Memory in Life, Lab, and Clinic: Implications for Memory Theory

Rose T. Zacks and Lynn Hasher

Basic and applied research on memory should and can inform each other to their mutual benefit much in the same way that laboratory and nonlaboratory studies can (see Bahrick, 1991; Tulving, 1991). Nonetheless, it is a challenge to integrate the wide-ranging contents of the presentations of this conference and to formulate implications for memory theory. Each paper contributed some interesting and unique findings and conceptual points, not all of which can be assimilated. With respect to memory theory, there were a number of themes that cut across several to most of the presentations. We begin with a consideration of those themes.

Themes of the Conference

Dissatisfaction with Past Interaction Between Basic and Applied Memory Research

In one way or another, several conference contributors expressed the view that the standard memory theories of the last 20 to 25 years provide, at best, an incomplete blueprint for designing effective memory improvement strategies. For example, Weingartner and Herrmann (this volume) pointed to the "fragmented or dissociated nature" of basic memory research and to the existence of several distinct "subcultures" of memory research, each with its own methods, findings, and concepts. These subcultures will need to be integrated into a unified framework, they argue, if basic research is to provide useful guidelines for application.

Gruneberg (this volume), Herrmann and Searleman (this volume) and Pressley and El-Dinary (this volume) had a somewhat different concern. They

noted with dismay that basic memory researchers have given low priority to memory improvement either as a proper goal of their work or as an arena in which to test the generality of their findings or their theories. For example, Herrmann and Searleman note that since Ebbinghaus, memory researchers have shown little interest in applied issues. From their point of view, the result has been a basic research endeavor that is insensitive to the problems and findings of clinical application. As basic memory researchers, we agree that there has been more separation between basic and applied work on memory than is desirable. Because of this separation, basic researchers have lost opportunities to use the memory clinic as a proving ground for theories and as a field station for the identification of phenomena that may lead to new theoretical insights. However, we should not exaggerate the degree of separation. For example, there is a tradition in Great Britain (e.g., in the work of Baddeley and Broadbent; see also Wilson & Moffat, 1984) of research that bridges the basic-applied gap, and even in North America, there are some notable exceptions to the typical situation. Included among North American basic researchers who have done serious applied work are McEvoy (e.g., this volume), Duke and colleagues (e.g., Duke, Haley, & Bergquist, in press; Duke, Weathers, Caldwell, & Novack, in press), Schacter and Tulving (e.g., Glisky, Schacter, & Tulving, 1986).

The Situational Specificity of Memory Improvement Strategies

A second theme was the conclusion that memory improvement strategies are, in general, "situationally specific". That is, there is frequently poor generalization of any improvement in performance from the training tasks to other tasks tested in the memory clinic or to analogues of the training tasks encountered in everyday situations. Just about every presenter at the conference mentioned situational specificity in one way or another. For example, Herrmann and Searleman (this volume) summarized the discouraging transfer results when people are trained to use one or more of the classical mnemonics such as the method of loci or the peg-word method. Although some instances of situational specificity may reflect metamemory deficiencies, including a lack of knowledge of the potential usefulness of a trained memory strategy or a belief that one is unable to use the mnemonic effectively (Hertzog, this volume), other instances (probably the majority) seem to require a different explanation. For example, a metamemory account of the pattern of memory abilities of Ceci, DeSimone, and Johnson's (this volume) subject, Bubbles P., seems unlikely. Bubbles P. has a truly exceptional memory for numbers but performs at an average level with non-numerical memory materials. He reports no special strategies or monitoring techniques that could account for this differential in performance.

As Payne and Wenger (this volume) make clear, the issue of the specificity

of memory-training effects is not a new one for psychology. In fact, it was an important topic of study in the early part of this century, when considerable effort was expended investigating the doctrine of "formal discipline," which proposed that practice would lead to the development of general mental skills. More than 60 years ago, Thorndike (1906) concluded that "several decades" of research had provided little evidence of practice-induced development of general mental skills. Instead, he suggested that positive transfer was largely item and task specific, a view that is in accordance with the results of more recent work on memory improvement.

