

CHAPTER 4

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CHAPTER 4

Source and Characteristics of Knowledge

I. Source of Knowledge

The person in the street often believes that knowledge has four sources: transcendental, direct, vicarious, and inference. This view is incorrect in detail, but is a reasonable jumping off point.

A. Erroneous Attribution to Transcendental Realization

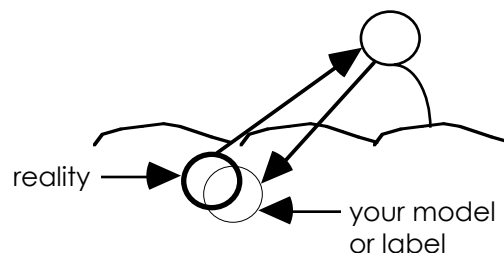
The first source is that it just pops into one's head. This source of information or knowledge can be dismissed out of hand. Things do not simply pop into existence. There is no evidence to suggest that the knowledge is based on anything more than the unconscious remembrance of what someone experienced or was told, with the actual empirical source(s) forgotten.

Transcendental knowledge has no consistent relationship with the truth. In fact it is typically thought to be true regardless of the facts. The acceptability of transcendental knowledge is best understood when it cuts against you rather than for you. For example, if I told you that I had transcendental knowledge that you were the best person on earth, regardless of the facts, you would consider my transcendental knowledge inspired, but if my transcendental knowledge told me that you were guilty of murder regardless of the facts, you would instantly (and correctly) reject transcendental knowledge. Knowledge which is unprovable and irrefutable because it is foisted off as transcendental has no place in science.

B. Direct Versus Indirect Source of Knowledge

1. Direct Empirical Experience as the Source of Knowledge

The most fundamental source of information is what a person comes to know by direct personal experience. This would include learning to ride a bike, that something is round, or that one thing is bigger than another.



A pencil on the desk is real because we can touch, taste, and smell it; a unicorn is not real because neither we nor others can experience a unicorn nor can we experience the results of a unicorn. However, a naïve reliance on direct personal experience to determine what is real is simplistic. What about errors or misunderstandings? How are we to deal with dreams, psychotic episodes, and drug-induced experiences. What about events which cannot be easily seen, heard, tasted, or felt.

The solution has already been discussed earlier but to review, it is to demand reliable observations, integration within a theoretical network, and consensual validation, as well as some form of empirical support. However, for now, it serves pedagogical purposes to simplify all those factors detailed in Chapter 1 into the statement “experience results in knowledge of what is real.” Real in the present usage means nothing more than it is consistent with a wide variety of empirically supported observations.

a. Methods for Gathering Empirical Information

If we wish to construct truthful systematic knowledge, then we will have to have procedures which will assure that we get exactly that. Methodologies for gathering empirical knowledge can be categorized into several general classes. These classes could be seen as lying on a rough continuum which varies from a relatively passive observation to the active manipulation of abstract variables in a completely controlled environment.

i. Information Obtained Without Manipulation (observation)

Observational techniques take nature the way it comes. As a metaphor, if knowledge were food, observation is getting a meal by going to a restaurant, you get it the way it is served. Sometimes it's useful knowledge that you can use to better understand things, but sometimes it's mixed with confounds which make it impossible to consume.

The task of observational research is one of abstraction of commonalities. The researcher comes up with axis labels which show systematic and reliable functions. Correlational techniques. Identification of functional relationships. This tends to be describing events and measuring the capacity of the organism. Methods vary along a dimension of constraint or structure. Simply watching something in order to see what is going on is relatively unstructured, conceptually demanding, and holds the potential of being the most productive. While at the other extreme, a check sheet is very structured, conceptually easy, but often tells us little more than we already knew. As with all research, the focus could be on the behavior and functional relations at face value only, or the intent could be to see the behavior as an instance of a more general process.

(1) Procedures**(a) Naturalistic Observation**

This is simply observing nature exactly as it occurs. The observer must hope that the data obtained are relevant and that the observation itself did not affect the behavior.

(b) Restricted Observation

Often we cannot gather information on every conceivable event. This category is the explicit recognition that many things are ignored.

(i) Restricted With Respect to Subject**((1)) Case Study**

A case study is an observation limited to a single individual.

(ii) Restricted With Respect to Information Collected**((1)) Survey**

A survey is a collection of a set of information (such as TV viewing habits) by gathering a limited subset of the potential data.

((2)) Check Sheet

A check sheet is a collection of a precisely specified subset of variables in a controlled format. It is the most restricted but has the advantage of speed and that the desired information will always be included.

(c) Contrived Observation

Contrived observations alter the situation. In a sense experiments could be seen as extremely contrived observations. This category is under the heading "types of observation" because if only minor changes are made, it is called an observation. If major changes are made which allow a comparison, then it is called an experiment. Obviously however, it is a name for a position on a continuum.

