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Varieties of consciousness and levels of awareness in memory

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Consciousness as an object of intellectual curiosity is the philosopher's joy and the scientist's nightmare. It is delightfully easy to generate all sorts of thoughts about consciousness, thoughts that can be related to other thoughts, supported by logical arguments, and illustrated with suitable anecdotes. It is distressingly difficult to come up with any hard data that clarify such thoughts by sorting out useful from less useful ones or, even more desirably, eliminating some thoughts as false altogether.

The problems plaguing the study of consciousness are well known. They include uncertainty as to what consciousness is, the uncertainty concerning its general status in the biological or psychological order of things, doubts about reliability and validity of empirical observations claimed to be "about" consciousness, the multitude of ways in which these observations can be interpreted, the difficulty of measuring consciousness, and many others. A pervasive symptom of the current state of affairs is the permeation of discussions of consciousness with intolerable vagueness.

One possible reason for the rather chaotic state of affairs in the scientific study of consciousness has to do with the widely accepted implicit assumption that consciousness is in some sense unitary, the assumption that consciousness is consciousness is consciousness. In this view, the major defining characteristic of consciousness is its distinction from the unconsciousness. Although theorists sometimes go beyond a simple "contrastive analysis" between conscious and unconscious processes (Baars, 1988), and differentiate between "levels" of consciousness—for instance, conscious, preconscious, subconscious, and unconscious processes (Kihlstrom, 1987)—these levels typically represent quantitative degrees of the same qualitative entity. Thus the prevailing view is that of a homogeneous consciousness, that is, that there exists a "single conscious mechanism" (e.g., Schacter, McAndrews, & Moscovitch, 1988, p. 270). This assumption is manifest in the tendency to describe and discuss consciousness as an undivided whole, to ask what consciousness is, how it is to be defined, what it does, what functions it serves, where in the mental activity it appears or does not appear, and how and in what sense it differs from nonconsciousness (e.g., Baars, 1988; Mandler, 1975; Marcel & Bisiach, 1988; Velmans, 1991). At the early stages of inquiry this was a perfectly reasonable orienting attitude. But today it is less appropriate.

Every now and then the assumption of unitary consciousness is questioned. For instance, Churchland recently observed that "what we now lump together as 'consciousness' may not be so much a unitary phenomenon admitting of a unitary explanation, but a rag-bag of sundry effects requiring a set of quite different explanations" (Churchland, 1988, p. 281). Similar opinions have been expressed by a few others as well (e.g., Allport, 1988; Farthing, 1992; Gazzaniga, 1985) but they have not yet become a basis of concerted action at the empirical level.

In this essay I will explore the possibilities of a more analytical, and less synthetic, approach to the study of consciousness. I do so by (a) dealing with consciousness as it manifests itself in phenomena of memory, (b) distinguishing between consciousness and awareness as separable concepts, and (c) exploring the notion that different forms of memory and different aspects of the operations of memory are correlated with different kinds of awareness. The general issue that ties together the various strands of the argument concerns the meaning of the claims that some forms of memory are "conscious" whereas others are "nonconscious." This kind of claim is frequently made, but it has not been sufficiently explicated. What does it mean?

The essay consists of five main sections, in addition to the present introduction and a final summary and conclusions: (1) Multiple memory systems, (2) Conscious awareness and memory, (3) The relation between consciousness and awareness, (4) Semantic "learning" without noetic awareness? (5) The coordination hypothesis.

Multiple Memory Systems

Everybody knows about Donald Broadbent's "Perception and Communication," a book that changed the history of experimental psychology (Broadbent, 1958). Everybody also knows about the distinction that he made in the book, between the S system and the P system. It represents an early important step on the road that psychology has taken toward the acknowledgement of the biological reality of modularity of the brain.

The early dichotomies between short-term and long-term memory and other similar distinctions have now developed into more complex classificatory schemes. These schemes in their various current versions (e.g., Roediger, 1990; Squire, 1987; Squire & Zola-Morgan, 1991; Tulving, 1987; Tulving & Schacter, 1990, in press; Weiskrantz, 1987, 1990), represent tentative resolutions of what now, 30 years after "Perception and Communication," has turned into one of the hot issues of the science of memory—how many different forms of learning and memory, or how many systems, are there?