In addition to the suggestion that specific knowledge (or associations, in Thorndike's time) but not general strategies can transfer from one memory task to another, the conference presenters mentioned two sorts of reasons for the situational specificity of memory improvement strategies. One of these (see Ceci et al., this volume; Herrmann & Searleman, this volume; Weingartner & Herrmann, this volume) is the idea that the memory system itself is not unitary--that it consists of a number of different modules for which different improvement strategies are required. The other proposed source of situational specificity, the embeddedness of memory, stands out as the third overarching theme of this conference and is discussed below.

The Embeddedness of Memory Functions

One of the major contributions of this conference has been to point out in various ways and with considerable force that memory is embedded in a larger cognitive system and in the personal, social, and emotional context in which individuals live. In other words, the claim is that the functioning of the memory system must be considered in relation to a large variety of other cognitive and noncognitive factors. Like memory specificity, just about everyone at the conference stressed this point, and examples of relevant observations can be found in most of the papers. We will mention only a few persuasive examples. One is the discussion by Hertel (this volume) of the complex interplay among emotional state, attentional allocation, and memory performance. Other examples are Best's (this volume) and Hertzog's (this volume) very similar analyses of the profound effects that an individual's perception of his or her memory ability (an aspect of the self-concept) can have on memory performance. The data clearly show that individuals who believe they have poor memories for their age group or for a particular type of information may fail to initiate the kind of effortful processing required for good memory.

These three major themes are, of course, interrelated: There is a strong possibility that memory's embeddedness is a factor in findings of situational specificity. For example, the failure of a face-name recall mnemonic to generalize beyond the training situation may well be due to embedding factors (e.g., social anxiety, cognitive overload, etc.), interfering with the use of this

mnemonic in many of the situations (e.g., large parties, job interviews) in which new names need to be learned. It can also be conjectured that applied researchers' dissatisfaction with basic memory theories stems from the weakness of such theories in handling the situational specificity and embeddedness characteristics of applied data. Conversely, it may well be these very characteristics that led basic memory researchers to ignore applied outcomes. That is, from the point of view of a basic memory researcher, whose goal is a nomothetic description of memory, there may be little utility to findings that have minimal generality and that are strongly influenced by factors from outside the memory system.

Reflections on These Themes

The discussion that follows centers on three major claims that jointly summarize our thoughts on the current status of the interplay between basic and applied research as well as our guesses about future prospects: (a) Effective memory improvement strategies *do* already incorporate major findings and concepts of basic memory research, (b) there are some potentially valuable findings and concepts of basic memory research that have not as yet been fully incorporated into memory improvement work, and (c) in part as a response to findings of the memory clinic, general memory theory is changing in a direction that may ultimately increase its applied usefulness.

Basic Memory Research Is Used in Applied Settings

It is clear to us that despite some statements about the irrelevance of basic memory research to the applied setting, memory clinicians make at least tacit (and often explicit) use of major findings and conceptualizations from the experimental laboratory. For example, it would be a rare intervention that did not aim for meaningful (Craik & Lockhart, 1972) and organized (Tulving, 1968) processing of to-be-remembered information. Similarly, the notions that short-term memory has a limited capacity and that chunking of information can help to functionally expand that capacity (Miller, 1956) are likely to be honored, where relevant, by any designer of a memory improvement strategy. So, although currently basic memory theories are not seen as providing complete recipes for memory improvement strategies, they nonetheless have an impact at a more general level. That is, the influence of these theories is at the level of the "folk wisdom" about memory that both basic and applied researchers share. In a few instances, as in the memory rehabilitation interventions designed by Duke and Haley et al. (in press) and Duke and Weathers et al. (in press), the influence is more direct and detailed.

