



Reply to Zeder: Maintaining a diverse scientific toolkit is not an act of faith

Here we address several concerns Zeder (1) raises about our recent paper (2).

- i) We are not interested in labeling individuals or mounting personal attacks. Instead, we provide a critique of a current trend in scholarship that prioritizes informal induction from particular facts and observations over theoretically informed scientific explanation.
- ii) In advocating an approach that acknowledges the evolutionary basis of human behavior, we are not making the claim that optimal foraging theory (OFT) provides the only framework for investigating the origins of agriculture (OA). We believe that OFT is one of many productive theoretical frameworks that can contribute to this effort. We also think that the implementation of models offers many advantages that might be used productively with niche construction theory (NCT). However, we do not champion OFT as a superior body of theory, and faith in its abilities to make accurate predictions is beside the point.
- iii) The “serious deficiencies” Zeder refers to include the failure of the diet breadth model (DBM) to explain OA in eastern North America as an efficiency-maximizing strategy. This is not a scientific failure, but rather a testament to the utility of using different models organized around similar theoretical premises to generate testable hypotheses. Disconfirmed hypotheses provide a scientifically sound

justification for seeking alternative explanations. Moreover, as discussed in ref. 2, careful reading of the literature from the Near East and Neotropics (Zeder’s other examples of deficient OFT applications) finds not “dizzying circularities,” but instead good fits between DBM predictions and archaeological/paleoecological data. Does Zeder really think that in the Neotropics megafaunal extinctions, marked Pleistocene-Holocene environmental change including forest advancement, and early Holocene cultural responses are “hypothetical”? (see refs. 3 and 4 for reviews of the evidence).

- iv) Zeder’s insistence that NCT and OFT are incompatible continues to perplex us. OFT contains no inherent “asymmetrical view of adaptation”; nothing in the approach prohibits the incorporation of feedback between human manipulation of the environment and subsistence decisions.

Finally, to ask OFT to “stand on its own, separate from the larger disciplinary categories of HBE and EE” is unreasonable because doing so would strip the approach of its theoretical foundation. Similarly, to test optimization theories without the optimization assumption is nonsensical. The optimization assumption is well grounded in the logic of evolutionary theory, but we do not maintain or expect that humans (or anything else) will act optimally all of the time. The assumption is simply a necessary

construct of the modeling framework, and it enables very explicit hypothesis testing. When such tests fail, we move on. Believing from the start that OFT and the DBM are invalid merely removes a useful set of tools from the analytical toolbox.

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1 Zeder MA (2014) Alternative to faith-based science. *Proc Natl Acad Sci USA*, 10.1073/pnas.1408209111.

2 Gremillion KJ, Barton L, Piperno DR (2014) Particularism and the retreat from theory in the archaeology of agricultural origins. *Proc Natl Acad Sci USA* 111(17):6171–6177.

3 Piperno DR (2011) The origins of plant cultivation and domestication in the New World tropics: Patterns, process, and new developments. *Curr Anthropol* 52(Suppl 4): S453–S469.

4 Piperno DR (2006) Quaternary environmental history and agricultural impact on vegetation in Central America. *Ann Mo Bot Gard* 93(2):274–296.

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