Age and Semantic Structures in Expert and Non-Expert Learning and Memory Performance

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ABSTRACT

AGE AND SEMANTIC STRUCTURES IN EXPERT AND NON-EXPERT LEARNING AND MEMORY PERFORMANCE

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Age and expertise as determinants of recall ability for information related or unrelated to the experts' specialized area were considered through expert - non-expert comparisons. Twelve adults at each of three age levels (young, 20-36 years; middle-aged, 37-54 years; and old, 55-70 years) had musical expertise. The remaining twelve at each age level, non-experts in the field of music but comparable in terms of education and health, served as controls. No subjects were experts in the contrasting control topic of dogs. All subjects read four passages, two on the development of different musical styles and two on the development of different dog breeds. After reading each passage, subjects answered questions based on information in the passage. Responses were scored as correct, correct plus additions, superordinate to correct, and subordinate to correct. After all four passages had been read, subjects free associated to a list of 5 dog categories and to a list of 5 categories of musical instruments. The response measures were total associations, number of paradigmatic associations and number of syntagmatic associations. Age had no effect on any measure of

memory or association. Music-related materials produced greater numbers of correct reproductions, total associations and paradigmatic associations, but this effect was consistently modified by an interaction with expertise, such that significantly superior performance with music-related materials was limited to music experts. These results were discussed in terms of the implications of expertise for maintenance of cognitive abilities in later life.

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TABLE OF CONTENTS

LIST OF TABLES

The present study examined the effects of aging on the memory ability of experts. Previous investigations of expertise have approached the topic primarily in terms of its relations with problem solving and learning. Accounts of expertise do, however, draw many assumptions from models of memory, particularly current models which emphasize the representation of knowledge. Little of the research on expert performance directly addresses the issue of memory, in the sense of examining the processes of acquisition, retention or retrieval. Thus, the major goal of the research on expertise has not been to gain insights into memory functioning but to explain problem-solving ability. Not surprisingly then, even less consideration has been given to the effects of expertise on memory changes in the elderly.

Such inquiries would seem to be worthwhile. The acquisition and efficient manipulation of sizeable bodies of knowledge represent an enormous investment of time and effort. Some indication of the durability of this skill and the manner in which the aging processes may potentially modify the expert's memory seems warranted. Furthermore, the everyday activities of work or other special interests which require training and practice constitute leading aspects of most lifestyles. Most people will have developed sizeable bodies of knowledge for these important activities. It seems appropriate to have an understanding

of learning and memory potential when wisdom and experience are brought to bear upon the task.

From a theoretical standpoint, the study of age-related memory changes in experts may also offer benefits that outweigh the hazards of combining diverse literatures. Inability to recall information is not restricted to the old. Current memory theory attributes a key role to the structure of knowledge in accounting for memory performance. It has been suggested that poor structure for the to-be-remembered information may be one important factor leading to recall failure.

It is difficult when assessing age effects to distinguish between those structures that were for some reason inadequately formed at the outset and those structures that at the time of formation were appropriately organized but have subsequently deteriorated due to aging mechanisms. For research purposes, comparisons among age groups have been the principal method used to assess changes, on the assumption that differences in outcome measures reflect age-derived changes. Such simple comparisons may be misleading if age differences are interpreted as the direct effect of aging processes; several forces may contribute to the observed results, such as educational or environmental factors (Bromley, 1974).

A sample of experts with relatively uniform professional qualifications, provides some assurance that

greater consistency existed in the quality of structure at the time of development; that the structures formed were efficiently organized, and that the ability to integrate additional information appropriately was initially acquired. Determining changes in the expert's memory over the life-span may, thus, give some clarification of age-based structural changes and of how these changes may relate to memory ability. The inclusion of expert participants, besides controlling for quality of the initial structure, also permits evaluation of the extent to which memory capacity benefits from topic familiarity in later life relative to beneficial effects derived in young adulthood. From the viewpoint of current memory theory, the present study attempted to relate some of the findings on expertise to the problem of memory performance of experts and non-experts in old age.

Experts with a high degree of knowledge about a specific topic, when tested on topic-related material, remember more than non-experts on the same material or than they themselves do when tested outside their field of competence (Larkin, McDermott, Simon & Simon, 1980). In contrast, memory performance declines in the older individual (Craik, 1977). One interpretation proposed to explain both these results links memory performance to the quality of semantic structures, that is, the knowledge representation. Thus, both better (expert) and poorer (aged) memory

capability have been attributed to the effects of semantic structures on organizational processes (Labouvie-Vief & Schell, 1982; Larkin, McDermott, Simon & Simon, 1980). If the memory performance of both experts and the elderly is derived from transformations in the structure of knowledge which are related to their respective conditions then an intriguing question is raised about changes in the expert's memory ability on growing old.

Studies examining adult age differences in memory relative to expertise are few (Charness, 1981). Since almost no empirical data exist concerning the effects of high levels of knowledge on memory in the older population, little is presently known about how or if expertise interacts with aging processes. In an effort to acquire some insight into the suggested relationship between semantic structure and memory proficiency, this study examined relative age losses in memory when new learning was or was not compatible with highly developed knowledge.

The line of development followed begins, in as much as a central issue is aging, with the major conventional conclusions on age-related memory. A rationale for focusing on knowledge effects is presented next. Then a synopsis of memory models reflecting the effects of semantic structures on memory processing is considered. These theoretical constructs as applied to expert memory are discussed and evidence which support the interpretation of expert

memory from the perspective of the role of semantic structures is presented. The adaptation of the semantic structure concept to theories of aging and memory follows. Preceding this study on expertise relative to aging, the line of argument developed closes with an examination of some research results bearing on this issue.

Background

Over the years the accumulated studies on acquisition and retrieval in the elderly reveal a pattern of results which is consistent (Botwinick, 1978); the elderly, as compared to the young, have greater difficulty on most retention tasks (Craik, 1977). Confronted with these same data, a number of different interpretations have been suggested to explain age differences in memory performance.

The numerous accounts of age decline can be roughly divided in two. The division turns on whether age-related memory decline reflects qualitative or quantitative changes in memory processes. These two viewpoints have been expressed as the difference versus the deficit hypotheses (Baltes, Reese, & Lipsitt, 1980).

From the qualitative view, age-related memory abilities are assumed to be the product of transformations in the cognitive system which, following from a Piagetian approach, may be caused by developmental influences (Labouvie-Vief & Schell, 1982) or, as is the premise of contextual models, caused by the effect of multiple environmental events (Hultsch & Pentz, 1980). In either case, the key assumption is that alterations in the knowledge structures of memory lead the elderly to process information in qualitatively different ways for different purposes. In the quantitative view, as a result of biological degeneration associated with aging processes, impairements are introduced in the

memory system. These defects obstruct efficient processing operations and performance deficits appear.

Major Trends in the Development of Deficit Theories

The implicit basis of most deficit hypotheses is a maturational growth model in which it is assumed that memory proficiency is yoked to biological state and that the cognitive system thus peaks in young adulthood. This model raises youthfulness to the first rank and ignores the possible contributions of wisdom and experience to the efficiency of memory functioning. The deficit model, accordingly, limits change to one of physiological deterioration which is assumed to proceed as a broadly continuous time-contingent process. As common levels of maturation are likely to produce broadly similar changes in the cognitive system such a viewpoint permits examination of aging effects without regard to the potential moderating influence of environmental events. In effect this approach assumes an orderly rate of cognitive change concomitant with time-related maturational state expressed as age.

The second important influence on the formation of deficit theory is the original information processing model of cognition which reflects the influence of developments in artificial intelligence. Early conceptualizations describe information analysis as a fixed-order series of analytic operations which exist in a hierarchy from simple to complex. This common operating principle is

apparent in multi-store models which assume successive levels of storage capacity (e.g., Broadbent, 1957) and in the original levels of processing framework (Craik & Lockhart, 1972) in which succesive levels of processing proceed from shallow to deep or sensory to semantic. The evolution of deficit theory, therefore, has its roots in fixed-order processing models according to which information is processed through a brief, pre-attentive, pre-categorical sensory store (Crowder, 1976) to a relatively stable associative, semantic long-term store.

The potential sources of deficit, drawn accordingly from the dimensions of maturational degeneration effects on one-way multilevel processing, fall under two notions: deficits in structural features such as limited processing capacity (Craik, 1977) or limited processing speed (Birren, 1974) and deficits in spontaneous use of control operations. Deficit proposals from the latter view encompass limited use of effortful as opposed to automatic encoding and retrieval strategies (Hasher & Zacks, 1979) including organization (Denney & Lennon, 1972), imagery and verbal mediators (Hulicka & Grossman, 1967), rehearsal and organized search (Zacks, 1982) as well as failure to process to semantic levels with sufficient elaboration (Craik & Simon, 1980). Taken together these two categories of deficit sources represent the hardware and software of the computer information processing analogy (Hunt, 1978)

or fluid versus crystallized intelligence (Horn, 1978).

The Development of the Role of Prior Knowledge in Memory and Aging Theory

Several factors have combined to encourage examining age-related memory changes from the view of transformations in semantic structures rather than as a deficit in processing. The "difference" position is an alternative which reflects an attempt to acknowledge changing social values on the topic of aging, a reaction against a strictly biologically specified view of aging mechanisms which excludes experiential factors, and an accommodation of recent assumptions on the functioning of memory in general.

Former social models of aging in which senescence was depicted as a stage restricted to lassitude and deterioration have been replaced by more positive images of growing older. Old age is increasingly described in terms of its own defining characteristics instead of in a negative relationship to youth. Just as the maturational growth model and the accompanying deficit theories are consistent with prior images of growing old so too are contemporary research trends in gerontology consistent with revised concepts on aging.

With the constraints laid down by the maturational deterioration model, increasing dissatisfaction grew from inconsistent results among various studies testing the same deficit source, from the strong intra-age task effects

and from the failure to eliminate as predicted age-based performance differences through various manipulations (Burke & Light, 1981). This discontent fostered growing speculation that biological degeneration relative to aging processes cannot be the whole story. Criticism, in general, was that the view of memory determination was overly simplistic and that changes in memory over the life span may possibly be accounted for by the structure of knowledge acquired from life events through the structure's influence on cognitive operations. The adoption of this perspective within research on aging and memory is compatible with a more general shift in research orientation in the parent field of memory.

Beginning with greater stress on individual control factors in memory (Neisser, 1967)) a change occurred in research trends. The life-span developmental model fostered another shift in emphasis towards the relationship between the individual and the environment. The knowledge gained from experience and its role in memory has attracted much research interest; the prevailing theories suggest that memory proficiency is inextricably mixed with access to knowledge and highlight the contribution of semantic memory and knowledge structures.

Recent concepts about memory characteristics assume that memory is a complex phenomenon and that memories are a central feature of an individual; the register of

individual experience. In a sense, the individual is the sum of experience stored within the brain (Rose, 1976). It is experience modified by genetic factors which sets individuals apart. With each succeeding year differences in circumstances between individuals accumulate; variation and diversity between individuals increase. Notably, developmental variations are slight during infancy whereas in the older segment of the population increasing diversity is apparent. This observation has led to proposals that experience generates idiosyncratic knowledge structures although the biological mechanisms for building these structures are certainly acknowledged to be common to all (Lindsay & Norman, 1977). Differences in semantic structure present one possibility in accounting for differences in memory performance on the assumption that the quality of the semantic representation governs the ability to recall an event. From this theoretical vantage-point, instead of focusing on the quantitative aspects of memory such as recall accuracy, the qualitative aspects of the data are of primary interest. To gain insights into the organizational processes, which presumably are guided by the structure of semantic memory, the emphasis rests on meaning and how meaning is transformed.

Notions of semantic influence on the ability to remember are not new. That recall is tied to meaningfulness is quite evident in everyday situations. However,

accurately assessing semantic effects requires offsetting semantic complexities, a difficult task which long ago Ebbinghaus (1965, originally published in 1885) urged best be avoided in the hope that simplifying the issue and minimizing semantic associations would reveal basic memory processes. Although Bartlett (1932) counterclaimed that the functioning of knowledge structures or schemata was indivisible from normal memory operations, until recently the role of knowledge was neglected while the search for basic memory processes set the pattern for research (Baddeley, 1982).

