

Appealing to the minds of gods: A novel cultural evolutionary account of religious appeals and an empirical assessment using ethnographic data from eight diverse societies

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Abstract

While appeals to gods and spirits are ubiquitous throughout human societies past and present, deities' postulated concerns vary across populations. How does the content of beliefs about and appeals to gods vary across groups, and what accounts for this variation? With particular emphasis on locally important deities, we develop a novel cultural evolutionary account that includes a set of predictive criteria for what deities will be associated with in various socioecological contexts. We then apply these criteria in an analysis of individual-level ethnographic free-list data on what pleases and angers locally relevant deities from eight diverse societies. We conclude with a discussion of how alternative approaches to cross-cultural variation in god beliefs and appeals fare against our findings and close by considering some key implications of our methods and findings for the cognitive and evolutionary study of religion.

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1. Introduction

Various approaches address why humans are the only species on the planet that entertains beliefs about gods, ghosts, and other spiritual beings (Geertz, 2020; Jensen, 2019). Some emphasize evolved cognitive faculties such as agency detection, anthropomorphism, and other mentalizing systems to account for beliefs in gods (e.g., Andersen, 2019; Bird-David, 1999; Barrett, 2000; Guthrie, 1980, 1995). Others argue that gods are attention-grabbing and more memorable by virtue of their social relevance inferred by our evolved moral cognition (Boyer, 2000, 2001) or suggest that aspects of gods' temperaments are projections of individuals' personal attitudes and characteristics (Johnson et al., 2015; Spiro and D'Andrade, 1958). While many of these approaches view beliefs as by-products of human cognition, others posit that spiritual sanctions can minimize defection in cooperative dilemmas (Johnson, 2005, 2016; Schloss and Murray, 2011) and/or expand cooperation beyond kith and kin (Norenzayan et al., 2016).

Two critical questions interwoven throughout these discussions are: *How does the content of beliefs about and appeals to gods vary across groups and what accounts for this variation?* While these questions have deep roots in the history of anthropological thought (e.g., Evans-Pritchard, 1965; Lang, 1909; Swanson, 1960; Tylor, 1920), the bulk of contemporary research mostly examines gods or religious traditions that are explicitly interested in human morality (Baumard et al., 2015; Beheim et al., 2021; Botero et al., 2014; Peoples and Marlowe, 2012; Roes and Raymond, 2003; Skogogard et al., 2020; Snarey, 1996; Watts et al., 2015). These studies primarily rely on—often the same—society-level data, usually from coded ethnographies and reports from travelers and missionaries (see Purzycki and Watts, 2018).

When studies have examined individual-level beliefs, they have mostly focused on moralistic gods' role in cooperation (e.g., Atkinson and Bourrat, 2011; Ge et al., 2019; Lang et al., 2019; Purzycki et al., 2016b; McNamara and Henrich, 2018; Willard et al., 2020) rather than attended to deities concerned with other matters and their ethnographic contexts. Yet, if religion can contribute to the evolution of cooperation, we should expect that variation in religious appeals, beliefs, and practices is partly attributable to variation in local threats to coordination and cooperation (Bendixen and Purzycki, 2020; Purzycki and McNamara, 2016; Purzycki and Sosis, 2022). However, despite isolated exceptions (e.g., Atran et al., 2002; McNamara et al., 2021; Purzycki, 2011, 2013, 2016; Singh et al., 2021), there remains a dearth of high-resolution, directly comparable, cross-cultural data with which to examine

how gods' concerns systematically vary cross-culturally.

To initiate this inquiry, we present and examine individual-level ethnographic free-list data on what pleases and angers deities across eight diverse field sites. In Section 2, we first review contemporary work on cross-cultural variation in gods' concerns. Building on this, we develop a cultural evolutionary account of that variation and outline a set of predictive criteria for what gods will evolve to care about given local socioecological features and constraints (cf., Bendixen and Purzycki, 2020). We then present methods of our data collection and summarize key results (Section 3). In Section 4, we assess how our free-list data informs our cultural evolutionary account. Finally, we discuss how alternative approaches fall short of accounting for the present findings and consider important implications and cautionary notes of the present work (Section 5).

Overall, we regard our contribution as taking the necessary theoretical and empirical first steps toward a systematic and predictive account of cross-cultural variation in beliefs about and appeals to gods and spirits. Given that these are first steps, we hope to spark constructive discussion about *i*) our cultural evolutionary account and its constituent elements; *ii*) the free-list data, its strengths, limitations, and interpretation; *iii*) our site-by-site synthesis of data and ethnographic contexts; and *iv*) the broader implications of our methods and findings for the cognitive and evolutionary study of religion, including the cognitive and cultural processes that give rise to variation and universals in supernatural appeals.

2. Social life and the minds of gods: A cultural evolutionary account

2.1. Variation in god beliefs and appeals

What do gods care about and why? While the subject of gods' concerns has been central to anthropological inquiry for over a century, its systematic empirical assessment has only recently begun. For example, Boehm (2008) surveyed 43 ethnographies covering 18 foraging societies, and found instances of supernatural punishment of at least one behavior construed as "antisocial" and "predatory on fellow band members" among all 18 groups. Other behaviors for which traditional gods punished were violations of what Boehm calls "nonmoral taboos" which include domains such as food, ritual, animals, sex, and life stages. In a general survey of ethnographic cases, Purzycki and McNamara (2016) broke down gods' concerns into three broad categories: things people do or are implied to be directed toward other people (e.g., moral conduct and virtuous qualities), toward the gods (e.g., ritual and faith), and toward nature (e.g., preservation and maintenance). Recent site-specific studies using contemporary social scientific methods corroborate these typologies

and also contextualize their relevance to interpersonal relationships (see below and [Atran et al., 2002](#); [McNamara et al., 2021](#); [Purzycki, 2011, 2013, 2016](#); [Shaver et al., 2017](#); [Singh et al., 2021](#)).

As ongoing theory-building suggests (cf. [Purzycki and McNamara, 2016](#); [Bendixen and Purzycki, 2020](#); [Purzycki and Sosis, 2011](#)), these classes of concerns point to some important roles that gods might play in local social ecologies. Yet, an encompassing theory of gods' concerns has yet to be assessed directly alongside systematically collected, detailed, individual-level ethnographic data. Assuming that cultural traditions are contingent on cultural evolutionary historical processes (for recent survey, see [Kendal et al., 2018](#)), we build upon these previous efforts to derive a constellation of general predictive criteria for when we might expect gods to care about particular behaviors. In doing so, we offer an account of what gods care about and why they care about the things they do, thus allowing us to make predictions about how religious traditions might continue to evolve (see Section 5).

2.2. Cultural evolution of gods' concerns

Social life is replete with promises and perils, and the origin of cooperation and coordination on human scales is often touted an evolutionary puzzle ([Cronk and Leech, 2012](#); [Henrich and Muthukrishna, 2021](#); [Richerson et al., 2016](#)). Many evolutionary mechanisms have been proposed for curbing selfishness and promoting cooperation in human societies (e.g., [Henrich and Henrich, 2007](#)), and among them are supernatural punishment ([Johnson, 2005](#)) and rituals ([Sosis and Bressler, 2003](#)). Indeed, as the work discussed in the previous section suggests, rather than being projections of individual cognition, mundane desires or interests, cultural models of gods' concerns appear to revolve around behaviors that correspond to locally salient threats to cooperation and coordination ([Bendixen and Purzycki, 2020](#); [Purzycki and Sosis, 2011, 2022](#); [Rossano, 2007](#)).

Our account posits that, as individual acts, appeals to a watchful and punitive deity are manipulative acts from a signaler to a receiver (see [Cronk, 1994a,b](#); [Rappaport, 1994](#)). These appeals include individually costly behaviors (e.g., “the spirits get upset if you hunt in that part of forest” or “the gods demand expensive sacrifices”) that—through threat of spiritual repercussions—can contribute to the reduction of defection in cooperative ventures when enacted ([Johnson, 2016](#)). Supernatural appeals are often invoked when local challenges to cooperation and coordination become salient and pressing ([Purzycki et al., 2020](#)) and as explanations of maladies and misfortune ([Boyer, 2021](#); [Fitouchi and Singh, 2021](#)). Given this, with time cultural models of gods' concerns should thus evolve to align themselves with particular kinds of communal problems—and corresponding behaviors that might

mitigate these—that people face or have faced in the past. We refer to such problems as “god-problems” and predict that they have generally recurring features (cf., [Bendixen and Purzycki, 2020](#)).

We predict that “god-problems” are first and foremost (a) social dilemmas that are game-theoretic in nature, including problems with cooperation, coordination and conflicts of interests ([Atran et al., 2002](#); [Lansing et al., 2017](#); [Purzycki and Sosis, 2022](#); [Shariff et al., 2014](#)). Coordination and cooperation are critical aspects of human social life, and concepts of deities that care about locally relevant issues may be relatively more culturally and cognitively attractive within a community ([Boyer, 2000, 2001](#); [Purzycki and Sosis, 2022](#)). As a result, god-problems are therefore also predicted to be (b) materially and/or socially costly, and therefore (c) cognitively salient.

Further, we expect god-problems to constitute a subset of local social dilemmas that are (d) relatively difficult to police with secular means and/or (e) more convincingly enforced by appeals to supernatural monitoring and punishment ([Johnson, 2016](#); [Norenzayan et al., 2016](#); [Rossano, 2007](#); [Rossano and LeBlanc, 2017](#)). Although empirical findings have been mixed overall, some studies have indicated that, at least under certain circumstances, cues of being watched may curb rule-breaking ([Bateson et al., 2006](#); [Dear et al., 2019](#); [Nettle et al., 2013](#); [Piazza et al., 2011](#); [Northover et al., 2017b,a](#)). Appeals to supernatural agents may function as cues of being watched and induce fear of supernatural sanctions under conditions where secular means and institutions are inefficient or unavailable (e.g., [Endicott and Endicott, 2014](#); [Leeson and Suarez, 2015](#); [Rossano, 2010](#), p. 205-207) or where strict norm adherence is particularly critical for a community ([Jackson et al., 2020](#); [Roes and Raymond, 2003](#); [Skoggard et al., 2020](#); [Snarey, 1996](#)). Such appeals are likely particularly cognitive and culturally attractive when a wide variety of frequently occurring maladies can be interpreted as supernatural sanctions, a consistent pattern across ethnographic reports ([Hartberg et al., 2016](#)). Lastly, since appeals to a deity might not be necessary, effective, or convincing if the consequences of a behavior are transparent and self-evident, god-problems likely have opaque pay-off structures (f) in that the implications of widespread defection are non-obvious to individuals.

2.3. Illustration with two ethnographic examples

To illustrate these predictive criteria, let us compare two ethnographic case studies. First, consider that in the Tyva Republic localized spiritual entities known as *spirit-masters* (*cher eezi*) are perceived to be particularly concerned with pollution, littering and over-exploitation of natural resources ([Purzycki, 2011, 2016](#), see also below and Supplementary Section S5.1). Traditionally, there is a widespread associa-

tion between *spirit-masters* and natural resource preservation and management (e.g., keeping rivers, land and sacred places clean; preventing excessive hunting). Spirits are typically associated with areas rich in natural resources and specific sacred areas where *spirit-masters* reside and rituals are performed. Littering, pollution and, more broadly, resource preservation and management, constitute a set of quintessential game-theoretic dilemmas (Colyvan et al., 2011; Hardin, 1968): the collective as a whole benefits maximally when everyone cooperates (e.g., no littering, no over-exploitation) but individuals themselves are better off defecting on cooperation (e.g., littering wherever, over-exploiting public/common natural resources), when everyone else cooperates. This fulfills criterion (a). It is also a costly dilemma, criterion (b), in that everyone is worse off if resources deteriorate beyond repair. Maintaining natural resources is also a very salient problem (c) to locals (Purzycki, 2016). Furthermore, littering, pollution and over-exploitation are often anonymous acts; in many cases it is impossible to identify the perpetrator (d), and hence, appeals to supernatural monitoring is likely a more effective means than secular alternatives (e). Finally, since pollution and over-exploitation are inherently collective affairs in that the severity of the problems depend on the accumulation of litter and/or over-extraction of resources over time (i.e., any one person is unlikely to cause serious damage on their own), the pay-offs of the dilemma may be considered non-obvious for the involved individuals (f).

