

A Theory of Intelligence: III.

A Unifying alternative to cognitive science and mainstream behaviorism

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Span theory in a single statement

$$P_{Task} = f(\text{span ability, } 1/\text{span load, other variables})$$

Span Theory: An overview

- Span theory deals with **developmental** and **individual differences** in the ability to perform in diverse tasks, both laboratory and “real life”
- Each individual has a stable, measureable **span ability**
- Span ability is measured with a **standard staircase span test** which is useful with just about everyone, with or without mental retardation, ages 2 through old age.
- For special populations individualized span tests can be developed
- Span ability increases during the developmental period, reaching a plateau in early adulthood, closely paralleling the development of mental age
- At any specific age there are important individual differences in span ability
- Psychometric span ability covaries surprisingly closely with a broad range of intellectual competence
- The role of span ability can, in principle, be determined for any given task through the process of **task analysis of span load (TASL)**
- Span ability interacts with experience to give rise to complex behavioral repertoires which constitute **intelligence**
- With a measured span ability and a span load value for a target behavior and teaching method, we can answer such questions as:
 - My child is severely involved and cannot take a standard IQ test, how can we estimate ability level?
 - My student’s mother wants me to teach him to write his name. I don’t think he is capable of learning that. How do we determine what is feasible?
 - My student’s mother insists her daughter understands whatever we say to her. I maintain she understands very little. How do we resolve this impasse?

Unification

- A unitary answer to the spans question (just one limit, not 3)
- Combines *experimental* and *psychometric* methods very much as suggested by Cronbach (1955)
- People with and without retardation are treated along a continuum of span ability
- Brings a natural science analysis (no mentalism) to the tasks of cognitivism
- Brings an ability construct, defined in terms of stimulus control, to behavioral conceptions of behavior and intelligence
- Dispenses with mind-body dualism
- Dispenses with the distinction between private events and overt behavior; both have the same logical status, both are inferred theoretical constructs based on observation of behavioral events
- It blurs the traditional distinction between basic and applied research
- It blurs traditional taxonomic distinctions: mental versus behavioral, verbal versus motor, and normal versus delayed
- Concepts similar to span ability have emerged in quite diverse traditions including early writings by Piaget and attention theory by Zeaman & House
- Comparative with general psychology (S, R, T; complex cues, span load, intelligence, ontogeny, phylogeny)

