

## **Do religious and market-based institutions promote cooperation in Hadza hunter-gatherers?**

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### ***Abstract***

Humans' willingness to bear costs to benefit others is an evolutionary puzzle. Cultural group selection proposes a possible answer to this puzzle- cooperative norms and institutions proliferate due to group-level benefits. For instance, belief in knowledgeable, moralizing deities is theorized to decrease selfishness and favoritism through threat of supernatural punishment. Similarly, norms of fairness and cooperation are theorized to have coevolved with engagement in markets, which necessitate anonymous exchanges. We investigate these theories among the Tanzanian Hadza who, until recently, have had minimal exposure to markets or major world religions. Engagement with Western tourists, village markets and Christian missionaries is increasingly leading researchers to ask how such interactions have affected cooperative behavior. We interviewed 172 Hadza from 15 camps varying in market proximity, and measured cooperative decision-making using economic games. We find that exposure to missionaries is associated with increased belief in a knowledgeable and punitive deity, with mixed evidence that these beliefs, in turn, affect game play. In contrast, we find some evidence that those living in market-adjacent regions exhibit less ingroup favoritism when cooperating. These results support the claim that market-norms, and to some degree religious beliefs, facilitate greater cooperation and fairness in social interactions.

Keywords: cooperation, market norms, religion, Hadza, cultural evolution, hunter-gatherers

## **Do religious and market-based institutions promote cooperation in Hadza hunter-gatherers?**

### ***1. Introduction***

The scale and degree of human cooperation is unmatched by almost all group-living animals. Through their capacity for cooperation, humans ameliorated many of the ecological threats common to other species – predation, starvation and perilous weather – and, as consequence, now number among the most ubiquitous and adaptable vertebrates on the planet. Despite the prominent role that cooperation plays in human sociality, explaining its evolutionary origins remains a challenge.

Cooperation, defined here as paying a cost for someone else to receive a benefit, is puzzling from an evolutionary perspective. In the absence of mechanisms to support the evolution of cooperation, it is predicted that natural selection will quickly eliminate those who cooperate. Traditional mechanisms such as kin selection and reciprocity can explain cooperation between kin and within small, stable groups of frequently interacting individuals (Hamilton, 1964; Komorita, Hilty, & Parks, 1991). And, these mechanisms account for many cooperative interactions observed in nature. However, these mechanisms are often insufficient for explaining revolutionary features of human cooperation – cooperation on a large-scale, where interactions are frequently anonymous and opportunities for repayment are little to none (for review, Apicella & Silk, 2019).

To fill this explanatory gap, recent theories have focused on cultural norms and beliefs promoted by different institutions, such as world religions and markets. It is proposed that such institutions proliferate, in part, because they help groups solve problems of cooperation (Gächter, Herrmann, & Thöni, 2010; Henrich, 2017; Henrich, et al., 2010). For instance, religions with morally-concerned deities or other moralistic forces are theorized to motivate cooperation to ever more distant co-religionists, through fear of supernatural punishment either in the current life, or an afterlife (Norenzayan, 2013; Shariff & Norenzayan, 2011). Beliefs in moralizing deities with perfect knowledge and the power of divine intervention may not only proliferate by providing group-level benefits during hegemonic struggles (Henrich et al., 2010) but also by harnessing other human psychological biases, such as mental anthropomorphizing, emulation and norm adherence (Boyer, 2007; Ensminger & Henrich, 2014; Fehr, Fischbacher, & Gächter, 2002).

Previous cross-cultural work has shown that belief in punishing and interventionist gods is associated with larger cooperative social circles (Johnson & Bering, 2006; Henrich et al., 2010; Norenzayan et al., 2016). A recent study of eight populations representing a wide array of global and local religious traditions found that participants reporting greater belief in a knowledgeable and moralistic god were more likely to allocate resources to distant co-religionists (Purzycki et al., 2016). Such beliefs were associated with less favoritism to oneself and to one's local group members relative to more distant co-religionists, as measured by the Random Allocation Game (RAG; Hruschka et al., 2014, Jiang, 2013). Notably, participants from the Hadza, a Tanzanian population who have traditionally subsisted through foraging, exhibited the lowest inclination to give to more distant group members and reported the least belief in punishing and monitoring gods (Apicella, 2018).

Market norms, which prescribe behavior in markets transactions, are thought to have evolved because they help to maintain the integrity of exchange relations with strangers, anonymous others, and infrequent interactants (Henrich et al., 2010). Such norms lead to shared standards and motivations for trust, fairness, and cooperation, thereby permitting individuals to

engage in a diverse range of mutually beneficial transactions with little cost (Bowles & Gintis, 1998). Communities prosper as the number of successful transactions increase (Henrich et al., 2010). And, individuals benefit by cultivating a reputation as someone who is cooperative, fair, and trustworthy. Such norms may also proliferate through the emulation of trading partners (Ensminger & Henrich, 2014) and by facilitating the development of more ‘complex’ networks of trade which provide benefits at a group level (Chudek & Henrich, 2011; Henrich et al., 2010). There is extensive cross-cultural evidence that associates market exposure with more equal allocations in economic games and a greater willingness to punish others at a cost to the self (Chudek & Henrich, 2011; Henrich et al., 2010; Henrich & Ensminger, 2014).

Our aim is to investigate how exposure to major world religions and markets influence cooperative decision-making. To do this, we turn to a unique population - the Hadza of Tanzania. Although early descriptions of the Hadza suggest some trade (Marlowe, 2010), they have traditionally subsisted through foraging and have experienced only minimal exposure to cash markets (Woodburn, 1964, Marlowe, 2002). Furthermore, due to geographic barriers, including a historic lack of road infrastructure as well as conditions (e.g. alkaline soil) hostile to horticulture (McDowell, 1981), both immigration and interaction with major world religions have traditionally been limited (Marlowe, 2010). This is changing. Driven in part by the nationwide growth of Tanzania’s tourist industry, and by increased international interest in forager lifeways and diets (e.g., Cordain, 2012, and see discussion by Crittenden & Schnorr, 2017). Hadza ethnotourism increased substantially between 1995 and 2010 (Marlowe, 2010) and in the decade since. Recent increases in onion farming over the last two decades in the Eyasi basin, especially around Mangola (Mabulla, 2012) have led to greater availability of agricultural produce, greater intranational immigration into the region and better transport links, including new roads. Over the last two decades there has also been an increase in the number and reach of organizations involved in missionary tourism. And communities like the Hadza have seen increases in Christian proselytization (see Section 1.5 and further discussion by Gibbons, 2018, Pollom, *et al*, 2020a and Purzycki & Sosis, 2018). Although researchers have worked in the region for more than a century, there has also been a substantial increase in research activity over the last half century (Gibbons, 2018). Each of these phenomena have created greater opportunities for interaction with non-Hadza, as well as trade and participation in cash markets. This is reflected in a reduction in foraging and an increase in reliance on cultigens in all areas of Hadza territory, and especially for market and tourist-route adjacent camps (Pollom, *et al*, 2020a). These changes provide an opportunity to investigate how changes in market and religious exposure affect prosocial behavior.

Many Hadza still, of course, rate low on market exposure measures and report minimal belief in a morally concerned deity (Apicella, 2018), though the Hadza are certainly “religious” *sensu lato* (Skaanes, 2017, Purzycki & Sosis, 2018). In the present paper we first briefly review previous published accounts of Hadza subsistence, religion and cosmology, exposure to missionaries and history of interactions with both market institutions and tourist agencies. We then assess individual differences in belief in a morally concerned deity, proximity to markets, interaction with missionaries and afterlife beliefs, and their impact on cooperative behaviour in two economic games.

