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ADULT DEVELOPMENTAL SHIFT IN MEMORY-ENCODING STRATEGIES: ADULT AGE DIFFERENCES IN RECALL OF VERBAL AND PICTORIAL STORY INFORMATION

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ADULT DEVELOPMENTAL SHIFT IN MEMORY-ENCODING STRATEGIES: ADULT AGE DIFFERENCES IN RECALL OF VERBAL AND PICTORIAL STORY INFORMATION

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Story Information

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CHAPTER 1

LITERATURE REVIEW

Introduction

Memory difficulties are the most common, as well as one of the most disturbing, cognitive decrements associated with old age. It is well documented that, as people age, they tend to perform more poorly on many types of memory tasks (Botwinick & Storandt, 1974). However, it is still a matter of controversy regarding which components of memory become defective. Various studies have implicated the registration of information (Botwinick, 1973) as well as its storage and retrieval (Anderson, Fozard, & Lillyquist, 1973). Another important factor in this memory deficit may be poor utilization of memory mediators by the elderly. Hulicka and Grossman (1967) found evidence that elderly adult memory deficits can be attributed to either a decreasing ability to utilize imagery mediators or increasing dependence on verbal mediators such that or particular tasks the elderly cannot select the optimal strategy (see also Underwood, 1969; Rowe & Schnoro, 1971; Eysenck, 1974; Howard, 1980).

This shift away from imagery mediators and/or toward verbal mediators may involve a change in what types of stimuli activate semantic memory. For example, Mergler and Zandi (1980) found evidence that a verbal prime causes a global activation, but that a pictorial prime causes only specific activation in older adults. Alternatively, this shift may reflect the preferred type of strategy utilized during memory encoding regardless of the nature of the stimuli. Gordon and Slevin (1975) demonstrated that young adults show a strong preference for imagery strategies while elderly adults used more verbal mediators when encoding verbal information.

Distinctions between verbal and non-verbal information processing with regard to the use of any mnemonic devices for a better encoding have been generated by "non-developmental" experimental theorists; the basic issues have been well elaborated and have a long tradition of discussion in both philosophy and psychology.

Words and Pictures as Inseparable Phenomena

Many early psychologists believed that thought was composed of images arranged by linear associational connections, and that persons could be typed according to the specific kind of images they habitually used. They also believed that thought was conscious, directed by free will and could be understood by introspection. Image and its relationship with thought was one of the crucial elements of philosophical discussion regarding the formation of thought. Aristotle considered images to be the basic elements of thought connected by associational relevance: the mind determines the object it will pursue or avoid by contemplation of these images which exist in the mind in the absence of external objects. In this formulation, Aristotle advanced an enduringly important concept about images: they have the power to motivate a person to emotion and effort.

Later, philosophers such as Locke and Hume formulated theories of cognition in which images were again basic elements. Locke (1964) believed that thought developed as perception that was recorded in residual images. These images were then recalled, as part of thought, and simple images could be recombined to form complex ideas. Hume (1964) attempted to separate images from perception. The image, however, was regarded as an exact copy of a perception. Hume suggested that memory must not only preserve perception as recorded images, but also retain some record of their order in time and positions in space.

Hartly (1964) speculated that there was thought in imageless form through the use of word signification without sensory quality. He believed that word meaning was acquired through the process of labeling objects. Hartly presumed two overlapping systems for the representation of thought: words with non-sensory quality and images of the various sensory types.

While the Aristotelian idea of image as a part of thought dominated the scientific views of thought through the nineteenth century, early psychologists like Marbe (1964) and Kulpe (1964) realized that their data contradicted the theory that images were the elements of thought. They suggested that images only record certain types of experience in individual perception.

Messer (1964) tried to study the "dispositions of consciousness" that had no representational form. He groped toward the idea that much of thinking went on below the conscious level and developed a model of various degrees of clarity. His model, like Freud's (1900), considered consciousness as a kind of superordinate sense organ: [conscious reward samples of thought].

The possibility of "imageless thought" was noted by Wundt. Titchener (1964), another influential theoretician and student of Wundt's, elaborated this idea. He suggested that there is no such thing as "imageless thought." Titchener argued that images from all sensory modalities were present but that images of kinesthetic or spatial quality were hard to recognize or describe.

Currently, most cognitive psychologists accept that thought is neither represented exclusively in images as was postulated by Locke, nor is it only represented by words. Words are perceptually activated by images, but images themselves have boundaries within the conceptual organizations of thought.

The encoding of verbal information based on the content and appearance of verbal information is also frequently discussed. The classic argument of verbatim versus gist memory by Ebbinghaus (1913) and Bartlett (1932) is the traditional example. In psychology the overwhelming majority of experiments have involved tests of verbatim memory. A typical experiment involved presenting subjects with a list of words, and then measuring subject's accuracy in recalling the exact words that were on the list. Years of experimentation of "exact recall" within this paradigm and rapid rate of forgetting of exact words developed a data base for a paradigm that could provide the experimenter with a better knowledge of processes involved in such memorization. Memory of gist was therefore adapted as a paradigm for the purpose of covering the gaps of knowledge that remained unanswered through the use of the former paradigm. Memory of gist is probably closer to naturalistic situations involving memorization. For example, when you read a novel, you don't try to memorize every bit of information written in the novel; rather, you try to abstract the general plots, or as is commonly stated, you transfer the given information in the novel into a semantic cluster of codes and memorize only clusters. This hypothesis was tested in 1967 by Jacquilin Sach. In her experiment, subjects heard a paragraph on some topic, such as how Galileo first learned about telescopes. At some point, the passage would stop, and subjects would be given a recognition test for a sentence from the paragraph. Sach found that when the recognition test was given immediately after the sentence had been heard, subjects were very accurate at detecting any type of change. However, if the test was delayed, the results changed drastically. Subjects were still very accurate at distinguishing the target sentences from a distractor sentence, but could not distinguish a target from a sentence containing implicit information from the passage.

Considering the fact that one memorizes the gist of the meaning instead of the verbatim body of information, the question arises--how are these meanings represented in our memory and overall cognitive system? This has been and still is one of the central problems in cognitive psychology.

Several new memory and attention models posit alternative views to explain the encoding of verbal and non-verbal information. Note that these models were not formulated within a developmental framework; however, the developmental extension of these models can be elaborated.

Dual Coding

Allan Paivio, an experimental psychologist, and his colleagues have suggested that the processing and storage of knowledge is based on two distinct systems--both involved in perception, memory, and thought. One system is specialized for processing non-verbal information including interpretation of sensory information and the generation of imagery, Paivio refers to it as the imagery system. The other system is specialized for processing linguistic information; that is, interpreting language and generating speech. Therefore, it is called the verbal system. According to this theoretical approach, the non-verbal system presumably includes processes capable of integrating and comparing information involving different sensory modalities. The verbal system includes visual-motor and haptic components (Paivio, 1969; 1974). For example, in visual modalities, printed words could be categorized under the verbal system while environmental sights would be assumed under the non-verbal. What is created by the verbal communicative system (such as writing, talking) is encoded by the verbal system. The non-verbal system is specialized for representing and processing environmental information.

Paivio suggested that the two systems are interconnected in the sense that activity in one system can activate the other system in non-random fashion (Paivio, 1974). Paivio also suggested that perception and cognition are continuous. This means that the function representation of the non-verbal system (e.g., drawing, imagery, etc.) is analogous and continuous in its nature and is also highly isomorphic with perceptual information (Paivio, 1974). This implies that environmental information is represented in the long-term memory in basically a perceptual form. Therefore, Paivio suggested that knowledge of the environment is perceptual.

There are many points within Paivio's system which need to be clarified. In his assumption of continuity of knowledge patterns from perception through memory, Paivio suggested that linguistic systems do not contain the perceptual or even abstract semantic information that could correspond to the knowledge of the world. Thus, our knowledge would be represented only within the imagery system which is non-verbal. Since this system is imagic in its nature, our knowledge would be perceptual and correspond to a storage of codes which are not conceptual and have a very low level of classification and abstraction (Carpenter & Just, 1975). But it has been argued that there is a higher order categorization system which is manifested in abstract forms. This system is originally perceptual, but when it reaches the last translation from the perceptual (concrete) to permanent memory, it is abstract. This transition, from perceptual to abstract thought is well-elaborated in studies concerning depth-of-processes (see Craik & Lockhart, 1972).

An example of this kind of knowledge transformation could be found in the transformation of sensorimotor knowledge which is purely perceptual (figurative knowledge), into the abstract operational thought. In this transformation, perceptual information gets into the knowing system but does not stay in concrete form. Rather, it is translated and categorized into abstract format, i.e., operative knowledge (Piaget, 1971). Paivio, in his argument involving the comprehension of pictorial information, suggests that pictures access the image system directly while a written statement accesses the verbal communication system. That is, we imagine a picture better and easier than a written statement. A word has to be encoded before the corresponding conceptual representation is activated in the image system (Paivio, 1974).

Nelson Model

The processing of pictures and words has also been a major concern for several other psychologists (Nelson, Reed, & McEvoy, 1977; Nelson, 1975) who have proposed a model for picture and word encoding. According to this model, pictures and words are assumed to differ in the order in which phonemics (i.e., the sound) and meaning are activated. Words activate both phonemic features and meaning in a direct manner, while the phonemic access for pictures is indirect. Nelson et al. (1977) like Pelegrino, Rusinski, Cniesi and Siegal et al. (1977) and Potter, Valian and Faulconer (1977) have tried to modify the Paivio dual coding model; although, particularly for Nelson et al. (1977), Paivio's dual coding model serves as a basic structure of semantic coding models. Nelson et al. suggested that a picture and a word for the same referent have the same semantic representation, but pictures convey this precise information more easily and are also easier to remember than words, even though they access the phonemic indirectly. In this model, memory for pictures is generally superior to memory for their labels because of the dual coding assumption that pictures are likely to be dually encoded as imaginal representations plus explicit verbal labels or name codes; that is, pictures are more likely to activate semantic information. This model also assumes that pictorial labeling is a relatively spontaneous process.

For example, Nelson and Brooke (1973) used pictures or their labels as paired-associate stimuli and raised the degree of sensory similarity among labels. They found that when the item was the picture, and the instructions made no reference to naming, label similarity failed to generate any interference whatsoever. These and many more related findings by Nelson and his colleagues were expanded into the "level-of-semantic-coding" (e.g. Craik, 1977; Nelson, Wheeler, Borden, & Broods, 1974). These levels define a processing continuum beginning with sensory attributes such as graphic and phonetic types (Nelson et al., 1977) and extending through meaning attributes (associative, semantic, and imaginal). Apparently the sensory information from words does not reach to the semantic memory and it interferes with lower levels of coding in contrast with the imaginal attributes which are encoded in semantic structures.

