Experience and Analog

Paul Tatter, New Mexico Academy of Science, November 16, 2002

A few years ago, I was watching some children engaged in informal science. They were messing around with a couple of liter soda bottles that were joined at their necks, each full of a liquid of different viscosity.[1]

"Wait, are they both like liquids -- like soap?" asked one child, searching for an analog in his experience that he could apply to the behavior of this material. He was not yet asserting the analogy. He was asking a question.

"...so they're just like -- squishy like," the child kept searching, trying out the analog through its attributes.
"Just like soap," said the child, now asserting the analogy.
"How's it like soap?" asked the teacher.

And the child responded, "I don't know." Now that's interesting! He really didn't know by the symbolic standards we use in schools. He had selected the soap analog by intuition or feeling, by an esthetic judgment, but he couldn't articulate it in symbolic form. It felt right, or at least as close to right as he had within his experience. An important effect of an analog is that it establishes a felt continuity between past and the present experiences. If this continuity is absent, then the analogical function is absent also. If there is continuity, then not only may understanding of the new experience be expanded by the past, but the past experience may be reexamined and expanded by the present, and this in turn may be applied to the new experience, and so on. An analogy is traversed in both directions, which is one reason for its power in developing thought.

The expansion of thought depends on the initial partial success and ultimate partial failure of analogies. From the beginning we feel that analogous things are the same, but understand they are different. Saying, "It's the same, only different," makes perfect sense to any child. Initially, the similarities among constituents of an analogy seem to have the most value. Ultimately, as analogies are elaborated, the differences acquire equal value. The differences free constituents to become analogous to new experiences, to develop independently from their prior associations. Yet the lingering similarities tie them together in a world view. This view consists, at bottom, of a web of analogs of experiences. Experiences being the same, only different, are necessary for both the structure and the dynamic of scientific thought.

Later on in their investigative play, the children notice bubbles of one liquid rising through the other. One says, "It's like a fish blowing bubbles - but without the fish." This makes sense to everyone there. It is interesting because the causal part of it -- the fish blowing bubbles -- is irrelevant to the immediate use of the analog. There is nothing like a fish making bubbles in the bottles, and even if there were, that wouldn't be the point. They are concerned only to describe the movement of the bubbles through the liquid. People need to make adjustments and caveats to their analogies in order to use them at all. They need to be able to say it's the same, only different; it's like a fish blowing bubbles, but without the fish. Significant advances in scientific thought have depended on such partial application of an analog.

[1] Zubrowski, B. *Salad Dressing Physics*, (Video Tape) Preliminary Version. Education Development Center, 1995.

Another reason for the power of analogies in developing thought is that they are grounded in activity. The common, basic ground of meaning in our experiences is our tendency to act in similar ways in response to different experiences. The common, basic ground of the expansion of meaning, is our capacity to act in different ways in response to similar experiences. All of our understanding of the world is created through these analogical qualities of action. The analogs are established by the similarities or differences in our *responses* to events. Meaning is created through similarities or differences in the *consequences* of our responses to events

No idea exists solely as a set of symbols. Ultimately, the meaning of an idea implies a connection to some sort of physical body. Furthermore, it implies the experience of some sort of bodily activity. I am not referring, here, to the generally accepted belief that people use their bodies as an experiential medium, as means for acquiring the raw material from which ideas may be created. Rather, I mean to say that their bodies are much more than merely vehicles for data. People's physical activities are included in the contents of their ideas. This is why engaging in some focused activity is so important in learning. The felt responses in people's activity are the elemental sources of their understanding. This is clearly exemplified in experimental science.

This, also, explains why it takes a long time to develop scientific concepts. Concepts require a repertoire of experiences whose felt behavioral responses are similar and have similar outcomes. Such activities serve as analogs for each other, and these analogs are analogous because of the felt, perceptual, esthetic, kinetic and emotional, qualities of the experiences. Developing such a repertoire of experiences takes time. And to become a repertoire requires not only that the experiences be had, but, also, that they be retrievable, that they be recognized and re-experienced in some part. A new, analogous experience must feel familiar in the context of a repertoire in order to contribute to the development of a concept.

All of this takes the kind of time in which the complex constituents of thought, current experience, activity, memories, feelings, intentions and transactions with others are held in attention long enough and often enough to become related and have an identity. And, although such broad attention is necessary for the development of concepts, it is not sufficient. In addition, a person must have some emotionally based need, desire, interest, purpose, intent or inclination to develop a concept, to understand the phenomena in question. The most broad and open of such inclinations we call curiosity.

The type of analog of experience I am referring to is derived from elemental biological processes that we share with other species. It is an organismic response to a current experience as being similar to a previous experience. It shares attributes with a dog recognizing a scent to follow, or a chimpanzee using a tool to extract termites. If the organism is aware of the similarity, the experiential analog has the attributes of a sign. For humans, this sign is iconic rather than symbolic in that it actually shares perceptually experienced qualities with the thing signified. Its significance is felt in some way by analogy to some prior experience.

Such analogs, with which people have a pre-theoretical, intuitive familiarity, are necessary in the development of understanding in science. Take, for example, the idea of momentum as $p=mv$. In symbolic form there is no connection to experience, and the notions of mass and linear velocity are as inscrutable as momentum. But consider creating opportunities for people trying to understand momentum to bump and crash themselves and other objects into things, and then to recall the experience of falling down, or banging into another player while chasing a soccer ball, or being hit in the shin by a softball. These are analogs of experience. They are not symbolic analogs. They are analogous to the actual experience of impact on one's body, the kinesthetics of the jarring sensation,

the perceptual qualities of force and resistance. From such analogs it is a small step to understanding momentum as the capacity of a moving body to exert force while it is being stopped, and this understanding can be the source of formally symbolizing the experience with the expression p=mv.

I believe that at the root of every significant advance in scientific understanding is a correlation with a new analog. The same can be said for every significant advance in an individual's understanding of the world. Both science and education rely on the use of analogies between one experience and another. The challenge in bringing science to the public is to create opportunities for analogies to be drawn among the common experiences of ordinary life and new scientific experiences. There can be no understanding without experiential analogs, and a key element in developing this understanding is to call attention to the similarities and differences among the experienced analogs. Like education, science is a social process for learning through experience. And the ultimate aim of science is not to understand and appreciate science, but to understand and appreciate the world in order to live well within it.