### ***1.1 The Hadza***

The Hadza are a small population of roughly 1,000 individuals who have traditionally lived around the Lake Eyasi Basin in Tanzania’s Great Rift Valley. It is estimated that fewer than 400

individuals subsist predominantly through foraging (Marlowe, 2010, Pollom, 2020a). The Hadza live in temporary, mobile camps of roughly 30 people. Camp composition is fluid and camp members move frequently between camps. The Hadza are relatively egalitarian with only minor inequities in wealth and status (Woodburn, 1982). Marriages are typically serially monogamous though polygamy is practiced. Within-camp food-sharing is endemic (Hawkes, 1991; 2018, Marlowe, 2010, Stibbard-Hawkes, 2020) and, except for clear gender divisions in food procurement strategy (Berbesque *et al*, 2009, Hawkes *et al*, 1997, Apicella 2017, Hawkes *et al*, 2018), there is little labor specialization. Men typically prioritize hunting game (Hawkes, 1991c, Wood & Marlowe, 2014, Stibbard-Hawkes *et al*, 2018; 2019) and collecting honey (Berbesque *et al*, 2016, Crittenden, 2011, Wood *et al*, 2014), while women typically forage for fruits and tubers (Schoeninger *et al*, 2001, Marlowe & Berbesque, 2009). June through September is the dry season and also the “high season” for tourist visits. Access is limited in the wet season when the dirt tracks become hazardous for vehicles. The number of tourists visiting the Hadza has steadily increased in the last decade (Marlowe, 2010).

## 1.2 Religious Beliefs

Over the last century, many anthropologists and ethnographers have described the Hadza as having either ‘no’ religion or minimal religion (for review see Marlowe, 2010). Some scholars have contested this framing and have described the Hadza as having a ‘full, mature, and complex cosmology’, albeit one that can appear ‘inconsistent, unstructured, and ephemeral... incorporeal, and multiform’ (Skaanes, 2017, p.16, 197). Explorer Erich Obst (1912) and anthropologist Dorthea Bleek (1931) reported that the Hadza claimed the sun as their god. Obst provided no further information about Hadza religious beliefs. Bleek offered a little more, saying the Hadza feared the sun because it could cause people to become sick or die whenever it wished. She also reported that the Hadza did not pray for the sick because the prayers only annoyed the sun. We are unaware of other ethnographic accounts that corroborate Bleek’s description. The Hadza have also been described as having no afterlife belief (Bleek, 1931, Marlowe, 2010, Woodburn, 1982). James Woodburn (1982), one of very few anthropologists fluent in Hadzane, claimed that *if* the Hadza do have an afterlife, it is unaffected by the beliefs and actions of people while they are living. In 2013, a small minority of informants, when questioned, reported that *Dundubi’i* and *Galatu* Mountains were sacred places where people could pray to ancestral spirits (Apicella, 2018). Similarly, Skaanes (2017; *in prep*) reports, from fieldwork conducted between 2011-13, that there are three ‘god-mountains’ in Hadza territory (*Sanzako*, *Dundubi’i* and *Anau*) where forebear spirits reside and where the spirits of the deceased return. Skaanes further reports that ‘the mountain gods and forebear spirits take care of... animals’ [and people’s] needs’ (p. 177). Skaanes (2017) also highlights the possibility of ‘eschatological belief of reincarnation of spirit through naming’ (p.112). As Skaanes notes, similar accounts are absent from 20<sup>th</sup> century Hadza ethnography. As both periods of fieldwork were recent, and as not all informants reported knowledge of the god mountains (Apicella, 2018), the antiquity and prevalence of these beliefs is unclear. Other descriptions of Hadza religion have stressed the Hadza’s lack of religious authorities, spaces, meetings and doctrines (Marlowe, 2010).

Hadza life is replete with ritual and cosmologic beliefs, which have been described in previous work. Many of the best described rituals center around *epeme* meat-eating and the *epeme* dance (Apicella, 2018, Marlowe, 2010, Power, 1997, Power, 2015, Woodburn 1964). *Epeme* is polysemic (Power, 2015). It embodies ideas of hunting, manhood, and the new moon but

materially it refers also to distinct cuts of meat (e.g., lungs, kidneys, hearts) that can only be eaten by *epeme* men – those who have killed a large animal or have reached middle age. Women and uninitiated youths are forbidden to see or even know what is consumed. *Epeme* beliefs play an important role in regulating meat redistribution and *Epeme* meat violations are thought to result in illness or death. The *epeme* dance occurs on moonless nights. Men dance individually while women and children accompany them in song. This dance is thought to bring unity, healing, happiness and good fortune (Apicella, 2018, Marlowe, 2010, Power, 1997, Power, 2015, Woodburn, 1964). However, much ritual knowledge concerning *epeme* is privileged to the initiated and many Hadza state it is dangerous to discuss it (Apicella, 2018). *Epeme* beliefs have also recently been related to spiritual kinship between humans and eland (Skaanes, 2017) although this association is also absent from earlier accounts of Hadza myth and cosmology (e.g., Kohl-Larsen, 1956).

The *Epeme* initiation ceremony is called *Maito*. Hadza women have a corresponding initiation ritual, *Maitoko*. The *maitoko* initiation involves ritualized gender reversal and the chasing and beating of men with a decorated *naricanda* stick (Power, 2015, Skaanes, 2015). *Maitoko* has traditionally also involved genital cutting, although some recent sources have reported that this practice is waning (Power, 2015). A detailed description of the ceremony and the cosmological beliefs surrounding *maitoko* is provided by Power, 2015.

Hadza cosmology features the sun, the moon and their children who are the stars (Bala, 1998). The names of these entities vary depending on the informant. Gudo Mahiya, a Hadza man who recorded a number of Hadza stories and songs, referred to the sun as “Haine” and the moon as “Seeta” (Blurton Jones, 2016). The German explorer Kohl-Larsen (1956) recorded Hadza stories and myths and reported that the Hadza referred to the moon as “Haine” and the sun as “Ishoko”. Stories sometimes depict Haine as Ishoko’s wife, but Haine sometimes takes on a separate male form. More recently, Marlowe (2010) reported that Haine is God, while Ishoko is both the sun and God. Moreover, Marlowe states that Haine is just the male version of Ishoko. In the first systematic survey of Hadza religious beliefs, Apicella, (2018) also surmised that Haine is likely the name of the god for all, though some Hadza incorporate Ishoko (the sun) into their beliefs of Haine. Ishoko on its own, however, usually refers to the physical sun (Apicella, 2018).

Recent work suggests that Hadza spiritual beliefs vary from person to person. Beliefs may also be changing. A 2011 survey of 259 Hadza reported that 9.6% of Hadza were Christian, while the remaining Hadza were classified as having a “traditional” religion (Migita, 2011). Joshua Project, an evangelical Christian organization that provides ethnologies of “unreached peoples” claims that only 5% of Hadza are Christian (Joshua Project, 2017). Apicella (2018) conducted a survey in 2013 and found that nearly three-quarters of Hadza interviewed reported believing in god (i.e., Haine) when asked. However, the Hadza conception of Haine as an omniscient deity with supernatural abilities, varied between participants. Between 40-60% of respondents either did not know or did not believe Haine had supernatural abilities such as the ability to know what people are feeling. For other Hadza, Haine had similar characteristics as the Judeo-Christian god, including a focus on human moral concerns and, indeed, recent studies of the Hadza language report that some Hadzane speakers extend the name ‘Haine’ to refer to the Christian god (Lusekelo, 2017). The discrepancies between prior and later surveys on Hadza belief in god probably reflects the increasing efforts of Christian missionaries in the region.