The Three Span Tasks

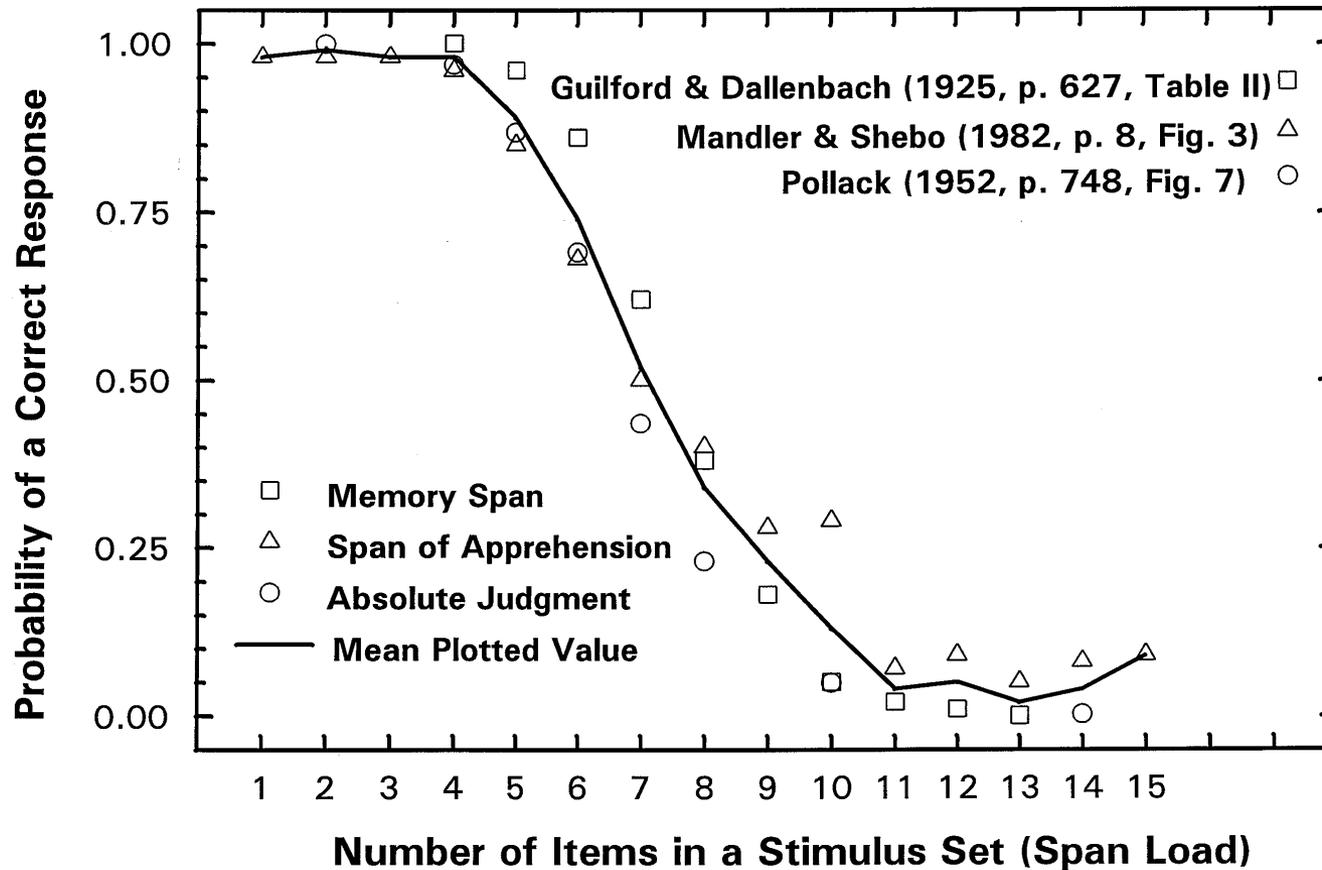


Figure 1. The probability of a correct response in the magical number tasks as a function of size of stimulus set. Miller's 7 corresponds to a 50% criterion, Cowan's 4 to a 100% criterion. Pollack's data have been corrected. Mean performances on single stimuli were raised to the power of span load to estimate performance on a full stimulus set considered collectively.

The Basic Span Phenomena:

Figure 1

- Set size is a potent variable
- Set size = span load
- The three limits are the same limit, a unitary conception of the three span tasks
- Developmental and individual differences in the three span limits covary closely
- Span ability is the ability to cope with span load (set size)
- Performance in diverse tasks is an inverse ogival function of span load
- Performance in diverse tasks varies directly with span ability
- Span ability interacts with span load to specify performance levels
- The empirical features of the span thresholds have excellent construct validity as measures of intelligence

If it walks like a duck and quacks like a duck . . .

Measures of span ability have surprisingly good ***construct validity*** as measures of ***intelligence***

- 1) They increase during the developmental period and reach a plateau in early adulthood.
- 2) There are important individual differences within each age group and they appear to be unimodally distributed.
- 3) They are general, that is, a wide range of stimuli, responses, and procedures can be used and still give comparable scores (or load on a span factor in factor analyses).
- ε) They covary directly with class standing.
- 0) They correlate positively with IQ.
- 7) They covary with performances in diverse tasks.
- ν) They covary directly with status as normal or mentally retarded
- λ) They are highly resistant to practice and training effects. When improvements are reported they are usually easily attributed to changes in repertoire, not span ability as defined and measured in span theory research.
- 9) Little or no race effect
- 10.) There is no Flynn effect. Span limits have been stable over the decades, but IQ tests have to be restandardized every few years because the scores have increased steadily

Successes of Span Theory

- It asserts a unitary answer to the spans question
- Explains the long-standing relative difficulty of simple, conditional, and oddity 2-choice discrimination learning tasks
- Explains the mental age effects in simple, conditional, and oddity 2-choice discrimination learning tasks
- It resolves the anomaly of the complex relation between IQ and learning
- It explains the positive manifold
- It explains the substantial link between mental age/intelligence level and language level
- It explains the correlation between creativity and intelligence
- It suggests a resolution of the race -IQ relationship
- It makes sense of the Flynn effect
- It explains the persistent failure to predict adult intelligence from childhood intelligence
- It explains the surprising link between the simple span test and IQ
- It brings the tasks of cognitivism, but not the mentalism, to behavioral analysis
- It has led to development of new evaluation methods useful in answering educational questions and conducting basic research
- Appears to get a handle on and explicate the roots of some traditional, useful, but suspect concepts:
 - intelligence as a biological quality, resistant to training;
 - mental development as growth, independent of reinforcement history;
 - educational goals as beyond one's ability;
 - reaching one's maximum potential
 - Matching educational demands to individual abilities