(i) With Respect to Context or Events**(ii) With Respect to Subjects**

ii. Information Obtained with Manipulation (experimentation)

Experimental techniques do whatever is necessary to reveal what you need to know to better understand the world. Building on the previous metaphor, if knowledge were food, then experimentation is getting a meal by making it yourself. You have the power to optimize it in any way you want. You have complete freedom and are only limited by your own imagination and skill. However, if it doesn't reveal useful knowledge, then you have only yourself to blame. Experimental design gives you the ability to eliminate confounding and to establish causation. It is, therefore, the best way to gain knowledge. Keep in mind, however, that the result may be that you discover that what you initially believed was wrong. Again, the focus can be on the behavior at face value or behavior as an illustration of a broader process. Gathering knowledge directly through the active manipulation of variables can range from simple to complex experiments. On the one hand, they can document the effects of some continuous series of manipulations such as dose effect curves or parameter documentation. At a different extreme, they could be "crucial" experiments which determine which of several theoretical accounts of behavior are correct. Alternatively, they could involve the deliberate manipulation of interesting variables simply to "see what happens." The logic of experimentation is covered in Chapter 8 Section IV. B.

(1) Procedures

A number of procedures have evolved which help extract knowledge from the environment while minimizing confounds and confusion.

(a) Single Subject Designs

In these designs, the difference in an individual's behavior with and without the treatment is the dependent variable. The difference in what the individual receives is the independent variable.

(i) ABA

x
x
x

(ii) Multibaseline

x
x
x

(iii) Schedules Under Discriminative Control

x
x
x

(b) Group Designs

In group designs, the difference in the average score of the two groups is the dependent measure. The difference in what the two groups receive is the independent variable. Note that the differences in the individuals contributes to the variability within each group.

(i) Quasi Experimental Designs

x
x
x

(ii) Single Independent Variable

x
x
x

((1)) Randomly Assigned

x
x
x

((2)) Matched

x
x
x

((3)) Blocked

x
x
x

((4)) Repeated Measures

x
x
x

(iii) Multivariate Designs

x
x
x

((1)) Factorial

x
x
x

((2)) Mixed

x
x
x

((3)) Hierarchical (nested)

x
x
x

((4)) Repeated Measures

x
x
x

iii. Other

Sometimes knowledge is obtained through experience which is not the result of typical “scientific” observation or experimentation procedures.

(1) Technological By-Product

x
x

x

(2) Puttering Around / Accident / Serendipity

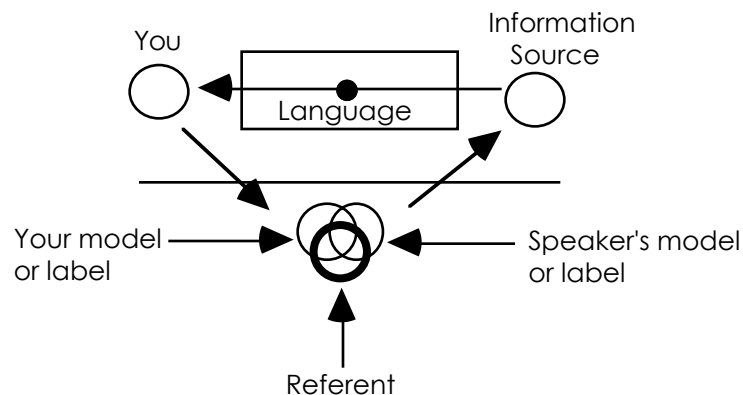
x

x

x

2. Indirect Vicarious Experience as the Source of Knowledge

Knowledge can be gained by receiving information from someone else who actually saw the event or did the experiment rather than you doing the data collection yourself. Alternatively, you could infer that something is the case based on evidence and some inference process. Synonyms for this category would be language, symbolic experience, communication, and thinking.



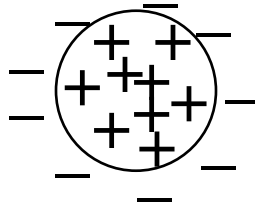
Because mentalistic terminology for vicarious experience and language is so strongly established, a correlative approach represents such a jarring paradigm change and the intent of the present text is to provide only an organizational and conceptual framework for knowledge; the treatment of vicarious experience is necessarily shallow. As a result, not all terminology can be simultaneously paradigmatically coherent and communicative.

In general terms, vicarious experience can best be understood in terms of the process of stimulus control (or its component parts: discrimination and generalization). It is the degree to which a behavior appropriate to one situation occurs to a different stimulus. The behavior controlled by the word dog or the symbols 2+2 becomes in some way similar to the behavior controlled by a dog and four objects on a table. Vicarious experience acts like direct experience in its relevant aspects. As a result, it makes it possible to predict what would happen (i.e., respond correctly) in a new situation even though the novel situation has never been personally or directly experienced. Someone can tell you a phone number you didn't know, or you could calculate where a planet will be in the future. In each case, a discriminative stimulus, a behavior, and a reinforcer is involved.

a. Machinery of Vicarious Experience

i. Boundary

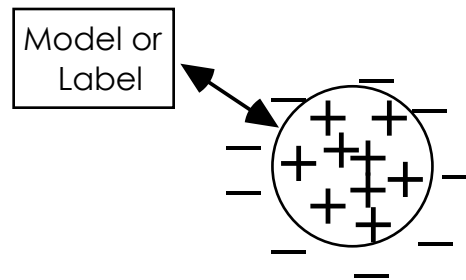
An important part of communication is the specification of what is and what is not included in the set of interest.



