Reply to Evteev and Heuzé: How to overcome the problem of modelling respiration departing from bony structures?

de Azevedo S[1*], González MF[1*] , Cintas, C[1*], Ramallo V[1], Quinto-Sánchez M[2], Márquez F[3], Hünemeier T[4] , Paschetta C[1], Ruderman A[1], Navarro P[1], Pazos BA[1], Silva de Cerqueira CC[5], Velan O[6], Ramírez-Rozzi F[7], Calvo N[8], Castro HG[9,11], Paz RR[10,11**], and González-José R[1**]

1 Instituto Patagónico de Ciencias Sociales y Humanas, Centro Nacional Patagónico - CONICET. Bvd. Brown 2915 U9120ACD, Puerto Madryn, Argentina.

2 Ciencia forense, Facultad de Medicina, Universidad Nacional Autónoma de México, Circuito de la investigación Científica s/n, Ciudad Universitaria, Del. Coyoacán, CP 04510, CDMX

3 Instituto de Biología de Organismos Marinos, Centro Nacional Patagónico - CONICET. Bvd. Brown 2915 U9120ACD, Puerto Madryn, Argentina.

4 Departamento de Genética e Biologia Evolutiva (IB), University of São Paulo Rua do Matão, no.277. Cidade Universitária, Cep: 05508-090, São Paulo, Brasil.

5 Superintendência da Polícia Técnico-Científica do Estado de São Paulo. Equipe de Perícias Criminalísticas de Ourinhos, São Paulo, Brasil.

6 Departamento Académico de Ciencias Morfológicas. Hospital Italiano. Tte. Gral. Juan Domingo Perón 4190, C1199ABB, Buenos Aires, Argentina.

7 UMR 5288 AMIS, CNRS, Fac. Chir. Dent., 1 rue Maurice Arnoux, 92120 Montrouge, France.

8 Universidad Nacional del Litoral. Pje El Pozo S/N. Santa Fe. Argentina.

9 Universidad Nacional del Nordeste (UNNE) - UTN-FRRe. Chaco, Argentina.

10 Livermore Software Technology Corporation (LSTC), 7374 Las Positas Rd., 94551 Livermore, California. USA.

11 Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET).

To whom correspondence may be addressed. Email: rodrigo.r.paz@gmail.com or rolando@cenpat-conicet.gob.ar.

Evteev and Heuzé (1) state that there is no evidence supporting that Chinese, Japanese and Korean populations exhibit cold-adaptation features. However, several facial traits present on these groups were previously interpreted as cold-climate adaptations (2-9). For instance, a composite sample including Chinese, Japanese and Korean individuals showed internal nasal variation compatible with theoretical expectations for cold climate adaptations (9). Also note that we applied CFD analyses that directly test for differences in the internal nasal mucosa, making irrelevant any prior difference among cold versus warm-evolved populations. Such potential prior differences are also irrelevant in the context of Lande's test, which departs from random evolution as null hypothesis.

Further, the statement that there are no differences between NEA and SWE (1) is incorrect: we reported significant Mahalanobis distances (10, Fig. 1D), observable even yet the morphospace is dominated by the two Neanderthals that occupy an extreme position, thus blurring differences between SWE and NEA.

Regarding contextual information, the human sample is composed by 21 females and 17 males, with an average age of 54.9 years. Note that we provided the more relevant information on the population origin of the samples in SI (10).

Evteev and Heuzé (1) also question the selection of reference specimens used in the reconstruction of the Neanderthal tract. Note that the selected individuals fall near their group-specific centroid in the morphospace defined by the two first PCs in Fig. 1b (10); and the distant placement of Neanderthals in the morphospace makes that any difference between the human references has no significant effects on the final warped reconstruction of the Neanderthal tract (10,p.5).

Regarding the interpretation of our CFD results, we report a key role of the most-anterior part of the nose as a key structure for air conditioning, and that the NEA model achieves faster air uniformity, followed by the Neanderthal model. In no way we denominate such results as "huge differences" as stated by Evteev and Heuzé (1). We are well aware of the fluctuating and unstable nature of the mucosa. However, reconstruction of 3D mucosa models departing from single individuals, even when prone to noising factors, provides a complementary picture to the classical one, based on the more stable (but not so relevant in terms of air conditioning) osseous traits.

The authors (1) also underestimate our covariation analysis, and refer to a previous work that found weak covariation between the anterior and posterior nasal airways (11). However, Bastir and Rosas didn't placed internal landmarks at the lateral walls of the cavity, and his focus was exclusively on modern humans. On the contrary, we aimed to validate the warping approach using a broader phylogenetic framework (10). In this sense, we detected a very significant pattern of covariation among different parts of the nose, as well as its stability across different clades: modern humans, chimpanzees, and *Macaca*, an outgroup including a cold-adapted species.

We do think that, considering the data available, our sample achieves the criteria needed to a proper reconstruction of the Neanderthal tract.

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