Memory systems are defined in terms of property lists, statements of the kinds of behavior or cognitive information they "deal with," the characteristics of their operation, and their neural basis (e.g., Sherry & Schacter, 1987; Squire, 1987; Tulving, 1984; Tulving & Schacter 1990; Weiskrantz, 1987, 1990). Different systems usually collaborate in the execution of tasks that confront the individual in its interaction with the environment. The untangling of the web of the complex system/task interactions is a major objective of the systems-oriented research. The relevant evidence is provided by empirical observations at different levels of analysis, in different divisions of neural, behavioral/ cognitive, and computational sciences. Various aspects of this evidence have been reviewed by Mitchell (1988), Polster, Nadel, and Schacter (1991), Schacter (1987, 1990), Sherry and Schacter (1987), Shimamura (1986), Squire (1987), Tulving (1987), Tulving and Schacter (in press), Tulving, Hayman, & Macdonald (1991), and Weiskrantz (1987, 1990), among others.

A classificatory scheme of five major memory and learning systems is shown in Table 1. The five are procedural memory, perceptual representation system (PRS), short-term memory, semantic memory, and episodic memory. Table 1 also shows some other closely related terms. Each of the five systems is large and complex, comprising a number of subsystems for which evidence at the present stage of our knowledge is of variable quality, as it is for the main systems themselves.

Table 1 about here

The ordering of these systems in the overall classification scheme corresponds roughly to their presumed developmental sequence, with the procedural system the earliest, and the episodic the latest. The ordering of the systems also reflects the conjectured relations among the systems: the operations of the higher ones depend on, and are supported by, the operations of the lower ones, whereas lower systems can operate essentially independently of the higher. The systems are also assumed to vary, roughly in the same order, either with respect to the extent to which their operations involve consciousness, conceived in its unitary formulation, or with respect to the kinds of consciousness or awareness that accompany their functions.

The procedural system is an action system. Its operations are expressed in behavior; they can occur independently of cognition, and do not require conscious awareness of a kind that characterizes non-procedural memory (Cohen & Squire, 1980; Squire, 1987). The other four are cognitive systems. Their operations are expressed in cognition, independently of behavior. (1) Perceptual (repetition) priming is a nonconscious form of learning that consists in the facilitation of perceptual identification of words and objects. It is subserved by the perceptual representation system, PRS (Schacter, 1990; Tulving & Schacter, 1990). PRS is a pre-semantic system, that is, its operations can be carried out independently of the semantic and other higher memory systems. (2) Short-

term memory retains perceptual and conceptual information for a period of time measured in seconds after the input. It makes possible a lingering conscious awareness of recently presented stimuli, or of recently contemplated thoughts. It is dissociated from long-term (episodic and semantic) memory (Shallice & Warrington, 1970; Shallice, 1988). (3) The semantic memory system makes possible acquisition, retention, and use of organized information in the broadest sense; its principal function is cognitive modelling of the world (Lockhart, Craik, & Jacoby, 1976; Tulving, 1983). (4) Episodic memory shares many properties with semantic memory. It depends on semantic memory for many of its operations, but it also uniquely transcends the range of the capabilities of semantic memory (Kinsbourne, 1989; Kinsbourne & Wood, 1975; Tulving, 1983, 1987; Tulving, Hayman, & Macdonald, 1991). It enables the individual to consciously remember personally experienced events embedded in a matrix of other personal happenings in subjective time.

As a historical footnote appropriate to the occasion that the present volume helps to celebrate, it is of interest to note that Donald Broadbent was an early proponent of the distinction between semantic and episodic memory, agreeing wholeheartedly with the same distinction made by Sir Frederic Bartlett, although not quite using the terms that we use today. The interested student of history can read all about it in Chapter 3 of "Perception and Communication" (Broadbent, 1958). Implicit in Broadbent's discussion of conscious recollection of personal events is a reference to one of the important albeit little discussed differences between retrieval from semantic and from episodic memory: with practice, the former can but the latter cannot become automatic or "nonconscious."

Conscious awareness and memory

I have suggested elsewhere that it may be useful to imagine a rough parallel between various forms of consciousness and different kinds of memory. Specifically, the retrieval operations governed by different memory systems from procedural to episodic may be associated with an ordering of forms of consciousness, from anoetic (non-knowing) at the lower end, through noetic (knowing) at the level of the perceptual and semantic systems, to autonoetic (self-knowing) consciousness that characterizes episodic memory (Tulving, 1985). This speculative idea is not without its problems (Schacter, 1989; Natsoulas, 1986), but it can serve as a heuristic basis for formulating more specific hypotheses.

