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Is the Levels of Processing effect language-limited?

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ABSTRACT

The concept of Levels of Processing (LOP), proposing that deep coding enhances retention, has played a central role in the study of episodic memory. Evidence has however been based almost entirely on retention of individual words. Across five experiments, we compare LOP effects between visual and verbal stimuli, using judgments of pleasantness as a method of inducing deep encoding and a range of shallow encoding judgments selected so as to be applicable to both verbal and visual stimuli. LOP effects were consistent but modest across the visual stimuli (mean effect size 0.5). In contrast, LOP effects for verbal stimuli varied widely, from modest for people's names and unfamiliar animals (mean effect size 0.6) to large for familiar animals and household items (mean effect size 1.4), typical of the dramatic LOP effects that characterize the existing verbal literature. We interpret our data through the Gibsonian concept of "affordance", proposing that visual and verbal stimuli vary in the number and richness of features they afford, and that access to such features will in turn depend on encoding strategy. Our hypothesis links readily with Nairne's feature model of long-term memory.

Introduction

Craik and Lockhart (1972) proposed that memory is a by-product of processing, the deeper the processing the better the retention. Their paper is one of the most highly cited in the history of cognitive psychology (Roediger & Gallo, 2001), and "one of the most influential systematic conceptual frameworks within which problems of memory can be raised and investigated" (Tulving, 2001, p. 24). While the assumption of a series of levels leading from perceptual to semantic was subsequently abandoned (Craik & Tulving, 1975), Levels of Processing (LOP) has continued to serve as a broad theoretical framework, accounting for a wide range of data within the field of human memory and potentially providing a fruitful basis for further investigation (Conway, 2002). Furthermore, the principle underlying the levels approach is of considerable practical relevance, providing an important and valuable means of improving learning, in contrast to the common tendency for learners to rely on rote rehearsal.

On the other hand, despite many replications and the magnitude of the effects shown (a series of studies by Hyde and Jenkins (1969) and Walsh and Jenkins (1973) yielded an average effect size based on Cohen's *d* of 2.27), the use of the framework to broaden our knowledge of human memory has been somewhat limited. One exception to this comparative lack of development comes from the demonstration by Tulving and Thomson (1973) of the importance of the match between encoding and retrieval in determining memory performance. This point was further developed with the introduction of the concept of *Transfer Appropriate Processing* (TAP), as proposed by Morris, Bransford, and Franks (1977). They showed that shallow phonological coding led to better performance than deeper semantic coding when rhyming words were used as retrieval cues for the items to be recalled, again

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demonstrating that memory performance depends crucially on conditions at retrieval, as well as at encoding. The concept of TAP is an important reminder that retrieval needs to be considered, but leaves open the question of how to determine transfer appropriateness.

In an attempt to develop the concept of TAP, Roediger (Roediger & Blaxton, 1987; Roediger, Weldon, & Challis, 1989) proposed to link it to the distinction between explicit episodic memory and more automatic implicit memory. Most explicit memory tasks involve processing in terms of meaning, hence benefiting from deeper encoding while implicit tasks tend to be perceptually based, depending more on the exact replication of shallower encoding cues. However, although there were many examples in the literature that fitted this pattern, it is not always possible to make a clear distinction between perceptual data-driven levels of analysis and analysis at a more conceptual or semantic level. Roediger, Srinivas, and Weldon (1989) proposed that any given situation could have components involving *both* levels of analysis which might or might not trade off against each other. While plausible, this compounds the problem of measuring transfer appropriateness. Furthermore, data began to appear suggesting that dissociations occurred *within* the proposed perceptual and conceptual paradigms (Hunt & Toth, 1990) presenting further difficulties in using TAP as a way of developing the original LOP approach, and leading Roediger (2002, p. 321) to conclude "we suggest that the field in general has not yet been able to develop an adequate characterization of procedures that account for memory phenomena despite efforts in this direction".