Underused Contributions of Basic Memory Research

We begin our discussion of untapped contributions of basic memory research with a consideration of the products of an earlier (precognitive) era in the study of memory: the verbal learning era. One reason for suggesting a reconsideration of the verbal learning literature is that it focussed on issues of direct relevance to the design of memory improvement strategies, namely, the dynamics of learning, transfer, and forgetting. As noted by Payne and Wenger (this volume; also, Hintzman, in press), the cognitive revolution initiated a shift in memory research away from such concerns and towards the description of static memory structures. An example here is the very large body of research on semantic memory models, fostered in part by widespread acceptance of Tulving's (1972) distinction between episodic and semantic memory. Basic research might better serve the goal of memory improvement if there was a return to the emphases of the verbal learning era. Such a return may have already begun. Hintzman, for example, argues that the currently popular connectionist (or parallel distributed processing, PDP) approach represents a "radical effort" to refocus attention on the learning process.

In the meantime, what kinds of things can we (applied *and* basic researchers) learn from the verbal learning work? Because verbal learners believed that associative strength was *the* major determiner of the memorability of prior experience, much of what we have to learn from their effort relates to the factors controlling associative strength. Building on the British Empiricist tradition, they saw three classes of variables--recency of experience, frequency of repetition, and similarity among items--as the major determiners of associative strength. The in-depth study of these variables yielded a large body of replicable and (within the confines of verbal learning paradigms) highly generalizable findings. This body of data has, we think, been insufficiently explored in terms of implications for memory improvement strategies. For example, a major proportion of the work on similarity had the goal of elucidating item-specific transfer effects. This work might suggest how to better achieve the goal of positive transfer from previous learning.

A more obvious example is the impact of distribution of practice, which verbal learners studied as part of their exploration of how repetition affects associative strength. As reviewed by Payne and Wenger (this volume), the finding that spaced repetitions yield better retention than massed repetitions is a very general one. In a very recent demonstration of this result, Kausler, Wiley, and Phillips (1990) showed that spacing of repetitions benefitted both younger and older adults' memory for repeated actions. The use of spaced, as contrasted to massed repetitions, does not seem to have been widely incorporated into memory amelioration strategies, though given its power to increase recall, it should be.

Another point relates to a contrast between the verbal learning and cognitive approaches in their views on the conditions necessary for good memory encoding. If the tenor of Plude's (this volume) contribution to this

conference can be taken as representative (and we think it can), the information-processing approach has assumed that memory acquisition is closely tied to consciously initiated, controlled processing. By contrast, the verbal learners have assumed a somewhat more passive organism, and in doing so, have put relatively more emphasis on the effects of mere exposure or repetition. To a degree at least, the verbal learning view makes sense to us, because much of what we learn in everyday life is acquired unintentionally. This is not to deny that deliberate learning strategies can have major effects on memory but rather to suggest that they perhaps have been given too much weight in the post-verbal-learning era. In line with this claim, we note that there has been a recent resurgence of interest in "implicit learning." This work by Reber (e.g., 1989), Lewicki (e.g., Lewicki, Hill, & Bizot, 1988), and others suggests that much complex and abstract information about the world may be acquired in the absence of deliberate, voluntary attempts to learn. Furthermore, such implicit learning has been shown to be present in young children to the same degree as it is in college students and has been shown to be relatively preserved in older adults and in other people who have deficits in explicit learning (see Reber, in press). Given the pervasiveness of implicit learning, it would seem promising to explore memory improvement strategies that tap into the products of such learning. As far as we know, this possibility has not been systematically explored.

Potential but unrecognized contributions of basic memory research to applied memory work relate not only to the acquisition of information (our emphasis so far) but also to retrieval. The verbal-learning literature could be gleaned for suggestions as to how to improve retrieval (e.g., consideration of the effects of similarity among potential memory targets on retrieval interference might be of interest), but it is probably time to consider newer work.

One of the major contributions of recent memory research has been to increase our understanding of the factors influencing retrieval and the interaction between encoding and retrieval mechanisms. (Some of these issues were discussed at this conference by Intons-Peterson and Newsome, this volume, and Payne and Wenger, this volume.) Memory retrieval, like memory encoding, can occur nonintentionally. Whereas until recently, cognitive theory has ignored nonintentional encoding, the same cannot be said of nonintentional retrieval. Two frequently studied phenomena, in which nonintentional retrieval is thought to play a major role, are semantic priming and "implicit" (Schacter, 1987) or "indirect" (Johnson & Hasher, 1987) memory. In relation to semantic priming effects, most accounts (e.g., Neely, 1977, 1991; Posner & Snyder, 1975) of how a prime facilitates access to semantically related targets involve the concept of *automatic* (i.e., stimulus driven and nonintentional) spreading activation. Similarly, the benefits from prior exposure that are seen on indirect memory tasks, such as fragment completion or perceptual recognition, seem to be largely dependent on nonintentional retrieval of the prior event (Schacter, 1987). It is interesting

