

Why do religious leaders observe costly prohibitions? Examining taboos on Mentawai shamans

SUPPLEMENTARY MATERIAL

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Supplementary Methods and Materials

All data and R code are available at <https://osf.io/3mbkz>.

Questions

Question IDs (e.g., beli1, coop1) match those in the dataset. Questions that did not load onto the relevant latent factor are marked with an asterisk (*).

Belief

beli1: *For example, there is a ceremony. Of the two of them here, someone eats sour [the consumption of sour is tabooed during ceremonies and believed to cause misfortune]. Who is it?*

beli2: *According to you, who believes more in Arat Sabulungan [Mentawai religion]?*

beli3: *According to you, who follows taboos less?*

Cooperativeness¹

coop1: *According to you, who is a thief?*

coop2: *According to you, who shares meat more?*

*coop3: *For example, there is a burning house. Who goes to help?*

*trus1: *For example, you are not here because you are working or with family somewhere far. Who do you look for to help take care of your children here?*

trus2: *For example, you need personal advice on a family issue. Who do you ask?*

¹ These questions were originally designed to target distinct inferences: a general cooperative disposition (is the shaman cooperative towards others?) and trustworthiness (would the participant trust the shaman in particular?). But given the similarity between these inferences and that they address the same prediction, we tested whether there is greater internal reliability among the questions as a single construct. We found evidence that there was. Cronbach's alpha was higher for all questions as a single construct than for two separate constructs. As described in the main text, we also found that coop1, coop2, and trus2 loaded onto a single construct whereas coop3 and trus1 did not (each instead loaded on its own unique factor).

Difference

*diff1: *Whose thoughts are closer to those of a non-shaman?*

diff2: *Whose thoughts are farther from those of a non-shaman?*

diff3: *Whose body is closer to that of a non-shaman?*

Power

powe1: *Who has weaker medicine?*

powe2: *Who has stronger medicine?*

powe3: *Who has stronger magic?*

Supplementary Figures

Figure S1. The frequency with which participants (N = 68) selected the non-self-denying (0) or self-denying (1) character as exhibiting the investigated trait (responses to reverse-worded questions have been inverted). Questions that did not load onto the latent structure are marked with an asterisk (*). See Table S6 for raw counts.