Evidence concerning the relation between consciousness and procedural memory is still scant, although a beginning has been made (e.g., Nissen, 1992). One possible method of empirical assessment of the role of consciousness in procedural memory tasks might take the form of systematic comparisons of first-person and third-person accounts (Marcel, 1988; Olson & Astington, 1987; Velmans, 1991) of performance on tasks systematically varying in their reliance on procedural memory. Discrepancies between the two accounts reflect the involvement of subjective experience, and therefore could be used as empirical indices of the role that consciousness plays in procedural and other forms of memory.

Systematic evidence regarding the issue of consciousness and primary memory is also meager, despite, or perhaps because of, William James' (1890) and others' (e.g. Atkinson & Shiffrin, 1971; Craik & Lockhart, 1972) identification of primary memory with consciousness.

The issue of conscious awareness becomes more central, and its study more systematic, in the distinction between explicit and implicit memory, or explicit and implicit retrieval (Graf & Schacter, 1985; Schacter, 1987). These labels refer to the presence or absence of the subject's awareness, at the time of retrieval, of the relation between present and past experience. In explicit retrieval one is directly aware that the present phenomenal experience is the re-experience of an earlier one.

The awareness of the referential relation between the present and the past is usually referred to as "remembering," "conscious recollection," or "recollective experience." In the GAPS theory (Tulving, 1983), it is based on "ecphoric information," a product of the interaction between stored memory traces and current retrieval information. In implicit retrieval a similar referential awareness is said to be absent: the person's present cognitive activity has been influenced by past experience, but the person is unaware of this fact.

It is important to note that despite the close relation between the two, explicit memory is not the same as episodic memory. Apart from definitional differences, relevant evidence also points to separation. Research by John Gardiner, his associates, and others, for instance, based on the distinction between "remembering" and "knowing" in explicit memory tasks, suggests that people can arrive at knowledge about specific past happenings, even in word-list experiments in the laboratory, on the basis of not only episodic memory but also on the basis of some other system or systems whose identity is not yet clear (e.g. Gardiner, 1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990; Gregg & Gardiner, 1991; Rajaram, 1991; Tulving, 1985). And there is some preliminary evidence, from a study of event-related potentials, that this distinction between remembering and knowing reflects a difference in brain activity at the time of encoding (Smith, 1991).

Thus, the distinction between explicit and implicit retrieval cuts across the classification systems shown in Table 1: procedural memory, PRS, and semantic memory retrieval are assumed to be implicit, whereas primary and episodic memory retrieval are explicit. [Footnote 1].

The literature on comparative studies of implicit and explicit memory is expanding rapidly. The core studies of implicit memory have been concerned with repetition priming (e.g., Richardson-Klavehn & Bjork, 1988). Repetition priming (henceforth simply "priming") is said to have occurred when the identification of an object, such as a word, is facilitated by a prior encounter or encounters with the same object or similar objects. Two basic forms of repetition priming have been identified (Tulving & Schacter, 1990; Schacter, 1990; Roediger, 1990). Perceptual priming, observed and measured in situations in which the test cue is perceptually or physically (in word priming, lexically) related to the target object, occurs independently of the cue's or the target object's meaning. Conceptual priming, observed and measured in situations in which the test cue is conceptually related to the target object, can occur independently of the cue's and the target's perceptual appearance.

Unlike the problematic and empirically uncertain statements concerning the presence or absence of consciousness in the operations of procedural memory, the nonconscious nature of priming, especially perceptual priming, is well established. A person who identifies many different patterns of retinal stimulation as one and the same familiar object, or recognizes a string of letters such as "percptual" as a familiar word, despite a missing letter, is perfectly aware that she is perceiving the object or the (misspelled) word, and totally unaware that she is engaging in an act of memory, that is, that she is in any way using information stored in memory. Specifically, we could say that the person in our example is anoetically aware of priming and noetically aware of the perceived object, and that she has no auto-noetic awareness of its earlier occurrences.

