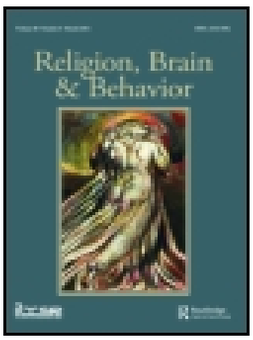

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High levels of rule-bending in a minimally religious and largely egalitarian forager population

Coren Lee Apicella

Department of Psychology, University of Pennsylvania, Solomon Laboratories, Philadelphia, PA, USA

ABSTRACT

Our species' biological success is unsurpassed – an achievement largely accredited to our remarkable capacity to cooperate. Large-scale cooperation, however, remains a puzzle. Recent work suggests that belief in the existence of omnipresent and omnipotent moralistic deities may have contributed to the emergence and maintenance of cooperation in large-scale societies. This study examines the relationship between religiosity and cooperation in the Hadza, one of the few remaining hunter-gatherer populations in the world. Hadza were surveyed about their religious beliefs and participated in two incentivized economic games, designed to measure rule-bending in favor of one's campmates (game 1) and self (game 2) at the expense of Hadza living in other camps. Consistent with previous ethnographic descriptions, the Hadza engage in few religious practices and lack a strong belief in the existence of powerful and moralizing deities. The Hadza also show very high levels of rule-bending. There is, however, little evidence that belief in moralistic deities is associated with decreased rule-bending within the Hadza. Instead, the findings suggest that rule-bending for one's campmates increases as the proportion of kin in one's camp increases. Also, Hadza living in a geographic region close to markets and increased tourism exhibit greater rule-bending in favor of self compared to more isolated Hadza. The high levels of rule-bending and low levels of religiosity observed in the Hadza are discussed in light of the strong norms of sharing and egalitarianism that characterize their lives.

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1. Introduction

It has been suggested that religiosity can enhance prosocial behavior (Atran & Henrich, 2010; Johnson & Bering, 2006; Norenzayan & Shariff, 2008). Specifically, it is thought that belief in omniscient and morally attentive deities motivates altruism by activating psychological mechanisms associated with reputation management and punishment avoidance. This study examines the relationship between religion and morality in Hadza hunter-gatherers. The Hadza offer two important contributions to understanding the evolution of religion and morality. First, the Hadza are one of the few populations in the world to have been described as having a minimalist form of religion, where individuals engage in few religious practices and show disbelief in the existence of powerful supernatural agents with moralizing concerns. Second, the Hadza continue to subsist day to day primarily by means of hunting and gathering, thus providing one of the few models available for how our ancestors may have lived in the absence of technological advancements, such as agriculture.[1]

CONTACT Coren Lee Apicella capicella@psych.upenn.edu
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This introduction provides an overview of Hadza life focusing on their social organization, supernatural beliefs, and cultural practices.[2]

1.1. Social organization

The Hadza are a population of hunter-gatherers who occupy a savannah-woodland type environment in northern Tanzania. It is estimated that 1000 individuals identify as "Hadza," though only 300–400 of them still subsist by means of hunting and gathering (Marlowe, 2010). It is this smaller subgroup that is the focus of this research.

The Hadza live in small groups or "camps" that number approximately 30 individuals, but camp sizes fluctuate in size. In dry seasons, camps tend to grow due to the reduced number of watering holes (Woodburn, 1968) and the greater concentration of game assembling near the water sources (Bunn, Bartram, & Kroll, 1988). Entire camps also shift location every seven to eight weeks as resources near the camp are depleted (Marlowe, 2005, 2010). Hadza residence is characterized by fission-fusion grouping: camps occasionally divide into smaller groups or fuse into larger groups. Finally, camp membership is also fluid, with individuals moving frequently between camps.

Camps generally consist of two to three extended families and many individuals end up co-residing with their siblings (Hill et al., 2011). Like the majority of foraging societies in the ethnographic record, the Hadza are multi-local (Marlowe, 2004b), meaning that couples may live with the wife's family, the husband's family, or neither family. While the Hadza show a preference for living with genetic relatives, affinal kin and friends are also frequently chosen as campmates (Apicella, Marlowe, Fowler, & Christakis, 2012). Also, individuals who engage in ritualistic acts with one another are more likely to interact in the future (Hill, Wood, Baggio, Hurtado, & Boyd, 2014).

Labor is divided between the sexes. Men tend to target animal-based resources and honey while women target plant-based foods. Men hunt alone during the day and will target animals of all sizes, from birds to zebra. Occasionally, pairs of men will hunt together at night by setting up a blind near a water source to ambush animals that approach. Women typically forage together in small groups. Men also forage for plant-based foods when they have been unsuccessful in securing meat or honey.

1.2. Economic and political life

The Hadza are remarkably egalitarian (Woodburn, 1982). Acquired foods are brought back to a central location and shared fairly evenly with all camp members (Hawkes, O'Connell, & Blurton Jones, 2001), though some items are shared more widely. Shared items tend to be larger (e.g., meat) or require extended processing (e.g., tubers), making it more difficult for individuals to hide or consume the goods immediately (Marlowe, 2010). Meat is occasionally shared between camps when packages are sufficiently large. While meat is shared widely, recent evidence suggests that the producer and his family receive larger shares than other group members (Wood & Marlowe, 2013). This finding suggests that men may not solely hunt for reputational benefits (Hawkes & Bliege Bird, 2002), but also as a means of provisioning their families.

High levels of egalitarianism also extend into other areas of Hadza life (Woodburn, 1982). While only a few personal possessions exist, inequality in material possessions is discouraged (Marlowe, 2010). This may be one reason why the Hadza show less psychological attachment toward owned items (Apicella, Azevedo, Christakis, & Fowler, 2014). Historically, the Hadza have not recognized land rights and camps do not claim ownership over natural resources (Woodburn, 1968). In the last few years though, the Hadza have successfully worked to secure land rights from the Tanzanian government. These actions are in response to the encroachment of other populations onto their land, which has diminished the size and quality of their habitat (Madsen, 2000). Nevertheless, the Hadza recognize the land as belonging to all Hadza.

