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Concepts of Memory

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Scientific research can be thought of as a game of communication involving two parties: scientists and nature. In some fields scientists do experiments that put questions to nature. If the questions are posed intelligibly, nature yields bits and pieces of clues and hints of answers. It is then up to the scientists to make sense of these bits and pieces, to have fruitful ideas about them, and ideally to come up with coherent descriptions of their subject-matter domain. In other situations, nature has voluntarily strewn bits and pieces of various answers around for the scientists to notice and to make up questions about them. The whole enterprise depends crucially on the cooperation of the two parties: nature's job is to provide the raw materials (data, facts, findings, observations) and the scientists' job is to make it meaningful by inventing and applying the mortar that binds the nature-given materials and man-made ideas (hypotheses, models, theories, conceptualizations) into complete scientific edifices.

The purely human side of science making ('theorizing') can be divided into two separate but intertwined branches. One consists of making up and answering 'what' questions about the domain of interest. The most basic form of this kind of question is 'What is *X*?' where *X* stands for any one of a very large number of words or expressions. In the science of memory, *X* could represent things such as accessibility, association, encoding, implicit memory, item, retrieval, source amnesia, working memory, and a long string of others. Other forms of 'what' questions arise in more closely circumscribed contexts. In the context of discussing, say, encoding, the question could be posed: 'Encoding of *what*?' In the context of remembering: 'Remembering *what*?' One can extend this series practically endlessly. These are not idle questions. Answers to them, or ideas about possible answers, shape the thinking of memory experimenters and theorists alike, and determine how the end products of research are recorded.

The other branch of theorizing consists of the construction of theories and models. In contemporary studies of memory these theories and models are typically descriptions and explanations of observed regularities in a chosen domain. The many chapters of this handbook are full of more or less complete theories and models of this kind.

This chapter is about concepts of memory. Concepts can be thought of as answers to 'what' questions. When we answer a question such as, 'What is implicit memory?' or 'What is it that people remember?' we have specified a concept, the concept of "implicit memory" in one case and the concept of, say, "previous experience" in the other. Both the premise and the thesis of the chapter is that conceptual

analysis of memory is as important to progress in the field as is gathering facts and constructing models and theories. Because little systematic work on concepts of memory has been done, and because there is almost no literature on the subject, the discussion herein is uncertain and tentative. Everything is subject to revision. Some previous musings, even more rudimentary than those here, can be found elsewhere (Tulving, 1979, 1985, 1991).

The chapter consists of six parts: 1. Why should we care about concepts? 2. Terms, concepts, and reality. 3. The concept of "memory." 4. Idioms of memory: behavior and cognition. 5. Priming and implicit memory: a case study. 6. Centrality of concepts. The six parts are followed by a conclusion.

Why Should We Care about Concepts?

With rare exceptions students of memory do not explicitly discuss the concepts they use in their work (Mitchell & Hunt, 1989; Gardiner & Java, 1993; also see Chapter 1 by Bower, and Chapter 3 by Lockhart). Given the premise of this chapter—that concepts play a vital role in any science, including ours—such a lack may seem surprising.

There are at least three reasons for the benign oversight of concepts in our field. First, we have managed to do pretty well so far without any formal analyses of the terms we use, and without fretting about the exact meanings of the concepts that the terms designate. The progress that we can call our own may have depended on the development and elaboration of concepts, but all this has occurred rather naturally, in the course of normal gathering of facts and making up theories about the observed phenomena. There is no evidence that the absence of any focused emphasis on concepts has been an impediment of any kind.

The second reason for the neglect of concepts lies in the fact that our research community as a whole does not perceive much value in conceptual analysis; there is no promise of social reinforcement for any single individual who might be attracted to the enterprise. Under the circumstances, clever people, especially if they are young, resist any temptation to get involved.

The third reason, mushiest of them all yet possibly most pertinent, is that conceptual analysis is far too easily judged, or instinctively felt to be scientifically irrelevant. Sure, one can wring one's hands over definitions and meanings of terms and usefulness of concepts, but real practicing scientists steer clear of such questionable intellectual neighborhoods. It is a game best left to philosophers, or linguists, or even semioticians who have much more time on their hands.

