

A Tooth Size Allocation Investigation into the Bodo Origins: Revisited

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Introduction

The Bodo are an ethnic group located north of the Brahmaputra Valley in the State of Northeast India. A previous tooth size allocation analysis by Fisher and Hemphill (2022) yielded inconclusive results. The current study examines another group located north of the Brahmaputra River, the Nyishis, who reside east of the Bodo in Arunachal Pradesh.



Image 1: Nyishi Couple



Image 2: Bodo Couple

Materials

Table 1: Ethnic Group Samples

Group Name	Abbreviation	Region	Total Sample Size	Male Sample Size	Female Sample Size
Khovar	KHO	N. Pakistan	186	92	94
Bhils	BHI	N.W. India	159	90	69
Garasias	GRS	N.W. India	190	101	89
Vaghela Rajputs	RAJ	N.W. India	154	127	27
Chenchus	CHU	S.E. India	171	103	68
Gompadhompti	GPD	S.E. India	138	68	70
Pakanati Reddis	PNT	S.E. India	153	93	60
Hmars	HMR	N.E. India (Kuki)	143	73	70
Koms	KOM	N.E. India (Kuki)	101	52	49
Paites	PAI	N.E. India (Kuki)	131	69	62
Sema Nagas	SEM	N.E. India (Naga)	184	81	103
Tangkhu Nagas	TNK	N.E. India (Naga)	150	70	80
Gurungs	GUR	N.E. India (North)	112	55	57
Sherpas	SHR	N.E. India (North)	103	43	60
Nyishi	NYI	N.E. India (Arun.)	142	68	74
Bodo	BOD	N.E. India	92	45	47

Regions & Ethnic Group Aggregates

N. Pakistan: n= 186
 N.W. India: n= 503
 S.E. India: n= 462
 N.E. India (Kuki): n= 375
 N.E. India (Naga): n= 334
 N.E. India (North): n= 215
 N.E. India (Arun.): n= 142

Methods

- Diestone dental casts were collected from school children between 14-19 years of age.
- Mesiodistal (MD) and buccolingual (BL) measurements were obtained for all permanent, except third molars.
- EM Estimation was used to estimate up to four missing values by individual. Those with more than four missing values were removed from further consideration.
- Univariate analyses (Levene's test, paired samples t-tests, one way ANOVA, Welch's test, Q-Q plots) were used to ensure homogeneity of variance and adherence to normality necessary for parametric analyses.
- Three multidimensional statistical analyses were used to test the inter-relatedness of the target and comparative groups: Canonical Variates Analysis (CVA), Multidimensional Scaling (MDS), and Neighbor-joining Cluster Analysis.

Hypotheses

- Given the paucity of archaeological evidence (Dikshit & Hazarika, 2011-12; Jamir, 2012), hypotheses concerning the origins of ethnic groups of northeastern India are based on linguistic affinities. All linguists agree that the Tibeto-Burman languages spoken in northeastern India are intrusive into the subcontinent, probably within the last three millennia (Blench & Post, 2014; Burling, 2003; Gadgil et al., 1997). Three alternative hypotheses may be tested:
 - 1) The introduction of Tibeto-Burman languages did not involve substantial population movement. Hence, ethnic groups of northeast India are indigenous inhabitants of this region distinct from other South Asians due to long-standing genetic drift (Jeong et al., 2017; Majumder, 1998; Sharma et al., 2012).
 - 2) The introduction of Tibeto-Burman languages occurred due to movement of populations from southern China along two vectors, one north of the Brahmaputra Valley, the other to the south via Manipur and Nagaland (Saha & Tay, 1990; Su et al., 2000; Wang et al., 2018).
 - 3) Tibeto-Burman languages were introduced from the north via the Tibetan Plateau (Blackburn, 2004; Gneccchi-Ruscione et al., 2017; Liu et al., 2022; Zhang et al., 2019) resulting in a genetic cline from north-to-south.

