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Effects of Item-Specific and Relational Information on Hypermnesic Recall

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The role of encoding conditions in producing hypermnesia (increased recall over successive trials) was examined by manipulating the availability of item-specific and relational information at encoding. Our findings demonstrate that encodings providing item-specific information (e.g., elaborative encodings) produce hypermnesia by facilitating the recovery of new items over trials, whereas encodings providing relational information (e.g., organizational encodings) produce hypermnesia by protecting against the loss of previously recalled items. Thus, the effects of encodings on hypermnesia may be understood by considering the type of trace information they make available.

Experiments employing multiple recall trials have repeatedly confirmed a commonly experienced aspect of memory: the accessibility of information in memory changes over repeated testing (e.g., Ballard, 1913; Brown, 1923; Tulving, 1964). Items not recalled on one trial may be recalled on another (item gain), whereas items recalled on early trials may not be recalled on later attempts (item loss). In some multitrial studies, item gains are offset by item losses, so that from trial to trial the number of items recalled remains approximately constant (e.g., Rosner, 1970; Tulving, 1967). In other studies, however, item gains exceed item losses, resulting in a net increase in items recalled over successive trials. This phenomenon has been labeled *hypermnesia* (Erdelyi & Becker, 1974).

Most investigators seeking an explanation for the occurrence of hypermnesia have focused their attention on the role of encoding conditions. From the numerous studies documenting hypermnesia (for reviews see Erdelyi, 1984; Payne, 1987; Roediger & Challis, 1989), three classes of encodings have been found reliably to produce hypermnesic recall. These include tasks that encourage subjects to form mental images of the to-be-remembered stimulus items (e.g., Erdelyi, Finkelstein, Herrell, Miller, & Thomas, 1976; Payne & Roediger, 1987; Roediger & Thorpe, 1978), tasks that encourage subjects to elaborate stimulus items by relating them to extralist material in memory (e.g., Belmore, 1981; Erdelyi, Buschke, & Finkelstein, 1977; Roediger, Payne, Gillespie, & Lean, 1982), and tasks that encourage subjects to organize the stimuli into categories (e.g., Mross, Klein, & Kihlstrom, 1988; Paris, 1978; Payne, 1986). Several investigators have speculated about a single process that might be responsible for hypermnesia (e.g., Belmore, 1981; Mross et al., 1988), but no proposal yet offered has been able to account for the fact that these three otherwise dissimilar encoding manipulations all produce the effect. Recently some investigators have suggested that factors other than encoding (e.g., retrieval conditions) may be more important for understanding hypermnesia (e.g., Roediger, 1982; Roediger et al., 1982).

It probably is the case that encoding factors alone cannot explain hypermnesia. However, some of the difficulty encountered in identifying the mechanisms underlying hypermnesia may be due to a failure to consider the specific effects of different encoding conditions on hypermnesic recall. By definition, hypermnesia requires a net increase in the number of items recalled over trials—item gains must exceed item losses. If item gains and item losses both occur over trials, a net increase in recall can result from processes that either increase the number of items gained, reduce the number lost, or both. Most attempts to account for the hypermnesia obtained with imaginal, elaborative, and organizational encodings have focused primarily on the overall capacity of these manipulations to produce a net increase in items recalled over trials. We propose that it may be more productive to focus on the way in which these encodings affect item gains and item losses.

The relation between encoding conditions and item gains and losses can be understood by considering the type of information made available by a given encoding. The types of trace information provided by imaginal, elaborative, and organizational encoding tasks are well documented. Imaginal (e.g., Marschark, 1985; Ritchey & Beal, 1980) and elaborative (e.g., Einstein & Hunt, 1980; Klein & Loftus, 1988) tasks both are assumed to promote the encoding of information specific to each to-be-remembered item. This *item-specific* information increases the distinctiveness of each item in memory by emphasizing features that distinguish it from other items (e.g., Hunt & Einstein, 1981; Marschark, Richman, Yuille, & Hunt, 1987). Organizational tasks, by contrast,

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encourage subjects to attend to features shared by the to-be-remembered items (e.g., Einstein & Hunt, 1980; Hunt & Einstein, 1981) and thereby lead to the encoding of associations between the items. This *relational information* serves to highlight similarities among the items, rather than to increase their distinctiveness (e.g., Hunt & Einstein, 1981; Klein & Kihlstrom, 1986).