Nelson et al.'s hypothesis (the notion of different properties for pictures and words with respect to the meaning codes) can be contrasted with Paivio's dual coding system. From the previous discussion involving the lack of clear separation of words and pictures with respect to the meaning which they carry spontaneously, Nelson's model seems to make the same mistake as Paivio's; that is, words and pictures are once again bound within a dual system. Even if both word and picture represent the same meaning, the dual system is not activated in the same way because pictures access the phonemic features indirectly. However, Nelson et al.'s model does suggest the assumption of the similarity of semantic representation for the pictures and words with the same representation when phonemic features do not play a major role in the encoding system and this might likely happen when information processing is taking place in semantic form rather than perceptual form.

There seems to be no necessary relationship between the two aspects of Nelson's model (i.e., phonemic and semantic) since it is obvious that meaning is not necessarily activated by phonemic information. Therefore, while pictures are not directly activated by the phonemic structures within the semantic knowledge it does not reduce any of the picture's semantic knowledge. Furthermore, neither verbal nor pictorial representations in the semantic system are necessarily far from the original perceptual form, especially in the visual modality since both words (containing letters) and pictures (containing lines or dots) are primarily graphic and must have the same category of sensori-information, there is no necessary reason to accept the Nelson assumption of separate access of words and pictures to the semantic knowledge. This assumption, like the dual coding assumption, may be a logical mistake. What seems to be important in clarifying this subject is that the meaning underlying the material is the one which represents a symbolic value of the objective (sensory) view of words and pictures. For word and picture encoding, the key issue is predicting the initial and eventual representation of knowledge rather than investigating sensory differences between verbal and pictorial stimuli.

Spreading Activation Theory

Quillian (1966; 1969) has proposed a model for storing semantic information in a computer-like memory, In this model, each word is stored with a configuration of a pointer to other words in the memory. This configuration represents the word's meaning. Quillian (1967), Collins and Quillian (1969) and Quillian (1969) suggest that each word is represented conceptually in semantic knowledge. According to this view, people's concepts contain indefinitely large amounts of information. Quillian (1969) studied this proposal by asking people to describe everything they knew about an object. Quillian noted that persons initially described obvious properties of an object, and whenever they ran out of obvious facts they began to give information that was less-and-less relevant to the object. Findings from this study suggested that the amount of information that a person can generate about any concept seems unlimited. Moreover, Quillian suggested that whenever subjects exhausted obvious facts about the object, they incorporated other concepts and attached their meaning, function, and description to the original object. Quillian (1969) suggested that a concept can be represented as labeled relational links from one node to other conceptual nodes. These links are pointers and usually go in both directions between two concepts. According to Quillian, links can have different "criterialities" which are numbers indicating how essential each link is to the meaning of the concept. In Quillian's theory, the full meaning of any concept is the whole network as entered from the conceptual node. According to this model, the search in memory takes place in a way that each mode would activate its related concept and when a mode's central concept is encountered, the spread of activation flows back to the original construction of the information.

Quillian's model was modified by Collins and Loftus (1975) to suggest that processing or activation of a particular concept, whether cued by pictorial or verbal stimuli, will prime the system for quick processing of subsequent related concepts regardless of the verbal or pictorial nature of original stimuli. Within this theoretical system, processing of initially presented information (or subject's expectancies concerning to-be-presented stimuli) will prime the system and subsequent conceptually related stimuli, whether pictorial or verbal, will be quickly and accurately processed. In other words, the apparent nature of representation and access to semantic memory may be task-dependent, and semantic information becomes dependent on the certain feature, configuration, and properties of the subject to-be-searched in memory. According to Collins & Loftus (1975), activation spreads out along the path of the network in a decreasing gradient when a concept is processed. The decrease is proportional to the accessibility or strength of the links in the path. Thus, activation is like a signal from a source that is attentuated as it travels outward. An activated concept operates within conceptual networks that are organized along the lines of semantic similarity.

The apparent nature of representation and access to semantic memory based on configuration and feature of a task has been well investigated. For example, Potter, Valian, and Faulconer (1975) observed that naming a picture takes more time than reading a word; yet, deciding whether a picture is a member of a specific category takes less time than an equivalent categorization decision for a word. Anderson and Paulson (1978) found that pictorial information can interfere with verbal information and vice versa in a timed recoginition task. However, within modality interference is more pronounced and implies that a "spreading activation" occurs within semantic memory that can be somewhat specific to the primary stimulus. They concluded that all pictorial and verbal material is stored within the same abstract knowledge system, but that the elaboration of activation is dependent on task demands and subject expectation.

In sum, according to the model, interpretation of verbal information most often involves the activation of enough memory to aid in interpretation of a sentence which can be checked afterwards by reference to the contextual environment or syntactic rules. Pictorial information contains its own contextual environment, and further checks in this case may be easier to perform than with verbal information. The semantic properties of a picture do exceed the semantic properties of verbal information because processes of pictorial processing can be faster than verbal processing (e.g., faster reaction time) but instigate less activation of semantic knowledge.

Global Coding

Tulving (1972) proposed a theory of semantic memory with one global coding system. In this model, he addressed many issues involving the semantic properties of words as members of statements and the underlying information which is carried during encoding of the statement. Basically, Tulving defined semantic memory as a store of more or less permanent knowledge, and of facts that are truly independent of context--such as cats are animals. Tulving (1972) suggested that a bit of knowledge that is related to a given context is classified under episodic memory, such as what Mr. Brown had for breakfast today. This concern with semantic memory has led to a series of experiments on semantic categorization (i.e., verbal and non-verbal categories which classify conceptual thoughts). In discussing the semantic categorization, we are inevitably faced with two general models, the set-theoretical model (Rips, Shoben, & Smith, 1973) and the network model, exemplified by the work of Collins and Quillian (1969; 1972). The latter model suggests that words or their conceptual counterparts exist as independent units in semantic memory connected in a network by labeled relation. In contrast, set-theoretical models suggest that the concept of words are represented by sets of elements. The elements might be unique descriptions or images of exemplars, attributes, names of subsets or supersets, or some mixture of these types (Meyer, 1970; Schaeffer & Wallace, 1970). In the attribute model, for example, robin and bird may be represented by sets of their defining attributes, and verification of the proposition, a robin is a bird, is based on a comparison process that determines whether every attribute of birds is also an attribute of robin (Smith, Shoben, & Rips, 1974). Now assume that we give a proposition such as a penguin is a bird to a subject who is also given the proposition, a robin is a bird; obviously the subject could verify the second proposition faster than the first because the semantic knowledge of the first proposition does not carry the same amount of information as the second one. In other words, verification of a proposition (based on words) is related to the representation of meaning which is conveyed with it. Smith et al. (1974) have analyzed the meaning of words in regard to this semantic feature and has suggested that the imaginal representation of a word is one which is responsible for a semantic feature translation into our knowledge. This could be very well verified in the examples such as big bird, which the relation to bird can be an important feature in the semantic knowledge. The same proposition can be represented in pictures; that is, verification of semantic units of information underlying a picture could be perceived through the elements of pictures and the message of meaning underlying the picture. For example, by looking at a picture of a big bird one could achieve the semantic codes of the picture, translate them into the knowledge, and represent the meaning. If asked to describe the picture, one might say this is a big bird (in comparison to the features, size, and concept of bird in one's knowledge.

The study of linguistic codes (words) and symbolic codes (pictures) in part is associated with the conceptual organization of images. With respect to this issue, we shall briefly review the role of images in formation of cognition in the following section.

Developmetal Aspects of Verbal and Pictorial Coding

Processing of verbal and pictorial information has only recently regained status as a respectable area of inquiry in learning and memory, but there is a long tradition of such research in cognitive developmental theories (Paivio, 1971; Piaget & Inhelder, 1971). Developmental aspects of pictorial processing are historically linked with the idea of imagery development while developmental aspects of verbal processing were originally linked with the underlying structure of verbal information (Chomsky, 1960) and comprehension of verbal information (Piaget, 1971).

The onset of imaginal abilities in developmental terms is difficult to ascertain, since the mental experience of pre-verbal children is rather inaccessible. It seems clear, however, that imagery appears at a very early age, and it is generally believed that imagery preceeds verbal representation as an effective mediational mechanism (Paivio, 1971).

Doob (1972) cites evidence to support his hypothesis that imagery is ontogenetically (and probably phylogenetically) primitive. REM periods during sleep, which supposedly belie the experience of dream images, are observed in children from birth onward. REM periods compose 55-80% of sleeping time in neonates (Hall & Van De Castel, 1966), and by the time children are three to four years of age, they report visual dreams if awakened during REM sleep. Dream imagery can therefore be assumed to occur before it can be reported.

Unlike Doob's theoretical position, other psychologists have integrated the developmental aspects of words and pictures into one package. For example, Piaget (1952) has discussed this issue under the heading knowledge integration. Like Paivio and Doob, Piaget's knowledge integration asserts that representation of knowledge goes through different stages throughout the course of development. According to this view, representation of knowledge in infancy happens through integration of objective information into the existing knowlege of the infant. Later, when the child is equipped with the conceptual thought (see Piaget, 1951), the overall cognitive system modifies its representation formula from objective to abstract thought. It seems crucial to notice, that for Piaget, representation of knowledge after the sensorimotor stage deals only with meanings which are conveyed by verbal or pictorial information into cognitive schemas and structures.

The Ontogeny of Imagery

Paivio assumed that the use of imaginal mediators increases with the relative concreteness of a task, and the use of verbal mediators increases with greater task abstractions. According to this view, verbal behavior (e.g., speaking and listening) has more abstractness than pictorial information, and pictorial information that activates only the imaginal mediators is concrete.

Restating Paivio's position within a developmental perspective, imaginal mediators should lose their power throughout the course of development because individual thought is shifting from concrete towards the abstract, and the latter clearly utilizes symbolic, verbal information more than pictorial information. On the other hand, as already mentioned, Doob (1972) and others have clearly demonstrated the ontogenetic aspect of imagery.

According to Doob, the basis of cognitive-memory processes proceeds ontogenetically from the storage of percepts, to the storage of images, and then to verbal storage. Imagery itself proceeds through a continuum from afterimage to imagination (Doob, 1972, p. 319). If imaginal abilities preceed verbal communicative abilities, then verbal storage, when it occurs, must affect the already present imaginal system. Doob, therefore, postulated that preverbal imagery is qualitatively different from postverbal imagery in, as yet, undetermined ways.

