Punishment sustains large-scale cooperation in prestate warfare. *Proceedings of the National Academy of Sciences*, *108*(28), 11375-11380.

Meleady, R., & Seger, C. R. (2017). Imagined contact encourages prosocial behavior towards outgroup members. *Group Processes & Intergroup Relations*, *20*(4), 447-464.

Melis, A. P., & Semmann, D. (2010). How is human cooperation different?. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *365*(1553), 2663-2674.

Miles, L., Caldecott, J., & Nellemann, C. (2005). Challenges to great ape survival. *World Atlas of great apes and their conservation*, 217-241

Milinski, M., Semmann, D., & Krambeck, H. J. (2002). Reputation helps solve the 'tragedy of the commons'. *Nature*, *415*(6870), 424.

Milinski, M., Sommerfeld, R. D., Krambeck, H.-J., Reed, F. a, & Marotzke, J. (2008). The collective-risk social dilemma and the prevention of simulated dangerous climate change. *Proceedings of the National Academy of Sciences of the United States of America*, *105*(7), 2291–2294.

Mitani, J. C. (2009). Cooperation and competition in chimpanzees: current understanding and future challenges. *Evolutionary Anthropology: Issues, News, and Reviews: Issues, News, and Reviews*, *18*(5), 215-227.

Mittal, C., & Griskevicius, V. (2014). Sense of Control Under Uncertainty Depends on People's Childhood Environment: A Life History Theory Approach. *Journal of Personality and Social Psychology*, *107*(4), 621–637.

Moore, C. (2009). Fairness in children's resource allocation depends on the recipient. *Psychological Science*, *20*(8), 944–948.

Myers, O. E., Saunders, C. D., & Garrett, E. (2003). What Do Children Think Animals Need? Aesthetic and Psycho-social Conceptions. *Environmental Education Research*, *9*(3), 305–325.

Nasi, R., Taber, A., & Van Vliet, N. (2011). Empty forests, empty stomachs? Bushmeat and livelihoods in the Congo and Amazon Basins. *International Forestry Review*, *13*(3), 355-368..

Negra, Christine, and Robert E. Manning. "Incorporating environmental behavior, ethics, and values into nonformal environmental education programs." *The Journal of Environmental Education* 28.2 (1997): 10-21.

Norris, K. S., & Jacobson, S. K. (1998). Content analysis of tropical conservation education programs: Elements of success. *The Journal of Environmental Education*, *30*(1), 38-44.

Nosek, B. A. (2005). Moderators of the relationship between implicit and explicit evaluation. *Journal of Experimental Psychology: General*, *134*(4), 565.

Nowak, M. A. (2006). Five rules for the evolution of cooperation. *science*, *314*(5805), 1560-1563.

Ostrom, E. (2003). How Types of Goods and Property Rights Jointly Affect Collective Action, *15*(3), 239–270.

Paul, E. S. (2000). Empathy with animals and with humans: Are they linked?. *Anthrozoös*, *13*(4), 194-202.

Reeson, A. F., & Tisdell, J. G. (2008). Institutions, motivations and public goods: An experimental test of motivational crowding. *Journal of Economic Behavior & Organization*, *68*(1), 273-281.

Root-Bernstein, M., Root-Bernstein, M., & Root-Bernstein, R. O. B. E. R. T. (2014). Tools for thinking applied to nature: an inclusive pedagogical framework for environmental education. *Oryx*, *48*(04), 584-592.

Rosati, A. G., & Hare, B. (2012). Decision making across social contexts: Competition increases preferences for risk in chimpanzees and bonobos. *Animal Behaviour*, *84*(4), 869–879.

Rosati, A. G., & Hare, B. (2013). Chimpanzees and Bonobos Exhibit Emotional Responses to Decision Outcomes. *PLoS ONE*, *8*(5).

Rosati, A. G., DiNicola, L. M., & Buckholtz, J. W. (2018). Chimpanzee Cooperation Is Fast and Independent From Self-Control. *Psychological science*, *29*(11), 1832-1845.