Note that psychologists' avoidance of concepts is highly specific to scientific or theoretical concepts as tools they use in their own day-to-day activity. Concepts formed and used by those that psychologists observe, in real life or in the laboratory, are embraced without embarrassment. Thus, concepts constitute basic components of network models of memory (Anderson & Bower, 1973; Balota & Lorch, 1986; Nelson, Bajo, & Canas, 1987), and topics such as concept learning (Smith & Medin, 1981), concepts and categories (Rosch & Mervis, 1975), conceptual processes (Roediger, 1989), and conceptual priming (Moscovitch, chapter 38 of this handbook) figure prominently in explorations of learning and memory.

Now, if it is true that students of memory have tacitly agreed to avoid conceptual analysis of their field, why should anyone wish to bother with it? Why a whole chapter on concepts in this handbook?

At least three reasons can be given. They are briefly mentioned here, and elaborated throughout the rest of the chapter. First, formal and focused attention paid to concepts is highly likely to result in greater terminological and conceptual clarity of thought and communication in the discipline. Right now there is altogether too much confusion in this respect. Given that we have trouble enough to coax nature to do its part in the joint venture, why should we compound the difficulties by deliberate carelessness on our own part? Second, concepts are crucial components of theories of memory, and therefore the goodness of our theories depends on the goodness of concepts. No sound concepts, no sound theory. The third reason has to do with our self-respect as students of memory. Surely one thing we should strive for are as clear and useful terms and concepts as we possibly can have at any given stage of the development of our science. Surely one thing we should avoid as much as possible is sloppiness and vagueness in our thinking about what the terms we use stand for. How can we respect ourselves, and how can we expect other scientists to respect us for what we have achieved, if the language we speak frequently sounds like babel?

It is widely accepted that the maturity of any scientific discipline is reflected in the maturity and sharpness of its terms and concepts (Holton & Brush, 1973; Mayr, 1982). Although our terms and concepts cannot be better than what the current stage of the development of our field allows, it also need not be worse than that. If we wish to see our discipline grow and blossom, we have to start paying attention to 'what?'

Terms, Concepts, and Reality

Concepts, like most other good things in life, come in many different forms and varieties, and they can be thought about in many ways. In order to optimize communication, some comments about the concepts of "term" and "concept" are necessary. These comments are based on Mario Bunge's lucid (1998, chap. 2 & 3) presentation and discussion of scientific concepts from the point of view of philosophy of science. His thorough conceptual analysis of terms and concepts, their place in scientific language, classification and taxonomy, systematics of concepts, vagueness and sharpening of concepts, definition and interpretation, and elucidation of concepts—a main mission of science—cannot help but enlighten every thoughtful scientist and is therefore highly recommended. Here only the barest outline of the central ideas can be given.

Bunge (1998) distinguishes among linguistic, conceptual, and physical levels of analysis, and uses the word *designation* to describe the relation between the linguistic and conceptual levels, the word *reference* to describe the relation between the linguistic and conceptual levels on the one hand and the physical level on the other hand, and the word *denotation* to represent the union of *designation* and *reference*. He further suggests using the convention of enclosing linguistic entities ('terms') in single quotes and conceptual entities ("concepts") in double quotes. Bunge's three-dimensional concept-space and terminological conventions are observed in this chapter wherever possible because they greatly contribute to the clarity of communication. Thus, a reader familiar with these distinctions who compares one sentence (such as, 'X' designates "Y") with another (such as, "X" refers to Y), will know something that a person unaware of the subtle but important distinction possibly cannot. Such purity, of course, is not always possible: we live in an imperfect world and are coping with pesky problems in an unfinished science.

At any rate, Bunge's (1998) analysis means that it is necessary to distinguish, as clearly as possible, among three kinds of interrelated existences: (1) *things*, entities existing in the *real world*; (2) *concepts*, entities existing in the form of pure abstract *thoughts* about real-world entities; and (3) *terms*, linguistic or other symbolic *signs*, entities that also exist in the real world but whose sole function is to denote concepts and their associated real-world correspondences. One interesting implication inherent in this conceptualization of the term 'concept' is that it would be most unusual for two individuals to completely share—that is, agree on the meaning of—any complex concept. Once we realize this fact and keep it in mind at all times, we can take appropriate precautionary measures and thereby simplify our lives.