Bachelder & Denny (1977a). A theory of intelligence: I. Span and the complexity of stimulus control. *Intelligence, 1*, 127-150.

Abstract

A theory of intelligence is couched in stimulus–response terms, bridging the gap between S-R and cognitive psychology. The chief theoretical concepts are span ability (a capacity notion), response string (sequentially cued responses), and complexity of stimulus control (task complexity). Span is equated with the ability to respond appropriately when several cues are conjunctively relevant for correct performance (complex stimulus control). So defined, span is consistently and broadly related to many aspects of intelligent behavior.

Bachelder & Denny (1977b). A theory of intelligence: II. The role of span in a variety of intellectual tasks. *Intelligence, 1*, 237-256.

Abstract

This paper is the sequel to Part I in which a theory of intelligence was developed in terms of the concepts of span ability and complex stimulus control. A broad range of topics is discussed including discrimination learning, language, language development, reading, the relation between intelligence and learning, task analysis and the training of the mentally retarded, the role of span in IQ subtests, and suggestions for research. The paper includes summaries of previously unpublished research by the first author as well as published work by other investigators.

The basic concepts as of Bachelder & Denny (1977 a, b)

- The number of ***conjunctively relevant stimuli*** = ***task complexity***
- Span ability is the ability to cope with ***conjunctively relevant*** stimuli
- Span ability is a ***developmental*** and ***individual differences*** variable
- People who are ***developmentally young*** (children or people with mental retardation) have smaller span abilities therefore they are limited in their ability to cope with complex stimulation and therefore fail to acquire the complex repertoires which comprise intelligence

Basic constructs now

- *Conjunct relevance* and *developmental* and *individual differences* in the *ability to cope* with conjunct relevance remain the central constructs
- *Span load* has replaced *task complexity* as the term for the number of conjunctively relevant stimuli. *Task complexity* is still used, but in a different way (below)
- *Span ability* is defined as the ability to cope with span load and is measured with the same *standard staircase span test* I have used from early on
- The *Task* is now taken as the fundamental unit of theoretical analysis
- The notion of a *task complexity* is now used to refer to the fact that tasks can be analyzed into configurations of *simpler* and *elementary tasks*
- Four *elementary tasks* are recognized:
 - *SoS* for *Span of sufficient Stimuli* (approximately, memory span)
 - *SoN* for *Span of Numerosity* (approximately, span of apprehension)
 - *SoM* for *Span of relative Magnitude* (approximately, absolute identification)
 - *SoL* for *Span of spatial Location* (approximately, memory for location)
- *Working presumption*: All Tasks can be analyzed ultimately as configurations of these four elementary tasks
- *Intelligence* is *acquired expertise*
- The *rate of acquisition* of expertise is a function of (a) quality and extent of *engagement* with the target material, (b) availability of *behavioral repertoire* as raw material and prerequisite skill, and (c) *span ability*
- Laboratory tasks are used to model behavior in applied settings or “Real life”

The seven defining characteristics of the *Task*

- *the stimulus pool*
 - *the response pool*
 - *the relevant stimulus set*
 - *The S-R correspondence statement*
 - *the procedure*
 - *the counting rule*
 - *the task equation.*
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- *This is not so esoteric as it first appears. All characteristics except the counting rule and the task equation are standard parts of the methods sections of both cognitivism and behaviorism. The concept of the task is critical in both traditions, but is usually thought of as a tool for investigating hypothetical processes, not as the **fundamental unit of behavior.***

Since Bachelder & Denny (1977a,b)