The Hadza are also non-hierarchical and while men are dominant to women, the difference is minor relative to other populations (Marlowe, 2010). Without any leaders, the Hadza make their

decisions together as a group. Age does appear to afford individuals added respect but older individuals are not thought to be more powerful than their younger counterparts. Likewise, better hunters do not appear to have more political or social power (Marlowe, 2010), though this has not been empirically tested.[3] The Hadza also do not have any labor specializations apart from those based on sex (Marlowe, 2010). Each man is capable of manufacturing his own bows and arrows, hunting, creating fire, and so on. Similarly, all Hadza women are capable of performing all female-typical tasks. Consequently, there is very little trading of labor and materials among the Hadza themselves.

1.3. Religious beliefs and rituals

Anthropologists have described the Hadza as having either no religion or a minimal form of religion since there are no religious structures, leaders, ceremonies, or belief in an afterlife (for a review, see Marlowe, 2010). However, it is claimed that they do have a cosmology that includes the female sun (*Ishoko*), the male moon (*Seta*), and their children, who are the stars. The Hadza have also referred to both *Ishoko* and *Haine* as gods, but there is confusion about exactly what this means. Marlowe (2010) suggests that *Haine* is the necessary male version of *Ishoko* but does not elaborate. In a book written by a Hadza man, *Haine* is called a sun, and like *Ishoko*, *Haine* is described as the mate of *Seta* (Bala, 1998). Prior to commencing the current study, I conducted in-depth questioning with a small but separate group of adult Hadza men and women ($N = 13$) about their religious beliefs and practices, herein referred to as religious landscape informants (RLIs). When asked to name all their gods, four RLIs claimed to not know or believe in a god, eight said they believed in *Haine*, and three reported belief in *Ishoko*. Of those who reported belief in *Ishoko*, two claimed that *Ishoko* was just a sun[4] and the third said that *Ishoko* was the same as *Haine*. One RLI said that *Haine* was the same as *Mungu*, which is the Swahili word for God. This informant also explained that *Haine* is the god for everyone, not just the Hadza. Another RLI claimed that *Haine* resembles a *muzungu* (white person), but no other Hadza provided physical descriptions of *Haine*. Given these responses, it is possible that *Haine* represents the Christian God to some Hadza.

All 68 participants in the current study were surveyed about their beliefs in *Haine* and *Ishoko* and the responses were similar. Approximately 76% of respondents said they believed in *Haine*, while 17% said they did not. The remaining participants (6%) reported that they did not know whether *Haine* exists. When asked whether they believe in *Ishoko*, 60% of respondents said yes, 34% said no, and 6% claimed to not know. Fifty percent of Hadza reported believing in both *Ishoko* and *Haine*, but most of those who believed in both (82%) stated that they are the same god. Some Hadza claimed to not believe in either *Ishoko* or *Haine* (7.4%) and a few others (5.9%) claimed that they do not know whether either exists.[5] Interestingly, only seven individuals reported believing in just *Ishoko* but most of them, when questioned further, either did not know or did not believe that *Ishoko* has any supernatural capabilities such as knowing what people are feeling or choosing what happens to people after they die. These findings suggest that *Haine* is the primary god for the Hadza. And while many Hadza incorporate *Ishoko* into their belief of *Haine*, *Ishoko* on its own usually refers to just the physical sun.

The data from this study suggest that many Hadza believe in a god. However, their conception of this god is both variable and limited. Figure 1 illustrates participants' beliefs about the abilities of *Haine*. Of those Hadza who believe in *Haine*, about 40–60% of them either do not know or do not believe that the deity has supernatural powers, such as the ability to know what people are feeling or the ability to control what happens to people after death. Some of the variability in their answers may reflect the fact that they do not have an organized belief system. On the other hand, some inconsistencies could reflect the recent influence of Christian missionaries who have periodically attempted to convert the Hadza over the last few decades. While Marlowe (2010) claims that there has been little conversion to Christianity, he notes that many children and teenagers sing Christian songs.

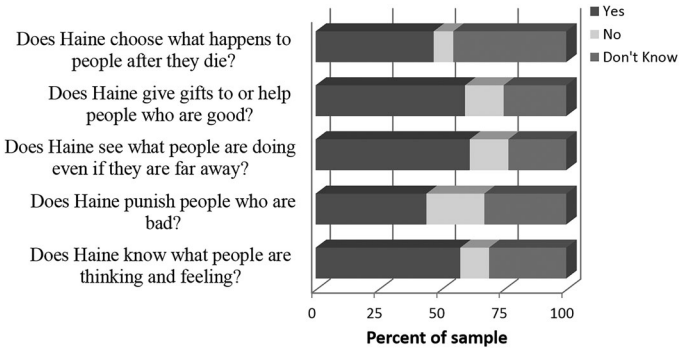

Figure 1. Graph showing the percentage of those participants who believe in *Haine* and also think he has different capabilities.

The Hadza are said to have a creation story of how they came to be on the earth. Marlowe (2010) recounts a description of this story, as originally told by a Swede in the 1960s and recorded by Matthiessen and Porter (1972), which involves humans either climbing down to earth from a baobab tree or on the neck of a giraffe. About half of the RLIs in the current study claimed to not know how the earth started or how people came into existence. One Hadza said that *Ishoko* created the world and the remaining RLIs said that *Haine* created the world. Not a single Hadza evoked the use of giraffes or trees in their accounts.

The Hadza have many other varied myths and stories about the past. For instance, there are stories that depict the ancestors of the Hadza as giants (Marlowe, 2010) and ancestors of some animals as human. Kohl-Larsen (1956) describes a story where a group of humans killed and ate *Haine*, and as a result, *Ishoko* punished those humans by turning them into hyenas. More than one Hadza story chronicles the behavioral origins of different tribes. Kohl-Larsen (1956) retells a story where *Ishoko* demanded that different tribes swallow her spit, and if they obeyed, they were given livestock and/or the ability to hoe. The Hadza refused to swallow *Ishoko*'s spit and were only allowed to eat what the lands provided them. In another story, the Hadza were not relegated to hunting and gathering, but instead were asked by *Haine* to choose a tool. The Hadza chose the bow and arrow but other tribes selected hoes, spears, and guns (Bala, 1998).

When I asked the RLIs what happens after death, most either did not know or did not think there was an afterlife (see Table S1 in the online supplementary material for all answers). In fact, many answers evoked earthly accounts rather than spiritual accounts. For instance, a number of participants spoke about the body getting buried and people crying. That said, a few RLIs discussed the possibility of their souls going to heaven, suggesting that some may believe in mind-body dualism.