Such auto-noetic awareness can be evoked in an explicit recognition test, in which the subject is asked whether she remembers having seen a particular word in the previously presented study list. In a certain proportion of cases, the auto-noetic awareness leads the subject to identify a test item as "old." In the same situation we can also test the subject's ability to identify incompletely specified words, words not spelled out completely but instead represented by graphemic fragments such as - N - V - R - E and U - I - E - S - . It is well known that a single previous encounter with the corresponding words may enhance the probability that the subject can complete the fragment, that is, that she can identify the incompletely described word. This is perceptual priming. It is also well known that such perceptual priming is (stochastically) independent of episodic recognition of studied words: priming effects are as large for the study-list words that the subject consciously recollects (recognizes) as having been in the study list as they are for the study-list words that the subject does not remember having seen in the study list (e.g. Tulving, Schacter, & Stark, 1982). This type of contingent dissociation provides objective empirical support for the notion that priming is "nonconscious."

We must nevertheless hasten to qualify the statement that perceptual priming is nonconscious because, like many other similar statements one finds in the literature, it too is intolerably vague. Surely the subject-participant in the experiment is as fully conscious an individual--wide awake, alert, aware of herself, aware of her surroundings and the task on hand--when she is performing the fragment-completion test as she is when she is making decisions about earlier occurrences of test items. And surely she is as conscious an individual when she contemplates the products of her performance on the "nonconscious" priming task as she is when she is looking at an "old" test item in the "conscious" explicit recognition task. How then can we talk about "nonconscious" priming?

The relation between consciousness and awareness

It is useful to draw a distinction between two aspects of consciousness, or subjective experience, that are frequently confused, or discussed indiscriminately (cf. Bunge & Ardila, 1987, Ch. 11). One is a general capacity that an individual possesses for particular kinds of subjective experience; I refer to it as consciousness. The other is a particular manifestation of this general capacity; I refer to it as awareness. [Footnote 2].

It is also useful to postulate the existence of different kinds of consciousness, and, therefore, different kinds of awareness. Thus, it seems reasonable to assume that consciousness of a young child differs from that of an adult, and the consciousness of an intoxicated person differs from that of a sober person. Different states of consciousness also characterize sleeping people, anaesthetized persons, comatose people, those who have suffered certain kinds of brain damage, and so on.

Consciousness as defined is determined by the properties of the individual's brain and its general state at any given time. A given kind of consciousness determines what kinds of awareness or subjective experience the person can have; it provides the individual with a potential for particular kinds of awareness. Consciousness is not directed at anything, whereas awareness is always of something (cf. Bunge & Ardila, 1987, p. 236). To be aware of something means to have a particular subjective experience that is determined by both the current (general) state of consciousness and the current (particular) stimulation from external and internal sources. Thus, awareness presumes consciousness, but consciousness does not imply awareness: consciousness is a necessary but not a sufficient condition of awareness. A sleeping person's consciousness, but not that of a waking person's, allows him to dream, but it does not mean that all sleep is dreams.

The relation between awareness of something, on the one hand, and consciousness on the other is analogous to seeing something, or visually perceiving a particular scene or object, on the one hand, and the sense of sight, on the other: consciousness allows certain kinds of subjective experiences but does not dictate any particular ones, as the sense of sight allows certain kinds of sensory achievements but in and of itself does not prescribe any.

Within a given state or kind of consciousness there are levels of awareness. We have already discussed three such levels--anoetic, noetic, and autonoetic--within normal, waking, alert consciousness. In our earlier example of recognition and primed fragment completion, the subject's consciousness was constant throughout the experiment, yet her awareness of the relation between a present object--the recognized word or the word completed from its fragment--and the earlier study episode varied with the task: she was autonoetically aware of the relation in the explicit recognition test, noetically aware of the cues and completed targets, and anoetically aware of priming in the implicit memory test.

Within a given level of awareness many particular kinds of subjective experiences may occur. We can think of (selective) attention as the primary process that determines the aspects of the stimulus situation of which the individual is aware.

As a concrete illustration of the application of the notions discussed, consider two (related) questions that for a long time has been of interest to students of consciousness: (1) Does nonconscious perception occur? (2) Can people "remember" semantic information nonconsciously?

Semantic "learning" without noetic awareness

In several recent experiments it has been demonstrated that surgical patients are capable of encoding, storing and subsequently retrieving information presented to them while they are in a "nonconscious" state under general anaesthesia (e.g., Jelicic, Wolters, Bonke, & Phaf, 1992; Roorda-Hrdlicková, Wolters, Bonke, & Phaf, 1990). In these experiments, subjects undergoing surgical operations were presented, via headphones, with a small set of categorized words. They were tested for the retention of these words a few hours after they came out of the

surgery. As usual (for a review, see Kihlstrom & Schacter, 1990), they had no conscious recollection of having heard anything during surgery. Yet their performance on a conceptual priming task--assumed to reflect the operations of semantic memory (Tulving & Schacter, 1990)--showed significant retention: given the names of different conceptual categories and asked to produce instances, the subjects were more likely to produce the words that had been presented to them under anaesthesia than words that had not been presented.