The Convergence of Information Processing and Life-Span Developmental Perspectives

New proposals on fundamental memory functioning and on the memory processes of the elderly stem from the revived interest in semantic effects. Within the conventional cognitive approach, speculation on the role of prior knowledge has emerged in studies of memory in general, whereas the role of semantic structures has prompted much enthusiasm in research on age-related memory primarily among life-span developmentalists. Thus, suggestions about the role of knowledge structures in guiding cognitive processes, span traditional information processing memory perspectives (Lindsay & Norman, 1977) and the multifaceted life-span developmental views (Hartley, Harker, & Walsh, 1980; Schaie, 1970). As such, the differences between

life-span approaches and conventional approaches are less extreme than is at first apparent within the constraints of research on age-related memory. The different theorists draw similar conclusions about the significance of semantic representations, but because they approach the topic from different points of view, they state their conclusions in very different terms. For example, information processing advocates will speak of encoding, storage and retrieval (Smith, 1980) whereas those of a contextual bent refer to perceiving, understanding and mnemonic reconstruction (Hultsch, & Pentz, 1980). Essentially, there is much common ground between these two positions.

This area of agreement can be described more clearly by using an example. Consider the distinction proposed by Tulving (1972) between episodic memory, which involves recall of specific experience, and that of semantic memory, which refers to the organized contents of the knowledge system: the definitions, symbolic representations, cognitive concepts and operations. The importance of making this distinction is that the capability of one system may depend upon the concurrent development of and access to the other system. The theory indicates that episodic performance may be linked to the structure of the semantic memory system. Potential episodic-semantic ties have been elaborated for children and for experts within the framework of conventional cognitive models.

To illustrate, a proposed interdependence between episodic memory and the growth in the structure of semantic memory with increasing knowledge has been used for interpreting the increased performance on retention tasks in children (Brown, 1975) and although some results are consistent with this hypothesis (Ceci & Howe, 1978) some are not (Arbuckle, 1981). Similarily, the expert's memory differences for material that is or is not relevant to their field of expertise as well as when compared to novices has been attributed to the quality and quantity of knowledge structures in semantic memory for child experts (Chi, 1978) and for adults (Chase & Simon, 1973).

Difference explanations of memory in the elderly can, accordingly, be conceptualized as a variation of the semantic-episodic link already pervasive within the literature. Rather than explaining better memory in terms of increasing size and complexity of semantic structure, however, the 'difference' theory attempts to explain age-related decreases in memory in terms of the restructuring of semantic memory. This approach assumes that the restructuring of knowledge leads to different but not deficit modes of processing. If so, then the older person is at a disadvantage on typical memory tasks because the task fails to tap the elderly's salient encoding dimensions (Labouvie-Vief, 1977).

To summarize, a distinction has been raised in the analytic approach to identifying the source of memory differences between age groups: deficit theory as opposed to difference theory. Deficit theory attempts to specify an equation defining some direct relation between memory functioning and chronological age (Spear, 1978). Difference explanations of aging and memory as presently elaborated stress the effects of experiential factors as reflected in semantic structures. The analytical potential of difference theory lies in the biological-age combination it acknowledges. Thus, the bases of the dispute, as with most constrasting positions, can shade into each other. Identifying the sources of age differences in memory requires the integration of findings from both deficit and difference studies.

There are assumptions endorsed in common between the two viewpoints on memory and aging, the most significant of which is the gradual adoption (e.g. Craik & Simon, 1980) of an interactive processing model of memory (Lindsay & Norman, 1977). This perspective on memory, in contrast to former views, credits conceptual processes with participating throughout the entire analysis and interpretation of incoming stimuli.

A Summary Description of Semantic Effects in Memory Models

Within the conceptual framework of which the interactive processing model is a part several common properties

of memory functioning are assumed. It is held that previous knowledge is formed into organized semantic structures (Hulse, Deese, Egeth, 1975) that induce what we perceive and how we understand a situation (Hultsch & Pentz, 1980). It is thought that through experience the structure of semantic information evolves into increasingly complex relational patterns (Chi, Feltovitch & Glaser, 1981) which entail both greater elaboration within the structure of a concept and increased links between concepts (Chi, 1981). The quantity and quality of the structure is assumed to influence how information is encoded during acquisition and retrieved at the time of remembering (Labouvie-Vief & Schell, 1982; Lindsay & Norman, 1977). By setting the semantic guidelines for interpreting the information available in an episode, an expectation is triggered. The onset of the expectation (Chiesi, Spilich & Voss, 1979) guides further analysis in that the organization processes are biased towards information that confirms the anticipated outcome while disregarding or reinterpreting discrepancies.

Both advantageous and detrimental effects on processing are considered to arise from the increasingly complex semantic patterns (Labouvie-Vief & Schell, 1982; Lindsay & Norman, 1977). The beneficial aspects proposed are an acceleration of the interpretive process by means of the rapid organization of input, and an increase in the information load carried within the limits of processing capacity (Larkin,

McDermott, Simon & Simon, 1980). This rapid encoding of organized complex units of information is assumed to assist in recall if the appropriate relationships have been established Reinstatement in primary memory of some detail of the to-be-remembered event enables access to related items linked within the semantic structures (Hulse, Deese & Egeth, 1975). Accurate links established during encoding should result in the retrieval of appropriate sets of information during recall.

Detrimental effects are the product, too, of highly complex semantic structures. Although memory for routine situations is enhanced by structural complexity because of the increased understanding that results from interrelated information, the ability to acquire and recall unusual events can be impeded. As experience develops, fewer entirely fresh situations remain. Some aspect of the event likely can be related to what is already known and structured which leads to decreased flexibility to accurately integrate departures from established structural relations (Collins & Loftus, 1975); Labouvie-Vief & Schell, 1982; Lindsay & Norman, 1977). Incompatible information will undergo semantic misinterpretation such that encoding and retrieval suffer accordingly.

In brief, it is proposed that the mind accepts best that which matches prior knowledge. The encoding of new input is viewed to be a process of mapping external referents

onto existing knowledge structures which set the boundaries for relating information. Accurate recall is thought to be proportional to how closely an episode fits the existing structure; the closer the agreement the better the recall (Chi, 1981; Chiesi, Spilich & Voss, 1979); Labouvie-Vief & Schell, 1982). Mapping information that contradicts the expectation that has been triggered or that is incompatible with existing semantic structures will, according to this view, produce distortions, deletions, simplifications, elaborations, or, in short, gross inaccuracies (Bartlett, 1932; Welford, 1980) that lead to poor recall.

From the standpoint of effects of knowledge, empirical support for adopting a model of memory which maximizes the contribution of meaning is both direct and indirect. Indirect evidence includes the known effects of familiarity (Poon & Fozard, 1978) and the effects of meaningfulness (Underwood, 1964) both of which are interpreted as a result of 'good fit' during the mapping process. The age-related increasing variability within the data on memory tasks (Botwinick, 1978) is also thought to demonstrate the effects of differential processing of information in congruence with the form of knowledge structures developed over a lifetime. Evidence which can be more directly interpreted as supportive of differences in processing due to differences in the amount and configuration of knowledge results

from studies of child (Chi, 1978) and adult (Chase & Simon, 1973) chess expertise. The better recall of knowledgeable individuals show that age and memory performance need not correlate. Differences between and within age groups may be accounted for by some factor other than age level. Differences in the richness and flexibility of semantic structures among individuals is one possibility. Within a specific topic, the implication is that those who possess a high level of knowledge for the domain can overcome whatever limitations are associated with maturational constraints (Chi, 1981) or surpass average operating capacity. The significance is that memory for events is less an absolute function of some ideal basic process as it is a relative function of efficient processing in accordance with the quality and organization of semantic structures.

The preceding perspective on how semantic structures are proposed to influence the mode of cognitive processing was presented to set the relation of semantic structures to models of expertise and models of aging. The discussion will now turn to the view on expert information processing within the framework of the effects of semantic structures.

Theories of Memory Processes in Experts

New information is more easily acquired and more memorable when it can be related to previous knowledge than when it cannot (Chiesi, Spilich & Voss, 1979). An important issue within the study of expertise is to explain how

differences in the quantity and quality of knowledge relates to performance differences. One approach to the problem has been to compare the memory ability of experts with that of novices on a task related to the experts' specialized field. Studies in the domain of chess indicate a memory superiority for experts which has been interpreted as the result of more richly developed semantic structures for both children (Chi, 1978) and adults (Chase & Simon, 1973; deGroot, 1966). The results have been replicated with other topics; for children with the domain of dinosaur knowledge (Chi & Koeske, in press) and for adults with the game of baseball (Chiesi et al., 1979), bridge and electronic circuity (cited in Baddeley, 1982).

It is reasoned that the experts' better organized, more elaborately structured information permits the encoding and retrieval of units of information (Chase & Simon, 1973). The advantage attributed to this 'chunking' of information (Miller, 1956) is that within the limited capacity of the cognitive system more information can be processed and associated with other relevant information. The expert can thus detect intricate, meaningful patterns embedded in a complex array of incoming stimili (deGroot, 1966; Larkin et al., 1980). The manipulation of a broad range of information results, thereby producing an increased understanding of the larger aspects of the situation. Moreover, information not present in the situation but linked and

available within existing structures also adds meaning to the analysis of the new information. In contrast, when new information must be mapped onto poorly structured knowledge, as is assumed the case in non-experts, then, without the unified relations to aid and accelerate the organization of information, the interpretive process must proceed bit by bit (Baddeley, 1982; Chase & Simon, 1973; Chi & Koeske, in press). Processing by individual components reduces the information load carried within cognitive capacity limits which has been related to greater difficulty in monitoring an event and in fully grasping its meaningfulness (Lindsay & Norman, 1977).

Efforts have been made to specify more precisely the form in which the expert's knowledge is structured and to determine how this structure enables fast and accurate acquisition and subsequent superior recall of information. A proposed explanation for the expert's advantage, reflecting the conceptualizations of several theories (Anderson, 1976; Newell & Simon, 1972; Newell, 1973), rests on the assumption that the knowledge representation can be portioned into two components: declarative knowledge and procedural knowledge. Declarative knowledge is viewed as a hierarchically organized network representation of concept nodes and their related properties (Anderson, 1976; Collins & Loftus, 1975). Procedural knowledge is defined

as sets of productions consisting of condition-action pairs, that is, each production relates a condition or situational state to the action that is appropriate for achieving some objective or preferred outcome (Chi, in press; Wickelgren, 1980). Procedural knowledge, like declarative knowledge, is viewed to be a hierarchical structure in which subgoals and related strategies serve to accomplish some overall goal or criterion (Chiesi et al., 1979). The working hypothesis states that when incoming information is mapped onto the semantic network with the result that a condition of a production is satisfied then the proper course of action will automatically be primed and possibly carried out (Chiesi et al., 1979; Larkin et al., 1980).

Experts presumably have greater knowledge than non-experts about properties of objects present in a episode but also have more elaborately structured representations of the contingencies that operate among objects, actions and associated sub-goals and primary objectives (Chiesi et al., 1980). Within this framework, new information is acquired by analogy, that is, by a comparison of the known and the unknown, (Lindsay & Norman, 1977) in order to understand more about the unknown. The broader the known part, the more comparisons that can be made, with the result that in mapping new information onto existing semantic structures the likelihood is greater of obtaining a good fit. From good fit stems recognition of the relevant

implications of a situation for obtaining some objective. In essence, the experts surpass the performance of non-experts because pertinent information can be rapidly accessed at the correct moment relative to the task at hand (Baddeley, 1982; Chiesi et al., 1979). As a result, experts appear to analyze the situation by sifting through those factors which can or cannot be ignored to arrive at the recognition of some meaningful theme or pattern, and then to 'know' without deliberation what course of action is necessary to accomplish the primary objective (Larkin et al., 1980). Since, from among the many potential alternatives, the expert demonstrates a better assessment of viable goals and strategies as compared to the novice, it has been concluded that with elaborately structured knowledge representations come a shift in the perception of events (Newell & Simon, 1972; Chi, Feltovitch & Glaser, 1981; Schoenfeld & Herrmann, 1982).

