

The Temporal Labyrinths of Eastern Eurasian Pleistocene Humans

Supporting Information

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Table S1. Pleistocene and recent human comparative labyrinthine samples. Data from this study unless indicated otherwise.

<i>Samples</i>	<i>Samples</i>
Eastern Eurasia	Middle Paleolithic modern humans (MPMH)
Lantian (LT) 1	Qafzeh 3,6,7,9,11–13,15,21 (2)
Hexian (HX) 1	Skhul 1, 5 (2,4)
Xujiayao (XJY) 15	
Liujiang (LJ) 1	Upper Paleolithic modern humans (UPMH)
	Cro-Magnon 1 (4)
Early Pleistocene (EPlleist)	Lagar Velho 1 (4)
Olduvai OH9 (1)	Laugerie Basse 1 (4)
Sangiran 2,4 (1)	Malaurie 1 (2)
	Nazlet Khater 2 (2)
Middle Pleistocene Europe (MPI-Eur)	Muierii 2 (8)
Biache SV1, SV2 (2,3)	Oase 2 (9)
La Chaise-Suard 3 (4)	Pataud 1,3 (4)
Reilingen 1 (4)	Rochereil 1 (2)
Steinheim 1 (4)	
	Recent humans (Recent, n=180)
Neandertals (Neand)	China (n=26)
Amud 1, 7 (2)	Belgium (n=100) (2)
Arcy-sur-Cure C7.1544 (5)	Worldwide sample (n=54) (1)
Dederiyeh 1 (4)	
Devil's Tower 1 (4)	
La Chapelle-aux-Saints 1 (4)	
Engis 2 (2)	
La Ferrassie 1–3 (4)	
Forbes' Quarry 1 (4)	
Kebara 1 (2)	
Krapina 38.1,38.12,38.13,39.1,39.4,39.8,39.13,39.18 (6)	
Marillac LP01-H02 (2)	
Le Moustier 1 (4)	
Obi-Rakhmat 1 (7)	
Pech de l'Azé 1 (4)	
Petit-Puymoyen 5 (4)	
La Quina 5, 27 (4)	
Spy 1,2 (4)	
Tabun 1 (4)	

Table S2. Measurements and indices of the labyrinths of the east Asian Pleistocene humans and comparative samples: anterior (ASC), posterior (PSC) and lateral (LSC) semicircular canal dimensions. w: width; h: height; R: radius. Measurements and indices following Spoor (1,4). Sample abbreviations as in Table S1.

