Spirit-Master Beliefs and Cooperation Among the Buryat of Mongolia (Pre-Registration)

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1.Introduction

Among the myriad markers of human uniqueness, there are two striking aspects of our social lives that stand out as especially notable: i) we are incredibly cooperative with others, including with those beyond our kin and reciprocal sharing partners; and ii) that all human societies exhibit some commitment to invisible supernatural beings who mete out punishment (i.e., we are a religious species). Are these two traits linked? That is, are we cooperative, at least in part, because we believe in punitive supernatural agents? Some empirical and theoretical research suggests "yes," although the evidence - which we discuss in more detail below - is far from equivocal and there remain many open questions.

1.1. Theory

At its simplest, cooperation will evolve when the benefits to helping others outweighs the personal costs to self, measured in terms of lifetime inclusive fitness (West et al., 2007). This can explain the evolution of such personally-costly altruistic behaviours through relatedness (Hamilton, 1964), but also mutually-beneficial cooperative behaviours such as reciprocity (Trivers, 1971). These two explanations, and particularly kin selection, seem to explain the majority of observed cooperation among non-human animals (Clutton-Brock, 2009). However, they appear insufficient to explain the large-scale cooperation observed among humans (Boyd & Richerson, 2022; Henrich & Henrich, 2007). While numerous solutions to this "evolutionary puzzle" have been proposed - e.g., based on reputation (Nowak, 2006; Roberts et al., 2021), cultural learning mechanisms (Boyd & Richerson, 1985), cultural group selection (Henrich, 2004) and institutional norms (Ostrom, 2015), among numerous others - here we focus on the role of religious beliefs, specifically religious punishment (which may not be mutually-exclusive from these other theories).

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How might religious beliefs promote cooperation? A key theory is known as the "supernatural punishment hypothesis" (Johnson, 2005; Schloss & Murray, 2011). Broadly, this theory states that, due to humans' mind-reading/mentalising capabilities, our ancestors had to come to terms with others exploiting them by anticipating their motivations and desires. Thus, institutions evolved to set social standards, coordinate behaviour, align incentive structures, and impose costs on those who breach moral expectations. In order to avoid costs of social sanctions, humans extend these abilities to the gods, claiming that gods/deities may know about, be interested in - and, crucially, potentially punish - humans for norm-violating behaviours. As a result of this socio-cognitive process, the circle of human cooperation may have expanded, especially towards distant co-religionists. This supernatural punishment hypothesis may be especially important in large-scale societies, via a co-evolutionary process between social complexity and supernatural punishment, and hence may help explain the evolution of large-scale human cooperation (Norenzayan et al., 2016).

A number of studies have provided evidence in support of this theory. For instance, comparative work using the Standard Cross-Cultural Sample has found that 'moralistic high gods' are associated with increased social complexity (Johnson, 2005), while large-scale cross-cultural studies have also reported small but consistent positive associations between religious punishment/monitoring and cooperation with distant co-religionists (Lang et al., 2019; Purzycki et al., 2016b). However, other observational work has found no relationship between supernatural punishment beliefs and cooperation (Ge et al., 2019). Cross-cultural work has also been questioned, due to the focus on 'moralistic high gods' (i.e., morally-concerned creator gods), rather than 'supernatural punishment' more generally; while the former is largely found in more socially-complex societies, broader supernatural punishment is common across societies, regardless of size (Lightner et al., 2023). Findings from more recent cross-cultural comparative research have been mixed, meaning the relationship between supernatural punishment and social complexity at the macro-level is unclear (Beheim et al., 2021; Turchin et al., 2023; Watts et al., 2015; Whitehouse et al., 2023).

Despite over two decades of research, the contribution of supernatural punishment to the expansion of human cooperation is still therefore ambiguous. In addition to the inconsistencies noted above, many open questions still remain. First, as much previous research has focused on so-called 'moralistic' religious traditions (e.g., Christianity, Hinduism, Islam), the extent to which beliefs regarding 'local' - i.e., indigenous and/or less-explicitly punitive, omniscient or moralistic - gods impact cooperation remains unclear. That is, does belief in a punishing/omniscient local god promote cooperation to distant co-religionists of the same 'local' religious tradition in the same way as with 'moralistic' religious traditions? Second, much previous research has not taken an explicitly causal approach to this question (for an exception, see Bendixen et al., 2023), meaning the extent to which previous conclusions reflect *causal* - as

opposed to merely *associational* - relationships is unclear (Hernán & Robins, 2020; Pearl et al., 2016).

As part of a wider cross-cultural data collection effort, this research therefore aims to assess the extent to which beliefs regarding local gods impact cooperation towards distant co-religionists of this 'local' religion, with a particular emphasis on causal considerations using data collected among a Buryat community in eastern Mongolia.