It is important to emphasize at this point that real-world existences include purely mental, phenomenal *experiences*, of the kind that have been usually labeled as 'subjective.' Thus, the feeling of warmth or pain by a sentient organism, and seeing red or hearing the sound of the waves crashing on to the shore, are kinds of real-world entities that one can have thoughts about (make up concepts about) and can designate by signs. They are nonphysical in the standard sense of the term, and they differ in basic ways from physical objects and events, yet they are part of the real world because they exist, as products of neural activity, in the four-dimensional space-time continuum, and they do so independently of concepts referring to them or signs designating them. For scientific purposes it is immaterial whether their existence is observed directly or is inferred from indirect evidence.

In brief, in this chapter, the 'concepts of memory' under scrutiny are *pure abstractions*, in the sense that they have no other existence than that in the minds of individuals. Concepts do not exist in any form in the real nonabstract world. To render them amenable to rational analysis, however, they are connected to the real world in two ways: they can be designated by signs (words or other symbols) and they refer to (are associated with) objects, situations, and events in the real world.

The Concept of "Memory"

Given the three-dimensional concept-space in the science of memory—term, concept, and

brain/behavior operations—difficulties arise not within a single dimension but between them. The one that occurs most frequently is the one-many relation between terms and concepts: one and the same term is used to designate many different concepts.

The problem has been discussed by Gardiner and Java (1993), who pointed out that a common source of confusion in theoretical discussions lies in the failure to make necessary terminological distinctions. Frequently, they argue, the same term—for example 'implicit memory'—is applied to (1) both memory tasks and memory systems, (2) both memory systems and memory processes, (3) both memory processes and the state of the rememberer's awareness, and (4) both states of awareness and memory tasks. Such indiscriminate use of a single sign to denote rather different concepts does not just breed confusion, it also is directly responsible for needless and frequently counterproductive arguments.

Gardiner and Java (1993) propose a rule of *incontrovertibility of terms*: any given term should be allowed to denote only a single concept or entity. Thus, if 'implicit memory' refers to a memory task in which the subject has no need to remember any particular past event, then terms such as 'implicit memory system' or 'implicit memory processes' should not be used. If, on the other hand, 'implicit memory' designates a particular process of retrieving stored information, then it should not be used in any other sense.

The idea of a rule such as *incontrovertibility of terms* is admirable, and beneficial, in more ways than one. In a perfect world its merits would not be even debated (although its label might be shortened). However, in the real world, it would be difficult to effect the general acceptance of the rule. There are powerful forces of history and tradition that militate against such rational behavior. As an illustration, consider the term 'memory' that designates the central concept of all the chapters in this handbook. What does it mean—that is, how is it used by students of memory?

The term 'memory,' in addition to denoting a field of study, can designate a number of different concepts. Among the more frequently occurring meanings of 'memory' are (1) memory as neurocognitive capacity to encode, store, and retrieve information; (2) memory as a hypothetical store in which information is held; (3) memory as the information in that store; (4) memory as some property of that information; (5) memory as a componential process of retrieval of that information; and (6) memory as an individual's phenomenal awareness of remembering something. In addition there are other senses in which writers use 'memory,' although such uses tend to be idiosyncratic.

Let us consider more concrete illustrations of these various concepts of "memory." Thus, when one speaks about 'testing a patient's memory' or about 'profound losses of memory,' one usually has in mind 'memory' in the broad sense of *"neurocognitive capability"* of a particular kind, one that is related to but separable from other neurocognitive capabilities such as perception and thought.

When one speaks about things such as 'encoding information into memory' or 'retrieving information into memory,' one usually has in mind, not the overall memory capability as such, but rather something more properly referred to as *"memory store."* (People who worry that the word *store* implies the acceptance of spatial (Roediger, 1980) or warehouse (Tulving, 1983) metaphors of memory can relax: it is perfectly possible to define "memory store" as a stage of information processing between encoding and retrieval.)