One important question to be asked of any theoretical framework concerns its breadth of application. As Roediger and Gallo (2001, p. 42) observe, LOP can be regarded as "a special case of transfer-appropriate processing that applies to memory for words in meaning-based tests". However, although language is clearly important, it is only part of our capacity to experience and remember the world, suggesting a need for LOP studies of non-verbal memory. We describe a series of experiments that began with the question of whether reliable LOP effects could be demonstrated using visual material. As relatively little is known we adopted an exploratory approach of comparing LOP effects for a range of visual and verbal materials. Our results show that different types of visual materials all yield modest LOP effects whereas verbal materials give a wider range such that the dramatic advantage to deep encoding typically found depends crucially on the nature of the material. These findings led us to propose a modified explanation of LOP effects that takes into account the "affordances" of a stimulus (Gibson, 1977) and applies to both verbal and non-verbal material.

An early critique of the LOP concept (Baddeley, 1978) noted the lack of evidence for LOP effects using visual stimuli. Although subsequent research on LOP has also been dominated by use of verbal stimuli, a number of studies have been performed across a range of other modalities, though largely using implicit memory measures for which LOP effects were, unsurprisingly found not to apply (Graf & Mandler, 1984; Jacoby & Dallas, 1981). There appears to be very little investigation of the LOP effect in studies of explicit episodic memory using nonverbal stimuli. Some exceptions to this generalization do however occur.

In the case of music, Halpern and Bartlett (2010) comment on a paucity of LOP studies in the literature, reporting only one positive result. Peretz, Gaudreau, and Bonnel (1998), found that judgments of the familiarity of a tune led to better subsequent recognition than judging the instrument playing the tune, commenting however that "the current authors failed to find LOP effects for unfamiliar music on numerous occasions (some published, some languishing in bottom drawers)" (Halpern & Bartlett, 2010, p. 234).

Attempts have also been made to study LOP effects in olfactory memory. Lyman and McDaniel (1986) varied encoding instructions in a study involving recognition of 30 odors after a 1 week delay. No difference in hit rate was found, but an advantage on a d' measure suggested that attempting to name and define each odor or linking it to a life episode led to better performance than forming a visual image or simply trying to memorize each stimulus. A subsequent replication by Zucco (2003) again found a significant effect for d' but not hit rate, with only the life episode condition showing a significant advantage. These results suggest a modest overall effect of deeper processing, operating mainly through reducing false alarm rate, far from the robust effects typical of verbal material.

There have been rather more attempts to detect LOP effects in visual memory, reflected largely in studies of memory for faces. Warrington and Ackroyd (1975) report better face recognition following pleasantness judgments than from estimation of the person's height, a somewhat challenging task from a portrait photograph. A much easier "shallow" task was used by Bower and Karlin (1974), judging the sex of the person portrayed. This proved less effective in facilitating subsequent recognition than did judgments of likeableness or honesty. This could however simply reflect the need to scan the face more intently in order to make these "deeper" judgments, as proposed by Winograd (1981) who found that an instruction to identify the most distinctive facial feature of a given face was more effective than the apparently deeper task of making a personality judgment. On the other hand, a study by Patterson and Baddeley (1977) which compared categorization on physical dimensions such as nose size and thickness of lips found these to be slightly less effective than judgments of pleasantness or intelligence. An attempt to increase depth of processing by providing a semantic context for each face by adding a description of the unfamiliar person's occupation, background and habits however, proved ineffectual (Baddeley, 1982; Baddeley & Woodhead, 1982). An attempt to maximize TAP by presenting the contextual information at both encoding and recognition did increase rate of detection, but this proved to be entirely attributable to inducing a positive response bias (Baddeley & Woodhead, 1982), with participants also more likely to erroneously say yes to a novel face, if accompanied by a previously presented description. Once again therefore, although it would be unwise to rule out the possibility of an LOP effect for faces, any such effects are clearly far weaker than those routinely found for verbal materials.