Ross, S. R. (2014). Captive chimpanzees. *The ethics of captivity*, 57-76.

Ruffman, T., Slade, L., & Crowe, E. (2002). The relation between children's and mothers' mental state language and theory-of-mind understanding. *Child development*, *73*(3), 734-751.

Santos, F. C., & Pacheco, J. M. (2011). Risk of collective failure provides an escape from the tragedy of the commons. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(26), 10421–10425.

Sevillano, V., Aragonés, J. I., & Schultz, P. W. (2007). Perspective taking, environmental concern, and the moderating role of dispositional empathy. *Environment and behavior*, *39*(5), 685-705.

Sheeder, R. J., & Lynne, G. D. (2011). Empathy-conditioned conservation: "Walking in the shoes of others" as a conservation farmer. *Land Economics*, *87*(3), 433-452.

Shkurko, A. V. (2012). Is social categorization based on relational ingroup/outgroup opposition? A meta-analysis. *Social cognitive and affective neuroscience*, *8*(8), 870-877.

Signal, T. D., & Taylor, N. (2007). Attitude to animals and empathy: Comparing animal protection and general community samples. *Anthrozoös*, *20*(2), 125-130.

Silk, J. B. (2002). Kin selection in primate groups. *International Journal of Primatology*, *23*(4), 849-875.

Silk, J. B. (2006). Practicing Hamilton's rule: kin selection in primate groups. In *Cooperation in primates and humans* (pp. 25-46). Springer, Berlin, Heidelberg.

Silk, J. B., & House, B. R. (2011). Evolutionary foundations of human prosocial sentiments. *Proceedings of the National Academy of Sciences*, *108*(Supplement 2), 10910-10917.

Smith, A. (1978). Lawrence Kohlberg's cognitive stage theory of the development of moral judgment. *New Directions for Student Services*, (1958).

Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis: An International Journal*, *32*(6), 957-972.

Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors and goals. *Journal of Environmental psychology*, *38*, 104-115.

Steinberg, L., Graham, S., O'Brien, L., Woolard, J., Cauffman, E., & Banich, M. (2009). Age differences in future orientation and delay discounting. *Child development*, *80*(1), 28-44.

Strayer, F. F., Wareing, S., & Rushton, J. P. (1979). Social constraints on naturally occurring preschool altruism. *Ethology and Sociobiology*, *1*(1), 3-11.

Struhsaker, T. T., Struhsaker, P. J., & Siex, K. S. (2005). Conserving Africa's rain forests:Problems in protected areas and possible solutions. *Biological Conservation*, *123*(1), 45–54.

Symons, D. K. (2004). Mental state discourse, theory of mind, and the internalization of self–other understanding. *Developmental Review*, *24*(2), 159-188.

Tam, K. P. (2013). Dispositional empathy with nature. *Journal of environmental psychology*, *35*, 92-104.

Tamura, M. (2018). Giving and Anonymous Giving for Signaling. In *Economic Signals* (pp. 23-35). Springer, Singapore.

Tan, J., & Hare, B. (2013). Bonobos share with strangers. *PLoS One*, *8*(1), e51922.

Tan, J., Ariely, D., & Hare, B. (2017). Bonobos respond prosocially toward members of other groups. *Scientific reports*, *7*(1), 14733.

Tomasello, M. (2014). The ultra-social animal. *European Journal of Social Psychology*, *44*(February 2014), 187–194.

Trivers, R. L. (1971). The evolution of reciprocal altruism. *The Quarterly review of biology*, *46*(1), 35-57.

Van der Linden, S. (2015). The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology*, *41*, 112-124.

Victor, D. G. (2006). Toward effective international cooperation on climate change: Numbers, interests and institutions. *Global environmental politics*, *6*(3), 90-103.