A simple comparison between developmental ideas in Doob's theory and possible developmental implications of Paivio's dual coding theory highlights many contradictions in these theories. First, Paivio's findings have not analyzed the ontogeny of imagery. Second, Paivio's dual coding theory has incorporated images only with respect to the concreteness of knowledge and has not appreciated the abstractness of imagery in the dynamics of human cognitive systems (see Piaget, 1971).

Doob's theory, due to a lack of appropriate procedures for testing the imaginal experiences of preverbal creatures, remains untested. The youngest children tested so far in the relevant studies are kindergarten children who demonstrated both linguistic comprehension and production.

While Doob's theory predicts qualitative differences between the two types of preverbal and postverbal imagery, Piaget (1971) classified imagery into two types, both of which are products of cognitive developmental stages. The first imagery is called reproductive imagery and is static long before the operational stages. In the operational stage (7-8 years of age) anticipatory imagery, which is dynamic, appears. Bruner (1964) also discussed an early developmental stage of imagery called iconic representation. Bruner suggested that imagery at this stage initiates the stage of symbolic representation which is represented by verbal behavior.

Young children often demonstrate a deficiency in the use of verbal mediational devices (Reese, 1962; Kendler, 1963). Flavell, Beach, & Chinsky (1966) investigated this deficiency by directly observing children's spontaneous verbalizations in a nonverbal serial recall task. They found that kindergarten children were less likely than second or fifth graders to rehearse the names of stimulus items--when the same item was presented several times--indicating a verbal production deficiency, as opposed to verbal mediation deficiency. Blank, Altman, & Bridges (1968) trained pre-schoolers on a discrimination task, in either a visual or tactual modality, using three-dimensional geometric stimuli. They then tested the subjects on the same problems in the opposite modality from training trials. The pre-schoolers successfully made the transfer from vision to touch, but not from touch to vision, indicating that they had some form of non-verbal representation--probably imagery--upon which their performance relied. Evertson and Wicker (1974) found better recall in nursery schoolers for stimuli which were visually elaborated than for verbally elaborated stimuli. However, as will be noted in the next section, some investigators have questioned the efficiency of imaginal mediation in the very young (Reese, 1970; Rohwer, 1970).

Ambiguities in the evidence have recently led to speculation regarding the existence of two separate imaginal abilities (Bird & Bennett, 1974; Wicker, 1971). Factor analyses of imagery tests by Divesta (1971) in adults and by Forisha (1975) in children indeed indicated two independent imaginal traits, labelled the cognitive and subjective. Wicker (1971) proposed the terms representational and mediational imagery to describe these traits. Representational (or subjective) imagery refers to a simple vivid visual memory which would be effective in the recognition of single items. Mediational (or cognitive) imagery refers to a cognitive process used in figural thought. This process is capable of relating stimulus-response items in an interaction and is, therefore, effective in associative tasks.

Verbal Representation

Discussion of the comprehension of verbal information (i.e., word context) distinguishes between two aspects of word meaning. First, the extension of a word refers to the set of objects which manufacture the meaning or referents of the word. Second, the intention of a word refers to properties which define the word. In the view of many psychologists and psycholinguists (e.g., Reese, 1962), words should be studied with their meaning, and this meaning is accompanied by both kind of referents. According to this view, a word's meaning cannot be represented independent of its extension and/or intention; rather, words only carry the meaning which is symbolized in itself. To illustrate this bond between verbal representation and its meaning, Bates, Benigimi, Bretherton, Camaion and Baltera (1977) and Carter (1978) have conducted experiments in which they showed that young children typically rely at first on deictic gestures--they gaze intently and point out whatever interests them. Carter found that this strategy is used especially in the absence of words. This strategy commonly leads to over-generalizations of one word to many relevant and irrelevant concepts. Miller (1978) suggested that the words that children learn first usually have multiple or holographic senses in adult use. Clark and Sengul (1978) further studied this issue. They have found that whenever children do not have names available for their purpose, they seem to rely on two general production strategies. The first is to use a general purpose deictic word which is generally accompanied by gestures, such as here, there, that, or look. The second is to "stretch" words already known or partially known to cover other things that appear sufficiently similar to the originals to justify use of the same name (Clark, 1974). Moor (1896), in a historical case based on observations of her child, noticed the overgeneralization of the word bird to moving animals, yet on hearing bird the child would look around for a bird and not, for example, be satisfied by seeing a cat. Overgeneralization is not limited to only linguistic production. They found some words that were always understood correctly. One child, for example, given the instructions "show me the dog" only selected pictures of dogs; although, in production he applied the word dog to all sorts of four-legged animals. In conclusion, these studies suggest the important role that imagery systems play in encoding and retrieving of information among children.

Imagery Mediation for Pictures and Words: Which one is easier for children to learn?

There is a growing literature on children's ability to generate internal imaginal elaborations and the effect of such elaboration on memory. In general, even nursery school children may be able to benefit from an instruction to form a mental image. However, the question still remains: do words or pictures initiate "better" images? Answers to this question and those like it are generally discussed under different paradigms of learning. In this part of this section, literature concerning the above question will be reviewed.

Paired Associate Learning

There are several types of imagery that have been studied using the paired association paradigm. Images can be provided by the experimenter in the form of pictures (imposed images). Moreover, the stimulus and response image can be depicted in separate pictures (unelaborated) or can be depicted in an interactive sense (elaborated) (Rohwer, 1973). Note that unelaborated verbal pairs consist of a word in the stimulus position and a different word in the response position.

Rohwer (1971) conducted an experiment which included the imposed image procedure. Rohwer contended that young, nursery-school-age children are less likely to spontaneously verbally label pictures than older children, and younger children derive less benefit from pictorial presentation. There were two hypotheses; the first, hereafter referred to as the "developmental hypothesis," was that older children learn relatively more than younger children from pictorial presentation as compared to verbal presentation. The second hypothesis was that any developmental increase in children's learning of pictorial pairs is mediated by older children's spontaneous verbal labeling of the pictures. Rohwer, Ammon, Suzuki, and Levin (1971) found among kindergarten, first, and third-grade children that the superiority of picture pairs over noun pairs in paired-associate learning increased with age. Dilley and Paivio (1968) reported that there was greater facilitation with increasing age between 4 and 6 years of age when pictures rather than words were in the stimulus position of the paired associate. Calhoun (1974) noted the same developmental increases as Dilley and Paivio (1968) with subjects 5 to 10 years old.

Although the developmental hypotheses has been supported, it is probably not exactly true that older children label the pictorial stimuli and younger children do not. It is not even clear that adding verbal labels aids children, especially younger children, in learning pictorial paired associates. The data are very contradictory. For instance, adding verbal labels to pictures aided the paired-associate learning of kindergarten, first grade, and third grade children in Rohwer et al. (1971); second graders in Rohwer (1973); third graders in Lynch and Rohwer (1972); fourth graders in Frederickson and Rohwer (1974); and third and sixth grade children in Rohwer, Lynch, Levin and Suzuki (1967). In other studies, however, labeling and the pictorial stimuli did not aid the paired associate learning of second graders (Davidson, 1964). Therefore it is not clear that labeling pictures aids younger children more than other children in paired-associate learning of pictures.

On the other hand, studies concerning the imposed imagery effect (where both verbal and pictorial elaboration is provided) suggested that imposed elaborations produce less effect on the learning of preschool-age children than on the learning of older children (perhaps due to contrasts between the child's image of the verbal information and the imposed images) and adults (e.g., Rohwer, 1970). Rohwer (1973) suggested that older children are more likely than younger children to store a verbal elaboration along with the pictorial elaboration. Although Rohwer's research (e.g., 1970-1973) indicated that imposed verbal elaborations were more facilitative than imposed pictorial elaboration for nursery school children, older children (third graders) learned the former better (pairs that were displayed in an interactive picture, but only named) than the latter (pairs in which members were linked by verbal but depicted side by side) (Rohwer, Lynch, Levin, & Suzuki, 1968). Thus, Rohwer (1970) contended that pictorial elaboration increased in effectiveness during the early elementary school years.

However, other research does not corroborate Rohwer's (1970) conclusion. Reese (1965; 1970) reported that nursery school children benefited as much from pictorial as verbal elaboration. Moreover, when the pictorial elaboration was presented as color photographs (instead of line drawings of black and white photos as used by Reese and Rohwer), nursery school children learned pictorially-elaborated pairs better than verbally-elaborated pairs (Evertson & Wicker, 1974; Jones, 1973).

In children's learning it seems to matter little whether an elaboration is presented pictorially, verbally, or both pictorially and verbally. However, one thing is clear. If there is any difference between the potency of pictorial and verbal elaboration, the difference is minuscule compared with the effect of <u>any</u> elaboration over none. How can this pattern of results be explained? Rohwer (1973) suggests that the elaboration provides a referent for both members of the pair. In Rohwer's (1973) formulation, meaning is not composed of "words, pictures, or any other kind of copy of sensory reality." Rohwer's (1973) contention that meaning is more abstract than words or images is consistent with current thinking about the meaning-of-meaning. Brewer (1974) contended that meaning in terms of isolated higher mental processes, such as imagery or language, are inadequate" (Brewer, 1974, p. 292). Anderson and Bower (1974) and Kintsch (1974) presented similar arguments; thus, an elaboration, whether verbal or pictorial, puts the pair in a meaningful context. According to this point of view, since meaning is not tied to either imagery or language but to higher order and more abstract processes, then it should matter little whether elaborations are verbal, pictorial, or both.

The alternative view is that the functional processes involved in pictorial and verbal elaboration are very different, but produce the same outcome. Kosslyn & Pomerantz (1977) make a strong argument that information can be encoded either pictorially or verbally, and that in some task situations, equal outcomes could be expected regardless of the mode of mediating cognitions.

Imagery and Experimental Paradigms

Although most of the research on imagery effects in children's learning has been conducted using the paired-associate paradigm, research on imagery and learning over the course of development has been examined in other task situations. The review will consider three different task situations of recognition, recall, and verbal discrimination learning paradigms, since data well-elaborated and more attended is in these three areas.

There is no doubt that even very young children's recognition memory for pictures is very good. Brown and Scott (1971) showed that preschool children (4 to 5 years old) performed at ceiling rates on a recognition task, even when the recognition task was made difficult by presenting a long list and perceptually similar pictorial stimuli (Brown & Campione, 1972). Pictorial recognition continues to be very good throughout childhood. In Nelson's (1971) study of memory development, children 7 to 13 years old performed at high levels when required to discriminate which of a group of realistic and abstract paintings were included in a presentation list. Nonetheless, several investigators have demonstrated that recognition memory for pictorial information improves with age. Hoffman and Dick (1976) demonstrated that recognition memory for magazine pictures improves between 3 and 7 years of age, and Dirks and Neisser (1977) reported that memory for information presented in complex pictures (many objects) increases between 6 years of age and adulthood. Nelson and Kosslyn (1976) showed that adult's recognition memory of realistic and abstract pictures was better than 5-year-olds' recognition memory for such pictures.