Samples	ASC w	ASC h	ASC h/w	ASC -R	PSC w	PSC h	PSC h/w	PSC -R	LSC w	LSC h	LSC h/w	LSC -R	SLI
East Asia													
LT	6.1	5.1	83.6	2.8	5.1	4.9	96.1	2.5	4.9	3.7	76.2	2.2	41.4
HX	7.4	6.6	88.5	3.5	6.5	6.2	95.4	3.2	6.1	5.4	87.8	2.9	53.5
XJY	6.2	5.4	87.1	2.9	5.7	5.6	98.3	2.8	5.8	4.8	82.8	2.7	61.4
LJ	7.0	5.6	80.0	3.2	5.5	4.9	89.1	2.6	5.7	5.2	91.2	2.7	45.5
EPleist													
Mean	7.2	5.5	77.2	3.2	5.9	6.4	108.9	3.1	4.7	3.7	78.4	2.1	53.3
S.D	0.5	0.3	9.5	0.1	0.4	0.6	3.8	0.3	0.5	0.7	13.9	0.2	6.8
max	7.6	5.8	88.0	3.2	6.2	7.0	112.9	3.3	5.2	4.4	88.1	2.4	61.0
min	6.6	5.3	70.0	3.1	5.0	5.8	105.5	3.1	4.2	3.0	62.5	2.0	43.0
n	3	3	3	3	3	3	3	3	3	3	3	3	3
MPI-Eur													
Mean	6.0	5.7	95.9	2.9	5.3	5.9	111.6	2.8	5.1	4.7	92.6	2.4	50.9
S.D	0.3	0.3	4.5	0.2	0.4	0.5	13.1	0.2	0.5	0.4	8.3	0.2	8.1
max	6.4	6.1	101.7	3.1	5.8	6.7	131.9	3.1	5.5	5.1	104.4	2.6	60.0
min	5.5	5.2	89.7	2.8	4.7	5.3	96.4	2.7	4.3	4.2	84.0	2.2	40.3
n	5	5	5	5	5	5	5	5	5	5	5	5	4
Neand													
Mean	6.2	5.8	92.6	3.0	5.7	5.6	100.7	2.8	5.4	5.0	92.7	2.6	63.5
S.D	0.5	0.4	5.0	0.2	0.4	0.6	8.0	0.2	0.4	0.4	6.7	0.2	5.8
max	7.3	6.6	103.5	3.4	6.8	6.7	114.8	3.4	5.9	5.9	111.7	2.9	76.0
min	5.3	5.1	84.3	2.6	5.1	4.7	87.1	2.5	4.7	4.3	82.7	2.3	52.1
n	22	22	31	31	22	22	30	30	22	22	31	31	30
MPMH													
Mean	7.1	6.2	88.5	3.3	6.1	6.0	100.0	3.0	5.2	4.3	83.4	2.4	53.0
S.D	0.5	0.5	6.9	0.2	0.4	0.4	7.9	0.2	0.4	0.5	9.7	0.2	6.2
max	7.7	7.0	97.9	3.7	6.8	6.7	113.9	3.2	5.9	5.1	98.0	2.8	62.5
min	6.1	5.4	71.8	3.0	5.5	5.3	88.1	2.7	4.7	3.7	68.2	2.1	40.2
n	11	11	11	11	11	11	11	11	11	11	11	11	11
UPMH													
Mean	7.1	6.3	89.5	3.3	6.1	6.5	106.5	3.1	5.3	5.0	94.0	2.5	43.7
S.D	0.5	0.4	6.7	0.2	0.5	0.4	7.6	0.3	0.4	0.4	6.2	0.2	9.4
max	7.9	6.6	98.0	3.6	6.6	6.9	118.2	3.3	5.8	6.0	104.0	3.0	55.0
min	6.5	5.5	79.7	3.0	5.4	5.7	96.2	2.5	4.7	4.5	85.9	2.2	31.2
n	9	9	9	10	9	9	9	10	9	9	9	10	10
Recent													
Mean	6.8	6.1	89.8	3.2	6.1	6.3	104.1	3.1	4.9	4.4	90.8	2.3	50.7
S.D	0.5	0.5	5.1	0.2	0.6	0.7	8.8	0.3	0.4	0.5	7.0	0.2	6.8
max	8.2	7.6	103.6	4.0	7.8	8.3	137.4	3.9	5.9	6.2	109.2	3.0	69.3
min	5.4	4.8	74.0	2.6	4.4	4.3	76.6	2.2	3.8	3.1	67.4	1.8	31.5
n	180	180	180	180	180	180	180	180	180	180	180	180	180

Table S3. Measurements and indices of the labyrinths of the east Asian and comparative samples: semicircular canal radii proportions (%R), torsion angles (tor), lateral canal orientations (LSCm<APA), and lateral canal versus facial nerve canal (LSCm<FC3) and posterior petrosal surface (LSCm<PPp) angles. Measurements and indices following Spoor (1,4). Sample abbreviations as in Table S1.