The Hadza engage in few sacred rituals and have few supernatural beliefs, but those that they have generally involve *Epeme*, which embodies ideas of manhood, meat or hunting, and the new moon (Woodburn, 1964). When a man reaches adulthood by either killing a large animal or by reaching middle age, he becomes an *Epeme* man. This allows him to eat parts of large animals (e.g., lungs, kidneys, and hearts) that young males and women are not allowed to eat or even witness eating. *Epeme* men cook and consume the meat together outside of their camp. It is forbidden for an *Epeme* man to eat the meat alone. Violation of *Epeme* rules is thought to result in sickness or death. Instances of misfortune in others are often attributed to *Epeme* rule violations as opposed to other violations, such as adultery and theft (Marlowe, 2010).

The *Epeme* dance is a sacred ritual involving dance and song that occurs when there is no moon and during the time of night when there is maximal darkness (for an overview, see Skaanes, 2015). Only *Epeme* men dance but children and women are present. Children usually sleep and women clap their hands and sing back to men. It is thought that the dance helps to unify the group, heal those who violated *Epeme* rules, and provides men with good fortune during hunting (Marlowe, 2010;

Woodburn, 1964). When I asked Hadza about the *Epeme* dance, many claimed that it was dangerous for them to discuss it. However, some did talk about it and stated that it is a Hadza tradition and they do it for themselves, not a god. While some claim that nothing bad will happen if they do not do the dance, it can be used to bring rain and good fortune, to heal the sick, and to make people happy. It is also possible that these rituals serve to cement bonds between individuals (see Hill et al., 2014).

Few sacred or religious places exist in Hadzaland. In fact, most RLIs said that there were no sacred places or if there were, they had never been. The most common sacred location, identified by multiple RLIs, is Dundubii, located on the eastern side of Lake Eyasi on top of a small mountain. At the top of the mountain there are three rocks that can be used as lithophones. The Hadza described these rocks to me as a family consisting of the mother, father, and child who make sounds when touched. One informant told me that the Hadza do not go there anymore but their ancestors used to go there to do *Epeme*. Another informant told me that he went once in order to pray to his ancestors and ask for things. He claimed that he did not know if the ghosts of his ancestors were there but that *Haine* may have created it. One informant mentioned Galatu Mountain as a special place for praying to ancestors when there is no meat. Though neither prayer nor sacrifice were included in the account of this Hadza, the Ujamaa Community Resource Trust of Tanzania conducted a cultural mapping project of the Hadza in 2007 and similarly concluded that Galatu Mountain was a sacred place, potentially frequented by Hadza for prayer and sacrifice to *Haine*. Finally, one RLI claimed that Mount Oldeani was another sacred place because many of their ancestors are buried there. Thus, while some Hadza have heard of sacred places, many have never visited.

Hadza men occasionally play a game, *lukuchuko*, where they compete with one another for arrows and other personally owned objects by throwing discs of bark against a tree; the winner is determined by how the bark lands. While skill in throwing may shift the odds in a person's favor, the game is largely chance-based (Woodburn, 1982). There is some disagreement over how much the Hadza play *lukuchuko*. Marlowe (2010) reports that the Hadza play this game infrequently, while Woodburn (1982) reports that the Hadza spend most of their time playing this game. Nevertheless, these accounts suggest that the Hadza do have experience with games involving chance outcomes.

1.4. Influence of other groups

Over the past few decades, the Hadza have had considerable interactions with neighboring groups with varying subsistence regimes (Marlowe, 2002). Despite this contact, evidence suggests that many aspects of Hadza life remain relatively intact. Comparisons of the earliest recorded descriptions and photographs of the Hadza (see Obst, 1912) to current descriptions and pictures suggest that their daily lives have changed very little over the past century (Marlowe, 2010). For instance, the Hadza have maintained their language, Hadzane, a linguistic isolate. Moreover, residence patterns, diet composition, and marital practices have changed very little since their first recordings (Blurton Jones, Hawkes, & O'Connell, 2005; Marlowe, 2010).

Of greater consequence to Hadza life and culture may be the influence of ethno-tourists who usually come from Western countries to visit the Hadza. Ethno-tourism has been increasing in frequency during the last 5–15 years. During visits, which last about two hours, the Hadza will sing and dance and demonstrate how to make fire and shoot arrows. They also manufacture porcupine-spine necklaces and arrows to sell to tourists (Apicella et al., 2014). While the majority of the visits have largely been confined to regions close to the Tanzanian village of Mangola, due to its proximity to roads that lead to safari parks, tourists can now be found in every region of Hadzaland. Sometime between 2010 and 2013 the Hadza also built a cultural center in Mangola where tourists are required to visit and pay fees. At the same time, camps located in Mangola settled on a fixed daily price for visiting tourists and researchers. Unlike previous visits, there is no room for negotiating the fee. Only two studies have explicitly compared groups of Hadza with more and less exposure to tourism and the results were mixed. One study documented a difference in the presence of a cognitive bias (e.g., the endowment effect) between Mangola Hadza and more isolated camps (Apicella et al., 2014),

while another study found no discernible differences in a number of social network measures (Apicella et al., 2012). The implications of ethno-tourism and exposure to Western life on Hadza behavior may not be fully realized. The current study will consider the influence of living in Mangola on levels of rule-bending.

2. Methods

2.1. Participants

Thirty-seven adult men and 31 women between the ages of 19 and 71 years ($M = 39.82$, $SD = 12.08$) were recruited from nine different Hadza camps on the eastern side of Lake Eyasi (Figure 2) during July 2013 to play two Random Allocation Games (RAGs). Camps ranged in size from 3 to 12 adults. Six of the camps were close in proximity to the Mangola region (high exposure to tourists), while three camps were more isolated (low exposure). Roughly half of the participants lived in low exposure camps ($n = 30$). Consent was obtained verbally from each participant. One subject was excluded from all the analyses due to a cognitive impairment. The University of Pennsylvania's Office of Regulatory Affairs and the Tanzanian Commission on Science and Technology approved this research.

