

Research Article

The Basic-Level Convergence Effect in Memory Distortions

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ABSTRACT—Whereas most previous findings suggest that memory may become more abstract over time, so that memory for gist outlasts verbatim memory, there are findings suggesting that abstract information may sometimes be instantiated in more specific terms. In this study, we examined the hypothesis that retained information tends to converge at an intermediate level of abstractness—the basic level. In two experiments, we found bidirectional, symmetrical shifts in the memory for story material: Participants presented with either subordinate terms (e.g., sports car) or superordinate terms (e.g., vehicle) tended to falsely report basic-level terms (e.g., car) instead. This pattern emerged for both recall and recognition memory tests, at both immediate and delayed testing, and under free and forced reporting. The results suggest that the basic level, which has been considered cognitively optimal for perception, categorization, and communication, is also the preferred level for retaining episodic information in memory.

Many studies of memory have shown that with the passage of time, specific detail is lost and what is retained is more general or abstract than what was originally encountered (e.g., Brewer & Dupree, 1983; Kintsch, Welsch, Schmalhofer, & Zimny, 1990; Stanhope, Cohen, & Conway, 1993; see Brainerd & Reyna, 1993, and Cohen, 2000). For example, Kintsch et al. (1990) found that following a 4-day retention interval, surface information (i.e., verbatim memory) from an original text became inaccessible, but memory for its semantic content (i.e., gist) was retained. Reyna and Brainerd (1995) proposed that separate gist (or meaning) and verbatim representations are extracted from stimulus inputs at encoding, but gist is characterized by a slower decay rate than verbatim memory.

A slower rate of forgetting for categorical than for item information has also been observed (Dorfman & Mandler, 1994). Although participants showed a decline over time in item memory (failing to discriminate between a studied item and other items from the same category), they could discriminate between same-category and different-category distractors.

In contrast, however, some observations imply a shift in the opposite direction, from general to more specific terms (e.g., Anderson & McGaw, 1973; Anderson et al., 1976; Dubois & Denis, 1988). For example, recall of a sentence such as “The animal shook hands with its paws” is better facilitated when *dog* rather than *animal* is given as a recall cue (Anderson et al., 1976). This implies that when people encounter a general term, they often use context and world knowledge to instantiate a more specific term. A more direct demonstration of instantiation was provided by McKoon and Ratcliff (1989). Participants presented with sentences containing phrases such as “squeezing a fruit to make juice” produced high false recognition rates for non-presented exemplars (*orange*) that were suggested by the sentence context. Thus, in some cases, the retained representation is actually more specific than the originally presented information (e.g., O’Brien, Shank, Myers, & Rayner, 1988; but for alternative interpretations, see Gumenik, 1979; Whitney, 1986; Whitney & Kellas, 1984).

In sum, whereas most findings indicate an upward shift in abstractness with time, instantiation studies imply a downward shift toward greater specificity. To reconcile these apparently contradictory findings, we propose that retained information tends to converge at an intermediate level of abstractness, perhaps a level corresponding to what Rosch and her associates termed the *basic level*. Let us examine this proposition as it applies to taxonomic hierarchies (Rosch, 1978; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976).

In general, people can identify or classify objects at different levels of abstraction. They can categorize an object at the superordinate level (e.g., a *vehicle*), the subordinate level (e.g., a *convertible*), or an intermediate level of inclusiveness and abstractness (e.g., a *car*). Rosch et al. (1976) established the preferred cognitive status of the intermediate level of abstractness: It is the level at which objects are spontaneously labeled; it is the preferred level for categorization and identification of objects; and it is the level at which most attributes of category members are stored. Hence, this level was designated the *basic level* (BL) of categorization. BL superiority effects have since been replicated and extended across cultures and domains (for reviews, see Gosselin & Schyns, 2001; Lassaline, Wisniewski, & Medin, 1992; Markman & Wisniewski, 1997). In particular, studies that have controlled linguistic factors by using artificial categories have yielded BL superiority effects comparable to those found for natural categories, indicating that linguistic factors (e.g., word length, frequency, age of acquisition) cannot be the sole basis of the BL effects (e.g., Murphy & Smith, 1982). Rather, there is an intrinsic cognitive basis

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for the BL advantage that is perhaps reflected in language (see Mervis & Rosch, 1981; Murphy, 1991).