There are aspects or elements that are the thing and there are aspects or elements that are not the thing. The boundary differentiates between reinforced and nonreinforced elements.

ii. Model or Label

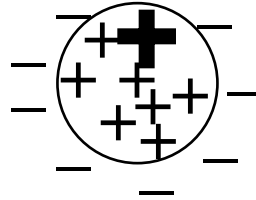
The model or label must reliably match the referent. Helen Keller was changed forever when she realized that words could be used to stand in place of their referents.



It's illuminating to consider the difference in how the lay and the scientific community talk about things. The lay put great store in their words and pay little attention to whether the listener has the same set of referents for their words. For example, if an IRA member said "terrorist" he is probably thinking of those "evil Arabs," while being unaware that an Irish Protestant probably thinks of those "dirty Catholics." Scientists focus almost exclusive attention on the boundary of their sets of interest and may not even care what word a particular colleague uses to refer to the set. For example, when "memory" or "self-actualization" is mentioned, the issues that are discussed have to do with its operational/ functional definition, not its label.

iii. Exemplars

An exemplar is one of the many positive instances of a set, but it poorly indicates where the boundary of the concept is. This is why someone can give the “right” answer in a classroom, but still be wrong.

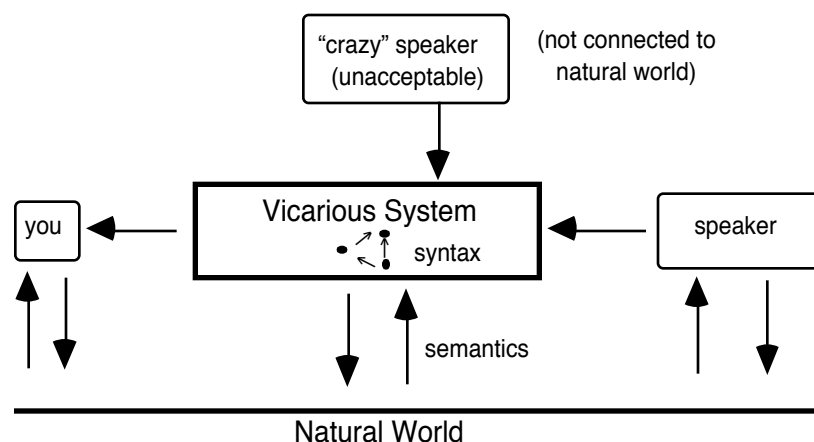


iv. Equivalence

Behavior can come under the control of stimulus equivalence. That is to say that a behavior controlled by Stimulus A will be controlled by Stimulus B if A and B are equivalent either through similarity or through some training experience. This effect is important in both communicating to someone and in developing a valid model of the natural world.

b. Utility of Vicarious Experience

Only to the degree that the boundaries, labels, and referents in the vicarious system are shared and validly connected to the natural world will that system be productive and eventuate in a reinforced response more quickly than the alternatives.



The issues discussed below were extensively discussed in Chapter 1 and are only briefly reviewed here.

i. Unproductive

Problems come about if systems of vicarious experience are not used correctly. There are problems with respect to the rules of the system (syntax) and problems with respect to the rules connecting the “model” to “reality” (semantics). Correctly carrying out the math involved in calculating πr^2 is proper syntax. Understanding the implications of the Rescorla-Wagner model of learning is syntax. Measuring the radius rather than the circumference is correct semantics. Measuring or predicting the response rate of an animal is semantics.

Examples of unproductive communication abound. If you find yourself in some problem related to language, it is probably because some of the rules or controlling variables of the language have been violated. As a result it fails to accomplish anything. For example, 1. What is love? Can you even describe it poetically to satisfy everyone at all times? It cannot be done because different people differ in their description of it and in fact also differ in pointing to a positive and negative example in the natural world.

ii. Productive

The rules for substantiating communication through the vicarious system (semantic and syntactic) are the rules which have previously been shown to be essential to separate fact from fiction (Chapter 1).

(1) “True”

As pointed out before, the ultimate base of reality is sense data within the maximally productive paradigm. Therefore science is the most appropriate foundation for validating the vicarious system. This method allows for self-correction. Science is a "guided" or feedback approach. Even if it is wrong at the start, it cannot stay wrong because its models will be shown not to match reality. Scientific procedures correct themselves and keep adjusting until they get it right, much like a person correctly playing "hot and cold." If they err at first they can correct their belief by listening to the clues and then changing direction based on the obtained knowledge. Sooner or later, they will correctly find the goal. This can be contrasted with a "ballistic" approach. In a ballistic approach, if the statement of belief happens to be right at the beginning then it is right all along. However, if it is wrong at the start then correct knowledge can never be reached. A ballistic approach has no method of correcting error. It has no “court of appeal.”

To review the meaning of “true” from Chapter 1:

- Empirical
- Reliable
- Multiple Converging Evidence
- Consensually Valid
- Operationally/Functionally Defined
- Explicit

Ontologically Valid
 Referential Correspondences
 Testable
 Minimal Error
 Systematic

(2) "Understood"

In addition to being true or substantiated, knowledge must be understood to be productively used.

