



# Optimal foraging theory and niche-construction theory do not stand in opposition

In a recent paper, Zeder (1) outlines core archaeological questions in domestication research, highlighting the importance of defining the process, when it happened, and why it happened in various global contexts. Importantly, she emphasizes the utility of separating initial domestication from intensive agricultural practices, pointing out that often, origins of agriculture studies actually deal with initial domestication. Zeder's explicit separation of these two economic behaviors, as well as identification of various markers that indicate initial domestication, makes this an extremely valuable contribution.

However, in addressing the frameworks used to explain domestication, Zeder (1) presents optimal foraging theory (OFT) and niche-construction theory (NCT) as two mutually exclusive approaches. However, NCT cannot adequately explain the process of domestication because it lacks a general theory of behavior that is required to explain why humans would construct niches (2). We argue that the processes of domestication can only be understood under the broader umbrella of human behavioral ecology.

Treating niche-construction behavior (NCB) as inseparable from human economic behavior allows for the development of predictions about when humans should modify their environment. Even at the most basic level, some subsistence behaviors will unintentionally alter the environment; these alterations

should have little associated cost and may or may not provide benefits. Intentional NCB should only occur when the net benefits outweigh the costs of investment. NCB should begin when individuals experience declining benefits in alternative strategies. This should lead individuals to further modify the environment to decrease the time needed to search for high-profitability resources or the time required to handle low-profitability resources, either of which should increase the benefits of territoriality or private ownership over modified patches (3).

These types of predictions can be used in a general model that evaluates the costs and benefits of NCB. Diet breadth models address the circumstances under which foragers would pay the cost of constructing niches, whether it be under circumstances of resource depression or because it is advantageous for a group of foragers to settle permanently in a resource-rich area, taking advantage of all locally abundant resources. Using these simple models does not imply foragers formulate and always adhere to a strict ranking of all resources in the environment, as has been argued (4). OFT frameworks simply offer a starting point, and allow us to understand the conditions under which the benefit of NCB outweighs the cost.

In order for NCB to make sense, economic decisions founded within OFT are useful. We agree with Zeder (1) that in most research

focusing on OFT models, researchers do not make NCB explicit, and agree that this outcome should be highlighted.

Although Zeder's recent article (1) follows a discussion of whether or not these two approaches can be integrated (2, 5), we believe that understanding the utility of both approaches is a more constructive outlook than the current and extremely polarized atmosphere permits.

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**1** Zeder MA (2015) Core questions in domestication research. *Proc Natl Acad Sci USA* 112(11):3191–3198.

**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** Coddling B-F, Bird DW (2015) Behavioral ecology and the future of archaeological science. *J Arch Sci* 56:9–20.

**4** Smith B (2015) A comparison of niche construction theory and diet breadth models as explanatory frameworks for the initial domestication of plants and animals. *J Arch Res*, 10.1007/s10814-015-9081-4.

**5** Smith B (2014) Failure of optimal foraging theory to appeal to researchers working on the origins of agriculture worldwide. *Proc Natl Acad Sci USA* 111(28):E2829.

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