# Tree-thinking: Do Pictorial Representations of Phylogenetic Relationships Help or Hinder Museum Visitors' Understanding of Evolution?

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**Introduction:** From Darwin's iconic representation of a simplified tree of life to abstract modern cladograms, pictorial representations of evolutionary relationships among diverse species have played a crucial role in conveying core ideas about common descent. One of the questions investigated in this study is whether such "tree-thinking" helps museum visitors grasp the counterintuitive idea that contemporary species have descended from a common ancestor, which is unlike its descendents. Common ancestry violates the everyday intuition that each kind of animal is characterized by an unchanging essence (Evans, 2001, 2008; Gelman, 2003; Mayr, 1982). Furthermore, this is the evolutionary principle most likely to be rejected by Biblical literalists.

**Method**: We assessed natural history museum visitors' (Novices: 21 children, 11-13 yrs; 12 youth, 14-18 yrs; 30 adults) and evolutionary biologists (15 Experts) interpretation of pictorial representations of four evolutionary trees: whale, human, HIV, and fruit fly. Visitors completed pre- and post-visit interviews, including closed- and open-ended questions for non-pictorial and pictorial scenarios, around a typical gallery visit to *Explore Evolution*, where the graphics were displayed. Experts completed the post-visit interview, only. Adults' education level (90% college graduates) and that of the children's and youth's parents' (89% college graduates) was high. Only one adult, a biology lab technician, indicated a biology background. Participants' open-ended verbal and spatial descriptions of the graphics, and their evolutionary explanations for species portrayed in the pictorial and non-pictorial scenarios were transcribed and coded (Cohen's Kappa=80%).

**Results**: In comparison with data collected on non-pictorial scenarios (see Evans et al., 2010), most participants—novice and expert—included discussion of common ancestry, time, and the relationships between species in their responses to the pictorial scenarios, even for complex trees. However, novice participants were more likely to report that one organism “changes into” another (anagenesis), focusing on individual need-based (purposeful) change rather than population change. Experts were more likely to describe the trees in terms of the scientific process (e.g., hypotheses, phenotypic data), to use expert terms (e.g., clade) and to use natural selection to explain how the changes happened. While both novices and experts used evolutionary concepts to explain whale evolution, the novices were less likely to do so for HIV evolution. Further, novices used intuitive reasoning along with evolutionary reasoning, particularly for the simplified "tree-like" representations, frequently describing evolutionary change as a developmental process.

**Discussion:** In sum, while tree-thinking fosters an acceptance of phylogenetic relationships and common descent and a recognition of the importance of time, it may impede an understanding of evolutionary mechanisms, particularly of natural selection. This may be, in part, because trees usually show a single member of a taxon, inaccurately suggesting (to novices) that the individual is the unit of change. Moreover, this kind of depiction does not show variation within a population, which is key to grasping natural selection. In comparison with cladograms simplified tree-graphics easily convey a clear message about relationships between species and common descent; however, they are also more likely to elicit the everyday intuition that evolutionary change is like developmental change especially to younger and/or less expert museum visitors. Ideally, when creating new exhibits, designers should take into account not only the main message of the exhibit and the age and expertise of the targeted audience but also whether certain aspects of evolutionary theory, not easily conveyed in a cladogram, may be more effectively presented in another exhibit component.

**References**

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http://www.umich.edu/~evansem/ (to access pdfs of some of the above publications)