To review the meaning of understood from Chapter 1 (and explanation from Chapter 5):

Describe
 Predict
 Control
 Synthesize
 Explain
 Truthful
 Explicit
 Testable
 Minimal error
 Comprehensible
 Systematic or principled

c. Breadth of Referent

i. Specific Instances

You can be told something specific such as “this is a pencil” or “Johnny will jump if you yell Boo”.

ii. General Principles

You can be told a general principle such as, if you suddenly yell at a living thing, it will probably withdraw. Obviously people who learn general models will be tremendously more productive in their interaction with the world than people who were told specific instances. With a general principle, they don't know just one relationship, but rather thousands and thousands. There are two catches. The first is that learning concrete things is easy. Learning abstract principles is difficult. The second catch is, of course, knowing when and how to apply the general principle and when it is not applicable.

d. Categories of Vicarious Experience

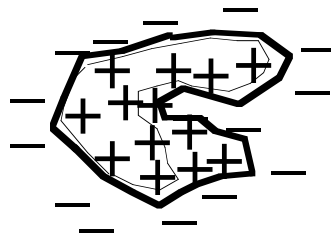
Even though the following categories are not mutually exclusive, have

overlapping elements, and are often conflated together; it is pedagogically convenient to partition vicarious experience into categories so that various issues can be systematically presented. Consider this organizational structure as scaffolding.

i. Knowledge via Communication or Discourse

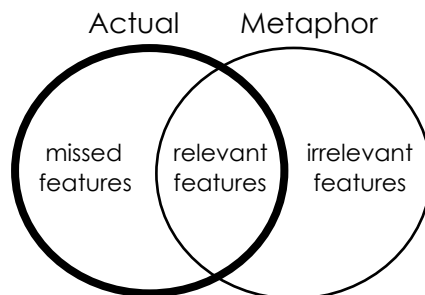
This source of knowledge involves one organism communicating some information to some other organism. A prototypical example would be finding out a person's phone number by having someone tell it to you. This source of knowledge requires that the speaker and listener share some set of arbitrary symbols which are equivalent to the same thing. Education is the term for the communication of abstract, general principles vicariously to people rather than having the people learn them through direct experience with actual concrete problems.

Very complex patterns are easier to communicate with metaphors rather than brute enumeration or some set of complexly related rules.



A metaphor specifies the boundary of a class by specifying some other well-known class and then specifying how to adjust the boundary to maximize the correspondence between the metaphor and the target.

A metaphor misses some features of its target and it carries with it some irrelevant features. Better metaphors have larger overlaps with the target (relevant features) and smaller superfluous areas (irrelevant features).



Metaphors are maximally helpful when the listener actively tries to test its appropriateness by considering how well it captures some aspect of nature. The task of the listener is to get their model to match reality by way of understanding

the speaker's words. This is actually quite difficult for both the speaker and the listener.

The speaker must have a correct model of reality.

The speaker must articulate it correctly.

The listener must hear it correctly.

The listener must create a model from the words which matches reality.

ii. Knowledge via Informal Inference

This source of knowledge is knowledge based on simple generalization of actually experience events or relationships.

iii. Knowledge via Formal Inference

In this case, some known relationship between entities is used as a potential solution for some unknown relationship between entities. This application is very broad and has extremely far reaching implications. This application includes logic and mathematics and is sometimes given the label "rules."

If we observe some sequence of empirical measures such as; point 1 is measured to be 250, point 2 is 300, point 3 is 350, 5 is 450, and 6 is 500, then we can infer that the measure at point 4 is probably 400. There are many similar situations where we need information but we can only infer that knowledge. This can occur because no one has measured them, or because they cannot be measured at all. Reasonable guesses can be made based on the evidence we have on hand, and the rules of logic and mathematics. Ultimately however, these inferences must appeal to empirical measures for their validity.

(1) Systems of Formal Inference

(a) Logic

(i) Deductive Logic

All men are mortal

Socrates is a man

Therefore, Socrates is mortal

x

x

(ii) Inductive Logic

The sun came up September 1

The sun came up September 2

The sun came up September 30

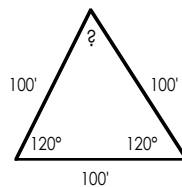
The sun will come up tomorrow

x

x

(b) Mathematics

Mathematics is a very sophisticated set of verbal sequences which “solve” problems. An obvious example is trigonometry to determine a span needed to bridge a chasm.



(2) The Goal of the Inference

(a) Inferred Measures

The example of inferring what value “point 4” had was making an inference about what a measure would be in a series of measures. This is generally accomplished by considering the function that connects the data elements. For example, we can infer that a linear model will match the series of data elements.

(b) Inferred Function

In this case, some quantitative function is used to represent the obtained data. The simplest example of this type of activity would be to use the mean to represent the data in a distribution. A second familiar example is to use a regression line to represent the data in a scatterplot. Many other applications exist. For example, data from a temporal discounting function appear to be best fit with a modified hyperbolic function.

