Comments on Rules and Higher Order Knowledge Pertaining to Stahl and the ‘‘Information-Constructivist Perspective’’: A Note from the Editor

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The goal of any taxonomy is to provide a sound basis for partitioning every entity in the applicable domain. Descriptors such as “higher order”, “concept learning” and “evaluation” in the Gagne (1985) and Bloom (1956) taxonomies, for example, are—as indicated by Stahl—inventions of the taxonomy builders. By way of contrast, the Structural Learning Theory (SLT) (Scandura, 1971, 1973) has just one basic construct—that of a rule. This construct, along with basic assumptions of the SLT, provides the basis for explaining, predicting and even controlling human behavior (e.g., in teaching).

A rule is said to be of a “higher order” only when it operates on and/or generates other rules. More succinctly, a rule is a rule is a rule! Rules may be represented at any desired level of detail. The representation of a rule at any given level of abstraction can always be further refined. Refinement can continue indefinitely. The more refined the representation, including data structures as well as processes, the greater the predictive precision that the representation makes possible.

As a simple example, consider column subtraction. At a high level of abstraction, the domain of the column subtraction rule consists of two numbers, the minuend and the subtrahend. At a more detailed level, the domain consists of digits (on which the rule operates). The digits are atomic indivisible elements on which actions (operations) are performed.*

Viewed at either of these levels, this subtraction rule is a “lower order” rule because it does not operate on or generate elements which are themselves rules.

Notice what happens, however, when we inquire more deeply about digits. Digits are not generated automatically, most especially not from the hands of a youngster just learning to write. What was originally seen as an atomic element, now at a deeper level, is seen to be in action or rule. This drawing rule operates on still more basic

* See Scandura (1984) for details.
elements such as line segments and curves. Viewed at this level of detail, the subtraction rule is a higher order rule.

For most educational purposes, one would not normally view a subtraction rule at the above level of detail (unless one was simultaneously interested in drawing behavior). The point to emphasize is that the determination of what is a higher order rule is strictly relative. It depends on the use to which a rule is being put in explaining a given instance of behavior. If it is operating on and/or generating elements which are not themselves represented as rules (i.e., if these entities are atomic), then the rule is said to be of "lower order". If it operates on and/or generates other rules, then it is termed "higher order".

Most, if not all, of Stahl's (this issue) assertions about the lack of completeness of rules and higher order rules stems from this misunderstanding. The notion of a rule, for instance, can be used to "capture" the essence of what Stahl calls 'infobits,' "infoschemata" and even "cognitive beliefs". Indeed, the aim of future research should be to make explicit SLT rule representations of the kinds of information that Stahl (as well as IC "theorists"—more accurately—"philosophers") believe to be critical in cognition. Analogous research directed toward the deeper aspects of Piagetian Conservation (Scandura & Scandura, 1980) and Polya's (1960) heuristics (Scandura, Durnia, & Wulfek, 1974) would serve as useful models. The major differences between what Stahl refers to as "infobits", "infoschemata", etc. and rules, as used in SLT, are the degree of predictive precision inherent in the rule characterization, and the uses to which rules have been put. (See Scandura, 1987, for a more updated and refined characterization of the rule construct.)

On p. 00, for example, Stahl (correctly I think) refers to the complex nature of "the invisible events that take place within individuals as they think, feel, act and learn". Indeed, a primary goal of the SLT has been to bring this complexity under scientific control. We can never know everything that a person might be thinking at any given time. Among other things any attempt to find out would of necessity change the very things we are trying to determine. In predicting human behaviour, a major tenet of the SLT is that attention may safely be limited to those cognitive constructs that make an observable difference. SLT assumptions work in conjunction with rule constructs to provide explanations and/or make predictions relative to some pre-determined problem domain. (The rule constructs are derived from that problem domain.)

In this context, as discussed in earlier writings (e.g., Scandura, 1971, 1973, 1977, 1978), and numerous unpublished talks, rules are best viewed as "rulers for measuring knowledge". Rules are constructs used to measure (or assess) those aspects of individual knowledge that make a difference from the standpoint of the scientist (or teacher) observing the information processor's behavior. Rather precise operational methods for effecting such measurements under specified boundary conditions, along with the underlying theory, are described in Scandura (1971; 1973; 1977, Chapter 2). Indeed, it can be shown that further information about the learner's cognitive state adds nothing as to predicting behavior relating to a given problem domain. Moreover, the results of analyzing any one problem domain (i.e., rules) provide a useful starting point for analyzing any more comprehensive domain. Structural analyses (e.g., Scandura et al, 1974, 1977, 1984) are cumulative, not discrete.
References


