TWO

From 'Expertise' to Situated Reason

The Role of Experience, Familiarity, and Usefulness

A considerable number of experienced scientists were not successful on different aspects of three graphing tasks, despite their provenance from and frequency in undergraduate textbooks of their domain. The results suggest that only parts of some session protocols are consistent with existing cognitive models of graph interpretations. The chapter first unfolds a traditional analysis of interpretation and then provides details from one protocol to show why and in which way such an analysis has shortcomings. Even if not made thematic in a protocol, successful performance occurs against a background of a meaningful totality, a dense web of signification, in which graphs are used for the sake and in the service of particular purposes. The analyses show that the less successful non-university scientists also considered the graphs as unrelated to real ecological systems and therefore as useless.

2.1. HOW COMPETENT ARE 'EXPERT' SCIENTISTS?

Research on graphing often operates on the distinction between expert and novices. From the reasoning of 'experts', so goes the story, we learn a lot about the special ways of thinking that distinguish them from others, less experienced in the field. I maintain, though, that if the tasks are from a rather familiar domain, so that over-learned procedures, rationalizations, and tacit understandings can be brought to the task we learn little about how experts work when the going gets tough. That is, it is of little value to ask an economist to 'interpret' a supply-demand graph, which has become a stereotypical over-rationalized case in the field. Such tasks do not elicit the 'ethnomethods' that characterize the work of the experts in their daily work but personal and cultural rationalizations. Much less frequently are 'experts' asked to work on tasks in unfamiliar domains. When expert writers and expert historians are in situations where they cannot draw on rationalizations of their activity, the image of smooth and efficient expert that had come from the research on chess and physics problem solving, becomes more qualified.[1] For example, one study described the initial interpretative effort of a university-based historian as consisting of 'much cognitive flailing'.[2] In the face of lacking detailed content knowledge, the historian regained intellectual footing, worked through confusion, and resisted the urge to simplify. As it turned out, the scientists in my study had even more problems than the historians have had, although I had culled the three graphing tasks from an introductory course in ecology (see Appendix). But before presenting scientists' levels of performance, here a brief general description of the scientists. (Specific information on particular scientists is provided in the context of detailed protocol analyses. Pseudonyms are used throughout.)

2.1.1. Scientist Participants

The sample for this study was constituted by 16 practicing scientists.[3] The scientists were generally highly successful, some having received doctoral and postdoctoral awards, were recipients of national and international awards for their publications, and had sizeable research projects in terms of the funding attracted from private and public sources. They had been recruited at three universities and several federal and provincial governmental research branches. All had obtained either a M.Sc. (7) or a Ph.D. degree (9); among the former, three were currently working on their Ph.D. degrees. All had five or more years of experience in conducting research for the purposes of publishing the results in reports and scientific presentations. All but three scientists (two had completed physics degrees, one obtained a degree as a forest engineer) can be classified as ecologists.

The interview sessions lasted between one and two hours, which amounted to between 4,500 and 10,000 words per session. In several instances, because of repeated interviewing, we obtained between four and ten hours of materials from the same person; in such cases, more protocol materials were available. The interviews were conducted to accommodate the scientists. Eight scientists chose to conduct the sessions in their own offices, the others were recorded in my office or laboratory.

2.1.2. Survey of Performance

The tasks consisted of three graphs and associated captions (see the Appendix, which also includes analyses of each task). All three graphs were of types that appear with high frequency in introductory university ecology textbooks. When the scientists' levels of performance are compared with those of the teachers,

Table 2.1. Frequency of correct 'standard' answers

Task	Frequency (%) Scientists (N = 16)	Teachers (N = 14)
Distribution		
Adaptation	56	44
Population Graph		
Unstable Equilibrium	75	44
Stable Equilibrium	63	22
Largest increase in N	6	0
Isoclines		
Essentiality	50	0
Substitutability	50	0
Complementarity	50	0

their characterization as 'experts' appears justified (Table 2.1); on all aspects, the frequency of correct answers was higher among the scientists than among the teachers. Yet one can also see from the table that the 16 scientists were far from perfect when it came to provide more than a literal reading and to arrive at the standard interpretations of the graphs. This was the case despite the fact that the graphs are similar to those encountered by students in an introductory ecology course and despite the fact that these types of graphs are standard for introductory textbooks on the subjects. The data also showed an interesting difference between university-based scientists and those working in the public sector. Using the number of correct interpretations as criterion variable, scientists who are based at the university or college level tended to be more successful than their non-teaching colleagues ($t(14) = 3.88$, $p = .002$). Clearly, the university-based scientists, involved in teaching or serving as teaching assistants were more familiar with doing such interpretive tasks (because they teach their students to do them) or with the materials than the non-university public sector scientists. Surprisingly, and contrary to the assumption that 'graphing' is a core scientific skill, a considerable number of scientists expressed difficulties reading the graphs (Table 2.2). Thus, with varying frequency, scientists suggested that a graph was 'a challenge to interpret,' 'not something I am dealing with,' 'a bad graph,' 'Christ almighty, confusing,' or 'Why do people make graphs like this?'[4]

In the case of the Distribution graph (see Appendix), 56% of the scientists causally linked the different positions of the distributions along the elevation gradient to the different photosynthetic mechanisms (C_3, C_4, CAM) or explicitly specified differential adaptation as the cause for the data as represented. The

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