Because of the absence of appropriate controls, it is not known how the magnitude of the priming effects observed in the anaesthetized subject compare with the same effects in subjects with normal consciousness. But even if the effect is smaller in anaesthetized subjects, the fact that conceptual priming occurs under these conditions has several noteworthy implications.

First, the results show that the absence of normal awareness of a presented auditory stimulus does not prevent an individual from extracting high-level semantic information from it. It is the semantic information stored about the presented words that is used at the time of the test to produce an outcome that is interpreted as conceptual priming: reliance on lower-level perceptual features would not suffice.

Second, if high-level semantic information is retained over time, it also must have been encoded at presentation. This is a straightforward inference: one cannot retain in memory what one has not perceived. Perception is a necessary condition for, and therefore can be inferred from, subsequent memory effects: the subjects must have "perceived" the words and processed them semantically even if they were, presumably, not aware of doing so. Thus, perception of semantic properties of words does not require normal waking, alert consciousness.

Third, the results suggest a researchable question: What is the relation between alterations in awareness attributable to the changes in the kind of consciousness and alterations in awareness attributable to manipulations of stimulus presentation and attentional processes within "normal" consciousness? The answer to the question has implications for the controversy as to whether normally conscious people who are not aware of the occurrence of a word can nevertheless "perceive" something of their semantic meaning (e.g., Cheesman & Merikle, 1986; Holender, 1986; Marcel, 1983, 1988; Reingold & Merikle, 1988).

The coordination hypothesis

The fourth implication of the findings of conceptual priming in anaesthetized subjects takes the form of a speculative hypothesis that I will refer to as the coordination hypothesis. It concerns the relation between awareness at encoding and awareness at retrieval: use of information stored in memory is possible at a level of awareness that is no higher than the level of awareness at the time of original experience.

In the experiments with anaesthetized subjects (Jelicic, Wolters, Bonke, & Phaf, 1992; Roorda-Hrdlicková, Wolters, Bonke, & Phaf, 1990), the subjects perceived and encoded the semantic information presented to them. We can say that the subjects were aware of the input at some low level: they were aware of it anoetically (non-knowingly). At the time of the test, the subjects could not retrieve anything at the level of auto-noetic awareness--explicit recall and recognition was zero. Furthermore, the subjects' noetic awareness of their performance in the semantic memory task of producing primed category instances was presumably the same for primed and unprimed targets. The difference between primed and unprimed production--the difference classified by the experimenter as the conceptual priming effect--thus expressed itself at the level of anoetic awareness.

A similar kind of relation between awareness at encoding and awareness at retrieval is found in analyses of childhood amnesia. Perner (1991) has obtained evidence suggesting that episodic memory and auto-noetic awareness are greatly impoverished, and may be absent altogether, in children younger than three or four years. These children, of course, are highly capable learners and memorizers; they have acquired a great of knowledge about the world. They can act on that knowledge, and report it verbally, and they can retain it over shorter or longer periods of time. What they cannot do, according to Perner, is to remember the experience of their own

personal involvement in the acquisition of this knowledge: they lack auto-noetic consciousness. One consequence of young children's inability to encode happenings as experienced, auto-noetically, is their inability to do remember these happenings as adults, the phenomenon of childhood amnesia.

Yet another example of the coordination hypothesis is provided by patients with anterograde amnesia (Talland, 1965). The inability of such patients to auto-noetically remember any personal happenings from the postmorbidity period could reflect the failure of the establishment of requisite memory traces because of damage to neural pathways of the episodic memory system. Such episodic-memory damage, however, does not necessarily prevent amnesic patients from acquiring new semantic knowledge, encoding and retrieving it at the level of noetic awareness. (For further discussion, see Tulving et al., 1991).

These kinds of phenomena--semantic learning in the absence of auto-noetic remembering under anaesthesia, in early childhood, and in anterograde amnesia--suggest that high-level semantic information, which can be encoded and retained in different systems, can be retrieved at a level of awareness no higher than the level of awareness accompanying the original encoding of the information into "remembering". [Footnote 3]. It is this idea--that information encoded at a given level can be later retrieved or used at the same level and at lower levels, but not at higher levels--that I refer to as the coordination hypothesis. The coordination hypothesis parallels a basic assumption that can be made about the relations among memory systems: information cannot be retrieved from a system into which it was not originally encoded.