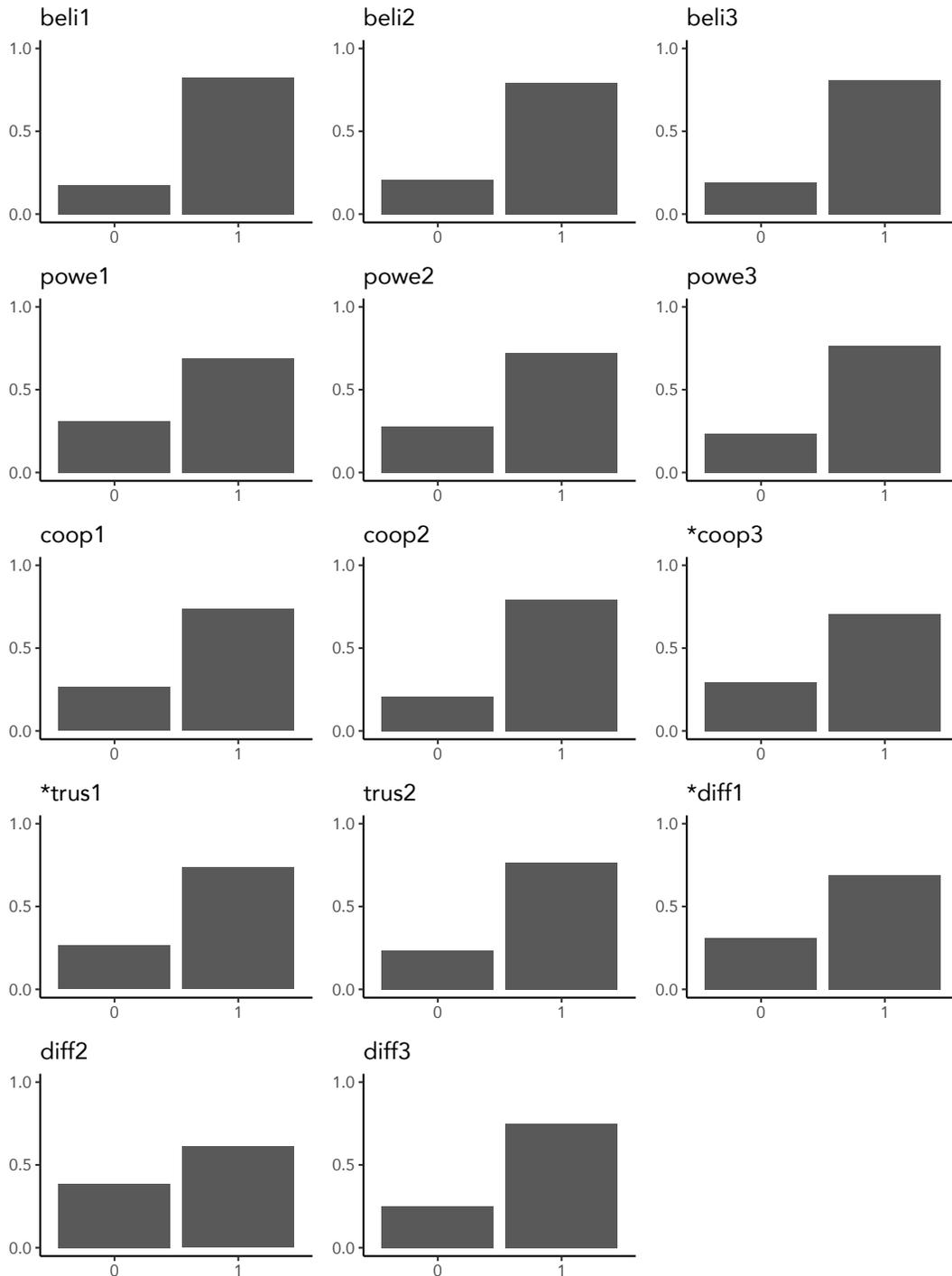
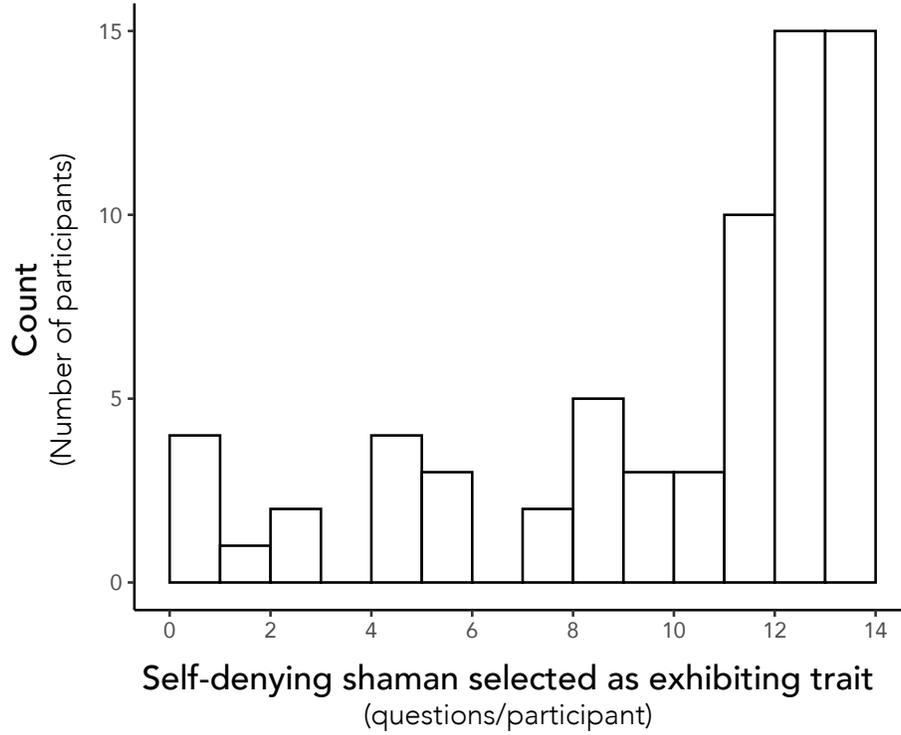