In contrast, consider Henrich and Henrich’s (2010) study of pregnancy-related food taboos in Fiji. They found that the marine species that pregnant and breast-feeding women are not supposed to consume are those carrying the highest levels of toxins to which pregnant and lactating women and newborns are particularly vulnerable. However, while these taboos appear to make adaptive sense and food taboos in general are often supernaturally enforced (Meyer-Rochow, 2009), local Fijians do not regard the pregnancy-related taboos as something local deities are concerned with. Henrich and Henrich (2010) suggest that “this is because compliance with the taboo is pretty high (threats of social sanctions or of harm to one’s infant seem sufficient to maintain them), so threats of supernatural sanctions may be unnecessary to sustain the adaptive behavior” (suppl. mat., p. 36). In other words, the costs of violating the taboo—although potentially high and salient (b and c)—are clear and unambiguous with a predictable outcome likelihood (f) and relatively easy and effective to enforce with secular social norms and stigma (d and e). Note in addition that the interests of the actors involved (the women, their families, the community) are aligned around the same outcome (or are at least not in any obvious conflict), namely avoiding the consumption of toxic foods. It is therefore unclear whether the Fijian pregnancy-related food taboos represent an actual social dilemma (a). Hence,

according to the criteria listed, we would not expect the Fijian pregnancy-related food taboos to constitute a god-problem.

In sum, we submit that appeals to gods will include or indicate behaviors that engage the kinds of challenges people face, in particular threats to coordination and cooperation, real or ersatz¹ (Bendixen and Purzycki, 2020; McNamara and Purzycki, 2020; Purzycki and Sosis, 2022, ch. 10). In the next sections, we systematically survey the content of religious appeals with freely listed ethnographic data from eight diverse field sites about what pleases and angers locally relevant deities (Section 3) and subsequently contextualize these cultural models of local gods' concerns (Section 4). We expect the most salient items (i.e., the most frequently and earliest listed responses; see Section 3.2) in these data to point to salient threats to cooperation, coordination, and conflicts of interests—and behaviors that might address these—within local social ecologies.

3. An empirical assessment of free-list data on deities' likes and dislikes

3.1. Participants

The present data is part of The Evolution of Religion and Morality Project² (Purzycki et al., 2022a) that was designed to explore and test hypotheses pertaining to religious beliefs and cooperation. The main study consisted of a series of experimental economic games and a battery of demographic and religiosity questions (see Lang et al., 2019; Purzycki et al., 2016b,a, 2018a, for further methodological details and presentations of field sites) conducted in eight diverse field sites from around the world (Table 1). We paid participants an initial fee of ~25% of the local average daily wage, and the participants kept their earnings in the experimental economic games with a potential total of ~50% of the local average daily wage. Participation in the main study took a total of around 90 minutes.

¹Note that our account does not assume that religious beliefs and behaviors are always beneficial for a community (see e.g., Edgerton, 1992). Just as cultural and ecological pressures can push a group to beneficial behavioral patterns, so too can cultural and ecological pressures (including time lag) push groups to sub-optimal traditions (e.g., Boyd and Richerson, 1990, 1992; Richerson and Boyd, 2005, chapter 5; for a case study, see le Guen et al., 2013). When we here focus less on maladaptive aspects of religion, it is mainly for the reason that, all else being equal, it is the more beneficial—or at least not extremely harmful—traditions that on the whole tend to survive long enough to become objects of contemporary scientific inquiry.

²The full protocol, summary of methods, and descriptions of the cultural samples are available at:

<https://github.com/bgpurzycki/Evolution-of-Religion-and-Morality>.

Table 1: **Summary of sample size, demographics, and items listed.** Aside from mean age and standard deviations, values reflect cross-variable sample size and, in parentheses, average number of items listed across domains. Number of individuals for which demographics are available and who completed at least one of the free-list tasks (N) and sub-sample sizes per free-list sub-domain (MG: moralistic god, LG: local god, PO: police). Note that there are mismatches between demography and free-list data, since some participants completed the demographic survey but not the free-lists and vice versa. Some participants completed the demographic survey but did not report their age.

Site	N	Age	Females	MG _{pleases}	MG _{angers}	LG _{pleases}	LG _{angers}	PO _{pleases}	PO _{angers}
Coastal Tanna	42	35.3 (14.4)	21	42 (2.2)	42 (3.0)	41 (1.2)	37 (1.3)	42 (2.5)	41 (3.7)
Hadza	68	39.8 (12.1)	31	58 (1.6)	57 (1.7)	47 (1.3)	47 (1.6)	69 (1.2)	69 (1.3)
Inland Tanna	73	37.4 (16.2)	36	74 (1.6)	74 (1.7)	74 (1.7)	74 (1.3)	72 (1.3)	68 (2.1)
Lovu Fiji	75	44.6 (16.9)	52	80 (2.7)	80 (2.8)	–	–	79 (3.1)	77 (3.3)
Marajó, Brazil	73	34.5 (13.2)	39	73 (2.5)	76 (2.6)	58 (1.8)	60 (1.5)	68 (2.1)	65 (2.4)
Mauritius	77	36.2 (14.9)	26	80 (3.5)	69 (2.4)	52 (2.4)	48 (1.6)	80 (3.2)	83 (3.4)
Tyva Republic	72	34.3 (13.0)	52	73 (2.6)	73 (2.7)	72 (2.4)	72 (2.2)	73 (4.0)	71 (3.8)
Yasawa Fiji	67	38.4 (16.1)	37	105 (3.1)	105 (3.0)	105 (2.2)	105 (2.2)	105 (5.0)	105 (4.9)
<i>Total</i>	547	37.7 (14.9)	294	585 (2.6)	576 (2.5)	449 (1.9)	443 (1.8)	588 (2.9)	579 (3.2)

3.2. Methods

Prior to the main study of which the present data was a part, we conducted preliminary ethnographic interviews where participants listed gods and spirits that were important in their communities. For each listed deity, we asked follow-up questions about their knowledge breadth, how punitive they were, and how concerned they were with moral norms (i.e., interpersonal social behaviors that benefit or harm others). Taking these ratings, we selected one deity that was the most knowledgeable, morally concerned, and punitive (the “moralistic deity” henceforth) and another locally important deity that was relatively less associated with these qualities (the “local deity” henceforth). We used these deities to design the main project with a new sample of individuals. Table 2 details the deities we selected and the working languages across our eight field sites.

Table 2: **Deities selected, language used in, and primary economy in each field site.** Note that no local gods were identified for the Lovu Fiji sample.

Site	Economy	Moralistic deity	Local deity	Language of study
Coastal Tanna	Hort./Hunting	Christian god	<i>Tupunus</i>	Bislama
Hadza	Hunting	<i>Haine</i>	<i>Ishoko</i>	Hadzane/Swahili
Inland Tanna	Hort./hunting	<i>Kalpapen</i>	<i>Tupunus</i>	Navhaal
Lovu, Fiji	Wage labor	Shiva	—	Fiji-Hindi/English
Mauritius	Wage labor	Shiva	spirit (<i>nam</i>)	Mauritian Creole
Marajó, Brazil	Wage labor	Christian god	St. Mary	Portuguese
Tyva Republic	Wage labor/herding	<i>Buddha-Burgan</i>	spirit-masters (<i>cher eezi</i>)	Tyvan
Yasawa, Fiji	Fishing/farming	Christian god	ancestor spirits (<i>kalou-vu</i>)	Bauan Fijian

An ideal method for soliciting naturalistic, discrete, and quantifiable ethnographic data is the free-list method (Smith, 1993; Smith and Borgatti, 1997). The method entails participants listing items that represent their knowledge about some topic. Compared to other social scientific instruments such as pre-fabricated item response scales, free-listing also ensures cultural relevance and validity (a particularly pressing issue in the study of “indigenous” religions; see Maarif, 2019), since the content is fully dictated by participants. As such, it is maximally useful among non-numerate populations.

After processing (see Supplementary Section S2), listed items are analyzed according to their frequency and order of mention to generate Smith’s S , an index of cognitive-cultural salience³. As such, the free-list method can reveal variation within and across topics, individuals and groups. Among many other questions and items (see Purzycki et al., 2016a), we asked participants to freely list:

1. the kinds of things the moralistic deity cares about or like
2. the kinds of things the moralistic deity dislikes.
3. the kinds of things the local deity cares about or likes.
4. the kinds of things the local deity dislikes.
5. up to 5 things that the police likes.
6. up to 5 things that the police dislike.

We designed these lists to be capped at five items per domain due to time, but some did offer more. We probed participants about deities in counterbalanced fashion (items 1-4), followed by questions about the police (items 5-6)⁴. In line with the prediction that some features of social life are more likely to be associated with supernatural rather than secular concern, questions about the police were included as a contrast to the two kinds of deities in order to directly compare cognitive and cultural models across secular and supernatural agents.

We coded these free-list data in two ways (see Supplementary Section S2 for further notes and procedures). The first method was general; two independent coders coded the data with the following twelve-category rubric drawn from Purzycki and McNamara (2016):

³Specifically, the Smith’s S of a listed item is calculated simply as $S = \frac{\sum (n+1-k)}{N}$, where n is the number of items an individual lists, k is the order number in which an item was listed, and N is the total sample size of the specific task. See Supplementary Section S4 for more details.

⁴We also asked participants to list up to 5 behaviors that make someone a good/virtuous/moral person and up to 5 behaviors that make someone a bad/immoral person. For an empirical report on the results of these questions, see Purzycki et al. (2018b).

1. **Morality:** generalized behaviors that have a benefit or cost to other people (e.g., hurting, being generous, sharing, etc.)
2. **Virtue:** individual qualities that may or may not have social ramifications (e.g., hard-working, kind, bad conscience, etc.)
3. **People:** in reference to the quality, and/or the state of people (e.g., people, people stay in good health, live beings, happy, etc.)
4. **Etiquette:** conventional social behaviors that have no immediate cost or benefit to others (e.g., shaking hands, wearing the proper clothes, etc.)
5. **Substance Use/Abuse:** Items that involve the use of illicit substances
6. **Religion:** any non-ritual or non-behavioral item concerned with the supernatural (e.g., faith, devotion, loving god, etc.)
7. **Ritual:** any behavior or object used in ritual devoted to the supernatural (e.g., praying, meditation, offerings, sacrifices, not participating in ritual, etc.)
8. **Ecology:** any behavior or object affecting non-human relationships (e.g., pollution, keeping sacred places clean, gardening, etc.)
9. **Food:** food items (e.g. yam, milk, etc.)
10. **Miscellaneous:** miscellaneous items, items that cross-cut categories, etc.
11. **D/K:** I don't know, not sure, etc.
12. **Specific:** Items that are specific to a culture (e.g., bel' leaf, *artysh*, etc.). These were subsequently re-coded into one of the other codes after consultation with field researchers.