1.2. Ethnographic Background of Field Site

The Buryats are an ethnic Mongolian people whose origins trace to the Khori and Tümed lineages inhabiting the northern regions of Mongolia, southern Siberia, and northeastern China (Atwood, 2004). Following the Tsarist Russian expansion and annexation of northern Mongolian territories between the seventeenth and twentieth centuries, local Mongolian populations came to be referred to by the Russian term *bratia* ("brother"), which later evolved linguistically into Buryat (Kudryavtsev, 2024). As a result of imperial conflicts and geopolitical reconfigurations, the Buryats were divided among three modern states—Mongolia, Russia, and China.

This research focuses on the *Sum* (district) of *Bayandun*, which has a total population of 3,189 people in four *bags* (subdistricts: *Türgen, Khairkhan*, *Yargai* and *Naran*), and is located in the *aimag* (province) of *Dornod* in eastern Mongolia. Over 90% of the population self-identify as Buryat, and most households depend on pastoral livestock herding as their main livelihood. Residents of *Naran* and *Yargai* bags also cultivate small household vegetable gardens during the summer. On average, households own between 150 and 800 animals, predominantly sheep and goats (~75%), but also cattle (~15%) and horses (~10%). Wealthier herding families typically have larger numbers of sheep and goats, while smaller herds are more cattle-dominant.

Buryat communities historically and contemporarily maintain a syncretic religious worldview that blends Buddhist cosmology with the veneration of spirit-masters (often referred to in scholarship as "shamanism"). This dual religious orientation reflects both the long-standing Buddhist influence introduced through Mongolian state formations and the resilience of local cosmological traditions grounded in kinship, ecology, and reciprocity with the natural world.

Shamanism, the beliefs in spirit-masters—locally known as *uul usnii ezed* ("lords of mountains and waters"), *tenger* or *tengri* ("sky"), and *ongod* ("spirits")—has existed for thousands years, especially during nomadic empires since the 4th century BCE on the current Mongolian territory. According to Sukhbaatar Gunjid (Sukhbaatar, 2023 [1992]), the aristocratic elites of successive nomadic empires formally adopted Buddhism as part of state governance and ideology. Competing noble lineages recognised Buddhism as a state religion, using it to consolidate political authority and extend cultural hegemony both domestically and across neighbouring regions. This process unfolded in three major historical waves - the Nirun Empire (330–555 CE, also known as "Rouran" or "Juan-Juan"), the era of the Great Mongol Empire (1206–1368), and under the Qing Dynasty and the subsequent Mongolian Theocratic State (1640–1924; Elverskog,

2013; Munkh-Erdene, 2011) - although belief in spirit-masters was never abandoned, and rulers selectively incorporated local deities and cosmologies into Buddhist rituals (Abrahms-Kavunenko, 2015; Dulam, 2024), resulting in a distinctive "Mongolian Buddhism" (Jerryson, 2007).

The subsequent rise of state socialism in the 1920s brought an even more profound rupture. Following the establishment of the Mongolian People's Republic, all forms of religious belief were banned, and the communist regime persecuted both Buddhist and shamanic practitioners. In the 1930s, more than 20,000 monks and hundreds of shamans were executed, and nearly all monasteries (~800) were destroyed (Baabar, 2010). For the next seventy years (1924–1991), both Buddhism and spirit-master worship survived largely underground, remaining dormant under the shadow of socialist control. Since the democratic transition of 1991, these two religious traditions have re-emerged side by side, gradually shedding their historical antagonism.

In *Dornod* province, Buddhist rituals are primarily conducted in temples and monasteries. Worship of spirit-masters and veneration of ancestral and shamanic spirits, by contrast, take place more commonly within the household and in the natural landscape. Buddhist rituals emphasise reflection on past lives, karma, and striving in the present for a better future existence. Among the Buryat - as is common throughout Inner Asia - Buddha (*Burgan*) is considered a deity who is thought to punish individuals and use karma to adjudicate moral laws (Berniūnas et al., 2020; Purzycki & Holland, 2019). The worship of spirit-masters, in contrast, teaches coexistence among the natural world, spirit-masters, humans, and animals, stressing that none should harm the others. Human life, in this view, depends directly on one's present actions. As such, any punishment by spirit masters is generally due to improper relations with the environment, rather than interpersonal transgressions.

In Mongolia, Buddhism has incorporated and absorbed many elements of spirit-master worship. In *Bayandun Sum*, nearly all households keep some kind of household altar or sacred object, though these are not always displayed openly. Typically, portraits of deities such as Buddha, Red Jamsran, or White Tara, or images of totemic animals - most often horses or camels - are placed upon the *khoimor* (the honoured section of the home). Younger families, however, tend to have fewer religious icons or ritual paraphernalia. Alongside the household altars, most homes possess small oil lamps and copper cups, which are used to make offerings of tea, milk, dairy products, and grains to the Buddha or to the spirit masters on ritual days. In Buddhist practice, offerings of juniper smoke are made to the Buddha and the *lus-savdag* (subterranean and nature spirits). In contrast, in shamanic or spirit-master traditions, *thymus vulgaris* (ganga) is burned as incense for ancestral spirits or local deities. Households also possess a "*dallaga*" pouch, usually made of silk, lamb skin, or cloth, which typically contain animal hair, horse manes and tails, grains, and candies. They are infused with spiritually potent substances collected from offerings made during Buddhist ceremonies or spirit-master rituals, symbolising the retention of livestock blessings and the household's natural abundance and the household's reception of divine and spiritual favour.