Samples	ASC %R	PSC %R	LSC %R	ASC tor	PSC tor	LSC tor	LSCm <APA	LSCm< FC3	LSCm< PPp
East Asia									
LT	37.6	33.6	28.9	9.0	-5.4	-4.0	33.1	72.9	57.5
HX	36.7	33.2	30.2	11.0	-9.1	1.8	32.1	76.0	65.9
XJY	34.6	33.7	31.6	13.4	-14.9	1.5	46.6	78.5	65.5
LJ	37.2	30.7	32.2	7.0	-12.2	0.9	30.5	63.5	51.2
EPlleist									
Mean	38.0	37.0	25.0				38.3		
S.D	1.0	1.7	2.0				6.1		
max	39.0	39.0	27.0				45.0		
min	37.0	36.0	23.0				33.0		
n	3	3	3				3		
MPI-Eur									
Mean	35.9	34.4	29.7	23.2	-10.1	-0.5	38.3	81.6	61.6
S.D	1.2	2.5	1.6	1.6	2.8	2.0	3.9	8.4	7.0
max	36.9	38.4	31.0	24.4	-7.2	1.7	41.6	91.8	67.0
min	34.4	32.2	27.2	20.8	-12.8	-2.5	32.6	73.1	53.7
n	5	5	5	4	4	4	4	4	3
Neand									
Mean	35.9	33.6	30.5	22.0	-11.3	2.7	45.9	86.6	69.4
S.D	1.5	1.6	1.1	6.5	5.8	5.0	4.6	8.6	7.9
max	41.1	36.0	39.0	32.0	1.9	12.0	55.0	103.5	82.0
min	34.0	29.0	28.0	11.0	-23.0	-6.3	40.3	73.6	55.0
n	30	30	30	21	20	21	21	17	14
MPMH									
Mean	38.1	34.7	27.2	14.9	-4.9	1.0	39.2	76.9	60.5
S.D	1.3	1.6	1.6	5.6	6.3	4.0	5.8	7.5	5.1
max	40.8	36.7	29.1	22.9	2.1	10.1	46.7	86.0	67.0
min	35.9	32.6	24.3	3.3	-18.5	-6.0	28.7	67.3	56.1
n	11	11	11	11	10	11	11	6	5
UPMH									
Mean	37.2	34.5	28.4	13.6	-13.3	3.5	35.2	73.2	57.5
S.D	1.4	1.7	0.9	2.5	5.4	3.3	3.6	5.4	12.1
max	39.5	37.0	30.1	18.8	-6.0	8.0	41.7	79.0	80.0
min	35.9	32.0	27.2	12.0	-21.0	-0.3	31.9	63.1	45.0
n	10	10	10	7	7	7	6	7	6
Recent									
Mean	37.3	36.0	26.8	15.2	-11.4	1.9	39.8	72.4	59.7
S.D	1.3	1.8	1.8	4.8	5.7	4.0	4.7	7.9	8.5
max	41.3	39.9	32.0	28.3	4.4	14.2	56.5	89.8	80.4
min	34.1	30.2	22.6	4.1	-27.8	-7.9	27.4	47.9	34.4
n	180	180	180	180	180	180	180	149	138

Table S4. Measurements and indices of the cochleae (CO) of the east Asian and comparative sample labyrinths. Measurements and indices following Spoor (1,4). Sample abbreviations as in Table S1.

Samples	COs<LSCm	COw	COh	COh/w	CO-R
East Asia					
LT	48.9	4.2	5.1	121.6	2.3
HX	52.0	4.4	5.2	119.0	2.4
XJY	71.6	4.1	5.2	127.0	2.3
LJ	58.1	4.0	4.8	121.0	2.2
EPlleist					
Mean	57.7	4.1	5.7	140.9	2.5
S.D	5.0	0.3	0.2	5.7	0.1
max	63.0	4.4	6.0	147.4	2.6
min	53.0	3.8	5.6	136.4	2.4
n	3	3	3	3	3
MPI-Eur					
Mean	47.2	3.8	4.8	128.6	2.1
S.D	4.9	0.3	0.8	20.4	0.2
max	54.2	4.1	5.5	145.0	2.3
min	43.3	3.5	3.8	102.6	1.9
n	4	4	4	4	4
Neand					
Mean	58.3	3.9	5.1	132.5	2.3
S.D	6.5	0.3	0.3	11.4	0.1
max	70.1	4.4	5.6	154.4	2.5
min	44.8	3.4	4.4	112.5	2.0
n	20	20	20	20	20
MPMH					
Mean	54.5	4.3	5.5	129.7	2.5
S.D	7.4	0.26	0.3	7.7	0.1
max	62.1	4.6	6.3	140.0	2.7
min	41.2	3.9	5.2	117.1	2.3
n	11	11	11	11	11
UPMH					
Mean	54.5	3.9	5.5	141.5	2.4
S.D	4.0	0.2	0.3	8.7	0.1
max	59.5	4.3	6.0	155.3	2.6
min	49.4	3.7	5.1	130.8	2.3
n	6	7	7	7	7
Recent					
Mean	59.0	3.9	5.2	132.7	2.3
S.D	6.6	0.3	0.3	9.1	0.1
max	74.9	4.7	6.1	163.6	2.6
min	36.3	3.3	4.4	112.2	2.0
n	180	180	180	180	180