Results

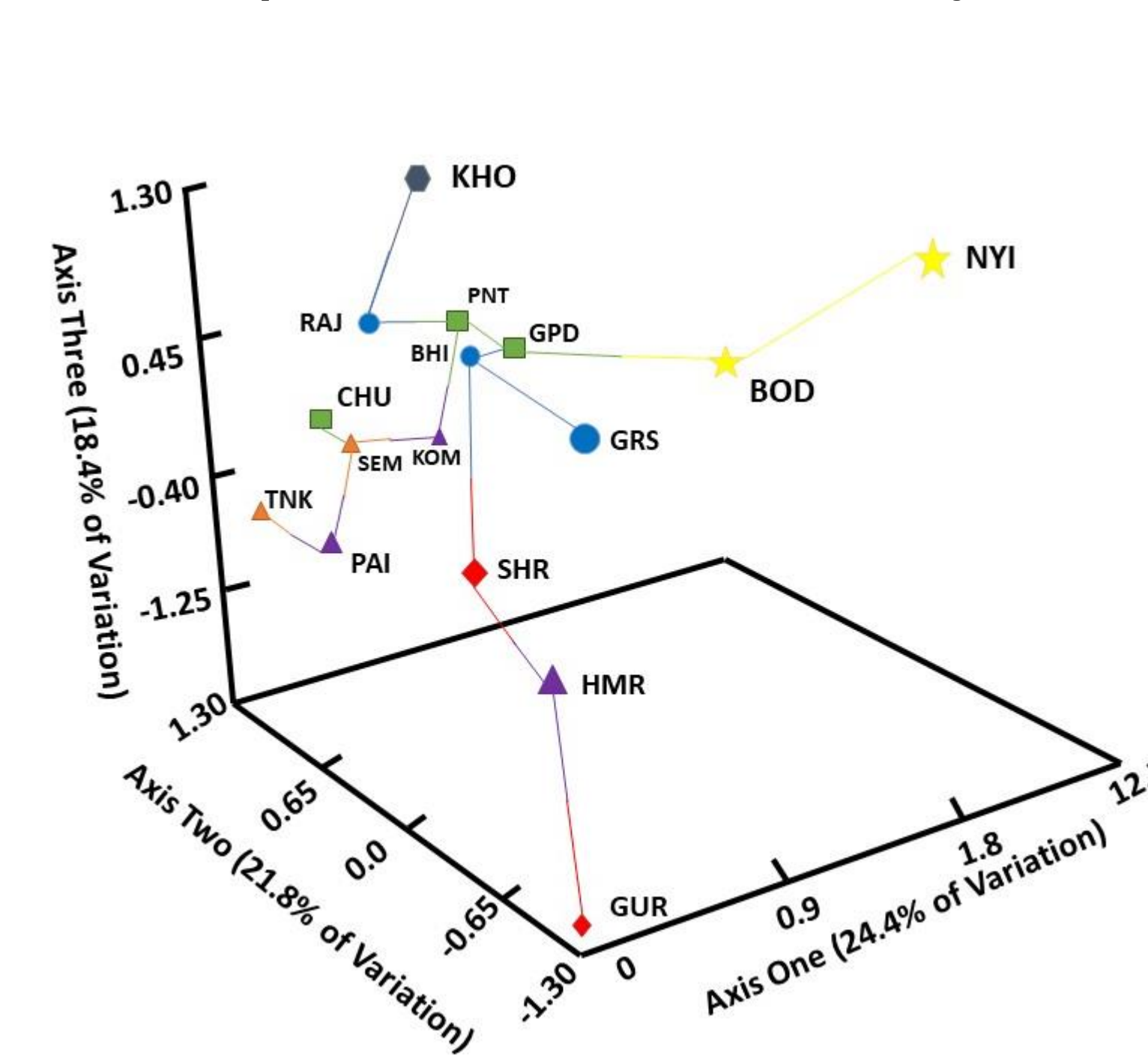
Table 2: Original CVA Classification Matrix