BL superiority has been explained in terms of cognitive economy (Rosch et al., 1976) or cognitive efficiency (Murphy, 1991), because the BL achieves the optimal balance between two competing goals of categorization: informativeness and distinctiveness. BL categories (e.g., *car*) are more informative than superordinate categories (e.g., *vehicle*) and more distinctive (i.e., dissimilar from their contrast categories; see Murphy, 1991) than the relatively undifferentiated subordinate categories (e.g., *sedan*, *convertible*). The BL is the level at which categories maximize within-category similarity (i.e., relatively many properties are shared by all category members) while minimizing between-category similarity (i.e., relatively few properties are shared by nonmembers), attaining optimal cognitive economy (Mervis & Rosch, 1981; Rosch et al., 1976).

If the BL is cognitively optimal for perception, categorization, communication, and knowledge organization, is it also optimal for retaining episodic information over time? To the best of our knowledge, the present study is the first attempt to investigate this question. We propose that perhaps the two apparently opposite tendencies reviewed earlier—loss of detail with time, on the one hand, and instantiation of general terms, on the other hand—reflect a common tendency to converge at the level that achieves the optimal balance between informativeness and distinctiveness. Thus, memory reports of items presented at different levels of taxonomic hierarchies might show bidirectional shifts, converging at the BL. In the experiments reported here, we attempted to show that participants not only lose specific information by moving upward toward the BL (e.g., remembering *pants* instead of *jeans*), but also may add information by moving downward toward the BL (e.g., remembering *dog* instead of *animal*).

EXPERIMENT 1

In Experiment 1, participants read a short story in which the critical items each appeared in one of three levels of abstractness. To trace memory changes over time, we manipulated the retention interval; half of the participants were tested after 10 min (immediate testing), whereas the remaining participants were tested a week later (delayed testing).

Method

Participants

Sixty Hebrew-speaking undergraduates at the University of Haifa, Israel, participated in the experiment for course credit.

Materials

Nine target items were used, each appearing in one of the three hierarchical levels: subordinate level (e.g., *jeans*), BL (e.g., *pants*), or superordinate level (e.g., *clothes*). These target items were embedded in a coherent 133-word story (in Hebrew) about a day in a young girl's life. The same story was presented to all the participants, but the level of each target item varied. For example, one third of the participants read the sentence: "While she was dressing, she noticed that her jeans were stained." Another third read the same sentence with the word *pants* replacing *jeans*, and a final third read it with the word *clothes*

TABLE 1

Examples of the Nine Cells in Experiment 1

Presented level	Reported level		
	Subordinate	Basic level	Superordinate
Superordinate	<i>clothes</i> jeans	<i>clothes</i> pants	<i>clothes</i> clothes
Basic level	<i>pants</i> jeans	<i>pants</i> pants	<i>pants</i> clothes
Subordinate	<i>jeans</i> jeans	<i>jeans</i> pants	<i>jeans</i> clothes

Note. This example is taken from the sentence "While she was dressing, she noticed that her _____ were stained." Each cell is defined by the target item presented (in italics) and the target item reported by participants (in boldface).

instead of *jeans*.¹ For each participant, one third of the target items were presented at each of the three levels; the level at which each item appeared was counterbalanced across participants.

Procedure

Participants received a booklet containing step-by-step instructions. Incidental learning was used, so that participants would not learn the story by heart: Participants were told that the study's aim was to assess the suitability of tasks for different age groups, and that they should read the story and rate its age suitability. Then, following a nonverbal filler task, 30 participants were tested for memory of the story, and the other 30 participants were released and returned a week later for the same memory tests.

The first memory test was cued recall: Participants were presented with sentence stems that they were requested to complete, based on verbatim memory of the story. These stems were the first five words (on average) of each sentence. The second test was a multiple-choice recognition test consisting of fill-in-the-blank sentences, with only the target item missing. Three possible answers, representing the three levels (see Table 1), were offered for each sentence, and participants were to choose the correct one. Additionally, they rated their confidence in their choice on a scale ranging from 33% (i.e., chance level) to 100%. Both memory tests entailed forced reporting: Participants were forced to respond even if they had to guess.

Results and Discussion

Scoring

Two independent judges scored the cued-recall responses to determine whether they belonged to the target taxonomy. For example, for the sentence stem "While she was dressing, she noticed _____," only target responses belonging to the *clothing* taxonomy (e.g., *clothes*, *pants*, *shirt*, *T-shirt*) were accepted as valid. The proportion of valid responses was .88 for immediate testing and .56 for delayed testing.