### ***1.3 Hadza and Datoga***

The Datoga are a pastoralist population living in increasingly close proximity with the Hadza. Though most Datoga still hold to their traditional spiritual beliefs, reports also suggest contact made by Christian missionaries. Unlike Gods in several Abrahamic religions, their deity, Aseeta, does not appear to intervene in human affairs (Bihariova, 2016). The Datoga have a long history of mixed, and sometimes negative, interactions with the Hadza (Marlowe, 2002). Because the Hadza and Datoga have had a turbulent history of regular resource conflict and sometimes violent interaction, using them as an “outgroup” provides a strong test of the limits of Hadza generosity. What’s more, recent work exploring how identity fusion and outgroup relations affect behavior in economic experiments support the notion of Hadza perceiving Datoga as an outgroup. Out of eight populations sampled, ranging from foragers to horticulturalists to fully market-integrated populations, Hadza reported the *highest* level of shared identity (i.e., identity fusion) with other anonymous selected Hadza; conversely, they showed the lowest levels of reported identity fusion (of all groups) with the Datoga (Purzycki & Lang, 2019). These findings suggest the Hadza may have a strong sense of group identity, motivating our decision to use the Datoga as an “outgroup” population.

### ***1.4 Hadza Tourism and market interactions***

Tourists have visited the Eyasi region for several decades. However, with the rise of popular interest in hunter-gatherer lifeways, alongside health and wellbeing fads such as barefoot running and the paleo-diet, a sizable tourist industry catering largely to Western tourists, has developed. While tourists can be found across Hadzaland, the bulk of the visits are concentrated in the Mangola ward found within the Karatu district of the Arusha region. While Mangola is best described as a sprawling settlement, there is a hub of economic activity found near the Lake Eyasi road in a small geographic area that locals refer to Gorofani; we refer to this area as the Mangola village, in line with previous accounts (Apicella, Azevedo, Christakis & Fowler, 2014). This area is about two-and-a-half-hour diversion off a main road connecting Lake Manyara National Park to the Ngorongoro Conservation Area making it a convenient detour for tourists on safari. It has been estimated that tourist visits in this area during the high season increased from approximately one car per week in 1995 to 10-20 cars per week in 2010 (Marlowe, 2010). Monetary compensation to the Hadza is provided for each visit. And, around 2013, set camp fees of approximately 40,000 Tanzanian shillings per visit (Approximately 18 USD) were codified. Souvenirs, including treated skins/bones of hunted animals, manufactured bows, arrows and decorative clothing items, are also sold to tourists (Apicella, Azevedo, Christakis & Fowler, 2014). Foraging demonstrations for tourist groups are another source of income (Pollom, *et al*, 2020a). Cash garnered from tourists is used to buy grains such as maize, rice, millet and green beans from surrounding market settlements, either directly or sometimes via motorbike couriers who bring food into the bush (Pollom, *et al*, 2020a, b). Cash may also be exchanged for alcohol, tobacco, or cannabis (Pollom *et al* 2020a). In most areas, such sources of income have partially replaced foraging (Pollom *et al*, 2020a, b). This increased rate of exposure to market culture (especially in the Mangola region) has the potential to also facilitate exchanges of cultural norms and ideas, along with goods and services.

### *1.5 Missionary Presence*

Though historically less frequent, Christian missionaries have had a long history of contact with the Hadza (Marlowe, 2006; Marlowe, 2010). Early reports of Hadza wearing European clothing (Bleek, 1931) hint at missionary activity in the region as early as the 1920s, and there have been numerous further reported interactions over the subsequent decades (e.g., McDowell, 1981). The goals of these missionaries are largely two-fold: to convert and, in their words, to “modernize” the Hadza (Marlowe, 2010). This was sometimes achieved through coercion: Ralph Farmer, a Lutheran pastor who reportedly gained Hadza trust by supplying meat, worked with Mbulu district authorities to establish, by force, a permanent Hadza settlement at Yaeda Chini between 1964-65 (McDowell, 1985, Ndagala, 1985). This settlement was short-lived, as were many other prior colonial and post-colonial government-driven attempts to sedentarize the Hadza, and by 1966 most Hadza had returned to the bush (McDowell, 1985, Ndagala, 1985, Marlowe, 2010). It was not until the late 1980’s that a somewhat permanent Hadza settlement, Mongo wa Mono, was successfully established by the government. Here missionaries would occasionally proselytize to the Hadza during short visits lasting no more than a few months (Marlowe, 2002; Marlowe, 2010). Generally, the Hadza are willing to listen to missionaries – at least long enough to obtain gifts of food – and many Hadza children have learned Christian songs. However, at the beginning of the current century, widespread conversion to Christianity was still not seen (Marlowe, 2002; Marlowe, 2010).

Anthropologists working with the Hadza, including current authors, have noted a sizable increase in missionary activity in the last decade (Brian Wood and Alyssa Crittenden, pers. communication, 2017, Gibbons, 2018, Pollom, 2020a). Christian groups are reportedly moving further into Hadzaland and are making concerted and creative efforts to proselytize the entire community. For instance, a small Christian church from the northwestern United States started a campaign called “Hope for Hadza”, visiting in late 2013, bringing 14 tons of corn<sup>1</sup>. The group returned in 2016 after raising a quarter of a million dollars, intending to install a deep-water well, provide crude farming tools, and more corn<sup>2</sup>. Another Lutheran group in the Midwest USA note on their website that they have been regularly working with the Hadza since at least 2014 and possibly earlier (People of hope; Jan, 2015)<sup>3</sup>. The evangelical “Grace Covenant Church” in Colorado sent missionaries to Hadzaland for 11 weeks in 2014 (gracecovenantlakewood.org). According to their ministry newsletters, they provided battery-operated audio-bibles and successfully baptized multiple Hadza. They even claim Hadza-lead evangelizing, asserting that two Hadza actively preach the gospel. When they returned in 2015, they boasted that some Hadza now regularly pray to God for help in obtaining food and healing the sick. Bible readings in Hadzane are now available online (hadzabebible.com), and the Grace Covenant Church confirm in 2019 that some Hadza now preach Christianity and maintain small followings<sup>4</sup>. There also may be other missionary groups in the area that have not yet come to our attention.

Like market exposure, missionary work has the potential not only to shift Hadza religious beliefs, but other norms as well. Indeed, such efforts are explicitly designed to effect such changes. There is no legal requirement for missionaries to disclose the durations of their visits, nor the

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<sup>1</sup> <https://www.gofundme.com/f/22cac4c>

<sup>2</sup> <https://www.gofundme.com/f/22cac4c>

<sup>3</sup> This account, accessed in January 2015, has since been removed or overwritten.

<sup>4</sup> <https://gracecovenantlakewood.org/about-gcc/>

specific content of their message. Further inquiry into the extent and content of proselytization efforts would therefore be valuable.

## **2. Methods**

### **2.1 Participants**

A total of 172 participants were recruited from fifteen different camps in October-November of 2014. Ages ranged from 18 - 75 ( $M= 39$ ,  $SD= 13.7$ ) and 50% were female. Camps were located using “snowball” sampling. Researchers first visited a location that Hadza had previously lived, then had participants direct them to other camps until the full quota was reached. Researchers recruited all willing individuals over 18 years of age in all camps. The data collection was part of a larger project studying the evolution of prosocial religions (Lang et al., 2019; Purzycki et al., 2016). While no Datoga were recruited to participate in any of the study measures, Datoga were named as the outgroup in both economic games. Grain allotted to the Datoga was weighed out and set aside. Datoga pastoralists live and herd throughout Hadzaland and in the Mangola ward. Thus, we regularly encountered Datoga during our travels between camps. Whenever we did, we offered any saved grain as a ‘gift from the Hadza’. None demurred.