(c) Inferred Reductionistic Processes

In this case, some underlying reductionistic process which would produce the measured data is inferred. This strategy is encouraged by our general cultural view that “causes” are to be found on the inside of organisms. It is critical, however, not to slip into accepting that an inferred function is actually a reductionistic process underlying the obtained data. We should be satisfied, for example, that a linear model predicts the obtained data, and feel no obligation to presume that there is an internal linear process, or a straight-line processing center in the brain or that a homunculus has an adding machine to figure out what to do next. The inferential illusion of positing a reductionistic causal process is similar to the illusion that seems to imply that A causes B when we find that A is correlated with our dependent variable B .

(d) Inferred Temporal History

In this case, some time course such as a developmental or evolutionary history is inferred based on some level of support but without experimental proof for that process.

(3) Conceptual Follow Up: The Slippery Slope of Inference

The allure of inferring causes is not easily resisted. While inference has been very productive, the inference of things that are invalid has drawn very many researchers down long dead end roads of their own making.

When it comes to using rational inference as a source of knowledge, the task is to avoid the two simplistic extremes of: 1) refusing to accept any inference regardless of the evidence and, 2) refusing to reject an inference regardless of the evidence. It is true that inferences may be true in the absence of conflicting information because "valid" has no meaning other than there has never been a discrepancy between the inference and empirical measure. But it is also the case that the most productive position is typically that inferences are not true until proven true.

II. Characteristics of Knowledge

A. Paradigmatic Context of Research

This section (i.e., A.) is here for conceptual clarity. Many of the details of the specific items are the things covered in this course and therefore this section is most completely understood after having read the entire manuscript.

1. Epistemology

What makes something true. What is it to understand something? What are considered facts? Only after facts are separated from illusion can the systematic collection of facts proceed. These issues were developed under the "Truth and Understanding" headings in Chapter 1 Section V.

2. Paradigmatic Level

a. Most Global Context (field)

Once a person chooses a level of molarity and a time scale, "Psychology of Learning" for example, rarely are other chosen fields or other time scales considered. Chapter 7 will present detailed information on molarity and time scale.

i. Molarity, Level of Analysis, or Unit Domain**ii. Time Scale of Adaptation or Time Domain****b. Context (research specialty or area)**

In point of fact, a researcher rarely steps outside a specific context or research specialty. Examples of these "local" contexts would be "matching" or "timing."

c. Immediate Context (researcher's own lab)

Sometimes research is carried out with very little connection to any other research at all. This can be OK, but it can also spell the doom of a lot of work. The work can be so idiosyncratic that virtually no one but the investigator (or his students) cares about or can benefit by the knowledge. When doing research, it may be a good exercise to consider how the research bears on each of the above contexts.

B. Degree to Which Research is Integrated Within Paradigmatic Context

The degree to which research is integrated within its paradigmatic context determines two important aspect of the research, its likely validity and its usefulness.

1. Extent

Research can be either more or less well integrated into its paradigmatic context.

2. Ramifications**a. Validity**

Research well integrated within a paradigmatic context has a wide variety of support and is likely to be valid, while nonparadigmatic research has only itself to provide proof or support.

b. Usefulness

Research well integrated within a paradigm also has many aspects which are "pre-understood." Its underlying machinery has generally already been thought through. Relationships are, therefore, understood. The relationship is predictable and generalizable. Integration enables the information to be used more effectively.

c. Purpose of Research

1. For Curiosity

It may be that it interests us and that is a good enough reason. If it interests us, then that means some implicit theory we believe did not prepare us for the event that piqued our interest. Presumably, whatever was of interest to us will be of interest to others once we get a “handle on it.” The research is not guaranteed to be of wide interests, but it is also not guaranteed to be idiosyncratic.

2. Construction of Functional Context

This type of knowledge gathering systematically obtains facts as well as the necessary other information to develop a coherent frame of reference or context for meaningful explanation. The following enumeration illustrates the kinds of procedures or kinds of information which could be obtained.

a. Relevant / Irrelevant Variables

What are functionally significant variables and which are irrelevant or are simply confounds?

b. Parameter Documentation

What changes in the dependent variable are caused by what changes in the independent variable?

c. Functional Similarity

What other well-understood functional relationships have properties which are similar so that even more fundamental explanations common to both phenomena can be uncovered?

3. For Theory Testing

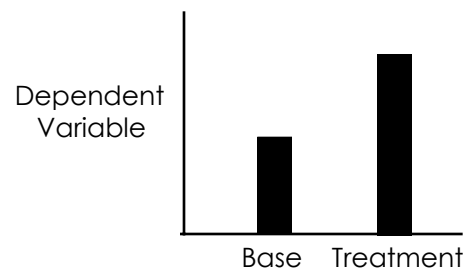
Often we carry out research to see if a theory is correct or not. We could deduce some experimental test such as: “according to my understanding of the processes involved, if we double the reinforcement rate on Schedule A, then the rate of behavior should be halved on Schedule C.” Keep in mind that a single positive finding supports a theory but only marginally, while a single negative finding whose interpretation is correct is very damaging to a theory. But also keep in mind that everything hinges on the author's understanding of the disconfirmation. For that reason, multiple converging evidence must be a requirement of theory testing.

D. Breadth of Research Findings

Research can produce a single fact or a large set of interrelated findings. This is not the degree of integration into the paradigm, but rather the degree of self integration or completeness of the findings themselves.