Immediate Recall

The results reported here were based on an analysis of variance (ANOVA) on the proportion of responses recalled in each of the nine

¹English translations of the experimental materials are available from the first author upon request.

experimental cells (see Table 1), with input-item level and output-item level (subordinate, basic, or superordinate) as within-subjects factors. This analysis was performed for each of the two memory tests and for each of the retention intervals. Figure 1a presents the results for the immediate recall test. The marginal values on the top show that the proportion of recalled items did not differ across the three input levels (.29, .30, and .29, respectively), $F(2, 58) = 1.34$, n.s. However, input level interacted with output level, $F(4, 116) = 62.39$, $p < .001$, such that the participants tended to recall the items at the BL, $F(2, 58) = 36.12$, $p < .001$. As the marginal values on the right side of the figure show, more than half of the valid responses (.49 out of .88) were recalled at the BL. Planned comparisons (with Bonferroni correction) revealed that the proportion of recalled items was significantly higher at the BL than at both the subordinate level, $t(29) = 6.12$, $p < .001$, and the superordinate level $t(29) = 6.71$, $p < .001$. The difference between the proportions recalled at the subordinate and superordinate levels was not significant, $t(29) = 0.16$, n.s. Thus, although items presented at the three levels were recalled equally often, many of them shifted to the BL, demonstrating a basic-level convergence effect (BLC).

A close examination of the nine individual cells in Figure 1a indicates that the majority of the items (falling on the main diagonal) were recalled at the same level as they were presented. However, more than one third of the items originally presented at the subordinate level (.11 out of .29) were recalled at the BL. Moreover, more than one third of the items presented at the superordinate level were also recalled at the BL. The nonsignificant interaction, $F < 1$, between the input level (subordinate, superordinate) and the degree of shift of the response (no shift, a shift of one level to the BL, a shift of two levels) confirmed that the bidirectional shift from the subordinate and superordinate levels to the BL was symmetrical.

Delayed Recall

The results for recall after the 1-week interval are shown in Figure 1b. The mean proportion of valid responses was much lower than at immediate testing, $F(1, 58) = 55.96$, $p < .001$. As in the immediate-recall condition, the proportion of recalled items did not differ across the three input levels, $F(2, 58) = 1.59$, n.s. However, the large majority of items was recalled at the BL, $F(2, 58) = 93.19$, $p < .001$. Again, the proportion of items recalled was significantly larger at the BL than at either the subordinate level, $t(29) = 10.93$, $p < .001$, or the superordinate level, $t(29) = 10.15$, $p < .001$, which did not differ from each other, $t(29) = 0.19$, n.s. The most striking result is that after 1 week, the level at which the target items were recalled was actually independent of the level at which they appeared in the original story. Thus, the interaction between input level and output level was not significant, $F < 1$, with the large majority of items recalled at the BL regardless of whether they were originally presented at the subordinate, basic, or superordinate level.

Immediate Recognition

On the recognition test, in contrast to the recall test, all responses were necessarily valid, and the response options were distributed equally across the three input levels. At immediate testing (Fig. 2a), although more items were recognized at the BL (.39) than at each of the other two levels (.30), the BLC was only nearly significant, $F(2, 58) = 2.77$, $p < .08$. Again, the shift to the BL was bidirectional and symmetrical, with no interaction between input level and degree of shift, $F < 1$.