Buryat religious observances and rituals are conducted both indoors—in *gers* (huts/yurts) and wooden houses—and outdoors, across the steppe, by rivers, and at ritual sites marked by cairns (*ovoo*). On specific days, households conduct rituals of worship, appeasement, and offering to the Buddha and to the spirit-masters of mountains and waters. There are a large number of ritual activities among ordinary Buryat households in *Bayandun Sum* which take place throughout the year and at various major events; these are discussed in more detail in section S1 of the supplementary information.

Of particular relevance to our study are ritual practices and offerings dedicated to spirit-masters at ritual cairns (*ovoo*; also referred to as *ovaa, obo* or *oboo* across the wider region). These offerings to the local spirits are primarily for good fortune, such as avoiding environmental hardships (e.g., heavy snow, drought), health and longevity, and good luck when hunting wild game. Offerings typically include products such as milk, cheese, confectionery, alcohol and meat, among other items. Engagement with *ovoo* rites and practices may also be relevant to cooperation in various ways. For instance, reciprocal participation in these ritual cairn practices may bond families separated by great distances (Mongush, 1992), particularly as this ritual cairn tradition may function to mark territorial boundaries in such low-density populations (Purzycki, 2010). As such, observing others engage in such *ovoo* practices has been associated with higher perceived trustworthiness (Purzycki & Kulundary, 2018). Together, this suggests that spirit-master beliefs may be potentially related to cooperation among distant *ovoo* practitioners.

2. Methods

Our protocols drew directly from the *Evolution of Religion and Morality Project* (ERM; Lang et al., 2023; Purzycki et al., 2016a, 2024). Our protocol consisted of the following modules: 1) a demographics interview; 2) a behavioral economics experiment; and 3) a religiosity interview that asked targeted questions about spirit-masters (*uul usnii ezed*) and Buddha (*Burgan*; based on Purzycki & Kulundary, 2018)**.** All interview questions were first translated into Standard (Khalkha) Mongolian, and subsequently back-translated and edited for consistency and clarity (available here on the project GitHub page: https://github.com/bgpurzycki/GGSL-Project/tree/main/Protocols/Objective%201).

2.1. Theoretical Model

We are aiming to estimate the causal effect of supernatural beliefs regarding spirit-masters on cooperation with distant *ovoo* practitioner co-religionists (i.e., this is our estimand of interest). A Directed Acyclic Graph (DAG) detailing our causal assumptions is presented in Figure 1 (this model was adapted from our core causal model for the wider project, available at: https://github.com/bgpurzycki/GGSL-Project/blob/main/Pre-Registration/Objective%201%20-%20Core%20Model/GGSL_Obj1_Core_Causal_Model.pdf). Our exposure of interest is the joint effect of 'supernatural beliefs', which includes punishment and omniscience by local spirit-master deities (described in more detail below). Our outcomes are measures of religious cooperation, namely cooperation with distant spirit-master co-religionists as measured by Random Allocation Game (RAG) and Dictator Game (DG; again, described in more detail below). We also include a range of confounders - age, sex, educational attainment, material security and number of children - which plausibly cause both the exposure and outcome (Baimel et al., 2022; Vardy et al., 2022), and hence need to be adjusted for in analyses to return unbiased causal effect estimates. Potential unmeasured confounders are denoted by the node '*U*' in the DAG. Features of the game, such as game order and comprehension checks, have also been noted here, although as they can only influence game behaviour they are not confounders.
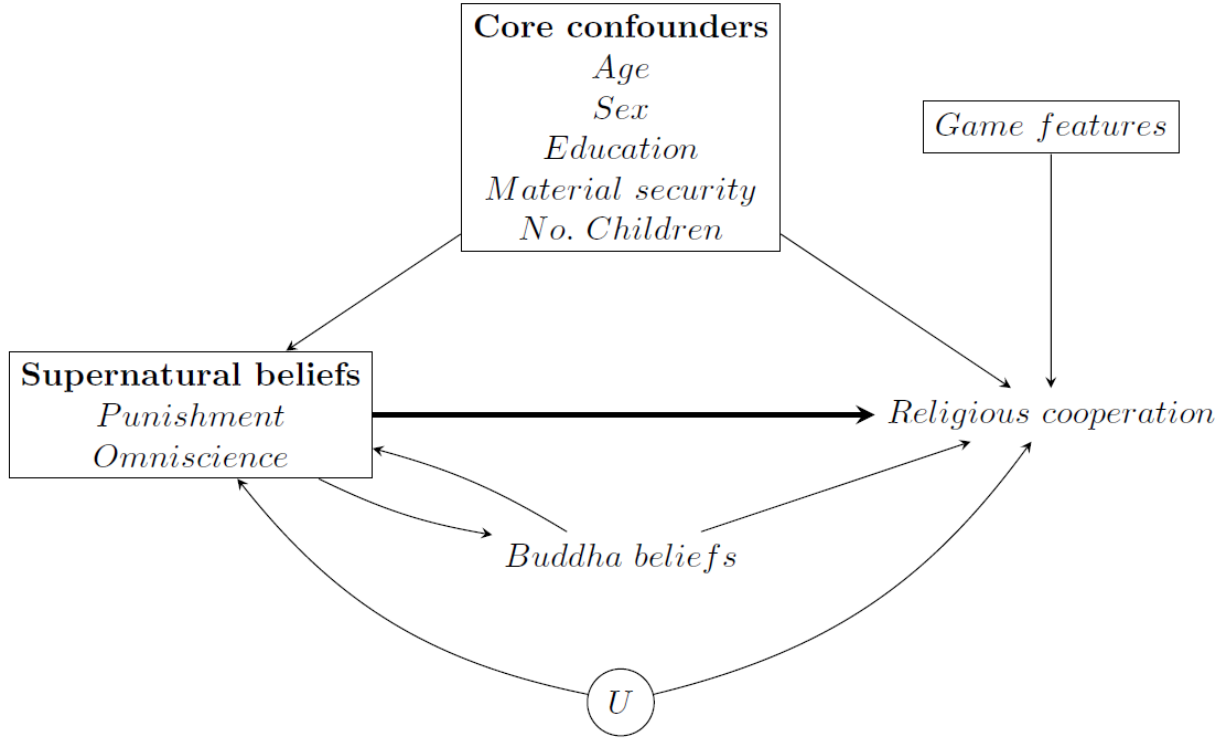
Figure 1: Directed Acyclic Graph (DAG) summarising our causal assumptions regarding the relationship between supernatural beliefs regarding spirit-masters and cooperation with distant co-religionists. The bold arrow denotes the estimand of interest. Causal relations between core confounders are not displayed here. Causal relations between the components of supernatural beliefs are also not displayed here, as our estimand is the joint effect of supernatural beliefs on religious cooperation (see the main text for more discussion on this). U = Potential unmeasured confounders.