However, is recognition memory of pictures better than recognition memory of words? Perlmutter & Myers (1976) found that 2½- to 5-year-old children performed significantly better on a recognition memory task with picture lists than word lists. Corsini, Jacobus, and Leonard (1969) observed the same effect with 4½- to 6-year-old children. Bird and Bennett (1974) showed that children 4 to 10 years old recognized the pictures better than words. Thus, there is good reason to believe that pictorial recognition is superior to verbal recognition throughout much of childhood (i.e., at least from 4 to 10 years old).

However, there is a possibility that picture recognition retains its superiority over word recognition at all developmental levels. For example, Sheperd's (1967) study of word and picture recognition in young and old adults revealed such a result. (Note: verbal and pictorial processing in adulthood is extensively discussed in the elderly adult parts of this review).

Although the majority of experiments examining the difference in free-recall of pictures versus words indicate that pictures are better recalled than words, the performance increments produced by pictorial presentation of recall lists have been small.

Rossi and Rossi (1965) reported that children 2 to 5 years old recalled objects and pictures better than verbal items. There was no age by mode-of-stimulus interaction. Horowitz (1969) reported that kindergarten and third grade children benefited equally from visual presentation of free and recall lists. Cole, Frankel, and Sharp (1971) also indicated that object and pictorial lists were free recalled better than word lists for first through eighth graders.

Other studies reported that children recall words as well as pictures (Jenkins, Stack, & Deno, 1969; Shepard, 1973; Levin, Rowher, Cleary, 1971). Roth and Rohwer (1974) again demonstrated that pictures are recalled better than words by fifth and eighth graders. Children were presented either picture or word lists, which were either elaborated or unelaborated. Pictures also produced more organized clustered recall. There was no interaction between the elaboration condition and mode of presentation. In conclusion, among children at a given age level, some benefit more than others from pictorial presentation of pair member (word and/or picture). In general, the functional processes involved in pictorial and verbal elaboration are very different, but produce the same outcome. Therefore, information can be encoded pictorially, and in some task situations, equal outcome could be expected regardless of the mode of mediating cognition.

Theory of Adult Change

It has been suggested (Underwood, 1969) that during adult development there may be a shift in information processing; specifically, the processing system becomes more dependent on verbal codes and more widely activated by a verbal prime (Mergler & Zandi, 1980). Walsh (1976) and Lindsay & Norman (1972) have pointed out that the most common dependent variable used in information processing paradigms is speed-of-response. The data based on reaction time is an insufficient index of adult developmental change in cognition because slowed reaction time throughout adult development may be due to decrease in speed of efferent and referent nerve conduction, stimulus specific attributes, and response modality as well as a decrease in speed of central processing. Most data which have indicated the adult age deficit in memory and encoding processes were collected in time-constrainted situations.

Adult Age Change as Decremental

One of the classic findings (Broadbent, 1958; Welford, 1960) in gerontological psychology is that speed of response declines with age. The interpretation of these data has been controversial. It (Horn & Donaldson, 1976) is in part representative of true deficit--decline in speed of information processing can and does have wide-spread implications for the entire processing system. Others (Baltes & Schaie, 1976) differentiate speed of motor performance and intellectual processing from intellectual competence.

Regardless of the interpretation of response slowing, one can investigate whether there is equivalent age change in speed of processing all types of information or if the response speed deficit is limited to certain forms of stimuli. Several researchers (Schonfield, 1967; Bower, 1966; Adamowicz, 1976) have found evidence that there is more adult age deficit for processing pictorial stimuli than for verbal stimuli.

A related issue is the particular modality being utilized for processing the information. There may be differential age slowing for processing in certain modalities. For example, Arenberg (1978) found facilitory effect when acoustic processing was added to visual processing of semantic information.

The literature on change in hemispheric function has increasingly concentrated on relationships between speed of response associated with age and hemispheric domination. For example, on tests of intellectual functioning such as the Weschler Adult Intelligence Scale (WAIS), tests tapping verbal functions generally demonstrate less of a decline than those tapping perceptual motor functions (Birren, 1974; Botwinick & Storandt, 1974). Horn and Cattell (1966, 1967) have developed a test to study "crystallized" and "fluid" intelligence. Findings from these studies showed that fluid intelligence declines with age while crystallized intelligence is well maintained.

Based on patterns of declining performance on psychometric tests, one could infer that there is a differential decline attributable to the aging process between left and right hemisphere functions with the right hemisphere declining faster than those formed in the left hemispheres (Stern & Newport, 1980). However, for consideration of such studies one should consider the possible biasness of testing procedures. Nevertheless, findings from studies concerning such hemispheric deficits were not supported by more direct measures of central nervous system function such as the EEG (Orbits, 1971). Elias and Kinsbourne (1974) have demonstrated that psychometric tests are not reliable instruments to discriminate between deficiencies in verbal and nonverbal abilities. Tests of verbal and nonverbal abilities, like vocabulary and block design sub-tests of the WAIS, differ in response requirement, stimulus familiarity, and task demands so as to preclude control or assessment of processing mode--verbal or nonverbal. Therefore, results of these tests are inadequate for conclusions about decline in right or left hemisphere functions and differential preference with age for verbal and pictorial stimuli.

Statement of the Problem and Hypotheses

There is a developmental pattern of changes in cognitive processes that involves a shift from concrete to abstract thought. This has been extensively investigated in childhood and adolescence but such change may continue throughout adulthood. Hence older adults may have a knowledge representation system that is qualitatively different from that of younger adults.

Piaget and Inhelder (1969) suggested that children's thought goes through a transitional stage at the end of the sensorimotor period and this transition is characterized by both symbolic and imaginal representation. Bruner (1962) has suggested that initially the child's world is known to him/her by the habitual action he uses for coping. In time, the process of representation through imagery is added which is relatively action-free. Gradually, there is added yet a third system of representation that can translate either action and image into language. For Bruner, the critical shift occurs when images appear to have powerful control of representational thought.

One can speculate whether the structure of the semantic representational systems remains consistent after early childhood or whether there might not be continued integration of imagic and linquistic coding. For example, from Craik and Lockhart's (1972) theory of semantic processing, one can infer that more richly-processed material is better remembered. Hence, continued integration of imagic and linguistic coding systems throughout adulthood could result in "richer" semantic representation of any concept.

Paivio assesses the hierarchy of coding and storage processes in a framework compatible with the cognitive developmental stages of Piaget and Bruner. According to the Paivio theory, the levels of processing are, in order: a) sensory storage, which is very brief and untransformed; b) representational processes, which involve the generation of images or verbal representations (words); c) referential associative reactions, which involve the generation of an image to a word stimulus or of a label to a picture stimulus; and lastly, d) associative chains, which involve chains of different words and images. Although Paivio believes images to be more dynamic (more active) than verbal representations, he states that verbal processes become increasingly dominant over imaginal ones with age. Hulicka and Grossman (1967) tested quite old subjects (mean age 74.1 years) and teenagers (mean age 16.1 years) and found that older subjects reported more use of verbal devices. However, both groups apparently actually used imaginal devices more than the verbal ones, suggesting that imagery was the preferred mediational process.

While the nature of adult developmental change in the image and linguistic coding systems has not been directly addressed, several researchers (Nebes, 1976; Botwinick, 1973) have suggested that poor memory performance among older as compared to younger adults is caused by a deficit in the nature of encoding. Originally this assumption (of encoding deficiency) was suggested in the theory of encoding variability that was proposed by Melton (1967) and Martin (1968). This theory is based on the assumption that an item to be remembered is encoded along with information about the context in which the item is presented. Ford, Hink, Hopkins, Roth, Pfifferbaum, and Kopel (1979) studied the nature of encoding in young and old adults and found that older adults encode somewhat more slowly than younger adults. Recent studies concerning older adult encoding deficits suggest that the nature of the to-be-encoded variable plays an important role in information processing among older adults (Walsh, 1976; Waugh & Bar, 1975).

Others (Anderson, Fozard & Lillyquist, 1972) have attributed the adult deficit to developmental change in memory retrieval. For example, Lillyquist (1972) suggests that young adults use such mediators as verbal phrases and mental images to enchance thir retention of stimulus material and that the elderly use such mnemonic devices only infrequently (Hulicka & Grossman, 1967; Rowe & Schnore, 1971).

Age-related decrements in memory functioning have been variously attributed to deficits at registration, storage, and retrieval phases (Adamowicz, 1976). It may be that there is widespread decrements in all phases of memory functioning for the elderly. Research findings may also be due to the following two issues. First, inconsistent methodology, stimulus presentation and response demands may interact with subject characteristics differently for young and older adults. Second, the nature of the stimulus materials (whether words or pictures) is infrequently considered in traditional memory research. Two possible adult developmental changes in the semantic representational system are suggested. Older adults may have a more integrated, richer coding system that elaborates with imagery and linguistic abstract on any incoming stimulation; thus, they establish a rich, abstract memory code. This could cause tremendous performance decrements in the usual time constrainted experimental context. The elderly could spend more time on all information and subsequent information could have associational ties to initially processed information that are not obvious to the young experimenter using "young" word association norms. Alternatively, the entire representational system could become biased toward the verbal linguistic form of coding. This shift of the entire system toward linguistic abstraction seems to be supported by research using imagic stimuli or imagery encoding instructions with young and older adults. Bower (1966) found younger adults tend to use imagery strategies more than older adults; Gordon and Selvin (1975) found a preference for use of verbal mediators rather than imagery among the elderly.

However, elderly adults can improve their memory performance when provided with imaginal codes (Bruning, Hozbaure & Kimberlin, 1975).

Treat and Reese (1975) found that old and young adults perform equally well in a memory experiment using verbal stimulus when they are equated on imagery strategy. These data may indicate an imagery strategy production deficit among the elderly; it is not that they cannot use imagery strategies, but that they do not generate imagery strategies spontaneously.

The type of concrete or abstract imagery which is demanded within these experiments has not been controlled. The nature of the prompt, whether pictures or words, has not been systematically studied.

Robert Nebes (1976) has proposed that the explanation for the "elderly imagery deficit" may lie with the length of time needed for them to construct an adequate image or the length of time required to convert a verbal cue into an adequate pictorial representation. Once again, the speed of processing may be the delineating factor in determining what type of strategies the elderly use during memory processing.