Figure S2. A histogram showing the frequency with which participants chose the self-denying shaman as exhibiting the trait of interest (belief, cooperativeness, difference, power). Fifteen participants chose the self-denying shaman for all 14 questions (this includes, for the reverse-coded questions, selecting the non-self-denying shaman). Four participants never chose the self-denying shaman (again, this includes selecting the self-denying shaman for reverse-coded questions).



Supplementary Tables

Table S1. Raw frequencies with which respondents named taboos on shamans during initiation and healing across four cultural regions. See Fig. 3 and the main text for details.

		FREE-LIST RESPONSES														AGGREGATED				
		Clear brush for gardening	Cook	Cut/break	Display anger or yell	Eat fern	Eat sour	Eat without self-control	Fast intermittently	Have sex (adultery)	Have sex (spouse)	Have sex (general)	Plant	Shower	Work (general)	Cooking/work	Disturb household	Eat	Groom	Have sex
INITIATION	SAB	0.00	0.00	0.15	0.05	0.15	0.25	0.40	0.00	0.20	0.20	0.30	0.00	0.00	0.10	0.20	0.05	0.65	0.00	0.55
	SAR	0.12	0.04	0.04	0.04	0.12	0.27	0.15	0.23	0.12	0.19	0.65	0.12	0.12	0.19	0.42	0.04	0.65	0.15	0.88
	SIL	0.14	0.05	0.05	0.24	0.00	0.38	0.10	0.05	0.19	0.29	0.33	0.00	0.14	0.29	0.33	0.24	0.43	0.14	0.57
	TAI	0.05	0.05	0.00	0.05	0.05	0.20	0.30	0.15	0.25	0.25	0.20	0.25	0.05	0.35	0.45	0.05	0.70	0.10	0.55
HEALING	SAB	0.05	0.00	0.05	0.15	0.05	0.10	0.40	0.00	0.05	0.15	0.35	0.05	0.10	0.05	0.15	0.15	0.50	0.10	0.45
	SRR	0.19	0.04	0.08	0.08	0.15	0.12	0.15	0.00	0.19	0.08	0.38	0.04	0.00	0.15	0.46	0.12	0.50	0.00	0.65
	SIL	0.24	0.00	0.00	0.29	0.00	0.10	0.05	0.00	0.14	0.29	0.24	0.05	0.00	0.48	0.67	0.29	0.19	0.10	0.57
	TAI	0.15	0.00	0.10	0.05	0.00	0.05	0.15	0.05	0.15	0.20	0.45	0.15	0.00	0.15	0.35	0.05	0.30	0.00	0.75

Table S2. Raw frequencies with which respondents reported dietary taboos on shamans across four cultural regions. See Fig. 4 and the main text for details.

	Eel <i>Anguilla bicolor</i>	Fern <i>Diplazium esculentum</i>	Flounder Pleuronectiformes	Gibbon <i>Hylobates klossii</i>	Green broadbill <i>Calyptomena viridis</i>	Mentawai squirrel <i>Callosciurus melanogaster</i>	Mushroom Unknown poliphore	Palm hearts {e.g., sago, coconut}	Simakobu (white morph) <i>Simias concolor</i>	Taro leaves <i>Colocasia esculenta</i>	Three-striped squirrel <i>Lariscus obscurus</i>	Turmeric <i>Cucuma longa</i>	Turtle <i>Heosemys spinosa</i>	Mentawai Langur* <i>Potenziani presbytis</i>
SAB	1.00	0.89	0.95	0.89	0.16	0.68	0.42	1.00	1.00	0.58	0.84	0.74	0.79	0.00
SAR	1.00	0.27	0.92	0.85	0.62	0.15	0.08	0.31	0.96	0.19	0.96	0.04	0.23	0.00
SIL	1.00	1.00	0.86	1.00	0.48	1.00	0.19	1.00	0.95	0.24	1.00	0.10	1.00	0.05
TAI	0.95	1.00	0.90	1.00	0.35	0.95	0.90	1.00	0.95	1.00	1.00	0.90	0.95	0.00