The term 'memory' in expressions such as 'amnesia is like normal memory weakened by reduced study time,' or 'memory changes after initial learning,' or 'memory decays rapidly,' or 'medial temporal damage affects recently acquired memories more than memories acquired long ago,' designates neither the overall capacity nor the memory store. Instead, the term 'memory' in these expressions corresponds to something like *"the information stored about an item or an event."*

Propositions such as 'time in the short-term store is not a major determinant of memory,' or 'memory is a function of depth and elaboration,' are not claims made about memory as a capability, or the memory store, or the nature and kind of information in the store. Instead these sorts of claims refer to a certain hypothetical property of the stored information, something that more specifically could be thought of as the *"strength" or "accessibility"* of "the memory trace" of an item or event.

When 'memory' occurs in an expression such as 'signal-detection theory enables us to separate the subjects' performance into two components, memory and decision,' it designates a hypothesized component of the *process* of retrieval.

Finally, 'memory' in an expression such as 'memory without awareness' designates the

experiential (phenomenological) flavor of the act of retrieval. As discussed by Roediger and McDermott in chapter 10 of this handbook, this kind of memory can be experienced even when the remembered events did not happen.

In most cases, the context within which a proposition is made is sufficient to specify the particular sense in which 'memory' is used: general capability, memory store, memory trace in the store, property of the memory trace, a process of retrieval, and phenomenal experience at retrieval, or what not. In the absence of adequate supporting context, the meaning of memory may, of course, remain unclear. Thus, for example, just reading that 'memory is largely a function of depth and elaboration' does not in itself provide information as to whether reference is made to the contents of an engram, the strength of the memory trace, the probability of recall or recognition, or something else.

Ideally, of course, we would curtail the abandon with which the central term of our discipline is used, and instead of the general term 'memory' would use terms such as memory store, stored information, memory trace, trace strength, mnemonic information (as one of the determinants of measured recognition performance), and recollection. It would aid communication and free time for more fruitful pursuits. It would also help outsiders who may now wonder how it is possible to have memories that contain memories that contain memories, a state of affairs logically embedded in the nexus of concepts of "memory" as discussed.

Idioms of Memory: Behavior and Cognition

We consider now another vital conceptual distinction that must be made in the study of memory. The distinction—yet another dichotomy, which we know that scientists love even if nature does not—pits pure action against pure thought, or behavior against cognition. People and other animals can acquire, through learning and memory, a wide variety of *behaviors* that are useful for their survival. They can also acquire a great deal of *knowledge* about the world in which they live and survive, and in which they practice their learned behaviors along with innately determined ones.

Reflection, as well as the results of a good deal of objective study, reveal that it is perfectly possible for people to engage in highly complicated forms of learned behavior without anything resembling the corresponding knowledge. Young children's ability to speak grammatically is one of the most obvious examples. An outfielder catching the near-home-run ball near the top of the high back fence of the field is another. The outfielder can talk about his feat in a way that a young child cannot, but such a verbal description is secondary (epiphenomenal) and plays no role in the execution of the highly skillful behavior. On the other hand, two masters can play chess without the board and pieces, entirely within their own minds. They need to rely on overt behavior only to communicate the results of their thoughts to each other, and for the loser to congratulate the winner at the end! In this situation behavior is an incidental by-product (epiphenomenon) of the exercise of thought.

A basic conceptual issue has to do with whether 'memory' whose operations are expressed purely in behavior, in the absence of corresponding (conscious) thought, can be regarded as the same kind of 'memory' whose operations are expressed in pure thought, in the absence of any *necessity* to convert the thought into behavior. That is, the issue concerns the extent to which the two *idioms* of memory, behavioral versus cognitive, mark the boundaries of rather different domains within which the search for unifying principles may turn out to be difficult if not futile. The concept of "idiom" of memory is introduced here to facilitate communication. 'Idioms of memory designate the particular ways in which memory manifests itself, or the mode in which the products of memory are expressed. The three main "idioms of memory" are related to behavior, knowledge, and remembering. Here the focus is on the contrast between behavior and knowledge. Analytical and empirical comparisons between knowledge and remembering can be found elsewhere (Tulving & Markowitsch, 1998; Wheeler, Stuss, & Tulving, 1997).