2.2. RAG and interview procedures

All questions and materials were adapted from the larger cross-cultural study featured in this special issue. Interviews and instructions were conducted in Hadzane, and inside a vehicle to preserve privacy. The main researcher, as well as a Tanzanian and Hadza research assistant, were present during interviews. The main researcher and the Tanzanian research assistant spoke Swahili but not Hadzane. Material insecurity, demographics, religiosity, and emotional closeness questions were asked immediately after the game in order to eliminate the potential for incomplete data due to participants leaving camp. The number of questions was reduced in the Hadza, relative to other societies in this issue, and Likert-scale questions were reformulated to forced-choice questions (e.g., yes/no/don't know) except for the emotional closeness questions, which comprised a visual guide that had been successfully employed in cross-cultural settings. In addition, questions that require an understanding of long time horizons were also eliminated due to difficulties in understanding numerically described time frames. These modifications to the interviews were made based on previous interview experience with the Hadza.[6] Participant fatigue is common in Hadza interviews.

The RAG is a one-player, non-strategic game that involves rolling a die multiple times to determine how a resource (e.g., a pile of coins) is divided between two individuals (see Hruschka et al., 2014; Purzycki et al., this volume). The game is designed to measure rule-bending.[7] All participants played two RAG games. The first game, the *Local Community Game*, pitted a current campmate (LOCAL) against a Hadza living in a different, unspecified camp (DISTANT). The second game pitted the participant (SELF) against a Hadza living in a different camp (DISTANT). All participants played both games in a counterbalanced order. Thirty-three subjects completed the *Local Community Game* first. Tokens rather than coins were used for these games.[8] Participants were informed that each token represented 1 (8oz) scoop of maize. A measuring cup filled with maize was shown to the participants during instruction. Food was used as the resource since there are many anecdotes of Hadza attempting to conceal food from others in order to benefit themselves and their families (Marlowe, 2010). A red and black die was used for determining allocation amounts and each game entailed 30 rolls of the die. The researcher brought a pair of dice to the field. Both dice were confirmed to be unbiased with respect to landing on one of two colors. Black proved victorious on 27 out of 50 trials on the one die ($z = .56$, $p = .58$) and 26 out of 50 trials on the other ($z = .28$, $p = .78$). The Hadza research assistant was trained in the games in Swahili and translated the instructions to the participants. The Hadza research assistant was from a semi-settled village,

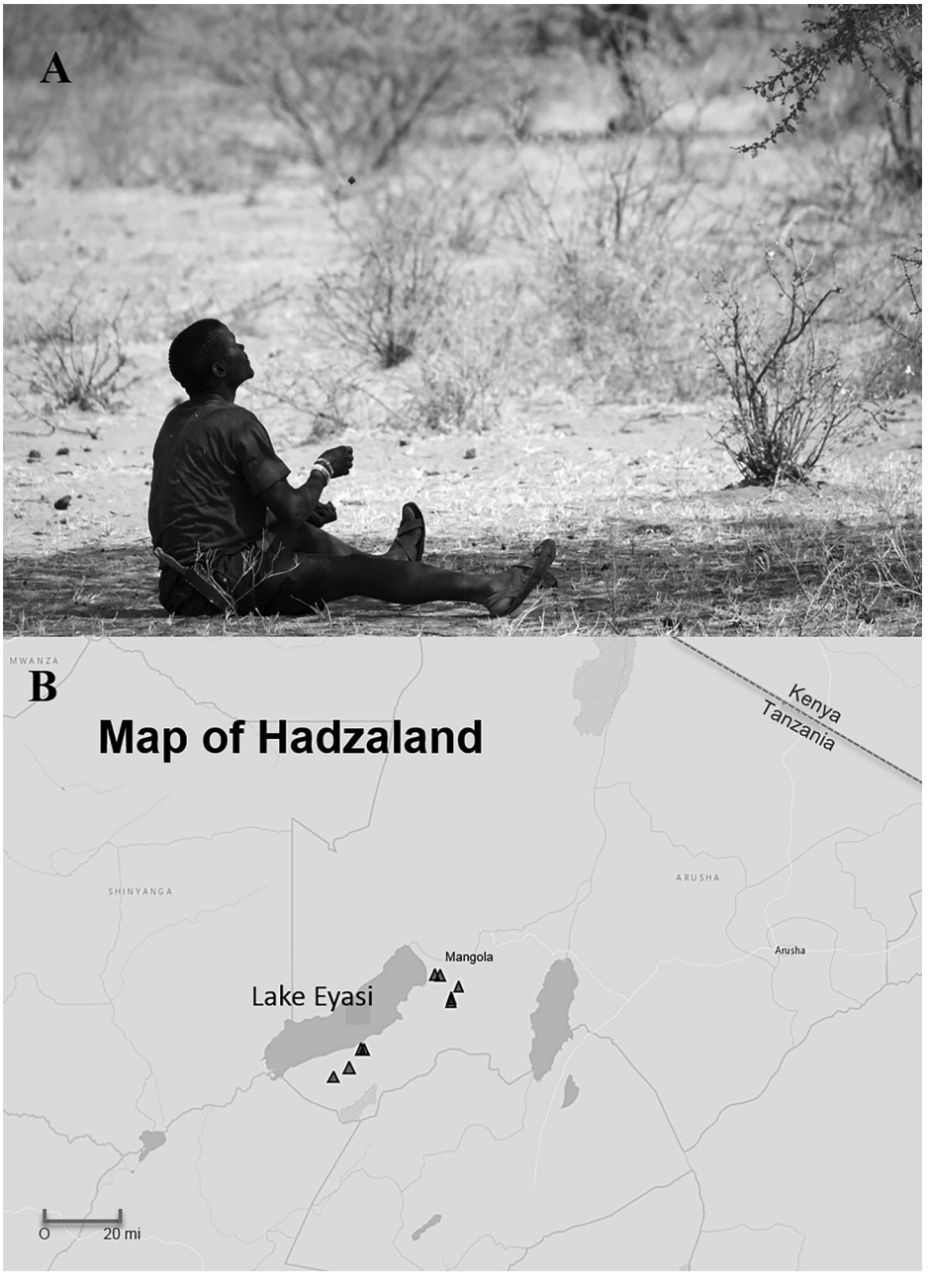

Figure 2. Panel A: re-enactment of a Hadza playing a Random Allocation Game. Panel B: map of Hadzaland showing the location of camps that participated in the Random Allocation Games.

Mong wa Mono, and had completed some secondary schooling. The Hadzane translation of the game was never written down due to literacy difficulties of writing in Hadzane. Participants were informed that the interviews would remain confidential. Likewise, participants were asked not to discuss the study with their campmates. Religious primes were not used in this study due to a lack of religious locations and visual religious symbols.

