CHAPTER 6

Conceptual Structure for Short-term Adaptation

I. Conceptual Precursor, Value of Conceptual Structures

A. Necessity of plausible origin and continuity
B. Dimensioning rationale
C. Partitioning rationale
D. Instance selection rationale

II. Dimensions of Research Activity

A. Requisite ontogenetic contingency history (canalization)
   1. functional relationships between fixed stimuli and fixed responses
   2. functional relationships between arbitrary stimuli and fixed responses
   3. functional relationships between arbitrary stimuli and arbitrary responses
   4. functional relationships between sets of arbitrary stimuli and sets of arbitrary responses

B. Requisite stimulus support
   1. single relationship
   2. serial relationship
   3. behavior sequence

C. Complexity in concurrent determination
   1. no concurrency
   2. concurrency, compatible
   3. concurrency, incompatible
   4. dynamic concurrency
   5. dynamic concurrency with significant shift cost

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CHAPTER 6

Conceptual Structure for Short-term Adaptation

I. Conceptual Precursor, Value of Conceptual Structures

Behavioral science is the definition and measurement of response dimensions as a function of changes in defined and measured stimulus dimensions or response dimensions. The following structure (presented in Section B) involves the postulation of dimensions, their definition, their rationale, how they are related, and how they can be productively partitioned in order to provide a coherent single framework for the variety of behavioral research. The dimensions are based on a correlative perspective but could actually also be seen from a reductionistic perspective. That is to say, the structure can most appropriately be seen to contain procedures which produce changes in their dependent variable which show short-term hysteresis. But, the structure could be seen to specify procedures which produce "knowledge" or "connections." It would be expected that multiple relationships with the same coordinates in the organizational scheme would function similarly, that relationships with the same value on a dimension would function similarly with respect to that dimension, and that the interaction of functional relationships would have some commonality with the spatial relationship in the spatial model.

A. Necessity of Plausible Origin and Continuity

The dimensions and elements of organismic adaptation must provide a plausible historical origin and an underlying reductionistic machinery (recall Chapter 1 Section V). The irrefutable fact is that nature simply works that way. Organismic adaptation cannot have come from the tooth fairy. There must be evolutionary continuity. The approach argued by Teitelbaum is especially appropriate in this regard. Voluntary behavior (control by ontogenic consequences) is the direction toward which evolutionary adaptation flows when flexibility is adaptive or the environment is variable. Reflex behavior (control by antecedents) is the direction toward which evolutionary adaptation flows when flexibility is not adaptive or when energy conservation is the driving force. A similar view was argued by Breland and Breland when they stated: "Each behavioral event is followed by the next more automatic one until the final molecule to molecule match (equilibrium) is achieved."

B. Dimensioning Rationale

What we are doing in this section is selecting axes which account for major sources of variance, i.e., what are the fewest and simplest continua which will maximize the proportion of variance accounted for. An additional benefit of this goal is that organizational dimensions may give us insights into actual functional dimensions in nature, and thereby help us identify previously unknown and unsuspected relationships.

C. Partitioning Rationale

The rationale which we use to partition a dimension into instances or into groups of instances may also give us insights into nature. If partitions are productive, they are so because they, in some way, mirror small but real changes in the global functional properties of the behavior along that dimension in nature. In this case, we are interested in the commonality of each partition or subset which causes its elements to be labeled the same, yet be different than members of other subsets of the same dimension.

D. Instance Selection Rationale

The particular instance on a dimension or specific behavioral phenomenon we select to research must produce orderly data and its functional relationships must connect to other levels. Beyond that it may be as simple as that particular phenomenon is what we as an individual researcher know or enjoy best or be a preparation that is convenient.

If different instances on a continuum exist then they may:

1. all function identically, in which case there are no subsets and the study of any is as good as any other;
2. all function differently, in which case all of the different subsets must be studied and the selection of any is as good as any other;
3. the whole may be more than the sum of the parts, and a paradigm must be developed around all of them and that paradigm must account for both individual properties and emergent properties. In that case, all of the different subsets must be studied and the selection of any is as good as any other.