then that semantic priming effects comparable to those shown by normals are found in individuals who have moderate to even severe deficits on typical explicit memory tasks, including the elderly (Burke, White, & Diaz, 1987; Howard, 1988) and, under some circumstances, amnesics (Graf, Squire, & Mandler, 1984). The same thing can be said of performance on various indirect memory tasks (e.g., Light & Singh, 1987; Nebes, 1989). An example of what can be accomplished with applied strategies that capitalize on such preserved memory abilities is found in Glisky et al.'s (1986) work. With their "vanishing cue" procedure, which seems to rely heavily on nonintentional retrieval, they were able to teach amnesics the rudiments of how to operate a microcomputer. More attempts along these lines might be fruitful.

Another set of issues relates to both nonintentional and intentional retrieval. As Tulving (e.g., Tulving & Pearlstone, 1966) made clear some time ago, the memories that are retrievable ("accessible") at any one time only very partially exhaust the memories that are present ("available") in the memory store. One demonstration of this is the fact that the provision of appropriate recall cues can greatly enhance recall over that obtained without such cues (Tulving & Pearlstone). (By appropriate cues, we mean ones consistent with the way the information was originally encoded [cf. Tulving and Thompson's, 1973, "encoding specificity" principle].) Indeed, the importance of retrieval cues for good memory performance cannot be overestimated: As has been forcefully argued by Duke and Haley et al. (in press), the encoding of effective memory cues may be the single most important means of improving memory.

Because environmental cues are among those that affect retrieval (e.g., Godden & Baddeley, 1975), constancy of the environment may be important to the probability that an earlier learning experience can be retrieved (cf. McEvoy, this volume). Social cues are also important, as Best (this volume) forcefully documented in describing one of the findings obtained in a study in which sixth grade children were able to clearly articulate a meaning-based organizational strategy when teaching younger children how to play a memory game. At the same time, they were unable to describe that strategy to an adult (Best & Ornstein, 1986).

Other considerations apply only to intentional retrieval situations. One is the finding (reviewed by Payne & Wenger, this volume) that memory performance improves with repeated attempts at recalling a set of target memories. Based on the memory-enhancing effects of repeated retrieval attempts and of additional cues, memory clinicians could suggest to their clients that successful recall frequently requires several attempts and that such attempts are especially likely to produce the desired memory if, in the process, additional cues are self-generated. To aid in the cue generation process, clients could be instructed in the use of the procedures included in the "cognitive interview" method developed by Geiselman, Fisher, MacKinnon, and Holland (1985).

Finally, we note that basic memory researchers are increasingly interested in the *interactions* among encoding operations, learning materials, and

demands of the retrieval task or environment. One important notion here is that of "transfer-appropriate processing" (Morris, Bransford, & Franks, 1977); this is the idea that performance is not merely a function of the encoding operations or the retrieval environment but of the compatibility between the two.

Another relevant line of work (e.g., Einstein & Hunt, 1980; Hunt & Einstein, 1981) begins with the assumption that materials and processing operations vary in the degree to which they foster the encoding of individual item versus relational information. In addition, because the parameters of the memory test (e.g., recall vs. recognition, length of the retention interval) determine the relative importance of these two types of information for good performance, predictions of memory performance will have to take into account the particulars of the memory test, as well as those of the materials and the encoding activities. Recently, these ideas have been systematized as the "material-appropriate processing" framework (e.g., Einstein, McDaniel, Owen, & Cote', 1990). Again, we believe that this work will soon provide, if it does not already, some useful hints for structuring memory improvement procedures.