In a series of experiments, Chiesi, Spilich and Voss (1979) tested the assumption that experts or individuals with high levels of knowledge are better at relating and evaluating states and actions. Individuals with high or low knowledge of baseball were presented with passages of baseball-related information and were later tested on their recall for sequences of states and actions as well as on recognition of old or new situations. Their results support the notion that experts do have better memory for

this type of related state-action information. They interpret their results as the mapping of sequences of events rather than the encoding of information piece by piece, the former of which is presumed to depend on the presence of sufficiently developed knowledge structures that link relevant relationships among the constituents of an event.

Schoenfeld and Herrmann (1982) examined the proposed shift in the expert's perceptual view of information related to the field of expertise. Rather than using the contrastive method of comparing experts with novices as has customarily been the case (e.g., Chase & Simon, 1973; deGroot, 1966; Larkin et al., 1980), they tested their subjects before and after taking a course in solving mathematical problems and then compared the results to those of experts. Using a sorting task, they asked the subjects to classify mathematical problems. Their results indicate that the non-experts classify the problems on the basis of the words or objects described in the problem. This criterion they have designated as surface structure. In contrast, after taking the course which stressed methods of solution, the subjects sorted problems on the basis of relevant principles of solution much like the sorts obtained from experts. This classification scheme they termed deep structure. The results were taken to mean that a shift occurred in the subjects' perception of the problems. As the

knowledge structures of the participants presumably became more richly interrelated, the characterization of the situation appeared to move from salient event objects to strategies or principles of solution, that is, from the surface structure to the deep structure of the events.

To summarize, expertise has been characterized as the restructuring of poorly linked semantic structures into richly interwoven ones. As a result the salient encoding dimensions along which episodes are classified shift from the declarative knowledge of factual information and object properties to the procedural knowledge of condition-action units; the situational working rules, thereby leading to a change in event perception. Taken as a whole, the expert's enhanced memory ability is thought to proceed from the capacity to detect common patterns within diverse events that then are automatically brought into relationship with the proper procedural knowledge. This unified analysis or encoding of episodes based on hierarchically organized semantic structures not only permits an increase in the information load carried within the constraints of capacity limits but also imposes optimum processing of relevant information and minimum processing of inconsequential information. The cognitive system is, thus, encoding and retrieving quantitively more and qualitatively better information in accordance with quantitive and qualitive improvements in semantic structure.

A Comparison of Expert and Age-related Memory Models

Whereas hierarchical transformation of semantic structures has been proposed as the basis of the expert's enhanced memory ability, paradoxically, it has also been suggested as explaining the elderly's decreased memory ability. Influenced by a Piagetian perspective on cognitive development in which an ordered unfolding of developmental stages occur, Labouvie-Vief and Schell (1982) have extended this view to later adulthood. They argue for processing differences in the elderly that are attributable to developmentally induced transformations of subordinate structures into increasingly superordinated higher order structures. The assumption is that this hierarchical restructuring is an adaptive response to handling the accumulated information of a lifetime within a fixed capacity processing system; it balances the gain of retaining command over sizeable amounts of accumulating information through processing higher level but more generalized information against the loss of processing discrete specific information.

Models of memory processing in experts and in the aged are similar in the assumption of semantic structural hierarchies and transformations of information during processing. The models differ in the transformations postulated; this leads to different conclusions about the dominant encoding and retrieval dimensions or mapping sequences in experts and in the elderly. For the expert,

elaborate semantic hierarchies are proposed to provide the means of relating and evaluating complete and complex sets of information such that rules and procedures become salient; that is hierarchical organization presumably subserves the retrieval of complex units of information subsequent to enabling the integrated encoding of multi-level relationships. For the elderly, hierarchical structures are proposed to underlie a transformation from detailed information to less precise but more manageable superordinate information whereby generalized information becomes dominant and to which later recall appears to be limited. Both models, thus, assume a shift from processing surface form to processing deep structure but 'deep' refers to procedures in the expert as opposed to general information in the old. For experts, there is a proposed expansion of the information load that can be carried, in contrast to the elderly, for whom there is a proposed compression of the information during processing.

The Relationship of Expertise and Aging to Memory

Within the perspective of the ways in which changing semantic structures affect memory, the combined effects of expertise and aging have received little consideration. In regard to theories on expert memory performance there are two important suppositions: chunking and automatic processing. Complex information is processed in chunks (Chase & Simon, 1973), and chunking is automatic (Chiesi

et al., 1979; Larken et al., 1980) as, for example, in evaluating and then relating an event to the proper strategy to obtain a particular outcome. If, under the guidance of hierarchical semantic structures, experts do automatically integrate information into retrievable chunks, then Hasher and Zack (1979) have provided a convenient proposal to commence the discussion of expertise relative to aging.

They interpret age-related decrements in memory in terms of automatic and effortful processes. Their suggestion is that automatic processing should remain relatively stable over the life span but that effortful processing would be sensitive to impairment with increasing age. An important assumption of their model is that effortful processes may become automatic with practice. This assumption rests on an older literature which dealt with response integration (e.g., Hebb, 1949; Harlow,1949 ; Mandler, 1962) and on more recent experimental demonstrations of the development of automaticity (e.g., Schneider & Shiffrin, 1977). If automatic processing does remain stable in the elderly and the advantage of expertise rests on the automaticity created by the expert's superior semantic structures, then the prediction would be that the automacity developed in experts should endure in old age The aged expert should maintain enhanced memory on retention tasks within their specialty.

This prediction is not supported by the results of a study by Charness (1981). Although the study was not designed to test directly the maintenance of automatic processing in elderly experts, Charness did assess age-related incidental recall of high and low skilled chess players using chess problem-solving tasks.

Charness presented four slides of chess positions to individuals equated for skill across age. The tasks included choosing the next best move, predicting the end game and recall of the original positions of pieces on the four slides. The results of the study indicated no age difference in the quality of move chosen nor in ability to predict end game. Only skill level distinguished the quality of performance. The recall test did, however, show an age effect on memory performance with the young recalling more than the old. There was also an age difference in the time taken to choose a move. Old experts chose a move significantly faster than young experts. The time taken to choose a move was, moreover, found to correlate with recall level: the faster the time to select a move the poorer the recall.

Charness interpreted his results as demonstrating a trade-off between skill and age. He concluded that, unlike the child or young adult, the older expert does not benefit from expertise to the same extent because of deficits in memory processing. He attributed the poorer memory scores

of the old to possible encoding or retrieval difficulties. This conclusion can be questioned because it does not take account of the older expert's faster selection time.

If the elderly choose the move faster, a move that matches that of younger experts in quality, and faster moves are related to poorer recall, then it is not at all clear that lower recall scores result from deficits in processing. It can be otherwise argued that the elder experts automatically integrate substantial information, rapidly and efficiently, since they fare as well as the young on the informed task of selecting the best move. The failure to account for the speed factor, thus, confounds the conclusions drawn about the effect of age on the the memory of experts.

Another difficulty with the Charness (1981) study for assessing semantic structural effects is the bias towards the quantitative aspects of memory since a chess position either is or is not correct. From the viewpoint of processing differences as a product of differences in semantic structures, it is the qualitative aspects of memory that are significant, a condition to which incidental recall of chess positions is likely insensitive.

Statement of the Problem

In the absence of accounting for the role of speed, and with the penalizing effects of the need to retain specific detail, the relationship between semantic structures, expertise and age relative to memory remains unclear. Therefore, the present study examined the interplay among potential changes in the structure of semantic information, high levels of knowledge and aging. To do so, the study used a cross-sectional design comparing three age levels and two skill levels under conditions where the new learning was or was not compatible with prior knowledge.

The topic chosen as the field of expertise was the development of musical style and the contrastive control domain was the development of dog breeds. This research was designed to examine the difference hypothesis of memory performance when the participants presumably differed in the structure of semantic memory as a function of age and expertise. That is, memory performance was evaluated in the elderly relative to the young when the subjects did and did not have richly developed semantic structures for the target material. Based on theories that biological changes associated with aging create deficits in information processing ability, it was predicted that the old would recall relatively less than the young. This expectation, however, was modified by postulates derived from

experiments which showed differences in information processing as a function of age level and level of expertise. A consideration of these bodies of literature led to the prediction that the direction and extent of age-related changes would vary depending on the level of expertise and on the type of response used to index memory. Under the assumption that with increasing age and increasing expertise knowledge structures are transformed into new superordinate structures which include previous structures as subordinates, it was expected that the old would differ from the young, and that experts would differ from non-experts in the type of information they extract and retain in a given situation.

With respect to old-young comparisons, the decline with age was expected to be greatest for measures of verbatim recall since higher order structures are assumed to lead to broader or more generalized processing with less emphasis on specific detail. In contrast, measures of superordination were expected to increase with age because of the increased reliance on generalized processing, and would be consistent with the view proposed by Labouvie-Vief and Schell (1982).

With respect to expert - non-expert comparisons the situation is more complex because the expert is assumed not only to have a highly structured superordinate knowledge system but also, as a result of this richly developed

system to have an enhanced ability to store and retrieve detailed information. Thus, there is the paradoxical situation already noted that in the case of the elderly increasingly higher order structures are proposed to explain the loss of memory for detail whereas in the case of the expert higher order restructuring is suggested to account for their superior recall ability. No specific prediction was, therefore, made but it was expected that the old expert would still demonstrate an advantage for material that is familiar as compared to memory for unfamiliar topics.

The present study was also designed to explore further the possible type of differences in processing with increasing age. On the basis of findings within the literature on expertise it was suggested that the expert in analyzing a situation focuses on the principles involved rather than on the objects within the event. One possibility that was considered here is that the elderly, through the effect of repetitive experience, also shift in their perceptions of events and accentuate the principles underlying a situation to the neglect of the objects present. This speculation is derived from the suggestion that both experts and the elderly share, according to theory, structural similarities in the hierarchical arrangement of information. There is evidence, moreover, for associative response differences between the old and the young that may reflect

not only a change in the older adults' semantic structural organization but also the elderly's possible shift in perception towards actions or function-based processing. The type of response of the elderly on a word association task (Riegel, 1968) were more syntagmatic, that is in syntactic sequence or usage-based, than those of younger subjects whose associations were paradigmatic or of the same form class (e.g., noun-noun, verb-verb). The type of associations generated on a word association task were used in the present study to evaluate the suggestion of a perceptual shift in older adults relative to hierarchical restructuring. If, as Schoenfeld and Herrmann (1982) argue, the experts' processing shifts to relevant principles as knowledge structures become enriched, the experts would be expected to produce more function-based responses than non-experts. Riegel's (1968) word association study suggests that the old would also generate more syntagmatic responses than the young. Since both expertise and aging have been linked to a shift in the nature of salient processing dimensions, it was predicted that differences in the type of response would be greatest between old experts and young non-experts, consistent with difference theory.

Method

Subjects

The subjects were 72 adults recruited from clubs, schools, churches and music faculties, ensembles and choirs. The subjects were classified by age at the time of testing into three groups: 20-36 years; 37-53 years and 54-70 years. The mean age of the sample was 44.48 years with the range from 20 to 70 years. The mean age and range in relation to age group and to level of knowledge is summarized in Table 1. Half the subjects within each age group were individuals with a high level of knowledge of music. High knowledge individuals were defined as persons who have received formal training in music and who participate in a professional music group or career either full or part-time. The remaining half of the subjects were persons with a low knowledge of music who were defined by having received no training in music and by no participation in a professional music group. Additional verification of high or low knowledge status was obtained by asking the subjects to self-rate their knowledge status as high or low. No subjects had high levels of knowledge for the control topic of dog breeds. To ensure comparable well-matched samples of old and young and of high and low knowledge subjects, each group included 6 women and 6 men, and as far as possible, individuals were equated for level of education (see Table 2) or commensurate experience,

Table 1

Mean age and Range for High and Low Knowledge Levels in Relation to Age Groups

	High Knowledge		Low Knowledge	
Age Groups	Range (Years)	Mean	Range (Years)	Mean
Young	23-31	28.17	20-33	28.50
Middle	37-51	44.08	37-53	43.50
Old	57-70	62.25	54-70	60.42

Table 2

Mean Number of Years of Education for High and Low Knowledge Levels in Relation to Age Groups

Age Groups	Level of Knowledge	
	High	Low
Young	16.33	15.66
Middle	17.33	16.41
Old	16.66	15.33

Note. Subjects reported degrees held. The years of education were represented as follows: bachelor, 16 years; masters, 18 years; doctorate or professional school, 21 years.

health according to self-assessment, and level of English. All participants self-rated their current health as average or excellent and all appeared to be in good health. Confirmation of proficiency in the English language was obtained by administering the Stanford-Binet Vocabulary Test. Subjects were offered a small honorarium for either their personal keeping or to be donated to an association in return for their participation.