Inter-coder reliability was generally quite high across domains (Supplementary Table S1). In cases of inter-coder conflicts, B.G.P. selected the one code of the two that best reflected the coding rubric (Supplementary Table S2).

The same individuals also coded the free-list data in a more specific, bottom-up fashion. As these specific codes are by definition more subjective and unconstrained in nature, there was much variation and inconsistency in granularity, labels, and (mis)spellings across the coders. We subsequently cleaned such entries and lumped together semantically similar items (e.g., what we coded as “No stealing” was initially coded by one assistant as “No stealing – Burglers [sic]”, “No stealing – Robbery”, “No Stealing – Thieves”). We report the specific codes from one coder (NC), who developed the most fine-grained coding scheme (see Supplementary Section S2).

We conducted salience analyses (Supplementary Section S4) of the coded free-list data using the `AnthroTools` package (Purzycki and Jamieson-Lane, 2016) for R (R Core Team, 2021). Once the free-list data were analyzed and summarized, T.B. examined the ethnographic literature for each field site in order to contextualize the data and evaluate the predictive criteria we detailed earlier. Importantly, the criteria were developed prior to the site-by-site ethnographic examinations (cf., Bendixen

and Purzycki, 2020), which goes some way towards ensuring that our account is not “over-fit” to the data and field sites at hand.

3.3. Results

3.3.1. Cultural models of agents’ concerns

Our key findings can be summarized as follows: (1) participants systematically responded that their deities and the police are angered and pleased by human behavior; (2) the moralistic gods and the police converge on similar themes of moral concern but also diverged in predictable ways; (3) while the moralistic gods and the police are primarily and unambiguously moralistic, the local gods also consistently exhibit some salient moral concern; and (4) compared with the moralistic gods and the police, which are generally similar across cultures, the local gods are associated with unique site-specific concerns. We elaborate on these findings in the following. Since much of contemporary research emphasizes the punitive aspects of deities, we focus here on what angers these agents (see Supplementary Figure S2 for panels of what *pleases* these agents).

Figure 1 reports Smith’s S for the general codes across sites and agents. Tables 3 and 4 report the most salient global and site-specific codes across agents (see Supplementary Section S6.1 for expanded salience tables of the general codes). Globally, both the moralistic gods (MO) and the police (PO) converge on disliking breaches of Morality ($S_{MG} = 0.64$, $S_{PO} = 0.78$) and Virtue ($S_{MG} = 0.26$, $S_{PO} = 0.11$) and both are pleased by social harmony (People: $S_{MG} = 0.16$, $S_{PO} = 0.15$). However, there are predictable divergences; in contrast to the police, moralistic gods are pleased by religious thought (Religion: $S_{MG} = 0.11$) and behavior (Ritual: $S_{MG} = 0.30$), while the police are more often associated with disliking Substance Use/Abuse (“Drugs” in graphs and tables: $S_{PO} = 0.16$)⁵. Notably, local deities (LG) are also angered ($S_{LG} = 0.19$) and pleased ($S_{LG} = 0.11$) by (im)moral behaviors, but typically to a lesser degree than moralistic gods and the police, thus confirming our design and operationalization; according to our design and definitions, “moralistic gods” are indeed more moralistic than our “local gods”.

The conceptual overlap between the moralistic deities and the police is further nuanced when examining the specific codes. Aggregated across all sites, the moralistic deities and the police share the same top four items in terms of what they are angered by: stealing, violence, lies, and disobedience (in general and toward the law) (see Table 5). These are unambiguously moral items. As was to be suspected,

⁵For the police, note also the high salience of “Don’t know” among the Hadza and Inland Tanna, two sites that are generally unfamiliar with a formal and organized police force.

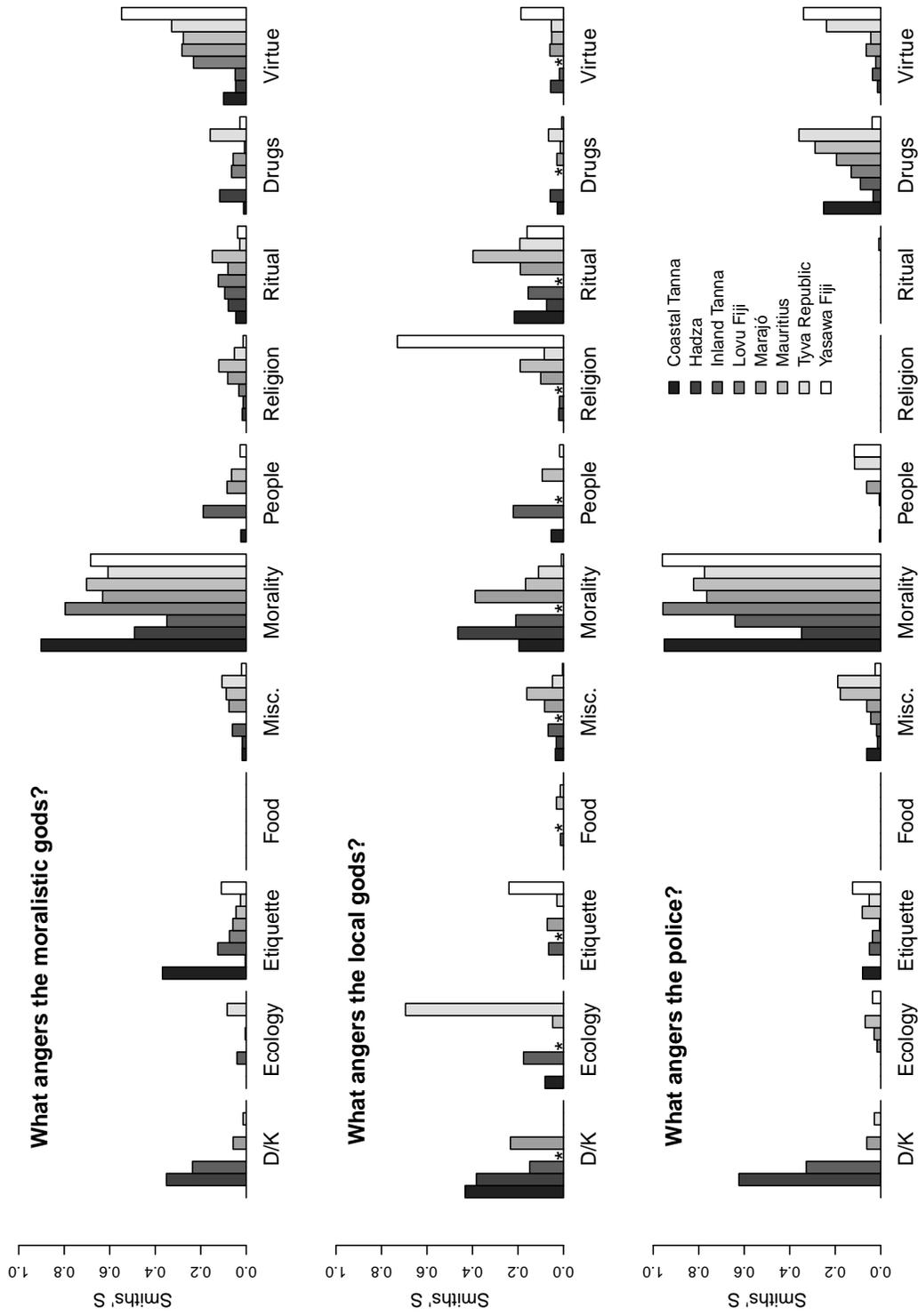


Figure 1: Smith's *S* of general codings for what *angers* the moralistic gods, the local gods and the police. Note that no local deities were identified for Lovu Fiji, hence the asterisks. D/K = Don't know; Misc. = Miscellaneous; Drugs = Substance Use/Abuse.

however, there are also some notable differences. In particular, the police are angered by concrete crimes, such as rape and murder, whereas the moralistic deities are displeased by more abstract, religious transgressions such as sin, swearing, and general “bad behavior”. In terms of what pleases moralistic deities and the police, there is some, but less overlap. Among the top three specific codes, obedience is again a shared concern but the police are primarily pleased by behaviors and qualities that directly support human social interactions, including abiding by the law, not stealing, honesty, discipline, and no violence. In contrast, the moralistic deities are again associated with more general themes, usually with religious connotations, including prayer, general “good behavior”, human welfare, faith, and truth. Taken together, the specific codes support the inference from the general codes in that the moralistic deities and the police are both very similar in their moral concern but also each associated with domain-specific items, namely law and crime for the police and religious devotion for the moralistic deities. The local gods, even though they are clearly associated with moral behaviors like the other two agents, are considerably more cross-culturally diverse, exhibiting unique signatures of localized concerns (see Figure 1 and Table 4). As such, we now turn to a finer-grained site-by-site contextualization of the free-list data on local gods’ concerns.

Table 3: **Global Smith’s S of and number of participants who listed the most salient general codes of what *pleases* and *angers* the moralistic gods (MG), the local gods (LG) and the police (PO).** Only Smith’s $S \geq .10$ is reported. “Substance Use/Abuse” is abbreviated as “Drugs”. “Don’t know” excluded.

MG_{pleases}	MG_{angers}	LG_{pleases}	LG_{angers}	PO_{pleases}	PO_{angers}
Morality (0.31, 220)	Morality (0.64, 413)	Ritual (0.29, 152)	Religion (0.23, 112)	Morality (0.55, 372)	Morality (0.78, 484)
Ritual (0.30, 212)	Virtue (0.26, 201)	Drugs (0.18, 91)	Morality (0.19, 94)	Virtue (0.30, 239)	Drugs (0.16, 137)
Virtue (0.28, 218)	–	Ecology (0.12, 57)	Ritual (0.19, 101)	People (0.15, 130)	Virtue (0.11, 106)
People (0.16, 119)	–	Morality (0.11, 70)	Ecology (0.15, 73)	Misc. (0.14, 107)	–
Religion (0.11, 92)	–	Food (0.11, 52)	–	–	–

Table 4: Cross-cultural Smith’s S of and number of participants who listed the most locally salient general codes of what *pleases* and *angers* the moralistic gods (MG), the local gods (LG) and the police (PO). “Substance Use/Abuse” is abbreviated as “Drugs”. “Don’t know” excluded.

Group	MG _{pleases}	MG _{angers}	LG _{pleases}	LG _{angers}	PO _{pleases}	PO _{angers}
Coastal Tanna	People (0.56, 25)	Morality (0.90, 41)	Ecology (0.16, 7)	Ritual (0.22, 8)	Morality (0.52, 25)	Morality (0.95, 41)
Hadza	People (0.31, 22)	Morality (0.49, 30)	People (0.29, 15)	Morality (0.47, 23)	People (0.21, 15)	Morality (0.35, 24)
Inland Tanna	Ecology (0.34, 26)	Morality (0.35, 29)	Food (0.56, 43)	People (0.22, 17)	Morality (0.22, 17)	Morality (0.64, 45)
Lovu Fiji	Morality (0.57, 53)	Morality (0.80, 68)	–	–	Morality (0.77, 73)	Morality (0.96, 76)
Marajó, Brazil	Virtue (0.36, 32)	Morality (0.63, 56)	Ritual (0.45, 27)	Morality (0.39, 25)	Morality (0.46, 35)	Morality (0.77, 52)
Mauritius	Ritual (0.68, 62)	Morality (0.70, 51)	Morality (0.40, 25)	Ritual (0.40, 21)	Morality (0.61, 58)	Morality (0.82, 75)
Tyva Republic	Morality (0.31, 29)	Morality (0.61, 51)	Ritual (0.57, 46)	Ecology (0.69, 53)	Morality (0.53, 50)	Morality (0.77, 67)
Yasawa Fiji	Virtue (0.58, 76)	Morality (0.68, 87)	Drugs (0.71, 79)	Religion (0.73, 84)	Morality (0.90, 103)	Morality (0.96, 104)

Table 5: Global Smith’s S of and number of participants who listed most salient specific codes of what *pleases* and *angers* the moralistic gods (MG) and the police (PO) (excludes “don’t know”). Only Smith’s $S \geq .05$ is reported.

