NINETY YEARS OF MENTAL METAPHORS[1]

Dedre Gentner
Bolt Beranek and Newman Inc.
Cambridge, Mass.

Jonathan Grudin
MRC Applied Psychology Unit
Cambridge, England

Abstract

In this paper we seek to trace the way in which psychologists's concepts of the mind have evolved over the roughly ninety years since the study of empirical psychology began in America. We examined metaphors used by psychologists to describe mental phenomenena, based on a corpus of mental metaphors used in the journal Psychology Review from 1894 to the present.

The chief finding was that the nature of the mental metaphors changed over time. Spatial metaphors and animate-being metaphors predominate in the early stages, declining later in favor of systems metaphors from mathematics, the physical sciences and artificial intelligence. A secondary finding was that the numbers of mental metaphors varied: They are more prevalent in the early and late stages of the century than in the mid-stages. These patterns are interpreted in terms of the evolution of psychologists' models of the mind.

Ninety Years of Mental Metaphors

In this paper we examine historical changes in the metaphors used by American psychologists to describe mental processes. Our aim is to use changes in metaphoric language to trace changes in the models psychologists have held of the mind. Three assumptions underlie this work. First, we assume that researchers bring to their field of study a theoretical framework -- which may be more or less explicit -- in terms of which they construe the phenomena they observe. Second, we assume that these frameworks can change over time, sometimes quite rapidly (Kuhn, 1962). Third, we assume that analogies and metaphors are used in the invention and organization of ideas in science (Gentner & Gentner, 1983; Hesse, 1966).

Cognitive psychology during the past hundred years seems a prime example of a field in which conceptual change has been rapid and extensive. It would be useful to have a method for tracing changes in the Zeitgeist. One way to do this might be by examining the metaphors used by psychologists. It has been argued persuasively that metaphors from other domains have played a role in the shaping of psychological theory. Roediger (1980) noted several distinct metaphors for human memory, ranging from Freud's rooms-of-a-house model to Atkinson and Shiffrin's storage-box model.

If indeed the metaphors used in psychology reflect the way that researchers have conceived of the domain, then changes in the kinds of metaphors used to describe the mind may provide an unobtrusive measure of changes in the conceptual paradigms used in American psychology. With this in mind, we undertook to collect a representative sample of metaphors of the mind. We chose as our source the journal Psychological Review, since it has a history of broad representation of major work in psychology that dates back to 1894. Thus, our project was (1) to sample Psychology Review

---

[1]Support for the preparation of the paper was provided in part by the National Institute of Education under Contracts No. HEW-NIE-C-400-80-0031 and HEW-NIE-C-400-81-0030.

systematically from 1894 to the present for mental metaphors; (2) to classify the resulting metaphors according to their base domain (their analogical domain, or domain of origin); and (3) to note any changes in the numbers or types of metaphors used across time.

The Survey

The volumes surveyed spanned nine decades, beginning with 1894, then 1905, 1915, and so on through 1975. We examined all articles in the first issue of each volume. All mental metaphors were recorded on their first occurrence in a given article. A mental metaphor was defined as a comparison in which either the mind as a whole or some particular aspect of the mind -- ideas, processes, etc. -- is or explained in terms of a nonmental domain. We included everything that seemed a possible metaphor, including many frozen or conventionalized metaphors, such as "mental health" or "intellectual level." In each article, only one instance of any given metaphor was collected. However, when several terms occurred in an extended metaphor, all of the terms were collected. An example of such a system occurs in James (1905). The phrases "an idea encountering a resisting idea," "an idea moving under its own momentum," and "ideas overcoming an obstacle" were each recorded, although they are clearly part of the same extended metaphor.

Categories of metaphors. Out of a total of 68 articles, 48 contained mental metaphors. We found a total of 265 metaphors for mental phenomena. After the set of metaphors was assembled, we sorted them into categories drawn from a common domain. The sorting was done by the content of the metaphors, crosscutting decade of origin. Where more than one category or subcategory might apply, we used the most central and specific features of the metaphor to select among alternatives. Our sorting yielded 20 subcategories, which combined into four major categories of metaphor: Animate-being metaphors (23 instances), Neural metaphors (16 instances), Spatial metaphors (61 instances), and Systems metaphors (80 instances).