One additional complicating factor in our theoretical model is the role of supernatural beliefs towards alternative deities - here, Buddha - and whether these are confounders or not. Although previous work from the ERM project has found that beliefs about moralistic gods are somewhat distinct from those of local gods (Purzycki et al., 2022), they are often correlated. This raises a range of complicated questions regarding the causal relations between these beliefs and how best to design analyses accordingly. For instance, in the present population perhaps beliefs about Buddha shape beliefs about spirit-masters, in addition to cooperation with distant co-religionists, in which case Buddha beliefs would need to be adjusted for in analyses to remove this source of confounding bias. It is also possible that spirit-master beliefs impact Buddha beliefs, meaning that "Buddha beliefs" would be a mediator on the causal pathway from spirit-master beliefs to cooperation, rather than a confounder (and hence would *not* need to be adjusted for). Alternatively, perhaps Buddha and spirit-master beliefs are completely independent, and hence adjustment for Buddha beliefs would not be required for an unbiased causal estimate. Other situations are also possible, such as both Buddha and spirit-master beliefs deriving from a shared

unobserved latent religiosity factor (again requiring adjustment for Buddha beliefs), or Buddha and spirit-master beliefs reciprocally causing one another (in which case both adjusting and not adjusting for Buddha beliefs would lead to biased estimates). Given these complex causal webs, we will conduct sensitivity analyses both not adjusting, and then adjusting, for Buddha beliefs, to see how this impacts results (for a similar approach, see Major-Smith, 2023; these analyses will be described in more detail below). We will also use descriptive statistics to compare the similarity between Buddha and spirit-master beliefs, and how similar or divergent they are.

Our exposure variables are a range of supernatural beliefs about spirit-masters, based on two broad categories:

1. Punishment: Based on the questions LGPUNISH (Do spirit-masters ever punish people for their behavior? [yes = 1, no = 0]) and LGDIE (Can spirit-masters influence what happens to people after they die? [yes = 1, no = 0]). As per previous ERM work (Purzycki et al., 2016b), these two variables will be averaged together, for both theoretical (as they likely measure the same/similar constructs) and practical (to limit the number of interaction terms; see below) reasons.
2. Monitoring/Omniscience: Based on the questions LGFEEL (Can spirit-masters see into people's hearts or know their thoughts and feelings? [yes = 1, no = 0]) and LGSEE (Can spirit-masters see what people are doing if they are far away? [yes = 1, no = 0; field assistants then explained that "far away" meant outside of their *nutag* (local community), such as in provincial centres including Duut, Ulaanbaatar, or foreign countries]). Answers to these two questions will again be averaged together.