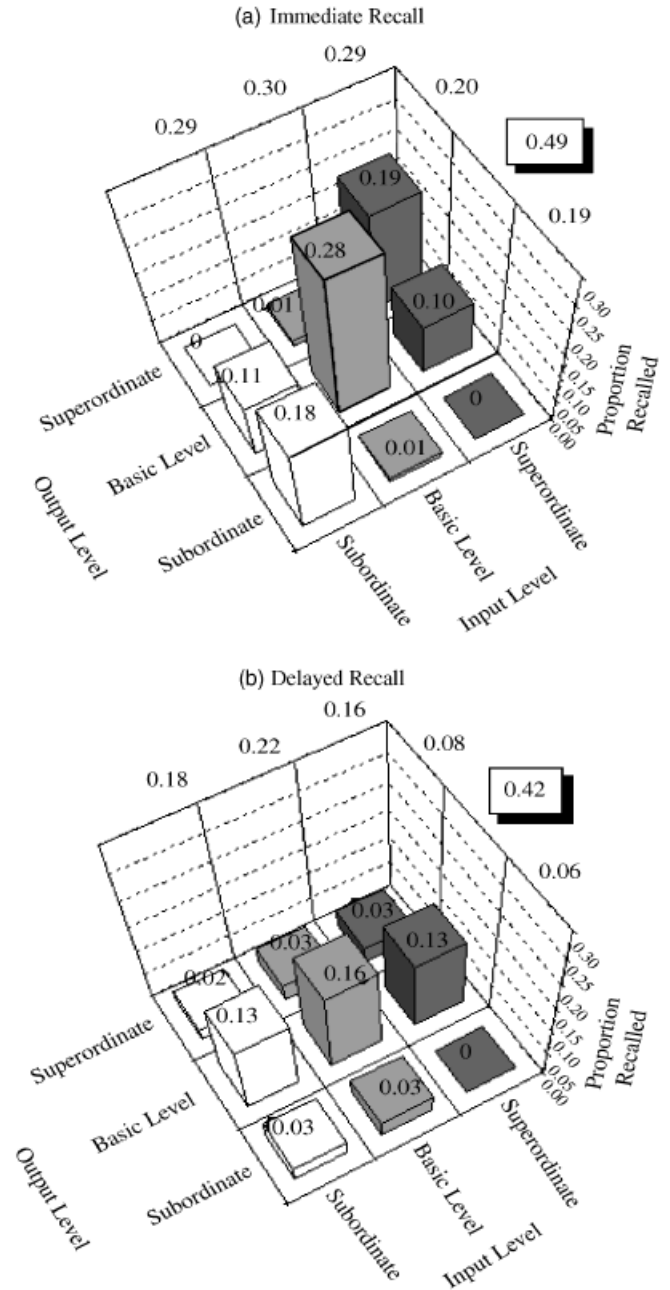


Fig. 1. Mean proportion of items recalled for each combination of input level and output level at immediate (a) and delayed (b) testing (Experiment 1). Note that the data include only responses belonging to the original target taxonomy.

Delayed Recognition

The results for the delayed recognition test (Fig. 2b) yielded a pattern similar to that for immediate recognition, but in this case the BLC was significant, $F(2, 58) = 10.64$, $p < .001$. More items were reported at the BL than at either the subordinate level, $t(29) = 4.40$, $p < .001$, or the superordinate level, $t(29) = 3.61$, $p < .001$, but no difference was found between the latter two levels, $t(29) = 0.59$, n.s. Thus, participants tended to choose items at the BL over items at the correct level, whether subordinate or superordinate, even when the correct level was offered as a potential response.

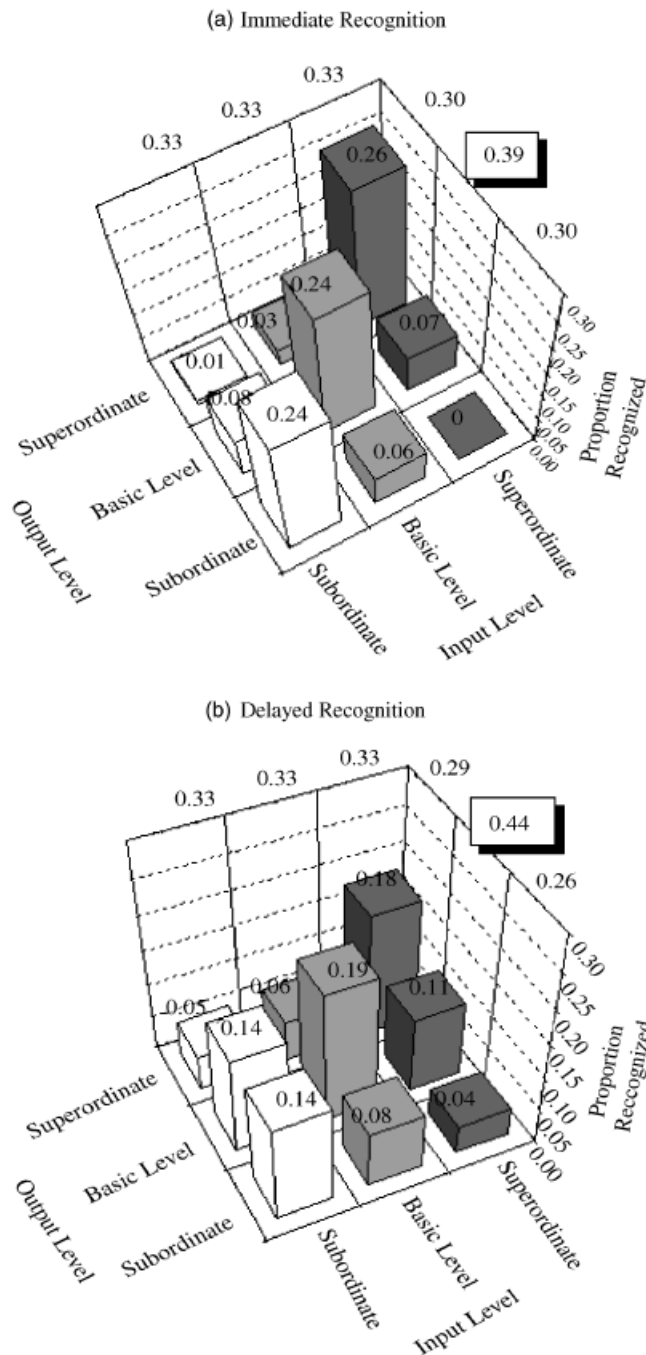


Fig. 2. Mean proportion of items recognized for each combination of input level and output level at immediate (a) and delayed (b) testing (Experiment 1).