The basic distinction between behavior and cognition, or action and thought, is reflected in the distinction between procedural and declarative (cognitive) forms of memory, which is universally accepted today. Hodges (chapter 28), as well as Mayes (chapter 27) and Markowitsch (chapter 29) discuss neuropsychological evidence pertaining to the distinction. Schacter and his colleagues (chapter 39) describe neuronal correlates of procedural and declarative memory as revealed by functional brain imaging methods.

Why is the distinction between the two idioms of memory important?

Apart from the fact that it contributes to terminological clarity and hence enhances the quality of communication, the distinction has a number of practical implications. Its main advantage lies in the needed constraints it places on facts and theories. Behavioral and cognitive memory have features in common (otherwise we would not classify both as memory), but they also differ in many ways. One consequence of these differences is that not every question that can be posed for one idiom makes sense in the other, and not every fact that is true of one idiom is true of the other. Keeping behavior apart from cognition frees us from the necessity of going through unnatural contortions if we tried to speak the same kind of language about both of these forms of memory. In the cognitive idiom, it is natural to speak about encoding and storing of information that represents what there is or could be in the world, as it is to speak about retrieving bits and pieces and various aspects of such information. The study of encoding, retrieval, and their interaction has occupied center stage of the cognitive idiom of memory for a long time, as many chapters in this handbook demonstrate (see especially chapter 6 by Brown & Craik). Trying to bring these concepts into play in the study of, say, behavioral skills such as reading or writing is awkward at best and silly at worst.

Consider another example. A great deal of experimental and theoretical effort has been devoted to the study of recall and recognition tests and processes assumed to underlie the performance on these tests. But the whole problem complex can arise only in the cognitive idiom, in situations where subjects' *thoughts* about the products of retrieval can be expressed in the production (recall) of appropriate responses or in the proper identification (recognition) of test items. The distinction between recall and recognition is devoid of meaning in the behavioral idiom. There is no way of telling whether a monkey in a delayed-matching-to-nonsample test (see chapter 30 by Zola and Squire) is engaged in recall or in recognition. The same argument applies to studies with human infants, described by Rovee-Collier and Hayne in chapter 17. Infants are capable of learning to make responses that activate the mobile, and they respond differentially to familiar and novel mobiles. But there is no way of classifying their task as that of recalling or recognizing.

The point is that fundamental distinctions that have occupied the focus of experimental and theoretical attention in the cognitive idiom of memory for a long time are meaningless in the behavioral idiom. We are well advised, therefore, to explicitly conceptualize behavioral memory different from cognitive memory. Unless we do so, we run the risk of tacitly assuming that behavior and knowledge are highly correlated ("the doctrine of concordance"; Tulving, 1989), and end up playing Procrustes in modern times: our ideas will end up mutilated.

Priming and Implicit Memory: A Case Study

A persistent theme of this chapter is that one can take any one of a very large number of terms that one finds in the memory literature and subject it to a thorough analysis. In many situations such action, of course, would border on madness; in some situations the payoff would not be worth the cost, but in many other situations the exercise might be worth while. As a case study let us consider the topic of priming and implicit memory.

An exceedingly important ability that organisms must possess in order to survive is that of responding discriminatively to different environmental stimuli. The first requirement for taking appropriate action about objects encountered in one's surroundings is telling them apart. In humans, whose environments have been largely shaped by civilization and culture, this ability has reached a very high level of development at which an adult has learned to identify, and discriminate among, tens upon tens of thousands of different objects.

'Identification,' like any other term, can be defined in many different ways. Here it means the assignment of a given object to a specific conceptual category. The category itself has to be socially shared rather than idiosyncratic, to distinguish object identification from, say, episodic-memory recognition where the categories "old" and "new" are specific to the individual in a given situation. But within such socially shared categories, many classifications are possible. A two-dimensional visual object may be categorized, and thus identified, as an indistinct blob, a roundish shape, a face, a human face, the face of a woman, a familiar face, the face of a well-known movie star of the past, the face of Marlene Dietrich, the face of my great-aunt. This ordering illustrates two

points. One, a general term such as 'familiarity' (one of the most frequently used terms in the memory literature) designates a large number of different concepts. The face of a complete stranger is a familiar object in one sense, the face of my great-aunt is familiar in another sense. Two, and more directly relevant in this context, in any discussion of object identification it is mandatory to specify the concept to which the term applies.