According to the Hadza research assistant, all participants passed the comprehension questions. After going through the questions, the Hadza research assistant estimated how many examples were

needed to explain the study. This approach was used instead of interrupting the instruction process to find out whether the subject answered each question correctly. Most subjects only needed one or two examples, and no participants needed more than four examples.

Cups for the game allocations were constructed from paper coffee cups with plastic lids. LOCAL, SELF, and DISTANT cups were labeled using the standard line drawings that were used at other sites. Unlike the other field sites, Hadza participants were only given the cups relevant to the specific game they were playing. This meant that they returned to the researchers with their cups before completing the second game. This method was used in order to minimize confusion. Hadza participants were instructed to complete the games far from camp and away from other individuals. The three researchers waited inside the vehicle until the participant returned with the cups. In camps that had large open spaces, the participants would walk far from camp but sometimes could still be seen in the distance (see Figure 2 for a Hadza re-enactment of the setup). In these instances, it was still impossible to observe their behavior. Allocations were awarded to participants and their camps on the final day researchers were in the camp.

3. Results

Table 1 provides basic demographics for all participants by low (isolated camps) and high exposure (Mangola region) groups. Table 2 includes the zero-order correlation matrix of all relevant variables. The difference in reported years of schooling between men ($M = 2.30$, $Mdn = 0$, $SD = 3.26$) and women ($M = .29$, $Mdn = 0$, $SD = 1.04$) was significant ($U = 737.50$, $p < .01$). A chi-square test revealed that women were also more likely to worry about there being enough food over the month ($X^2(1) = 3.44$, $p = .064$) and year ($X^2(1) = 5.41$, $p = .02$). Self-reported household size was bigger in the low exposure camps ($t(66) = 2.07$, $p = .042$). Despite this, individuals in the high exposure group reported feeling greater emotional closeness to their camp members (LOCAL) ($t(66) = -2.31$, $p = .024$, $d = .53$), but no differences emerged in reported emotional closeness to Hadza living in other camps (DISTANT). It may be that exposure to other ethnic groups and/or tourists increases feelings of connectedness between individuals within camps. Interestingly, the Hadza in the high exposure camps also reported greater emotional closeness to the Datoga, a pastoralist population with a long history of interacting with the Hadza ($t(66) = -2.7$, $p = .009$, $d = .69$). Degree of emotional closeness to other groups, including tourists, was not ascertained.

3.1. Rule-bending among the Hadza

To examine whether there was favoritism of LOCAL and SELF over DISTANT in the Hadza, I first compare the distribution of allocations across the entire sample to the expected binomial distribution

Table 1. Basic demographics for participants by high and low exposure camps. Material insecurity questions reflect the percentage of "yes" responses to whether participants worry that there will be enough food in the next month and year. For reported emotional closeness, LOCAL refers to Hadza living in the same camp, DISTANT refers to Hadza living in a different camp, and Out-group refers to members of the Datoga tribe.

					Material Insecurity		Emotional Closeness		
	% Men	Age Mean (SD)	Household size Mean (SD)	Years of school Mean (SD)	Month % worried	Year % worried	LOCAL Mean (SD)	DISTANT Mean (SD)	Out-group Mean (SD)
Low Exposure ($n = 30$)	50	39.4 (10.24)	4.77 (2.25)	1.40 (2.58)	79%	79%	3.57 (.86)	3.07 (1.11)	.33 (.61)
High Exposure ($n = 38$)	57.9	40.16 (13.48)	3.68 (2.04)	1.37 (2.79)	89%	86%	3.92 (.36)	3.18 (1.01)	1.13 (1.52)
All Hadza ($n = 68$)	54.4	39.82 (12.08)	4.16 (2.20)	1.38 (2.68)	85%	82%	3.76 (.65)	3.13 (1.05)	.78 (1.27)

Table 2. Bivariate correlations of allocations, basic demographic variables, material insecurity, and emotional closeness.

	1	2	3	4	5	6	7	8	9
1 *Local Community Game*	–	–	–	–	–	–	–	–	–
2 *Self Game*	.29*	–	–	–	–	–	–	–	–
3 Age	.22†	.13	–	–	–	–	–	–	–
4 Sex	.16	−.05	.08	–	–	–	–	–	–
5 Material Insecurity (month)	.08	.09	.07	−.23†	–	–	–	–	–
6 Material Insecurity (year)	.12	.04	.05	−.29*	.72***	–	–	–	–
7 Years of School	.22†	.06	−.14	.38**	−.09	−.18	–	–	–
8 Emotional Closeness (LOCAL)	−.01	−.09	−.10	.12	−.09	−.06	.11	–	–
9 Emotional Closeness (DISTANT)	.05	−.07	.02	.06	.12	.01	.20	.24*	–
10 Household Size	.10	.01	.04	−.12	−.20	−.16	.00	−.18	.06

*$p < .05$.
**$p < .01$.
***$p < .001$.
†$p < .10$.

that results from using a fair die. That is, the total number of coins allotted to participants' campmates' cup for the LOCAL vs. DISTANT condition (LOCAL allocations: $M = 18.51$, Mo = 17, Ra = 10–30) and self cup for the SELF vs. DISTANT condition (SELF allocations: $M = 17.82$, Mo = 18, Ra = 2–30) was calculated and compared to the expected binomial distribution. Figure 3(A) depicts the percentage of the sample allotting each possible number of coins to LOCAL and DISTANT compared to the theoretical binomial distribution. The results indicate higher than expected allocations to LOCAL members over DISTANT, providing some evidence for rule-bending. For example, the probability that all 30 rolls of the die would favor the LOCAL group is 2^−30, which is approximately one in one billion. However, approximately 6% of the sample allocated all of their coins to their campmates. Similarly, when comparing SELF versus DISTANT allocations to chance-based allocations, higher than expected allocations to SELF are made (see Figure 3(B)). While the expected percentage of individuals allocating more than 22 of their tokens to themselves should be less than 1%, about 12% of participants did so. These results suggest that the Hadza did not always follow the binary mechanism of the die.