MG _{pleases}	MG _{angers}	PO _{pleases}	PO _{angers}
Prayer (0.13, 102)	Stealing (0.18, 142)	Law Abiding (0.15, 127)	Stealing (0.44, 315)
Obedient (0.07, 55)	Lies (0.16, 120)	No Stealing (0.12, 97)	Violence (0.22, 184)
Behaviour - Good (0.06, 49)	Violence (0.11, 89)	Obedience (0.07, 52)	Disobedience - Law (0.13, 110)
People (0.06, 36)	Disobedient (0.07, 57)	Honesty (0.07, 47)	Lies (0.11, 101)
Faith (0.05, 41)	Sin (0.07, 49)	Discipline (0.06, 48)	Murder (0.10, 92)
Truth (0.05, 39)	Swearing (0.06, 50)	No Violence (0.05, 49)	Disobedience (0.06, 48)
–	Behaviour - Bad (0.06, 42)	–	Rape (0.06, 62)
–	Murder (0.06, 49)	–	–
–	–	–	–

4. Local gods in ethnographic context

By contextualizing the most culturally salient facets of local deities' concerns at each field site, we can assess aspects of our cultural evolutionary account. Here, we restrict our discussion to the most salient (i.e, Smith's $S \geq .05$) specific codes (see Supplementary Tables S12-S15 for expanded salience tables). We provide broader ethnographic discussions of the local spirits in Supplementary Section S6. Recall our account, which predicts that god-problems—the things that people associate deities with—will tend to be: (a) game-theoretic social dilemmas, that are (b) costly and/or (c) salient, (d) difficult to monitor and enforce with (appeals to) secular alternatives and/or (e) more convincingly and effectively enforced with supernatural appeals, and/or (f) where the consequences of norm deviation are opaque. Importantly, the free-list data can neither directly confirm nor reject our account since we only measure here are individual appeals. However, we do argue that the data bolster significant aspects of it; as we treated the data as appeals, our subsequent site-by-site ethnographic inquiries yielded some important insights.

4.1. Tyva Republic

Consistent with previous research (Purzycki, 2011, 2013, 2016), *spirit-masters* of the Tyva Republic dislike pollution and destruction of the natural environment and are primarily pleased by “no pollution” (see Section 2.3) and ritual devotion (e.g., *sang salyr*/sanctification, bowing, and various food offerings). Throughout Inner Asia, people make offerings at cairns and other places of ritual significance that are strategically located in the landscape, such as at territorial borders and natural springs. Adhering to local rituals signals trustworthiness among Tyvans (Purzycki and Arakchaa, 2013) and violating ritual and resource obligations are believed to result in bad luck. Taken together, appeals to spirits and their associated behaviors may align people toward the problem of curbing instances of territorial trespassing and resource over-exploitation (Section 2.3) and thereby reduce costly conflict between neighboring camps (Purzycki, 2010; Purzycki and Arakchaa, 2013). The Tyvan free-list data, then, fit with the criteria for god-problems discussed earlier, in that territorial defense, disputes, and pollution can be construed as social dilemmas (a) with salient and real costs to people involved (b and c). Conceivably, since territories cover vast and sparsely inhabited land and pollution is typically anonymous, these dilemmas are difficult to police with secular means (d), such as patrolling, and the pay-offs are likely opaque (f) (e.g., pollution accumulates over time; not performing rituals saves time, effort and material goods, but being caught trespassing or not adhering to ritual prescripts is potentially very costly) without appeals to supernatural monitoring (e).

4.2. Tanna

In both of the Tanna sites, food crops, gardening, and garden rules are recurring themes of concern for *Tupunus*, the spiritual force of the local sacred garden system. On Tanna, indigenous garden rules and taboos regulate who can enter the sacred crop gardens and what should be done in the gardens at various times of the year (Bonnemaison, 1984, 1991; Flexner et al., 2018; Kouha, 2015). Importantly, *Tupunus* is angered by taboo violations and punishes perpetrators with sickness and bad luck (Atkinson, 2018; Nehrbass, 2011). In line with the god-problem criteria, ethnographic sources suggest that garden taboos revolve around conceivable threats to coordination and cooperation, particularly ensuring proper cultivation and distribution of collective resources (Bonnemaison, 1991, p. 75-76, 86) and their maintenance (Flexner et al., 2018, p. 258). Resource management constitutes a costly (b) and salient (c) set of game-theoretic dilemmas (a) (Hardin, 1968; Ostrom, 2009; Rogers, 2020) with opaque pay-offs (f) in that resource mismanagement is a cumulative problem (see Section 2.3). In lieu of dedicated secular institutions (d; indeed, on Tanna, the police are not thought to care about these matters; see Tables S14-S15), it might be the case that defection is more effectively enforced by spirit beliefs and appeals (e).

4.3. Yasawa, Fiji

Yasawans free-list the ancestor spirits, *kalou-vu*, as primarily pleased by “kava” rituals and their own “worship”. Kava is a pepper plant with sedative properties that can be prepared into a mildly narcotic substance and, according to one ethnographer, “kava stands metaphorically at the center of Fijian public life” (Tomlinson, 2007, p. 1066). Throughout Polynesia, kava is consumed at nightly drinking ceremonies traditionally associated with ancestor worship (Shaver, 2015; Shaver and Sosis, 2014; Tomlinson, 2004; Turner, 2012). Consistent with the god-problem criteria, the religious system involving *kalou-vu* beliefs and kava drinking is closely linked to central (c) cooperative affairs (a); kava ceremonies are arenas for a host of salient (b) social activities, including competition for status among males (Shaver, 2015; Turner, 2012), forging social bonds and coordinating communal projects (Tomlinson, 2004), as well as dissolving disagreements and aligning economic interests (Tomlinson, 2007); activities, with inscrutable long- and short-term costs and benefits (f), where appeals to spirits (e) are perhaps particularly potent at disincentivizing defection above and beyond locally available alternatives (d).

However, interpreting the free-listed dislikes of the ancestor spirits among Yasawans is complicated by the presence of a particular form of Christianity. The ancestor spirits are perceived as angered by such things as “faith”, the “word” and

“grace” of God, and “truth”, themes closely related to Christianity. As traditional ancestor worship and kava-drinking are viewed as illegitimate and sometimes associated with witchcraft from the perspective of the local Christian churches (McNamara, 2012, p. 17-18; Tomlinson, 2004; Turner, 2012), the free-list responses reveal a form of cultural competition between Christianity and traditional ancestor beliefs (McNamara and Henrich, 2018; McNamara et al., 2021) where Christian churches have successfully demonized the *kalou-vu*. We see a similar feature in Mauritian responses about *nam* spirits.

4.4. Mauritius

Nam spirits, the local gods of the Mauritius sample, are similar to the Western concept of the soul (Kundtóra Klocová et al., 2022; Xygalatas et al., 2018). When a person dies, the *nam* leaves the body of the deceased. If the death was undramatic and natural, and if the bereaved honor the deceased with prayer and ritual offerings, the *nam* will peacefully journey to the realm of the spirits. However, if the death was sudden, unexpected or violent, the spirit is hindered in its transition and can get trapped between the world of the living and the dead. In these cases, rituals, prayer, and offerings toward these spirits is critical lest they transform into *jab*, evil spirits that retaliate ritual neglect with misfortune, illness, or death (Colwell-Chanthaphonh and de Salle-Essoo, 2014; Sussman, 1981). Therefore, *nam* spirits, in the form of *jab*, are sometimes associated with black magic and sorcery (Kundtóra Klocová et al., 2022; Xygalatas et al., 2018). The ambivalent nature of these entities may explain why *nam* are free-listed as pleased with predominantly *immoral* things, such as “bad behavior”, “fear”, and “revenge”. Similar to the case of Yasawan ancestor spirits, *nam* are displeased with such things as “prayer”, “good people” and “God”, which might reflect cultural antagonism between local religious systems, since sorcery is illegal under Mauritian law (Kundtóra Klocová et al., 2022; Xygalatas et al., 2018). However, *nam* spirits like “bad behavior” but also (the act of) “loving”. Further, “prayer” is something they both like *and* dislike. These seeming contradictions may be a result of distinct and conflicting cultural models of *nam* as either a good-willed spirit or a force of evil in the form of *jab* (cf., Kundtóra Klocová et al., 2022), and, again, may reflect cultural competition between different local belief systems in that *nam* like prayer directed towards themselves but dislike prayer dedicated to other “rival” deities. Note that for these reasons this particular ethnographic context complicates assessing our predictive criteria (a through f).

4.5. Hadza

Among the Hadza, *Ishoko*, represented by the Sun, was selected as the local deity. *Ishoko* is free-listed as primarily concerned with (im)moral deeds (e.g., in-

sults, loving, murder, sharing, stealing, violence) and virtuous states and qualities (e.g., peace, good heart) as well as ritual acts (e.g., singing). Morality constitutes a straightforward set of god-problems, in that (im)moral actions almost always involve social dilemmas (a) with substantial (b, c) cost/benefit trade-offs (Alexander, 1987; Curry et al., 2019; Purzycki et al., 2018b) that might be easier to coordinate with appeals to an intervening supernatural agent (e), particularly when secular institutions are weak or absent (d; note that many participants of our Hadza sample responded “Don’t know” with regards to what the police dislike, indicating a general unfamiliarity with formal law-enforcement, see Figure 1).

The relatively high moral salience of *Ishoko* is worth highlighting. As a cultural group, the Hadza is often regarded as a prototypical hunter-gatherer society (e.g., Peoples and Marlowe, 2012; Wright, 2010), but no other site in our sample scores a higher Smith’s *S* of Morality for something that upsets a local god than the Hadza⁶ (see Figure 1). This finding supports a classic view, namely that the presence of moralistic deities are not limited to large-scale, complex societies (e.g., Evans-Pritchard, 1965; Malinowski, 1992). Complimentary analyses further indicate that the moralistic concerns of *Ishoko* (and *Haine*, the “moralistic god” of our Hadza sample) cannot be fully accounted for by external influence from moralizing world religions and missionary activities (Purzycki et al., 2022b; Stagnaro et al., 2022).