In the laboratory, the subject is typically informed of the general nature of the relevant supra-category and the question put about each stimulus, 'What is this object?' The subject responds by naming or in some other way describing the appropriate subcategory. Various derivatives of the basic question are also used: 'Is this object X?' (e.g., 'Is this string of letters a word? Does this word represent a living thing?), or 'Tell me about objects in category X' (e.g., 'Name words beginning with letter "L", or 'List all the Presidents of U.S.', or even 'Draw a house'). The study of variables affecting identification of objects has been a favorite pastime of psychologists for ages. Many different kinds of objects and many different tasks of object identification have been used. In perceptual identification tasks, the examiner shows the subject a Mooney figure and asks whether it represents a face or not, or flashes a word on the screen and asks the subject to name the word. In clinical tests, patients suspected of suffering from agnosia are shown pictures of common objects and the patient asked to name them. In intelligence (knowledge, language, vocabulary) tests, subjects are asked questions: What does 'tranquil' mean? What is another name for interstellar space? What is the capital of France? Do you know two European capitals whose names have the same two initial letters and the same three final letters? In studies of semantic memory, the participant may be asked: Name colors, or writers, or famous singers. Do canaries have wings? Is X famous for any reason?

In all of these cases the respondent's success on the identification task depends on relevant skills and knowledge, and on the nature of the information provided. For an adult to answer the question about the capital of France comes effortlessly, whereas the question about the two other capitals with similar names is difficult, despite the fact that everyone knows the two names. (This last example illustrates the problems involved in the concept of "identification" but also those in the concept of "knowing."

Memory—more precisely, cognitive memory—is relevant to the issue of object identification in two ways. First, the knowledge base whose use makes the answering of identification questions possible is clearly a product of (cognitive) memory. (Note that there is no generally accepted term that designates this knowledge base. What should it be called, other than the ungraceful and vague 'knowledge base'?) Second, changes in this knowledge base (expansion, enrichment, elaboration, refinement, as well as reduction, impoverishment, degradation) occur continuously throughout life, and some of these changes can be observed, analyzed, and measured in the laboratory and in the clinic, in studies of memory. One such change is known as priming.

Priming and Object Identification

Priming is the name of the hypothetical process that underlies an observed improvement in identification performance that is attributable to previous experience. It is also used as a term to denote such improvement. There are three general categories of situations in which priming has been studied. One kind of priming is studied in a paradigm introduced by Meyer and Schvaneveldt (1971). It is described and discussed by Balota and colleagues in chapter 25, under the label of 'semantic priming.'

The second kind of priming occurs in connection with the use of successive tests. The idea is that the first test, say yes/no recognition, may affect the subject's performance on the second test, say cued recall, resulting in the second-test performance that reflects both the initial study and priming by the first test (Humphreys & Bowyer, 1980). This kind of successive-test priming is discussed by Kahana in chapter 4.

The third type of priming, currently the most intensely studied one, has to do with *identification* of objects in the sense of answering the question 'what?' about a presented stimulus. The spirit of the question put to the subject in a test for priming is *always* this: 'I am thinking of an object. Indeed, it is recorded here on my answer sheet. I want you to tell me what it is. Here is a clue about the object. What is the object?' The subject also usually knows the *general* category to which the *target* object is to be assigned: it is the name of a place or a person, or an English word, or a line drawing of a concrete thing, or

the photograph of a celebrity, or whatever. (See table 16.1 in Toth's chapter 16 for an extensive listing.)

Initially the type of priming that is observed in these kinds of situations was referred to as 'repetition' priming, because the clue at test was seen as a kind of a repetition (even if partial or fragmentary) of the target item (see Bower, chapter 1, and Lockhart, chapter 3). Actual repeated presentation of the to-be-identified objects, however, occurs only in some priming tasks. For example, picture naming (Mitchell & Brown, 1988) and lexical decisions about pairs of words (Goshen-Gottstein & Moscovitch, 1995) are faster when the picture or pair is presented for the second time in a particular context. Similarly, after reading a word in a list, the subject is more likely to produce that word when a conceptually related clue is given and the subject instructed to say the first word, or the first *n* words, that 'comes to mind.' In many other priming situations, however, no such direct repetition of stimuli between study and test occurs, and 'repetition' priming is a misnomer. More appropriate are labels that identify the nature of the clue used in the identification task. The two major categories are 'perceptual' and 'conceptual' clues, and accordingly a distinction is drawn between 'perceptual' priming and 'conceptual' priming (Roediger & Blaxton, 1987; Tulving & Schacter, 1990; also see Toth, chapter 16).