Materials

Four test passages were constructed, two pertaining to the development of musical style and, as a means of control, two to the development of dog breeds. The styles of music selected were jazz and chant, and the breeds of dogs chosen were Bouviers des Flandres and Poodles. In the case of jazz and the Bouvier, both are recent in appearance within their respective fields. By contrast, both chant and the Poodle trace their origins far back in history and in their present form have distinct varieties. Thus, the attempt was made, despite the contrast of topics, to equate as nearly as possible for the length of passage and the complexity of the described development. Other factors considered in choosing the four topics were their potential inherent interest, and the probability that the topics would be somewhat familiar to most people so that participants, in spite of differing knowledge levels, would not experience intrinsic vocabulary problems which,

produce floor effects. .

Following each passage were 15 questions which asked about information specifically given in the passage and which could be answered with one or two words or a short sentence. An answer guide for use by scorers was constructed for each of the four passages.

For the free association test, two lists were constructed, the one containing five categories of musical instruments and the other, five classifications of dog breeds.

The passages, questions, answer guides and two lists were typed on separate 21.2 x 27.6 cm white paper.

Procedure

Personal data were collected at the beginning of the experimental session. Subjects were individually tested in a quiet location. They were informed prior to reading the four passages that the object of their task was to remember the information they read. Each subject was asked to read the text once only. The passage was then returned to the experimeter and the subject was given seven minutes to write answers to the fifteen questions. This procedure was repeated until all four passages and associated questions had been completed. The order of presentation of the four passages was counterbalanced across subjects within experimental treatments. Following a three minute break the subject was given the lists of classification of musical

instruments and dog breeds with the order of presentation of the two lists counterbalanced across subjects within treatment conditions. The subject was asked to generate as many word associations as possible within the topic realm. The subject was told to associate freely but always to associate to the category name and to list single words rather than phrases. The task ended after a 30 second delay in which no associations were formed or after three minutes total time, whichever occurred earlier.

The recall of each subject for each question was compared to the answer guide (see Appendix 1) and, in accordance with the proposed hierarchical structure of semantic knowledge, was scored in terms of the following four categories: (a) correct reproduction, where the subject reproduced the essential features of the information in the passage, e.g., size at maturity, height at development; (b) superordinate, where the subject's response was superordinate to the text, thereby giving the correct response in general terms, e.g., "keep in" as opposed to the correct response of "sleep indoors"; (c) subordinate, where the subject's response was subordinate to the information asked for, e.g., "retrieving ducks" where the text states "hunting", and (d) correct addition, where the subject reproduced the correct answer but added information consistent with the passage but not stated in it.

Two performance measures were derived for scoring each word association list: number of associations and the type of association with respect to paradigmatic versus syntagmatic response. Paradigmatic responses were defined as associations based on declarative or factual information, that is, which are in the same form class as the category names, which in this case would be noun-noun responses. Syntagmatic responses were defined as associations that are procedural or related to the formation of sequences, that is, which are usage based or verb and action related.

Of the total 288 text recall protocols (four per subject x 72 subjects), two raters using the response classification scheme independently and blindly classified the responses of the first three subjects from each of the six groups for a total of 72 protocols. The results were scored until a high level of classification agreement was reached. The remaining protocols were divided with 54 protocols scored by each rater. Half of the 144 word association lists were scored by each rater, that is, 72 per rater.

Results

In order to assess the effect of age, high versus low levels of knowledge of a particular topic and information that is or is not related to the specialized field of knowledge, the performance measures for recall and for associations were analyzed by three-way univariate analyses of variance (ANOVAS) using 3(age levels) x 2(knowledge levels) x 2(material type levels) with repeated measures on the third factor. Additionally, two three-way ANOVAS were done, one for reading time and the other for vocabulary score. ANOVA summary Tables A through I are presented in Appendix 3.

The selection of univariate ANOVAS rather than multivariate ANOVAS rests on the following considerations. Davidson and Toporek (1983) point out that for repeated measures designs, although either a univariate or a multivariate approach is possible each has associated advantages and disadvantages so that neither approach is always better. For example, the univariate test involves the assumption of uniform variances and covariances (Davidson, 1972) whereas, the multivariate test rests on less restrictive assumptions but is less powerful (Poor, 1973). Moreover, Harris (1975) recommends that if there are several performance measures within each experimental treatment then the univariate approach to repeated measures is preferable. Thus, preference was given to and the interpretation relied

upon univariate ANOVAS. Additional analyses using the multivariate techniques were performed. However, the results were highly similar to those found using the univariate analysis; no significant differences were either lost nor found with the multivariate approach. Therefore, only the results using the univariate approach are reported.

Analysis of the Mean Scores on the Recall Task

The mean scores for all recall measures in relation to age group, material type and level of knowledge are summarized in Tables 3 through 6 in Appendix 2.

Correct Reproduction Analysis of age effects, either alone or in interaction, indicate that age differences were not a significant factor in determining correct reproductions. There was a main effect of knowledge, F (1,66) = 4.02, $p < .05$ with music experts scoring higher overall (Mean = 9.21) than non-experts (Mean = 7.85). Similarly there was a main effect of materials, F (1,66) = 51.97, $p < .0001$, with music passages eliciting more correct reproductions (Mean = 10.33) than dog passages (Mean = 6.72). Both these main effects, however, were qualified by a significant Knowledge Level x Material Type interaction, F (1,66) = 9.99, $p < .01$, illustrated in Figure 1. Post hoc Tukey tests on this interaction showed that the recall of music experts was significantly superior to that of non-experts only for the music passages, and that the superior recall of music passages over dog passages was found only with the music experts, not with the non-experts.

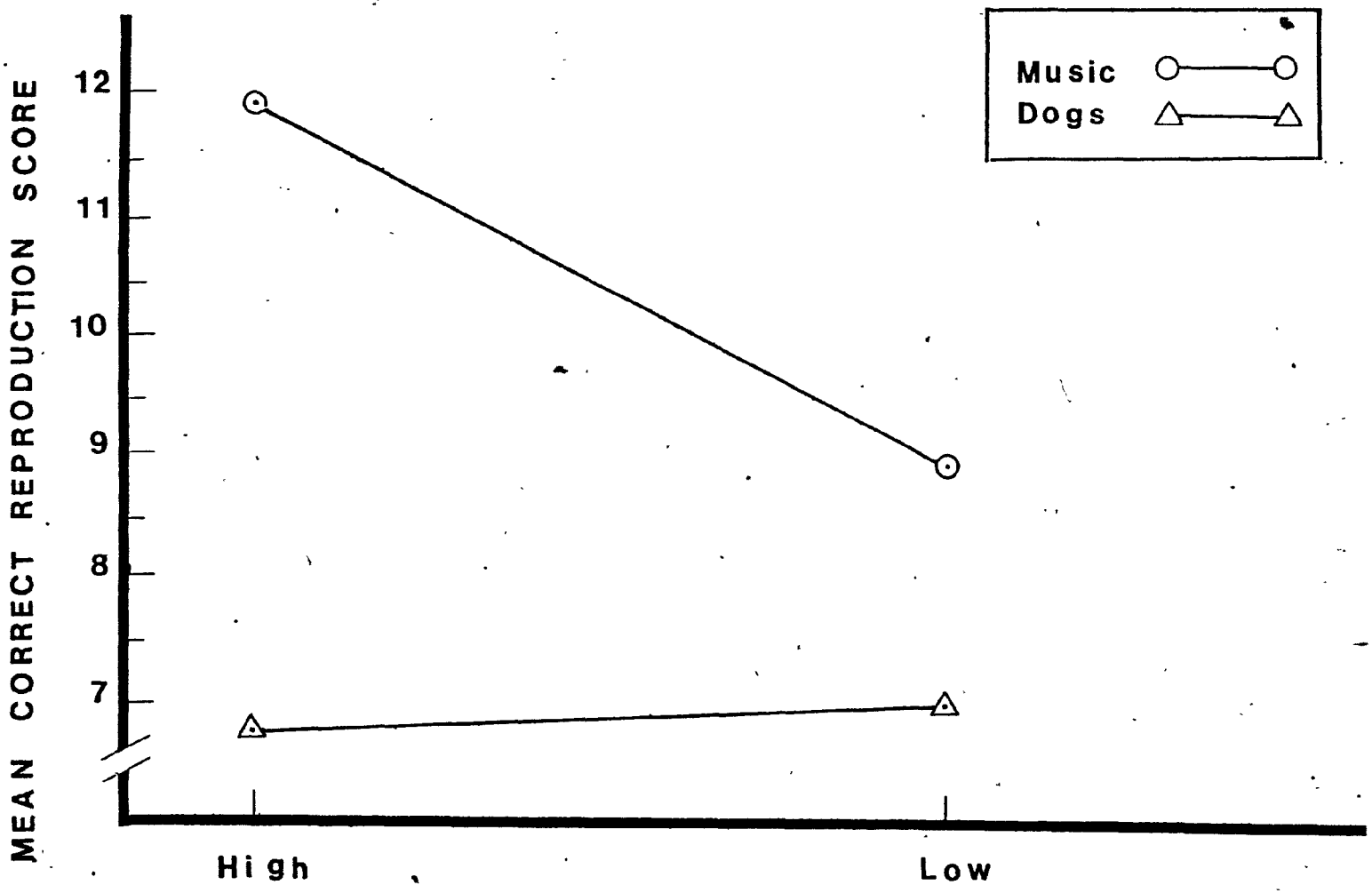

Figure 1. Mean correct reproduction scores in relation to level of knowledge and material type level.

Superordinate, Subordinate and Correct Addition Measures

None of the observed differences in mean scores differed significantly with age or knowledge level for the three scoring categories of superordinate, subordinate and correct addition responses. While material was not a significant factor for the subordinate or correct addition response, for the superordinate response, a main effect of Material Type was significant, F (1,66) = 26.91, $p < .0001$, with this effect due to the higher scores on dog passages (Mean = 4.49) than on the music passages (Mean = 2.83).

Analysis of the Mean Scores on the Association Task

The mean scores for Total Association, Paradigmatic and Syntagmatic responses in relation to age group, material type and knowledge level are presented in Tables 7, 8 and 9 in Appendix 2.