Joint Analysis of Memory Performance

A joint ANOVA combining both recall and recognition memory tests at both immediate and delayed testing revealed a significant BLC, $F(2, 116) = 53.41, p < .001$. The BLC was more pronounced for recall than for recognition, $F(2, 116) = 15.87, p < .001$, and was greater at delayed than at immediate testing, $F(2, 116) = 3.09, p < .05$.

Confidence Ratings

Were BL-shift responses associated with lower confidence than accurate (verbatim) responses? There were only 12 participants (in the

delayed testing condition) who exhibited instances of both verbatim and BL-shift responses for both subordinate and superordinate items. Their confidence when a BL shift occurred averaged 65%, and was not significantly lower than their confidence in accurate recognitions (67%), $F < 1$. However, as shown in Figure 3, items presented at the subordinate level (e.g., jeans) were associated with higher confidence when they were recognized at the subordinate level (73%) than when they shifted upward to the BL (63%), whereas for items presented at the superordinate level (e.g., clothes), confidence was actually higher for BL responses (68%) than for accurate responses (61%). The interaction between the input and output levels was significant, $F(1, 11) = 6.57, p < .05$, suggesting that the downward shifts were those that felt particularly compelling.

EXPERIMENT 2

One possible interpretation of the BLC observed in Experiment 1 is that it reflects a guessing bias rather than changes in memory. To rule out this explanation, we had to use somewhat more artificial stimuli in Experiment 2. Specifically, we composed sentences that were relatively context free, so that they could be completed with items belonging to a variety of different taxonomies. Obtaining a BLC under conditions that minimize the ability to guess would support the view that the BLC is a memory phenomenon. To obtain a baseline for

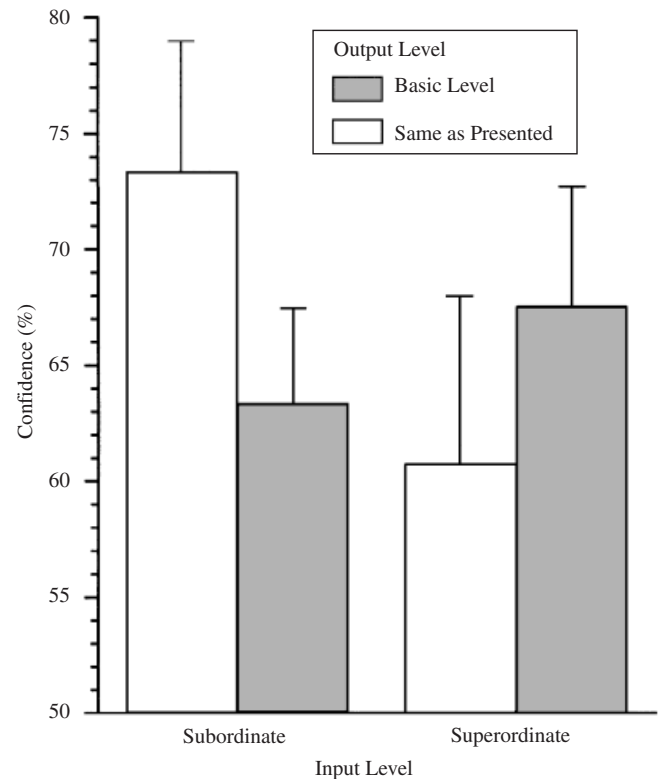


Fig. 3. Mean confidence ratings assigned to accurate responses (i.e., recognized at the same level as they were presented) and to basic-level-shift responses, for items presented originally at either the subordinate or the superordinate level (Experiment 1, delayed testing, $n = 12$). Error bars indicate 1 SEM.

guessing performance, we included a control group that was required to guess the response without having read the story.

An additional difference from Experiment 1 was that in Experiment 2, participants were given the option to refrain from guessing. Koriat and Goldsmith (1994, 1996) showed that providing participants with the option of free report (i.e., allowing them to withhold responding) substantially improved report accuracy compared with forced reporting. Obtaining a BLC under both forced-report and free-report conditions would also be evidence against a guessing account of this effect. Thus, in Experiment 2, participants underwent both a free-report phase and a forced-report phase, using a paradigm adapted from Koriat and Goldsmith (1994, 1996).