In this article we show that the types of information made available by the encoding conditions known to produce hypermnesia contribute differently to hypermnesic recall: specifically, that item-specific information primarily enhances item gains across trials, whereas relational information acts primarily to reduce item losses. Item-specific information, by increasing the distinctiveness of items in memory, facilitates the initial retrieval of items. If a first recall trial does not exhaust the store of items in memory, item-specific information may continue to facilitate the recovery of new items on subsequent trials. Once recalled, however, the potential availability of a given item on future trials is enhanced if the item is part of an organized retrieval scheme (e.g., Donaldson, 1971; Rosner, 1970; Runquist, 1986). Relational information provides a basis for organizing items retrieved on each trial and in this way serves to increase the likelihood that an item, once recalled, will be recalled again on subsequent trials (i.e., to reduce item loss between trials).

A review of the available data on item gains and losses reveals some evidence consistent with this view. Hypermnesia studies reporting gain and loss data often find that the hypermnesic advantage for conditions that encourage the encoding of item-specific information (e.g., imaginal and elaborative tasks) over conditions providing information that has less potential for enhancing the distinctiveness of items (e.g., orthographic and phonemic tasks)[1] lies in their capacity to promote greater item gains (e.g., Belmore, 1981; Erdelyi et al., 1976; Klein, 1981; Payne, 1986; Roediger & Thorpe, 1978). Item losses between these two types of conditions, however, often do not differ (Erdelyi et al., 1976; Klein, 1981; Roediger & Thorpe, 1978; but see Payne, 1986). By contrast, studies comparing conditions that promote the encoding of relational information (e.g., organizational tasks) with conditions that do not (e.g., rote memorization) have found that the hypermnesic advantage for the former conditions resides in their greater capacity for reducing item losses, not in their potential for enhancing item gains (McConkey & Kinoshita, 1988; Paris, 1978).

To examine the roles of item-specific and relational information in hypermnesia, we draw on recent work by Einstein and Hunt (1980; Hunt & Einstein, 1981) that showed that the information made available during encoding is a function of *both* the task performed and the relatedness of the words presented for study. According to those investigators, subjects viewing a list of highly related words spontaneously notice and encode the relations among the words. In this case a task that makes available relational information provides information redundant with that made salient by the list structure, whereas a task that makes available item-specific information provides information not already provided by the list structure. By contrast, subjects given a list of apparently unrelated words will be more likely to attend to each word individually and thus to encode item-specific information. Here, performing an item-specific task provides information redundant with that already made available by the stimuli, whereas performing a relational task provides information otherwise unlikely to be detected. Einstein and Hunt show that recall produced by conditions encouraging the encoding of both item-specific and relational information exceeds that produced by conditions that encourage the encoding of either type of information alone (see also Einstein, McDaniel, Bowers, & Stevens, 1984; Klein & Loftus, 1988).

Einstein and Hunt's work suggests a way of exploring our hypotheses about the different effects of item-specific and relational information on the gain and loss components of hypermnesic recall. As we have noted, item-specific information is assumed to enhance item gains over trials, and relational information is assumed to reduce item losses. Consequently, when relational information is provided by the stimulus material (e.g., a list of obviously related words), item losses over trials for subjects performing item-specific tasks should be comparable to those for subjects performing relational tasks. However, superior hypermnesia should be found for subjects performing item-specific tasks because the item-specific information these tasks provide will result in greater item gains. By similar reasoning, when item-specific information is made available through the stimuli (e.g., a list of apparently unrelated words), item-specific and relational tasks should show similar item gains. Here, superior hypermnesia should be found for subjects performing relational tasks because the relational information provided by these tasks will result in fewer items lost between trials.

