A theory of intelligence, III: A unifying alternative to cognitive science and mainstream behaviorism[1]

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Span theory is closely associated with this meeting. Five early presentations were made at the "Gatlinburg meetings" (Bachelder, 1977, 1978, 1980; Bachelder & Denny, 1976). Two papers, *A theory of intelligence, I* and *II,* are published in *Intelligence* (Bachelder & Denny, 1977a, b). My collaborator, M. Ray Denny, was a prominent figure in the early meetings. My presentation will summarize the basic concepts of those early papers and update them with the main developments since then.

Span theory arose in the behavioral tradition aiming to bring a rigorous non-mentalistic approach to the study of intelligence and mental retardation. It was eclipsed by the cognitive revolution. The revolution is now over 50 years old and we hear voices of dissent from within cognitive science (e.g. William R. Uttal, 1998, 2000, 2001, 2005, 2007) as well as from without. A behavioral journal has reprinted a cognitivist paper by Michael Watkins (1996a, b). Span theory is a unifying alternative to both cognitive science and mainstream behaviorism. As with any challenge to the mainstream, there is much to trouble both behaviorists and cognitivists. There is also much to appeal to both.

The theory is a natural science account of individual and developmental differences in intelligence and mental retardation. It is firmly rooted in the literatures of behaviorism, cognitivism, and psychometrics. It incorporates key features of all three traditions, but rejects others. It focuses on the tasks of cognitive science, but has no mentalism. It incorporates behaviorism's repertoire notion of intelligence, but adds an ability construct defined in traditional behavioral terms. Its mode of explanation is much more in the behavioral than cognitive science tradition, making use of empirical generalizations expressed in mathematical form whenever possible. It avoids mental and neural reductionism. It has no mental processes, intervening variables, hypothetical constructs, or conceptual nervous system. It aims to observe, communicate about, and predict *behavioral events*; no more, no less.

A theory of intelligence, I and *II* introduced the concepts of *joint relevance of stimuli, task complexity, span ability,* and *relative task difficulty*. They summarized the research strategy and the data showing how these concepts account for individual and developmental differences in diverse tasks, including memory span; span of absolute identification; span of apprehension/numerosity; probe-type STM tasks; language reception, expression, and development; IQ subtests; discrimination learning tasks; reading; verbal learning; the relation between intelligence and learning; and the efficacy of behavioral task analysis in training people with retardation.

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Task complexity has been replaced by *span load.* The *task* is now taken as the central construct. The task is not viewed as a tool to investigate hypothetical underlying processes such as memory or conditioning. Rather, *the task is the fundamental unit of theoretical analysis*. A task is characterized in terms of its (1) stimuli, (2) responses, (3) procedure, (4) a statement of stimulus-response correspondence, (5) a counting rule, and (6) the task equation.

Performances in diverse tasks are linked via task equations of the form:

$$\text{Performance}_{\text{task}} = f(\text{span ability, span load, + other variables and setting conditions}) \quad (1)$$

Span ability is measured with a simple span test. Span measures vary continuously from low to high values which closely parallel measures and various indexes of intelligence ranging from well below to well above average. Span load is assessed through a process called *task analysis of span load* or *TASL* ("tassel") which grew out of behavioral task analysis.

Complex tasks are analyzed as configurations of simpler tasks leading to new task equations with the same form as Equation (1), though the mathematics are likely to be more complex. Task equations are treated as hypotheses which must be tested empirically and revised accordingly.

Finally, measures of span ability covary closely with measures of intelligence, but *intelligence* is a term from cognitive theory and does not appear in span theory. It can, however, be linked to the concept of span ability. The standard measure of intelligence, the IQ test, is a complex task, so it follows from the arguments above:

$$\text{Performance}_{\text{IQ}} = f(\text{span ability, span load, + other variables and setting conditions}) \quad (2)$$

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