We focus on supernatural beliefs regarding punishment and omniscience for pragmatic and theoretical reasons; that is, these two factors have been proposed as key to promoting cooperation, while other facets of supernatural belief - such as moral concern and rewards - have received little empirical support for their relationship with cooperation (Bendixen et al., 2023; Lang et al., 2019; Purzycki et al., 2016b, 2018).

Note that in the DAG in Figure 1 the causal relations between these components of supernatural beliefs were not displayed. This was intentional, due to the difficulties in separating the causal effects of these aspects of supernatural beliefs (e.g., are they independent? Do they reciprocally cause one another? Are they caused by a latent unobserved "religiosity" factor?). Instead, we focus here on the *joint* effect of these supernatural belief variables. That is, our focal contrast will be when punishment and omniscience both take the value 0 vs when they both take the value 1. We cannot therefore isolate the causal effect of, say, supernatural punishment, by itself, but we do assume that we can measure the joint causal effect of supernatural beliefs more broadly.

Although punishment and omniscience mini-scales have been used previously, it is possible that the individual variables comprising each scale do not measure precisely the same thing. For instance, regarding omniscience, people may believe that the spirit-master is able to know their thoughts and feelings, but is not able to see what distant people from other regions and religions are doing. As an additional sensitivity analysis, we will therefore repeat results using just LGPUNISH for punishment and LGFEEL for omniscience to assess whether we obtain similar results.

In order to estimate an unbiased causal effect our theoretical model makes a range of strong assumptions, including: no unmeasured confounding, no measurement error or residual confounding, no selection bias, and that the causal relations between variables are specified correctly. While these are of course strong assumptions, as our aim is causal inference we have endeavoured to make our causal assumptions clear; we will discuss potential violations of these assumptions, and implications for any inferences, in the Discussion section.

2.2. Materials and Procedure

Data collection took place in late July 2024, with a team of six field researchers collecting data for this project over 10 days. The initial plan was for data collection to sample equally from all four *bags* in the *Bayandan* district (i.e., approx. 20 participants per *bag*); however, due to heavy rains making travel to distant areas impossible, of the 83 participants who took part, the majority (51; 63%) were from the central *Naran bag* (including 30 residents from the *sum* centre), with smaller numbers from the other *bags* (12 from *Türgen bag*, 15 from *Khairkhan bag*, and five from *Yargai bag*). On rainy days for data collection in the *sum* centre, the research team conducted interviews indoors at their rented accommodation, a classroom at the local primary school, and a room at the district hospital. For data collections outside of the *sum* center, all interviews were conducted in the participant's homes.

Following the study protocol, participants completed three components: (1) a 26-item demographic questionnaire; (2) four experimental games; and (3) a 62-item religiosity survey. Before beginning, researchers provided a full explanation of the study's purpose, procedures, and confidentiality measures, emphasising participants' right to withdraw at any point. Data collection began only after obtaining verbal and written informed consent. Each participant was assigned a randomly generated code number used to link all three components of the study.

2.2.1. Demographic and religiosity surveys

The demographic survey was a relatively short questionnaire (26 items) assessing general sociodemographic characteristics. Of most relevance to the present study, this included variables used as confounders (age, sex, education, number of children and material security).

The religiosity survey was a longer questionnaire (62 items) covering multiple dimensions of supernatural belief and practice, including punishment, omniscience, moral concern, ritual frequency, in relation to both "local" (spirit master) and "moralistic" (Buddha *Burgan*) deities.

As discussed above, of particular relevance to this study are perceptions of supernatural punishment (i.e., whether said deity ever punished people for their behaviour, and whether deity can influence what happens in the afterlife) and monitoring/omniscience (i.e., whether deity can know peoples' thoughts and feelings, and whether deity can see what people are doing in a far away town/city).

2.2.2. Experimental games

We measured cooperation using two Random Allocation Games (RAG; Hruschka et al., 2014) and two companion Dictator Games (DG). Each type of game consists of two variants with two dyadic recipients. In one variant, participants played between themselves and *ovoo* practitioners from *Duut Sum*, a western province of Mongolia over 2,000 km away. In the other variant, participants allocated money between local co-religionists of the *ovoo* tradition in *Bayandan* province, and another anonymous *ovoo* practitioner from *Duut Sum*. All participants played the RAGs first, then the DGs, with both sets counterbalanced.

For the RAG, participants were instructed to envision which cup they preferred to put a coin into, then roll a two-colored die that was checked for fairness. Participants were *supposed* to put a coin into the cup they thought of if the die came up black, otherwise, they were supposed to put the coin into the other cup. Participants played alone. Given the anonymous conditions, they had the opportunity to override the rules (consciously or otherwise) and allocate coins to whichever cup they preferred. Each variant of the RAG consisted of 30 decisions and corresponding rolls of the die. Systematic, statistically detectable deviations from a 50% chance indicate biasing allocations. Each RAG involved 30 coins as tokens, each equivalent to 1,000 MNT (~$0.30 USD) and allocated them into paper cups with lids, with identifying information about recipients written on the cups. For each DG, participants decided how to divide ten 1,000 MNT notes between two envelopes, corresponding to the relevant recipients. While the RAG measures impartial rule-following, the DG indicates generosity. Only participants who passed all comprehension pre-tests played these games. In addition to the show-up fee of 20,000 MNT (~$6 USD), participants knew that they would receive any of the money allocated to themselves.