Table S3. Probabilities that different items are tabooed in the four cultural regions according to cultural consensus analyses.

	Eel <i>Anguilla bicolor</i>	Fern <i>Diplazium esculentum</i>	Flounder Pleuronectiformes	Gibbon <i>Hylobates klossii</i>	Green broadbill <i>Calyptomena viridis</i>	Mentawai squirrel <i>Callosciurus melanogaster</i>	Mushroom Unknown poliphore	Palm hearts {e.g., sago, coconut}	Simakobu (white morph) <i>Simias concolor</i>	Taro leaves <i>Colocasia esculenta</i>	Three-striped squirrel <i>Lariscus obscurus</i>	Turmeric <i>Cucuma longa</i>	Turtle <i>Heosemys spinosa</i>	Mentawai langur* <i>Potenziani presbytis</i>
SAB	>0.99	>0.99	>0.99	>0.99	<0.01	>0.99	0.47	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	<0.01
SAR	>0.99	<0.01	>0.99	>0.99	>0.99	<0.01	<0.01	<0.01	>0.99	<0.01	>0.99	<0.01	<0.01	<0.01
SIL	>0.99	>0.99	>0.99	>0.99	0.77	>0.99	<0.01	>0.99	>0.99	<0.01	>0.99	<0.01	>0.99	<0.01
TAI	>0.99	>0.99	>0.99	>0.99	<0.01	>0.99	1.00	>0.99	>0.99	>0.99	>0.99	>0.99	>0.99	<0.01

Table S4. Details about cultural consensus analyses. According to Weller (2007), a consensus model can be used to represent a group's responses when the Comrey's ratio approximates 3 to 1 or greater. The results show that the model can be used for each of the four cultural regions but not when combining participants' responses from across cultural regions into a single set. This is to be expected given that the combined dataset mixes participants from different cultural communities.

	Negative competencies	Competencies over 1	Comrey's Ratio
SAB	0	0	2.67
SAR	1	0	2.90
SIL	0	0	3.73
TAI	0	0	3.63
All rivers combined	0	0	1.66

Table S5. The twenty-four nonaquatic, foraged animals presented to subjects. Items tabooed to shamans in all four regions are shaded. See also Fig. 4.