Specific Hypotheses, Extension to Prose

There is a possible shift away from imagery mediators and toward verbal codes when information is presented in preorganized, contextual form.

The importance of imagery for facilitating recall of concrete and abstract words revealed that concrete words are remembered better than abstract (Paivio, 1969, 1971); and when subjects are instructed to use imagery as a mnemonic strategy, they often remember more words than when they use other strategies. Paivio and Furth (1970) showed that for concrete words, an imaginal strategy produces better recall than a verbal mediational strategy, whereas for abstract words, the verbal strategy is better than the imaginal. Another factor found to be crucial for recall of both concrete and abstract words is organization (how they are listed or formed in a group). In studies investigating the effects of organizational factors on memory, subjects play an active role as processor or encoder of information (Tulving & Madigan, 1970; Melton & Martin, 1972; Voss, 1972).

According to Tulving (1974), retrieval of information is greatly dependent upon the individual's cognitive environment at the time the retrieval occurs. "All retrieval of information from the memory store is considered to be cued" (Tulving & Madigan, 1970). It is often not clear what constitutes a retrieval cue; Tulving and others suggested evidence that effectiveness of a retrieval cue is dependent on its encoding at the time of storage with the contextual information to be remembered. In other words, "what is stored is determined by what is perceived and how it is encoded, and what is stored determines what retrieval cues are effective in provding access to what is stored" (Tulving & Thompson, 1973, pp. 256).

Data regarding the organizational factor in memory generally suggests a strong positive correlation between organization factors and recall or recognition of to-be-remembered information (Russell & Sewell, 1972; Sehulster, McLaughlin & Crouse, 1974; Crouse, 1970; Jensen & Anderson, 1970). An increasing number of investigators have attempted to apply the findings concerning organizational variables to simple sentences and more significantly to factual prose materials. In general, when subjects are presented with a well-organized passage, free recall of facts is higher than it is when the sentences are presented in a random order (Myers, 1974).

Another advantage or organizational factors in recall and recognition of to-be-remembered information is well documented in studies concerning the effect of ambiguity or disambiguity of text. For example, Schallert (1976) investigated such effects. She presented the young adult subjects with two verbal passages, one type involved factual evidence explicitly stated, the second type involved information that could lead to implicit interpretative conclusions (information impliable from the facts). She found that organizational factors inherent in the text were not as important for recall of both types of information as was the implicitness of the information. Specifically, she found that less-elaborated information was recalled better than explicit information when the elaborated information were organized information and explicit information was not organized. Riding and Taylor (1976) investigated the elationship between speed of response and imaginal representation of information among children. They found that children who responded quickly with information that could be represented in imaginal form were superior on the immediate recall of a concrete prose passage while those who responded more slowly to imagery information were better on an abstract passage.

Interpretation of data such as Schallert (1976) and Riding and Taylor (1976) involves questions about the strategies that have been utilized by subjects for factual and vague information. Since factual information represents a more concrete and/or accessible information that should be encoded based on objective meaning (e.g. Craik & Lockhart, 1972; Bagget, 1975), it might be assumed to be differently encoded than when interpretation of a vague idea is presented. Whereas, based on the imagery facilitating assumptions of Paivio (1971), one should expect to see a better memorial performance for concrete information (Riding & Calvey, 1981) since concrete information directly accesses the imagery system.

Specific Hypothesis

Since the elderly adult memory deficit is attributed to a decreasing ability to utilize imagery mediators (e.g., Hulicka & Grossman, 1967) or increasing dependence on verbal mediators (e.g., Howard, 1980), this study investigates what type of strategies young and older adults utilize for remembering organized stimulus information (e.g., story information) that can be encoded with imagery codes or verbal codes or both. The experiment specifically concentrates on adult age differences during the encoding of explicit-verbal, implicit-verbal, explicit-pictorial, and implicit-pictorial stimulus information when 1) the verbal information was presented alone, 2) the verbal information was presented with pictures (story and picture) and 3) when the picture information is presented alone (picture). Thus the independent and the interactive effects of adult subjects' age (young and old), untimed presentation of contextual information (story, story and picture, picture), and type of information encoded (explicit-verbal, implicit-verbal, explicit-pictorial, implicit-pictorial) was to be assessed.

The following hypotheses were generated:

1) Age. Young adults use both imagery strategies and abstract verbal strategies during encoding information, while the older adults use only verbal-abstract strategies during encoding. This will be evidenced in the subjects' memory performance as an age main effect; specifically, younger adults will remember more story information than older adults since they are using more encoding strategies.

2) Age x Type of Information Asked. a) Explicit-verbal information is easily associated with an image if one uses imagery encoding strategies. Implicit-verbal information is less easily encoded using imagery strategies. There will be a larger difference in memory performance for explicit-verbal information than for implicit-verbal information. Young adults can utilize the two types of possible encoding strategies for explicit-verbal information while older adults utilize only one. However, both age groups use only one type of strategy--verbal--for implicit-verbal information. This will be evidenced in the subject's memory performance as an age x type of information interaction. There will be a larger age difference in memory for explicit-verbal than for implicit-verbal information. b) Explicit-pictorial information should be recalled if one can use one's own imagery strategies when pictorial cues are given. Implicit-pictorial information must be deduced from information available in the stimulus pictures or one's own images. Older adults can utilize imagery encoding system when the images are provided, thus, they can effectively encode explicit-pictorial information given the proper presentation. Further, they will process this information and develop the implicit-pictorial information. Young adults produce their own images. This may interfere with the given images; and result in younger adults recalling less explicit-pictorial information than explicit-verbal. They also may be less likely to deduce correct implicit-pictorial information than older adults since the younger adults have two possibly-confilicting images to consider. This will be evidenced as an age x type of information interaction. For the young adults, there will be a greater percentage of verbal than pictorial information remembered.

There will also be a larger age difference in memory for explicit-pictorial information; for older adults, there will be a greater percentage of pictorial than verbal information correctly recalled across any stimulus presentation condition since they will be able to use imagery strategies some of the time for questions regarding pictorial information.

3) Age x Presentation Condition. The memory system is predominately verbal, particularly for older adults. Thus, stimuli presented in verbal form will prompt the use of verbal encoding strategies, especially for older adults, while younger adults may additionally use some imagery strategies to process verbal information.

Stimuli presented in pictorial form should activate the imagery system in general. Because of the older subjects' tendency to use primarily verbal strategies, they may use the verbal encoding strategies to comprehend pictorial stimuli. The younger adults would rely on the imagery system.

Young adults can benefit from simultaneous presentation of verbal and pictorial information since both encoding strategies will be actively used to encode information. Simultaneous presentation in general may not be as useful for older subjects because the overall encoding system relies more upon the verbal strategies than imagery. Therefore, they may attend more to verbal stimuli that matches their encoding system. Thus, the old adults' recall will be best in the story alone condition. This will be evidenced in subjects' memory performance as an age x presentation condition interaction.

4) Age x Presentation Condition x Question Type. An interaction among age, presentation condition, and question type is expected to occur. Specifically, there will be an age x presentation condition interaction that is different for each type of question.

Although the memorial system of older adults is predominately verbal, they will not necessarily have good recall of all possible types of verbal information. Since older adults do not utilize imagery strategies when encoding verbal material, they should experience some difficulties in regard to those verbal material that are associated with the imagery system, specifically those that involve explicit (concrete) information. It is predicted that older adults' recall of explicit-verbal information will be significantly less than that of younger adults. However, failure to spontaneously utilize imagery mediators is compensated for by adding imagery information (picture + story), thus older subjects will have improved recall of explicit-verbal information in the combined story and picture condition.

Younger subjects, due to the regular, simultaneous use of verbal and imagery encoding strategies, will benefit less proportionally from the simultaneous presentation of verbal and pictorial information. Since imagery strategies are usually utilized in this group of subjects, presentation of imagery information may interfere with their own spontaneous imagery formation.

Recall of verbal-implicit information that does not invoke imagery strategies should not be different for young and older adults. Also, combined presentation of implicit-verbal and pictorial information should not be facilitative nor disruptive for either age group.

It is expected that the older subjects' recall of explicit information in the combined presentation condition will be superior to their recall of explicit information in only story or only picture condition; that younger adults' recall of explicit information in the story condition will be better than the older adults' recall of the same information; and that young and older adults' recall of implicitly available information should be equally good regardless of presentation condition.

Finally, for question types involving non-available information for which the correct response is "I do not know," there will be the following age x presentation condition interaction: older subjects will be more confused regarding the information in story alone and picture alone conditions because they tend to encode this type of information when they represent an explicit idea. Less confusion is expected when pictures and story are jointly presented. Young subjects' correct responses in this condition is expected to be more in story than picture alone or story and picture combined presentation condition, since the spontaneous image of verbal information in combined condition and mismatch of picture information with their image may cause more confusions.

CHAPTER II

METHOD

Subjects and Design

Thirty older women (age range 55-79) were telephone recruited from University of Oklahoma alumni lists. These women were community residents and had an average of 14.4 years of education. Thirty young women (age range 18-24) from the General Psychology subject pool participated for research credit. They had an average of 13.5 years of education. There were no age differences between the young and older women for state or trait anxiety (Speilberger, Corsuch & Lushene, 1970).

A split plot factorial design with age (young, older), story presentation condition (verbal, pictorial), and type of cued question (9 types) was employed with type of cued question as a within subject for factor (see Diagram 1). Nine different types of questions were utilized that required correct memory for explicit, implicit, and not available information in the heard story and seen pictures.

DIAGRAM 1

Adult Age Differences in the Effect of Auditory-Verbal and Visual-Pictorial Stimuli on Retention of Implicit and Explicit Information

Design:

			E			I			N		
											Available in story
		E	**I**	**N**	**E**	**I**	**N**	**E**	**I**	**N**	**Available in picture**
Young	**Presentation Condition**	**P**									
		S									
		S&P									
Old	**Presentation Condition**	**P**									
		S									
		S&P									

Number of Ss 30 young, and 30 Elderly adult
10 of each age in each presentation condition of Picture, Story, Story & Picture

Question types: E,E E,I E,N I,E I,I I,N N,E N,I N,N

E= Explicit information
I= Implicit information
N= Non available information

Materials

A story with three small paragraphs was developed that focused on a family with an ill member (Appendix A). The story purposely excluded historical references (Kausler & Pukett, 1981), and the temporal sequencing of story events was well specified. A tape-recorded version (male voice) of this story was made and timed (one minute and 25 seconds). Three colored pictures, one for each paragraph, were constructed which depicted the same story; however, the pictorial story did not completely overlap with the taped story version. In the story there were 48 explicit and 39 implicit lists of information; in the picture, 45 explicit and 25 implicit bits of information. Nine types of questions were then constructed to assess subject's recall for both story versions and included all possible combinations of explicit (E), implicit (I), and not available information from both taped and pictorial story version [E(S) E(P), E(S) I(P), E(S) N(P), I(S) E(P), I(S) I(S), I(S) N(P), N(S) E(P), N(S) I(P), N(S) N(P)].