The experiment reported here tests these hypotheses by examining the recall of subjects over two trials, with orienting task (item-specific vs. relational) and relatedness of words in the study list (related vs. unrelated) varied between subjects.

Method

Subjects

One hundred and forty University of Illinois undergraduates were recruited from the Psychology Department subject pool. Subjects were tested in small groups of 2–3 in sessions lasting about 40 min.

Materials and Design

Two 42-noun lists were prepared: a related list and an unrelated list. For the related list, the Battig and Montague (1969) norms were used to choose 6 frequent instances from each of 7 categories (a four-footed animal, a part of the human body, an article of clothing, a country, a fruit, a type of music, and a sport). Pretesting indicated that subjects shown a random ordering of this list had no difficulty

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[1] The encoding of letter combinations (orthographic tasks) or sound patterns (phonemic tasks) of stimulus words is likely to be less effective in providing distinctive information for individual stimulus words than is the encoding of word meanings or images because letter combinations and sound patterns are more likely than meanings or images to be shared among stimulus words (e.g., Einstein & Hunt, 1980; Nelson, 1979).

identifying its categorical structure. For the unrelated list, the experimenters generated 42 nouns whose relations were obscure; the nouns could, however, be evenly divided into 7 ad hoc categories if subjects were made aware of the appropriate category labels (things that fly, things that are green, things that are hot, things that are liquid, things that make noise, things women wear, and things made of wood). Without this provision, pretested subjects reported that they perceived the list as a collection of unrelated words.

Each noun was typed in capital letters in the center of a separate index card. Subjects each received a different random ordering of the word list appropriate to his or her experimental condition. The list orderings were constructed in such a way that all seven categories were represented within each seventh of the list and that no items from the same category appeared adjacently.

Following Einstein and Hunt (1980), the item-specific task required rating the nouns for pleasantness, and the relational task required sorting the nouns into categories. Previous research has demonstrated that pleasantness ratings promote the encoding of item-specific information without drawing attention to relations among list words, whereas a category sorting directs attention primarily to relational information (e.g., Hunt & Einstein, 1981).

The experimental design was a 2 × 2 × 2 mixed factorial with orienting task (pleasantness rating and category sorting) and list structure (related and unrelated) varied between subjects and recall trial varied within subjects. Thirty-five subjects were randomly assigned to each of the four experimental conditions.

Procedure

An incidental learning situation was established by telling subjects that the study was investigating the characteristics of common words.

Subjects were presented with a deck of 42 cards placed face down and were instructed to select cards in succession from the top of the deck. Subjects performing the pleasantness rating task rated the pleasantness of each word on a 5-point scale, where 1 = *very pleasant* and 5 = *very unpleasant*. Subjects performing the category-sorting task were given a cardboard sheet with the seven category labels appropriate to their list condition printed on it, and for each word they placed the card face down under its correct category label. An experimenter paced subjects through the deck at the rate of 8 s per card. Subjects in each condition received practice trails with their respective tasks before beginning the experiment.

After completing the encoding phase, subjects worked on a distractor task for 3 min. They were given a series of letter sequences and asked to determine the correct letter to continue each sequence.

Finally, an unexpected test of free recall was administered. Subjects were given 5 min to write, in any order, as many of the words as they could remember. So that order of recall could be examined, they were instructed to write only one word per line. At the end of the 5-min period, recall sheets were collected, and subjects were told that a second recall trial was to follow, in which they were to recall the words they had recalled previously, as well as any additional words they could remember. They were encouraged to try to improve their recall from the first test. Following Erdelyi and Becker (1974), they were then given 5 min to think about the stimulus words that had been presented. At the end of the *think* interval, new sheets were handed out, and a second 5-min recall test was administered.

