REPLY TO EVTEEV AND HEUZÉ:

How to overcome the problem of modeling respiration departing from bony structures

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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 in these groups were previously interpreted as cold-climate adaptations (2–9). For instance, a composite sample that included Chinese, Japanese, and Korean individuals showed internal nasal variation compatible with theoretical expectations for cold climate adaptations (9). It is also noteworthy that we applied computational fluid dynamics (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 a null hypothesis.

Further, the statement that there are no differences between northeastern Asian (NEA) and southwestern European (SWE) (1) is incorrect: We reported significant Mahalanobis distances (figure 1D of ref. 10), observable even when 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 of 21 females and 17 males, with an average age of 54.9 y. Note that we provided more relevant information on the population origin of the samples in our study's *SI Appendix* (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 first two principal components in figure 1B of ref. 10, and the distant placement of Neanderthals in the morphospace ensures that any difference between the human references has no significant effects on the final warped reconstruction of the Neanderthal tract (ref. 10, p. 5).

Regarding the interpretation of our CFD results, we report a key role of the anterior-most 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 do 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 based on a single individual, even when prone to error due 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 (11) did not place internal landmarks at the lateral walls of the cavity, and their 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

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the nose, as well as its stability across different clades: modern humans; chimpanzees; and *Macaca*, an outgroup that includes a cold-adapted species.

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

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