### **2.2 Interview procedures**

All questions and materials were adapted from a larger cross-cultural study featured in this special issue. All procedures were conducted in Swahili. Interviews were conducted in private by Ibrahim Mabulla, with supervision from Duncan Stibbard Hawkes. Participants answered questions involving their beliefs and understandings/conceptions of god (i.e., Haine), their exposure to missionaries, resource scarcity<sup>5</sup> and basic demographics (sex, age, years attended school, number of children in the home). Questions were asked immediately following the economic games (described below) to mitigate incomplete data collection due to participants leaving camp. To prevent participant fatigue, the number of overall questions asked relative to the larger cross-cultural study was reduced. Questions relating to long time horizons were also removed because some participants are inexperienced with numerical time frames. Similarly, numerical Likert-scale questions were reformatted to forced choice questions, where participants could answer “yes”, “no” or “I don’t know” (IDK).

## **2.3 Measures**

### **2.3.1 Giving Behavior**

Giving behavior was measured using two different economic games: The Dictator Game (DG), and the Allocation Game (AG). Participants played four games in total, involving different recipients, in counterbalanced order.

The DG is a non-strategic, two-player game, in which the individual in the role of the sender (dictator) unilaterally splits a resource between two parties. In the standard DG, allocations are made between self and another anonymous individual. Once the sender has made their decision, both parties receive their respective allocations and no other decisions are made. Here, it is in the

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<sup>5</sup> Item: “Do you worry that there will not be enough food for your family in the next month?” “Yes” (28.49%), “No” (66.86%), Those answering “IDK” (4.65%) were removed from this coding.



sender's self-interest to send nothing to the recipient. The AG is a non-strategic<sup>6</sup>, three-player game, in which the individual in the role of the allocator unilaterally splits a resource between two other parties. The key difference between the AG and the DG is that the AG provides no opportunity to keep any portion of the endowment, removing the impact of direct self-interest. Each game had different configurations of recipients (Table 1). Participants decided how to split an endowment between (DG1) themselves and a distant ingroup member (an unnamed, Hadza in a different camp); (DG2) themselves and an outgroup member (a Datoga); (AG1) a local ingroup member (an unnamed Hadza living in the subject's camp) and a *different* distant ingroup member; and (AG2) a local ingroup member and a member of an outgroup<sup>7</sup>. Participants were asked to indicate their decisions by placing tokens in colored plastic cups. There were four different colored cups, each representing a different recipient. Although tokens are abstract representations of wealth, a traditional Hadza game, 'lukuchuko' (see Apicella, 2019; Woodburn, 1970; Crittenden, 2016) utilizes pieces of baobab bark as 'gambling chips'. Participants are thus notionally familiar with reasoning using abstract game currencies and researchers noted no confusion for participants in comprehending the task. To facilitate instruction, each cup was labelled with stick figure drawings. Participants were informed that the local ingroup members were different people.

Table 1. A two-by-two matrix of participants' decisions.

	Distant In-Group	Out-Group
Self	<b>DG 1</b>	<b>DG 2</b>
Local In-Group	<b>AG 1</b>	<b>AG 2</b>

The dependent variable was the number of tokens (out of 10) given to the "recipient" in each game (outgroup or distant ingroup). Each token could be traded for ¼ cup of maize. We used food in lieu of cash since food is habitually shared and many Hadza have little experience with cash. Participants were informed that both interview responses and decisions would remain confidential. Participants were asked not to discuss the game with others.

### 2.3.2 Belief in a Haine as a Powerful, Moralizing God

Reported belief in Haine was high: 94.77% of participants affirmed belief in Haine's existence using the single item "Do you believe that Haine is real?". However, the term Haine may be used to denote both a Christian-like god and the 'traditional' Hadza cosmological entity. Therefore, to further investigate conceptions of Haine as a supernatural, moralizing God, we employed a four-item survey to elicit specific beliefs with the response options: "Yes," "No," and "IDK". Items in the survey include: 1-Does Haine know what people are thinking [in their heads]? (No- 14%, Yes- 72%, IDK- 14.5%). 2-Does Haine reward [give gifts] to people who are good? (No- 15.7%, Yes-

<sup>6</sup> Note the AG is only non-strategic in a context where the individual making the decision cannot communicate their decision to either of the recipients, making anonymity critical.

<sup>7</sup> We depart from the others in this issue by using the term "in/outgroup" compared with "co-religionist". Our reasoning is Hadza who live in the same camp may not share the same religious beliefs despite sharing the same culture/ group identity. Conversely, it is possible that some Hadza and Datoga may actually share similar beliefs due to common missionary exposure.

73.3%, *IDK*- 11.1%). 3-Does Haine punish people for being bad? (*No*- 27.3%, *Yes*- 59.3%, *IDK*- 13.4%). 4-Does Haine see what people are doing? (*No*- 14.5%, *Yes*- 77.3%, *IDK*- 8.1%). Dropping “*IDK*” responses, and focusing on those responding, “*Yes/No*,” produces reasonably high internal consistency averaging across the four items (using  $Yes=1/No=0$ ) ( $alpha=.82$ )<sup>8</sup>. We average these four items<sup>9</sup> for each participant to make a Haine belief composite, “HB-composite” hereafter.

### 2.3.3 Market Exposure

Following the methods of Apicella et al., (2014), we defined those Hadza living in close proximity to the Mangola village (see section 1.4) as a ‘high market exposure’ group. This area serves as the economic hub of the Mangola ward and is where Hadza routinely trade goods, make purchases in the markets, and receive compensation from tourists. Those participants in the more inaccessible regions towards the south of Hadza territory were labeled the ‘low market exposure’ group (see supplementary materials for map, Figure S1). In the current study, 63.95% were designated “low exposure,” and 36.05% “high exposure”. This distinction is coarse and, as the Hadza become increasingly exposed to outside cultural institutions and markets, the appropriateness of the current binary will fade. This binary variable was effectively employed in a previous study (Apicella, 2014) and this paper uses data collected in 2014. However, data collected six years later suggests that knowledge of country- and world-affairs is not correlated with camp location (Smith & Apicella, 2020). Moreover, while the daily frequency of tourist visits is higher in village-adjacent camps compared to bush camps, both groups routinely interact with tourists throughout the year and today share a similar degree of access to market goods (Alyssa Crittenden, pers. comms).

### 2.3.4 Missionary Exposure

We also employed a single-item measure of missionary exposure: “*Has a missionary ever tried to teach you about God?*” - using the Swahili word for “God” (i.e., Mungu).<sup>10</sup> We chose this because it is typically the word used by Christian missionaries. As before, the response options included: “*Yes*,” “*No*,” and “*IDK*.” Out of the full sample, 63.37% responded “*Yes*”, 36.05% responded “*No*”,. Less than 1% responded, “*IDK*.” We find, on average, those who reported interacting with missionaries also reported greater belief in Haine as a punishing and knowledgeable god ( $M=.86$ ,  $SD=.26$ ) compared to those who reported no missionary exposure ( $M=.70$ ,  $SD=.39$ ),  $b=.16$ , 95%  $CI: .04, .27$  (Figure 1).