BHI	BOD	CHU	GPD	GRS	GUR	HMR	KHO	KOM	NYI	PAI	PNT	RAJ	SEM	SHR	TNK	% CORRECT	
BHI	89	3	3	23	0	0	9	0	4	2	9	7	5	1	1	56	
BOD	6	24	6	1	12	0	5	2	0	16	1	1	4	5	4	26	
CHU	6	3	77	7	9	0	12	10	3	4	6	8	14	7	0	45	
GPD	9	0	7	92	3	0	4	7	6	2	8	15	10	5	5	88	
GRS	23	2	8	6	97	0	4	9	2	6	3	8	12	4	2	51	
GUR	4	3	1	33	6	44	2	0	7	2	6	8	2	8	12	49	
HMR	3	1	7	2	6	1	36	10	8	20	3	4	10	2	22	25	
KHO	5	2	6	7	4	0	3	135	0	0	4	6	6	4	0	73	
KOM	3	1	3	11	5	0	4	3	84	2	5	4	5	14	5	84	
NYI	5	7	3	0	3	0	3	2	0	108	1	0	3	1	4	76	
PAI	2	0	2	5	6	0	21	2	11	1	45	6	2	10	2	84	
PNT	10	3	16	18	13	0	2	14	5	0	4	41	15	5	4	27	
RAJ	4	0	17	9	22	0	0	15	9	2	3	10	86	5	1	86	
SEM	9	1	6	10	0	0	7	5	5	3	7	8	8	92	3	50	
SHR	10	2	4	10	5	0	6	3	5	1	0	3	4	21	21	8	20
TNK	3	3	7	3	2	0	8	8	7	3	11	2	5	18	2	68	45
TOTAL	191	55	173	147	216	45	117	234	160	126	132	157	234	68	170	44	

Table 3: Jackknifed CVA Classification Matrix

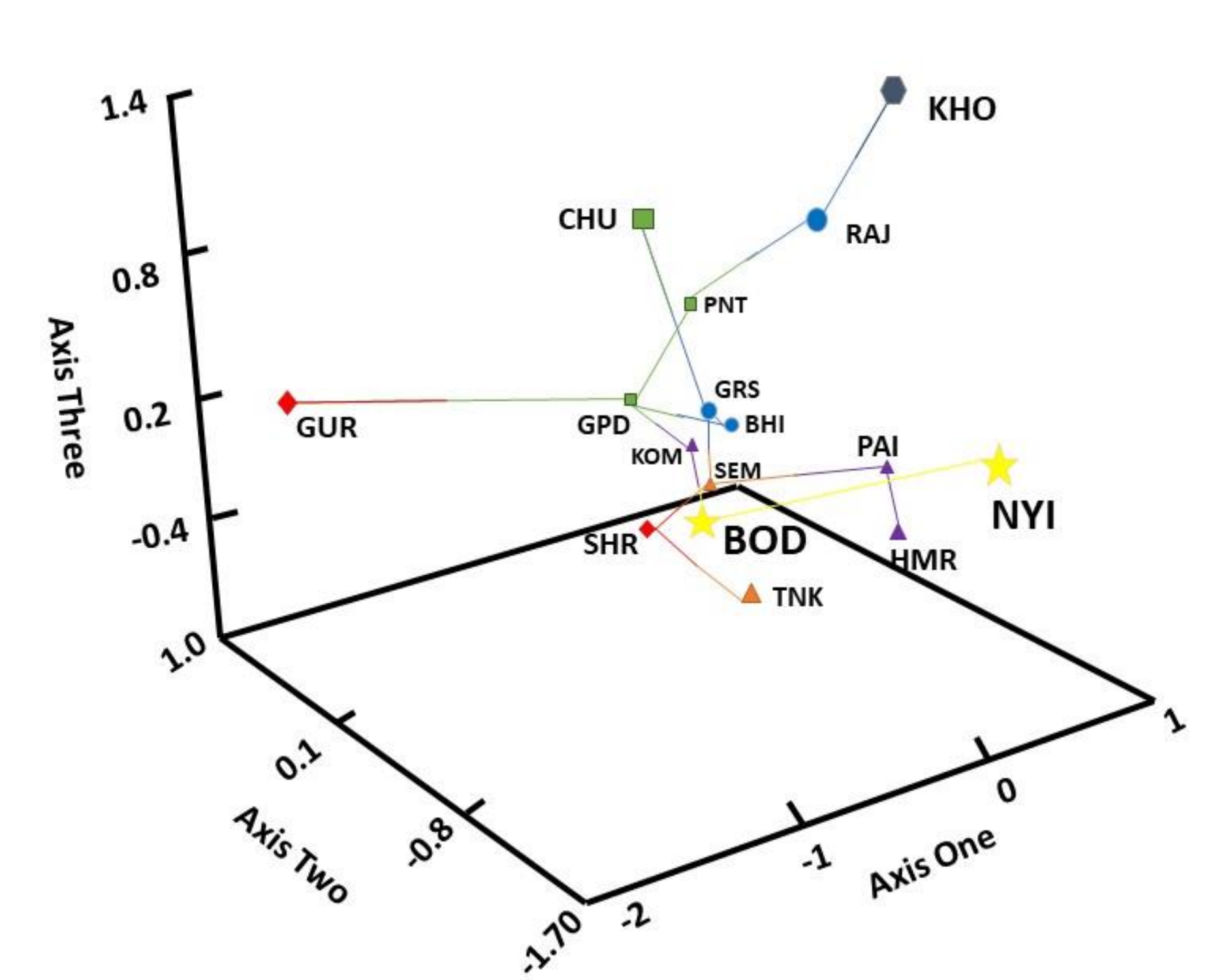
BHI	BOD	CHU	GPD	GRS	GUR	HMR	KHO	KOM	NYI	PAI	PNT	RAJ	SEM	SHR	TNK	% CORRECT	
BHI	80	4	3	5	27	0	0	9	0	4	2	9	8	5	2	1	50
BOD	7	14	6	1	13	0	5	2	0	20	1	1	4	5	4	7	17
CHU	7	4	71	7	9	0	12	11	3	4	6	9	16	7	0	5	42
GPD	9	0	9	40	3	0	6	7	6	2	8	22	10	6	5	5	29
GRS	23	3	9	6	88	0	6	11	2	6	3	10	12	4	3	4	46
GUR	4	3	1	3	6	44	2	0	7	2	6	8	2	8	12	4	59
HMR	3	1	8	3	6	1	29	10	11	6	22	3	4	10	2	24	20
KHO	5	2	6	7	4	0	3	131	0	2	4	7	7	4	0	4	70
KOM	3	1	3	11	5	0	5	4	27	2	7	4	6	14	7	2	27
NYI	6	10	4	0	3	0	3	3	0	102	1	0	3	1	4	2	72
PAI	2	1	2	6	6	0	21	2	11	1	41	6	2	11	2	17	81
PNT	10	3	17	22	14	0	1	16	5	1	4	30	16	6	5	3	20
RAJ	4	0	20	9	22	0	0	15	10	2	3	12	49	6	1	1	82
SEM	10	2	6	10	0	0	7	5	5	3	9	8	9	88	5	22	45
SHR	10	4	5	10	7	0	5	3	6	1	0	3	4	22	15	8	15
TNK	3	3	7	3	2	0	10	9	7	3	12	2	5	21	3	60	40
TOTAL	186	57	177	143	215	45	115	238	161	129	134	157	213	70	169	39	