The selected relationship, the specific stimulus, or the specific response can be chosen for a variety of reasons:

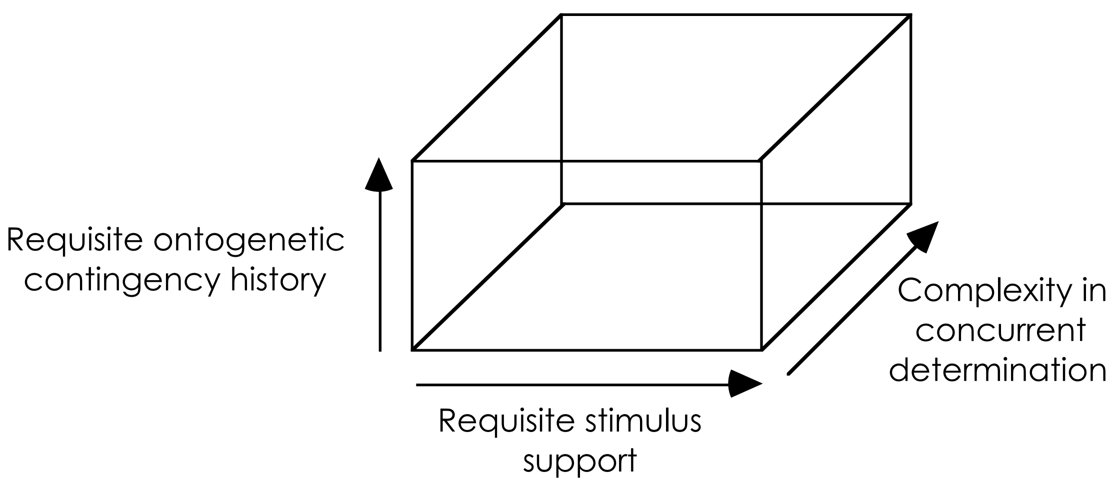
1. especially revealing
    a. minimal error variance
    b. minimal free parameters (number of dimensions)
        i. how much more is added with each dimension; each new
        ii. parameter increases the fit but reduces the parsimony;
    c. apt (especially general, or especially easy to understand)

2. popular
3. under-researched
4. piques curiosity
5. convenient

II. Dimensions of Research Activity

The various paradigms of short-term behavioral adaptation could be organized in terms of three dimensions.

To the degree that these three dimensions represent functionally important dimensions in nature then understanding the structure of research activities will allow us to more easily understand the determinants of behavior. The structure also provides us with a plausible scenario for the incremental development of successively more or less complex relationships as the result of variation, selection, and nonregressive reproduction (i.e., long-term adaptation or evolution).