2.3. Statistical Model

Based on our theoretical model (DAG in Figure 1), we aim to estimate the joint causal effect of our supernatural belief exposures on our outcomes of cooperation with distant co-religionists (via RAG and DG). All models will adjust for the core set of confounders of age, sex, education, material security and number of children. For RAG data we will use aggregated binomial models, while for the DG we will use ordinal models, both with separate models for SELF vs DISTANT and LOCAL vs DISTANT conditions. Bayesian models will be conducted using Stan via the 'brms' package (Bürkner, 2017), using weakly-informative priors with four chains of 2,000 iterations (1,000 as warm-up). R-hat values, effective sample sizes, and visual inspection of chain convergence will be assessed to ensure that chains are well-mixed and sufficiently-powered. Analyses will be performed in R 4.4.1 (R Core Team, 2024).

To estimate the causal effect of supernatural beliefs, we will use *g*-computation methods (Hernán & Robins, 2020) to estimate the marginal causal effect of a change in exposures, from punishment and omniscience coded as '0', to both coded as '1'. To aid interpretation, these marginal causal effects will reflect the average change in the outcome (i.e., the average treatment effect) on the count scale (e.g., the difference in the number of tokens given to distant co-religionists) in each game, based on the posterior predictions from the models.

Exposures will first be treated as additive (i.e., independent of one another), followed by testing whether a multiplicative model is a better fit to the data, via the inclusion of an interaction term between punishment and omniscience (see Bendixen et al., 2023). Model fit will be compared by the LOOIC information criterion. However, due to our relatively small sample size (~90), our analyses may be underpowered to detect such interaction effects (Blake & Gangestad, 2020).

As noted above, we will also perform two sets of sensitivity analyses. The first will include supernatural beliefs regarding the moralistic god (Buddha) as covariates in the model, as these may be relevant confounders to adjust for. Equally, these may be mediators of our focal relationship, in which case adjustment for Buddha beliefs will lead to overadjustment bias; we will explore different adjustment sets to see how different causal assumptions impact our inferences. The second sensitivity analysis will compare different definitions of the supernatural punishment and omniscience exposures (2 variables each in the main analysis vs 1 variable each in the sensitivity analysis).

We assume no/minimal missing data, and hence do not plan to impute data. However, if, after accessing the data, we observe a high proportion of missing data (>10% missing in complete-case analyses) we will perform multiple imputation and describe details of this in the final paper.

Example scripts demonstrating the proposed analyses on simulated data are available here: https://github.com/bgpurzycki/GGSL-Project/tree/main/Pre-Registration/Objective%201%20-%20Buryat.

2.4. Sampling and Participants

Participant selection aimed to achieve representation across *bags*, age groups, and gender. Team leaders first met with *bag* governors to explain the study's purpose and obtain household records, contact numbers, and route maps. However, due to the environmental challenges and road conditions discussed above, the original target sample of 20 participants per *bag* had to be revised, resulting in recruitment focusing on the more central and easy-to-access areas.

In total, 83 residents of *Bayandun Sum* participated in the study, including forty-seven women (56.6%) and thirty-six men (43.4%). Participant ages ranged from 18 to 78, with an average of

44 years. Most belonged to middle-aged cohorts actively engaged in herding, household labour, and community affairs, while a smaller number of elderly participants—often grandparents caring for grandchildren—were recruited from the *sum* centre. Younger adults, particularly those pursuing education or employment in urban areas, were largely absent from the sample, reflecting the broader pattern of seasonal and long-term rural outmigration observed across eastern Mongolia. The participants' mean educational attainment was 12.3 years, indicating that most had completed secondary schooling. This level of formal education aligns with the generational shift toward greater literacy and school attendance in the post-socialist era, when universal education became accessible even in remote areas. On average, households comprised 3.6 members, and participants reported an average of 2.6 children, suggesting small to medium family units typical of semi-nomadic Buryat herders, in which married sons or daughters often establish separate *gers* nearby while maintaining daily cooperation with parents and kin. Only one participant declined to participate in the research, citing other commitments.

3.5. Pre-registration

Note that data for this study has already been collected, cleaned and processed ready for analysis (details on the methodology prior to data collection can be found in the grant proposal: https://github.com/bgpurzycki/GGSL-Project/blob/main/Pre-Registration/Proposal/TRT_Purzycki.pdf). We therefore possess some information about the data, which has been useful to help understand the ethnographic context and any potential complexities of the data to help inform decisions regarding our causal model and analyses (e.g., the potential complex causal relations between spirit-master and Buddha beliefs, missing data). For full transparency, descriptive statistics for key variables and regressions based on the core causal model for the wider project (as noted above) were conducted for a project workshop in January 2026; importantly, this was *after* the causal model described here was finalized, meaning that this information did not influence our causal model or corresponding statistical approach.