Total Associations Knowledge level had a significant effect on the total associations score, F (1,66) = 9.09, $p < .01$, with music experts forming more associations (Mean = 26.68) than non-experts (Mean = 20.57). There was also a main effect of material, F (1,66) = 36.67, $p < .0001$ with the music passages generating more total associations (Mean = 27.90) than dog passages (Mean = 19.35). As may be seen from Figure 2, both these main effects were qualified by a Knowledge Level x Material Type interaction, F (1,66) = 17.87, $p < .0001$. Post hoc Tukey tests showed that music experts had significantly higher total

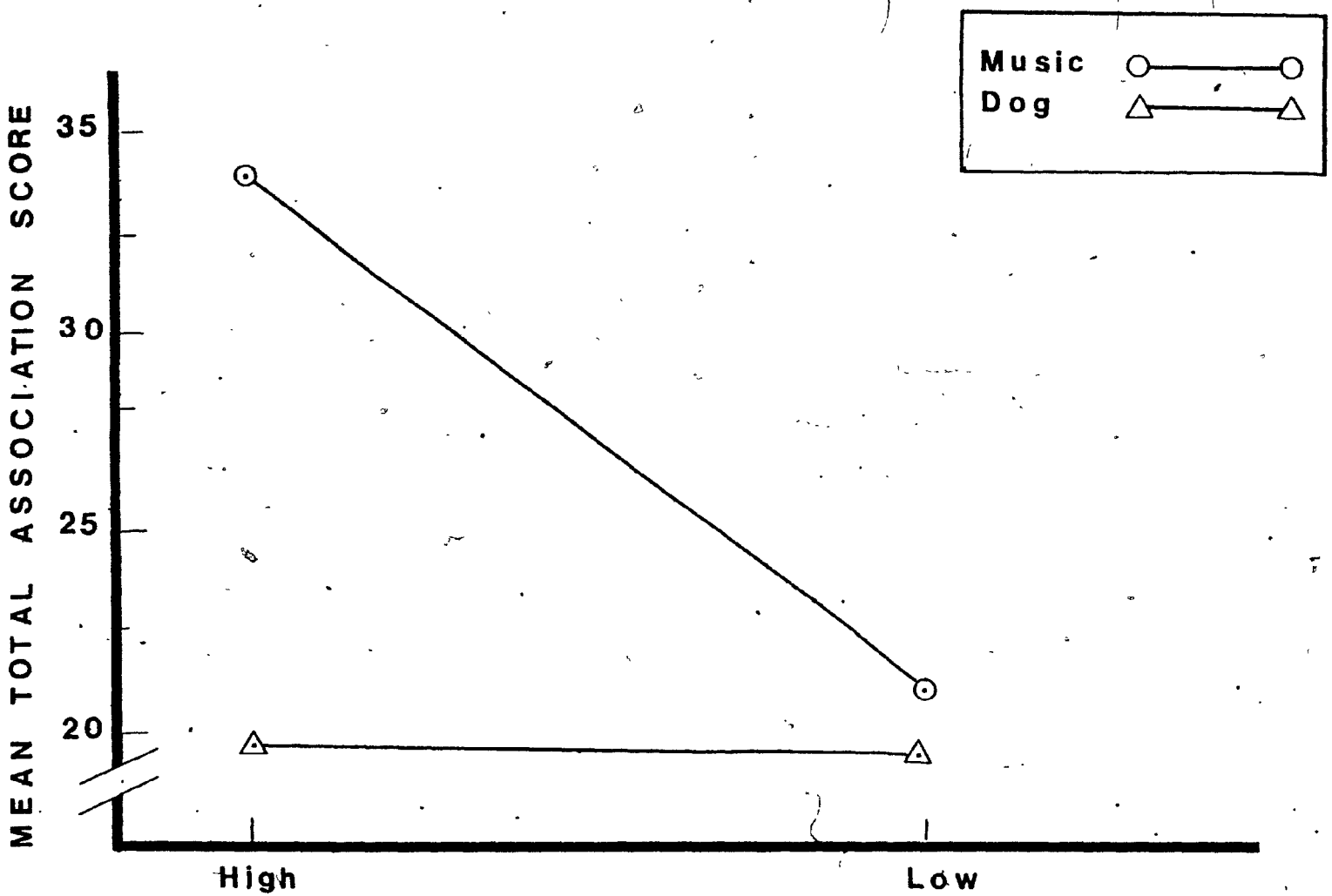

Figure 2. Mean total association scores in relation to level of knowledge and material type level.

association scores on the music categories list than non-experts on the same topic or than they themselves did on the dog categories list. The two knowledge levels did not differ significantly in generating associations on the dog categories list nor did non-experts differ on lists related or unrelated to music. Level of age had no effect, alone or in interaction.

Paradigmatic and Syntagmatic Association Scores.

Analysis of the paradigmatic scores showed no effect of age level. The effect of knowledge was significant, F (1,66) = 9.62, $p < .01$, with music experts producing more paradigmatic responses overall (Mean = 21.04) than non-experts (Mean = 15.50). There was also a main effect of material, F (1,66) = 93.13, $p < .0001$, with the music categories list eliciting more paradigmatic associations (Mean = 24.33) than the dog categories list (Mean = 12.21). These main effects were qualified by a Knowledge Level x Material Type interaction, F (1,66) = 15.92, $p < .001$ (see Figure 3). Post hoc Tukey tests on the interaction showed that experts scored higher than non-experts only for the music category list as there were no differences on the dog category list, and that both experts and non-experts scored higher on music than on dog lists. Syntagmatic responses were only differentially affected by material F (1,66) = 40.77, $p < .0001$, with the higher syntagmatic scores on the dog category list (Mean = 3.78) than on the music category list (Mean = .97).

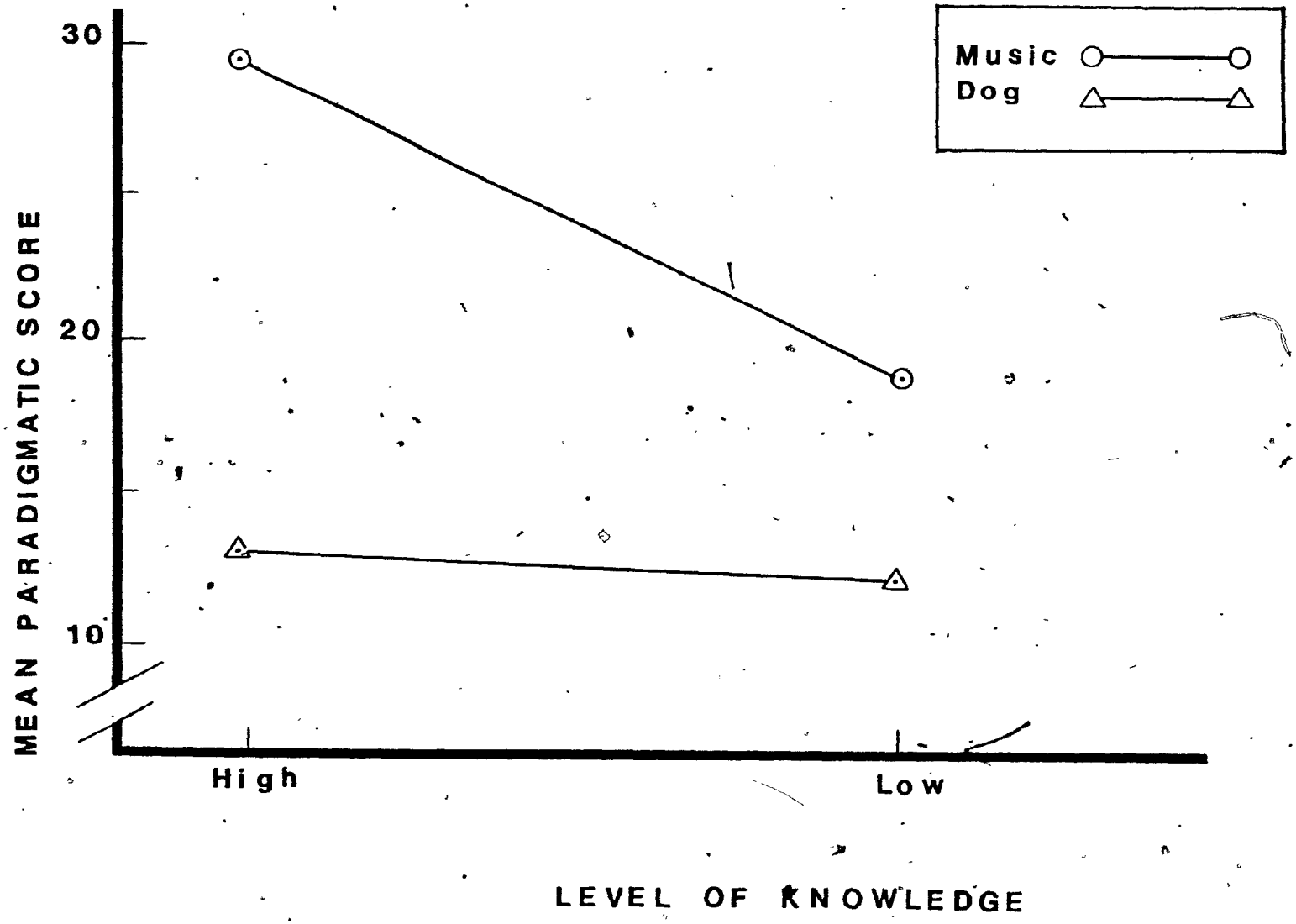

Figure 3. Mean paradigmatic scores in relation to level of knowledge and material type level.

Analysis of the Mean Scores for Reading Time and Vocabulary

The mean scores for reading time and vocabulary in relation to age and knowledge are listed in Table 10, Appendix 2. In the case of reading time there was a significant Age x Knowledge interaction, F (2,66) = 3.48, $p < .05$, which post hoc Tukey tests showed was attributable to the relatively long reading times for young non-experts in comparison with all other conditions. There was a main effect of age on the vocabulary scores, F (2,66) = 6.97, $p < .001$. Post hoc Tukey tests showed that while the middle and the old age groups did not differ significantly from each other, both the middle and old age groups scored significantly higher than the young. The level of knowledge had no effect.

Discussion

Recall Task

Hypotheses The main purpose of this study was to determine whether high and low levels of knowledge of a topic elicit differences in recall for information that is or is not related to the high knowledge domain, and how such knowledge effects are qualified by the effects of age. The study began with the assumption that the structure of knowledge guides the processing of information and, as maintained in the literature on expertise and aging respectively, that the expert and the old have increasingly higher order structures. Under the assumption that for the elderly, hierarchical superordination is a process through which the information extracted comes to be increasingly generalized, the hypothesis that the old would recall less detail than the young because of their generalized mode of encoding received no support. For the expert, the assumed effects of hierarchical semantic organization are to enhance the integration of new information into richly developed structures and to facilitate recall through the retrieval of the integrated units of information. The hypothesis that the expert would recall more than the non-expert within their field of expertise but not for information outside the specialized area was supported.

Each hypothesis, that is, with respect to old - young comparisons and expert - non-expert comparisons, was

qualified by the expectation that the lower performance of the old and the higher performance of the expert would vary depending upon the effect of knowledge level and the effect of age respectively. However, because age never was a significant factor, this expectation was not supported.

Correct Reproductions The manipulation of Material type significantly increased correct reproduction scores only for the individuals with high knowledge and only for information related to that knowledge. The experts' enhanced correct reproduction scores under the music treatment contrast with the essentially equivalent scores across levels of knowledge given the dog related material. This finding supports the hypothesis on expert - non-expert comparisons. It is also consistent with the assumption that associated with increasing knowledge is the development of a richly structured knowledge representation, the effects of which are thought to facilitate abstraction, integration and retrieval of units of information.

The finding that age level had no effect alone and that the effect of knowledge was not influenced by age effects fails to support the idea of age differences in semantic structures. Specifically, the absence of any age-related declines argues against the idea that the old tend towards increasingly higher and more generalized abstractive processing due to higher order semantic structures, since the recall of detailed and exact information

was relatively stable across age levels. Furthermore, since there was no interaction between knowledge effects and age effects, the results do not lend support to Charness' (1981) position of a trade-off between expertise and age, nor to a maturational deficit explanation of memory processing in the old.

Superordinate, Subordinate and Correct Addition There were no significant differences due to the effect of age, or level of knowledge on any of the three measures nor did the relevant interactions ever approach significance. It was assumed that in place of using global measures of recall accuracy, the inclusion of recall measures reflecting a hierarchical structure should discri-criminate the three age groups and possibly the two know-ledge levels. The observation that among the performance measures none differed with age argues against the position of the difference theorists that older individuals process information in a qualitatively different way (e.g., Labouvie-Vief & Schell, 1982). However, in the absence of any differences between knowledge levels, another possibility is that the measures used were insensitive to qualitative processing differences. A consideration of the main effect of materials under the superordinate category, that is, the higher scores for dog passages, qualifies this sug-gestion. Under the dog condition both experts and non-experts have low levels of knowledge. Thus, it appears

as if a low level of knowledge with its assumed inferior semantic structures might elicit more processing at the superordinate level.

Association Task

Hypothesis The hypothesis that experts perceive and process information in terms of strategies and goals and that this mode of processing might also operate in older individuals was not supported.

Total Associations The findings of primary interest concerned the effects of knowledge level on the total associations response measure and in what manner the knowledge effects were modified by the effect of material type. Individuals with high knowledge produced significantly higher numbers of associations than low knowledge individuals but only under the music related condition. In contrast, the total number of associations did not vary with knowledge level under the dog related condition. The results also revealed nonsignificant differences across age groups for both music and dog associations. The implication of a greater number of associations on the part of high knowledge individuals within their specialized area is that greater numbers of associations are linked and accessible within their richly elaborated semantic structures. The similar numbers of associations between young and old, that is, the old did not produce fewer associations, does not support the idea of

impairments which obstruct efficient processing with increasing age.