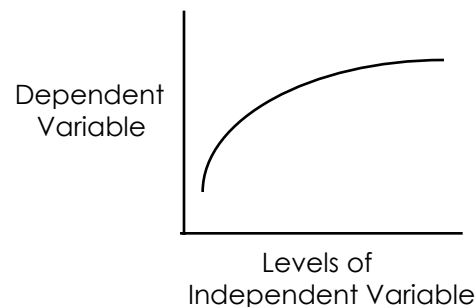
1. Production of Single Fact, or Isolated Treatment Effect

We may want to find out what happens if we do x to our subjects. This is a single fact. In this case, it is determined that level x of independent variable y will have z effect. 5 grams of food results in 50 pecks. This is illustrated in the figure below.



2. Production of Quantitative Function

The task in this case is to do enough research to understand how something works across its whole range. In this case, it is determined that the whole family of levels which independent variable y can take can be described by equation Z . This is illustrated in the figure below. Note the difference between the information it provides and the information provided by an isolated treatment (the above figure).



E. Generality or Degree of Abstraction of Research Findings

This refers to the degree to which an event is taken at face value or is seen as an instance of a more fundamental process. Do you see a pigeon pecking on a red key, or do you see an operant maintained by its consequences? The knowledge

sought can be simple "at face value" information, such as "John jumped when I said boo." Or the knowledge sought can be a general rule, such as "sudden stimuli produce startle responses." Or your interest may be even broader, such as "some stimuli cause unconditioned responses." In order to generalize an event to a general class, you must have some paradigm within which to view the event. It is the paradigm that gives a finding its generality. Applied behavior analysis would not exist unless Skinner had realized that a pigeon pecking a key was the same as a person being a good parent or a person pursuing a career.

1. Face Value or Per Se

In the absence of any abstraction, the actual behaving organism is what you are watching and you want to know, for example, if it will move to the right or to the left when you "poke" it. Precisely why that seems like an interesting thing or what it means is difficult or impossible to articulate. This type of question is very concrete. It tends to be interesting to an individual because of some implicit connection to some implicit paradigm for that individual.

2. Specific Only as a Model of Something Else

At the other extreme of abstraction is considering some specific behavior as a representative of something else. In this case, a pigeon pecking a red key is taken to indicate that reinforcement rate affects response rate. A specific research question may be implemented with some specific subject and some specific procedure, but they are seen as arbitrary (other than the necessity that the model must accurately reflect the properties of interest in the target). Experimental paradigms, which are used to provide information on some other specific situation, or on all situations, are labeled "models."

a. Aspects or Features

There are a countless number of ways two things can be the same or different: same size, same weight, same proportions, same color, same material, same location, etc. A model must be the same as the target with respect to relevant features. It does not matter whether there are similarities with respect to the irrelevant features. In fact, a model is very often used to eliminate some undesired features. For example, we may make a model airplane because the size and cost of a real one make it prohibitive for children to play with.

i. Relevant / Irrelevant

Those features of a model of specific interest are relevant. A model of a wing must have the same lift, but the color is irrelevant. A model of a wall color must have the same color, but can be any material or shape.

b. Target**i. Model Other Specific Situations**

If you want to know if some specific drug will cure a disease in humans, you could test it in an animal as long as the animal reacted like a human to the drug.

ii. Model as an Instantiation of a Fundamental Process

Alternatively, you may not be so much interested in modeling a specific situation but rather all situations. For example, rather than seeing simply pecks to the blue light at 90% body weight, you may see the behavior as an instantiation of the effect of altered motivation on behavior as envisioned within some paradigmatic structure. Because science is the quest for general knowledge, virtually all research is seen in this latter perspective (i.e., as a model of a broader process). In sum, we are not so much interested in discovering some unique finding, but rather we are interested in discovering the common laws that explain the unique finding. We want to know why things are the same.

F. Type of Knowledge Produced by the Research

When studying behavior, two distinctly different kinds of questions emerge. One type asks things such as, "How fast can a pigeon peck," or "How many colors can pigeons discriminate?" A second type, one that's vastly more important to psychology, asks things such as, "Why does this type of experience produce that type of rate change," or "What type of experience produces that type of control by the stimuli?" Note that none of these questions necessarily requires a reductionistic explanation. Whether the explanation appeals to higher or lower levels of molarity or shorter or longer time scales is a different issue.

1. Capacity of Organism: Structural

This type of research is focused on determining the pattern in the behavior or the capacity of the organism. It characterizes behavior without specifying how behavior changes as a function of other events. Examples of this would be the specification of how fast a pigeon can peck, or the sensory capacity of a cat, or the memory span of a person, or how much convergence was necessary before a person detected depth, or the pattern of walking used by various insects.

