Full results for Reconsidering the link between past material culture and cognition in light of contemporary hunter-gatherer material use.

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1. Full Results

1.1. Taphonomic Signature

1.1.1 Baseline and Trade

I estimated the probabilities of artefacts containing at least one material with a moderate/strong taphonomic signature in a binomial regression. First I constructed a baseline (mean only) model (Table 1.1). The mean probability of any artefact containing a material with a moderate/strong taphonimic signature was approximately 1/3rd. Next I explored the influence of traded materials. As materials attained from trade were typically hard-wearing and non-biodegradable (metal, glass and plastic), items with traded components were substantially more likely to have a moderate/strong taphonomic signature than those without (Table 1.2), a mean absolute probability increase in of 0.67 with no overlap between distributions. The model including trade was substantially preferred to the baseline model in a leave-one-out (LOO) cross-validation model selection, commanding 100% of model weight when only baseline and trade models were considered (Table 2.1).

Model #	Parameter	Mean P	5% HDCI	95% HDCI
Model 1.1				
	Intercept	0.32	0.27	0.37
Model 1.2				
	NoTradedComponents	0.15	0.11	0.19
	TradedComponents	0.82	0.75	0.90

Table 1: *Mean posterior probabilities with 90 percent credibility intervals for artefact containing at least one component material with a moderate or strong taphonomic signature. Mean-only model first, followed by estimates for tool with and without components attained from trade.*

Population

I next explored the impact of population on the probability of artefacts including enduring materials. I ran a fixed-effects model including population as a predictor, and a multi-level model, with population-level varying (i.e. 'random') slopes and intercepts and trade as a predictor. The varying-effects model including trade was preferred to both the baseline model, the fixed-effects trade model and the fixed-effects population model in a LOO model selection, commanding 99% of model weight when these four models were compared (Table 2.2). For artefacts without a traded component, those used by the Mbuti were the least likely to contain components with a moderate-strong taphonomic signature (mean p = 0.08), while G//ana artefacts were the most likely (mean p = 0.24; Table 3.1), with little overlap between these two distributions. The mean probability for Hadza artefacts was lower than for G//ana artefacts, though these two distributions overlapped substantially. For artefacts with a traded component, as before, the probability of an artefact having a moderate/strong taphonomic signature was uniformly high (mean $p > .76$) with considerable overlap between population distributions.

1.1.2 Artefact Function

I next explored the influence of artefact function. Although most artefacts were only coded as having a single function, any one artefact could take a maximum of three functions. For this reason, rather than coding artefact function as a 9-factor variable, I used nine binary dummy variables: 1) Tools used in the preparation of other materials or other tools (e.g., hammers, awls, anvils, needles); 2) Storage/transport tools (e.g., food containers, bags, slings); 3) Ritual tools and items of personal adornment; 4) Tools for play or leisure (e.g., instruments, toys); 5) Tools used in grooming, hygiene or medicine; 6) Items of furniture or shelter; 7) Foraging tools (e.g. arrows, digging sticks); 8) Cooking, eating and food-preparation tools; 9) Items of clothing or protection. In addition to the models described above, I ran three further models; a fixed-effects model including the function variables only, a fixed-effects model including the function variables and trade, and a multilevel ('full') model with population-level varying slopes/intercepts and trade plus all function variables as predictors.

When these 7 models were compared in a LOO model selection, the full model outperformed all others (Table 2.3). For artefacts including traded components, the probability of having a moderate/strong taphonomic signature was high for all artefact function categories except items of clothing. Distributions were wide for certain categories (e.g. furniture/shelter) reflecting a category-specific paucity of information. There was substantial overlap between populations.

For those without traded components, most artefact types had very low probabilities of containing components with moderate/strong taphonomic signatures (Figure 1). Clothing was the least likely to contain enduring components, with population means centring on p = 0.01-.02 (Table 3.2) and a substantial proportion of each distribution neared zero. Tools used for storage and transport, items of furniture/shelter, articles of play and leisure, foraging tools and grooming/hygiene tools each also had low probabilities of containing enduring materials across populations. Only two artefact types - artefacts used in cooking/food-consumption, and tools used in raw-material-preparation or tool-manufacture - had increased probabilities of containing enduring components across population. Probabilities were higher for Hadza and G//ana artefacts (with overlapping distributions) than Mbuti artefacts. For two populations, artefacts with a ritual or personal adornment function also had an increased probability of containing enduring materials than artefacts with other functions. However, i) distributions for these populations were wide/uncertain