4.6. Marajó, Brazil

In Marajó, Brazil, St. Mary (Our Lady of Nazareth – *Nossa Senhora de Nazaré*) was the selected local deity. It is clear from the free-lists that St. Mary resembles a moralistic deity; she is first and foremost concerned with (im)moral behavior (e.g., loving, violence, sin, murder) as well as ritual and religious acts (e.g., prayer, faith, worship) dedicated to her (see Table 4). While ethnographic details of this field site do not lend themselves to a fine-grained examination of the predictive criteria, as noted earlier, (im)moral behaviors are generally costly (b) and pertinent (c) social dilemmas (a) that often require third-party policing (d), such as appealing to a

⁶Note that some participants considered *Haine* and *Ishoko* to be identical entities, an observation that might account for the high moral salience of *Ishoko* as well as the general similarity between *Haine* and *Ishoko* (see e.g., Table 4). In cases where participants said that *Haine* and *Ishoko* are the same, the free-list data from *Haine* were duplicated to *Ishoko*, a decision made by the local field research team. However, to assess how this decision impacts the main results, in the Supplements we analyze and plot the salience of the general codes separately for those Hadza participants who said that *Ishoko* and *Haine* are “different” or the “same” (Figures S3 and S4). Analyzing these two groups of participants separately does not substantially change the main results. See Sections S3, S7, and Figures S3 and S4 for further discussion.

watchful and punitive deity (e).

The moralistic deity for Marajó was the Christian God, and since St. Mary is central to Catholicism, the primary religious denomination at this field site, it is likely that the close conceptual link between St. Mary and the Christian God influences adherents' conception of the former's concerns. Indeed, other work with some of the present participants found that ratings of St. Mary as a punitive and moralistic figure predicts increased prosociality in anonymous economic games (Cohen et al., 2018), suggesting that St. Mary shares important features with moralizing deities in general (Lang et al., 2019; Purzycki et al., 2018a, 2022b). In this sample, however, the general codes suggest that St. Mary is distinct from the Christian God in at least one way, namely, that Ritual is more salient for her ($S_{\text{Likes}} = 0.45$; $S_{\text{Dislikes}} = 0.19$) than for the Christian God ($S_{\text{Likes}} = 0.27$; $S_{\text{Dislikes}} = 0.08$; see Table 4 and Supplementary Tables S4-S7). This salient association is likely due to the fact that St. Mary is the patron saint of the sampled village of Pesqueiro and residents throw religious festivals in her honor (see Cohen et al., 2018; Purzycki et al., 2016a), suggesting that the free-list data reflect a key feature of local cultural tradition.

5. Discussion

We began with asking the following questions: *How does the content of beliefs about and appeals to gods vary across groups, and what accounts for this variation?* Despite a growing contemporary literature on moralizing aspects of deities, relatively few studies have systematically investigated the many other concerns that deities are associated with and their ethnographic contexts. To initiate this inquiry, we first presented a novel cultural evolutionary account of god beliefs and appeals, which includes a set of predictions, derived from prior theoretical, experimental, and ethnographic evidence, for when we might expect people to appeal to the supernatural. We then reported individual-level free-list data on a diverse set of deities' likes and dislikes across eight societies and contextualized the cultural models of local deities' concerns in light of our account. As noted throughout, the degree to which the free-list data and the ethnographic literature allowed a direct assessment of the predictive criteria varied across sites. However, we argue that the data are at least consistent with our account.

Several key findings are worth highlighting, which provide preliminary answers to our guiding questions: First, we show that rather than random, arbitrary, universal, or idiosyncratic, individuals' appeals to locally relevant gods' concerns are *i*) constituent parts of shared cultural models that *ii*) systematically point to *iii*) human behaviors associated with site-specific contexts that *iv*) mediate interpersonal rela-

tionships. In other words, even though gods could have cared about mythical ideas or idiosyncratic things that individuals transparently project onto the gods, appeals to gods’ concerns point to human behaviors that share a constellation of features that reflect local pressing challenges to social life, referred to herein as “god-problems”. Second, while the moralistic gods and the police are closely aligned in terms of general moral salience, supporting a popular notion that deities of world religions come to resemble law-enforcing entities (e.g., [Johnson, 2016](#); [Norenzayan, 2013](#)), the specific content of their moral concerns also predictably diverge—the police are more often concerned with concrete crimes (e.g., rape and murder), whereas the moralistic gods are concerned with personal and collective displays of devotion and general “good behavior”. Third, supporting a classical view that deities of even smaller-scale societies are often morally salient and relevant (e.g., [Evans-Pritchard, 1965](#); [Lang, 1909](#); [Malinowski, 1936](#)) local gods also exhibit stable moral concern, though not typically to the extent of moralistic gods or the police. In this final section, we first discuss how alternative approaches to accounting for cross-cultural variation in god beliefs and appeals fare in the face of these findings and close by considering some key implications and cautionary notes of the present work.

5.1. Alternative accounts of variation in god beliefs and appeals

Consider first the view that god concepts are “catchy” because gods are intuitively thought to be morally interested ([Boyer, 2000, 2001](#)). This is a helpful perspective in that it predicts that gods will revolve around consequential aspects of social life, a prediction we confirmed. However, while deities might in general be *intuitively* moralistic ([Purzycki et al., 2012, 2022b](#)), we found that there was considerable cross-cultural variation in the *explicit* appeals people employ, suggesting that the local context might play a more important role in the evolution of god beliefs and appeals. By way of illustration, consider the idea that gardening is a “catchy” god concern on Tanna (Section 4.2), but not in any other of our sites. This particularism makes sense in light of the ethnographic context but is not obviously accounted for by claims about beliefs being “catchy” for their general social or moral salience *per se*.

Other approaches (e.g., [Johnson et al., 2015](#); [Spiro and D’Andrade, 1958](#)) investigate variants of the “projection hypothesis”, namely that gods’ concerns are projections of believers’ own concerns, temperaments, and interests. While this suggestion might help address some very specific aspects of beliefs (e.g., when elites use appeals to gods as a means for social control; [Ellwood 1918](#); [Swanson 1960](#), chapter 9), it is limited in a few important ways ([Bendixen and Purzycki, 2020](#)). First, the many things that deities are *not* associated with are arguably as revealing as

the things that they are associated with, and overall we do not find that deities care about all manner of personal whims and preferences. As we showed, representational models of deities are, overall, culturally shared rather than idiosyncratic. Second, many god-problems such as commitments to costly ritual routines and temporal or spatial prohibitions on the use of natural resources, are costly to individuals and therefore are inconsistent with immediate, projected self-interest. Third, individuals do not simply project their own explicit moral values onto local gods; there is little overlap in what people say their deities care about and what they say make a person “good” and “bad” (see Purzycki, 2016; Purzycki et al., 2018b). Contrary to some implied variants of the projection hypothesis, then, individuals’ personal concerns and whims are rather separate from those of the gods.

Many current accounts of god beliefs emphasize various moral aspects of deities (e.g., Johnson, 2005, 2016; Norenzayan et al., 2016; Schloss and Murray, 2011). While participants attributed all gods, “moralistic” and “local” alike, with some moral concern (see Purzycki et al., 2022b), they are also culturally specialized in that they are each associated with a locally limited but globally diverse set of concerns that are often not explicitly moralistic. This finding is consistent with our cultural evolutionary account that beliefs about and appeals to deities reflect locally salient challenges and dilemmas in the socioecological landscape. However, what the present work shows is that even if deities are not *explicitly concerned with* general moral prescriptions and prohibitions, they are unambiguously relevant to the costs and benefits of social life (Teehan, 2016). And so, if we are to conceive of morality *as* cooperation (Alexander, 1987; Curry et al., 2019), all of these deities would clearly be construed as “moralistic”. This too calls for a closer examination of local deities and their associations and in-context roles in mediating human relations.

5.2. Implications and cautionary notes

While we have argued that the present work shows that appeals to gods and spirits reflect threats to coordination and cooperation in the local socioecological landscape, we have *not* demonstrated that these beliefs and appeals actually *motivate* corresponding behaviors that mitigate such threats. Even though particular religious systems exhibit clear features of adaptive self-organization (e.g., Bird et al., 2013; Lansing et al., 2017; Sosis and Bressler, 2003) and many other cases are interpreted as such (e.g., Angsongna et al., 2016; Connors, 2000; Leeson and Suarez, 2015; Rossano, 2007; Rappaport, 1968; Reynolds and Tanner, 1995; Strassmann et al., 2012), it remains unclear exactly how beliefs about and appeals to deities

are implicated in such systems (Purzycki and Sosis, 2022).⁷ There is experimental evidence across 15 diverse field sites showing that higher individual ratings of gods’ general monitoring and punitive tendencies predict fairer and more generous behavior towards co-religionists in behavioral economic games (Lang et al., 2019). However, crucially, this work shows no clear relationship between how much money individuals allocate to others in these experiments and how moralistic they think their gods are.

Nonetheless, consistent with our account, some detailed ethnographic case studies employing contemporary social scientific methods suggest that god beliefs and appeals can in fact have tractable behavioral consequences and curb defection in cooperative dilemmas. For instance, among the Mentawai on Siberut Island, Indonesia, the local spirit, *Sikameinan*, punishes people with illness or accidents for violating meat sharing norms. *Sikameinan* can be appeased by hosting costly ceremonies, which among other elements involves sharing meat with community members. As such, beliefs about the punitive *Sikameinan* seems to motivate exactly the kind of behavior that the spirit is associated with (Singh et al., 2021). To take another example, in the Maya lowlands of Guatemala, the native Itza’ Maya traditionally profess beliefs that local spirits protect the rain forest, for instance by punishing violations of the spirits’ “preferences” for certain species and patches of land⁸ (Atran et al., 2002). These beliefs appear to have co-evolved with the subsistence practices of the Itza’, which are determined as more productive and sustainable compared to neighboring groups’ across a range of physical measurements. Thus, spirit beliefs among the Itza’ appear to contribute to the management of forest resources (see also Atran et al., 1999; le Guen et al., 2013).

Finally, since social life is rife with a variety of challenges and dilemmas—modeled as cooperative “games” (Bednar and Page, 2007; Smaldino and Lubell, 2014)—that

⁷Caution is also generally warranted in inferring functional behavior from cultural beliefs in lieu of rigorous analysis and evidence (e.g., Elster, 1983, 2015; Smith and Wishnie, 2000). A related methodological issue pertains to the non-trivial task of drawing rich inferences from free-list data; since free-list responses in isolation are often subject to several interpretative *etic* outcomes, insight into the local *emic* context is crucial for valid conclusions. For instance, in the Mauritius case, many participants listed food-related items (e.g., milk, bel’leaf, flowers, water) as something Shiva likes (see Supplementary Table S10), but since certain foodstuffs play a prominent role in Hindu ritualistic tradition, these responses were coded as Ritual according to the general coding rubric.

⁸These preferences “represent a synthesis of experience accumulated over generations. Violations of spirit preferences can lead to accidents, falling ill, or worse. It matters little if the supernatural threat is real or not: if people believe in it, the threat of punishment becomes a real deterrent” (le Guen et al., 2013, p. 781).

might shift and change over time, we expect that that when communities face novel challenges and dilemmas, appeals to gods’ concerns will co-evolve with behaviors that address these problems (cf., [Jensen, 2019](#), ch. 7; [Purzycki and Sosis, 2022](#), ch. 10; [Sørensen, 2004](#)). Some experimental and ethnographic evidence support this prediction. For example, believers are more likely to emphasize that greed angers God after receiving no return in a trust game ([Purzycki et al., 2020](#)). In Tyva, alcoholism is a severe social ill, and drinking is a steady component of what displeases or angers *spirit-masters* ([Purzycki, 2016](#)) and Buddha ([Purzycki and Holland, 2019](#))⁹ (see [Figure 1](#) and [Supplementary Tables S5 and S7](#)). In Taiwan, the traditional sea goddess, Mazu, was recently co-opted as the patron deity of the local anti-nuclear movement after an oracle of Mazu accurately “foresaw” the non-operation of a newly constructed power plant ([Shih, 2012](#)). And across the globe, “eco-spiritual” movements have recently emerged within world religions in the wake of increased sociopolitical attention on environmentalism (e.g., [Sponsel, 2014](#)). Additionally, when religious systems compete—such as at our field sites in Mauritius and Yasawa, where spirit worship is suppressed as illegal or illegitimate—local deities and spirits appear highly concerned with ritualized commitments to themselves and neglect of or antagonism toward rival deities (see [Figure 1](#), [Sections 4.3-4.4](#), and [Supplementary Sections S5.3-5.4](#)); a pattern that makes sense from a cultural evolutionary perspective, in that god concepts that did not evolve to demand constant attention, particularly when under pressure, would likely be outcompeted by more persistent strains. All of these cases provide hints of the ways in which religion evolves, but of course, we are only just beginning to make sense of these evolutionary processes ([Bendixen and Purzycki, 2020](#)). In particular, cross-cultural longitudinal studies would allow researchers to track religious appeals and behaviors across changing demographic, existential, cultural, social, and ecological circumstances and thereby disentangle the various forces at play in the cultural evolution of gods’ minds ([Bendixen and Purzycki, 2021](#)).