<sup>8</sup> Keeping the “*IDK*” responses and making a continuous score (scoring  $IDK = .5$ ) produces a lower alpha,  $alpha = .80$ .

<sup>9</sup> Using only the three variables for the composite (*Does Haine know what people are thinking? Does Haine punish people for being bad? Does Haine see what people are doing?*), such as in the main article in this issue, produces qualitatively identical results, and shows a lower  $alpha=.72$ .

<sup>10</sup> Researchers use “Mungu” when referring to the Abrahamic god. Though the word often typically references Christianity, in Swahili, Mungu may also refer to the Islamic God. However, we are not aware of any Islamic missionizing in the region. Further, neighboring groups such as the Datoga and Iraqw largely practice traditional religions and/or Christianity, rather than Islam. When referencing Haine specifically, we used the name “Haine”.



Figure 1. A histogram showing the distribution of HB-composite score by missionary exposure. The y-axis represents frequency of the total sample. The x-axis consists of binned increments of the HB-composite. Lines indicate kernel density estimates.

### 2.3.5 Afterlife Belief

The missionary exposure measure does not distinguish those who internalized missionary teachings from those who heard, and rejected, such messages. Thus, the HB-composite may not reflect internalized beliefs. Missionaries often arrive with grain and other gifts that can incentivize declarations of Christian belief. To address this issue, we investigate responses to an open-ended theologically-relevant question: “*What happens to people after they die?*” Responses to this question may indicate internalized missionary teachings. Participants were able to respond freely, using single words or full sentences (e.g., “*They go with Haine*”; “*I don’t know*”; “*If you are good, you go to Heaven, if you are bad you go to Hell*”). While Christian theology teaches that a soul lives on after death in either a place of punishment or reward, classic Hadza ethnographic work has highlighted that Hadza cosmology does not include an afterlife belief (Apicella, 2018; Marlowe, 2010; Woodburn, 1964, but see Skaanes 2017). Thus, we coded participants’ responses into a dichotomous variable “Afterlife Belief”, grouping any mention of a god, soul, heaven, or hell as representing “Non-traditional Beliefs” (e.g., “*go to Haine*”; “*Haine takes soul*”) ( $n= 112$ ), and responses indicating a lack of belief or uncertainty in the afterlife (e.g., “*I don’t know*”; “*Nothing happens*”) as “Traditional Beliefs” ( $n= 57$ ). Of the participants coded as having “Traditional Beliefs” 47.4% indicated missionary exposure, compared to 72% of those coded as having “non-Traditional Beliefs”,  $\chi^2= 9.94$ ,  $p<.01$ . Additional details and methods regarding the coding, the frequency of keywords used when describing afterlife beliefs, and alternative coding schemes can be found in the supplementary materials (supplementary section S1, Table S1).

## 3. Results

As noted above, participants made four separate decisions about how to divide ten tokens between two parties. The distributions of responses (Figure 2) were highly zero-centered, clearly bounded

(0-10, with no participant choosing the highest value), and consequently had no long tails. Thus, unless noted, analyses employ binomial logistic regressions with clustered standard errors on participant, due to the non-independence of observations. Our approach, adapted from Purzycki, et al. (2016), detects which variables impacted these allocation decisions. For each analysis, we report an odds ratio and 95% CIs. A conventional rule of thumb for interpretation is that an odds ratio equal to 1 indicates no difference/effect, while an odds ratio between 1.5 and 1.68 (and their <1 counterparts), is considered “small”, similar to Cohen’s D (Hopkins, 2002; Chen, Cohen, & Chen, 2010).

Results are divided into two sections. Primary analyses (3.1) follow the format of other papers in this special issue, focusing on how belief in an all-knowing and punitive God impacts game decisions. Secondary analyses (3.2) explore the role of missionary and market exposure and include hypotheses that were not formulated at the time of data collection. Several alternative models for each result are provided in the supplementary materials, including Tobit and Logistic regression analysis (supplementary sections, S2, S3). For the logistic regression analyses, we use a dichotomous variable comparing those who gave nothing to those who gave something. The supplementary materials also contain analyses of all results just for the subset of participants who gave one or more tokens, as well as a number of robustness checks, including adding controls (i.e., camp fixed effects, resource scarcity and demographics). Regression tables for all models comprise supplementary tables, S2-5.

### 3.1 Primary Analyses

#### 3.1.1 Economic Games

The average amount given in the games (out of ten units), collapsing across decisions, was small,  $M= 1.19$ ,  $SD= 1.53$ . The mode and median were zero (51.89%). Only 3.63% of the sample made a 50/50 split, and only three individuals gave more than half of their allocation in any condition. In each of the four games independently, the average number of tokens allocated to distant ingroup or outgroup members was low (Table 2).

Table 2. Numbers indicate means and standard deviations (in parentheses) for number of tokens, of 10, given to the recipient (DG) or allocated away from the local ingroup (AG).

	Distant In-Group	Out-Group
Self	<b>DG1</b> 1.37 (1.48)	<b>DG2</b> .79 (1.32)
Local In-Group	<b>AG1</b> 1.68 (1.66)	<b>AG2</b> .93 (1.49)

Using a series of binomial logistic regressions, we first look at each decision independently. DG decisions showed significant bias in favor of the participant, distant ingroup vs self: *Odds*= .16, *95% CI*: .13, .19, outgroup vs self: *Odds*= .09, *95% CI*: .07, .11. AG decisions showed significant bias in favor of the local ingroup: distant ingroup vs local ingroup *Odds*= .20, *95% CI*: .17, .24); outgroup vs local ingroup *Odds*= .10, *95% CI*: .08, .13 (Figure 2).

Across games, a clear pattern emerges where the number of tokens sent to an outgroup member ( $M= .86$ ,  $SD= 1.41$ ) was 78% lower than those sent to a distant ingroup member ( $M= 1.52$ ,

SD= 1.58) (Figure 2). We tested this with a binomial logistic regression. We collapsed games DG1 and AG1 together and DG2 AG2 together, in order to compare the amount given to a distant ingroup member to the amount given to an outgroup member. Thus, our predictor is the recipient (distant ingroup vs outgroup) and the outcome is the number of tokens given to that recipient. We see a meaningful higher probability of giving to distant ingroup members Odds= 1.81, 95% CI: 1.54, 2.12.

There is some evidence that the game-type had an effect (Figure 2) where larger amounts (21% more) were given in the AG ( $M= 1.31$ ,  $SD= 1.62$ ), than the DG ( $M= 1.08$ ,  $SD= 1.43$ ), Odds= .82, 95% CI: .74, .90. Lastly, we see no evidence of an interaction between game-type and group membership of recipient, Odds= .96, 95% CI: .82, 1.12. Due to the lack of interaction, we analyze the data by collapsing across all four decisions to maximize power (with distant ingroup and outgroup as the recipients), and examine each game decision independently.<sup>11</sup>