Paradigmatic and Syntagmatic Associations The results revealed a differential effectiveness of knowledge level on paradigmatic associations under the high knowledge related and unrelated material types. Significantly increased paradigmatic scores occurred only for the individuals with high levels of knowledge and only for music related associations. The number of paradigmatic associations formed did not differ significantly between individuals with high and low knowledge levels in the dog condition. No differences were found due to the effect of age level.

Thus, although knowledge level is an important source of access to associations, and the relation of the material to the specialized knowledge is an important factor, the effect of age seems to be negligible. This finding argues against theories of impaired cognitive processing in the old. Similarly, the absence of age effects and the presence of enhanced paradigmatic scores made by high knowledge individuals does not support the hypothesis that the expert and possibly the old shift from object oriented to action oriented modes of encoding. The possibility remains, however, that the measures used were insensitive.

On the measure of syntagmatic associations, the differences between young and old and betwen high and low

levels of knowledge were nonsignificant. This suggests that under the task requirements of forming associations, usage-based associative responses are not a primary dimension. The data thus offered no support for the idea that the processing of the expert and the old is focused on action related information, that is that the cue word would trigger action related processing.

Time and Vocabulary Measures Reading time increased significantly for the young but only under the low knowledge condition. The reason for this is not clear as it would seem to suggest that reading skills improve with age which may or may not be the case but nothing else within the data would concur with this position.

The score on vocabulary increased significantly with age whereas the level of knowledge had no effect. The vocabulary test was introduced as a screening device to assure that the participants had proficiency in English. However, the expected significant increase in vocabulary score with age does provide corroborative evidence that typical age effects were operating within the study. If age effects were absent on all measures then one possibility would be to question whether the subject sample for some unspecified reason was unrepresentative of the three age levels under study. In this instance, however, the older subjects did show a typical effect of age; an increase in vocabulary which is consistent with most literature

on aging. The vocabulary differences provide support for the statement that these were representative samples of these age levels and thus imply that the absence of age differences on recall and association measures requires some explanation.

Age Differences

It is important to consider why similar performance levels were found between the young and the old. The general pattern of results showed an effect only for specialization and only on the specialized material. The old low knowledge individuals in comparison with the young low or high knowledge individuals showed no age differences for information unrelated to the specialized area. The critical finding is that the memory capabilities appeared not to differ for the various age groups.

This finding does not support Charness' (1981) findings and theory that there is a trade-off between age and skill in which age-related deficits in processing are compensated by skill-related increased efficiency: although old experts did indeed recall more than young non-experts there were no performance differences between young and old experts. One possible explanation of the apparent contradiction between Charness' results and the results of this study would be if the age range of the two studies was not comparable. The mean age of the Charness sample was 38.7 years

with a range from 16-64 years while, as can be seen from Table 1, the mean age of this study's sample was 44.48 years with a range from 20 - 70 years. The difference in the results of the two studies can therefore not be attributed to unequal age comparisons. The idea then that the sample in this study was not sufficiently old to detect age differences in memory is not supported. It is worth noting that Charness did find skill-related but not age-related effects on two tasks that were not primarily measuring memory, problem solution and rapid evaluation. On his memory task, however, he found age declines, whereas neither the memory task nor the association task of the present study showed age effects.

Another possibility for explaining the nonsignificant differences between age groups is to consider the general calibre of the sample, both those of high and low knowledge groups. It is important to realize that the high - low distinction was for the field of music only. Both the expert and non-expert groups were comprised of highly educated, cognitively active individuals. Pending further investigation, one suggestion might be that high levels of education and participation in intellectually stimulating environments prevents or at least delays the onset of age declines in memory.

Considerations for Future Research

One common occurrence of memory processes, already noted by Bartlett (1932), is the tendency to condense

information. Rather than using superordinate measures reflecting increasing generalization, it would perhaps be better to test for condensation of material. The apparent generalization suggested by Labouvie-Vief and Schell (1982) may reflect the reduction of material during cognitive processing. However, material may be condensed at any level of the hierarchy. Testing for the proposed condensation has the advantage of not being limited to the hierarchical scoring system as retrieved information may well be reduced from that provided without moving up or down the hierarchically organized semantic structure. Some support for this approach results from the experience gained during the scoring of the protocols. It was noted that some responses were partially correct but failed to duplicate the exact meaning as provided in the passage because they had been condensed. Future studies should give some consideration to the synthesizing of information over the life span.

The extremely low incidence of syntagmatic associations did not support the hypothesis that action based associations increase with age. However, the literature on expertise reports than when young experts are tested there is a movement in the direction of action based or goal based processing. In the absence of significant increases in syntagmatic associations on the part of the young high knowledge group it is suggested that this method of assessing usage based on goal oriented processing may not have

been effective. A more sensitive measure of expert and non-expert comparisons in the use of strategy and goal based processing over the life span would be more appropriate.

A factor that should be considered in future studies is the contribution made to competent processing by the individual's level of cognitive activity. The position suggested here is analogous to the idea that good physical development accompanied by continued exercising is beneficial to maintaining physical flexibility and tone. Cognitive efficiency may also be influenced by good knowledge development accompanied by remaining cognitively active over the adult years.

Conclusion

The results of this study suggest that neither the deficit view nor the difference view of aging and memory can entirely account for the course of information processing efficacy over the adult years. If, as deficit theorists propose, the introduction of impairments into the information processing system reduces encoding and retrieval efficiency, the prediction that the old would recall less than the young should have received some support. It was not supported, however, since there were no significant age effects, either alone or in interaction. The lack of memory decline over the adult years does not demonstrate that maturational declines do not occur; to propose this

would be unwarranted in the light of the large body of research on aging which clearly show such declines, but the results argue against the time of onset and the degree of impairment assumed.

The hypothesis, represented by the difference position, that due to the expansion of the knowledge base, an age-related shift occurs in the mode of processing from extracting detailed information to increasingly generalized abstract information was not supported. Not only were old individuals equally adept as the young at recalling information correctly but, both the absence of age differences in general and the relative absence of responses in the superordinate category argue against the difference position that age-related hierarchical superordination results in processing limited primarily to general information. Given the caution that the measures used may have been insensitive, this conclusion suggests either that the establishment of increasingly higher order structures does not occur with age or that higher order structures do not result in the processing of more general information.

Although the prediction that with age more generalized information would be processed was not supported, this finding does not show that the general theoretical position of difference theorists is not valid. The prediction that the effects of knowledge and familiarity with task material would enhance recall was supported. The advocates of a life-

span developmental view (e.g., Labouvie-Vief & Schell, 1982) have emphasized that both familiarity with materials and the effects of specialization are of concern in the assessment of age effects.

While the present study clearly demonstrated that high levels of knowledge for a specialized topic enhance the ability to remember new information related to the specialized area, the critical finding was the absence of relative age losses in the ability to remember. The results suggest that within the age range examined, decreased processing efficiency is not an inevitable result of growing older but that when individuals are knowledgeable and stay cognitively active they retain their cognitive skills.

This finding has both theoretical and social implications. The results call for further research into the effects of specialization, one possibility being to extend the age range of the older individuals beyond age 70. In addition, the results suggest that changing social views towards a more positive image of aging are warranted.

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Appendix 1

Examples of Passages, Questions, Answer Guides, Association Task and Instructions to Subjects

Development of Jazz as a musical form

The merger of blues and ragtime into the new instrumental music called jazz originated about 1900 and has taken a number of different directions since that time. Ragtime gave jazz one of its most distinctive features, a syncopated rhythm, with the accents falling on unexpected beats, and the beats themselves divided unevenly. This gives the music rhythmic complexities that are difficult to notate accurately. Blues vocal style gave jazz a second characteristic feature, the practice of improvisation. In a basic improvisational style of early jazz, called "hot" jazz, the leader gives the tempo, the group plays the basic melody once and then each instrument takes its turn playing solo. The soloist ornaments or otherwise changes the melody in whatever way he wishes. Excellence in improvisation, termed "hot", is marked by ingenuity, technical brillance, and speed. Normally, the soloist is backed up by the rhythm section. A final chorus is played by the entire group when the leader signals a halt to the solos and this final section often repeats some of the variations devised by the soloists. The self-expression of improvisation restricted the group size. The expansion of the band size initiated the changeover to a new style of jazz and a new kind of ensemble, the big band. Whereas the basic or small jazz band consisted of no more than nine players the big bands included as many as twenty-five musicians. Such a large size ensemble limited the possibilities for improvising. For a time the small band playing "hot" jazz existed side by side with the big band. The big band developed a smooth style that came to be called "swing". Swing included both genuine big-band jazz and commercial music. With the popularity of swing came the revival of older forms and a version of the original jazz style termed "Dixieland". Following World War II several small ensembles had formed again and began to develop new jazz styles. In contrast to the elderly musicians who played by ear and who seldom knew how to read music the

post-war musicians were trained; they were more sophisticated in approach and their music, unlike earlier melodies, was not for dancing but for listening. Their complex melodies and dissonant harmonies were called "cool" as opposed to the "hot" Dixieland style. The 1950s brought the development of still another style, "progressive" jazz, featuring such refinements as classic counterpoint and harmonic development subject to improvisation. Jazz has interested and influenced composers of other kinds of music, for example, Igor Stravinsky. Conversely, the influence of contemporary serious music on jazz musicians was also apparent during the 1950s and 1960s.

IDENTIFICATION NUMBER_____

PLEASE RESTRICT YOUR ANSWERS TO INFORMATION GIVEN IN THE PASSAGE YOU JUST READ. One or two words or a phrase will usually do. Answer in your own words.

1. As a style of music, when did jazz originate?

_____

2. One of the most characteristic features of jazz, syncopated rhythm, grew out of what kind of music?

_____

3. The practice of improvisation, another distinctive feature of jazz, developed through the influence of what style of music?

_____

4. In the basic improvisational style of early jazz the leader provides direction in two ways. What are they?

_____

5. In the final section of the melody what is often repeated?

_____

6. According to the text, what term is applied to excellence in the early style of jazz improvisation?

_____

7. A new style developed with the change in band size. Why did band size contribute to a stylistic change?

_____

8. A maximum of how many musicians partipated in the small band and how many in the big band?

_____

9. What distinguished post-war jazz musicians from the early jazz players?

_____

10. The main role or intent of early jazz music differed from that of post-war jazz. How?

_____

11. According to the text, what could describe the "cool" style of post-war jazz?

_____

12. What is the name of the jazz style whose development began in the 1950s?

_____

13. This style of jazz which first appeared in the 1950s featured what musical refinements?

_____

14. What composer was mentioned who was influenced by jazz although his compositions are of another musical form?

_____

15. What effect does syncopated rhythm have on the recording of music in written form, that is on notation?

_____

ANSWER GUIDE JAZZ

1. About 1900
2. Ragtime
3. Blues vocal style
4. Gives the tempo
   signals halt to the solos
5. Some variations devised by the soloists
6. Hot
7. Limited the possibilities for improvising
8. Nine and 25
9. Post-war were trained musicians whereas early musicians played by ear, seldom knew how to read music
10. Earlier melodies were for dancing, post-war jazz was for listening
11. Complex melodies and dissonant harmonies
12. Progressive jazz
13. Classical counterpoint, harmonic development subject to improvisation
14. Ignor Stravinsky
15. Difficult to notate accurately

Development of Chant as a musical form

The term chant is derived from the Latin word 'cantare' which means sing and is applied to song generally but more particularly to liturgical song, that is, song related to worship. Several types of chant have developed over a period of many centuries. The oldest form is the Jewish chant. Of the Christian chants there are three principle kinds: Byzantine chant, Gregorian chant and Anglican chant. The Byzantine chant originated in the Christian church of the Byzantine Empire and had considerable influence on the chant of the various eastern Orthodox churches but the extent of its influence on Gregorian chant is disputed. Very likely both Gregorian and Byzantine chant are derived from older Jewish models. Like Gregorian chant, Byzantine chant is unaccompanied by ins truments and is monophonic, that is, having only one voice-part as is a type of Jewish chant, cantillation. The cantillation style is performed by a soloist, the cantor, and is the chanting of the prose books of the Old Testament. The music is in free rhythm and each book of the Bible is assigned its own mode, not unlike the modes used in the medieval Christian church. Gregorian chant is an enormous body of music, made up of about three thousand chants. Each chant consists of a single melody, sung either by a solist or by a choir which sings in unison. The music is in free rhythm, and there are no bar lines and no time signatures. That is, the music is entirely monophonic and in free rhythm, lacking regular meter and measure. Instead, the music follows the rhythm of the words. Despite rigorous simplicity, the Gregorian chants possess in reality a most refined technique. They are based on the rules of Latin accentuation, to which they owe their musical, melodic, and rhythmic form. The words themselves most often come from the Bible, especially the Book of Psalms and were always sung in Latin until the 1969s, at which time translations began to be permitted. In addition to the similarities of monophony, modal style and lack of accompaniment,

the view that Gregorian chant is most likely based on Jewish chant is supported by the large number of texts from the Old Testament as well as the fact that its early development took place in Palestine and Syria. In the fourth century the development of Gregorian chant shifted to Rome. The early Middle Ages saw the center of development shift to what came to be called the Holy Roman Empire and it was probably under its early rulers in their capital city of Metz that the Gregorian chant assumed what is today considered its traditional form. In the Renaissance, with vocal polyphony (more than one voice-part) at its height, polyphonic versions of the Gregorian chant were devised and some attempts were made to fit the chant into rhythmic forms. In the nineteenth century the Benedictine monks at the Abbey of Solesmes in France began restoring Gregorian chant to its medieval tradition on primitive integrity. Working with original manuscripts dating as far as the tenth century and found all over Europe, Solesmes established the proper interpretation of hundreds of ancient Gregorian melodies. Anglican chant began to be composed in the sixteenth century after the Reformation. At the time composers began to write long four-part settings or harmony of psalms in imitation of the psalm tones used in the Gregorian chant. It differs from Gregorian chant in the use of harmony, metrical divisions and English text.