Theory Developments

Despite the newly rediscovered value of issues and data from the verbal learning tradition, there were, of course, major shortcomings of this view. Among these, we note a few with special relevance to application of laboratory findings to clinical problems. The verbal learning approach assumed that the study of college undergraduates would illuminate a universal set of laws that characterize the human's unitary learning system. As many papers (e.g., Best, this volume; Ceci et al., this volume; Hertzog, this volume) at this conference demonstrated, there is much to be learned from subjects who are not college students. An adequate general model should recognize both developmental and individual differences in memory.

As many papers (e.g., Herrmann & Searleman, this volume; Weingartner & Herrmann, this volume) at this conference also demonstrated, the assumption of a unitary memory system is extremely problematic: With few exceptions (which possibly include the benefits of spaced over massed practice), general laws of memory are not easily discernable. Perhaps in response to this, the majority of the theories that arose after the demise of the verbal learning perspective proposed that there are different memory functions with distinguishable properties: that is, that memory functioning could not be characterized by a single set of general laws. The shift to a nonunitary view is clearest for those models that propose memory *modules* or *subsystems*, each with its own functional characteristics. However, at least to some degree, a similar point is made by the so-called *processing* views that tie variability in

memory functioning to differences in processing, especially during encoding.

The earliest popular example of the subsystem approach is the Atkinson and Shiffrin (1968) model with its multiple memory stores. A few years later, Tulving (1972) forcefully argued that the long-term memory of the Atkinson and Shiffrin formulation includes two distinguishable subsystems: episodic and semantic memory. The episodic-semantic memory distinction has, in turn, undergone a series of modifications and elaborations, culminating perhaps in Squire's (1987) model, which proposes six or more different subsystems of long-term memory. Similarly, Baddeley (1986) has proposed that short-term (or for him, working) memory comprises three distinct subsystems.

The original processing view was that of Craik and Lockhart (1972). They focussed on processing differences and their consequences for memory, arguing that the properties of a memory trace (including its durability, accessibility, etc.) are not primarily a function of the memory store in which the memory resides but instead, of the kind of processing that led to the establishment of the memory trace in the first place. In particular, memorability was tied to the type of rehearsal used (maintenance vs. elaborative) and to the level of processing engaged in (structural, phonological, or semantic).

Like the subsystem approach, the processing approach has not remained constant since its inception. Concepts such as elaboration, distinctiveness, and transfer-appropriate processing have broadened and complicated Craik and Lockhart's original formulation (1972; see Lockhart & Craik, 1990). Additionally, our own (Hasher & Zacks, 1979) description of encoding processes as varying along an automatic to effortful continuum of capacity demands can also be seen as a processing approach. (We note that this framework explicitly addressed the effects of such differences among groups of individuals differing in age and mood state. For us, this was an acknowledgement of the embeddedness of memory in a larger cognitive [e.g., the role of attentional factors] and personal [e.g., the role of mood] context.)

We cannot say that applied memory results, specifically the demonstrations of situational specificity and memory embeddedness, were the primary impetus for most of these developments in memory theory, but we think they were part of that impetus, especially among British psychologists like Baddeley and Broadbent. In addition, Hirst, Schacter, Tulving, and other basic researchers who have studied amnesia (e.g., see Glisky & Schacter, 1986; Hirst & Volpe, 1988) are all attuned to applied memory issues. Regardless of the source of memory theory's evolution, it is clear from this conference that from the point of view of applied memory work, further evolution is needed.

One promising form of such evolution is a view that combines subsystem and processing approaches--in our minds, a sensible idea because each approach makes valid claims and each has limitations. An example of a combined approach is Johnson's (1983; Johnson & Hirst, in press) Multiple-Entry Memory or MEM model. This model includes both multiple memory systems and multiple modes of processing within each. It also begins to take

account of the embeddedness of memory and attempts to describe how motivational, emotional, and attitudinal factors interact with more purely cognitive ones in influencing memory trace formation, maintenance, and retrieval.