Results

Replicating Einstein and Hunt

To evaluate the success of the manipulations in making available item-specific and relational information, we first examined our data in light of pattern of category clustering and recall predicted by Einstein and Hunt's (1980; Hunt & Einstein, 1981) framework.

Category clustering. Category clustering reflects the extent to which words from the same category are recalled successively. A high degree of clustering is assumed to indicate the organization of stimulus words in memory through the encoding of relational information.

Category clustering data are presented in Table 1. Clustering was measured using Roenker, Thompson, and Brown's (1971) adjusted ratio of clustering (ARC), which sets chance clustering at 0 and perfect clustering at 1. Analysis of the ARC scores yielded a significant main effect for list structure, $F(1, 136) = 406.67$, $MS_e = .04$, $p < .001$, indicating greater clustering for the related ($M = .73$) than for the unrelated ($M = .23$) list. There was also a main effect for task, $F(1, 136) = 54.31$, $MS_e = .04$, $p < .001$, with the category-sorting ($M = .57$) task showing greater clustering than the pleasantness rating ($M = .39$) task. Most important, the significant interaction between list structure and task, $F(1, 136) = 89.92$, $MS_e = .04$, $p < .001$, replicated Einstein and Hunt's results (1980). In the related list condition, where relational information is provided by list structure, the category-sorting and pleasantness rating tasks produced comparably high levels of clustering (Ms = .71 and .76 respectively). In the unrelated list condition, however, clustering was found for the category-sorting task ($M = .44$), but the pleasantness rating task, with its emphasis on item-specific information, provided little basis for clustering ($M = .02$).

Recall. Table 2 presents the mean number of words recalled for each experimental condition. A significant effect of list structure, $F(1, 136) = 48.39$, $MS_e = 34.94$, $p < .001$, indicated superior recall for the related list. Although the main effect for task was not significant ($F < 1$), task interacted with list structure, $F(1, 136) = 61.55$, $MS_e = 34.94$, $p < .001$. Consistent with Einstein and Hunt's (1980; Hunt & Einstein, 1981) proposal that the memorial effectiveness of the pleasantness rating and category-sorting tasks depends on the extent to which the trace information they yield is not redundant with information already made available by list structure, Newman-Keuls analysis ($p < .05$) revealed that in the related list condition pleasantness ratings produced higher recall ($M = 25.59$) than did category sorting ($M = 19.81$), whereas in

Table 1
Mean Category Clustering Scores (ARC) as a Function of Orienting Task, List Structure, and Recall Trial

Recall trial	Orienting task: Category sorting	Pleasantness rating	*M*
Related list			
Trial 1	.57	.67	.62
Trial 2	.85	.84	.85
M	.71	.76	
Unrelated list			
Trial 1	.35	.00	.18
Trial 2	.53	.04	.28
M	.44	.02	

Table 2
Mean Number of Words Recalled as a Function of Orienting Task, List Structure, and Recall Trial

Recall trial	Orienting task: Category sorting	Orienting task: Pleasantness rating	*M*
	Related list		
Trial 1	19.03	23.86	21.44
Trial 2	20.60	27.31	23.96
M	19.81	25.59	
	Unrelated list		
Trial 1	18.80	14.14	16.47
Trial 2	22.09	16.11	19.10
M	20.44	15.13	

Table 3
Mean Item Gain and Item Loss Scores as a Function of Orienting Task and List Structure

Component of recall	Orienting task: Category sorting	Orienting task: Pleasantness rating	*M*
	Related list		
Item gains	3.14	5.11	4.13
Item losses	1.57	1.66	1.61
Gains – losses	1.57	3.45	
	Unrelated list		
Item gains	4.03	3.60	3.81
Item losses	0.74	1.63	1.19
Gains – losses	3.29	1.97	

the unrelated list condition category-sorting produced greater recall ($M = 20.44$) than did pleasantness ratings ($M = 15.13$).