3.2. Predicting rule-bending

The data suggest that the Hadza display greater levels of rule-bending in the RAG game involving their campmates (LOCAL) versus themselves (SELF), though this was not significant (paired $t(67) = 1.08$, $p = .28$). The order in which they played the games did not affect participants' allocations to LOCAL over DISTANT game ($t(65) = 1.14$, $p = .26$), but it did in the SELF over DISTANT game ($t(65) = -2.26$, $p = .03$). Individuals allocated more tokens to SELF when the game was played second ($M = 19$, $SD = 4.39$ vs. $M = 16.68$, $SD = 4.03$). A Spearman's rank order correlation indicates a small but significant positive slope between allocations made to SELF and allocations made to LOCAL ($r = .288$, $p = .02$). This suggests that those individuals who favored their campmates were also likely to favor themselves over an individual in another Hadza camp. This also suggests that the allocations were not entirely random. If allocations were made entirely based on chance, there should be no correlation in individual performance between the two games. Of the 19 Hadza individuals who allocated 20 or more tokens to themselves, just over half of them ($N = 11$) also allocated 20 or more tokens to their campmates. Thus, while some individuals showed high levels of rule-bending in both conditions, others displayed rule-bending in one only condition.

The remaining analyses explore predictors of rule-bending. Due to the non-continuous distribution of allocations, general linear model regressions with a logit-link function in the binomial family were used. Allocations to LOCAL and SELF were selected as dependent variables in the models. Fixed effects were added stepwise on the basis of their significance and improvement to the model (e.g., Akaike Information Criterion with a correction for small samples; AICc). The

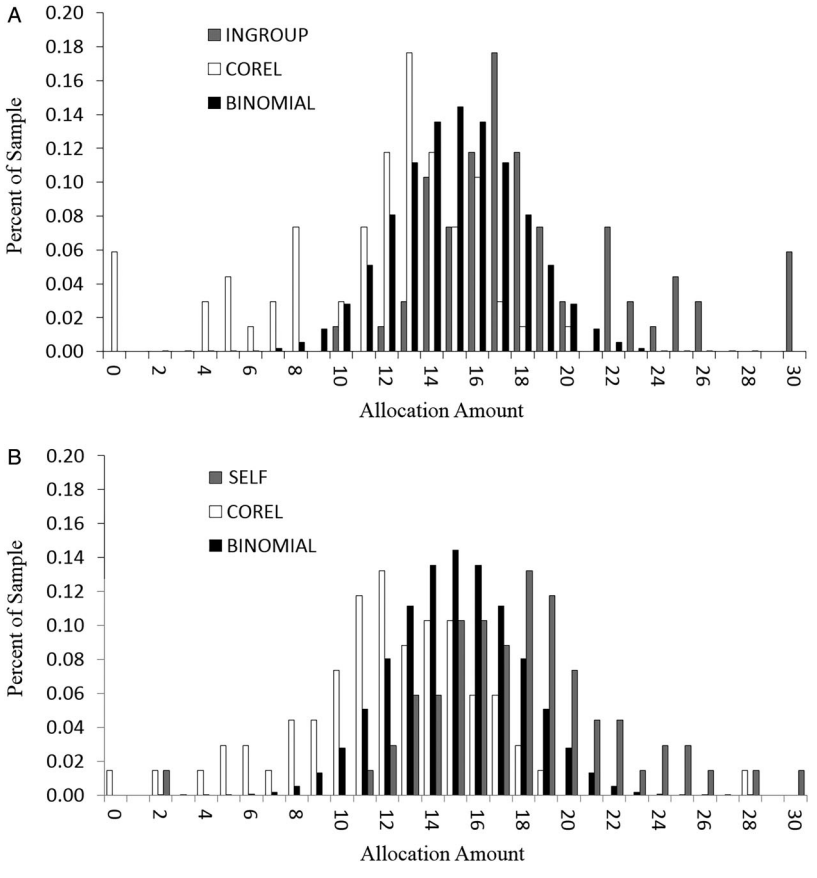

Figure 3. Panel A: allocation distribution for in-group and DISTANT compared to the expected binomial distribution. Panel B: allocation distribution for self and DISTANT compared to the expected binomial distribution.

order in which predictors were added was as follows: order of game (for SELF game only), demographics (camp location, age, sex, household size, and years of schooling), material insecurity and emotional closeness questions, belief in *Haine* and belief in *Haine*'s capabilities (see Tables S2 and S3 for all models).

Table 3 reports the preferred models for allocations to LOCAL vs. DISTANT. Participants' age and number of years of formal education consistently emerged as significant predictors. Older and more educated Hadza allocated a greater number of tokens to LOCAL. Belief in *Haine* did not predict allocation amounts to LOCAL. Furthermore, of those individuals who believe in *Haine* ($N = 52$), views concerning his capabilities and powers did not predict allocation amounts, with the exception of whether *Haine* has the ability to see what people are doing (see Table S2). Individuals who think that *Haine* can see them show less rule-bending in favor of LOCAL compared to those who think *Haine* cannot see them and those who claim to not know whether *Haine* can see them. Sex appeared as a significant predictor in a few models, with men allocating more tokens, on average, to LOCAL.

Unlike the LOCAL RAG game, formal education and age did not predict allocation amounts to SELF vs. DISTANT (see Table 3 for preferred model and Table S3 for all models). After controlling for order effects, camp location emerged as a predictor of allocation amounts to SELF. Specifically, Hadza living in low exposure camps engaged in significantly more rule-bending. Belief in Haine did not predict allocation amounts to SELF. Furthermore, of the 52 individuals who believe in *Haine*, their views concerning his abilities did not predict allocation amounts, with the exception of whether

Table 3. Estimated odds ratios with confidence intervals for preferred models of rule-bending for LOCAL (vs. DISTANT) and SELF (vs. DISTANT). Standard errors are in parentheses. Belief in whether *Haine* rewards is categorical "yes/no/don't know" ("don't know" responses not shown).

	Rule-bending (LOCAL)				Rule-bending (SELF)			
	B(SE)	Odds	Lower	Upper	B(SE)	Odds	Lower	Upper
Intercept	.43 (.08)	1.54	1.33	1.79	.41 (.13)**	1.50	1.16	1.95
Game order (local 1st)	–	–	–	–	.44 (.11)***	1.56	1.25	1.92
Camp (low exposure)			–	–	.30 (.11)**	1.35	1.09	1.67
Age (centered)	−.01 (.00)**	.99	.98	1.99	–	–	–	–
Sex (female)	−.06 (.10)	.94	.77	1.14	–	–	–	–
Years of school	.06 (.02)**	1.06	1.02	1.10	–	–	–	–
Haine Rewards (yes)	–	–	–	–	−.40 (.13)**	.67	.52	.87
Haine Rewards (no)	–	–	–	–	−.65 (.18)**	.52	.37	.74

**$p < .01$.
***$p < .001$.

Table 4. Estimated odds ratios with confidence intervals for preferred models of rule-bending for LOCAL vs. DISTANT with the ratio of household size to camp size added as an additional predictor. Standard errors are in parentheses. Belief in *Haine* is categorical "yes/no/don't know" ("don't know" responses not shown).