Priming and Implicit Memory

As mentioned earlier, the knowledge base that makes identification of objects possible is *acquired.* It is a *result of* learning: perceptual learning for identification of an object on the basis of its appearance; conceptual learning for the identification of an object on the basis of its meaning. This is as true of experimentally nonprimed as it is of experimentally primed identification.

Many experiments have demonstrated that the use of previously acquired knowledge for the purpose of object identification can be totally independent of remembering the past (Toth, chapter 16). Normally, indeed, people are oblivious to the fact that any memory of any kind is involved in perceiving an object, regardless of whether such perceiving has been experimentally primed or not. They are retrieving (using) stored information, but are not aware that they are doing so. Therefore, object identification, whether specifically primed or not, could be said to represent an instance of 'implicit retrieval' (Schacter, 1987).

Although this proposal should be generally acceptable to all students of memory, it is not. Whereas there is little disagreement in the literature concerning the implicit nature of priming, there is considerable disagreement as to whether (unprimed) retrieval of information from the general knowledge store is to be thought of as implicit or explicit. Many writers take the stance that, for example, identifying Paris as the capital of France represents an instance of explicit retrieval because the subject is fully aware that she is relying on her (semantic) memory when she answers the question or thinks of the fact on her own. These writers believe that only *changes* in this knowledge occur implicitly. Thus, nonprimed retrieval is explicit, priming is implicit.

On the other hand, there are others who believe that both unprimed and primed retrieval of semantic information, such as that concerning Paris, should be thought of as implicit, in keeping with the definition of 'implicit' in terms of the individual's lack of awareness of the nature of the relation between a current identification task and any previous happening (Graf & Schacter, 1985). This definition is satisfied in typical situations in which the individual retrieves information from the general knowledge store, regardless of whether the information is used for object identification or for answering questions about the world, and regardless of the priming status of the information.

The disagreement here—is retrieval of "unprimed" semantic information explicit or implicit?—clearly has its roots in different concepts of "implicit memory." If 'implicit' is conceptualized in terms of the individual's lack of awareness of the relation between current performance and any previous event (Graf & Schacter, 1985), then answering the Paris question clearly is an instance of implicit retrieval. If, on the other hand, 'implicit' designates the individual's lack of awareness that he is now retrieving previously acquired knowledge, then answering the Paris question is not an instance of implicit retrieval. Both views may be held, of course, but not by the same person at the same time.

Centrality of Concepts

In the last section of the chapter we return to the issue of the central role that concepts play

in living science, and consider yet another example that involves the concept of "memory."

As is well known, there exist today two large classes of students of memory—those who believe in a unitary memory and those who believe in multiple memories. They can be differentiated in terms of their answers to the question: 'What is memory?' (Tulving, 1999). They can also be distinguished by analyzing the terms they use. Thus, for example, unitarians use terms such as 'direct' (or 'explicit') versus 'indirect' (or 'implicit') *measures of memory* (Richardson-Klavehn & Bjork, 1988), on the assumption that memory is one, but the ways in which it can be measured vary. Believers of multiple-memory systems, on the other hand, would claim that an expression such as 'direct versus indirect measures of memory' makes no sense, because there is no such single thing as memory. They would argue that different aspects or operations of different kinds of memory can be measured in different ways, and that it can be done with respect to changes in stored information originating in a given event.

The issue of unitary versus multiple memory systems is hotly debated at the present time (Foster & Jelicic, 1999), and it revolves around the concept of memory, around the answer to the question of 'what is memory?' The kind of answer one gives, or calls his own, regardless of the manner of its articulation, has fundamental implications for how one proceeds in one's study of memory.