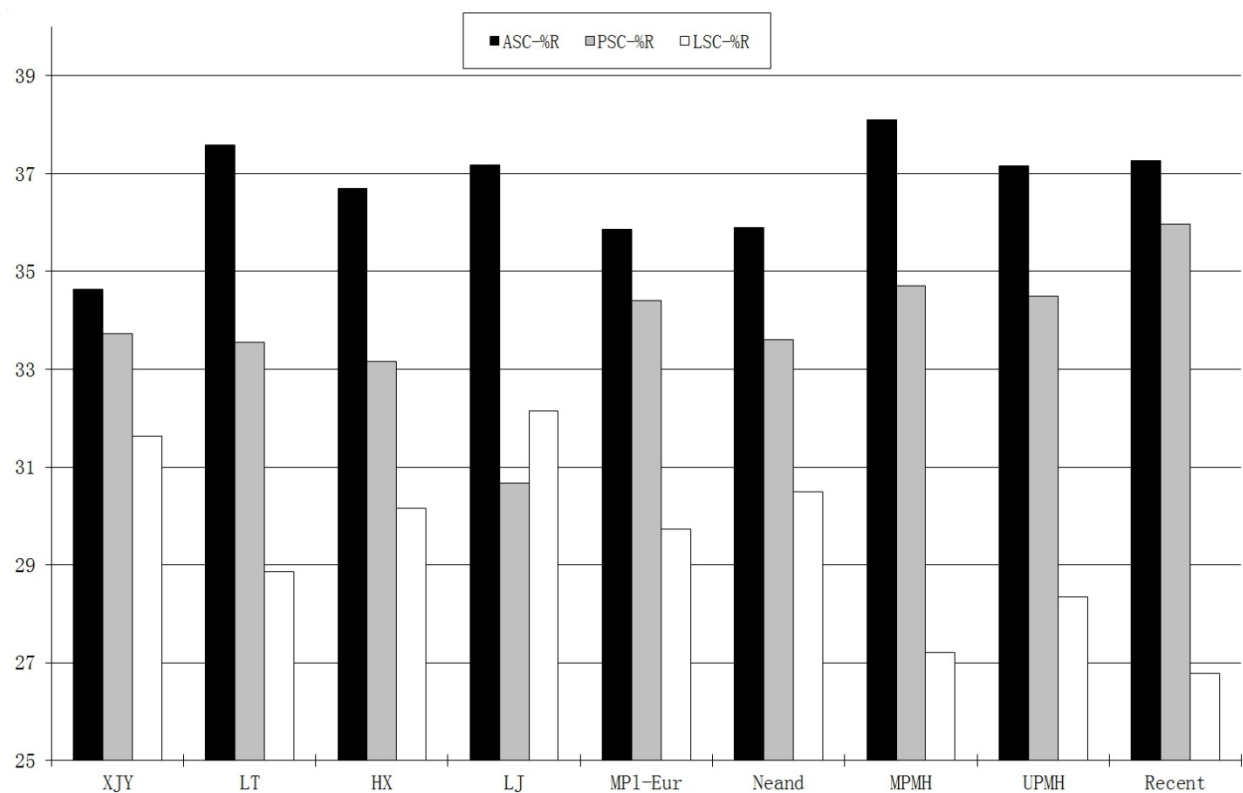


Figure S1. Graphic representation of the relative proportions of the semicircular canals in Xujiayao 15 (XJY), Lantian 1 (LT), Hexian 1 (HX) and Liujiang 1 (LJ) compared to Middle Pleistocene humans (MP1-Eur), Neandertals (Neand), Middle Paleolithic modern humans (MPMH), Upper Paleolithic modern humans (UPMH), and Recent modern human. Dark gray columns: ACS%R; gray columns: PSC%R; white columns: LSC%R.

Table S5. Principal Components Analysis (PCA) loadings with six-variable analyses of Xujiayao 15, Lantian 1, Hexian 1, Liujiang 1 and the five comparative groups.

	PC 1	PC 2
SLI	0.496	0.785
PSC-R	-0.622	0.351
PSC%R	-0.903	0.265
LSC%R	0.921	-0.166
LSC-R	0.597	0.072
LSCm<APA	0.192	0.921
Percent of variance	44.8%	28.2%

Table S6. Posterior probabilities of the eastern Asian labyrinth proportions relative to each of the five comparative samples, using 25 variables. The highest ones are in boldface.