In our work (e.g., Hasher & Zacks, 1988), we continue to be concerned about embedding memory in a larger cognitive context and about broadening the range of groups whose performance we hope to account for. Additionally, we attempt to include in our analysis some aspects of the personal situations of the individuals under study. Before turning to a description of our framework and some of our recent findings, we address a major theoretical orientation that we have so far ignored. That theoretical orientation is represented by Jenkins' (1979) tetrahedral model of memory. The major claim of such a view is that an adequate account of memory must be highly contextualized, that is, it must simultaneously consider the effects of variables relating to subjects, materials, orienting tasks, and criterial tasks, and their interactions. The influence of this type of view was most clearly seen in McEvoy's (this volume) presentation, but a close cousin is Herrmann and Searleman's (this volume) multimodal model. It is easy to see why the Jenkins' view might be popular with memory improvement researchers. It readily incorporates findings of situational specificity and memory embeddedness. In fact, Jenkins himself predicted (1979, p. 430) that a contextualist view would be popular with memory researchers.

We have a mixed reaction to such views. On the positive side, we believe that ultimately a complete theory will have to speak to the range of variables Jenkins (1979) identified. However, in accepting a contextualist view, we think there is a danger of concluding that it is hopeless to search for broader generalizations: for findings and concepts that have validity across different populations, circumstances, and memory tasks. Additionally, although the tetrahedral model and others like it may serve as "useful heuristics" (Jenkins' description, 1979 p. 431) for memory research, they are, in general, incomplete as mechanistic accounts of memory. For the most part, they have as yet to be fleshed out so as to provide specific predictions for new findings and detailed accounts of existing data. One example of the kind of development we see as moving in the right direction can be found in McEvoy's (this volume) presentation. In particular, we refer to her suggestion that it becomes increasingly important to consider emotional and contextual factors in designing memory improvement strategies, as the degree of memory impairment of the target population increases. Systematic development along such lines can be fruitful but will require a formidable effort.

New Trends in Memory Theory: An Example

Our view of cognitive functioning (Hasher & Zacks, 1988) embeds memory in a series of events that link attention, working memory, retrieval processes

and goals. Taken together, these influence a wide array of behaviors, including language comprehension, language production, and decision making.

Attentional processes, we argue, include both activation and suppression processes and, together with goals and aspects of the stimulus array, they determine what gains access to working memory. The role of suppression is particularly important, because it operates to prevent the processing of stimuli and thoughts that are not central to an individual's current goals. In particular, suppression operates at encoding to prevent access to working memory and/or to reduce time in working memory. It operates at retrieval to prevent the exploration of non-goal-path linkages.

To evaluate this model, we have concentrated on the consequences of diminished suppression mechanisms--as, we have argued, may well be the case in aging. (We note that Gernsbacher, 1990, has made a similar argument for low verbal ability young adults). We (Hasher, Stoltzfus, Zacks, & Rypma, 1991) and others (McDowd & Oseas-Kreger, 1991; Tipper, 1991) have reported substantial and consistent evidence that the attentional mechanism variously called inhibition, suppression, or negative priming, is indeed impaired in old age.

If suppression is dysfunctional, more information that is only marginally relevant--or even irrelevant--to the goal path (say of comprehending this presentation or paper) will be able to enter working memory. Indeed, there is now evidence that older adults permit richer access to working memory. For example, Ellen Stoltzfus, in a dissertation project in progress at Duke, has found evidence that both young and older adults show priming (or activation) for the expected ending: such as supplying "baby" to the high cloze sentence, "The famous stork brought him a _____." Only older adults show facilitation for a word related to the high cloze ending, here "child." Apparently, defective suppression mechanisms permit greater access to working memory by information that is beyond the narrow range appropriate for sentences such as those used here.

Another set of experiments used a different procedure, reading in the face of distraction, to explore the ability of older adults to ignore distraction (Connelly, Hasher, & Zacks, 1991). In one of the experiments in this project, younger and older adults read aloud a brief paragraph printed in italics that, in the experimental conditions, was interleaved with extraneous text in another font. The extraneous text was either meaningfully related to the target text or was irrelevant to the target. In either event, it was to be ignored. Older adults were differentially slowed in their reading, relative to younger adults, by the presence of any distraction. For younger adults, text-related and unrelated distraction was equally disruptive. For older adults, related distraction was still more disruptive to their reading than was unrelated distraction. Inefficient suppression appears to create problems, in part by permitting more information to gain access to working memory, perhaps particularly so if that information is at least marginally related to target information. Elsewhere, there is the suggestion that older adults also fail to quickly dismiss ideas that

are activated by irrelevant information (e.g., Hamm & Hasher, 1992; Hartman & Hasher, 1991).