Data availability statement

All data and analysis code will be made available on the project GitHub website: https://github.com/bgpurzycki/GGSL-Project/tree/main.

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Supplementary Information

Section S1: Additional information on Buryat rituals

According to the lunar calendar, *Tsagaan Sar*—the Lunar New Year—is celebrated on the first day of the spring month. On the eve of the festival (*bitüün*), every Buryat household carefully wipes away the dust from their household altar. If the altar items are stored in a chest, they are taken out, exposed to fresh air, cleaned, and placed back. Fresh offerings of dairy and grain are set in the small ritual bowls and cups. That night, before going to sleep, families customarily place a piece of ice or snow above the doorway outside. This offering is said to provide water for the horse ridden by *Lkham Bodhisattva*, who, according to Buddhist cosmology, travels before dawn on the first day of the new year to count the population. To be "included in the census of the deities and spirits" symbolically marks one's successful entrance into the new year.

Early on New Year's morning, households offer a libation of milk tea to the sun and to the *lus savdag*—the tutelary spirits of the land, mountains, and waters. Some families make this offering to the household Buddha inside the *ger* (hut/yurt); others sprinkle a few drops into the hearth fire. This gesture of offering tea upwards is repeated most mornings, especially during festivals, ceremonies, and departures for long journeys. As one woman explained, "In gratitude for receiving the blessings of the land and the world, we make our offering. We share the first portion of tea with the surrounding spirits and masters, so they protect us from misfortune."

A newly emerging practice is to climb a nearby high hill at dawn to watch the sunrise on New Year's First Day. While most ethnic groups in the region gather at nearby *ovoo* cairns, Buryats regard their *ovoo* as distant, high-mountain shrines visited only during official rituals. At other times, they offer milk tea or grain to these mountains from afar. Dressed in their finest *deel* garments, both men and women rise early to greet the sunrise and make their tea offerings. Afterwards, the *Tsagaan Sar* celebration begins with the respectful greeting ritual (*zolgokh*), in which the younger person extends both arms forward beneath the elder's hands. After sharing food at home, families visit grandparents, parents, and senior relatives over the next seven days to exchange greetings.

Following *Tsagaan Sar*, each household commissions monks at the local monastery to recite sutras and perform rituals, asking for good health and prosperous work throughout the year. Symbolic offerings of food are prepared on a plate, imbued with Buddhist mantras and blessings, and shared among family members. The platter typically includes sweets and pastries for children and adults, and consecrated grain received from the monastery; a few grains are kept in the dallaga pouch for the year's prosperity.

Whenever illness, misfortune, or livestock disease occurs, people burn juniper or sweet grass (*ganga*), fumigating the house and offering portions of dairy or milk tea outside to the mountains

and waters—and again, sometimes to the household altar indoors.

On the 25th day of the first summer month, the community conducts the annual *ovoo* offering ritual to honour their tutelary mountain. The *sum* (district) administration organises this ceremony, and it consists of two parts: the *ovoo* worship itself and the *ovoo naadam* (festival). The local government coordinates the ritual and provides most of the funding. In addition to the official festival, shamans occasionally convene independent *ovoo* ceremonies with the informal participation of local officials. During the *ovoo naadam*, horse races, wrestling, and archery contests are held in the valley below the sacred mountain. Several families sponsored the prizes in collaboration with the local administration, and families competed to contribute awards for the following year's festival.

Everyone dresses in their best clothes, prepares offering plates and tea, and joins the celebration. People from both nearby and distant areas come to worship at the *ovoos* of sacred mountains such as *Dun Uul, Zürkh Uul, Khairkhan Uul*, and *Ugtam Uul*. Monks from Ugtam Buddhist Monastery in Bayandun or from the provincial centre are invited to officiate. Occasionally, Buryat lamas from the Republic of Buryatia (Russian Federation) also lead the rituals in other times of official worship. Men, women, and children may all participate, though with reverence—shouting, littering, or relieving oneself on the mountain is strictly forbidden. Participants spread their offerings, place portions of food before the *ovoo*, sit quietly while the monks chant, and respond in unison with "*khurai*!" At *Zürkh Uul ovoo* in *Khairkhan bag*, however, women are traditionally prohibited from climbing to the summit, as it is believed that female visitors may fall ill or displease the mountain spirit (although an alternative explanation may be that *Zürkh Uul's* steep slopes make ascent especially difficult).