A similar idea was suggested by Eich (1984). He pointed out that unattended events usually cannot be recollected consciously, but this fact does not rule out the possibility that "even though the effects of memory for unattended events may not--and probably cannot--be revealed in tests of retention that require remembering to be deliberate or intentional, such effects might become manifest in tests that do not demand awareness of remembering" (Eich, 1984, p. 105, emphasis added).

The coordination hypothesis helps us to re-evaluate some of the issues concerning consciousness that have been of considerable interest to contemporary cognitive psychologists (e.g., Baars, 1987; Cheesman & Merikle, 1986; Holender, 1986; Marcel, 1983, 1988; Marcel & Bisiach, 1988; Velmans, 1991)--such as whether it is possible for human observers to extract semantic information from words of whose presence they are unaware. Many assert that people cannot perceive and "consciously recollect" any semantic information of which they were unaware at the time of presentation (e.g., Holender, 1986). Others, relying on the kinds of phenomena summarized above, believe that people are capable of "learning" high-level semantic information of which they are not consciously aware. The coordination hypothesis resolves the apparent conflict between these two propositions. The skeptics' denial may be true in situations in which the subjects are tested for awareness of the presented information at a higher level than that prevailing at encoding; the believers' assertion may be true if the encoded information is used or retrieved at an appropriate level of awareness.

Summary and conclusions

In this essay I have reflected on the claim that some forms of memory are conscious while others are nonconscious. I suggested that such a claim is too vague to be of much scientific value. The major problems with such a formulation have their roots in the tendency to assume that consciousness is a unitary concept, as well as the failure to distinguish systematically between different kinds or states of consciousness, on the one hand, and different levels of awareness of particular aspects of experience within a given kind or state of consciousness, on the other hand.

I outlined a general classificatory scheme of five memory systems, and related these systems to the distinction between implicit and explicit retrieval. I then raised the question of what it means to say that implicit retrieval--which characterizes the use of information in procedural memory, in the perceptual representation system, and semantic memory--is nonconscious. To answer the question I proposed a distinction between consciousness and awareness: consciousness is the general capacity for having subjective experiences, and awareness is the particular

exercise of that capacity. Implicit retrieval, in this scheme, refers to the cognitive act, performed by a normally conscious individual, of using previously stored information in the absence of either autonoetic or even noetic awareness of the relation between the present and the past.

I then briefly described experiments reported by Bonke and his associates, and observations by Perner regarding the relation between autonoetic remembering in early childhood and later-life childhood amnesia, and mentioned the phenomenon of anterograde amnesia. These illustrate what I referred to as the coordination hypothesis: retrieval or use of information stored in a memory system is possible only at a level of awareness that does not exceed the level of awareness that characterized the system's operations at the time of original experience or encoding.

Notes

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Footnote 1. Not all writers accept this organization. Squire and Zola-Morgan, for instance, still lump episodic and semantic memory together into declarative memory, which they identify with explicit memory, (e.g., Squire & Zola-Morgan, 1991). In their scheme, declarative memory deals with the acquisition of "information about facts and events," it also "refers to conscious recollections of facts and events" (Squire & Zola-Morgan, 1991, p. 1381, emphasis added).

Footnote 2. This choice of terms to designate the distinction between the general capacity and its particular expressions is, of course, highly arbitrary, and by no means optimal. But the use of existing terms is preferable to the adoption of new ones, because psychologists, by and large, tend to be suspicious of, and averse to, new terms.

Footnote 3. "Remembery" is a term recently suggested by William James Morrow, which I use here in the sense of hypothetical, abstract processes that maintain a record of the kinds of events that can be potentially remembered and of other cognitive (propositional, symbolically representable) information that can be potentially used. William James is James McGaugh's grandson. He is 60 years younger than Donald Broadbent. I thank William James's grandfather for making me aware of the word.

Table 1
Classification of Human Memory Systems--1991

Major System	Other Terms	Retrieval
1. Procedural memory	Skill learning	Implicit
2. Perceptual representation (PRS)	Perceptual priming Quasi-memory (QM)	Implicit
3. Short-term memory	Primary memory, working memory	Explicit
4. Semantic memory	Knowledge system, generic memory categorical memory	Implicit
5. Episodic memory	Autobiographical, personal memory.	Explicit

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