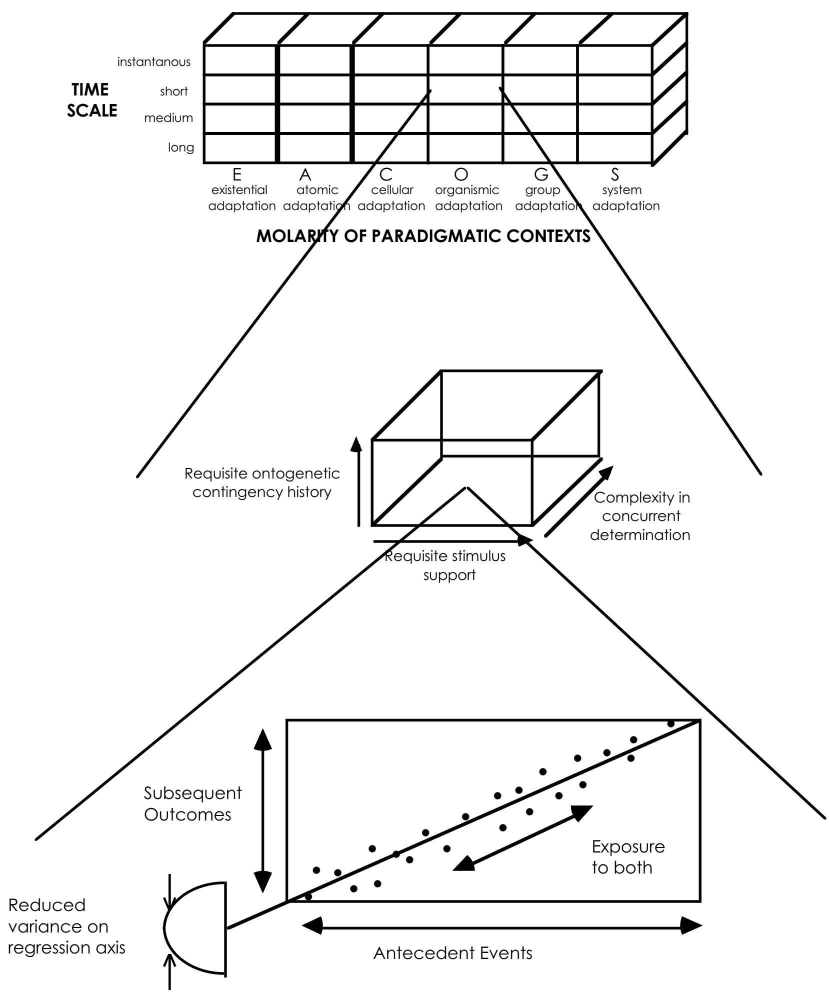
The conceptual structure organizes various relationships as a function of: 1) requisite ontogenetic contingency history, 2) degree of independence from explicit stimulus support, and 3) degree of complexity in concurrent determination. In sum, any specific behavioral equilibrium could be seen as a function of three classes of environmental determinants. Alternatively, any particular behavioral relationship can be categorized in terms of its position on those three axes.

Reductionistically, the structure could be seen as a continuum from phylogenetically modified synaptic connectability to ontogenetically modifiable synaptic connectability (vertical axis) which varies from pre-connected stimuli and responses (e.g., reflex) to unconnected stimuli and unconnected responses (e.g., operant). Orthogonal to this dimension are variations from simple stimulus control of a single response by a simple stimulus (left front) to long sequences of responding under the control of a simple initial stimulus (right front) and finally the front to back dimension depicts the degree to which multiple behaviors are simultaneously controlled.

The above structure fits into the single cell labeled short-term organizational adaptation in the unit of molarity by the time scale structure which is illustrated below.

For reference or for context on your second read through this manuscript, the first structure is also one level more global than the four elements making up a contingency. (See 1. b. ii. (2)) (The *x, y,* and *z* axes of that first figure organize or schedule the "big four" elements of a contingency.)

The hierarchical relationship of the three organizational schemes is illustrated below.



Models of the natural world are always suspended between the number of dimensions which can easily be envisioned and manipulated (three or less) and the number of dimensions which correctly characterize the world. The hope is that, if in reality, more than three are required, at least three are sufficient to reduce complexity by a meaningful amount and that nature can be productively conceptualized in dimensions taken three at a time. The position taken in the present manuscript allows nine dimensions to be manipulated even if it is in groupings of two (time and molarity), and three (ontogenetic contingency history, stimulus support, and concurrency), and four (difference in the antecedent, difference in the consequence, degree of correlation, and degree of exposure to the conjunctions) dimensions at a time.

A. Requisite Ontogenetic Contingency History (Canalization)

The vertical axis is the proportion of variance accounted for by short-term effects. This dimension specifies the degree to which the behavior of each member of the species is already at equilibrium with the components of a given contingency at, or effectively at, birth. A reflex can be said to be "phylogenically learned" or totally prelearned. A conditioned reflex is the name given to a functional relationship which shows control by an arbitrary stimulus (CS) over a response (UR) which had been under the control of a nonarbitrary stimulus (US). This new hierarchical control is established through ontogenetic contingencies. An operant response is acquired through an individuals exposure to environmental contingencies involving both arbitrary stimuli (cues) and arbitrary responses (operants).