⁹[Purzycki and Sosis \(2022, ch. 10\)](#) frame the potential costs and benefits of social drinking as a social dilemma.

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Author Contributions

T.B. and B.G.P. led project development, data checks, analysis, and writing. B.G.P. managed the greater project of which this was a part, compiled data, and organized coding of the free-list data and T.B. led analysis and ethnographic background research. J.H., A.N., and B.G.P. designed the Evolution of Religion and Morality Project. C.A., Q.A., E.C., R.A.M., B.G.P., A.K.W., and D.X. collected data.

Data Availability

All data and code to reproduce the present study is available at: <https://github.com/tbendixen/cross-cultural-free-list-project>. The main project repository including raw data, full protocols, and related materials is available at: <https://github.com/bgpurzycki/Evolution-of-Religion-and-Morality>.

References

- Alexander, R.D., 1987. *The Biology of Moral Systems*. Aldine Transaction, New Brunswick.
- Andersen, M., 2019. Predictive coding in agency detection. *Religion, Brain & Behavior* 9, 65–84.
- Angsongna, A., Ato Armah, F., Boamah, S., Hambati, H., Luginaah, I., Chuenpagdee, R., Campbell, G., 2016. A systematic review of resource habitat taboos and human health outcomes in the context of global environmental change. *Global Bioethics* 27, 91–111.
- Atkinson, Q.D., 2018. Religion and expanding the cooperative sphere in kastom and christian villages on Tanna, Vanuatu. *Religion, Brain & Behavior* 8, 149–167.

- Atkinson, Q.D., Bourrat, P., 2011. Beliefs about God, the afterlife and morality support the role of supernatural policing in human cooperation. *Evolution and Human Behavior* 32, 41–49.
- Atran, S., Medin, D., Ross, N., Lynch, E., Coley, J., Ek', E.U., Vapnarsky, V., 1999. Folkecology and commons management in the Maya Lowlands. *Proceedings of the National Academy of Sciences* 96, 7598–7603. doi:[10.1073/pnas.96.13.7598](https://doi.org/10.1073/pnas.96.13.7598).
- Atran, S., Medin, D., Ross, N., Lynch, E., Vapnarsky, V., Ek', E.U., Coley, J., Timura, C., Baran, M., 2002. Folkecology, Cultural Epidemiology, and the Spirit of the Commons: A Garden Experiment in the Maya Lowlands, 19912001. *Current Anthropology* 43, 421–450. doi:[10.1086/339528](https://doi.org/10.1086/339528).
- Barrett, J.L., 2000. Exploring the natural foundations of religion. *Trends in Cognitive Sciences* 4, 29–34.
- Bateson, M., Nettle, D., Roberts, G., 2006. Cues of being watched enhance cooperation in a real-world setting. *Biology Letters* 2, 412–414. doi:[10.1098/rsbl.2006.0509](https://doi.org/10.1098/rsbl.2006.0509).
- Baumard, N., Hyafil, A., Morris, I., Boyer, P., 2015. Increased affluence explains the emergence of ascetic wisdoms and moralizing religions. *Current Biology* 25, 10–15. doi:[10.1016/j.cub.2014.10.063](https://doi.org/10.1016/j.cub.2014.10.063).
- Bednar, J., Page, S., 2007. Can Game(s) Theory Explain Culture?: The Emergence of Cultural Behavior Within Multiple Games. *Rationality and Society* 19, 65–97. doi:[10.1177/1043463107075108](https://doi.org/10.1177/1043463107075108).
- Beheim, B., Atkinson, Q.D., Bulbulia, J., Gervais, W., Gray, R.D., Henrich, J., Lang, M., Monroe, M.W., Muthukrishna, M., Norenzayan, A., Purzycki, B.G., Shariff, A., Slingerland, E., Spicer, R., Willard, A.K., 2021. Treatment of missing data determined conclusions regarding moralizing gods. *Nature* 595, E29–E34. doi:[10.1038/s41586-021-03655-4](https://doi.org/10.1038/s41586-021-03655-4).
- Bendixen, T., Purzycki, B.G., 2020. Peering into the minds of gods: What cross-cultural variation in gods' concerns can tell us about the evolution of religion. *Journal for the Cognitive Science of Religion* 5, 142–165. doi:[10.1558/jcsr.40951](https://doi.org/10.1558/jcsr.40951).
- Bendixen, T., Purzycki, B.G., 2021. Competing forces account for the stability and evolution of religious beliefs. *The International Journal for the Psychology of Religion* 31, 307–312. doi:[10.1080/10508619.2020.1844969](https://doi.org/10.1080/10508619.2020.1844969).

- Bird, R.B., Taylor, N., Coddling, B.F., Bird, D.W., 2013. Niche construction and Dreaming logic: aboriginal patch mosaic burning and varanid lizards (*Varanus gouldii*) in Australia. *Proceedings of the Royal Society B: Biological Sciences* 280, 20132297. doi:[10.1098/rspb.2013.2297](https://doi.org/10.1098/rspb.2013.2297).
- Bird-David, N., 1999. “Animism” Revisited: Personhood, Environment, and Relational Epistemology. *Current Anthropology* 40, S67–S91. doi:[10.1086/200061](https://doi.org/10.1086/200061).
- Boehm, C., 2008. A biocultural evolutionary exploration of supernatural sanctioning, in: Bulbulia, J., Sosis, R., Harris, Erica, Genet, R., Wyman, K. (Eds.), *Evolution of Religion: Studies, Theories, and Critiques*. Collins Foundation Press, Santa Margarita, CA, pp. 143–152.
- Bonnemaison, J., 1984. The tree and the canoe: Roots and mobility in vanuatu societies. *Pacific Viewpoint* 25, 117–152. doi:<https://doi.org/10.1111/apv.252002>.
- Bonnemaison, J., 1991. Magic Gardens in Tanna. *Pacific Studies; Laie, Hawaii* 14, 71–89.
- Botero, C.A., Gardner, B., Kirby, K.R., Bulbulia, J., Gavin, M.C., Gray, R.D., 2014. The ecology of religious beliefs. *Proceedings of the National Academy of Sciences* 111, 16784–16789. doi:[10.1073/pnas.1408701111](https://doi.org/10.1073/pnas.1408701111).
- Boyd, R., Richerson, P.J., 1990. Group selection among alternative evolutionarily stable strategies. *Journal of Theoretical Biology* 145, 331 – 342. doi:[https://doi.org/10.1016/S0022-5193\(05\)80113-4](https://doi.org/10.1016/S0022-5193(05)80113-4).
- Boyd, R., Richerson, P.J., 1992. Punishment allows the evolution of cooperation (or anything else) in sizable groups. *Ethology and Sociobiology* 13, 171 – 195. doi:[https://doi.org/10.1016/0162-3095\(92\)90032-Y](https://doi.org/10.1016/0162-3095(92)90032-Y).
- Boyer, P., 2000. Functional origins of religious concepts: ontological and strategic selection in evolved minds. *Journal of the Royal Anthropological Institute* 6, 195–214. doi:[10.1111/1467-9655.00012](https://doi.org/10.1111/1467-9655.00012).
- Boyer, P., 2001. *Religion Explained: The Evolutionary Origins of Religious Thought*. Basic Books.
- Boyer, P., 2021. Deriving Features of Religions in the Wild. *Human Nature* URL: <https://doi.org/10.1007/s12110-021-09410-y>, doi:[10.1007/s12110-021-09410-y](https://doi.org/10.1007/s12110-021-09410-y).

- Cohen, E., Baimel, A., Purzycki, B.G., 2018. Religiosity and resource allocation in Marajó, Brazil. *Religion, Brain Behavior* 8, 168–184. doi:[10.1080/2153599X.2016.1267029](https://doi.org/10.1080/2153599X.2016.1267029).
- Colwell-Chanthaphonh, C., de Salle-Essoo, M., 2014. Saints and evil and the wayside shrines of mauritius. *Journal of Material Culture* 19, 253–277. doi:[10.1177/1359183514540066](https://doi.org/10.1177/1359183514540066).
- Colyvan, M., Justus, J., Regan, H.M., 2011. The conservation game. *Biological conservation* 144, 1246–1253.
- Connors, S.M., 2000. Ecology and religion in Karuk orientations toward the land, in: Harvey, G. (Ed.), *Indigenous religions : A companion*. Cassel, London, pp. 139–151.
- Cronk, L., 1994a. Evolutionary theories of morality and the manipulative use of signals. *Zygon* 29, 81–101.
- Cronk, L., 1994b. The use of moralistic statements in social manipulation: A reply to roy a. rappaport. *Zygon* 29, 351–355.
- Cronk, L., Leech, B.L., 2012. in: *Meeting at Grand Central*, Princeton University Press.
- Curry, O., Whitehouse, H., Mullins, D., 2019. Is it good to cooperate? testing the theory of morality-as-cooperation in 60 societies. *Current Anthropology* 60.
- Dear, K., Dutton, K., Fox, E., 2019. Do ‘watching eyes’ influence antisocial behavior? a systematic review & meta-analysis. *Evolution and Human Behavior* 40, 269–280.
- Edgerton, R.B., 1992. *Sick societies: Challenging the myth of primitive harmony*. Free Press.
- Ellwood, C.A., 1918. Religion and social control. *The Scientific Monthly* 7, 335–348.
- Elster, J., 1983. *Explaining technical change: A case study in the philosophy of science*. CUP Archive.
- Elster, J., 2015. *Explaining social behavior: More nuts and bolts for the social sciences*. Cambridge University Press.