Method

Participants

Ninety new undergraduates participated in the experiment for course credit.

Materials

The same materials as in Experiment 1 were used except that we added 6 more target items, for a total of 15, and replaced each sentence that included context information that pointed to a specific taxonomy (e.g., “While she was dressing, she noticed that her _____ were stained.”) with one that did not (e.g., “Despite her efforts, she could not find the _____ she was looking for.”).

Procedure

Testing took place immediately after the filler task for 30 participants and after 24 hr for the remaining participants. The procedure was the same as in Experiment 1, with the following exceptions. First, memory was tested using a single cued-recall test involving fill-in-the-blank sentences with only the target item missing. Second, report option was manipulated within subjects. In the free-report phase, participants were instructed to volunteer only accurate responses under the payoff schedule of a 1-point gain for each accurate response (i.e., verbatim reproduction) but a 2-point penalty for each inaccurate response. In the subsequent forced-report phase, the participants were requested to answer all previously skipped questions. Half of the participants (at each retention interval) performed these phases in the reverse order, first filling in all blanks and then deciding which answers to volunteer under the same payoff schedule.

In addition, 30 control participants were told that they would be presented with a story from which certain words were omitted, and their task would be to fill each blank with the first word or word pair that came to mind that would complete the story coherently.

Results and Discussion

As in Experiment 1, two independent judges omitted responses that did not belong to the target taxonomy.² The proportion of remaining valid responses was .68 for immediate testing and .46 for delayed testing.

²We also omitted 4% of the responses that entailed horizontal shifts (e.g., reporting *shirt* when *pants* or *jeans* was presented). This omission did not alter the pattern of results, yet it allowed a clearer interpretation of the differences between free and forced reporting.

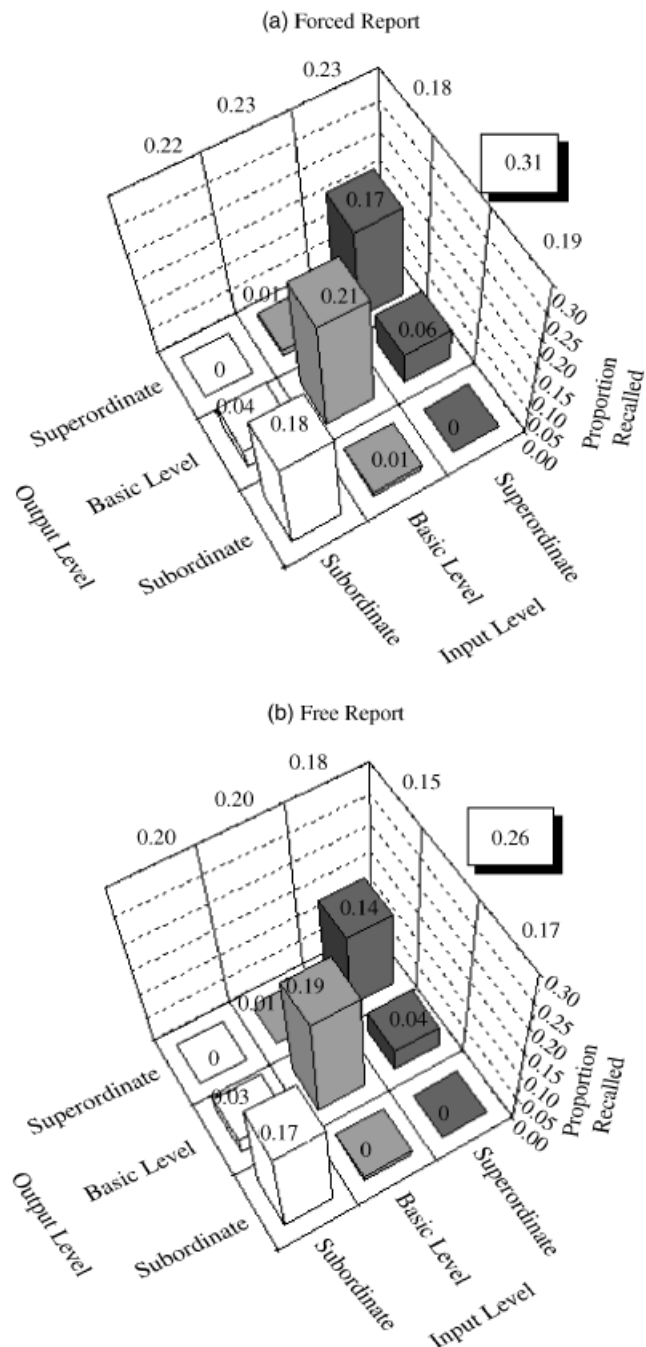


Fig. 4. Mean proportion of items recalled for each combination of input level and output level under forced-report (a) and free-report (b) conditions, at immediate testing (Experiment 2). Note that the presented data include only responses belonging to the original target taxonomy.