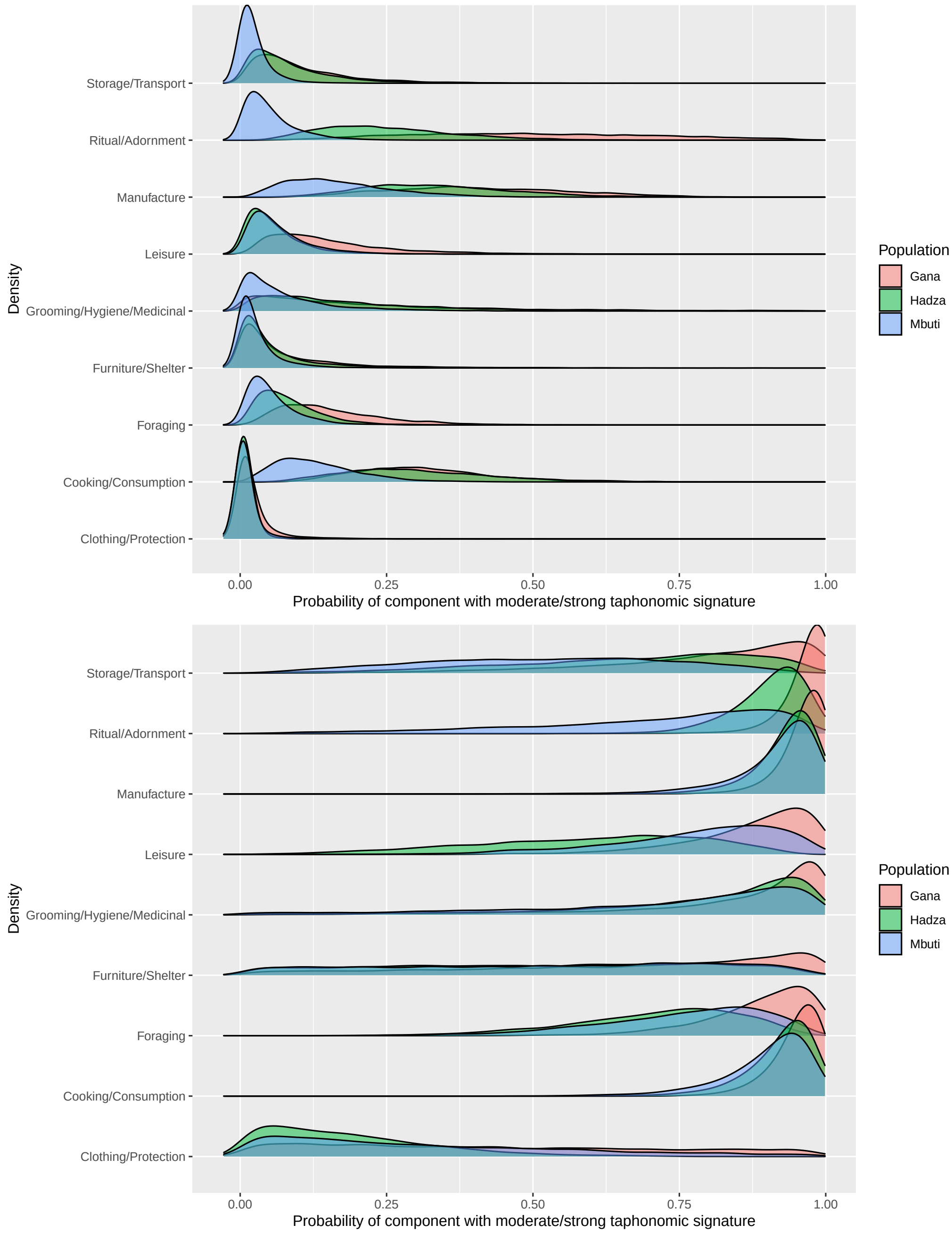

Figure 1: *Ridge plots showing posterior probability densities for all nine tool function types, for each of the three study population of containing one or more components with a moderate or strong taphonomic signature. Top figure contains distributions for artefacts without traded materials, bottom figure for artefacts including traded materials.*