Sixty preliminary questions of the various nine types were constructed from the story and pictures for the cued recall task. "Explicitly available information" (E), provided subjects with direct and concrete ideas; subjects did not have to interpret or imply any information from the story. Explicit information was sometimes provided in both the taped and pictorial story version (e.g., color of Joe's hat). Explicit information was sometimes provided in only one story version (e.g., the color of the car that hit Joe, which was only demonstrated in the pictures; or the direction in which Joe was walking, which was only mentioned in the taped story version).

"Implicitly available information" (I) was that which represented an abstract idea and was not directly accessible. In order to answer questions concerning implicit story information, processing of the given explicit information was required. Implicit information was sometimes provided in both story versions (e.g., the statement that Joe was going toward the hospital in the taped story and Joe was walking toward the hospital in the pictorial version should enable the subject to infer Joe's distress). Implicit information was sometimes provided in only one source of information (e.g., from the explicit information that Joe was thrown four feet into the air, subjects should have inferred the seriousness of the accident, this statement was only given in the taped story version; or the question what time of the day did the accident occur? could be inferred from the picture that contained time of day cues).

The category of "not available information" (N) served mainly as a control condition and referred to the lack of information in one or both story versions. For example, the question what color was the car that hit Joe? was "not available information" in the story. Subjects who heard the only picture condition or subjects given both story versions should correctly respond "orange." Subjects in the story condition should respond "I do not know."

The nine types of questions were indicated as E-E, E-I, E-N, I-E, I-I, I-N, N-E, N-I, N-N. The first letter alwways represented the availabiltiy of information in the taped story version (E, explicit; I, implicit; N, not available). The second letter always represents the availability of the information in the pictorial version.

The total of 45 questions--five for each of the nine types of questions--were selected from the pool of original 60 questions. In order to test the reliability of these cued recall questions, the percentage of agreement of 25 psychology and English volunteer undergraduates was measured against the experimenter designed question typology. Nine of the pilot subjects listened to the story and saw the pictures simultaneously, then they were asked to read the 60 questions. After answering each question, they were asked to evaluate this question: "Given the two presentation conditions, what type of information did you utilize in order to respond to the question?" The subjects were given the three response cateogires of availability (explicitly, implicitly, or not available; each subject was given an example of each type of question). The same procedure was carried out for the remaining 16 subjects, but half of them looked at the pictures and did not hear the story while the other half only heard the story. The percentage of subject agreement was collapsed across all three presentation conditions and only those questions that earned 80% subject agreement with experimenter's question typology were selected to be used in the study (See Appendix B).

Imagery Task

A short (45 question) version of Paivio's (1965) imagery assesment scale was administered to all subjects. The 45 items in this task were randomly selected with the following restrictions: each of 15 items represented: low, middle, and high imagery concepts respectively (e.g., potato--high; winter--middle; velocity--low). The subjects were instructed to read the words and try to develop an image of each one; then they rated their image of each word on a scale of one through seven (one--low image; seven--high image). Therefore the maximum score for all 45 questions was 315 and the minimum total was 45. Based on a previously normed study by Paivio, low imagery words had an average of 2.35, medium imagery words had an average of 4.60, and high imagery words had an average of 5.39. There was no significant difference between young and older subjects' average combined score performance. There was also no significant difference between young and older subjects within each category of low, medium, and high imagery words (See Appendix C).

Procedure

Within each age group, subjects were randomly assigned to one of the three conditions of story presentation (Picture, Story, Story and Picture). Subjects were administered the state and trait anxiety scales and the older adults received the cardiovascular subscale of the Cornell medical index. Each subject was then presented with the assigned story version. Subjects in group (P) were instructed to look at each of three pictures for 30 seconds. Pictures were presented one by one in sequential order. Subjects in group (S) were instructed to listen to the taped story which lasts one minute and twenty-five seconds. Subjects in group (S+P) were instructed to listen to the story and simultaneously watch the pictures that were presented in sequential order for 30 seconds each. The subjects in this group were told that the pictures represented the story they were listening to. After story presentation was completed, they were instructed to orally respond to the 45 cued recall questions that the experimenter read to the subject. These questions were in the same order as Story and Picture presentation.

CHAPTER III

RESULTS

Scoring Procedures

Subjects' responses to the cued-recall questions were tape recorded, and subsequently transcribed and scored independently by two raters. Criteria for acceptable responses were developed and tested in two pilot studies. Acceptable responses to questions concerning explicitly available information in either story version were limited, in most cases the subject's response had to be an exact detail. For example, for subjects only having the taped story version, a correct response to the question, "How far was Joe thrown into the air when he was hit by the car?" would only be "4 feet"--since this information was specifically mentioned on the story tape.

Acceptable responses to questions concerning implicitly available information in either story version were determined by the range of responses provided by the pilot study subjects. A wider range of possible responses were judged acceptable for these questions. For example, an acceptable response to the question, "What parts of Joe's body were injured in the accident?", had to be inferred from the description of the accident. Acceptable responses included his whole body was beat up, many broken bones, his arms and legs, etc. Acceptable responses to questions concerning unavailable information were variants of "I don't know." See Appendix D for (1) acceptable responses to each of the 45 cued-recall questions and (2) the scoring sheets used by the raters. See Appendix F for the raw scored data.

Definition of Dependent Variables

The subjects' responses were considered within two separate but overlapping categories. One set of analyses considered correctness as defined by acceptability of each response. Credit was given for correctly recalling explicit details and inferred ideas and for correctly admitting "I don't know." No credit was given for incorrect recall of explicit details or illogically inferred ideas or guesses (whether correct or not!) to questions the subject could not have known.

A subcategory of this variable was correct knowledge which included acceptable recall of explicit details and inferred ideas; a second subcategory of this variable was correct admission of no knowledge which was only the correct admission of "I don't know."

A second set of analyses included knowledge as defined by the information any subject actually offered during recall, whether accurate or not. Knowledge included correct or incorrect recall of explicit details, correct or incorrect inference of implicit ideas and any guessed response to questions concerning unavailable information. The converse, no knowledge, included the "I don't know" responses to any question type.

Knowledge also involved two subcategories. The first was correct knowledge and was redundant with a subcategory order the Correctness definition. The second was subject-generated knowledge and included wrong responses to questions tapping explicit detail or implicit ideas and guessed responses to questions concerning unavailable information (See Table 1).

Table 1

Definitions of Dependent Variables

Possible types of subject responses

responses to questions regarding explicit detail:

a. acceptable detail

b. unacceptable detail

c. I don't know

responses to questions regarding implicit ideas:

d. acceptable idea

e. unacceptable idea

f. I don't know

responses to questions regarding unavailable information:

g. guesses

h. I don't know

Types included within a particular definition

1. Correctness a,d,h

   correct knowledge a,d

   correct admission of no knowledge h

2. Knowledge a,b,d,e,g

   correct knowledge a,d

   subject generated knowledge b,e,g

Correctness

An age (2) x presentation (3) x question type (9) ANOVA was computed using correctness as the dependent variable. The ANOVA summary table is included in Appendix E, Table 1. The main effects of age, F (1, 54) = 16.8, presentation condition, F (2, 54) = 3.9, and question type, F (8, 432) 32.6, were all significant at $p < .01$ (see Table 2). Since the correct response to a specific question type varied with the presentation condition, the main effect for presentation condition is not meaningful.

The interaction of age by presentation condition, F (2, 54) = 7.1, and presentation condition x question type, F (16, 432) = 7.1 were also significant, $p < .01$ (see Table 2). Simple effects analyses of the age by presentation condition revealed that the elderly exhibited significantly different performances across the three presentation conditions; specifically, they showed better performance in the picture presentation condition in comparison to combined P & S F (1, 32) = 4.107 $p < .05$. For young subjects, analysis of simple main effect revealed a significant difference across the three presentation conditions F (1, 18) = 3.00 $p < 0.5$).

Table 3 depicts that presentation x question type interaction in a more meaningful manner. Row 1 looks at questions tapping information that was available in the picture for (1) subjects who saw only the picture and (2) subjects who heard the taped version of the story and saw the pictures. Note that the number of question types for those who saw only the pictures collapses to three (_,E; _,I; _,N) categories of 15 questions each; since these subjects never heard the taped story version, that source represented unavailable information. For those who both heard and saw the story, the equivalent questions would be those that considered information available only in the pictures. These three specific types of questions (five each) are included in Row 1. Row 2 looks at questions tapping information that was unavailable in the taped version for (1) subjects who heard only the story and (2) subjects who both heard the story and saw the pictures. Again, equivalent categories of questions are compared across these two story conditions. Row 3 depicts correctness of response to questions concerning information that was redundantly available from both sources of information. Comparison down Column 1 reveals the effect of all three presentation conditions for questions dealing with explicit, implicit, or unavailable information (See Figures 1 and 2).

Table 2 (1)

Significant Effects for Correctness Analysis

Percentage of responses to 45 questions rated as correct:

Age	young subjects	76%
	older subjects	69%

Story Presentation

taped story	74%	]* (vs. taped story & pictures)
pictures	75%	*[(vs. taped story & pictures)
taped story & pictures	70%	

Age & Presentation

	Old		Young
tape story	69%	**	80%
pictures	75%		73%
taped story & pictures	64%	*	75%

* tape story vs. pictures (Old); * pictures vs. taped story & pictures (Old)

Presentation x Question Type

	E.E	E.I	E.N	I.E	I.I	I.N	N.E	N.I	N.N
tape story	68%	58%	75%	81%	92%	66%	73%	61%	95%
pictures	84%	63%	43%	63%	93%	78%	79%	69%	96%
taped story & pictures	86%	62%	38%	83%	93%	61%	48%	69%	85%

(1) See Table 4, Appendix E for single effect analysis of variance

* significant $p < .05$

** significant $p < .01$

Table 3

Percentage of Correct Response to Collapsed Question Types within Each Presentation Condition

		Picture		Taped Story & Picture
Row 1	(-,E)	73%	(N,E)	48%
	(-,I)	74%	(N,I)	69%
	(-,N)	77%	(N,N)	85%

		Story		Taped Story & Picture
Row 2	(E,-)	63%	(E,N)	38%
	(I,-)	78%	(I,N)	61%
	(N,-)	81%	(N,N)	85%

		Taped Story & Picture
Row 3	(E,E)	86%
	(I,I)	93%
	(N,N)	86%

KEY: P(X,Y) = Percentage of subjects with a particular cell giving correct response.

