The Working Mind

Meaning and Mental Attention in Human Development

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Preface

This book highlights a general process model of the psychological organism "from within" (i.e., from a subject's own processing perspective). It takes the form of a scientific essay with explanations, model definitions, and illustrations of relevant empirical data across periods of child development. It does not review systematically relevant literature. We believe this theory of the "psychological organism" (Theory of Constructive Operators—TCO), and its methods of process/task analysis, can advance understanding of human intelligence, mental attention, problem solving, stages of development, cognitive complexity measurement, brain semantics, and the constructivist *causal-organismic* tradition within human science (which recognizes psychological processes as rooted or embodied in the organism, and having multiple organismic causes that interact and combine, see chapter 1). The theory also can help to explain motivation and the intertwining of cognitive and affective processes. Our method of process/task analysis "from within" the person's processing (*metasubjective* analysis) can expand qualitative, subjective analysis (e.g., phenomenology, hermeneutics) into causal-organismic models of processing in mental performance or tasks, often yielding quantitative, interval-scale estimates of process or task complexity. We use precise terminology to express our ideas, and the reader may find some of it unusual. To facilitate familiarization with terminology, we include a glossary at the end of the book.

By *psychological organism* (or psychological brain) we mean a general model of sensorimotor or mental processes analyzed "from within," to explain complexities of human performance. Such a general model could provide operative tools for real-life behavior or mental analysis, study of thinking, and scientific investigation. Epistemologically, the TCO model is mainly based on European (particularly French) constructivist epistemology, that is, an empirically grounded and critical rationalism. Our work has an epistemological influence from A. R. Luria (1973, 1979), which is why we adopted the title *The Working Mind*, to tacitly suggest Luria's famous book, *The Working Brain*. We present

the TCO model informally, but in an explicit manner, open to expansion. *Rationalist epistemology* (meta-theory of knowing) primordially considers knowledge a product of the working mind, whereas *empiricist epistemology* interprets knowledge mostly as modeled by constraints of outer Reality.[1] Constructivism is a dialectical middle way for these two epistemologies.

The two complementary types of epistemology/metatheory in human science are empiricism (or more precisely *meta-empiricism*—empirical-method empiricism with much theoretical sophistication) and *constructivism* (empirical rationalism). Empiricist or meta-empiricist theories tend to be local and descriptive, whereas constructivist ones are general and causal-organismic. The TCO is a constructivist general-organismic causal model. The two types (in method and theory) are incommensurable: we cannot present one by using presentational methods of the other. For instance, one does not clarify constructivist theories by critically reviewing empiricist research and judging whether constructivism meets empiricist constraints. Like the theory of evolution, constructivist theories must be argued using metatheoretical biological arguments and by interpreting concrete and diverse examples that use the same constructivist organismic-causal model—something we do repeatedly in this book.

From this constructivist middle position, knowledge seems to emerge with the mind's repeated syntheses and compromises between Reality and the psychological organism's own organizing principles and operators (brain resources). Notice that Reality (with capital R to signal uninterpreted actual reality) can be regarded as packages of interrelated Resistances to goal-directed activity, as we discuss in detail in chapter 5. An important developmental construct is mental-attentional capacity. This is a maturational causal factor of working memory, constituted by several resource processes that we call hidden operators (see chapter 7). The capacity of mental attention grows with age in childhood, allowing children to cope with increasing complexity, particularly within misleading situations (in which some aspects strongly induce unsuitable task responses or habits).

Seven Founding Principles

Our dialectical constructivism (dialectical because it has dynamic competitive processes in it) gives special importance to developmental (including learning) and evolutionary processes, to create models and knowledge about the human biological and psychological organism. We highlight seven founding principles.[2]

1 Reflective Abstraction

Reflective abstraction, as Piaget called it (Vygotsky's internalization), brings into the conscious and unconscious mind recurrent aspects (i.e., functional regularities, probabilistic "invariants") from active experience or goal-directed activity in the world, and from directed mentation (the mind's work). Learning takes place by adapting innate or acquired schemes to actual situations of agency/praxis, and current thought. Such mental construction is a dialectical enterprise. This adaptation will incorporate, within a functional invariant, task-relevant *resistances* or restrictions conjointly imposed by the Real to the actions and cognitions of agents. Piaget called *accommodation* this adaptive change to Reality. Reality resistances, when facilitating for a task, are called affordances; when misleading or distracting, they are called obstacles or encumbrances. Notice that Reality prior to knowing can be construed, for any given individual, as constituted by many distinct coordinated packages of mutually entwined resistances, elicited during agency/praxis; these packages are species-specific.