#	Definition	ELPD Difference	SE Difference	Weights
2.1				
	0 + Trade	0.00	0.00	1.00
	Mean	-50.05	9.18	0.00
2.2				
	(0 + Trade ∣ Population)	0.00	0.00	0.99
	0 + Trade	-4.78	2.76	0.01
	0 + Population	-48.37	9.20	0.00
	Mean	-54.84	9.07	0.00
2.3				
	(0 + Trade + Function1..9 ∣ Population)	0.00	0.00	0.99
	0 + Trade + Function1..9	-4.73	3.71	0.01
	(0 + Trade ∣ Population)	-14.38	5.65	0.00
	0 + Trade	-19.16	6.44	0.00
	0 + Function1..9	-52.41	9.07	0.00
	0 + Population	-62.75	9.80	0.00
	Mean	-69.22	9.65	0.00
2.4				
	(0 + Trade ∣ Population)	0.00	0.00	0.69
	(0 + Trade + Symbolism ∣ Population)	-0.85	1.38	0.30
	0 + Trade	-4.78	2.76	0.01
	0 + Trade + Symbolism	-4.96	2.99	0.00
	0 + Population	-48.37	9.20	0.00
	Mean	-54.84	9.07	0.00
	0 + Symbolism	-55.84	9.04	0.00
2.5				
	0 + Trade + Population	0.00	0.00	0.90
	0 + Trade	-17.91	6.22	0.10
	0 + Population	-86.73	11.70	0.00
	Mean	-108.38	12.93	0.00

Table 2: *Leave-one-out model selection results including expected log-predictive density differences, standard errors and Akaike weights. 1-4 have taphonomic signature as the outcome, while 5 has component materials as the outcome. Model definitions provided in BRMs Linear syntax (in some cases reported analyses were coded using equivalent non-linear syntax, see ESM for details)*

Model #	Traded	Function	Mean_Mbuti	M90%CI	Mean_Hadza	H90%CI	Mean_Gana	G90%CI
Model 3.1								
	No		0.08	0.03-0.13	0.17	0.1-0.25	0.24	0.15-0.34
	Yes		0.80	0.65-0.94	0.76	0.65-0.88	0.94	0.85-1
Model 3.2								
	No	Clothing/Protection	0.01	0-0.03	0.01	0-0.02	0.02	0-0.05
	No	Storage/Transport	0.02	0-0.05	0.08	0-0.18	0.10	0-0.22
	No	Furniture/Shelter	0.03	0-0.07	0.05	0-0.13	0.08	0-0.19
	No	Foraging	0.05	0-0.11	0.08	0.01-0.15	0.16	0.02-0.29
	No	Ritual/Adornment	0.05	0-0.11	0.25	0.07-0.43	0.50	0.16-0.83
	No	Play/Leisure	0.06	0-0.13	0.06	0-0.11	0.15	0.01-0.3
	No	Grooming/Hygiene/Medicinal	0.08	0-0.18	0.18	0-0.4	0.21	0-0.51
	No	Cooking/Consumption	0.13	0.02-0.24	0.30	0.1-0.51	0.30	0.13-0.47
	No	Manufacture	0.17	0.03-0.3	0.34	0.14-0.54	0.41	0.17-0.66
	Yes	Clothing/Protection	0.32	0-0.7	0.19	0-0.39	0.44	0-0.86
	Yes	Furniture/Shelter	0.52	0.07-0.93	0.51	0.1-0.94	0.66	0.22-1
	Yes	Storage/Transport	0.52	0.19-0.87	0.67	0.36-0.97	0.79	0.53-1
	Yes	Ritual/Adornment	0.71	0.39-0.98	0.90	0.82-0.99	0.97	0.93-1
	Yes	Grooming/Hygiene/Medicinal	0.73	0.35-1	0.80	0.54-1	0.84	0.56-1
	Yes	Foraging	0.76	0.54-0.96	0.71	0.49-0.93	0.89	0.76-1
	Yes	Play/Leisure	0.78	0.57-0.98	0.60	0.29-0.9	0.87	0.73-1
	Yes	Cooking/Consumption	0.90	0.79-0.99	0.92	0.85-0.99	0.95	0.9-1
	Yes	Manufacture	0.92	0.83-1	0.93	0.87-0.99	0.97	0.92-1
Model 3.3								
	No	HasSymbolism	0.06	0.01-0.11	0.13	0.04-0.22	0.34	0.11-0.56
	No	NoSymbolism	0.10	0.03-0.16	0.19	0.1-0.27	0.22	0.13-0.32
	Yes	HasSymbolism	0.71	0.5-0.94	0.74	0.61-0.88	0.94	0.87-1
	Yes	NoSymbolism	0.82	0.7-0.96	0.82	0.7-0.94	0.92	0.84-1

Table 3: *Mean posterior probabilities with 90 percent credibility intervals for artefact containing at least one component material with a moderate or strong taphonomic signature. All are varying effect models with population as a grouping variable. Model 1 includes trade as a predictor, model 2 includes trade and all nine function variables, model 3 includes trade and symbolism*

and ii) this pattern did not hold for Mbuti artefacts.