- Making a living in independent practice (1980-2004) with a primary focus on school learning and adjustment problems
- Coming to grips with the puzzling reactions to span theory manuscripts (precisely what happens when one challenges mainstream points of view)
- Expanding the scope of span theory from *elicitation span*, a simple non-mentalistic conception of the “memory” span task, to *span load*, a conception general enough to be applied to just about any task so as to assert testable hypotheses about the role of developmental and individual differences in diverse tasks
- Bearing down on a critical analysis of Miller’s (1956) famous paper which focusses on the 3 span tasks and helped launch the cognitive revolution; explicating what he accomplished, how he failed, and what he overlooked
- Explication of the roots of span theory in behaviorism and comparative psychology
- Explication of the evolution of span theory as a simple behavioral formulation of the so-called “memory” span task to span theory as a comprehensive and coherent *scientific paradigm*
- Exploring *metatheoretical* matters:
 - What is scientific theory and does span theory match up?
 - What should a theory of mental retardation and intelligence look like?
- SAAS123, continuing development of applications of span theory
- Exploration of *J. R. Kantor’s Interbehaviorism*. It appears that the span theory concept of the *Task* is entirely compatible with, or an example of, Kantor’s concept of the *interbehavioral field*

Teaching and training implications

- The difficulty of performance and learning varies with the span load of the ***target behavior*** and the ***training method***
- If span loads encountered in learning situations are too high in comparison with the span ability, the probability of success drops dramatically
- Learning proceeds best with an optimum match between span load and span ability
- Psychometric span ability is an important measure for planning training programs
- Understanding of the span loads of diverse target tasks and teaching/training methods lets us assess the practicality of specific learning goals for specific students/trainees
- Setting reasonable educational/training goals should greatly reduce waste due to pursuit of goals obviously too difficult for an individual

The Research Strategy

- Explore the role of span ability in diverse tasks
 - Span Ability X Experimental Conditions designs to assess the amount of variance accounted for by a span ability factor
 - Measurement of the correlation between psychometric span and performance in diverse tasks
 - Development of span theory models of existing published data in diverse tasks
 - Development and validation of task explications
- Development of alternative test methods for special populations
- Development of Task Analysis of Span Load
- Development of a ***taxonomy of Tasks***

Puzzling Reactions:

- Little or no reaction at all, which is surprising for a theory which succeeds in so many important areas
- Mischaracterizations of the theory, usually as a “memory theory”
- Most reactions to span theory are variations on “Span theory violates the rules of my school of thought.”
- Little or no critical reaction to span theory ***on its own terms***

Puzzling Reactions:

- “Bachelder & Denny (1977a,b) assert the centrality of memory in understanding intelligence”
 - In fact, we asserted a non-mentalistic conception of the so-called memory span task; ***complex stimulus control, not STM***
 - Work which is out of the mainstream will first be ignored or shoe horned into the mainstream point of view (Kuhn, 1970)

Puzzling reactions:

- “Behaviorism is dead”
 - Not in my office
 - Maybe span theory has evolved to the point it is no longer behaviorism, but its roots are clearly behavioral (*elicitation theory*, Denny, 1966) and seems to strike cognitive scientists as behavioristic
 - Cognitivism is currently ascendant and history tells us that behaviorism is likely to ascend again (Amsel, 1989)
 - To cognitive scientists behaviorism is dead because it did not foster research in the so-called mental phenomena; however, span theory does and it does it without mentalism

Puzzling Reactions:

- “There’s no theory in Span Theory”
 - This derives from a parochial notion of scientific theory, one not observed by span theory and other sciences
 - Cognitive science presumes that theory must specify an underlying hypothetical mental or neurological mechanism to account for overt behavior
 - Span theory is nonreductionistic. It rejects mentalism and avoids speculation about neurological factors (as elicitation theory, experimental analysis of behavior, and interbehaviorism)
 - Span theory explains via empirical generalizations, expressed in the form of mathematical equations whenever possible (in the mainstream of all science)
 - Span theory views the brain as a *participant* in behavior, not the cause or explanation of behavior (as interbehaviorism)

Puzzling reactions:

- “Span theory only describes, it doesn’t explain”
 - Description is the first critical step toward an empirical generalization
 - Span theory, from the very beginning, has worked with empirical generalizations based on description
 - Empirical generalizations are considered legitimate explanations in most other sciences (apparently, all but cognitive science)

Puzzling reactions:

- “Span theory seems incapable of accounting for all the variables that cognitive science theories do.”
 - It is way too early to be confident in that criticism
 - Span theory focusses on developmental and individual differences in the span limitations, with initial and primary interest in people with mental retardation, ignored, by an large, by mainstream cognitive science
 - Cognitive science tends to define itself as the science of mental life in normal adults where the range of developmental differences in span ability is essentially 0 and the range of individual differences in span ability can be ignored (for the time being)
 - Many of the variables studied by cognitive science and captured in their mental models can be expected to be incorporated in the parameters of the task equations in span theory:
 - $P_{Task} = f(\text{span ability, } 1/\text{span load, acquired repertoire, other variables})$

Puzzling Reactions:

- “Span theory doesn’t explain anything, except in a mathematical sense”
 - But mathematical explanations are widely used in other sciences
 - Mathematical formulations are often considered the epitome of scientific achievement
 - Modern thought in the philosophy of science acknowledges that both types of explanation, ***mechanism*** and ***empirical generalization***, are valid and complementary (e.g. Salmon, 1998, p. 89-90)

Troubling to Cognitivists

- “There’s no mind”
 - Span theory rejects mind body dualism, but
 - The **Tasks** traditionally considered to measure aspects of mind are legitimate phenomena
 - $P_{\text{task}} = f(\text{span ability, span load, acquired repertoire, other variables})$
- “There are no mental processes”
 - Keep constructs close to the data level
 - **Thinking** as an inferred class of behavior is captured in the explication of specific tasks, a central activity of span theory
- “There are no neurological processes”
 - Brain is a *participant* in behavior, not the ultimate explanation of it
 - Reductionism, that is, explanation of behavior in terms of hypothetical mental or neurological processes, is rejected

Troubling to Cognitivists

- “The concept of *working memory* is much better developed, there is much more data, and measures of working memory correlate much better with IQ than do measures of span ability”
 - Granted, to a point. There has been a huge amount of data collected deriving from the working memory construct, but that can be said of any successful scientific paradigm. History tells us (Thomas Kuhn) that after the *revolution* scientists more or less turn their backs on the previous work, precisely what cognitive science has done with respect to behaviorism
 - Span theory, because it focusses on *Tasks*, has made use of data (always collected in a *Task*) from diverse scientific paradigms extending back over 130 years
 - The high correlations between IQ and working memory are very interesting, but beware of making too much of them. IQ subtests also correlate highly with IQ. Are we ready to hypothesize that “the ability” measured by each subtest is the central ability underlying intelligence? Perhaps working memory tests are no more than another IQ subtest remaining to be understood in basic terms
 - What if the correlation between working memory and IQ were perfect. What does that say about the obvious role of learning in the acquisition of skills sampled by IQ tests?
 - Measures of “memory span” correlate much higher with IQ than typically granted. For example, Bachelder (1970/1971) found a correlation of 0.79 (N=84) between staircase digit spans and IQ. That figure has been greeted with considerable skepticism, but keep in mind it used a wider than usual range of IQs, 51-115, most subjects were dull normal or below, and the staircase span test generally has better reliability than other span tests.

Troubling to mainstream behaviorists

- “***Span ability*** is mentalistic, just another word for a mental ***faculty*** which we reject”
 - Span ability was a term chosen to be theoretically neutral as the first step toward answering the ***spans question***, “***What is the nature of the curious span limitations?***”
 - The first hypothesis about the nature of span ability was ***elicitation span*** (***elicitation*** as we used it was very similar to ***occasion***), ***the maximum number of stimuli which can reliably elicit/occasion response sequences***
 - The current term is ***span load***, the number of stimuli, considered conjunctively, which specify the target response
 - Span load is a simple elaboration of the behavioral notion of ***stimulus control***
 - Span ability is an empirical construct, ***the quality of being able to function reliably when multiple stimuli are conjunctively relevant for target responding***

Troubling to mainstream behaviorists

- “Span theory makes virtually no mention of ***reinforcement***”
 - Mainstream behaviorism distinguishes ***stimulus control*** and ***reinforcement***
 - span theory simply observes that traditional distinction and asserts that an understanding of mental retardation, development, and intelligence requires careful consideration of stimulus control as a significant factor
 - ***Span theory*** is about ***developmental*** and ***individual differences*** in the ability to cope with [complex] stimulus control (now called ***span load***)
 - I have become highly skeptical of the mainstream behavioral notion that reinforcement history provides the central account of developmental and individual differences in span ability and intelligence
 - I would welcome a behavioral colleague to begin rigorous investigation of the role of reinforcement in changing psychometric span ability.
 - If research shows that psychometric span ability can be substantially changed, then span theory clearly implies that we can substantially increase intelligence