Specific name	English name	Mentawai name	Mean ranking	Standard deviation
<i>Anthracoceros coronatus</i>	Malabar pied hornbill	<i>kailaba</i>	6.46	1.39
<i>Ardea sumatrana</i>	Great-billed heron	<i>meccau</i>	2.28	1.32
<i>Calyptomena viridis</i>	Green broadbill	<i>luikluik</i>	4.59	1.76
<i>Centropus sinensis</i>	Greater coucal	<i>kemut</i>	5.13	1.59
<i>Ceyx erithacus</i>	Three-toed kingfisher	<i>sikoplaitak</i>	1.28	0.60
<i>Cuculux fugax</i>	Hawk-cuckoo	<i>buccik</i>	4.28	1.39
<i>Cuora amboinensis</i>	Box turtle	<i>lokipat</i>	3.10	1.63
<i>Dicaeum cruentataum</i>	Scarlet-backed flowerpecker	<i>ritdit</i>	3.73	1.74
<i>Dicaeum trigonistigma</i>	Orange-bellied flowerpecker	<i>dbadhatdhat</i>	4.36	2.05
<i>Geomyda spinosa</i>	Spiny turtle	<i>toulu</i>	3.70	1.71
<i>Hylarana nicobariensis</i>	Nicobar golden-backed frog	<i>loloakkek</i>	4.05	1.88
<i>Hylobates klossii</i>	Kloss's gibbon	<i>bilou</i>	4.93	1.95
<i>Lariscus obscurus</i>	Three-striped squirrel	<i>soksak</i>	2.50	1.85
<i>Macaca pagensis</i>	Pagai macaque	<i>obaketa</i>	5.88	1.81
<i>Occidozyga laevis</i>	Puddle frog	<i>utetsopak</i>	6.63	1.41
<i>Paradoxurus hermaphroditus siberu</i>	Siberut palm civet	<i>lamusek</i>	3.45	2.18
<i>Phaenicophaeus curvirostris</i>	Chestnut-breasted malkoha	<i>koitkot</i>	5.83	1.41
<i>Pycnonotus melanoleucos</i>	Black-and-white bulbul	<i>pusitattat</i>	4.59	1.87
<i>Pycnonotus plumosus</i>	Olive-winged bulbul	<i>rotdot</i>	5.56	1.70
<i>Rhynchophorus ferrugineus</i>	Sago palm weevil (larvae)	<i>tamara</i>	6.40	2.37
<i>Simias concolor</i>	Simakobu monkey (black morph)	<i>simakobuk</i>	6.90	1.37
<i>Simias concolor</i>	Simakobu monkey (white morph)	<i>simabulau</i>	3.90	1.57
<i>Sturnus sturninus</i>	Daurian starling	<i>ngorut</i>	6.88	1.38
[<i>Tadpole</i>]	Tadpole	<i>kalabbok</i>	1.48	0.75

Table S6. How often participants (N = 68) selected the non-self-denying (0) or self-denying (1) character as exhibiting the investigated trait (responses to reverse-coded questions have been inverted). Questions that did not load onto the relevant latent structure are marked with an asterisk (*).

Question	Response	Count	Frequency
beli1	1	56	0.824
beli1	0	12	0.176
beli2	1	54	0.794
beli2	0	14	0.206
beli3	1	55	0.809
beli3	0	13	0.191
powe1	1	47	0.691
powe1	0	21	0.309
powe2	1	49	0.721
powe2	0	19	0.279
powe3	1	52	0.765
powe3	0	16	0.235
coop1	1	50	0.735
coop1	0	18	0.265
coop2	1	54	0.794
coop2	0	14	0.206
*coop3	1	48	0.706
*coop3	0	20	0.294
*trus1	1	50	0.735
*trus1	0	18	0.265
trus2	1	52	0.765
trus2	0	16	0.235
*diff1	1	47	0.691
*diff1	0	21	0.309
diff2	1	41	0.612
diff2	0	26	0.388
diff3	1	51	0.750
diff3	0	17	0.250

Table S7. Loadings from exploratory factor analyses assessing whether each of the four sets of questions load onto a single construct. The dotted lines separate different factor analyses.

Question	MR1	MR2	MR3
beli1	0.73	0.08	-
beli2	0.93	-0.06	-
beli3	0.96	0.02	-
-----	-----	-----	-----
powe1	0.97	-0.11	-
powe2	0.99	0.03	-
powe3	0.75	0.18	-
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coop1	0.99	-0.13	0.10
coop2	0.90	0.09	-0.05
coop3	0.01	0.93	0.09
trus1	0.02	0.05	0.96
trus2	0.66	0.29	-0.07
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diff1	0.00	0.68	-
diff2	0.77	-0.08	-
diff3	0.57	0.41	-

Table S8. Loadings from exploratory factor analysis conducted with responses to all questions. The factor analysis does not produce four distinct factors corresponding with each of the four sets of questions, indicating correlations among responses across questions.