In Animate-being metaphors, ideas or aspects of the mind are likened to creatures; e.g., "Through lying, the mind grows wary or strong from swimming against the stream." (Dewey, 1904). In Neural metaphors, the analogical domain is some version of the physical nervous system, as when it is stated that word meanings are stored as mental images "located in different regions of the gray cortex of the brain, and joined together in a unit by a series of association-tracts which pass in the white matter under the cortex" (Starr, 1894). or movement of objects in space, as in "things active against a background of consciousness" (Strong, 1894). Systems metaphors are those that liken some mental phenomenon to a system of lawfully constrained interactions among elements. Often, they draw on a physical or mathematical system or on an artificial device as their analogical domain: e.g., "fusion of ideas" (Peterson, 1935), or "critical band behaving like a variable band-pass filter" (Zwicker & Scharf, 1965) Instances from each of these categories are given in Table 1 for early, middle and recent periods.

In addition to the four major categories, there were two other categories: "Conventional" metaphors (71 instances) possible metaphors whose metaphoric associations seem to have been lost: e.g., "mental health" and "intellectual growth"; and "Idiosyncratic" or unclassifiable metaphors (14 instances).

Patterns of distribution. The major finding is a shift in the categories of metaphoric domains used over time. Figure 1 shows the number of metaphors used in each of the four major categories in each of the three tri-decade blocks. In the early samples, Spatial metaphors and Animate-being metaphors dominate. There is a sharp drop across time in the number of Animate-being metaphors, along with a less severe reduction in the use of Spatial metaphors. Systems metaphors show the opposite trend: Starting as an unimportant category, with 5 members in the first tri-decade, System metaphors gradually come to predominate. Statistical analyses indicate that

Table 1

Examples of the Four Major Categories of Metaphor by Tridecade.

Early: 1894-1915	Middle: 1925-1945	Recent: 1955-1975
ANIMATE		
10) Through lying, mind grows wary or strong from swimming against stream.	34) Reaction arcs block each other, varying in tension, until one waxes strong enough.	85) Super discriminating pre-perceiver who selectively prevents recognition.
11) Ideas struggle with one another.		85) Ego defenses.
NEURAL		
5) Associations among images like white matter connecting regions of gray matter.	34) Thinking is neural impulses shifting along associative fibers from one area to another	81) Inhibitory processes.
11) Wider ideas shortcircuit smaller ideas.	63) Anger shortcircuits excitation into the parasympathetic system.	81) Loudness perhaps proportional to number of mental impulses
SPATIAL		
11) Anything hiding in the background is not mental activity.	41) Habitual connections between ideas.	81) Critical Band is formed.
21) Tracing is to a photograph as memory is to immediate attention.	63) Fear inundates the sympathetic nervous system.	82) Reservoir model for Fixed Action Pattern.
SYSTEMS		
11) A body moves in empty space by its own momentum as when our thoughts wander at their own sweet will.	48) Nervous system is like a switchboard mechanism.	72) O = R/R + I, Where R = # of relevant elements I = # of irrelevant elem. O = conditioning constant
21) Associative force	49) Goal gradient: positive/ negative transfer.	94) Serial iterative operations

Animate-being, Spatial and Idiosyncratic metaphors decrease significantly in numbers. Systems metaphors increase across time. Neural metaphors and Conventional metaphors remain constant in number.

Variation in overall metaphor usage. A secondary finding is a U-shaped variation in the overall numbers of metaphors used in different periods. Metaphors for the mind are abundant at the outset of our sample (1894-1915), drop sharply from approximately 1925 to 1945, and rise to even greater numbers during the most recent tri-decade (1955-1975). The dip in mental metaphors during the middle third of our survey (1925-1945) seems part of a general decline in the use of mentalistic language due to the influence of behaviorism. Articles from this period tended to be straightforward reports of data, devoid of any discussion of the internal workings of the mind.

Conclusions

The most interesting finding is the shift in the kinds of domains from which metaphors were drawn. Why did systems metaphors replace the animate and spatial metaphors that predominated in the early stages? We turn now to consideration of the explanatory goals these metaphors were intended to serve. To begin with, we pose three questions that will serve to organize the discussion: (1) What is the function of metaphor in scientific explanation; (2) Are some explanatory metaphors better than others; and finally, (3) If so, have the mental metaphors in psychology improved over time?

In scientific exposition, an analogy can allow prediction by mapping known relationships from a familiar domain into an unknown target domain (Gentner, 1980; Gentner & Gentner, 1983). The predictive usefulness of a metaphor reflects not only the precision and plausibility of its correspondances, but also its systematicity: the degree to which its inferred predicates form a mutually constraining system. Systematicity is valued in scientific explication, because interrelations among the inferred predicates allow new predictions.