Troubling to mainstream behaviorists

- “All this talk about *intelligence* is simply traditional mentalism”
 - *Intelligence* is not a span theory term, it is a term from cognitivism and lay theory. It is useful, probably necessary, in trying to *translate* from span theory to mainstream points of view
- “*Intelligence is behavior*”
 - Agreed, that is explicit in span theory. The *Task* is defined in terms of stimuli and responses with no reference to hypothetical mental or neural processes
- “*Developmental and individual differences* in intelligence are simply the result of reinforcement history”
 - I am well aware of this *received working presumption* about mental retardation , development, and intelligence, but from this point of view the span phenomena are *anomalous* which is what led me to study the span phenomena in the first place
 - Resolution of *anomalies* has often lead to important scientific discoveries, in this case a simple elaboration on the concept of stimulus control, leading to an understanding of mental retardation in terms of a limitation in the ability to function under complex stimulus control

Troubling to mainstream behaviorists

- “Focussing on ***theory*** is inconsistent with behavior analysis”
 - Span theory is theory in the same way behavior analysis is theory
 - The concepts of ***operant, respondent, stimulus control, and reinforcement*** are all theoretical terms. Explanation of behavior in terms of reinforcement history is a theoretical explanation, though not a ***reductionist*** explanation
 - ***Span load*** is simply an elaboration on the behavioral notion of ***stimulus control***
 - ***Span ability*** is an empirical construct based on the observation that there are reliable and highly stable individual differences in performance as a function of ***span load*** and they are ***highly resistant to improvement with practice or training***
 - Skinner argued against ***reductionism***, that is, explanation of behavior in terms of hypothetical mental and neurological processes
 - Span theory is not a reductionist theory

The Evolution of Span Theory

- The roots lie in *interbehaviorism, behaviorism, and comparative psychology*
- The concept of *complex cue* as central to understanding phylogeny, ontogeny, and mental retardation
- The memory span task as a *good preparation* for studying mental retardation
- The span phenomena as *anomalous findings*
- Memory span as *elicitation span*, a complex cue
- *Span ability* as the ability to cope with complex stimulus control defined as the number of *conjunctively relevant stimuli*
- The *Task* as the fundamental unit of theoretical analysis
- *Span load* (a new term to replace *complex stimulus control*) as a defining characteristic of a *Task*
- *Span ability* as the ability to cope with *span load*
- The *Task* as an *interbehavioral field*

The evolution of the concept of *span load*

- ***Complex* or *subtle cues***
 - Denny & Ratner (1970) Related them to phylogeny and ontogeny
 - Denny (1964) People with mental retardation have a relative deficit in responding with complex cues
- ***Elicitation span***
 - Bachelder (1970/1971) Higher span individuals learn faster and easier because it is easier to elicit complex responses
- ***Complex stimulus control, task complexity***
 - Bachelder & Denny (1977a, b)
- ***Span load* for conjunct relevance, *task complexity* for analysis of *complex tasks* analyzed in terms of simpler and *elementary tasks* (*SoS, SoM, SoN, & SoL*)**
- ***Task* as the basic unit of theoretical analysis, *span load* as a central dimension of a task definition (specified by the *counting rule*)**
- ***Task* as an *interbehavioral field* (J. R. Kantor's *interbehaviorism*)**

Denny on learning and mental retardation

- Higher vertebrates are better able to use ***complex cues*** than lower vertebrates
- More mature organisms perform ***complex learning tasks*** better than immature organisms of the same species
- What is ***learned*** is what is ***elicited***
- Those with ***mental retardation*** have a deficit in ***complex learning*** and functioning with ***complex cues***