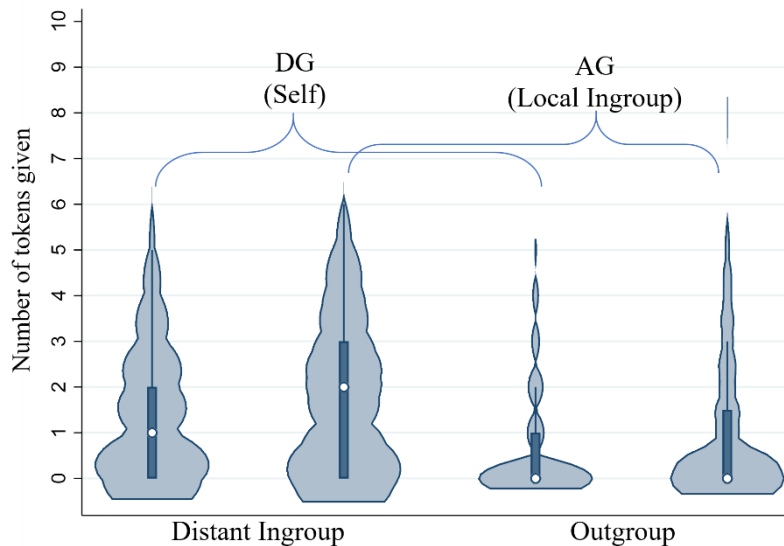


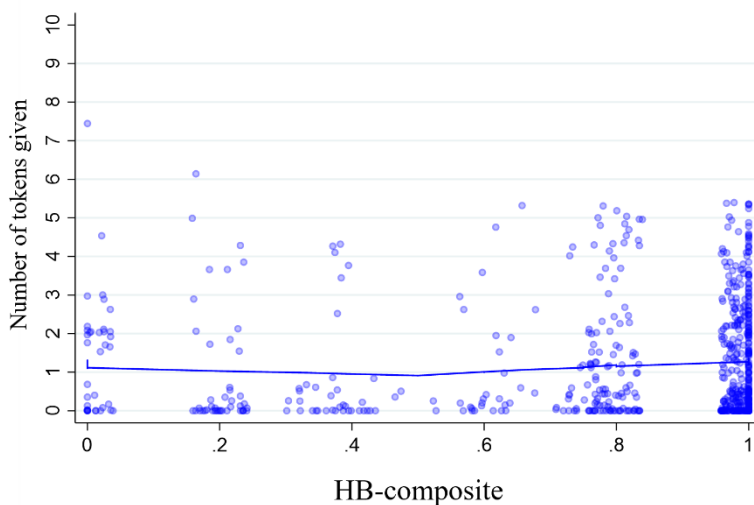
Figure 2. Violin plots show distributions of the number of tokens (of 10) given in each game. For the DGs it represents tokens allotted to distant ingroup (versus self) and outgroup (versus self). For the AGs it represents tokens allotted to distant ingroup (versus local ingroup) and outgroup (versus local ingroup). Number of tokens given on the y-axis, and recipients (as specified) are on the x-axis.

### 3.1.2 Religious Beliefs on Game Decisions

Next, we examine the relationships between number of tokens given and the HB-composite. Using the HB-composite as our predictor and collapsing across all games for the outcome variable, a binomial logistic regression revealed a modest evidence of an effect, Odds= 1.33, with wide CIs including “1”, 95% CI: .75, 2.35 (Figure 3). This indicates that with each unit increase the HB-composite, the odds that a participant allocates a token is increased by 1.33. These results remain largely unchanged when controlling for demographics (supplementary table, S2) or when

<sup>11</sup> Our sample size lacks sufficient power to investigate potential three-way interaction; however, for each of the following additional variables: Haine-belief, market and mission exposure and afterlife belief, yield no evidence of a three-way interaction.

modeling an alternative HB-composite that incorporates the IDK responses as midway between “yes” and “no” (supplementary section S4 and figure S2). Further, using the same composite belief score with just three variables like several other manuscripts in this issue (omniscience, punitive, telepathic,  $\alpha = .72$ ) also produces a comparable, but smaller, result in the same direction,  $Odds = 1.23$ ,  $95\% CI: .72, 2.12$ . Due to the clear skewing of both variables (high overall belief and low overall giving), we also create a dichotomous version of the HB-composite, binning belief as “1” if belief is at the highest level (i.e., full belief), and “0” if below (i.e., partial belief). However, we still see only minor evidence of an effect of full belief on number of tokens given (an increase of 13.4%), again with wide CIs,  $Odds = 1.14$ ,  $95\% CI: .77, 1.68$  (supplementary figure S3).



*Figure 3. Scatterplot depicts distribution of number of tokens given (averaged across all four games on the y-axis), where the recipients are either distant ingroup or outgroup. The x-axis depicts the HB-composite score. Lowess line indicates locally weighted regression for the number of tokens given at each level of the HB-composite*

Disaggregating the individual games and using the same binomial logistic regression to assess effect of HB-composite on number of tokens given in each game, shows an overall comparable result, with similarly modest odds ratios and consistently wide CIs: distant ingroup in DG1  $Odds = 1.37$ ,  $95\% CI: .70, 2.69$ ; distant ingroup in AG1  $Odds = 1.29$ ,  $95\% CI: .69, 2.41$ ; outgroup in DG2  $Odds = 1.67$ ,  $95\% CI: .66, 4.23$ ; outgroup in AG2,  $Odds = 1.30$ ,  $95\% CI: .43, 3.9$  (Figure 4). Note, all above results are comparable when using the three-item belief aggregate.

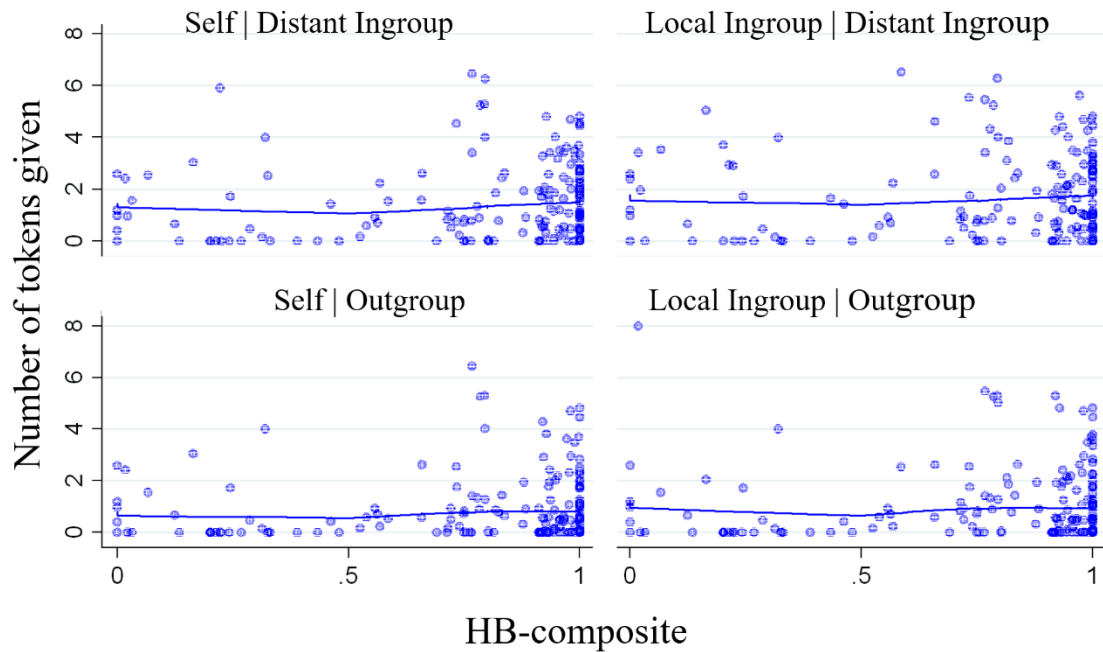


Figure 4. Scatterplot distribution of number of tokens given on the y-axis, for each game. The x-axis depicts HB-composite score. Lowess line indicates locally weighted regression for the number of tokens given at each level of HB-composite.