2. Behavioral Processes: Functional

This is the specification of the functional relationships relating behavior to its controlling or causal factors. The difference between the following categories is basically a matter of the researcher's or the field's realization of what's going on. "Static" is only to those who do not see change, "dynamic" and no more is only to those who do not understand the underlying relationships. "Relationship" only, is

to those who cannot specify a thing's controlling factors. "Controlling" only, is to those who do not know the paradigm within which the specified relationship fits. Each of these descriptions can be applied to the same research topic. Obviously, to do any of them requires some rudimentary understanding of what factors are relevant to describe.

a. Describe a Behavior's Static Properties

This activity is simply describing an observed behavior without describing its changing aspects. Clearly behavior changes as a function of many variables, especially time, and the meaning of a behavior is with respect to the absence of that behavior. However in this case, the dimension across which the behavior changes is not systematically noted, e.g., the kangaroo jumped, or John slept.

b. Describe a Behavior's Dynamic Properties

This activity describes the changes in an observed behavior without describing in detail how that change is related to other nontemporal factors. Very often this type of observation is overlooked. For example, as John sleeps many systematic changes take place over time, the most well known being entry and exit from REM sleep.

c. Describe a Behavior's Relationship with Covariates

This activity systematically describes the changes in both an observed behavior over time and changes in other events which vary with the behavior without extensive examination of the necessity or sufficiency of that covariance (e.g., the distance of a kangaroo jump is a direct function of the number of dingoes present and an inverse function of their distance; or the incidence of cancer is a positive function of the amount of cigarettes smoked).

d. Specify a Behavior's Controlling Factors

This activity describes changes in behavior and how that behavior is a function of some controlling factor without precisely integrating those controlling factors into some relatively complete, paradigmatic context. This type of research strives to determine the environmental determinants of the behavior (especially the consequences maintaining the behavior or the history of experience which produces the behavior). A good example of this type of research is the determination of the object in a room which is causing an allergic reaction.

The only way to find out whether or not one event truly affects or "causes" another is to systematically change or manipulate the occurrence of the supposed cause and see what happens to the effect. Unless this is done, a controlling or causal relationship between the two events has not been demonstrated. Just

because some child started to walk after using your snake oil therapy for the first two years of its life does not give you the right to claim that the therapy should get the credit. You must actively manipulate the independent variable while holding all other variables the same if you wish to infer causation. You must give the therapy to some children and not to others. If only therapy children walk then the therapy can claim credit for the ability to walk.

An essential aspect of identifying a controlling or causal variable is the separation of various potential causal factors and their independent manipulation. For example, if it is believed that the convergence of railroad tracks in a picture makes that picture appear three dimensional., then looking out a window at railroad tracks can be compared to looking at two-dimensional pictures with tracks converging and not converging for their appearance of depth. The separate manipulation of “real” depth (the window) and the depth “cues” (pictures with and without convergence) is an essential aspect of this research. Without the separation of the cues and the reality, you would be left with nothing to say except that apparently the person knew depth. A “researcher” with no aversion to tautology could then claim that it must be that the person has a depth understanding center in their brain and that’s how people react to depth correctly. Another “researcher” equally unintimidated by tautology could claim that it must be that the brain evolved with the ability to know depth because it was reproductively successful.

In this sense, research must show how the animal is “stupid,” rather than show how the animal is “smart.” Showing a person real depth and measuring the fact that they know real depth gives us no knowledge. The only explanation available is the postulation of an inner process. If you show that the subject is stupid (i.e., sees depth in a two-dimensional picture), then you have discovered the cause. This is the meaning of the quip “stupid animals prove researchers smart, smart animals prove researchers stupid.”

e. Integrate the Functional Relationship within a Larger Framework

This activity provides a general well integrated framework or paradigm within which an event can be understood. The controlling factors for a behavior may be correlatively specified in terms of its evolutionary, developmental, learning, and perceptual context. In this sense, description sufficient to provide prediction detailed enough to be labeled causation within a broader context is an explanation. The emphasis on integration is crucial to science because it provides the broadest base of support for the phenomena. It is the antithesis of eclecticism. Eclecticism is, by definition, without any integrating systematic framework. The therapist or researcher picks and chooses therapies or behavioral processes willy-nilly for no other reason than it appears to serve their purposes in that situation.

Simple eclecticism is the professional sounding word for ignorance. It is ignorance because there is no specifiable way to reliably choose a course of action.

See Chapter 7 Section I.

G. Phase of Research Helix

1. Analysis

This aspect of research proceeds by breaking a phenomenon down into simpler elements. Analysis is based on the assumption that the action of a whole is the result of the action of its parts and their interaction. By isolating the parts and coming to understand their simple processes, then complex wholes can best and most efficiently come to be understood. The belief is that the complexity and unpredictability of wholes is due to the action of the many small difficult to control processes making up the whole. Analysis is specifically designed to obtain information concerning the nature of the underlying behavioral process by breaking the phenomenon into its parts. This is the process of isolating active variables or ingredients, or the removal of irrelevant or confounding variables. Example: If given boxes and a hanging banana, a chimpanzee will move the boxes to form a ladder and will get the banana. We can easily show that that activity is not some mystical or transcendental insight by using analysis. By providing or withholding various component experiences, we get predictable variations in the final behavior. Experience with each precursor is necessary for the complete behavior to emerge.

An extremely important realization for a researcher to make is that the task is to show why the behavior occurred as the result of simple environmental experiences by proper analysis. To show that the behavior had to be the result of a “smart” animal -because you were unable to isolate the cause- is to have failed as a researcher: The question “why” has not been answered. Thus, “... and then a miracle happens,” or “... and then the animal realized the right solution,” or “... and then the animal used its cognitive map”-type of research is pointless. Rather than uncovering a cause for the behavior, the researcher needlessly demonstrated once again that sometimes animals do things that appear very “intelligent.” We already know that. The point of research is to discover why. In perception research, we need not demonstrate that people know that some objects are far away. We already know that. We need to determine what aspect of the stimulus makes the person react as if the object were far away.