For a unitarian, an interesting finding might be that even when an event cannot be retrieved consciously, as in a recall or recognition test, it may nevertheless be retrieved nonconsciously or implicitly. The important word in the immediately preceding sentence is *it*. The task now necessarily becomes that of explaining the dissociation. Hundreds of experiments can be conducted to find out how different conditions affect the presence, absence, or the magnitude of the dissociation. The task dissociation, say one between 'aware' and 'unaware' memory, has become a *phenomenon to be explained.*

A multiple-systems person, who begins with the idea that there are many different memory systems and subsystems, has a different research program. As a unitary-system person seeks to describe and understand all of memory, so the multiple-systems person seeks to describe and understand each different system, and to ascertain their similarities and differences. Multiple-systems people would not spend much time trying to explain (answering 'how' and 'why' questions) about dissociations between aware and unaware memory tasks for the same reason that they would not wonder about the meaning of dissociations between, say, vision and audition. Vision and audition are different evolved adaptations by which organisms receive and internalize information about their environment, and there exist no a priori reasons to expect that they operate according to the same principles, although there may be some similarities. Different forms of memory, or different memory systems, are different evolved adaptations by which organisms can benefit from past experiences in meeting the exigencies of the present situation, and there exist no a priori reasons to expect they operate similarly in every respect. Therefore, the dissociation between aware and unaware memory is not a phenomenon to be explained; rather, it is an *item of relevant information* by which properties of different systems can be identified.

The point is that the debate concerning unitary and multiple memories is not something that would clearly or directly benefit from doing experiments and constructing process theories or models. The debate is to a large extent a conceptual one. Because there exist no practical criteria that could be used to assess the truth or goodness of concepts and terms, and no useful rules for judging the correctness of answers to the 'what' questions, it is not possible for anyone to adjudicate the various disagreements and conflicts that openly enliven the happenings on the conceptual scene or that lie hidden behind theoretical debates in memory research today. As always in science, the merits of different ways of classifying and thinking about things in the broad domain of memory will become clear only in the future.

Concepts of memory are continually molded and shaped by empirical findings in the field, and by people's thoughts about the findings. However, experience suggests that conceptual changes in memory research occur with the speed of the movement of tectonic plates. Although it is not entirely unknown for an individual scientist to radically alter his or her ideas about 'what *X* is,' the usual mechanism for conceptual change lies in the gradual flow, and passing, of generations of practitioners.

Under the circumstances, where the world in which we live and work cannot be changed, and where we cannot change our basic convic-

tions as to *what* the entities are that we study and work on, we must be alert to two things that are perfectly possible: (1) making sure that we understand the similarities and differences between each others' terms and concepts; and (2) making sure we understand the nature of debates and disagreements: Are we arguing about 'how' and 'why,' or are we disagreeing about 'what?'

Conclusion

In science, 'what' questions are at least as important as 'how' and 'why' questions. 'What' questions are about concepts. In the science of memory, as in any other field, terms and concepts play a central role in shaping the inquiry and articulating its fruits.

In the past, relatively little explicit attention has been paid to terms and concepts. As a result, problems have arisen. A frequent source of confusion lies in the use of one and the same term to designate rather different concepts. The term 'memory,' for example, has at least six, and probably many more, clearly different meanings. Sometimes important concepts cannot be discussed because of the lack of appropriate terminology. Thus, although behavioral and cognitive memory clearly represent rather disparate entities, and although differences between them are generally accepted, the language for comparing them is not clearly available. In this chapter the two are thought of as two of the main three *idioms* of memory, remembering representing the third.

The conceptual issues that face today's memory researchers are illustrated with the analysis of a paradigmatic case study of object identification, priming, and implicit memory—terms that are among the most popular ones in the contemporary science of memory.

A final illustration of the centrality of concepts involved the distinction between unitary and multiple memory systems. This distinction has led to a heated debate that to many appears to be revolving around interpretations of facts and explanations of phenomena, but which in fact is rooted in a conceptual disagreement. The different concepts of the parties have led to radically different research programs.

The terms and concepts of memory that have been useful in the pursuit of the understanding of nature's secrets have evolved as natural by-products of the normal data-gathering and hypothesis-making activities of students of memory. The time may be ripe now to switch from the hunting and gathering mode to one of planned cultivation.

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