Major Influences on Span Theory

- A strong undergraduate background in the ***physical*** and ***biological sciences*** and ***mathematics***
- ***Interbehaviorism*** indirectly, via its influence on Stanley Ratner and M. Ray Denny
- ***Comparative psychology*** via Ratner & Denny (1964), Denny & Ratner (1970)
- ***Elicitation theory*** (Denny, 1966)
- ***B. F. Skinner*** and ***experimental analysis of behavior***
- ***Attention theory*** of Zeaman & House, a neo-Hullian theory of learning in 2-choice discrimination tasks
- ***Task analysis*** and the work of Marc Gold
- ***Serendipity***, reassignment from behavior modification specialist to psychometrician exposed me to intelligence testing and the ***memory span task***
- ***Psychometrics, test theory, face validity, construct validity***
- Thomas Kuhn's concepts of the ***scientific paradigm, evolution*** and ***revolution*** in science, and ***paradigm clash***.
- ***Philosophy of science*** on the nature of explanation and the nature of science
- ***Interbehaviorism*** directly, through reading the work of ***J. R. Kantor*** and present day interbehaviorists

Bachelder (1970/1971).

- ***Elicitation span***, a behavioral conception of the traditional ***memory span*** task
- $S_1 S_2 \dots S_n \rightarrow R_1 R_2 \dots R_n$
- People with mental retardation clearly have an ***elicitation span deficit***
- The elicitation span deficit appears to be another type of ***complex cue*** deficit
- ***Word span = f(elicitation span)***
- ***Digit span = f(elicitation span + experience with digits)***
- ***Mental retardation*** is the result of a deficit in ***elicitation span*** and ***behavioral history***
- Since what is learned is what is elicited, MR have learning problems because it is relatively difficult to elicit complex behavior from them (or for them to ***emit*** complex behavior to be ***reinforced***)

Cognitive Science and Span Theory

Cognitive Science

- Tries to explain the nature of the span limits in terms of hypothetical mental and neural mechanisms
- Tries to explain why there is a limit
- Views span limits as “simple span,” a reflection of rehearsal and storage
- Focusses on the **working memory** construct
- Emphasizes that **working memory** correlates higher than “simple span tests” with IQ

Span theory

- Avoids **reductionism** in favor of **measuring** the span limits
- Explores the validity of the working proposition:
 - Performance in diverse tasks is a function of span ability and acquired repertoire
- Models life tasks in terms of laboratory tasks
- Models complex tasks as comprising simpler or **elementary tasks**
- Emphasizes that the “simple span test” has excellent **construct validity** as a measure of **intelligence**

Clinical impressions based on my experience as a psychologist in independent practice

- Individual and developmental differences in span ability are not likely to help us understand the students typically diagnosed as **learning disabled**
- The so-called **learning disabled** student suffers an **engagement disorder**. The nature and quality of their engagement of academic demands is problematic in diverse ways, much more **emotional** than **intellectual**
- The so-called “ADD” individuals are a heterogeneous lot better conceptualized and treated as having stress-related concentration problems or one or another diverse mental disorder
- A behavioral-style analysis (such as span theory) is effective in understanding and guiding interventions for both groups of students
- The behavioral-style approach will continue to be resisted vigorously as it has for decades because it challenges long traditions of lay, medical, and educational theory and practice

Bachelder (2001). The magical number $4 = 7$: Span theory on capacity limitations. *Behavioral and Brain Sciences*, 24(1), 116-117.

- Figure 1
- The value of the magical number varies with the criterion one uses to define it. Cowan (2001) uses a 100% criterion, span theory uses 50%

Bachelder (2005). *Crucial errors in Miller's application of information metrics in a comparison of the spans of absolute judgment and immediate memory.* Paper presented at the 38th Annual Conference of the Society for Mathematical Psychology, Memphis, TN

- Miller used two different and incompatible measures of span limits in memory span and absolute judgment
- When the same measures are used in both, the span limits in both are essentially equivalent
- When his error is corrected his analyses support a unitary conception of the span limits in memory span and absolute judgment

Span Theory in a Nutshell

- Performance in a ***Task*** is a function of :
 - (1) developmental and individual differences in ***span ability***,
 - (2) ***span load*** (a task characteristic), and
 - (3) ***additional variables***.
- Span ability is measured by a ***span test***
- Span load is determined by ***TASL*** (task analysis of span load)
- Additional variables are determined by ***experimentation***

Span Theory

Cognitive Science

Experimental
Analysis of Behavior

Span theory incorporates key features and rejects key features of both *Cognitive Science* and *Experimental Analysis of Behavior*