Measures of Hypermnesia

Recall. Hypermnesia is indicated by a significant main effect of recall trial, $F(1, 136) = 147.18$, $MS_e = 3.14$, $p < .001$, reflecting an increase of 2.57 words on Trial 2. This hypermnesic effect is substantially qualified, however, by a significant three-way interaction, $F(1, 136) = 14.25$, $MS_e = 3.14$, $p < .001$. Simple effects tests revealed that in the related list condition, pleasantness ratings produced significantly greater hypermnesia than did category sorting (mean increase = 3.45 and 1.57 words, respectively), $F(1, 68) = 9.89$, $MS_e = 3.14$, $p < .01$. In the unrelated list condition, however, the relation between hypermnesia and task was reversed. Here, greater hypermnesia was obtained with the category-sorting task than with the pleasantness rating task (mean increase = 3.29 and 1.97 words, respectively), $F(1, 68) = 4.81$, $MS_e = 3.14$, $p < .05$.

Item gain and item loss. The differential effects of list structure and task on hypermnesia can be understood in light of the way in which these two factors affected the gain and loss components of hypermnesia. In the related list condition, where relational information is provided by list structure, we expected comparable item losses regardless of the task performed. The superior hypermnesia found for subjects in this condition who performed the pleasantness rating task should thus be due to greater item gains.

By contrast, in the unrelated list condition, where item-specific information is made available by list structure, we expected pleasantness ratings and category sorting to show similar item gains. Here, the superior hypermnesia found for subjects performing the category-sorting task should reflect fewer items lost.

To examine these hypotheses, we conducted separate mixed analyses of variance (ANOVAS; Orienting Task × Component of Hypermnesia) on the data for the two list structures.[2] Table 3 presents the mean item gain and item loss scores for each condition.

For the related list, item gains exceeded item losses, $F(1, 68) = 60.03$, $MS_e = 3.69$, $p < .001$. More important, there was an interaction between task and component of recall, $F(1, 68) = 8.44$, $MS_e = 3.69$, $p < .01$. Newman-Keuls analysis ($p < .05$) revealed that as predicted, pleasantness ratings produced larger item gains ($M = 5.11$) than did category sorting ($M = 3.14$). Item losses, however, did not differ between tasks ($Ms = 1.66$ and 1.57, for pleasantness ratings and category sorting, respectively).

For the unrelated list, gains also exceeded losses, $F(1, 68) = 92.88$, $MS_e = 2.60$, $p < .001$. A significant interaction between task and component of recall, $F(1, 68) = 5.80$, $MS_e = 2.60$, $p < .05$, revealed, however, that as predicted, pleasantness ratings and category sorting yielded similar item gains ($Ms = 4.03$ and 3.60, respectively), whereas item losses were lower for category sorting ($M = 0.74$) than for pleasantness ratings ($M = 1.63$). These observations were confirmed by Newman-Keuls analysis ($p < .05$).[3]

[2] It should be noted that between-list comparisons of item gains and item losses are not useful because they may reflect differences in the contents of the two lists rather than differences in the availability of item-specific and relational information. For example, the higher overall recall, and hence greater opportunity for forgetting, in the related list condition ($M = 22.70$ versus $M = 17.79$ for the unrelated list) makes it difficult to separate the effects of list memorability from the effects of relational information on item losses between lists.

[3] Although our hypotheses do not address the effect of recall trials on clustering, this issue is relevant to current controversy in the hypermnesia literature. According to Davis and Dominowski (1986) increased clustering over trials should be associated with increases in hypermnesic recall. By contrast, Waring and Payne (1987) have presented evidence that clustering changes are unrelated to the magnitude of hypermnesia.