A related error is to assume that a plausible excuse is an actual explanation. Often the discussion section of a paper offers a plausible excuse for the obtained effect without the empirical analysis required to convert the “likely story” into a “proven fact.” These plausible excuses often seep into the literature as “proven facts.” Much time has been wasted by researchers assuming that reasonable sounding explanations in a discussion section were factual explanations proven in the results section.

a. Empirical

This class of analytical experiments analyzes a relatively complex behavioral phenomenon by breaking it down into each of its proposed component processes for an eventual correlative description and subsequent integration into a coherent set of laws.

b. Theoretical

This class of analytical experiments is to see if a theory is true. The theory is "analyzed" by formally or informally deriving predictions from the formal or informal theory and testing them. The research is not at all interested in what a particular subject will do in a particular situation. Rather the research is to examine the theory's ability to predict correctly. If theory A is correct then the behavior will occur one way whereas if theory B is correct then the obtained behavior will be different in some obvious way (using the steam shovel under the lake metaphor, this would be testing whether a series of high spots (boom) came out of one end as the theory would predict. Otherwise the object may be a truck. Note that you don't really care about the high spots other than as support for the theory which suggests that it is a steam shovel rather than a truck down there.).

It is occasionally asked "why study pigeon pecks?" or "who cares why a pigeon pecks?" Both of these questions indicate a fundamental ignorance of the purpose and logic of theoretical analyses. The ignorance is easy to illustrate by changing the research area to personality and asking "why study people putting pencil marks on an answer sheet?" or to medicine by asking why study the killing of bacteria by mold? In all three cases, the error comes from a failure to understand the abstract and general nature of the research question. The subject, apparatus, and procedure are arbitrary; it is what the results reveal about general processes that is important.

2. Synthesis

Synthesis is the putting together or creation of something. The purpose of synthesis is to assemble known parts into a whole. The result is the production of a complex behavior or an integrated theory. It is an important stage in the empirical collection of knowledge because it provides feedback with respect to the validity of the presumed process.

The analysis phase is the first stage in the construction of an integrated framework of explanation. Synthesis is the second stage. The synthesized results demonstrate the validity of their presumed causal mechanism. If you are collecting information correctly and in such a way that you understand it, then you can generate correct theoretical models of the presumed underlying process and you can create or synthesize new forms of the behavior at will.

a. Empirical

This type of synthesis is the production of a specific behavioral phenomenon, specifically as a test of your understanding, or for some practical use (which also validates your understanding).

i. Direct Synthesis

This approach proceeds by reconstituting the phenomenon from component parts in order to identify the underlying cause or to assure that the analysis which specified its component parts was correct.

Example: If the behavior under a fixed-interval schedule is thought to be the interaction between a schedule that is strengthening and a schedule that is weakening which are implemented concurrently. The direct implementation of such a schedule would reveal the supposition to be true.

ii. Modulation via Necessary Element

This procedure demonstrates the causal factors underlying a phenomenon by causing it to occur and to cease by introducing and removing a necessary element.

Example: You come to believe that the amount of your roommate's studying is under the control of your studying. You test this by studying and not studying on random days while you monitor the amount of studying in your roommate.

iii. Demonstration with Other Subjects or Species

This procedure demonstrates the causal factors underlying a phenomenon by demonstrating the phenomenon in animal models.

Example: Animal models could be used to demonstrate that language evolves and works the way we think it does. Some lower animal could be taught a language with grammatical rules.

b. Theoretical Synthesis or Paradigmatic Integration

This is the creation or synthesis of an explanation or theory. It is the integration of an event into a large coherent body of knowledge. A detailed treatment of what it means to explain a phenomenon is covered in Chapter 5. Theoretical synthesis is essential for the understanding of a phenomenon.

i. General Theoretical Model

This type of synthesis is the specification of how the phenomenon is thought to be caused and how it is thought to work. It is the model. This was what Aristotle referred to as a formal cause. It is the specification of a thing's implicit form or meaning through precise metaphors and models. It would include the

laws underlying or describing the action. The model can be reductionistic or correlative.

ii. Prediction

This type of synthesis demonstrates the correctness of a model or theory for something by making correct predictions based on those factors. If all of a model's predictions are supported and no findings are incompatible with the model, then the model must be considered as true as any other model with the same predictive success.

iii. Integration of Divergent Phenomena

This type of synthesis demonstrates the correctness of a model or theory for something by showing how that theory can make sense out of numerous phenomena which are otherwise intractable to explanation.

Example: It was shown that the explanation for credit card debt, flunking out of school, unwanted pregnancy, and substance abuse; were all understood with the notion of hyperbolic temporal discounting.

H. Conceptual Follow-Up: Epistemology, Generality, and Rigor

It is useful to position knowledge with respect to its generality of applicability, the degree to which it is based on empirical data, and the rigor of its methodological foundation. In that way, it is easier to know how much and in what way that information can be relied on.