2 Individual Constructivism

Individual constructivism is recursive and provokes emergence of distinct levels of processing (some sensorimotor, other symbolic) that interact to cause functional structures for knowing (i.e., schemes, schemas). Schemes adapt to increase their effective complexity as individual development progresses. These processes are qualitatively recursive (in the mathematical sense) because they apply on their own products—schemes of schemes of schemes, and so forth. These complex schemes (often called schemas) are organized in the person at functionally distinct semantic-pragmatic levels, to constitute the substratum for valid information processing. Piaget, Case, and many others call this diverse substratum *functional structures*.

Complexity in constructivism corresponds to what physicist Murray Gell-Mann (1994) called *effective complexity*, that is, the nonrandom aspects of a system "roughly characterized as the length of a concise description of the regularities of that system or string" (Gell-Mann, 1994, p. 50). He concluded: "Effective complexity is then related to the description of regularities of a system by a complex adaptive system [such as a person] that is observing it." Gell-Mann understood by "regularities," as Piaget did, the relevant probabilistic *functional invariants* (Ullmo, 1967) that emerge during repeated situations, generating relational meaning. Tolman (1959) called these task-relevant interrelations "means-end readinesses." Random aspects vary, but functional invariants are preserved over repetitions.

Concepts, repeatable patterns of action, stable representations, and repeatable relations are examples of invariants. These schemes often carry and produce expectancies.

The effective complexity of schemes/schemas relates to the number of invariants ("regularities") essential to characterize the given experience (e.g., person, object, thought, performance, situation).

To maintain effective reasoning, abstraction within misleading situations always demands mental-attentional capacity. Mental capacity is a maturational causal factor of working memory, constituted by several hidden operators (see chapter 7). The theory predicts that power of mental attention generally increases by one unit (one additional scheme that can be held in mind) every two years during normal childhood (Pascual-Leone, 1970). We present data to validate this prediction. We also outline (and give numerous examples of) a method of task analysis to quantify mental-attentional demand of tasks. Effective complexity of schemes involved in a task is both objective and *metasubjective*—it should be analyzed objectively, but "from within" the intended agency (e.g., person, robot) coping with the task.

3 Constructivist Complexity from Combination of Different Schemes

Growth of effective complexity during development is action-driven and holistic (schemes coordinate toward *functional totalities* of perceiving, thinking, or doing). However, inside the brain these functional totalities appear deconstructed into units (circuits or networks that are information carriers of schemes) or discrete but interrelated functional systems; psychologically these units are schemes. Schemes must be self-consistent (noncontradictory) in their internal functioning. Once formed, they are recursive, constituting flexible hierarchies or families of schemes.

4 Schemes Are Self-Propelling

Schemes are self-propelling (Piaget's assimilation function), and consequently, each behavioral, perceptual, or cognitive act is overdetermined by the strongest cluster of mutually compatible schemes activated in the current situation. *Overdetermined* means multidetermined by schemes and hidden operators that interact in nonlinear ways to produce performance. This is a multidetermination in which a dynamic synthesis produces truly novel results that are beyond a simple combination of constituent factors (see chapters 1 and 6). The dominant set of compatible schemes in a situation overdetermines overt or mental behavior.

5 Functionality of Schemes

Cognitive schemes are functional systems that carry with them a *truth value*. They tacitly make inferences or expectancies anticipating results/outcomes of their application (i.e., a plausible or probabilistic truth, the match of expected effects with encountered

Reality). Schemes are formed by extracting repeatable functional components from the given sort of agency (or thinking) from which they were abstracted, and to which they later can be applied. This functional component carries with it (in sufficiently complex schemes) the inference or expectancy of ensuing results. *Affective schemes* (pure feelings) do not carry a truth value; they carry a *vital value* (i.e., a life-significant organismic appraisal or feeling evaluation).

6 Emergence of Conflicts among Schemes

Schemes are self-propelling, autonomous, and internally consistent, but they are often in contradiction with other schemes. When several mutually contradictory schemes are activated and compete for application, conflict or misleadingness emerges. These problem-situations are where maturational levels or stages of child development can be found. Stages are largely caused by complexity of tasks beyond the mental-attentional capacity of age groups of children.

7 Hidden Organismic Operators and Principles Regulate Schemes

Dynamic coordination and synthesis of schemes, and their activation in tasks or learning processes, are regulated by hidden operators and principles—brain infrastructural resources. These operators and principles relate to constructs from the psychology and neuroscience literatures.

Our book discusses schemes/schemas, hidden operators, and principles in detail, as well as how together they organismically overdetermine performances. We illustrate this "from within" (metasubjective) theory with numerous task analyses of distinct age-group performances. The theory is comprehensive in that it incorporates ideas and findings from many diverse branches or schools of psychology: Piagetian theory, learning theory, Gestalt theory, psychoanalysis, cognitive psychology, and neuroscience. We do not aim to reject, replace, or dismiss other approaches, but rather recognize their value and attempt to integrate their findings into a more general, causal-organismic theory of development.