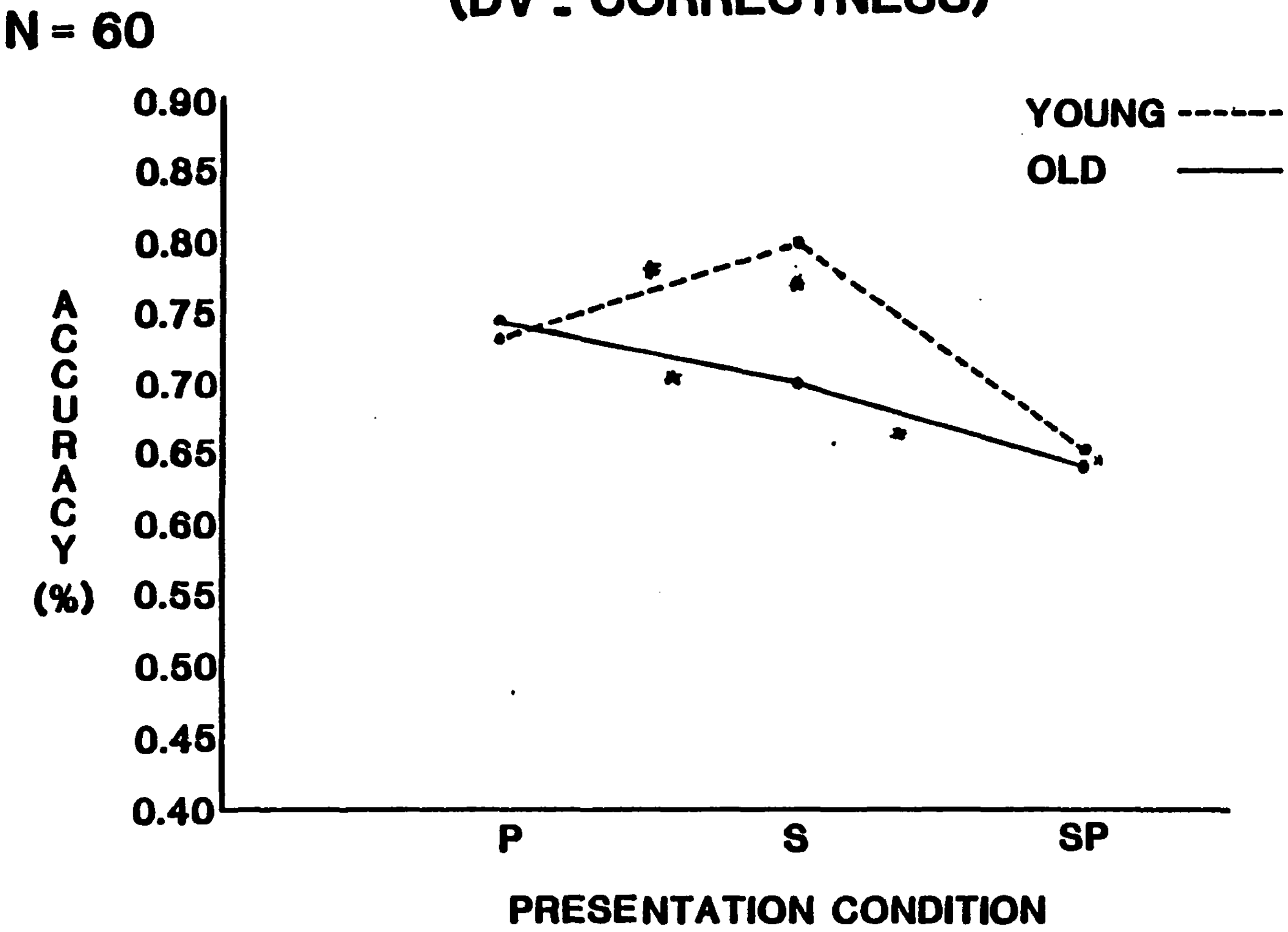
X = availability of correct response to question in the "heard" story.

Y = availability of correct response to question in the "seen" pictures.

N = Not available.
E = Explicitly available.
I = Implicitly available.
- = Collapsed over all 3 levels of availability.

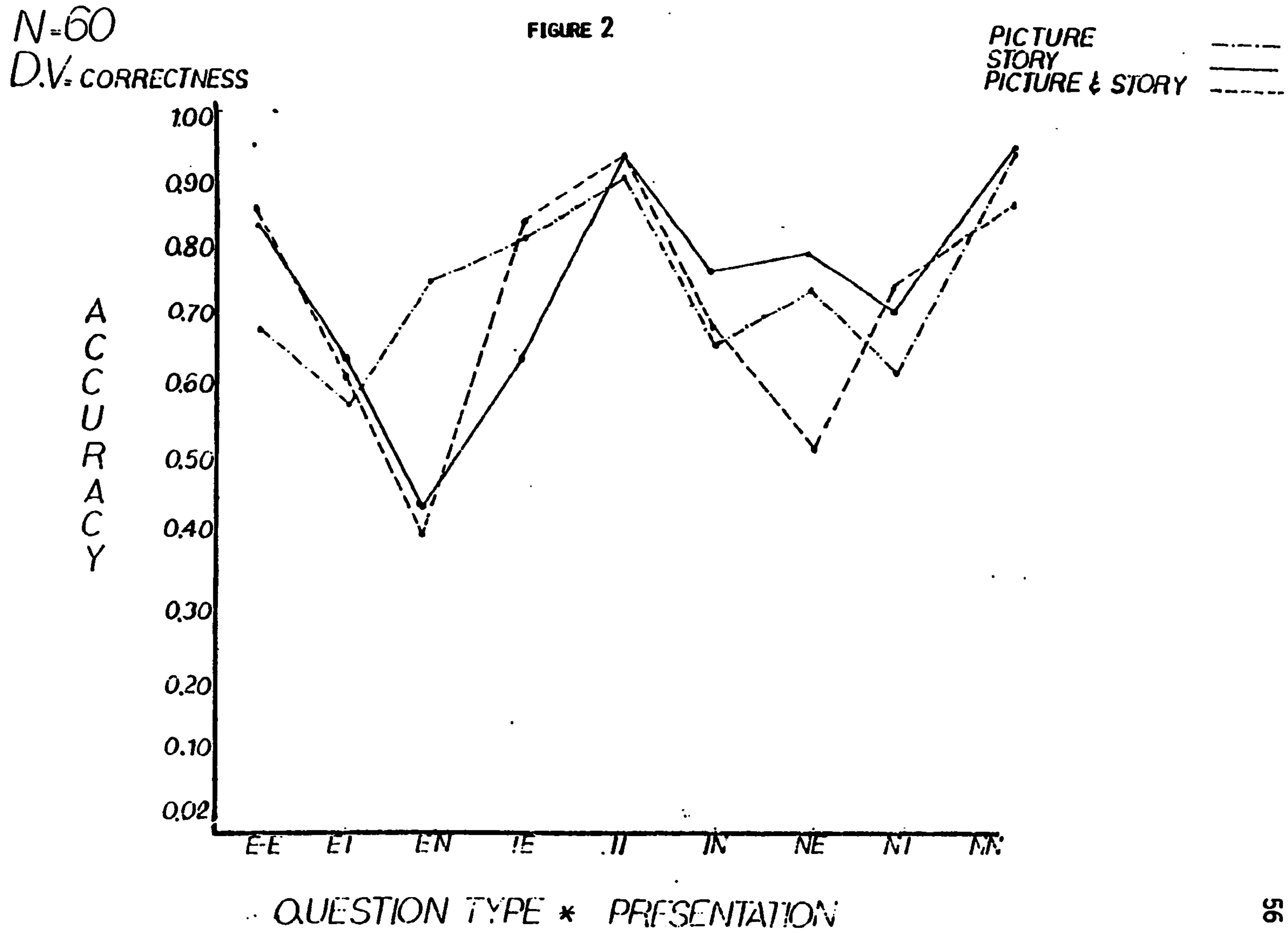
FIGURE 1

THE INTERACTION of AGE & PRESENTATION CONDITION (DV : CORRECTNESS)



