Levels of Processing: A Framework for Memory Research

F. I. M. Craik and R. S. Lockhart


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Many theorists now agree that perception involves the rapid analysis of stimuli at a number of levels or stages (Selfridge & Neisser, 1960; Treisman, 1964; Sutherland, 1968). Preliminary stages are concerned with the analysis of such physical or sensory features as lines, angles, brightness, pitch, and loudness, while later stages are more concerned with matching the input against stored abstractions from past learning; that is, later stages are concerned with pattern recognition and the extraction of meaning. This conception of a series or hierarchy of processing stages is often referred to as "depth of processing" where greater "depth" implies a greater degree of semantic or cognitive analysis. After the stimulus has been recognized, it may undergo further processing by enrichment or elaboration. For example, after a word is recognized, it may trigger associations, images or stories on the basis of the subject's past experience with the word. Such "elaboration coding" (Tulving & Madigan, 1970) is not restricted to verbal material. We would argue that similar levels of processing exist in the perceptual analysis of sounds, sights, smells and so on. Analysis proceeds through a series of sensory stages to levels associated with matching or pattern recognition and finally to semantic-associative stages of stimulus enrichment.

One of the results of this perceptual analysis is the memory trace. Such features of the trace as its coding characteristics and its persistence thus arise essentially as byproducts of perceptual processing (Morton, 1970). Specifically, we suggest that trace persistence is a function of depth of analysis, with deeper levels of analysis associated with more elaborate, longer lasting, and stronger traces. Since the organism is normally concerned only with the extraction of meaning from the stimuli, it is advantageous to store the products of such deep analyses, but there is usually no need to store the products of preliminary analyses. It is perfectly possible to draw a box around early analyses and call it sensory memory and a box around intermediate analyses called short-term memory, but that procedure both oversimplifies matters and evades the more significant issues.
Although certain analytic operations must precede others, much recent evidence suggests that we perceive at meaningful, deeper levels before we perceive the results of logically prior analyses (Macnamara, 1972; Savin & Bever, 1970). Further elaborative coding does not exist in a hierarchy of necessary steps and this seems especially true of later processing stages. In this sense, "spread" of encoding might be a more accurate description, but the term "depth" will be retained as it conveys the flavor of our argument.

Highly familiar, meaningful stimuli are compatible, by definition, with existing cognitive structures. Such stimuli (for example, pictures and sentences) will be processed to a deep level more rapidly than less meaningful stimuli and will be well-retained. Thus, speed of analysis does not necessarily predict retention. Retention is a function of depth, and various factors, such as the amount of attention devoted to a stimulus, its compatibility with the analyzing structures, and the processing time available, will determine the depth to which it is processed.

Thus, we prefer to think of memory tied to levels of perceptual processing. Although these levels may be grouped into stages (sensory analyses, pattern recognition, and stimulus elaboration, for example) processing levels may be more usefully envisaged as a continuum of analysis. Thus, memory, too, is viewed as a continuum from the transient products of sensory analyses to the highly durable products of semantic-associative operations. However, superimposed on this basic memory system there is a second way in which stimuli can be retained -- by recirculating information at one level of processing. In our view, such descriptions as "continued attention to certain aspects of the stimulus," "keeping the items in consciousness," "holding the items in the rehearsal buffer," and "retention of the items in primary memory" all refer to the same concept of maintaining information at one level of processing. To preserve some measure of continuity with existing terminology, we will use the term primary memory (PM) to refer to this operation, although it should be noted that our usage is more restricted than the usual one.

We endorse Moray's (1967) notion of a limited-capacity central processor which may be deployed in a number of different ways. If this processing capacity is used to maintain information at one level, the phenomena of short-term memory will appear. The processor itself is neutral with regard to coding characteristics: The observed PM code will depend on the processing modality within which the processor is operating. Further, while limited capacity is a function of the processor itself, the number of items held will depend upon the level at which the processor is operating. At deeper levels the subject can make greater use of learned rules and past knowledge; thus, material can be more efficiently handled and more can be retained. There is apparently great variability in the ease with which information at different levels can be maintained in PM. Some types of information (for example, phonemic features of
words) are particularly easy to maintain while the maintenance of others (such as early visual analyses -- the "icon") is apparently impossible.

The essential feature of PM retention is that aspects of the material are still being processed or attended to. Our notion of PM is, thus, synonymous with that of James (1890) in that PM items are still in consciousness. When attention is diverted from the item, information will be lost at the rate appropriate to its level of processing -- slower rates for deeper levels. While PM retention is, thus, equivalent to continued processing, this type of processing merely prolongs an item's high accessibility without leading to formation of a more permanent memory trace. This Type I processing, that is, repetition of analyses which have already been carried out, may be contrasted with Type II processing which involves deeper analysis of the stimulus. Only this second type of rehearsal should lead to improved memory performance. To the extent that the subject utilizes Type II processing, memory will improve with total study time, but when he engages in Type I processing, the "total time hypothesis" (see Cooper & Pantle, 1967) will break down. Stoff and Eagle (1971) have reported findings in line with this suggestion.

To summarize, it is suggested that the memory trace is better described in terms of depth of processing or degree of stimulus elaboration. Deeper analysis leads to a more persistent trace. While information may be held in PM, such maintenance will not in itself improve subsequent retention; when attention is diverted, information is lost at a rate which depends essentially on the level of analysis.

References