	Rule-bending (LOCAL)			
	B(SE)	Odds	Lower	Upper
Intercept	.27 (.10)	1.31	1.06	1.61
Age	−.01 (.00)**	1.01	1.00	1.02
Sex (female)	−.07 (.10)	.92	.76	1.13
Years of school	.06 (.02)**	1.06	1.02	1.10
Household size/Camp size	.78* (.36)	2.18	1.08	4.40

**$p < .01$.

participants believe that *Haine* rewards people for being good. However, it is those individuals who claim that they "do not know" whether *Haine* rewards people, who allocate the most tokens to SELF. Also, those individuals who claim that *Haine* does not reward people show the least amount of rule-bending.

Since the Hadza share food widely within their camps, exploratory analyses were conducted to explore the role of camp size on allocation amounts in both games. Also, since household members should receive greater shares of any goods generated from the games as the ratio of household size to camp size increases regardless of whether they are playing the game for a campmate or SELF, exploratory analyses were also conducted to examine whether the ratio of household size to camp size predicted rule-bending in either game. Camp size was estimated from self-reported household size as stated by heads of households in each camp, and ranged from 10 to 27 individuals ($M = 18.33$, $SD = 5.43$). Camp size was added as an additional predictor to the two preferred models reported in Table 3, but was not found to significantly predict rule-bending to LOCAL ($p = .25$) or SELF ($p = .25$). However, the ratio of household size to camp size positively predicted allocations to LOCAL (Table 4). These findings suggest that the Hadza are more likely to bend rules in favor of campmates as the potential benefits to kin increase. Similar results were not found for the SELF game ($p = .81$).

4. Discussion

One of the most recognizable features of hunter-gatherer life is the high degree of egalitarianism and sharing between individuals. The Hadza are no exception. Resources are pooled and distributed among camp members irrespective of kinship (Hawkes, 1991; Hawkes et al., 2001; Marlowe, 2010). Occasionally, when there is a surplus, goods are also transferred to other camps (e.g., large game). Given that sharing and egalitarianism are a fundamental part of Hadza daily life, one might have expected the Hadza to allocate their tokens fairly according to the roll of the die or to

bend the rules to achieve more equal distributions. Instead, the Hadza displayed some of the highest levels of rule-bending among the societies featured in this special issue. Some Hadza brazenly allocated all 30 tokens to their campmates and themselves.

Previous cross-cultural data have situated the Hadza on the lower end of ultimatum game offers (Henrich et al., 2001) and the lowest end of dictator game offers (Henrich et al., 2010). Marlowe (2004a) suggests that the lower levels of generosity observed in the Hadza, compared to other societies, may be due to the Hadza being worn out by the constant demands of having to share in their daily lives. Thus, when opportunities arise to behave more selfishly, the Hadza will take advantage of them. Interestingly, other experimental work suggests that the Hadza engage in very little third-party punishment when observing others give unequal offers (Henrich et al., 2006). It is possible that if third-party punishment is indeed low in Hadza society, fear of punishment by one's peers may not be a strong motivator for limiting self-serving behavior.

The fact that the Hadza have a minimalist religion may be another reason why the Hadza show relatively higher levels of rule-bending. Even of the Hadza who believe in a deity, only about 40% believe that he punishes people for being bad. Interestingly, Marlowe (2010) claims that the Hadza do not attribute misfortune in others to moral violations like adultery and theft. Rather, misfortune is attributed to either bad luck or *Epeme* rule violations. It is unclear to researchers what the mechanism is that the Hadza believe leads to sickness after an *Epeme* violation. It is possible that they think it is due to the physical properties of the *Epeme* meat itself, rather than supernatural forces.

Among the Hadza, there is little evidence for a moderating influence of religion on allocation amounts to campmates and self over Hadza living in other camps. For instance, belief in *Haine* had no impact on allocation amounts to LOCAL and SELF over DISTANT. In addition, of those who report belief in *Haine*, whether they think *Haine* is capable of various supernatural phenomena (e.g., punishment) also did not predict allocation amounts to LOCAL over DISTANT, with one exception: those who think *Haine* has the ability to see what people are doing display more rule-bending in favor of their campmates. This finding was not found in the *Self Game*. Only one deity capability emerged as a predictor of allocation amounts to SELF over DISTANT: whether *Haine* rewards people for being good. Again, it is those individuals who claim that they "do not know" whether *Haine* rewards people who show the greatest bias in allocating tokens to SELF over DISTANT. The lack of consistency in the predictive ability of various measures of religiosity within and between games suggests that religion plays a small role in mediating rule-bending.

While the Hadza reported higher levels of religiosity in this study than in previous ethnographic accounts, their levels of both skepticism and agnosticism are still high. In addition, there was a lack of consensus in the number of supernatural agents that were reported to exist and whether supernatural deities with different names in fact represent a single agent. Even among those who did believe in these agents, there was little consensus about their abilities in influencing human life (and afterlife). This lack of consensus may be due, in part, to the fact that the Hadza do not have an organized or developed religious belief system. It is also possible that Christianity has been recently incorporated into the Hadza belief system and consequently created some confusion and/or produced disparate views among the Hadza. Finally, there is a chance of demand characteristics. The Hadza may have exaggerated or fabricated their beliefs to accord with what they believe the author would want to hear. The Hadza have had interactions with missionaries who often hand out food in return for their time and attention (Marlowe, 2010). This is not so dissimilar of a setting under which research is conducted with the Hadza, where researchers provide material compensation for their participation. Some Hadza may have learned about religion from these missionaries and simply repeated what they remembered. If this did happen with some of the participants, it may have obscured any true relationship between religiosity and behavior in the games.