Comparison Between Control and Experimental Groups

The probability of providing a response in the target taxonomy was only .07 for the control group. Of course, this was significantly lower than the probabilities for the experimental groups at both immediate testing (.68), $t(58) = 17.21, p < .001$, and delayed testing (.46), $t(58) = 8.53, p < .001$. Chi-square analyses established that this pattern held true for each and every item. Thus, the responses of the experimental participants cannot be attributed to guessing.

Immediate Recall

At immediate testing, the results in the forced-report condition (Fig. 4a) replicated the BLC, indicating that participants tended to recall the target items at the BL, $F(2, 58) = 15.22, p < .001$.

When given the option to decide which answers to volunteer (Fig. 4b), participants withheld some of the responses, but the pattern of results did not change. A significant BLC emerged again, with the majority of items recalled being at the BL, $F(2, 58) = 11.60, p < .001$. Furthermore, the BLC found under free-report conditions did not differ from the BLC found under forced-report conditions, as the interaction between report option and output level did not reach significance, $F(2, 58) = 3.11, n.s.$ Note that the overall verbatim accuracy of the reported items (see Koriat & Goldsmith, 1996) improved considerably under free report (.77) compared with forced report (.57), $t(29) = 6.93, p < .001$.

Delayed Recall

For delayed recall (Fig. 5a) as well, the proportion of recalled items under forced-report conditions indicated a tendency to recall the items at the BL, $F(2, 58) = 33.41, p < .001$. The same pattern emerged under free-report conditions (Fig. 5b), with the majority of items recalled being at the BL, $F(2, 58) = 26.36, p < .001$.

GENERAL DISCUSSION

The results of this study demonstrate a tendency of retained information to converge on an intermediate level of abstractness—the BL. The shifts to the BL were bidirectional and symmetrical: They occurred both when the information was originally presented at the subordinate level and when it was presented at the superordinate level. The BLC was stronger for recall than for recognition, and increased with retention interval (Experiment 1). The BLC could not be attributed to guessing. Neither was it confined to forced reporting: It was found even when participants were free to volunteer only responses that they believed to be accurate (Experiment 2). Finally, confidence ratings (Experiment 1) were no lower when a BL shift occurred than when the response was accurate. Rather, items reported at lower taxonomic levels elicited higher confidence ratings regardless of their accuracy.

These results suggest that the BL, which has been shown to be the cognitively optimal level for perception, categorization, and communication, is also the preferred level for retaining episodic information over time. Possibly, the BL is beneficial for remembering information because it achieves the optimal balance between informativeness and distinctiveness (Murphy, 1991). Thus, memory is distorted not only by losing detail, but also by adding details that were not contained in the original information, perhaps in an attempt to achieve some degree of specificity and concreteness.

What are the memory mechanisms underlying this type of memory distortion? At what stage does a *poodle* transform to a *dog* and *jewelry* to a *ring*? One possibility is that the BLC occurs at the encoding or storage stages. According to fuzzy-trace theory (see Brainerd & Reyna, 2001), items are encoded at multiple levels of abstraction in parallel. We propose additionally that because of the preferred cognitive status of the BL, BL representations may tend to dominate. Moreover, this may be particularly true at longer retention intervals

