STRUCTURAL LEARNING THEORY

The Structural Learning Theory (Scandura, 1971, 1973, 1977, 1980) is a natural extension of earlier research (Scandura, 1964, 1970, 1976), which provides a unifying theoretical framework from which to view interactions between individual learners and their environment (e.g., in teaching and learning). Structural Learning Theory is not a theory in the usual sense but rather is a class of content and population specific theories. However, it is not simply a scientific language. Definitive assumptions are made about how and why people behave as they do. Numerous specific realizations of the theory have been detailed and verified empirically.

In structural learning theories, what an individual does and can learn in any particular situation is assumed to depend directly on what the person already knows. It is assumed that human cognition may be characterized in terms of specific individual knowledge (represented in terms of rules) and universal characteristics of the human information processor.

Knowledge refers to an individual's potential for behavior (under pre-specified test conditions). Universal characteristics, by way of contrast, are best thought of as those aspects of human cognition functioning inherent to people generally; they need not, and in some cases cannot, be learned. Nonetheless, universal characteristics impose important constraints on the way knowledge may usefully be represented and measured.

Two universal characteristics of human cognition are assumed in structural learning theories; one pertains to control (allowable interactions among rules) and the other to processing capacity and speed. The assumed control mechanism explains how and why particular rules are used in particular situations, by "goal switching," or, more accurately, by deepening the level of rule search (Scandura, 1980, 1981).

In structural learning research, control mechanisms have been the subject of direct empirical study (Scandura 1971, 1973, 1974, 1977). This research has demonstrated that a wide variety of behavioral phenomena, ranging from problem solving and learning to motivation, memory (Scandura, 1977), and skill development (Scandura, 1981), may be explained and predicted by introducing appropriate lower and higher order rules and assuming the following control mechanism: When confronted with a problem, the learner is assumed to check each rule available (e.g., in working memory) to see if it applies. If exactly one such rule is found, it is actually applied. When no solution rules are immediately applicable, or when there are more than one, the search moves to the next level to check for higher order rules that have the potential to generate a unique solution rule that applies, and so on as necessary. Once a rule has been selected and applied, the output of such application, possibly a newly generated rule, is added to the set of available rules. Control then reverts to the next lower level where the search continues, this time to a rule set that contains the new rule.

Processing capacity is the second hypothesized cognitive universal (Scandura, 1971, 1973; Voorhies & Scandura, 1977). In contrast to most cognitive theories, working memory in the Structural Learning Theory is assumed to hold not only data (the stuff on which rules operate), but the rules (processes) themselves. This difference has a number of implications pertaining to a variety of memory and performance phenomena (Scandura, 1973, 1978), only some of which have been investigated empirically.

In general, the desired level of behavioral precision determines which universal characteristics and which level of (knowledge) representation is required in a structural learning theoretical account of the phenomena. Specifically, two levels of structural learning theories are readily distinguished. At the behavioral level, such theories involve only the control mechanism and rules represented in terms of behaviorally atomic components. They make it possible to predict individual responses but they are silent on the issue of processing time. They are, in effect, idealizations that fit reality only to the extent that processing capacity is not a factor (Scandura, 1977, 1978, pp. 152-153).

At the second or process level, structural learning theories involve the control mechanism, processing capacity, and process atomic rules. Theories at this level can validly be tested under less stringent conditions. Correspondingly, they deal with latencies and hence provide more detailed accounts of behavioral phenomena (Suppes & Groen, 1967; Scandura, 1973, 1977, 1978, pp. 155-166).

In contrast to universal cognitive constraints, specific knowledge is assumed to vary over individuals. The first step in constructing a particular structural learning theory is to identify the prototypic competence underlying the given problem domain and to represent this competence in terms of a finite set of rules. These underlying rules must be represented in sufficient detail that all of the specified components make direct contact with assumed minimal capabilities of (all) students in the target population. These components must be either uniformly available or atomic relative to the target population.

In structural learning research, a general method of analysis called structural analysis has evolved for the purpose of generating such competence (Scandura, 1977, 1980, 1981). The general theory also incorporates a performance test theory that shows how prototypic competence (i.e., rules of competence prototypic of given populations) may be used operationally to define the knowledge available to individual members of such populations. The theory tells how, through a finite testing procedure, one can identify which parts of which rules individual students know (and do not know). Rules of competence serve in a very real sense as rules of measurement and provide a sufficient basis for the operational definition of human knowledge (Scandura 1977).

In the theory, a number of important but sometimes subtle interrelationships exist among content, cognition, and individual differences. For example, restrictions imposed on the procedures of rules, together with key encoding/decoding assumptions, greatly simplify the representation of competence without reducing generality. These constraints "force" competence into a form that is unambiguous (relative to encoding/decoding assumptions) and that has considerable heuristic power insofar as operationalizing individual knowledge is concerned. Similarly, adding ranges (to rules) that are independent of the domains and the procedures plays a crucial role in goal-switching control.

Completing the circle, goal-switching control not only has found strong and direct empirical support in its own right, but it makes possible a pragmatically useful basis for identifying what must be learned in instructional situations. Thus the separation of specific knowledge/competence from control greatly simplifies the task of dealing with high-level interrelationships that are frequently involved in analyzing complex domains and makes it easier to identify this competence (via structural analysis).

ALGORITHMIC HEURISTIC THEORY

CONCEPT LEARNING

LEARNING THEORIES

THORDIKE'S LAWS OF LEARNING

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