Our clustering data indicate that increases in clustering are not reflected in the magnitude of hypermnesia. For example, in our related-list condition, category sorting and pleasantness ratings produced similar increases in ARC scores over trials, but hypermnesia was greater with pleasantness ratings. This is understandable if one assumes that increased clustering across trials reflects primarily the retention of previously recalled items (e.g., Davis & Dominowski, 1986; Puff & Van Slyke, 1985). Optimal hypermnesia requires item gains as well, and this component of hypermnesic recall is facilitated by the item-specific information made available by pleasantness ratings.

Discussion

Research on the role of encoding conditions in hypermnesia has focused almost exclusively on the capacity of particular encodings to produce a net improvement in recall over trials. As a result, it is known that certain encodings (imaginal, elaborative, and organizational) reliably produce hypermnesia, but because a common mechanism among these encodings has not been identified, the precise role of encoding conditions in producing hypermnesia has remained unclear.

We suggest that the effects of encoding conditions on hypermnesia may be better understood by considering the way in which they influence the gain and loss components of hypermnesic recall. Some evidence indicates that imaginal (e.g., Roediger & Thorpe, 1978) and elaborative (e.g., Erdelyi et al., 1977) encodings enhance the item gain component of hypermnesia, while organizational encoding reduces item losses over trials (e.g., Paris, 1978). If these encodings are viewed in terms of the type of trace information they make available, it is reasonable to conclude that conditions providing item-specific information facilitate item gains, whereas conditions providing relational information protect against item losses. The present results offer strong support for this interpretation.

It appears that much of the controversy about the role of encoding conditions in hypermnesia may be the result of a failure to appreciate the effects of encoding on both components of hypermnesic recall. Our findings indicate that tasks that promote the encoding of item-specific and relational information contribute to hypermnesia differently; thus, it is not surprising that single-process models of hypermnesia have been unsatisfactory. Although it is unlikely that encoding conditions can explain hypermnesia entirely, we suggest that if the study of encoding conditions is approached with item gains and item losses in mind, the results may be more informative about the basis of hypermnesia.

Implications for Retrieval Accounts of Hypermnesia

Some recent treatments have been critical of encoding explanations of hypermnesia, arguing instead that retrieval factors play a more important role in producing the effect (e.g., Roediger, 1982; Payne & Roediger, 1987; Roediger et al., 1982). Roediger and his colleagues have proposed that the occurrence of hypermnesia is a result of the length of the recall trials in multitrial studies.

Roediger and Thorpe (1978) found that multitrial cumulative recall (i.e., the number of items recalled at least once over successive trials) is identical to the number of items recalled during a single trial of equal duration. This suggested to Roediger and his colleagues (e.g., Roediger et al., 1982) that the characteristics of single-trial cumulative recall functions may be relevant to understanding hypermnesia. An important property of single-trial cumulative recall is the inverse relation between the cumulative recall asymptote and the rate at which the asymptote is approached: Raising the asymptote tends to slow the rate at which it is reached (e.g., Bousefield & Sedgewick, 1944). In a multitrial situation, conditions promoting high asymptotic cumulative recall should be more likely to show item gains beyond the initial trial than conditions with low asymptotic cumulative recall, as recall should be further from asymptote when Trial 1 ends.

Roediger et al. (1982) concluded that any factor that raises the level of cumulative recall will provide a greater opportunity for item gains across trials. The hypermnesia obtained with imaginal, elaborative, and organizational encoding thus could be seen as reflecting the capacity of these encodings to produce relatively high levels of recall.

Although some aspects of our data are consistent with the predictions of the cumulative recall level hypothesis (within each list structure, the task giving rise to the highest level of recall produced the greatest hypermnesia), other aspects of our findings call into question the adequacy of cumulative recall to explain hypermnesia. One limitation of that approach is that cumulative recall functions reflect only the number of items recalled at least once; they are unaffected by item loss between trials. A cumulative recall explanation of hypermnesia implies that differences between conditions in the amount of hypermnesia they produce should be seen only in item gains. Our findings demonstrate, however, that two conditions can produce different amounts of hypermnesia but show identical item gains over trials. Specifically, the hypermnesic advantage for subjects performing the category-sorting task over those performing the pleasantness rating task on the unrelated word list was shown to be due to fewer items lost with the category-sorting task. Item gains between the two groups did not differ. Thus, the cumulative recall level hypothesis breaks down when item losses, rather than item gains, are responsible for differential hypermnesia between conditions (similar findings are reported by Payne, 1986).

