

Explore Evolution Front End Evaluation

Part I: Museum Visitors Explain Seven Evolutionary Problems

Part II: Museum Visitor Reactions to Explore Evolution Topics

by

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Explore Evolution is a project funded by the National Science Foundation to make evolution accessible to young people and the general public. It includes development of permanent museum exhibit galleries, publication of an activity book for middle school aged youth, collaboration with 4-H youth organizations, and construction of a website. This report focuses on two studies that comprised the front end evaluation. The purpose of the front end studies was to provide baseline data on museum visitors' interest in and understanding of the organisms and evolution concepts featured in the Explore Evolution Project.

The front end evaluation included two studies: Part I, Visitor Explanations, a qualitative structured interview designed to elicit visitors' reasoning about evolution, and Part II, Visitor Interest Survey, a quantitative survey assessing visitor interest in and familiarity with Explore Evolution topics. These studies were designed to help guide the development of the components of the Explore Evolution Project. Both of these studies were completed prior to the opening of the Explore Evolution exhibits, and were conducted at three Midwest university natural history museums (Nebraska, Oklahoma and Michigan). They were approved by each institution's Institutional Review Board prior to data collection. Demographic information collected for these studies showed the subjects had similar education levels to visitors at other U. S. science museums.

In the Visitor Explanations study, a sample of thirty-two museum visitors were interviewed and asked to explain biological change in the seven diverse organisms featured in the exhibit: whale, human, finch, fly, ant/fungus, diatom, and virus. To learn whether museum visitors would spontaneously invoke evolutionary explanations, the subjects were not told that these were evolutionary problems, nor was the term evolution used in the questions. Conceptual units within each response were individually coded into themes, and each subject's reasoning pattern was profiled. The coded conceptual units within subjects' responses fell into three categories of reasoning: *informed naturalistic reasoning*, in which one or more core Darwinian evolutionary terms or concepts, such as the VIST concepts (variation, inheritance, selection, time), was referenced; *novice naturalistic reasoning*, in which intuitive modes of reasoning were used to explain evolutionary processes; and *creationist reasoning*, in which supernatural explanations were invoked.

Results showed that all the subjects used mixed patterns of reasoning in their responses, using one or more of the three reasoning patterns in different permutations and combinations across the seven organisms. Seventy-two percent used a combination of informed naturalistic reasoning and novice naturalistic reasoning to explain the evolutionary events. Just over one-quarter (28%) of subjects used a combination of creationist reasoning and both of the naturalistic reasoning patterns.

The majority of visitors, however, did have a dominant reasoning mode, which they used most frequently. The most common reasoning pattern, invoked by 53% of the respondents, was novice naturalistic reasoning. This indicates that over half of the subjects demonstrated a very limited understanding of evolution. Thirty-four percent of subjects used informed naturalistic

* The first two authors contributed equally to these studies and are listed alphabetically.

reasoning as their dominant reasoning mode, showing a reasonable grasp of core evolutionary principles. A minority, 6%, used predominately creationist reasoning in their responses.

Each of the seven organisms tended to elicit distinctive reasoning patterns. Questions about the whale, human and finch were more likely than the other organisms to elicit informed naturalistic reasoning. Of these, the finch elicited informed naturalistic reasoning most frequently. The fly, ant/fungus, diatom, and virus were more likely than the finch, human and whale to elicit novice naturalistic reasoning. These smaller organisms typically elicited non-evolutionary explanations in which the visitor responded as if the organisms had always been here on earth (but someplace else). For example, visitors stated that the different species of flies were brought to the islands “by the Dole pineapple people” or that the different varieties of diatoms or viruses were always there, but undetected.

The question about humans and chimps was the most likely to elicit creationist reasoning. Creationist reasoners fell into two groups. One group was a sophisticated vocal minority, who rejected most references to evolution and who explained variation as part of God’s plan (e.g., built into the DNA). The majority of creationist reasoners in this sample, however, used creationist reasoning that was organism specific: Humans were created by God, even though the other organisms change over time.

Visitors’ explanations also differed depending on their prior museum experience. Subjects who visited museums more often were significantly ($p < .05$) more likely to use evolutionary terms in their responses.

The second part of the front end evaluation, the Visitor Interest Survey, used a quantitative approach to assess visitor interest in and familiarity with exhibit topics. The survey instrument focused on the seven organisms and the key evolutionary terms (variation, inheritance, selection, and time) that are used as a conceptual framework for the exhibit. A different sample of 60 museum visitors from the same three natural history museums participated in this survey. The majority of visitors were knowledgeable about the organisms, except for the diatom, with which only 20% of visitors were familiar. Misconceptions were more commonly elicited by the smaller organisms (virus, diatom, and ant/fungus). When asked how interested they would be to learn more about the seven organisms, participants were most interested in whales, humans, viruses and diatoms, and least interested in flies.

Overall, the majority of visitors associated biological organisms with the words variation, inheritance, and selection in the context of a natural history museum. Seventy-two percent associated variation with biological diversity, but the majority referred to the variation across species, rather than the more evolutionary relevant within-species variation. A total of 60% understood that inheritance had biological meaning, and their answers referred to genetics, evolution or traits passed from generation to generation. Fifty-eight percent associated selection with terms such as natural selection, Darwin, or survival of the fittest. Thirty-eight percent referred to biological organisms when asked about *time*. Over 80% of visitors explained the term evolution by referencing the evolution of humans, fossils or a combination of the VIST terms. This suggests that many visitors recognize the appropriate context for evolutionary terms, although it does not indicate that the biological meaning of these terms is fully understood.

Results from the Front End Evaluation studies provide an important baseline for understanding visitor interest in and knowledge of the topics to be featured in the Explore Evolution Project. Public understanding of evolution is critical to understanding many of the health and environmental issues of our time. These studies underscore the complexity of the task of educating visitors about evolution, and the need for more research on visitor reasoning.

Understanding the factors that elicit different reasoning patterns and how to move visitors toward more informed naturalistic reasoning can help make museum exhibit more effective.