	MPI-Eur	Neand	MPMH	UPMH	Recent
Lantian 1	<0.0001	<0.0001	0.9845	0.0023	0.0130
Hexian 1	<0.0001	<0.0001	0.9991	<0.0001	0.0008
Xujiayao 15	<0.0001	0.9485	0.0305	0.0012	0.0197
Liujiang 1	<0.0001	0.0018	0.3261	0.3894	0.2827

The Xujiayao Site and Human Remains

The Xujiayao human remains were discovered during excavations at Locality 74093 (40° 06' 02" N, 113° 58' 39" E) of the Xujiayao site complex in Houjiayao village, northwestern Nihewan Basin, northern China. The Xujiayao locality is an open-air site comprised of fluviolacustrine deposits. The paleoanthropological remains derive from fluvial sediments that have been dated to the early Late Pleistocene (most likely Marine Isotope Stage 5) based on associated faunal species (10,11), six Uranium-series dates on *Equus* sp. and *Coelodonta antiquitatis* tooth enamel (≈ 104 to ≈ 125 ka BP) (12,13), and the presence of an underlying paleomagnetic reversal that most likely represents the Blake Excursion ≈ 123 ka BP (14,15). Suggestions of an earlier Middle Pleistocene age from the sedimentary paleomagnetism (16,17) are based in unverifiable assumptions of sedimentation rates.

The Xujiayao 15 human fossil was associated with abundant archeological and faunal remains (18,19), as well as sixteen other human craniofacial and dental remains, some of which may derive from the same individuals. They include a juvenile left partial maxilla with six teeth (four unerupted), three isolated molars, fourteen fragments of the neurocranium, and a mandibular ramus (Table S7).

The Xujiayao 15 largely complete adult left temporal bone (Figure S2) was discovered in 1979 (20). The zygomatic process was broken off at the anterior end of the supraglenoid sulcus. The anterosuperior corner of the squamous suture contour is absent, apparently as a result of a missing sutural bone along the sphenotemporal suture extending to pterion in the temporal fossa. The medial tip of the petrous portion is absent, but the petrous portion is intact beyond the internal acoustic meatus and almost to the medial end of the carotid canal. There is neither postmortem distortion nor pathological alteration.

Table S7. The human fossil remains from Xujiayao (XJY).

XJY No.	IVPP No.	Original No.	Discovery date	Preservation	Reference
1a	PA 1480	1	1976	Immature partial left maxilla with M ¹ and P ³ , P ⁴ and M ² germs, all teeth <i>in situ</i>	10,11,21
1b	PA 1480	1	1976	Unerupted left I ¹ (from XJY 1a crypt)	10,
1c	PA 1480	1	1976	Unerupted left C ¹ (from XJY 1a crypt)	10,11
2	PA 1481	2	1976	Right M ³ (or possibly M ²)	10
3	PA 1482	3	1976	A small section of a parietal bone	10

XJY No.	IVPP No.	Original No.	Discovery date	Preservation	Reference
4a	PA 1483	4	1976	Anterior left parietal bone with coronal suture and stephanion	10
4b	PA 1484	5	1976	Anterior right parietal bone with bregma and adjacent sutures	10
4c	PA 1491	11	1977	Part of left parietal bone close to sagittal suture	22
5	PA 1485/88	6	1976	Largely complete left parietal bone missing corners (immature)	10,11,23
6a	PA 1486	7	1976	Occipital bone with squamous portion and superior nuchal plane	10,11
6b	PA 1490	10	1977	Largely complete right parietal bone	11,22
7	PA 1487	8	1976	Posterior portion of a left parietal bone (<i>ex situ</i>)	10
8	PA 1489	9	1976	Anterosuperior right parietal bone	10,23
9	PA 1492	12	1977	Inferior half of a right parietal bone	22
10	PA 1493	13	1977	Asterionic corner of a right parietal bone	22
11	PA 1494	14	1977	Right and left posterosuperior parietal bones	22,24
12	PA 1495	15	1977	Occipital bone with nuchal plane and partial squamous portion	11,22
13	PA 1496	16	1977	Left M ¹ or M ²	11,22
14	PA 1497	10A	1977	Right mandibular ramus	11,22,25
15	PA 1498		1979	Left temporal bone	11,20
16	PA 1499		1979	Right anterior parietal with a part of coronal suture	22
17	PA 1500		1979	Right M ₃ (or possibly M ₂)	22