We also use the dichotomous version of HB-composite (i.e., full versus partial belief), to assess each game decision, in DG1 there was a 14.6% increase in giving to distant ingroup recipients, *Odds*= 1.17, 95% *CI*: .76, 1.80, in AG1 there was a 17.3% increase in giving to distant ingroup recipients, *Odds*= 1.21, 95% *CI*: .80, 1.83, in DG2 there was a 15.3% increase in giving to outgroup recipients, *Odds*= 1.17, 95% *CI*: .63, 2.17, and in AG2 there was only a 3.9% increase in giving to outgroup recipients, *Odds*= 1.04, 95% *CI*: .58, 1.89 (supplementary figure, S4). Thus, there is some slight evidence of increased giving as a function of belief, but the estimates are noisy and ratios are quite small.

### 3.2 Secondary Analyses

#### 3.2.1 Exposure to Markets on Game Decisions

Using the dichotomous market exposure variable as our independent variable, we conduct a binomial logistic regression predicting the number of tokens given (collapsing across all four decisions with distant ingroup and outgroup as the recipients) and find only a minimal effect, *Odds*= 1.17, 95% *CI*: .82, 1.67. Those in the high market exposure group gave slightly more (16.7%), on-average ( $M = 1.31$ ,  $SD = 1.56$ ) compared to the low exposure group ( $M = 1.12$ ,  $SD = 1.51$ ). Breaking down each game, using a binomial logistic regression, we see little to no difference in giving as a function of market exposure for distant ingroup members (DG1: *Odds*= 1.17, 95% *CI*: .79, 1.72, AG1: *Odds*= .88, 95% *CI*: .60, 1.29). We however do see a small to moderate increase

in giving as a function of market exposure for decisions involving outgroup recipients (DG2:  $Odds= 1.72$ , 95%  $CI$ : 1.01, 2.96, AG2:  $Odds= 1.47$ , 95%  $CI$ : .88, 2.47 (supplementary figure S5).

We also collapse across sender identity and focus on the group affiliation of recipients (distant ingroup members versus outgroup members). Using a binomial logistic regression, we interact group affiliation of recipients with market exposure and find evidence of an interaction,  $Odds= .65$ , 95%  $CI$ : .48, .88. We see that decisions involving distant ingroup members are comparable between both high ( $M= 1.52$ ,  $SD= 1.65$ ) and low ( $M= 1.52$ ,  $SD= 1.54$ ) market exposure,  $Odds= 1.00$ , 95%  $CI$ : .72, 1.40), with less than .1% increase as a function of exposure. However, in decisions involving outgroup recipients, we see high exposure ( $M= 1.10$ ,  $SD= 1.44$ ) versus low exposure ( $M= .72$ ,  $SD= 1.38$ ) does appear to make a difference, with a 52% increase in the amount given,  $Odds= 1.55$ , 95%  $CI$ : .95, 2.53, Figure 5.

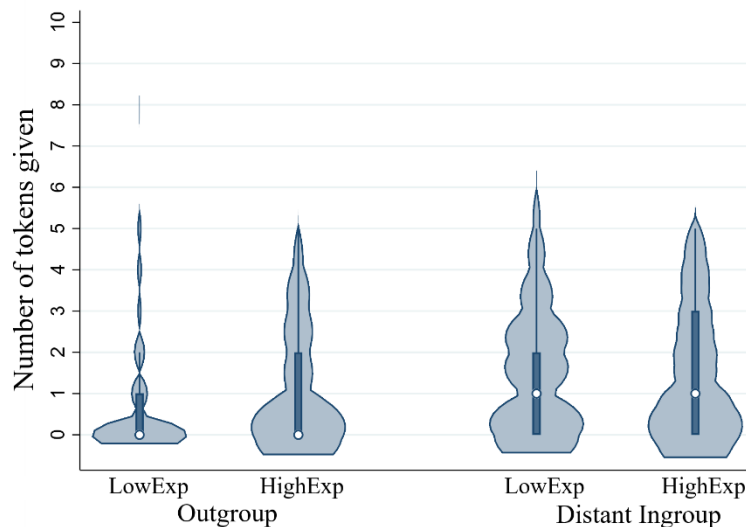


Figure 5. Depicts violin plots showing amount given on the y-axis, broken down by decisions involving distant ingroup versus outgroup recipients. Further divided by level of market exposure, x-axis.

To check for robustness, we ran a series of models assessing the above interaction with controls and the above results hold in both size (even slightly increasing) and direction, varying little in  $CI$  width,  $Odds= .66$ , 95%  $CI$ : .48, .92. Full regression results provided in supplementary table S3.

### 3.2.2 Exposure to Missionaries on Game Decisions

Using the dichotomous missionary-exposure variable as our predictor, we conduct a binomial logistic regression predicting amount given in game decision (collapsing across decisions with distant ingroup and outgroup as the recipients). We find a small effect of missionary exposure on the number of tokens given, with an on-average decrease of 18% in amount given, as a function of exposure, (reported missionary exposure:  $M= 1.13$ ,  $SD= 1.50$ , no reported exposure:  $M= 1.34$ ,  $SD= 1.59$ ),  $Odds= .84$ , 95%  $CI$ : .60, 1.19. Using the same set of binomial logistic regression analyses looking at each decision independently, using the dichotomous missionary exposure variable as our predictor, we see no strong evidence for an effect of reported missionary exposure on any specific game decision: DG1:  $Odds= .91$ , 95%  $CI$ : .62, 1.35, AG1:  $Odds= .8$ , 95%  $CI$ : .56,



1.15; DG2: *Odds*= .77, 95% *CI*: .45, 1.33, AG2: *Odds*= .8, 95% *CI*: .48, 1.35. There was also no evidence of a group affiliation interaction using the same dichotomous variable as above, interaction term: *Odds*= 1.09, 95% *CI*: .79, 1.50. Full regression in supplementary table S4.

### 3.2.3 Afterlife Belief on Game Decisions

Using a binomial logistic regression, with the dichotomous afterlife belief variable as our predictor, and the number of tokens given (collapsing across all four decisions) as the outcome, we see those with non-traditional afterlife beliefs gave on average 39% more ( $M= 1.30, SD= 1.56$ ) compared to those with more traditional afterlife beliefs ( $M= .93, SD= 1.37$ ), *Odds*= 1.40, 95% *CI*: .98, 2.01), Figure 6. Adding in controls only slightly diminishes the size of the effect, but does widen the CIs, *Odds*= 1.23, 95% *CI*: .80, 1.90), full regression table (Supplementary table S5).

Disaggregating the individual games also suggests a small to moderate impact of afterlife belief on giving where those with nontraditional afterlife beliefs gave more: DG1: *Odds*= 1.53, 95% *CI*: 1.02, 2.31, AG1: *Odds*= 1.13, 95% *CI*: .778, 1.64; DG2: *Odds*= 1.97, 95% *CI*: 1.04, 3.72, AG2: *Odds*= 1.67, 95% *CI*: .85, 3.26, figure S6.

