Reply to Price and Bird: No inconsistency between the date of gene flow from India and the Australian archaeological record

In our paper (1), we demonstrate gene flow from India to Australia, which Price and Bird (2) do not question. Based on genetic evidence, we date this gene flow to around 4,200 y ago. This date is interesting and significant because it reappears in different contexts in debates about Australian prehistory concerning the mid-Holocene transition, which involves changes in stone tool technology and the first appearance of the dingo in the fossil record. Price and Bird question whether these archaeological changes have anything to do with the inferred gene flow from India and additionally question the absence of a corresponding signal of Indian gene flow in Southeast Asia.

We are aware that the mid-Holocene transition in Australia is a highly controversial topic, and we acknowledge this controversy in our article. We do not link the gene flow directly to the archaeological changes, as our work is based solely on genetic evidence, but we suggest that the inferred date of migration fits very well with the "classical" view of mid-Holocene changes in Australia, and we are glad that our study has stimulated further discussion on this point.

Price and Bird suggest microliths and detoxification of Macrozamia plants appear in the archaeological record earlier than others have suggested, during late Pleistocene or early Holocene. However, if the Indian gene flow to Australia was not a one-time event, but occurred over a period of time, then the inferred date of admixture would indicate the most recent period of contact (3). Hence, there is no contradiction between the (controversial) earlier dates cited for the appearance of the microliths and detoxification of plants and the date for the presumed gene flow from India.

Similarly, for the origins of dingo, there are other views than that presented by Price and Bird. For example, a recent Y chromosome study (4) reports a unique haplogroup in dingos that is derived from a haplogroup not present in Island Southeast Asia (ISEA). This argues against Southeast Asia as the origin of the dingo; Indian dogs were not included in this study. The study suggested instead that the dingo might have been brought from Taiwan by the Austronesians, but no impact of the Austronesian expansion on any aspect of Australia has ever been described. It seems that genome-wide data from dingos and all potential sources (dogs from India, Southeast Asia, and New Guinea) would really be needed to resolve the question of dingo origins.

Last, on the lack of an Indian genetic signal in ISEA, while of course in principal it is possible that subsequent migrations have erased the signature of the Indian gene flow, this is highly unlikely as other gene flow events from around the same time (i.e., the Austronesian expansion) or even earlier (i.e., a possible Austro-Asiatic substrate) are readily detected in ISEA (5). Given the early development of sailing technology in India (6), it does not seem surprising to us that people could have sailed directly from India to Australia, either deliberately or accidentally.

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4 Sacks BN, et al. (2013) Y chromosome analysis of dingoes and southeast asian village dogs suggests a neolithic continental expansion from southeast Asia followed by multiple austronesian dispersals. *Mol Biol Evol* 30(5):1103–1118.
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The authors declare no conflict of interest.

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