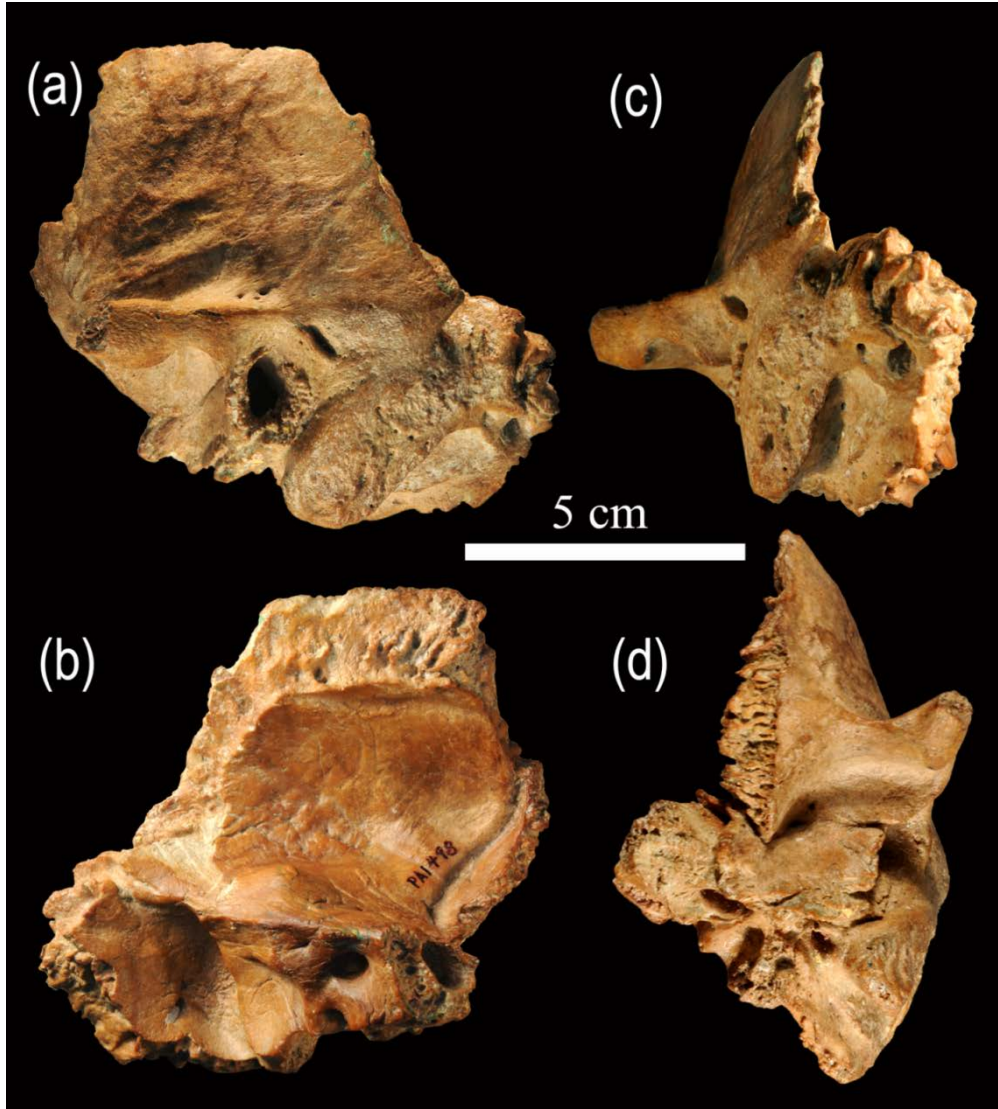


Figure S2. The Xujiayao 15 temporal bone, in lateral (a), medial (b), posterior (c) and inferior (d) views. The posterior view is slightly posteroinferior. Note that a sutural ossicle in the region of pterion, along the anterior squamous portion, is absent, such that the original squamous contour was probably more rounded anteriorly.