IDENTIFICATION NUMBER_____

NAME_____

PLEASE RESTRICT YOUR ANSWERS TO INFORMATION GIVEN IN THE PASSAGE YOU JUST READ. One or two words or a phrase will usually do. Answer in your own words.

1. Chant, although it can be used to refer to song in a general sense, is usually a reference to what type of song?

_____

2. How many variations of Christian chant are mentioned?

_____

3. Although the influence of the chant style of the Byzantine Empire on Gregorian chant is controversial the two chant styles share the likelihood of a common origin. What is this origin?

_____

4. How would you describe the rhythm of the cantillation style of Jewish chant?

_____

5. The modes used in cantillation are similar to what other modes as stated in the passage?

_____

6. What rules form the basis of the technique, that is the musical, melodic and rhythmic form of Gregorian chant?

_____

7. The texts of Gregorian chant are derived largely from which Book of the Bible?

_____

8. The center of development of Gregorian chant shifted several times over the centuries. In what city was its traditional form first assumed?

_____

9. How did the renaissance influence the form or technique of Gregorian chant?

_____

10. The Benedictine monks of Solesmes, France, have worked to restore or reverse the influence of the Renaissance on Gregorian chant interpretation. What is the source of the monks' interpretation?

_____

11. Anglican chant began to be composed following what notable historic event?

12. How is Anglican chant imitative of Gregorian chant?

13. How does Anglican chant differ in musical style or form (not language) from Gregorian chant?

14. Although Jewish chant and Gregorian chant are similar in having only one voice-part, in what ways can the execution of this monophony occur in the Gregorian style?

15. The Anglican chant is based on English texts whereas Gregorian chant was formerly always sung in Latin but this is no longer so. What has changed the language of Gregorian chant?

ANSWER GUIDE

1. Liturgical song
2. Three
3. Jewish chant
4. Free rhythm
5. The modes of the medieval Christian Church
6. The rules of Latin accentuation
7. Book of Psalms
8. Metz
9. Polyphonic versions were devised
10. Original manuscripts
11. The Reformation
12. Four-part settings imitative of psalm tones
13. Harmony, metrical division
14. Sung by a choir or by a soloist
15. Translations

Development of the Bouvier des Flandres as a breed

It is nearly impossible to trace the origins of the Bouvier des Flandres with any certainty. Dogs of this type have been bred for centuries in Flanders, Belgium, and in the northern part of France but no attempt was made to breed selectively until the latter part of the nineteenth century. It is probable that the body configuration is attributable to the Belgium Matin type of dog, the coat to the shepherd types or, some contend, to the Scottish Deerhound, given as gifts to the monks when wool grown in England was sent to Belgium to be woven into cloth, with perhaps some hunting dog influence from Barbet types. Another possibility regarding the origin of this Franco-Belgian breed is that it was formed by crossing the griffon and the beauceron. Early in the twentieth century a number of dogs resembling one another to a noticeable extent were discovered in the farming are between the river Lys and the northern seacoast. These dogs were used as a basic stock for the development of the Bouvier des Flandres as a breed. During World War I the Bouvier des Flandres' home territory became a battlefield and the area behind it became a supply-advancing zone. Thus, during the war the breed was pressed into military service. They were used to patrol the beaches in defense of the country against the entry of spies, they served as ambulance dogs and as message carriers. As a result the number of Bouvier des Flandres was drastically reduced and the breed was almost totally destroyed. In addition some were moved into new areas of Belgium, France, and the Netherlands. Only in 1923 following the war, were the few remaining Bouviers gathered from here and there and an earnest attempt was made to reconstruct the breed and establish standardization. In its present form the Bouvier des Flandres has a square, powerful physique. It has a large, heavy head with a beard and moustache, an

elongated nose and a wide muzzle. The standard has been described as a square-built dog, massive through the chest, neck carried almost upright, well-chiseled head, tail which is docked highly placed and the body well posed on pillarlike, well-boned limbs but without heaviness in the gait. The coat of the Bouvier is largely weatherproof enabling it to live in most climates. The top coat is harsh and wiry, and sheds both dirt and water. Under this is a soft, dense undercoat which thickens in cold climates and provides extra insulation against both heat and cold. Colors range from black through fawn, gray or brindle. Because of its strength, adaptable coat, intelligence, natural tendency to defend, and excellent temperament the Bouvier des Flandres has been put to multiple uses. The variety of jobs they perform include the following; cart dog, guard dog, guide for the blind, family dog and cattle drover which was its prime function in the past. Unlike many other cattle dogs, the Bouvier is not a "heel-nipper" but actually throws a body block against the cow and bumps the stray cow back to the herd. The Bouvier des Flandres is suited to either city or rural life.

IDENTIFICATION NUMBER _____

NAME _____

PLEASE RESTRICT YOUR ANSWERS TO INFORMATION GIVEN IN THE PASSAGE YOU JUST READ. One or two words or a phrase will usually do. Answer in your own words.

1. When were the first attempts made to selectively breed the Bouvier des Flandres?

_____

2. What in the appearance of the Bouvier des Flandres is attributed to the Belgian Matin type of dog?

_____

3. According to the passage, in what relationship and through what means are the beauceron and the griffon linked to the Bouvier?

_____

4. Dogs noticably resembling one another were found in the farming area between the river Lys and the northern seacoast. According to the text, what is the importance or connection of these dogs to the Bouvier des Flandres?

_____

5. What three special functions of a military nature did the Bouvier des Flandres perform during World War I?

_____

6. What was the effect of World War I on the Bouvier breed?

_____

7. The Bouvier traces it origins to Belgium and France but during the war some were moved into a third country. What was it?

_____

8. When were the first efforts made to establish a standard for the Bouvier des Flandres?

_____

9. The Bouvier's large and heavy head with its elongated nose and wide muzzle has two additional identifying or typical features. What are those two features?

_____

10. What quality or characteristic should not be present in the gait or walk of the Bouvier?

_____

11. The Bouvier's coat is described as weatherproof. Describe the appearance and characteristic properties of the top coat.

_____

12. The Bouvier's coat enables it to adapt to most environments. What property of the undercoat contributes to the adjustment to the cold and why?

_____

13. The Bouvier, according to the passage has strength, an adaptable coat, intelligence and an excellent temperament. Also named was one other inherent or instinctive characteristic. What was it?

_____

14. How is the Bouvier different from other cattle dogs and what specifically does the Bouvier do to move a stray cow?

_____

15. To what life-style(s) can the Bouvier des Flandres be accommodated?

_____

ANSWER GUIDE BOUVIER DES FLANDRES

1. Latter part of the nineteenth century
2. The body configuration
3. Bouviers' origin formed by crossing them
4. They were the basic stock for the development of the breed
5. Patrol, ambulance dogs, message carriers
6. Numbers reduced, almost totally destroyed
7. The Netherlands
8. 1923, following the war
9. A beard and a moustache
10. No heaviness
11. Harsh and wiry and sheds dirt and water
12. Thickness, provides extra insulation
13. A natural tendency to defend
14. It is not a heel nipper, throws a body block to bump cow
15. City and country.

Development of the Poodle as a breed

The Poodle breed is divided into three varieties which differ among themselves only in the matter of size at maturity: from largest to smallest they are the Standard, the Miniature and the Toy. Because Poodles are often referred to as French Poodles, people often assume the dog originated in France. Many North American Poodles are descended from French ancestors but the majority trace their bloodline to English dogs many of which in turn descend from German and Russian dogs. Of all dogs the Poodle is one of the oldest breeds with the most ancient of its varieties being the small white Toy. The traditional white Toy Poodle is, however, not related in blood to either the Miniature or the Standard Poodle. Far from being a true Poodle, this earlier white Toy is a distinct and separate type believed to trace its ancestory to the Petit Barbet, a white, long-bodied, softcoated French water dog. Poodles of Toy stature result from crossing Miniatures with Toys in an effort to produce colored Toys and to improve the Toys, to make them true Poodles in fact as well as in name. Generally, the combination and recombination of the Miniature and Toy genes successfully produces a small size Poodle but Toy faults do appear due to the recessive genes of the white Toy. Within the Toy division the purest of the Toys is that which has, by intensive selection, been created from pure Miniature stock without the introduction of white Toy blood. The results

are of perfect Poodle type dwarfed down by selection to Toy and near Toy sizes. The larger Poodles, the original Standard and Miniature, are thought to trace their ancestory to the Water Spaniel. As early as 1600, English writers mention the 'Water Dogge'. The Standard and Miniature Poodles have been called by various names such as Grand Barbet, Caniche, a name derived from the French 'Canard' (duck), Chien Canard, Mouton and Moufflon while in the German language the poodle has been referred to as Wasserhund and Pudel, a name very close to the modern English designation. In the past these dogs were used for hunting and sporting purposes. The old theory, although inaccurate, that Poodles working in the water needed a heavy coat to protect their lungs has been responsible for the Poodle's clip for hundreds of years. Strongly entrenched in the breed, the present day Standard and Miniature Poodle retain an inherent swimming and retrieving ability, and the Standard Poodle remains a first-class hunting dog. The Poodle, despite its ability to retrieve from wet marshy areas, needs clipping, must sleep indoors and is predominantly a companion or pet. Although the origins of the Poodle is controversial among authorities, agreement exists that there were three continental varieties: the German, the Russian, and the French and certainly the early English 'Water Dogge' was also a Poodle. The main sources of the modern Poodle differed from each other primarily in the thickness of the bone and in the texture of the coat. Some early Poodles with corded coats.

Corded Poodles, numerous and popular at the end of the last century, are not classified as a separate variety but are now rarities because of the inconvenience of the immensely long coat which swept the ground. With rigorous breeding methods to mould bloodlines into Poodle conformation and with the norms laid down, the Poodle has been unified and refined to such an extent that now they are comparatively uniform in their structure, and variation is largely confined to size and color.

IDENTIFICATION NUMBER _____

NAME _____

PLEASE RESTRICT YOUR ANSWERS TO INFORMATION GIVEN IN THE PASSAGE YOU JUST READ. One or two words or a phrase will usually do. Answer in your own words.

1. What criterion is used to classify the three varieties of Poodles?

_____

2. Of all breeds, what is the status of the Poodle as a breed in respect to chronological position, that is, the time of the breeds appearance?

_____

3. What is the relationship of the Petit Barbet to the Poodle?

_____

4. What relationship exists between the traditional white Toy and the original Miniature and Standard Poodle?

_____

5. What causes white Toy faults to appear in the Toy litters produced by crossing Miniature Poodles and white Toy Poodles?