In this sense, the vertical dimension of the conceptual structure is also proportion flexibility versus proportion inflexibility. The pupillary reflex is very inflexible. Light is the stimulus and pupillary constriction is the response and that's all there is to it. A conditioned reflex such as salivation to a bell shows more flexibility. A variety of stimuli other than a bell could have been brought to elicit the response. An operant is even more flexible in that a variety of stimuli can come to control any of a variety of behaviors. The requisite ontogenetic contingency history dimension could, therefore, be labeled degree of susceptibility to short-term environmental contingencies.

Finally, the vertical axis could be also be viewed teleologically. The organizing principle in this case would be how to best prepare the organism across evolutionary time for any particular event in the future. It is always known what to do with light in the eye; respond with a pupillary contraction. Other things, such as when to salivate may have a variety of appropriate stimuli (salivation to a bell would be correct given some situations). Finally, it would also be necessary to be able to acquire literally unimaginable behaviors in literally unimaginable situations (i.e., be capable of operant learning).

An additional step up the vertical axis in the flexibility dimension would be any of a class of stimuli controlling any of a class of behaviors which are under the control of a particular consequence. A further step on the requisite ontogenetic contingency history dimension (not illustrated) is relatively easy to imagine. Following a sufficient history of discriminative stimuli, appropriate behaviors, and reinforcers, even more flexible relationships may be possible. These might be those typically referred to as observational learning, rule-governed behavior, voluntary behavior maintained by internal verbal reinforcers, formal operational thought or even self-motivated behavior in the absence of explicit reinforcers. Clearly, however, these behaviors must be seen in the context of the real events which control them. Some exposure to some contingency over some time scale.

Most hierarchical organizations of the body of knowledge of associative short term organismic adaptation use what is in effect requisite ontogenetic contingency history as their primary categorization. This manuscript will do likewise. Each major level will be covered as a chapter. The other two axes "requisite stimulus support" and "complexity in concurrent determination" will be covered both within the chapters detailing the requisite ontogenetic contingency history partitions and also summarized in a chapter.

1. Functional Relationships Between Fixed Stimuli and Fixed Responses

2. Functional Relationships Between Arbitrary Stimuli and Fixed Responses

3. Functional Relationships Between Arbitrary Stimuli and Arbitrary Responses

4. Functional Relationships Between Sets of Arbitrary Stimuli and Sets of Arbitrary Responses

B. Requisite Stimulus Support

The second or *x* axis (left to right horizontal) of the organizational scheme is the degree to which behavior is independent of a stimulus. Behavior sequences can be more or less dependent on explicit immediately antecedent stimuli. A single instance of a discrete stimulus could control a single discrete response; each of a series of consecutive stimuli could each control a behavior; or a single stimulus could control a relatively long enduring sequence of responses. This conceptualization is of course relative. Ultimately, there are no "single" stimuli and no “single” responses.

1. Single Relationship

A single stimulus controls a single response

S R

Tacts in verbal
CRF
x
x

2. Serial Relationship

A stimulus controls a behavior which results in the next controlling stimuli which in turn controls the next response.

S RSRSRSRS

3. Behavior Sequence

A stimulus controls a behavior which in turn controls the next behavior.

S R R R R R R R

For example, a fixed action pattern is a rigid sequence regardless of the availability of support stimuli throughout the sequence.

x tandem schedule
x intraverbals

C. Complexity in Concurrent Determination

The third or front to back axis of the organizational scheme is the degree of complexity in the concurrency of the control over the resulting response. More than one stimulus or condition may be in effect at the same time such that several behaviors occur simultaneously or several behaviors are in competition. These situations and their resulting behaviors can be arranged in order of that complexity on a continuum. It would range from effectively no concurrency where only one behavior is likely in a situation or where one behavior is very much more likely than any potential competitor. The next two categories would contain situations where either compatible or incompatible behaviors were somewhat equally likely. The next grouping would contain situations in which the degree of control exerted by the concurrent contingency change over time, and as a result, would control changing behavioral equilibria. Finally, the cost of "changing" behavior (such as flying from one bush to another) can be increased such that that shift cost becomes a significant factor in the resulting behavioral equilibrium with respect to that changing environment.