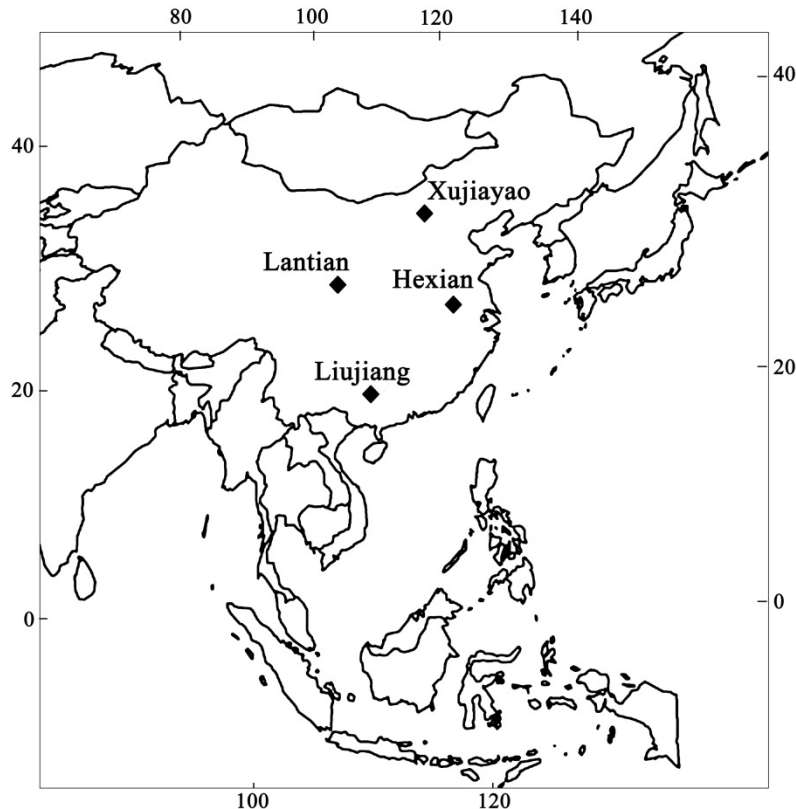


Figure S3. Map of eastern Asia with the locations of the four Pleistocene specimens yielding temporal labyrinthine data.

The Lantian, Hexian and Liujiang Human Remains and Comparative Samples

The Lantian temporal bone (PA 105(3))

The Lantian 1 cranium was found in 1964, at Gongwangling village, Lantian county, Shanxi province (26). In addition to the eroded frontal and parietal bones (27), there is a separate petrosal portion of the right temporal bone. The petrous portion is fairly well preserved, and the cochlea and the semicircular canals within the pyramid were clearly identified in X-ray films (25). The dating of the Lantian cranium is about ≈ 1.15 ma BP based on the secure identification of both the Bruhnes/Matuyama paleomagnetic boundary and the Jaramillo event through the stratigraphic sequence (28).

The Hexian 1 cranium

The Hexian 1 neurocranium was found in 1982, at Longtandong, Hexian county, Anhui province (29). Although the base of the cranium is largely missing, the petrosal portions of the temporal bones are completely preserved bilaterally. The age of the Hexian hominid was estimated to be ≈ 412 ka using combined ESR and U-series analyses (30).

The Liujiang 1 cranium

The Liujiang 1 cranium was found in Tongtianyan Cave of Liuzhou district, Guangxi Zhuang Autonomous Region (31). The petrosal portion of the right temporal bone is well preserved, while the left petrosal portion is incomplete. Because the exact layer that yielded the fossil is unclear, arguments about

the chronology of the cranium exist (32). Based on the associated mammalian fossils, the Liujiang human fossil is Late Pleistocene in age (11).

The Comparative Samples

The comparative human labyrinths providing data are grouped into six samples (Table S1), only one of which (the Early Pleistocene one) includes specimens from the eastern Old World (partial data from the two Sangiran crania from Indonesia). The Middle Pleistocene sample includes mostly later Middle Pleistocene specimens from Europe, which show overall morphological affinities to the Late Pleistocene Neandertals (33-35). The early modern humans are separated into Middle Paleolithic (MIS 5c) southwest Asian remains and later (MIS 3-2) Upper Paleolithic modern humans from Europe plus one MIS 3 northeast African specimen. The pooled recent humans include two regional samples, from northwest Europe and northern China, plus one that includes specimens from across the Old World. Data sources are provided in Table S1. Note that not all of the fossil specimens have the complete series of labyrinthine measurements available for them.

Only two additional Early to Late Pleistocene archaic human remains from eastern Asia retain the temporal bone, Dali 1 (36) and Jinniushan 1 (37). Neither one is available for analysis, and their labyrinthine configurations have not been investigated. They are therefore not included.

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