_____

6. What method is used to obtain Toys or perfect Poodle type that avoids the introduction of white Toy blood.?

_____

7. What is the relationship of the Grand Barbet to the Poodle?

_____

8. From where is the name Caniche derived?

_____

9. To what purpose were Poodles put in the past?

_____

10. What theory underlay the development of the Poodle's clip?

_____

11. What abilities are inherent in the Miniature and Standard Poodle?

_____

12. According to the text, whatare the requirements of care and shelter for the Poodle?

_____

13. Despite the varied nationalities, how primarily did the main sources of the Poodle differ from each other?

_____

14. Why are corded Poodles, formerly numerous and popular, now almost unheard of?

_____

15. Poodles commonly vary in size and color. What characteristics of the Poodle is now relatively uniform?

_____

ANSWER GUIDE POODLE

1. Size at maturity
2. One of the oldest breeds
3. Ancestor to the white Toy
4. Distinct and separate, not related
5. Recessive genes of white Toy
6. Dwarfing down by intense selection of Miniature Poodles
7. A name for the larger Poodle
8. French word canard
9. Hunting and sporting
10. Protect their lungs while in the water
11. Swimming and retrieving
12. Clipping, sleeping indoors
13. Thickness of bone, texture of coat
14. Inconvenience of long coat
15. The structure

IDENTIFICATION NUMBER _____

NAME _____

A) STRINGED INSTRUMENTS

B) WIND INSTRUMENTS

C) PERCUSSION INSTRUMENTS

D) KEYBOARD INSTRUMENTS

E) ELECTRONIC INSTRUMENTS

IDENTIFICATION NUMBER _____

NAME _____

A) WORKING DOGS

B) GREYHOUNDS

C) TERRIERS

D) TOYS

E) HUNTING DOGS

PRE-TEST VERBAL INSTRUMENTS

This task takes about an hour. The task consists of three sections.
Specific instructions are given at the beginning of each part.
The general procedure is the following.

1. Task One

   The first partof the task looks at word knowledge, that is, the meaning of the words.

2. Task Two

   Then, the second part of the procedure examines the influence of the meaning of the material on how it is remembered.

3. Task Three

   Finally, the third section looks at the associations made with cue words selected from different concepts.

Do you have any questions regarding the general steps involved?
If you are ready, we will begin the first part of the task.

PASSAGE INSTRUCTIONS

This section of the task consists of four presentations. The procedure takes the form of reading a text with the goal of remembering it, immediately followed by answering questions on information given in the passage. In a few moments you will be given the first passage to read. Take as much time as you need to read it, but read it once only. After you have read it, give the passage back. The questions will then be handed to you and you will have seven (7) minutes to answer them. When the time is up this procedure will be repeated until all four texts and related questions have been presented. Have you any questions? Here is the first passage.

Word Association Instructions

In a moment I will ~~give~~ you a list of five words. List as many associations (single words, not phrases) as you can think of for each of the categories listed on the page. These words need not be restricted to item names or things. Please associate freely but always associate to the category name. Try to associate some words for each of the given categories. This task ends after a 30 second delay or after three (3) minutes total time, whichever is shorter. There ~~are~~ two sets of categories, that is, two pages in this part of the task. When the first set is completed you will be given the second set. Are there any questions? If you are ready, begin now.

PERSONAL DATA FORM Your participation in the present study is much appreciated. The following information is necessary to evaluate the results. All information is kept confidential. If, however, you prefer to remain anonymous you may leave the name blank and use an identification number.

Name: _____ Sex: M F Date of Birth __ __ __
D M Y

YOUR IDENTIFICATION NUMBER: Place the initial of your family name first and then your birth date. For example, if your name is Smith and you were born on 28 January, 1962, then your number is S280162. Please follow the same order as in the birth date you have given above, that is, Day, Month, Year. Fill in your number now in the space provided.

IDENTIFICATION NUMBER _____

Languages: First _____ Other(s) _____

Were you educated in English? Yes__ No__

have you worked in English? _____

Education: Hih School_____Some University _____Degree____

In what discipline was the degree completed? _____

Other diplomas or certificates obtained _____

Occupation:_____Are you currently employed? _____

How many years, approximately, have you worked in this field?

Any other experience you feel is relevant_____

Health: Please rate what you believe to be your current state of health: Excellent____Good ____ Average ____Poor____

Have you ever had any serious illness? Yes_____ No_____

If yes, please indicate the problem _____

_____

Vision: normal _____ normal corrected _____

Hearing: normal _____ normal _____

Have you received formal training in music

Yes _____ No_____

If yes please check which level you think best describes your training:

Moderate_____ Advanced _____Very advanced_____

Experience and participation in the field of music:
(e.g., full or part-time profession, play instrument in a band or orchestra, sing in choir, none)

Please give a brief description: _____

_____

Is this current? Yes___ No___, If no, how long ago did your most recent participation in a musical activity occur?

_____

Self-rating of: i) level of knowledge of music

High _____ Low _____

ii) level of knowledge of dogs

High _____ Low _____

Appendix 2

Tables of Means

Table 3

Mean Correct Reproduction Scores in Relation to Age Group, Material Type and Knowledge Level

Group	Material Type	Level of Knowledge	
		High	Low
Young			
	Music	11.42	10.58
	Dog	6.50	5.83
Middle			
	Music	12.50	7.17
	Dog	6.17	5.75
Old			
	Music	11.50	8.83
	Dog	7.17	8.92

Table 4

Mean Superordinate Scores in Relation to Age Group, Material Type and Knowledge Level

Group	Material Type	Level of Knowledge	
		High	Low
Young			
	Music	3.58	2.42
	Dog	5.25	4.42
Middle			
	Music	3.42	2.42
	Dog	4.17	4.67
Old			
	Music	2.58	2.58
	Dog	3.33	5.08

Table 5

Mean Subordinate Scores in Relation to Age Group, Material Type and Knowledge Level

Group	Material Type	Level of Knowledge	
		High	Low
Young			
	Music	1.75	1.09
	Dog	1.08	.92
Middle			
	Music	2.08	1.25
	Dog	2.17	2.00
Old			
	Music	1.50	2.17
	Dog	1.58	1.58

Table 6

Mean Correct Addition Scores in Relation to Age Group, Material Type and Knowledge Level

Group	Material Type	Level of Knowledge	
		High	Low
Young			
	Music	2.08	1.58
	Dog	1.67	1.92
Middle			
	Music	1.75	1.33
	Dog	1.92	1.17
Old			
	Music	1.92	1.42
	Dog	.66	.92

Table 7

Mean Total Association Scores in Relation to Age Group, Material Type and Knowledge Level

Group	Material Type	Level of Knowledge High	Low
Young			
	Music	34.25	22.50
	Dog	20.42	19.25
Middle			
	Music	35.08	22.67
	Dog	19.08	22.00
Old			
	Music	32.50	20.42
	Dog	18.75	16.59

Table 8

Mean Paradigmatic Scores in Relation to Age Group, Material Type and Knowledge Level

Group	Material Type	Level of Knowledge	
		High	Low
Young			
	Music	30.08	19.05
	Dog	11.58	11.75
Middle			
	Music	29.42	19.17
	Dog	13.42	14.25
Old			
	Music	29.33	18.25
	Dog	12.42	9.83

Table 9

Mean Syntagmatic Scores in Relation to Age Group, Material Type and Knowledge Level

Group	Material Type	Level of Knowledge High	Low
Young			
	Music	2.08	1.25
	Dog	4.58	3.67
Middle			
	Music	.42	.6
	Dog	3.42	3.92
Old			
	Music	.83	.58
	Dog	3.58	3.50

Table 10

Mean Reading Time and Mean Vocabulary Scores in Relation to Age Group and Knowledg Level

Age Group	Level of Knowledge	Reading Time	Vocabulary Score
Young			
	High	14.07	33.17
	Low	17.56	31.33
Middle			
	High	15.95	36.50
	Low	14.13	35.50
Old			
	High	15.64	37.00
	Low	15.73	35.25

Appendix 3

Source Tables of Analysis of Variance for Correct Reproductions, Superordinate, Subordinate, Correct Addition, Total Association, Paradigmatic, Syntagmatic, Reading Time and Vocabulary

Table A

Source Table of Analysis of Variance

for Correct Reproduction

Source	df	MS	F
Between			
Age Group	2	17.63	1.06
Knowledge Level	1	66.69	4.02*
Age Group x Knowledge Level	2	20.88	1.26
Error	66	16.58	
Within			
Material Type	1	469.44	51.97***
Material Type x Age Group	2	22.63	2.51
Material Type x Knowledge Level	1	90.25	9.99**
Material Type x Age Group x Knowledge Level	2	20.44	2.26
Error	66	9.03	

* $p < .05$

** $p < .01$

*** $p < .0001$

Table B

Source Table of Analysis of Variance

for Superordinate

Source	df	MS	F
Between			
Age Group	2	3.26	.53
Knowledge Level	1	.56	.09
Age Group x Knowledge Level	2	10.68	1.72
Error	66	6.20	
Within			
Material Type	1	98.34	26.91*
Material Type x Age Group	2	.34	.09
Material Type x Knowledge Level	1	12.84	3.51
Material Type x Age Group x Knowledge Level	2	1.72	.47
Error	66	3.65	

* $p < .0001$

Table C

Source Table of Analysis of Variance

for Subordinate

Source	df	MS	F
Between			
Age Group	2	5.77	1.53
Knowledge Level	1	1.36	.36
Age Group x Knowledge Level	2	2.53	.67
Error	66	3.78	
Within			
Material Type	1	.25	.18
Material Type x Age Group	2	2.33	1.66
Material Type x Knowledge Level	1	.25	.18
Material Type x Age Group x Knowledge Level	2	1.58	1.13
Error	66	1.40	

Table D

Source Table of Analysis of Variance

for Correct Addition

Source	df	MS	F
Between			
Age Group	2	4.09	1.42
Knowledge Level	1	2.78	.96
Age Group x Knowledge Level	2	.84	.29
Error	66	2.88	
Within			
Material Type	1	3.36	1.91
Material Type x Age Group	2	2.92	1.66
Material Type x Knowledge Level	1	1.36	.77
Material Type x Age Group x Knowledge Level	2	1.17	.67
Error	66	1.76	

Table E

Source Table of Analysis of Variance

for Total Associations

Source	df	MS	F
Between			
Age Group	2	92.27	.62
Knowledge Level	1	1344.44	9.09**
Age Group x Knowledge Level	2	18.00	.12
Error	66	147.90	
Within			
Material Type	1	2635.11	36.67****
Material Type x Age Group	2	.63	.01
Material Type x Knowledge Level	1	1284.03	17.87***
Material Type x Age Group x Knowledge Level	2	26.17	.36
Error	66	71.85	

** $p < .01$

*** $p < .0001$

**** $p < .0001$

Table F

Source Table of Analysis of Variance

for Paradigmatic

Source	df	MS	F
Between			
Age Group	2	30.89	.27
Knowledge Level	1	1105.56	9.62**
Age Group x Knowledge Level	2	15.43	.13
Error	66	114.91	
Within			
Material Type	1	5292.56	93.13***
Material Type x Age Group	2	26.02	.46
Material Type x Knowledge Level	1	905.00	15.92**
Material Type x Age Group x Knowledge Level	2	5.50	.10
Error	66	56.83	

** $p < .01$

*** $p < .0001$

Table G

Source Table of Analysis of Variance for Syntagmatic

Source	df	MS	F
Between			
Age Group	2	9.77	.63
Knowledge Level	1	1.77	.12
Age Group x Knowledge Level	2	4.71	.31
Error	66	15.42	
Within			
Material Type	1	283.36	40.77*
Material Type x Age Group	2	1.34	.19
Material Type x Knowledge Level	1	.11	.02
Material Type x Age Group x Knowledge Level	2	.90	.01
Error	66	6.95	

* $p < .0001$

Table H

Source Table of Analysis of Variance

for Reading Time

Source	df	MS	F
Age Group	2	4.14	.33
Knowledge Level	1	6.17	.49
Age Group x Knowledge Level	2	43.51	3.48*
Error	66	12.52	

* $p < .05$

Table I

Source Table of Analysis of Variance

for Vocabulary

Source	df	MS	F
Age group	2	116.38	6.97
Knowledge Level	1	42.01	2.51
Age x Knowledge Level	2	1.26	.08
Error	66	16.70	

** $p < .001$