The fact that the Hadza exhibit in-group favoritism is surprising in light of their flexible residence patterns, high levels of fission-fusion grouping and the absence of demarcated clans and land borders. Also, when the Hadza have been asked with whom they would like to live in the future, about

half of nominees lived in a different camp than the nominator (Apicella et al., 2012). All of this suggests that there are few socially delineated borders separating groups of Hadza from one another. Thus, understanding why Hadza may favor current camp members over other Hadza is perplexing. That said, individuals are probably living with people whose company they enjoy, since they chose to live with them. Also, to the extent that reciprocal altruism underlies within-group food transfers, then participants may have viewed rule-bending for their campmates as part of a larger, ongoing reciprocal exchange, even despite the fact that the results of the games are not made public. An interesting follow-up would be to examine whether individuals who feel indebted to their camp members – perhaps because they are relatively poor producers of food – bend the rules more for their campmates. Another possibility is that individuals hope that the campmate recipient of the maize will be a close relative. Since camps generally comprise a few nuclear families, this is a real possibility. The fact that overall camp size did not predict allocation amounts to LOCAL, whereas the ratio of household size to camp size did, suggests that rule-bending for one's campmates may be partially motivated by a desire to help kin.

Older and more educated Hadza also exhibited higher levels of rule-bending in favor of campmates. There are a number of possible reasons for this result, including spurious associations. One plausible explanation is that older and more educated Hadza feel a greater sense of responsibility for the well-being of their campmates compared to younger and less educated Hadza. Also, with increased age and education, individuals may be more able to discern the situations under which rule-bending behavior is more likely to be detected and/or punished. Neither of these explanations explains why older and more educated Hadza did not show favoritism to SELF vs. DISTANT. Moreover, previous work has not found a clear relationship between cognitive ability and prosociality (e.g., Benjamin, Brown, & Shapiro, 2013).

It has recently been proposed that those individuals with increased resource or food insecurity may also favor in-group members and self as a way to safeguard against the risk of shortages (Hruschka et al., 2014). Of the two temporal measures of material insecurity examined in the Hadza, only one neared significance (e.g., material security over the year). This result was confined to the *Local Community Game*. Hence, at least within the Hadza sample, material insecurity has little predictive value on degree of rule-bending. Cross-culturally, however, higher rule-bending observed in the Hadza may be due to relatively higher levels of increased material insecurity associated with hunter-gatherer life. One might imagine day-to-day subsistence may be associated with overall decreased food security. That said, no differences in the proportion of Hadza who report feeling worried about having enough food were found between Hadza in the high exposure and low exposure groups. While tourists now visit both groups, Hadza in the Mangola village area still receive substantially more visits (Marlowe, 2010).[9]

Previous work finds that degree of market integration can account for considerable cross-populational differences in levels of prosociality. Specifically, groups with higher levels of market integration tend to split pots of money in various incentivized economic games more fairly with anonymous others (Henrich et al., 2010). It has been suggested that successful market exchanges, where transactions between non-kin and even strangers are common, depend, in part, on group adherence to norms of fairness, trust, and reciprocity (Henrich et al., 2010). As such, norms of fairness should culturally evolve in contexts that necessitate frequent and mutually beneficial interactions, especially between strangers. The results presented here reinforce this hypothesis: Hadza living in the high exposure region demonstrated significantly less rule-bending in favor of SELF over an anonymous person living in another camp, compared to Hadza living in low exposure regions of Hadzaland. Here the comparison is made between two genetically and historically culturally homogeneous groups such that many of the confounds that are present when data are gathered across different societies are eliminated. Also, the findings are robust to the addition of a number of socio-demographic controls, including material insecurity and how emotionally close individuals feel to Hadza living in other camps. Taken together, the findings suggest that as the Hadza have become more integrated into markets, they have internalized norms of fairness when dealing with

anonymous others. Nevertheless, the findings are correlational, and any differences between the two groups could, in theory, have resulted from self-selection into market regions. Future work tracking individual migration patterns and behavioral measures of prosociality over time may help to establish causality.

5. Conclusion

As part of a larger study examining the role of religiosity on cooperative behavior, the Hadza provide a noteworthy contribution. Historically, they have been noted for their absence of religious beliefs and practices, and still today they exhibit a minimalist form of religion compared to most other societies. Consistent with the hypothesis that belief in interventionist and omniscient deities who care about how people treat each other functions to promote the spread of cooperation, the Hadza show some of the highest levels of rule-bending cross-culturally. This finding is surprising in light of Hadza social life, which is characterized by fluid social and residential arrangements, a lack of stable grouping, and high levels of cooperation within and between groups. Among the Hadza, however, there is little evidence for the role of religiosity in facilitating benevolence to Hadza in other camps. Instead, there is evidence that Hadza break the rules at a cost to more proximally distant, anonymous Hadza.

Notes

1. See Marlowe (2010) for discussion on how the Hadza compare with other warm-climate, non-equestrian hunter-gatherers on a number of important demographic, social, political, and economic traits.
2. It is important to note that at the present time the Hadza are undergoing rapid social and economic change due to the ever-increasing presence of ethno-tourists, missionaries, and neighboring groups (Apicella et al., 2014) so that ethnographic descriptions of their way of life and belief systems may need to be continually revised.
3. It should be noted that hunting reputation is associated with reproductive success (Apicella, 2014; Marlowe, 1999), suggesting that there are advantages to being a better hunter.
4. One of these two informants was explicit in stating that *Ishoko* is not alive and does not breathe.
5. One participant volunteered a belief in *Seta* (the moon), but according to the participant the moon did not have any supernatural capabilities such as knowing what people are thinking and/or feeling or the ability to punish and reward people.
6. The Hadza have little or no experience with scale questions that measure intensity of feelings toward topics and statements. Marlowe (2004c) posits that the Hadza are not able to complete Likert scales. In my own experience, even simple forced-choice questions require extended explanation and time to administer.
7. In terms of ecological relevance, the RAG is a little unusual since the Hadza do not rely on chance outcomes for distributing resources, though they understand the concept of luck. However, they do follow the rule that resources should be divided evenly, which the RAG largely ensures. Thus, any deviation from the binomial expectation suggests that they are breaking a fundamental rule of their society.
8. Tokens were used in lieu of money. First, as a matter of principle, many Hadza researchers avoid giving the Hadza money. Second, experience with money and access to places where it can be spent may vary between the Hadza. In contrast, the value of each token is the same for all participants.
9. The self-reported number of days worked in wage labor by individuals in the high exposure group ($M = 8.75$, $SD = 4.29$) was greater than that in the low exposure group ($M = .27$, $SD = .83$). However, these numbers should be met with caution since their concept of various time frames (e.g., weeks, months) and numerical knowledge may be limited.

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