In everyday life, a widespread notion associated with *ovoo* and spirit-master worship is "entering the consultation" (*üzlegt orokh*). Whenever a household member becomes ill, experiences repeated misfortunes, or when wolves attack livestock or other calamities occur, *Bayandun* Buryats visit shamans or lamas for guidance or consultation. The causes of misfortune are commonly interpreted as failures to respect the mountains and waters—breaking a flower or tree on a mountain, digging or disturbing the earth, polluting a stream, or frightening wild animals. Such acts are said to be revealed through divination (*merge tölgö*), showing the person's transgression. In most cases, these explanations resonate: someone in the household is believed to have disturbed or offended the living natural world.

As nature itself is regarded as animate, rituals of appeasement are performed—offering grain or milk tea at an ovoo, inviting a shaman (*böö* or *udgan*) to perform a ceremony, or commissioning lamas to recite sutras to placate the *lus savdag*. In Bayandun, these Buddhist and spirit-master appeasement practices frequently overlap, though people most often consult shamans to determine the appropriate ritual action.

In addition to visiting monasteries or shamans, households also perform these rituals

independently. Whenever a wolf enters the animal pen, livestock go missing, or accidents occur, families reexamine their recent behaviour and interactions with the environment, correcting any perceived transgressions. Rather than hunting or killing a wolf that has entered the corral, people choose to forgive it, interpreting the event as the spirit-masters of the mountains and waters appearing in the form of the wolf to claim what is due to them. The same wolf seldom returns, and herders accept one or two such incidents a year as part of the natural order. As one herder explained, "The spirit-masters have taken what belongs to them through the form of a 'creature of the mountains.' Or, in your modern words, the wolf is also a living being—its food has become scarce, and since we humans have encroached on its land, it turns to livestock out of necessity." When illness or misfortune strikes, people similarly interpret it as a sign of improper interaction with the land and spirits, discussing these events within the community as moral lessons.

Another local ceremony is the "*toonot takhikh*" ritual, celebrated in the *Türgen* subdistrict. This ritual marks the symbolic burial of the placenta three days after childbirth, acknowledging the birth of a new person and entrusting the mother and child to the protection of Mother Nature. In earlier times, relatives and neighbours gathered to celebrate the event together. Today, since most births occur in hospitals and placenta burial is no longer feasible, the residents of Bayandun *Sum* have adapted the practice. During summer, Buryat people gather on the southern shore of Lake Türgen Tsagaan for a communal celebration. The ceremony symbolically reenacts the burial of the placenta to honour the birth of new children and the health of mothers, accompanied by offerings of dairy, grain, and milk tea to the local landscape and mountain spirits. Children's wrestling competitions follow, and families introduce newborns to the broader community.

Another form of ritual behaviour concerns the use of natural resources, aimed at appeasing the spirit-masters of the mountains and avoiding their punishment. When people draw water from a spring, stream, or lake for the first time, they usually offer a handful of grain to the spirit-master—never directly into the water—and touch the water to their head or lips before drinking. This ritual expresses respect for the purity of the source, obliging people to avoid polluting it. Livestock are watered downstream, never at the spring's origin. When digging soil near one's home or corral, people silently utter prayers; if digging in a new or sacred place, they consult a lama or shaman beforehand. In cases of burials, lamas or shamans are invited to "petition the land" on behalf of the deceased. Lamas mark the site with a brass *vajra* (ritual thunderbolt), then chant sutras and mantras to appease the mountain and water deities/spirits.

A similar custom accompanies modern construction projects, where a "land consecration ceremony" (*shav tavikh yosol*) is performed. Lamas are invited to recite mantras, offer tea and grain to the land's spirits, and bury these offerings in the soil to request permission from the mountain and water spirit-masters. The land is thus regarded as the property of these spirits. When individuals must dig into the ground for other purposes, an elder man may symbolically mark the soil using a wild boar tusk, saying, "We are not digging; the creature under your

domain, the wild boar, is doing so." Because wild boar tusks have become rare today, only shamans and a few elders still possess them.

For cutting firewood or gathering timber, households must first obtain permission from the local administration. However, whenever Buryats need to cut or break wood, they always offer dairy or grain to the spirit-masters of the mountains and silently express their intentions and apologies.

The worship of spirit-masters is closely tied to weather phenomena—storms, floods, droughts, and blizzards are interpreted as signs of the spirit's anger. People explain these events as consequences of human disrespect toward the natural world, and additional ovoo ceremonies are sometimes held outside the regular schedule to appease the offended spirits/deities. In recent years, however, Bayandun has experienced generally favourable conditions, so no supplementary rituals have been required.

People also explained the interpersonal conflicts and social discord through the lens of spirit-master beliefs. Quarrelling, arguing, or living in disharmony is interpreted as a failure to honour and respect the local mountains and waters, or as a lack of spiritual devotion. Those who misbehave toward the spirit-masters or the land are described as "having lost their balance" (*buruutsan*) or "deviating from right conduct" (*uil ni khazaisan*). Such language functions as a moral and social sanction within the community, reinforcing collective norms. Consequently, Buryat families strive to behave properly, avoid gossip and disputes, and maintain respectful relations with their local environment and its spiritual guardians.