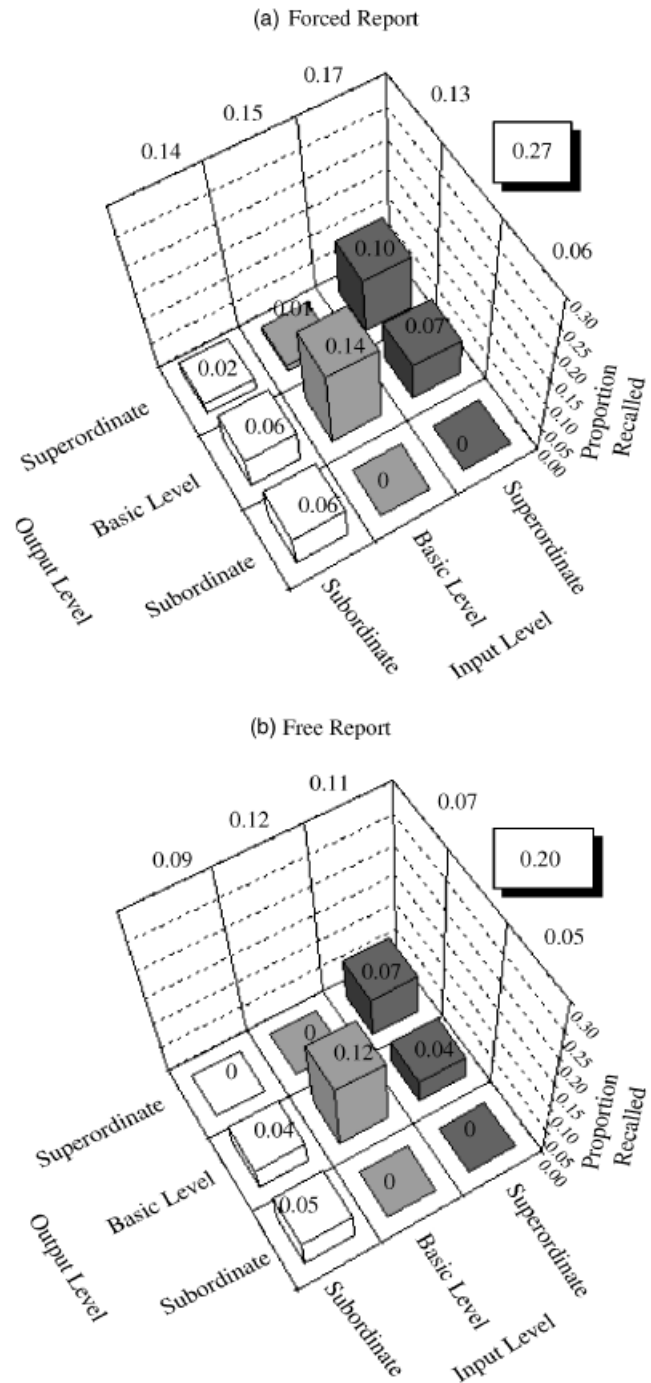


Fig. 5. Mean proportion of items recalled for each combination of input level and output level under forced-report (a) and free-report (b) conditions, at delayed testing (Experiment 2). Note that the presented data include only responses belonging to the original target taxonomy.

because BL representations decay more slowly than other representations. Brainerd and Reyna (2001; Reyna & Brainerd, 1995) made a similar argument in the context of the verbatim-gist distinction.

The BLC may also result from a reconstructive process that occurs at retrieval. Assuming that some of the attributes of memory items are lost over time, and that these items are reconstructed during retrieval

through a process of pattern completion (Schacter, Norman, & Koutstaal, 1998) or assembly of activated fragments (Smith, 2000), it is possible that this reconstructive process involves a tendency to mold the accessible partial information into a BL term. This account is reminiscent of Nelson, Fehling, and Moore-Glascock's (1979) "reconstruction proposition" based on data collected using a savings paradigm. In interpreting their results, they proposed that when a memory trace has deteriorated, "partial information remaining in the memory trace is used to reconstruct a possible candidate for the previously learned item" (p. 242).

Needless to say, these ideas are speculative, and more work is needed to clarify the mechanisms underlying the BLC. In particular, the contribution of nonmemorial factors to the BLC should be considered. First, when memory for the original information is imperfect, BL terms may have an advantage in reporting simply because they are shorter (Brown, 1958) and more frequent (Wisniewski & Murphy, 1989) than other terms. Second, according to Grice (1975), one cooperative principle that typifies communication between people is the tendency to be as informative as required, but not more informative. Reporting information at the BL could be one way in which this principle is implemented, even when people are asked (as in the present study) to report input verbatim (see also the fuzzy-processing preference principle of fuzzy-trace theory, Brainerd & Reyna, 2001). Third, because of response constraints inherent in our methodology, misremembering either subordinate or superordinate terms was more likely to produce BL terms than the input terms' opposites (i.e., subordinate for superordinate and vice versa). Thus, the obtained BLC may have derived from a measurement limitation analogous to a regression toward the mean. However, the small proportion of shifts from the BL to the other two levels and the pattern of confidence and free-report data make it unlikely that this measurement limitation alone accounts for the BLC obtained.

Finally, although both the upward and downward shifts documented in this study may stem from advantages of the BL noted earlier, the possibility must be entertained that the two types of shifts derive from different processes that happen to converge on the BL. This possibility is presently under investigation.

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