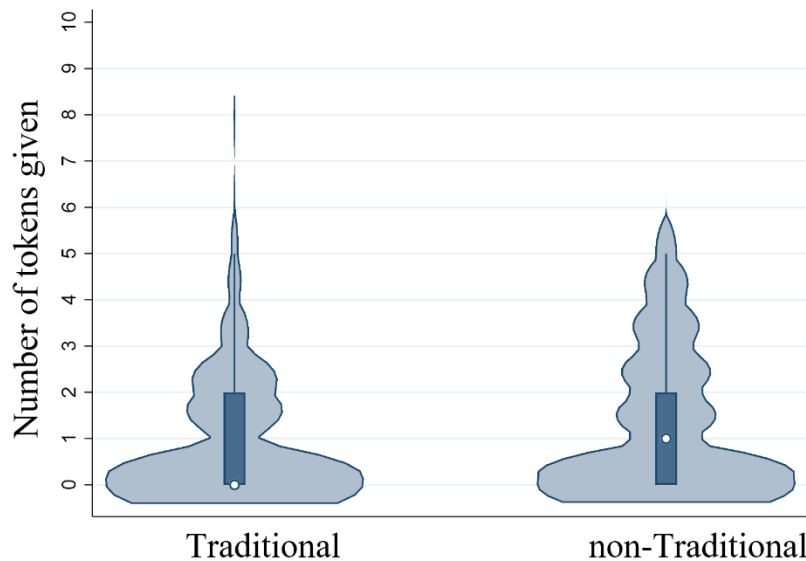


Figure 6. Violin plots showing number of tokens given (collapsing across all four decisions) on the y-axis, divided by afterlife belief on the x-axis.

As with exposure to markets, we see some evidence that afterlife belief more strongly affects allocations to outgroup individuals. Specifically, we see a 72% increase in giving to outgroup recipients among those who indicate non-traditional belief in an afterlife, compared to traditional, materialism/indifference beliefs. In contrast, we only see a 25% increase to distant ingroup recipients. We also use a binomial logistic regression with the number of tokens given as the outcome variable, interacting recipient type (distant ingroup vs outgroup) and afterlife belief

(traditional vs non-traditional); however, the CIs are notably wide: *Odds*= .72, *95% CI*: .46, 1.13, suggesting a noisy estimate<sup>12</sup>.

#### 4. Discussion

Proselytization has been occurring in the Lake Eyasi region at low rates for a long time (Marlowe, 2010). Recently, however, the extent of Christian evangelization in the region has substantially increased. This appears to be visible in our own data: Nearly 95% of respondents in the current study reported a belief in Haine, compared to approximately 76% in 2013 data (Apicella, 2018), though this could reflect sampling differences. Although the questions were worded differently, <50% of respondents in 2013 data reported an afterlife belief, compared to the 63% in this study who used language suggestive of belief in an afterlife. Moreover, we also find evidence that proselytization is effective; those Hadza who report exposure to evangelizing were also more likely to conceptualize Haine as an omniscient god who rewards good, and punishes bad, behavior; and to use language that indicates belief in an afterlife.

A recent and expanding body of literature has posited that both belief in omniscient, morally concerned deities and interaction with market institutions promotes cooperation (Henrich, et al., 2010, Norenzayan et al., 2016) and may help account for the endemic ‘ultrasociality’ that characterizes human societies (Purzycki et al., 2016). We find only little evidence that giving behavior in the DG and AG games is impacted by belief in Haine as an omniscient, moralizing and punitive god. There was similarly little evidence of an effect when collapsing across games and comparing recipients (i.e., allocations between distant ingroup vs outgroup). Apicella (2018) also reported that answers to several questions indicating belief in Haine as an omniscient and moralizing deity did not predict rule-bending in economic games among the Hadza. We also found very little effect of exposure to missionaries; and, this was in the opposite direction, indicating a slight decrease in tokens given.

Notably, we did find small to moderate evidence that belief in an afterlife had an effect on levels of giving, especially toward outgroup recipients. This finding is notable because afterlife belief was the only religious survey question that was open-ended. Of course, these results should be interpreted with caution. Similar to researchers that visit the Hadza, missionaries also bring food and supplies to incentivize religious participation. Thus, it is possible that some of our participants who answered affirmatively to the religious questions were attempting to be “good participants” – that is, stating belief in omniscient and moralizing deities because they think it is socially desirable rather than because they believed it. However, open-ended questions rely on participants to use their own words and may be less subject to researcher influence and bias (Sudman & Bradburn, 1974).

Overall, we find only mixed support for the notion that belief in a moralizing deistic agent promotes greater prosociality among the Hadza. While it is possible that fear of punishment by an omnipotent deity has little impact on Hadza giving behavior, it is also possible that our methodology is not fully tapping into true religious convictions. Further research, using innovative methodologies to further access actual underlying convictions, would be enlightening.

The Dictator Game results were typical of findings reported previously for the Hadza. As in previous studies (e.g., Marlowe, 2004) we find that DG offers are low. Moreover, in line with expectations, participants allocated more to themselves than to close ingroup members, and more to distant ingroup members than outgroup recipients (i.e., Datoga). This further supports other

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<sup>12</sup> We find no strong evidence of an interaction between afterlife belief and market exposure on giving. Further, we find evidence that both effects appear to be fairly independent of each other, S5.

work suggesting that the Hadza share a high ingroup identity, and a strong perception of the Datoga as outgroup members (Apicella, 2018; Purzycki & Lang, 2019).

Results provide greater support for the prediction that market institutions facilitate greater cooperation and fairness. We operationalized market exposure using proximity to areas of high trade (i.e., bush camps adjacent to the village Mangola, figure S1).<sup>13</sup> As with previous studies (e.g., Henrich et al., 2010; Gurven et al., 2015), exposure to markets showed some evidence of an increase (about 16%) in absolute levels of giving. However, we found that the bulk of this increase was due to those in the market adjacent region giving more equitably in games involving outgroup individuals. This effect was robust and persisted when controlling for specific camp, resource scarcity and demographic variables. More recent research with the Hadza suggests that those Hadza with greater exposure to and knowledge of outside cultural institutions, including markets, also exhibit stronger preferences for cooperativeness in their social relationships (Smith and Apicella, 2021). The effect of markets on cooperative behavior within a single population was also documented in Oromo cattle herders of Ethiopia; individuals living in more market-integrated regions were more conditionally cooperative (Rustagi, Engel, & Kosfeld, 2010). While exposure to markets may account for our findings, there may be other underlying causes. For instance, increased regular and repeated one-time interactions with non-Hadza in market-adjacent areas, may also decrease outgroup bias, perhaps by normalizing the act of giving to strangers (see Becker, 1957; Stagnaro, Dunham, & Rand, 2018). Finally, this data is correlational. It is possible that those individuals who exhibit less bias to outsiders are more inclined to move to market regions where such interactions are common.

The present study focuses on a critical question: what roles do religious beliefs and markets play in motivating prosocial behavior? We found only little evidence that belief in an omnipotent and punitive deity is associated with cooperative game play. However, we do find stronger evidence that belief in an afterlife is associated with more generous and equitable divisions, but these effects were still modest and there was uncertainty around the estimates. Notably, Hadza living in market regions exhibit greater impartial prosociality – they give more to outgroup recipients at the expense of themselves and ingroup members. These results provide some evidence that market interactions, either through norm transmission or experience, may help sustain cooperation. Findings underscore how rapidly the Hadza are changing and how important it is for researchers to not only document but also acknowledge the change.

## ***5. Acknowledgements***

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<sup>13</sup> Data from 2019 suggests that Hadza in all regions now report substantial exposure to outside groups and institutions (Smith & Apicella, 2020). Thus, future research contrasting village-adjacent bush camps (i.e., camps near the Mangola village) to camps further inside Hadza territory may no longer be appropriate.

## ***6. Permits and Approval***

Research was conducted with approval from The University of Pennsylvania's Office of Regulatory Affairs and the Tanzanian Commission for Science and Technology (Permit Number 2014317-ER-2000-80).

## ***7. Contributions***

MNS, DSH, CLA wrote the paper. CLA designed the study protocols and materials. DSH supervised data collection in the field. MNS performed the statistical analyses.

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