Roediger and Challis (1989) recently acknowledged that the problem of differential intertrial forgetting must be taken into account if the cumulative recall level hypothesis is to provide a general account of hypermnesia. However, they noted that the conditions leading to differential intertrial forgetting are poorly understood. Our findings offer insight into this aspect of hypermnesia by demonstrating that the type of trace information made available by an encoding condition can reliably identify it as likely either to enhance item gains or reduce item losses.

Explanations for hypermnesia based solely on either encoding or retrieval seem unlikely to be sufficient (for a similar view, see Roediger, 1982). Cumulative recall level clearly is a significant factor in hypermnesia, but the cumulative recall level hypothesis does not address features of encoding that also have been shown to be important. Our findings may offer a key to incorporating knowledge about the contributions of both encoding and retrieval conditions into a more successful account of hypermnesia.

References

Ballard, P. B. (1913). Obliviscence and reminiscence. *The British Journal of Psychology* (Monograph Supplements), *1*(2).

Battig, W. F., & Montague, W. E. (1969). Category norms for verbal items in 56 categories: A replication and extension of the Connecticut category norms. *Journal of Experimental Psychology Monograph, 80*(3, Pt. 2).

Belmore, S. M. (1981). Imagery and semantic elaboration in hypermnesia. *Journal of Experimental Psychology: Human Learning and Memory, 7,* 191–203.

Bousfield, W. A., & Sedgewick, C. H. W. (1944). An analysis of sequences in restricted associative responses. *Journal of General Psychology, 30,* 149–165.

Brown, W. (1923). To what extent is memory measured by a single recall? *Journal of Experimental Psychology, 6,* 377–385.

Davis, S. C., & Dominowski, R. L. (1986). Hypermnesia and the organization of recall. *Bulletin of the Psychonomic Society, 24,* 31–34

Donaldson, W. (1971). Output effects in multitrial free recall. *Journal of Verbal Learning and Verbal Behavior, 10,* 577–585.

Einstein, G. O., & Hunt, R. R. (1980). Levels of processing and organization: Additive effects of individual item and relational processing. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 588–598.

Einstein, G. O., McDaniel, M. A., Bowers, C. A., & Stevens, D. T. (1984). Memory for prose: The influence of relational and proposition-specific processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 133–143.

Erdelyi, M. H. (1984). The recovery of unconscious (inacessible) memories: Laboratory studies of hypermnesia. In G. Bower (Ed.), *The psychology of learning and motivation* (Vol. 18, pp. 95–127). New York: Academic Press.

Erdelyi, M. H., & Becker, J. (1974). Hypermnesia for pictures: Incremental memory for pictures but not words in multiple recall trials. *Cognitive Psychology, 6,* 159–171.

Erdelyi, M. H., Buschke, H., & Finkelstein, S. (1977). Hypermnesia for Socratic stimuli: The growth of recall for an internally generated memory list abstracted from a series of riddles. *Memory & Cognition, 5,* 283–286.

Erdelyi, M. H., Finkelstein, S., Herrell, N., Miller, B., & Thomas, J. (1976). Coding modality vs. input modality in hypermnesia: Is a rose a rose a rose? *Cognition, 4,* 311–319.

Hunt, R. R., & Einstein, G. O. (1981). Relational and item-specific information in memory. *Journal of Verbal Learning and Verbal Behavior, 20,* 497–514.

Klein, S. B. (1981). *Hypermnesia and self-reference.* Unpublished master's thesis, Harvard University, Cambridge.