1. No Concurrency

This class is illustrated by a simple schedule of reinforcement. Thorndike and Pavlov examined the impact of functionally significant events on behavior under the control of antecedent stimuli. While it is true that ultimately all behavior could be seen as choice, in some situations the relative value of the concurrent reinforcers are so disparate that it is reasonable to consider the situation as being a single behavior under a single reinforcer. The behavior class could be labeled as adaptive behavior, preparation, or expectation. In any case behavior is under the control of only a single factor.

2. Concurrency, Compatible

This class is illustrated by a conjoint schedule of reinforcement. A single class of responding is under the control of two reinforcement schedules. For example, keypecking could be maintained on both a fixed-interval and a fixed ratio schedule at the same time. The first peck following 60 sec could be reinforced while every fifth peck was also reinforced.

3. Concurrency, Incompatible

This class is illustrated by a simple concurrent schedule. Pecks to one key could be reinforced on a VI 60-sec schedule while pecks to a second key could be reinforced on a VI 30-sec schedule. The allocation of behavior is a function of the allocation of reinforcers.

Graphic

If we assume stimulus generalization, then we can conceptualize responding controlled by two concurrent schedules in the same framework as signal detection. We can infer payoffs for portions of distributions and "explain" behavior change.

Graphic

This model could be used to explain a fundamental descriptive law.

Graphic

Because of generalization, we have a continuous series of ratios of the two stimuli as we change along the x-axis (stimulus continuum correlated with the two schedules. This could be seen as causing a continuous series of reinforcement ratios which in turn would cause a continuous series of ratios of responding.

Graphic

4. Dynamic Concurrency

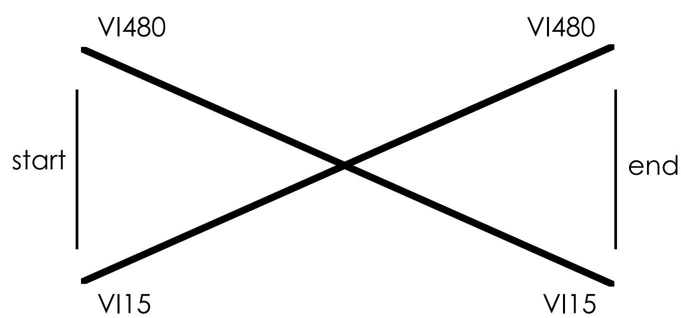
This class of concurrency refers to concurrent schedules with a changing relationship such as a concurrent xy where the requirement for x is slowly decremented while the requirement for y is slowly incremented.

Example: Dynamic concurrent schedule

Conc (VI 15 → VI 480)
(VI 480 → VI 15)

It is possible that a fixed-interval schedule may best be seen as a dynamic concurrent schedule. The passage of time is correlated with an increasing imminence of the subsequent food presentation and increasing distance from the period maximally removed from food (i.e., interval onset).

Each point in the interfood interval can be seen as controlling a specific ratio of behaviors.



The within trials distribution specifies how behavior is organized in time by the thing that defines time and the trial food presentation.

Graphic

The addition of clock stimuli would move us from perception to schedule research by making portions of the interval explicit rather than implicit.

Manipulating clock stimuli would help us understand what organizes the behavior.

When are a series of instances thought to repeat? Why does behavior ramp up to food then "start over" immediately after food?

- what resets clock ---> probably S_{min} of the S_{min} S_{max} continuum
- when can data be overlapped
- what is octave or helix
- should behavior be seen in a molar or atomistic view

5. Dynamic Concurrency With Significant Shift Cost

x
x
x

Foraging

Reaction of mealing to FR size (Collier, 1977).

x
x
x

Graphic

As can be seen behavior shows "stay then shift" or inertia.. Shift cost determines inertia. Economic theory fits in here.