- Endicott, K.L., Endicott, K.M., 2014. Batek Childrearing and Morality, in: Narvaez, D., Valentino, K., Fuentes, A., McKenna, J.J., Gray, P. (Eds.), *Ancestral Landscapes in Human Evolution: Culture, Childrearing and Social Wellbeing*. Oxford University Press, Oxford.
- Evans-Pritchard, E.E., 1965. *Theories of primitive religion*. Oxford University Press.
- Fitouchi, L., Singh, M., 2021. Supernatural punishment beliefs as manipulated explanations of misfortune. URL: psyarxiv.com/vejac, doi:10.31234/osf.io/vejac.
- Flexner, J.L., Lindstrom, L., Hickey, F., Kapere, J., Lindstrom, L., Hickey, F., Kapere, J., 2018. Kaio, kapwier, nepek, and nuk: Human and non-human agency and ‘conservation’ on Tanna, Vanuatu, in: Verschuuren, B., Brown, S. (Eds.), *Cultural and Spiritual Significance of Nature in Protected Areas*, pp. 251–262. doi:10.4324/9781315108186-17.
- Ge, E., Chen, Y., Wu, J., Mace, R., 2019. Large-scale cooperation driven by reputation, not fear of divine punishment. *Royal Society Open Science* 6, 190991. URL: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6731744/>, doi:10.1098/rsos.190991.
- Geertz, A.W., 2020. How did ignorance become fact in American religious studies?: A reluctant reply to Ivan Strenski. *Studi E Materiali Di Storia Delle Religioni* 86, 365–403.
- le Guen, O., Iliev, R., Lois, X., Atran, S., Medin, D.L., 2013. A garden experiment revisited: Inter-generational change in environmental perception and management of the Maya Lowlands, Guatemala: A garden experiment revisited. *Journal of the Royal Anthropological Institute* 19, 771–794. doi:10.1111/1467-9655.12064.
- Guthrie, S.E., 1980. A cognitive theory of religion. *Current Anthropology* 21, 181–203. doi:10.1086/202429.
- Guthrie, S.E., 1995. *Faces in the clouds: A new theory of religion*. Oxford University Press, New York.
- Hardin, G., 1968. The Tragedy of the Commons. *Science* 162, 1243–1248. doi:10.1126/science.162.3859.1243.
- Hartberg, Y., Cox, M., Villamayor-Tomas, S., 2016. Supernatural monitoring and sanctioning in community-based resource management. *Religion, Brain & Behavior* 6, 95–111.

- Henrich, J., Henrich, N., 2007. *Why Humans Cooperate: A Cultural and Evolutionary Explanation*. Oxford University Press, Oxford, UK.
- Henrich, J., Henrich, N., 2010. The evolution of cultural adaptations: Fijian food taboos protect against dangerous marine toxins. *Proceedings. Biological Sciences* 277, 3715–3724. doi:[10.1098/rspb.2010.1191](https://doi.org/10.1098/rspb.2010.1191).
- Henrich, J., Muthukrishna, M., 2021. The Origins and Psychology of Human Cooperation. *Annual Review of Psychology* 72, 207–240. doi:[10.1146/annurev-psych-081920-042106](https://doi.org/10.1146/annurev-psych-081920-042106).
- Jackson, J.C., Caluori, N., Abrams, S., Beckman, E., Gelfand, M.J., Gray, K., 2020. Tight cultures and vengeful gods: How culture shapes religious belief. doi:[10.31234/osf.io/n74fx](https://doi.org/10.31234/osf.io/n74fx).
- Jensen, J.S., 2019. *What is religion?* 2. ed., Routledge.
- Johnson, D.D.P., 2005. God’s punishment and public goods. *Human Nature* 16, 410–446.
- Johnson, D.D.P., 2016. *God is watching you: How the fear of god makes us human*. Oxford University Press, USA.
- Johnson, K.A., Okun, M.A., Cohen, A.B., 2015. The mind of the lord: Measuring authoritarian and benevolent god representations. *Psychology of Religion and Spirituality* 7, 227.
- Kendal, R.L., Boogert, N.J., Rendell, L., Laland, K.N., Webster, M., Jones, P.L., 2018. Social learning strategies: Bridge-building between fields. *Trends in cognitive sciences* 22, 651–665.
- Kouha, C., 2015. A comparison between the God of the Bible and the Tannese primal gods: An apologetic to educate Tannese Christians. *Melanesian Journal of Theology* 31.2, 65.
- Kundtova Klocová, E., Lang, M., Kundt, R., Xygalatas, D., 2022. Cigarettes for the dead: Effects of sorcery beliefs on parochial prosociality in Mauritius. *Religion, Brain & Behavior* .
- Lang, A., 1909. *The making of religion*. Longmans, London.

- Lang, M., Purzycki, B.G., Apicella, C.L., Atkinson, Q.D., Bolyanatz, A., Cohen, E., Handley, C., Kundtová Klocová, E., Lesorogol, C., Mathew, S., et al., 2019. Moralizing gods, impartiality and religious parochialism across 15 societies. *Proceedings of the Royal Society B* 286, 20190202.
- Lansing, J.S., Thurner, S., Chung, N.N., Coudurier-Curveur, A., Karakaş, a., Fesenmyer, K.A., Chew, L.Y., 2017. Adaptive self-organization of Bali's ancient rice terraces. *Proceedings of the National Academy of Sciences* 114, 6504–6509. doi:[10.1073/pnas.1605369114](https://doi.org/10.1073/pnas.1605369114).
- Leeson, P.T., Suarez, P.A., 2015. Superstition and Self-Governance. *New Thinking in Austrian Political Economy* 19, 47–66. doi:[10.1108/S1529-213420150000019003](https://doi.org/10.1108/S1529-213420150000019003).
- Maarif, S., 2019. Indigenous religion paradigm: Re-interpreting religious practices of indigenous people. *Journal of Studies in Philosophy* 44, 103–121. doi:<http://doi.org/10.15068/00155157>.
- Malinowski, B., 1936. *The Foundations of Faith and Morals*. London: Oxford University Press UK.
- Malinowski, B., 1992. *Malinowski and the Work of Myth*. Princeton University Press, Princeton. URL: <https://www.degruyter.com/document/doi/10.1515/9781400862801/html>. publication Title: Malinowski and the Work of Myth.
- McNamara, R.A., 2012. When does it matter that God is watching?: Differential effects of large and small gods on cheating as a function of material security in Yasawa, Fiji. Ph.D. thesis. The University of British Columbia.
- McNamara, R.A., Henrich, J., 2018. Jesus vs. the ancestors: how specific religious beliefs shape prosociality on Yasawa Island, Fiji. *Religion, Brain & Behavior* 8, 185–204.
- McNamara, R.A., Purzycki, B.G., 2020. Minds of gods and human cognitive constraints: socio-ecological context shapes belief. *Religion, Brain & Behavior* 10, 223–238. doi:[10.1080/2153599X.2019.1678510](https://doi.org/10.1080/2153599X.2019.1678510).
- McNamara, R.A., Senanayake, R., Willard, A.K., Henrich, J., 2021. God's mind on morality. *Evolutionary Human Sciences* 3, E6. doi:[10.1017/ehs.2021.1](https://doi.org/10.1017/ehs.2021.1).
- Meyer-Rochow, V.B., 2009. Food taboos: their origins and purposes. *Journal of Ethnobiology and Ethnomedicine* 5, 18. URL: <https://doi.org/10.1186/1746-4269-5-18>, doi:[10.1186/1746-4269-5-18](https://doi.org/10.1186/1746-4269-5-18).

- Nehrbass, K., 2011. Dealing with Disaster: Critical Contextualization of Misfortune in an Animistic Setting: Dealing with Disaster. *Missiology* 39, 459–471. doi:[10.1177/009182961103900404](https://doi.org/10.1177/009182961103900404).
- Nettle, D., Harper, Z., Kidson, A., Stone, R., Penton-Voak, I.S., Bateson, M., 2013. The watching eyes effect in the Dictator Game: It's not how much you give, it's being seen to give something. *Evolution and Human Behavior* 34, 35–40. doi:[10.1016/j.evolhumbehav.2012.08.004](https://doi.org/10.1016/j.evolhumbehav.2012.08.004).
- Norenzayan, A., 2013. *Big gods: How religion transformed cooperation and conflict*. Princeton University Press.
- Norenzayan, A., Shariff, A.F., Gervais, W.M., Willard, A.K., McNamara, R.A., Slingerland, E., Henrich, J., 2016. The cultural evolution of prosocial religions. *Behavioral and brain sciences* 39.
- Northover, S.B., Pedersen, W.C., Cohen, A.B., Andrews, P.W., 2017a. Artificial surveillance cues do not increase generosity: Two meta-analyses. *Evolution and Human Behavior* 38, 144–153. doi:[10.1016/j.evolhumbehav.2016.07.001](https://doi.org/10.1016/j.evolhumbehav.2016.07.001).
- Northover, S.B., Pedersen, W.C., Cohen, A.B., Andrews, P.W., 2017b. Effect of artificial surveillance cues on reported moral judgment: Experimental failures to replicate and two meta-analyses. *Evolution and Human Behavior* 38, 561–571. doi:[10.1016/j.evolhumbehav.2016.12.003](https://doi.org/10.1016/j.evolhumbehav.2016.12.003).
- Ostrom, E., 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325, 419–422. doi:[10.1126/science.1172133](https://doi.org/10.1126/science.1172133).
- Peoples, H.C., Marlowe, F.W., 2012. Subsistence and the evolution of religion. *Human Nature* 23, 253–269.
- Piazza, J., Bering, J.M., Ingram, G., 2011. “Princess Alice is watching you”: Children's belief in an invisible person inhibits cheating. *Journal of Experimental Child Psychology* 109, 311 – 320. doi:<http://dx.doi.org/10.1016/j.jecp.2011.02.003>.
- Purzycki, B.G., 2010. Spirit masters, ritual cairns, and the adaptive religious system in tyva. *Sibirica* 9, 21–47.
- Purzycki, B.G., 2011. Tyvan *cher eezi* and the socioecological constraints of supernatural agents' minds. *Religion, Brain & Behavior* 1, 31–45.

- Purzycki, B.G., 2013. The minds of gods: A comparative study of supernatural agency. *Cognition* 129, 163 – 179. doi:<http://dx.doi.org/10.1016/j.cognition.2013.06.010>.
- Purzycki, B.G., 2016. The evolution of gods' minds in the Tyva Republic. *Current Anthropology* 57, S88–S104. doi:[10.1086/685729](https://doi.org/10.1086/685729).
- Purzycki, B.G., Apicella, C., Atkinson, Q.D., Cohen, E., McNamara, R.A., Willard, A.K., Xygalatas, D., Norenzayan, A., Henrich, J., 2016a. Cross-cultural dataset for the evolution of religion and morality project. *Scientific Data* 3, 160099. doi:[10.1038/sdata.2016.99](https://doi.org/10.1038/sdata.2016.99).
- Purzycki, B.G., Apicella, C., Atkinson, Q.D., Cohen, E., McNamara, R.A., Willard, A.K., Xygalatas, D., Norenzayan, A., Henrich, J., 2016b. Moralistic gods, supernatural punishment and the expansion of human sociality. *Nature* 530, 327–330. doi:[10.1038/nature16980](https://doi.org/10.1038/nature16980).
- Purzycki, B.G., Arakchaa, T., 2013. Ritual Behavior and Trust in the Tyva Republic. *Current Anthropology* 54, 381–388. doi:[10.1086/670526](https://doi.org/10.1086/670526).
- Purzycki, B.G., Finkel, D.N., Shaver, J., Wales, N., Cohen, A.B., Sosis, R., 2012. What does god know? supernatural agents' access to socially strategic and non-strategic information. *Cognitive Science* 36, 846–869. doi:[10.1111/j.1551-6709.2012.01242.x](https://doi.org/10.1111/j.1551-6709.2012.01242.x).
- Purzycki, B.G., Henrich, J., Apicella, C., Atkinson, Q.D., Baimel, A., Cohen, E., McNamara, R.A., Willard, A.K., Xygalatas, D., Norenzayan, A., 2018a. The evolution of religion and morality: a synthesis of ethnographic and experimental evidence from eight societies. *Religion, Brain & Behavior* 8, 101–132.
- Purzycki, B.G., Holland, E.C., 2019. Buddha as a God: An Empirical Assessment. *Method & Theory in the Study of Religion* 31, 347–375. doi:[10.1163/15700682-12341453](https://doi.org/10.1163/15700682-12341453).
- Purzycki, B.G., Jamieson-Lane, A., 2016. Anthrotools: An R package for cross-cultural ethnographic data analysis. *Cross-Cultural Research* 51, 51–74.
- Purzycki, B.G., Lang, M., Henrich, J., Norenzayan, A., 2022a. The evolution of religion and morality: Reflections and looking ahead. *Religion, Brain & Behavior* X.