Klein, S. B., & Kihlstrom, J. F. (1986). Elaboration, organization, and the self-reference effect in memory. *Journal of Experimental Psychology: General, 115,* 26–38.

Klein, S. B., & Loftus, J. (1988). The nature of self-referent encoding: The contributions of elaborative and organizational process. *Journal of Personality and Social Psychology, 55,* 5–11.

Marschark, M. (1985). Imagery and organization in the recall of prose. *Journal of Memory and Language, 24,* 734–745.

Marschark, M., Richman, C. L., Yuille, J. C., & Hunt, R. R. (1987). The role of imagery in memory: On shared and distinctive information. *Psychological Bulletin, 102,* 28–41.

McConkey, K. M., & Kinoshita, S. (1988). *Hypnotic hypermnesia: The relevance of relational and item-specific stimulus information.* Unpublished manuscript.

Mross, E. F., Klein, S. B., & Kihlstrom, J. F. (1988) *Levels of processing and levels of recall in hypermnesia.* Unpublished manuscript.

Nelson, D. L. (1979). Remembering pictures and words: Appearance, significance, and name. In L. S. Cermak & F. I. M. Craik (Eds.), *Levels of processing in human memory* (pp. 45–76). Hillsdale, NJ: Erlbaum.

Paris, S. G. (1978). Memory organization during children's repeated recall. *Developmental Psychology, 14,* 99–106.

Payne, D. G. (1986). Hypermnesia for pictures and words: Testing the recall level hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 12,* 16–29.

Payne, D. G. (1987). Hypermnesia and reminiscence in recall: A historical and empirical review. *Psychological Bulletin, 101,* 5–27.

Payne, D. G., & Roediger, H. L. (1987). Hypermnesia occurs in recall but not in recognition. *American Journal of Psychology, 100,* 145–165.

Puff, C. R., & Van Slyke, D. A. (1985). The temporal relationship between recall and subjective organization. *Bulletin of the Psychonomic Society, 23,* 21–24.

Ritchey, G. H., & Beal, C. R. (1980). Image detail and recall: Evidence for within-item elaboration. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 66–76.

Roediger, H. L. (1982). Hypermnesia: The importance of recall time and asymptotic recall level. *Journal of Verbal Learning and Verbal Behavior, 21,* 662–665.

Roediger, H. L., & Challis, B. H. (1989). Hypermnesia: Improvements in recall with repeated testing. In C. Izawa (Ed.), *Current issues in cognitive processes: The Tulane Floweree Symposium on cognition* (pp. 175–199). Hillsdale, NJ: Erlbaum.

Roediger, H. L., Payne, D. G., Gillespie, G. L., & Lean, D. S. (1982). Hypermnesia as determined by level of recall. *Journal of Verbal Learning and Verbal Behavior, 21,* 635–655.

Roediger, H. L., & Thorpe, L. A. (1978). The role of recall time in producing hypermnesia. *Memory & Cognition, 6,* 286–305.

Roenker, D. L., Thompson, C. P., & Brown, S. C. (1971). Comparison of measures for the estimation of clustering in free recall. *Psychological Bulletin , 76,* 45–48.

Rosner, S. R. (1970). The effects of presentation and recall trials on organization in multitrial free recall. *Journal of Verbal Learning and Verbal Behavior, 9,* 69–74.

Runquist, W. N. (1986). The effect of testing on the forgetting of related and unrelated associates. *Canadian Journal of Psychology, 40,* 65–76.

Tulving, E. (1964). Intratrial and intertrial retention: Notes towards a theory of free recall verbal learning. *Psychological Review, 71,* 219–237.

Tulving, E. (1967). The effects of presentation and recall of material in free-recall learning. *Journal of Verbal Learning and Verbal Behavior, 6,* 175–184.

Waring, S. M., & Payne, D. G. (1987, April). *Imagery, level of recall, and organization of recall in hypermnesia.* Paper presented at the meeting of the Eastern Psychological Association, Washington, DC.

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