In addition to heightened distractibility, what are the consequences of diminished suppression? A major one will most certainly be increased retrieval problems. These will be, in part, the consequence of the enrichment of working memory permitted by weakened suppression mechanisms. This is because events linked by simultaneous occupancy of working memory retain those links, and any memory search initiated for a target may well also activate its associated relevant and irrelevant connections. The more thoughts activated by a retrieval cue, the slower and more inaccurate retrieval will be (these effects are known variously as the "fan" effect or as competition at retrieval). We (Gerard, Zacks, Hasher, & Radvansky, 1991) have recently shown a far greater fan effect for older adults than for youngers.

This slowing of retrieval will also create problems for language comprehension and speech production--insofar as the social contexts in which language occurs are time limited. Both activities require relatively quick access to antecedent information as well as an ability to maintain a topical focus. At their extremes, retrieval problems while speaking will result in meandering and repetition of familiar themes--since access to other information will be momentarily blocked.

Thus, a mechanism of attention appears to have a major role to play in determining memory, language comprehension, and language production. Of course, these problems will impact on other domains that depend on retrieval and topically focussed processing such as problem solving and decision making.

We and others have tried to integrate memory into its larger cognitive context. Cognition, in turn, is embedded in a social world that has expectations of behavior, and constraints as well. These too must ultimately be integrated into a thoughtful picture of human cognition (see Best, this volume; Hertzog, this volume).

What implications does our model have for memory impairment? These we have not yet specified, and we expect that others may see the consequences more clearly than us. Some consequences--and any remediation--will depend on the degree to which suppression is under an individual's control. Logan (1989) has argued eloquently that even the most automatic processes are under partial control by a subject. For example, the degree of Stroop interference in the standard color-naming version of that task will vary as a function of the proportion of congruent items (ones in which the to-be-named hue and the color word are the same) versus incongruent items.

Research on the degree of control of suppression is underway. In the meanwhile, it seems clear that the functioning of individuals with diminished suppression can be aided by a variety of adjustments to their environments. Since many mental activities are stimulus driven, reductions in environmental distractions should prove helpful. (Reductions from thought distraction will be tied to the issue of the degree to which suppression is under voluntary

control.) Since retrieval problems can be expected to be profound, ideas or objects that need to be accessed should either be directly visible or nearly so, as is true, for example, when labels are used to indicate the contents of drawers and cabinets. Filing drawers or closet doors, because they visually hide their contents, may actually be impediments to people with diminished suppression.

Furthermore, the physical environment needs to be consistent from day to day. The problem of retrieving your car when you do not park in the same place each day will be greatly magnified for individuals with diminished suppression mechanisms. We have in mind here the clever solution generated by McEvoy (this volume) to the problems of an elderly Alzheimer's patient who moved among her children's houses.

Other applications await both research and the expertise of those more familiar with the everyday problems of people seeking remediation. In sum, we are in substantial agreement with those who see that the problems of cognitive psychology can only be solved by rich, varied, and interconnected approaches (e.g., Bahrick, 1991; Tulving, 1991). We applaud this conference, because we concur with its goals--that of sharing the richness of the empirical data base and the process of theory development in memory, whether those contributions come from the laboratory, life, the clinic, or from another academic discipline.

Summary

In closing, we reiterate what we take as the major contributions this conference offers to mainstream cognitive psychology: New efforts at the classical questions of the acquisition, transfer, and retention of information are to be desired. Memory occurs in a social, personal, and cognitive context and these should be part of the concerns of mainstream cognition. Theories need to be more inclusive of the variability among people; they should be informed by data from subjects of a wider range of ages, abilities, and states than is often the case. These efforts would ensure greater interaction among laboratory, life, and clinic.

Endnotes 1

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Douglas J. Herrmann / Herbert Weingartner
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