Graph 1: Canonical Variates Analysis



- With their group centroids plotted in the upper right of the array, Bodos and Nyishis stand apart from all other groups.
- Occupying the upper-left and lower-left, respectively, Khovars and Gurungs also represent distinct outliers to other South Asians.
- The Naga samples aggregate together in the center-left, but the two Kuki samples are widely dispersed, with Koms showing close affinities to Nagas, but Hmars are marked by distant affinities to Himalayan groups.
- Peninsular Indian groups occupy the center of the array but lack regionality.

Graph 2: Multidimensional Scaling (Kruskal)



- Located in the foreground of the array, Bodos and Nyishis are both isolates that share only distant affinities to one another.
- Located in the upper-right and extreme left, respectively, Khovars and especially Gurungs stand apart as isolates.
- Peninsular groups aggregate together in the upper-center of the array.
- Naga and Kuki groups intermix with one another in the lower-center and forefront.

Discussion

- Our results offer some support for the first hypothesis, as northeast Indians do stand apart from South Asians of other regions, however, as there is no clear patterning among the northeast groups. It would thus stand to reason that genetic drift has affected northeast groups.
- Regarding the second hypothesis, a separation exists between northern and southern groups from the northeast, but both CVA and MDS show exceptions. The Bodo and Nyishi were not associated with groups residing north of the Brahmaputra valley.
- The third hypothesis, that Tibeto-Burman-speaking ethnic groups from northeast India are related to groups of the Tibetan Plateau and this relation would be strongest in the North and weakest in the South, is not supported by our results. The Bodo and Nyishi have no affinities to the Sherpas or Gurungs, and the Tangkhu Nagas, located in the south, have the strongest affinities to these groups.
- The Bodos and Nyishi shared no affinities to the sample presented, and their origins may be sought elsewhere, such as Myanmar or Thailand.

Acknowledgements and References

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