Vogelsang, M., Jensen, K., Kirschner, S., Tennie, C., & Tomasello, M. (2014). Preschoolers are sensitive to free riding in a public goods game. *Frontiers in psychology*, *5*, 729.

Volz, K. G., Kessler, T., & von Cramon, D. Y. (2009). In-group as part of the self: in-group favoritism is mediated by medial prefrontal cortex activation. *Social neuroscience*, *4*(3), 244-260.

Vugt, M. Van. (2009). Averting the Tragedy of the Commons, *18*(3), 169–174.

Wang, M., Rieger, M. O., & Hens, T. (2016). How time preferences differ: Evidence from 53 countries. *Journal of Economic Psychology*, *52*, 115-135.

Warneken, F. (2015). Precocious Prosociality: Why Do Young Children Help? *Child Development Perspectives*, *9*(1), 1–6.

Warneken, F., & Tomasello, M. (2008). Extrinsic rewards undermine altruistic tendencies in 20-month-olds. *Developmental psychology*, *44*(6), 1785.

Warneken, F., & Tomasello, M. (2013). The emergence of contingent reciprocity in young children. *Journal of experimental child psychology*, *116*(2), 338-350.

Warneken, F., Hare, B., Melis, A. P., Hanus, D., & Tomasello, M. (2007). Spontaneous altruism by chimpanzees and young children. *PLoS biology*, *5*(7), e184.

Wendling, Z.A.,Emerson,J.W.,Esty,D.C.,Levy,M.A.,deSherbinin,A.,etal.(2018). *2018 Environmental Performance Index.* New Haven, CT: Yale Center for Environmental Law & Policy. https://epi.yale.edu/

Wilkie, D. S., & Carpenter, J. F. (1999). Bushmeat hunting in the Congo Basin: an assessment of impacts and options for mitigation. *Biodiversity & Conservation*, *8*(7), 927-955.

World Health Organization. (2019). *China.* Retrieved from https://www.who.int/countries/chn/en/

World Health Organization. (2019). *Democratic Republic of the Congo.* Retrieved from https://www.who.int/countries/cod/en/

World Health Organization. (2019). *United States of America.* Retrieved from https://www.who.int/countries/usa/en/

Yang, F., Choi, Y. J., Misch, A., Yang, X., & Dunham, Y. (2018). In Defense of the Commons: Young Children Negatively Evaluate and Sanction Free Riders. *Psychological science*, *29*(10), 1598-1611.

Zafar, A. (2007). The growing relationship between China and Sub-Saharan Africa: Macroeconomic, trade, investment, and aid links. *The World Bank Research Observer*, *22*(1), 103-130.

Zoratto, F., Oddi, G., Gori, E., Micucci, A., Petrillo, F. De, Paglieri, F., & Adriani, W. (2018). Social modulation of risky decision-making in rats (Rattus norvegicus)

and tufted capuchin monkeys (Sapajus spp .). *Behavioural Brain Research*, *347*(November 2017), 37–48.

Biography

Aleah graduated from Harvard University with a Bachelor of Arts in Human Evolutionary Biology in 2013 where she studied cross-cultural perceptions of fairness and inequality. She joined the Department of Evolutionary Anthropology at Duke as a graduate student in 2013. Her research combines methods from psychology and behavioral economics to understand how populations develop attitudes towards wildlife and conservation. Much of her work relies on cross cultural comparisons between populations in the United States, the Democratic Republic of the Congo, and China. She strives to use evidence-based approaches to develop population-specific strategies for conservation marketing and education. During her time at Duke, Aleah worked with Zoo Atlanta, Friends of Bonobos, and the Jane Goodall Foundation to apply insights from conservation psychology into educational and media initiatives. Aleah is a National Science Foundation Graduate Research Fellow and a Duke Dean's Graduate Fellowship recipient. In 2019 she was named a Beijer Young Scholar at the Beijer Institute of Ecological Economics at the Swedish Royal Academy of Sciences. She will receive her doctorate in Evolutionary Anthropology from Duke University in September 2019.