- Purzycki, B.G., McNamara, R.A., 2016. An ecological theory of gods' minds, in: De Cruz, H., Nichols, R. (Eds.), *Cognitive Science of Religion and Its Philosophical Implications*. Continuum, New York, pp. 143–167.
- Purzycki, B.G., Pisor, A., Apicella, C., Atkinson, Q.D., Cohen, E., Henrich, J., McElreath, R., McNamara, R.A., Norenzayan, A., Willard, A.K., Xygalatas, D., 2018b. The cognitive and cultural foundations of moral behavior. *Evolution and Human Behavior* 39, 490–501.
- Purzycki, B.G., Sosis, R., 2011. Our gods: Variation in supernatural minds, in: *Essential building blocks of human nature*. Springer, pp. 77–93.
- Purzycki, B.G., Sosis, R., 2022. *Religion Evolving: The Dynamics of Culture, Cognition and Ecology*. Equinox.
- Purzycki, B.G., Stagnaro, M.N., Sasaki, J., 2020. Breaches of Trust Change the Content and Structure of Religious Appeals. *Journal for the Study of Religion, Nature and Culture* 14, 71–94. doi:[10.1558/jsrnc.38786](https://doi.org/10.1558/jsrnc.38786).
- Purzycki, B.G., Watts, J., 2018. Reinvigorating the comparative, cooperative ethnographic sciences of religion. *Free Inquiry* 38, 26–29.
- Purzycki, B.G., Willard, A.K., Klocová, E.K., Apicella, C., Atkinson, Q., Bolyanatz, A., Cohen, E., Handley, C., Henrich, J., Lang, M., Lesorogol, C., Mathew, S., McNamara, R.A., Moya, C., Norenzayan, A., Placek, C., Soler, M., Weigel, J., Xygalatas, D., Ross, C.T., 2022b. The Moralization Bias of Gods' Minds: A Cross-Cultural Test. *Religion, Brain and Behavior* , 25.
- R Core Team, 2021. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. Vienna, Austria.
- Rappaport, R.A., 1968. *Pigs for the Ancestors: Ritual in the Ecology of a New Guinea People*. Yale University Press.
- Rappaport, R.A., 1994. On the evolution of morality and religion: a response to lee cronk. *Zygon*® 29, 331–349.
- Reynolds, V., Tanner, R., 1995. *The Social Ecology of Religion*. 2. ed., Oxford University Press, New York.
- Richerson, P., Baldini, R., Bell, A.V., Demps, K., Frost, K., Hillis, V., Mathew, S., Newton, E.K., Naar, N., Newson, L., et al., 2016. Cultural group selection

- plays an essential role in explaining human cooperation: A sketch of the evidence. *Behavioral and Brain Sciences* 39. doi:[10.1017/S0140525X1400106X](https://doi.org/10.1017/S0140525X1400106X).
- Richerson, P.J., Boyd, R., 2005. *Not by genes alone: How culture transformed human evolution*. University of Chicago Press Chicago.
- Roes, F.L., Raymond, M., 2003. Belief in moralizing gods. *Evolution and Human Behavior* 24, 126–135. doi:[10.1016/S1090-5138\(02\)00134-4](https://doi.org/10.1016/S1090-5138(02)00134-4).
- Rogers, A.R., 2020. Beating your neighbor to the berry patch. bioRxiv doi:[10.1101/2020.11.12.380311](https://doi.org/10.1101/2020.11.12.380311).
- Rossano, M., 2010. *Supernatural selection: How religion evolved*. Oxford University Press.
- Rossano, M., LeBlanc, A., 2017. Why add the supernatural? *Religion, Brain & Behavior* 7, 375–377.
- Rossano, M.J., 2007. Supernaturalizing Social Life: Religion and the Evolution of Human Cooperation. *Human Nature* 18, 272–294. doi:[10.1007/s12110-007-9002-4](https://doi.org/10.1007/s12110-007-9002-4).
- Schloss, J.P., Murray, M.J., 2011. Evolutionary accounts of belief in supernatural punishment: a critical review. *Religion, Brain & Behavior* 1, 46–99.
- Shariff, A., Purzycki, B.G., Sosis, R., 2014. Religions as Cultural Solutions to Social Living, in: Cohen, A.B. (Ed.), *Culture Reexamined: Broadening Our Understanding of Social and Evolutionary Influences*. APA Books, Washington, DC, pp. 217–238.
- Shaver, J.H., 2015. The evolution of stratification in Fijian ritual participation. *Religion, Brain & Behavior* 5, 101–117. doi:[10.1080/2153599X.2014.893253](https://doi.org/10.1080/2153599X.2014.893253).
- Shaver, J.H., Fraser, G., Bulbulia, J., 2017. Charismatic signaling: How religion stabilizes cooperation and entrenches inequality. *The Oxford Handbook of evolutionary psychology and religion* .
- Shaver, J.H., Sosis, R., 2014. How Does Male Ritual Behavior Vary Across the Lifespan? *Human Nature* 25, 136–160. doi:[10.1007/s12110-014-9191-6](https://doi.org/10.1007/s12110-014-9191-6).
- Shih, F.L., 2012. Generating power in Taiwan: Nuclear, political and religious power. *Culture and Religion* 13, 295–313. doi:[10.1080/14755610.2012.706229](https://doi.org/10.1080/14755610.2012.706229).

- Singh, M., Kaptchuk, T.J., Henrich, J., 2021. Small gods, rituals, and cooperation: The mentawai water spirit sikameinan. *Evolution and Human Behavior* 42, 61–72. doi:<https://doi.org/10.1016/j.evolhumbehav.2020.07.008>.
- Skoggard, I., Ember, C.R., Pitek, E., Jackson, J.C., Carolus, C., 2020. Resource Stress Predicts Changes in Religious Belief and Increases in Sharing Behavior. *Human Nature* 31, 249–271. doi:[10.1007/s12110-020-09371-8](https://doi.org/10.1007/s12110-020-09371-8).
- Smaldino, P.E., Lubell, M., 2014. Institutions and cooperation in an ecology of games. *Artificial Life* 20, 207–221. doi:[10.1162/ARTL_a_00126](https://doi.org/10.1162/ARTL_a_00126).
- Smith, E.A., Wishnie, M., 2000. Conservation and Subsistence in Small-Scale Societies. *Annual Review of Anthropology* 29, 493–524. doi:[10.1146/annurev.anthro.29.1.493](https://doi.org/10.1146/annurev.anthro.29.1.493).
- Smith, J.J., 1993. Using ANTHOPAC 3.5 and a Spreadsheet to Compute a Free-List Salience Index. *CAM* 5, 1–3. doi:[10.1177/1525822X9300500301](https://doi.org/10.1177/1525822X9300500301).
- Smith, J.J., Borgatti, S.P., 1997. Salience Counts—And So Does Accuracy: Correcting and Updating a Measure for Free-List-Item Salience. *Journal of Linguistic Anthropology* 7, 208–209. doi:[10.1525/jlin.1997.7.2.208](https://doi.org/10.1525/jlin.1997.7.2.208).
- Snarey, J., 1996. The natural environment’s impact upon religious ethics: A cross-cultural study. *Journal for the Scientific Study of Religion* , 85–96.
- Sosis, R., Bressler, E.R., 2003. Cooperation and commune longevity: A test of the costly signaling theory of religion. *Cross-cultural research* 37, 211–239.
- Spiro, M.E., D’Andrade, R.G., 1958. A cross-cultural study of some supernatural beliefs. *American Anthropologist* 60, 456–466.
- Sponsel, L.E., 2014. Spiritual ecology: Is it the ultimate solution for the environmental crisis? *Choice* 51, 1339–13448.
- Sørensen, J., 2004. Religion, evolution and an immunology of cultural systems. *Evolution and Cognition* 10, 61–73.
- Stagnaro, M.N., Stibbard-Hawkes, D.N.E., Apicella, C.L., 2022. Do religious and market-based institutions promote cooperation in hadza hunter-gatherers? .
- Strassmann, B.I., Kurapati, N.T., Hug, B.F., Burke, E.E., Gillespie, B.W., Karafet, T.M., Hammer, M.F., 2012. Religion as a means to assure paternity. *Proceedings of the National Academy of Sciences* 109, 9781–9785. doi:[10.1073/pnas.1110442109](https://doi.org/10.1073/pnas.1110442109).

- Sussman, L.K., 1981. Unity in diversity in a polyethnic society: The maintenance of medical pluralism on mauritius. *Social Science and Medicine. Part B: Medical Anthropology* 15, 247 – 260. doi:[https://doi.org/10.1016/0160-7987\(81\)90051-X](https://doi.org/10.1016/0160-7987(81)90051-X).
- Swanson, G.E., 1960. *The birth of the gods: The origin of primitive beliefs*. University of Michigan Press.
- Teehan, J., 2016. Religion and Morality: The Evolution of the Cognitive Nexus, in: Liddle, J.R., Shackelford, T.K. (Eds.), *The Oxford Handbook of Evolutionary Psychology and Religion*.
- Tomlinson, M., 2004. Perpetual Lament: Kava-Drinking, Christianity and Sensations of Historical Decline in Fiji. *The Journal of the Royal Anthropological Institute* 10, 653–673.
- Tomlinson, M., 2007. Everything and Its Opposite: Kava Drinking in Fiji. *Anthropological Quarterly* 80, 1065–1081. doi:[10.1353/anq.2007.0054](https://doi.org/10.1353/anq.2007.0054).
- Turner, J.W., 2012. Listening to the ancestors: Kava and the Lapita Peoples. *Ethnology* 51, 31–53.
- Tylor, E.B., 1920. *Primitive culture: Researches into the development of mythology, philosophy, religion, language, art, and custom*. London: Murray. URL: <http://archive.org/details/primitiveculture01tylouoft>.
- Watts, J., Greenhill, S.J., Atkinson, Q.D., Currie, T.E., Bulbulia, J., Gray, R.D., 2015. Broad supernatural punishment but not moralizing high gods precede the evolution of political complexity in Austronesia. *Proceedings of the Royal Society of London B: Biological Sciences* 282, 20142556. doi:[10.1098/rspb.2014.2556](https://doi.org/10.1098/rspb.2014.2556).
- Willard, A.K., Baimel, A., Turpin, H., Jong, J., Whitehouse, H., 2020. Rewarding the good and punishing the bad: The role of karma and afterlife beliefs in shaping moral norms. *Evolution and Human Behavior* 41, 385–396. doi:[10.1016/j.evolhumbehav.2020.07.001](https://doi.org/10.1016/j.evolhumbehav.2020.07.001).
- Wright, R., 2010. *The evolution of God: The origins of our beliefs*. Hachette UK.
- Xygalatas, D., Kotherová, S., Maño, P., Kundt, R., Cigán, J., Klocová, E.K., Lang, M., 2018. Big gods in small places: The random allocation game in mauritius. *Religion, Brain & Behavior* 8, 243–261. doi:[10.1080/2153599X.2016.1267033](https://doi.org/10.1080/2153599X.2016.1267033).