Have psychology metaphors become more systematic? A remark by William James (1890) suggests this possibility: "At a certain stage in the development of every science a degree of vagueness is what best consists with fertility." James and other earlier writers may have used metaphor in an expansive, less precise manner. Certainly some of the early animate metaphors seem to lack systematicity; for example, "Memory moves more easily from a name to a person [its referent] than the reverse, as a fish swims more easily from upriver down to the ocean." (Starr, 1894). In contrast, when the analogical domain is a mathematical or physical system, concatenations of immediate predictions into further predictions are possible. Algebraic metaphors such as the learning theory equation ($\theta = r/r+i$) are one example (Restle, 1955). The systematic nature of the analogical domain allows a set of interrelated predictions: e.g., that θ (the conditioning constant) should rise with the number of relevant elements (r) and decrease with the number of irrelevant elements (i); that the ratio of relevant to irrelevant elements should be $\theta/1-\theta$, and so on. The move towards systematic analogies was surely partly motivated by desire for this kind of predictive power.

Now we turn to the specific question of why, in recent times, computer systems metaphors have dominated over other systems metaphors. Certainly the adoption of these metaphors does not guarantee either rigor of application or interestingness of results. Use of the computer metaphor does not even guarantee avoidance of animism. Terms like "retrieving", "detecting" and "searching" can all describe human behaviors as well as machine operations, and this ambiguity is sometimes exploited in vague analogizing. It has been observed that an entire homunculus can be concealed within one processing box in a flow diagram (Mandler, 1978). Nevertheless, a computer analogy can represent a genuine simplification, if the powers of the individual processors are sternly limited. As Dennett (1978) puts it, "If one can get a team or committee of relatively ignorant, narrow-minded, blind homunculi to produce the intelligent behavior of the whole, this is progress."

It is tempting to conclude that there has indeed been a change in the "degree of vagueness" tolerated in modelling, and that the current analogies are more conducive to progress in understanding the mind. But, according to the thesis assumed here, our judgements must be cautious, since we see through the metaphors of our time. Our own frameworks remain to be evaluated.

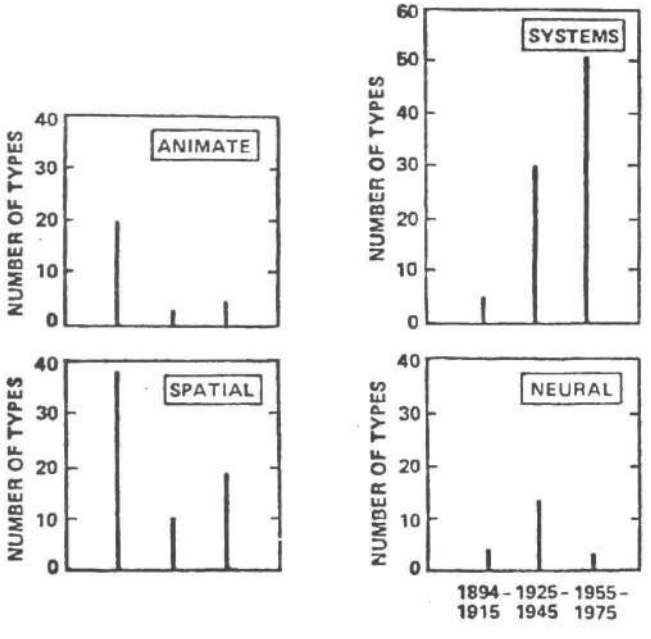

Figure 1. Numbers of metaphors in each tri-decade for each of the four major categories.

References[2]

Dennett, D.C. Brainstorms. Montgomery, Vermont: Bradford Books, 1978.

Gentner, D. & Gentner, D. Flowing waters or teeming crowds: Mental models of electronic circuits. In D. Gentner & A. Stevens (Eds.), Mental models. Hillsdale, N.J.: Erlbaum, 1983.

Gentner, D. Structure-mapping: A theoretical framework for analogy. Cognitive Science, in press.

Hesse, M. Models and analogies in science. South Bend, Indiana: University of Notre Dame Press, 1966.

James, W. The principles of psychology. New York: Holt, 1890.

Kuhn, T. The structure of scientific revolutions. Chicago: University of Chicago Press, 1962.

Lakoff, G. & Johnson, M. Metaphors we live by. Chicago: University of Chicago Press, 1980.

Mandler, G.A.,An ancient conundrum: Review of K.R. Popper and J.C. Eccles, The self and its brain, Science, 1978, 200.

Roediger, H.L. Memory metaphors in cognitive psychology. Memory and Cognition, 1980, 8, 231-246.

---

[2]To save space, references to surveyed articles from Psychological Review are omitted: they can be found in the first issue of their year of publication.