1.1.3 Symbolism

The potential for any artefact to constitute symbolic evidence is closely related to artefact function. The majority of objects used in ritual contexts would constitute evidence of symbolic abstraction, as would all items of jewellery and adornment and many artefacts used in play or leisure (e.g. musical instruments; toys). However, many artefacts, although primarily used in subsistence, had additional modification or adornment (e.g. decorated hunting bows, storage containers etc). For this reason, I ran another set of models, replacing tool-function variables with a single binary variable 'evidence for symbolism' variable. I once again ran three models; a fixed-effects model including the symbolism variables only, a fixed-effects model including the symbolism variable and trade, and a multilevel model with population-level varying slopes and intercepts and trade plus the symbolism variable as predictors (the full model). This time, the trade-only model was preferred in a model selection (Table 2.4), though did not greatly outperform the full model.

For artefacts with traded components, as before, the probability of having a component with a moderate/strong taphonomic signature was, again, high across populations (Table 3.3). Here there was substantial overlap in distributions between those artefacts that constituted evidence of symbolism and those that didn't for all populations. For artefacts without traded components, those which constituted evidence of symbolism were more likely to have a moderate/strong taphonomic signature than artefacts that didn't among the G//ana but not the Hadza or Mbuti.

1.2. Material Use

Finally, I explored material selection directly. Sample size across the whole dataset was 362. I coded material as a factor variable, with three categories representing animal-derived materials ('animal'), plant-or fungus-derived materials ('vegetable') or inorganic materials ('mineral'). I ran four fixed-effects multinomial regression models with material as the outcome variable; a mean only baseline model, a model including trade, a model including population, and the 'full' model which included trade and population. In a LOO model-selection, the full model was overwhelmingly preferred (Table 2.5). Thus, I report results for the full model only (Table 4).

For all populations, materials attained from trade were overwhelmingly inorganic in origin, and overwhelmingly unlikely to be animal by-products (Figure 2). A minority of materials attained from trade were plant-derived, and was slightly more likely among the Mbuti than the other two populations.

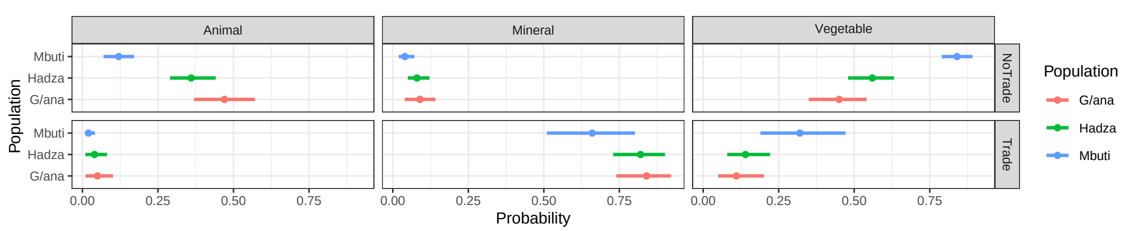

Figure 2: *Bar plots showing fitted mean probabilities and 90% CIs for each of the three study populations of using animal-derived, inorganic and plant-derived tool components. Untraded components above, traded components below.*

For materials not acquired through trade, there were substantial population differences (Figure 2). Such materials were unlikely to be inorganic for all populations, but slightly less likely for the Mbuti. Materials used by the G//ana were more likely to be animal by-products, and less likely to be plant-derived than the other two populations. Materials used by the Hadza were less likely to be animal-derived and more likely to be plant-derived than the G//ana though probability distributions for the Hadza and G//ana showed moderate overlap. Materials used by the Mbuti were substantially less likely to be animal-derived and substantially more likely to be plant-derived than the other populations, with no overlap between distributions; for the Mbuti the mean probability of any material being plant-derived was 0.84.

Traded	Material	Estimate_Mbuti	M90%CI	Estimate_Hadza	H90%CI	Estimate_G/ana	G90%CI
No	Animal	0.12	0.07-0.17	0.36	0.29-0.44	0.47	0.37-0.57
No	Mineral	0.04	0.02-0.07	0.08	0.05-0.12	0.09	0.04-0.14
No	Vegetable	0.84	0.79-0.89	0.56	0.48-0.63	0.45	0.35-0.54
Yes	Animal	0.02	0.01-0.04	0.04	0.01-0.08	0.05	0.01-0.1
Yes	Mineral	0.66	0.51-0.8	0.82	0.73-0.9	0.84	0.74-0.92
Yes	Vegetable	0.32	0.19-0.47	0.14	0.08-0.22	0.11	0.05-0.2

Table 4: *Mean fitted probabilities with 90 percent credibility intervals for plant-derived, animal-derived and inorganic materials with population and trade as predictors.*