Question	MR1	MR2	MR3	MR4
beli1	0.53	0.22	0.45	0.28
beli2	0.68	0.52	0.40	0.17
beli3	0.58	0.55	0.39	-
powe1	0.80	0.42	0.21	0.10
powe2	0.90	0.36	0.23	-
powe3	0.57	0.43	0.36	0.12
coop1	0.44	0.80	0.11	0.14
coop2	0.28	0.87	0.21	0.14
coop3	0.17	0.23	0.91	-
trus1	0.69	0.20	0.62	0.27
trus2	0.15	0.66	0.34	0.35
diff1	0.70	0.11	-	0.15
diff2	0.17	0.21	0.13	0.95
diff3	0.38	0.36	0.55	0.40

Table S9. Indices of internal reliability and unidimensionality for the four sets of questions. The table includes values both when including (I) and excluding (E) questions that did not load onto the relevant factor.

	Cronbach's alpha	Average inter-item correlation	Unidimensional criterion ¹
Belief	0.77	0.52	1
Power	0.81	0.58	1
Cooperativeness (I)	0.76	0.38	0.99
Cooperativeness (E)	0.76	0.51	1
Difference (I)	0.57	0.31	1
Difference (E)	0.55	0.38	1

¹The unidimensional criterion is a recent measure of unidimensionality available using the unidim function in the psych package in R (Revelle 2019).

Table S10. Comparison of estimated probabilities with and without data exclusion; 95% CIs are included in brackets.

	Excluding participants	Without excluding participants
Belief	0.92 [0.84, 0.96]	0.84 [0.76, 0.90]
Cooperativeness	0.88 [0.78, 0.94]	0.82 [0.73, 0.89]
Difference	0.78 [0.64, 0.88]	0.73 [0.61, 0.83]
Power	0.84 [0.72, 0.91]	0.77 [0.66, 0.85]

Table S11. Comparison of estimated probabilities with and the without removal of questions; 95% CIs are included in brackets.

	With removal of coop3, trus1, diff1	Without removal
Belief	0.92 [0.84, 0.96]	0.91 [0.84, 0.95]
Cooperativeness	0.88 [0.78, 0.94]	0.85 [0.76, 0.91]
Difference	0.78 [0.64, 0.88]	0.77 [0.65, 0.86]
Power	0.84 [0.72, 0.91]	0.83 [0.72, 0.90]

Table S12. Results of the logistic regression (observations = 747; participants = 68). The outcome is a binary variable representing whether or not the participant chose the self-denying shaman for a given question.

	Estimate	SE	z
Intercept	1.35	0.73	1.84
Trait ¹			
<i>Cooperativeness</i>	-0.44	0.31	-1.40
<i>Difference</i>	-1.16	0.34	-3.15
<i>Power</i>	-0.79	0.31	-2.54
Sex ¹	0.71	0.68	1.04
Stimuli counterbalance ²	0.26	0.59	0.44
Category of self-denial ¹	0.92	0.61	1.52

Mixed effects logistic regression with random effects for participant, conducted with the glmer function (lme4 package) in R. The effects package was used to produce the probability estimates presented in the text and in Fig. 5.

¹Reference levels are Belief (Trait), Male (Sex), Food (Category of self-denial).

²Stimuli counterbalance is a dummy variable referring to whether the self-denying shaman had one set of counter-balanced text or the other.

Table S13. Estimated odds ratios for all possible pairs of trait inferences.

	Odds ratio	SE	z	Adjusted p
Belief-Cooperativeness	1.55	0.49	1.40	0.486
Belief-Difference	3.19	1.08	3.42	0.004
Belief-Power	2.20	0.68	2.54	0.055
Cooperativeness-Difference	2.05	0.67	2.21	0.108
Cooperativeness-Power	1.42	0.42	1.18	0.486
Difference-Power	0.69	0.22	-1.17	0.486

References

- Revelle, W. (2019) psych: Procedures for psychological, psychometric, and personality research. R package version 1.19.12. <https://cran.r-project.org/package=psych>
- Weller, S. C. (2007) Cultural consensus theory: Applications and frequently asked questions. *Field Methods* 19:339–368. doi:10.1177/1525822X07303502