*significant

FIGURE 2

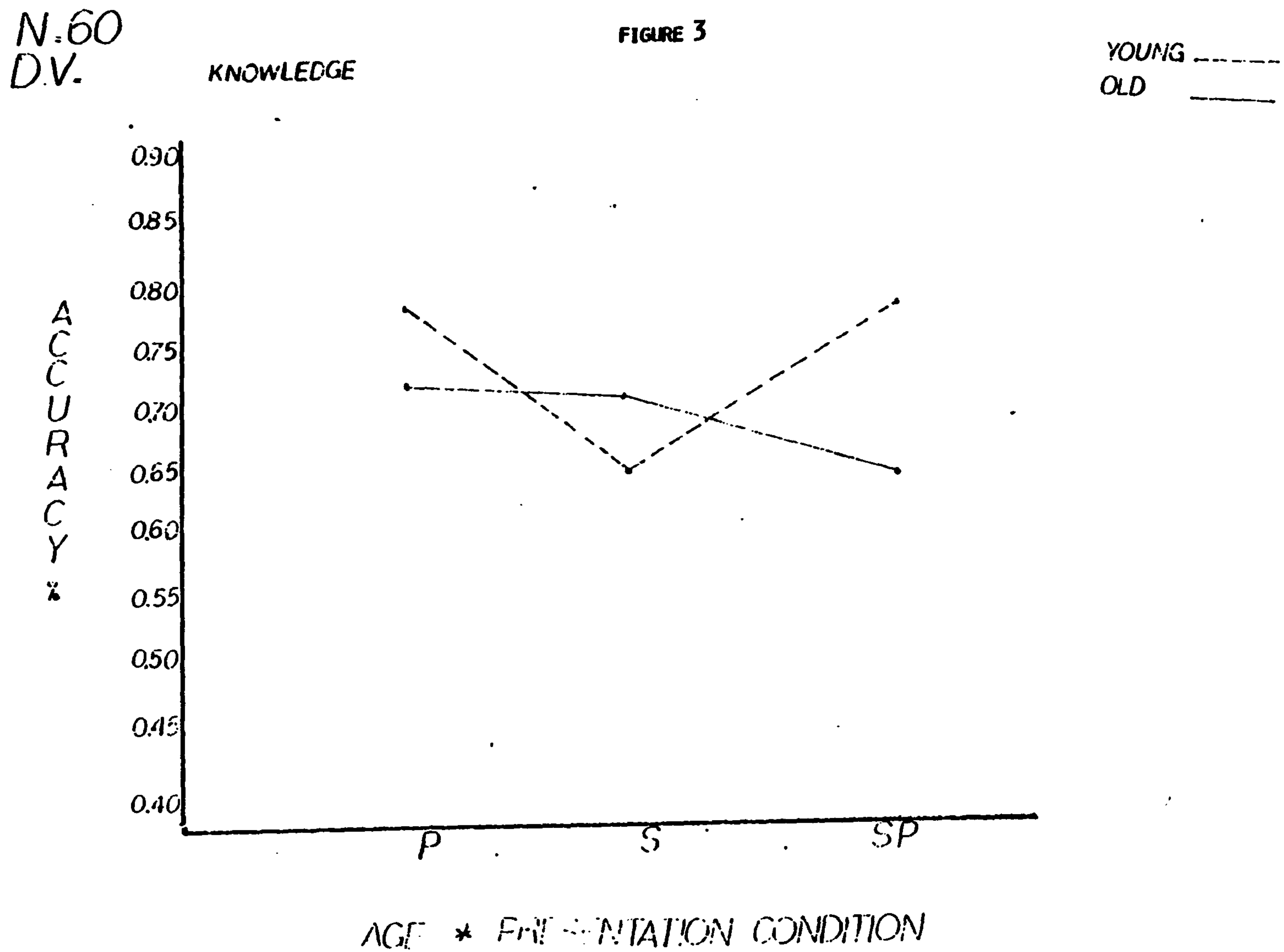

N=60
D.V.= CORRECTNESS
PICTURE
STORY
PICTURE & STORY
ACCURACY
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.02
E-E
EI
EN
IE
II
IN
NE
NI
NN
QUESTION TYPE * PRESENTATION

Knowledge

An age (2) x presentation condition (3) x question type (9) ANOVA was computed using <u>knowledge</u> as the dependent variable. (Knowledge includes correct responses in all three presentation conditions and disregards the correct admission of no knowledge, "I don't know.") ANOVA summary table is included in Appendix E, Table 2.

Main effects of presentation condition, F (2, 54) = 34.7, question type, F (8, 16) = 145.71, were significant at $p < 0.1$. The interactions of presentation condition x question type, F (16, 432) = 2.80; question type x age x presentation condition, F (16, 432) = 34.25 were also significant at $p < .01$ (see Table 3). The single effect ANOVA revealed a signficant difference between young and older adults' recall of explicitly redundant information F (1, 18) = 2.45, $p < .05$. Also, younger adults benefit more from combined presentation of picture and story than older subjects F (1, 18) = 3.05, $p < .05$ (See Figures 3-10).

FIGURE 3


N.60
D.V.
KNOWLEDGE
YOUNG
OLD
ACCURACY %
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
P
S
SP
AGE
CONDITION

N:20
DV:Knowledge

FIGURE 4
Story & Picture

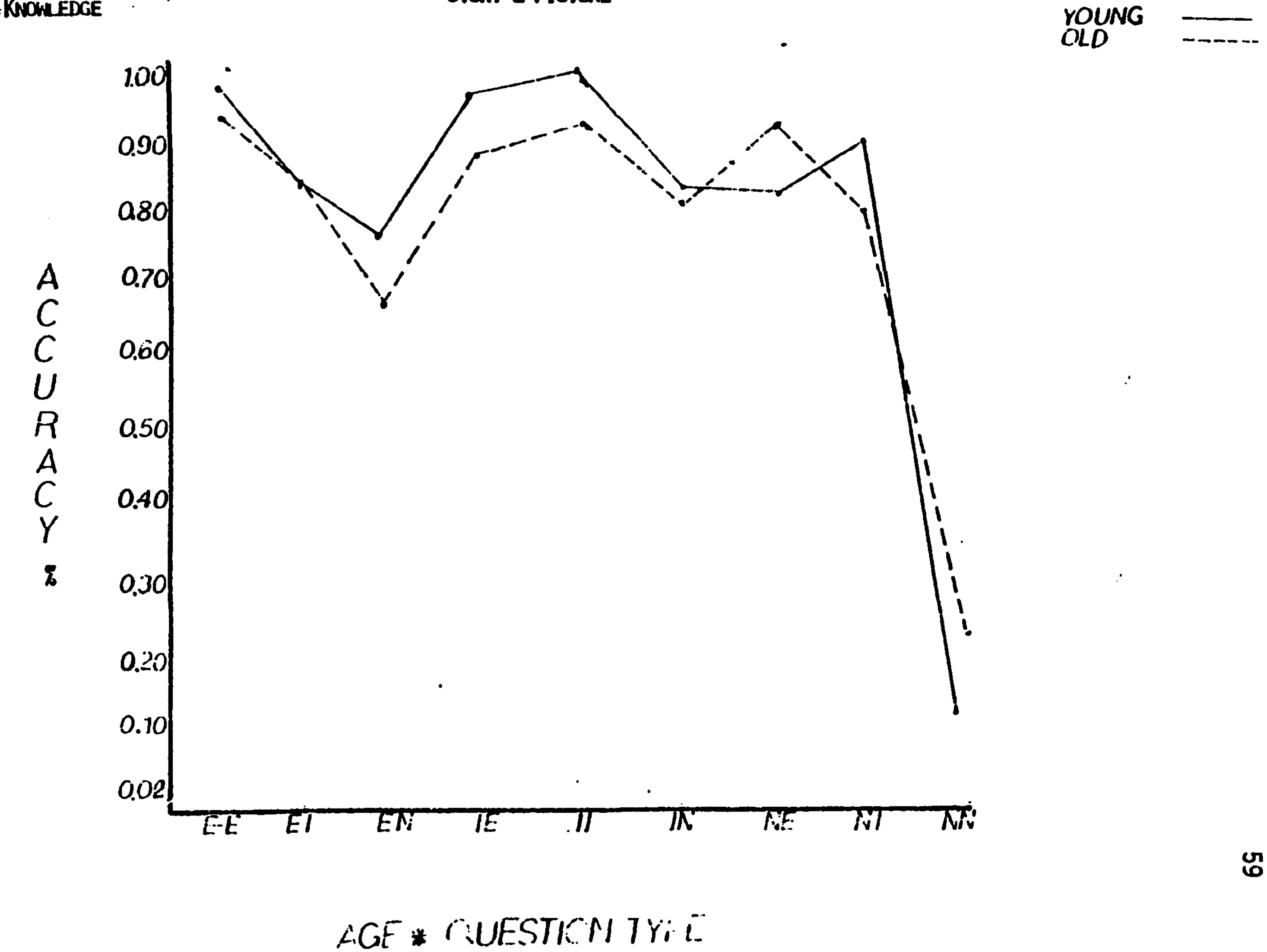
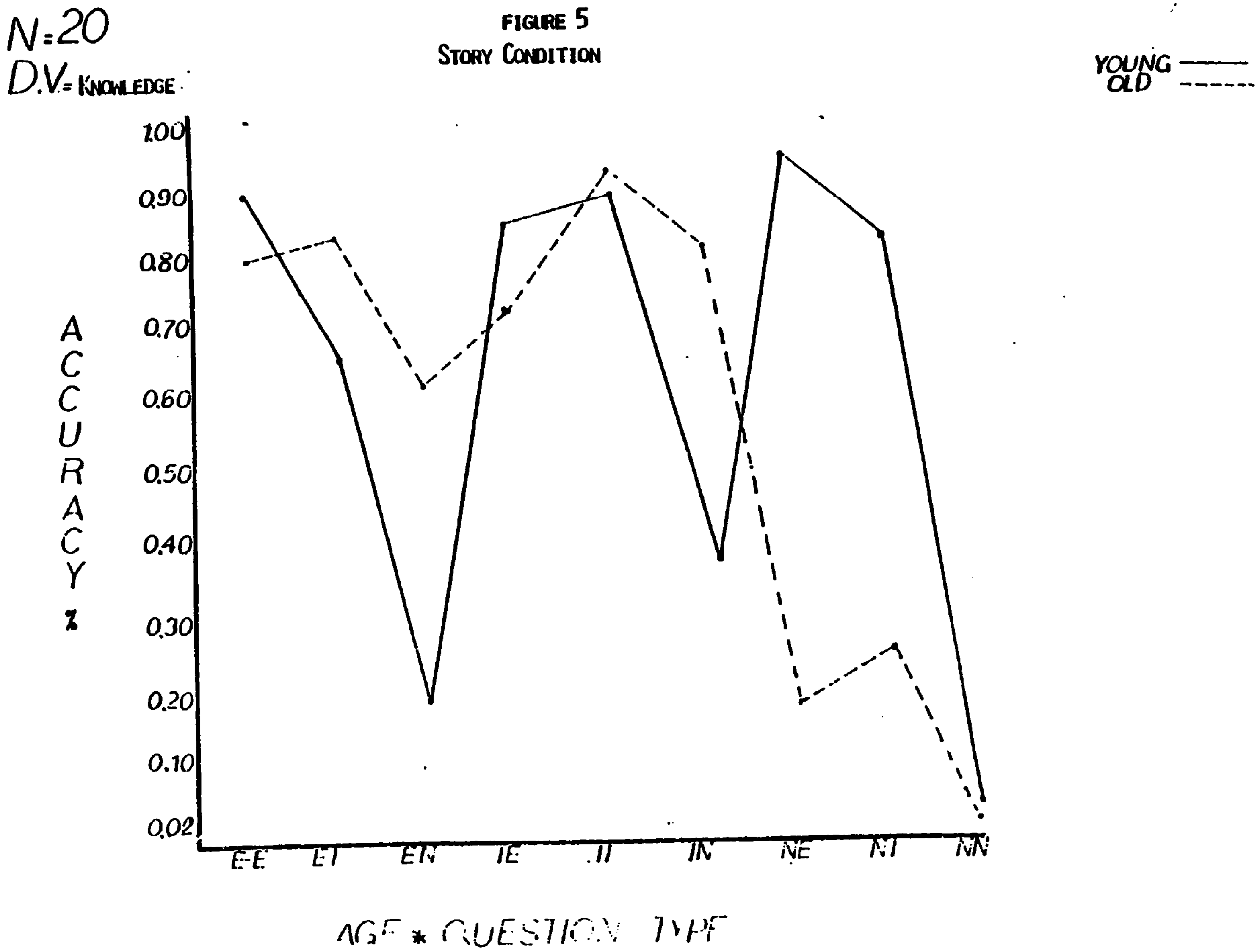
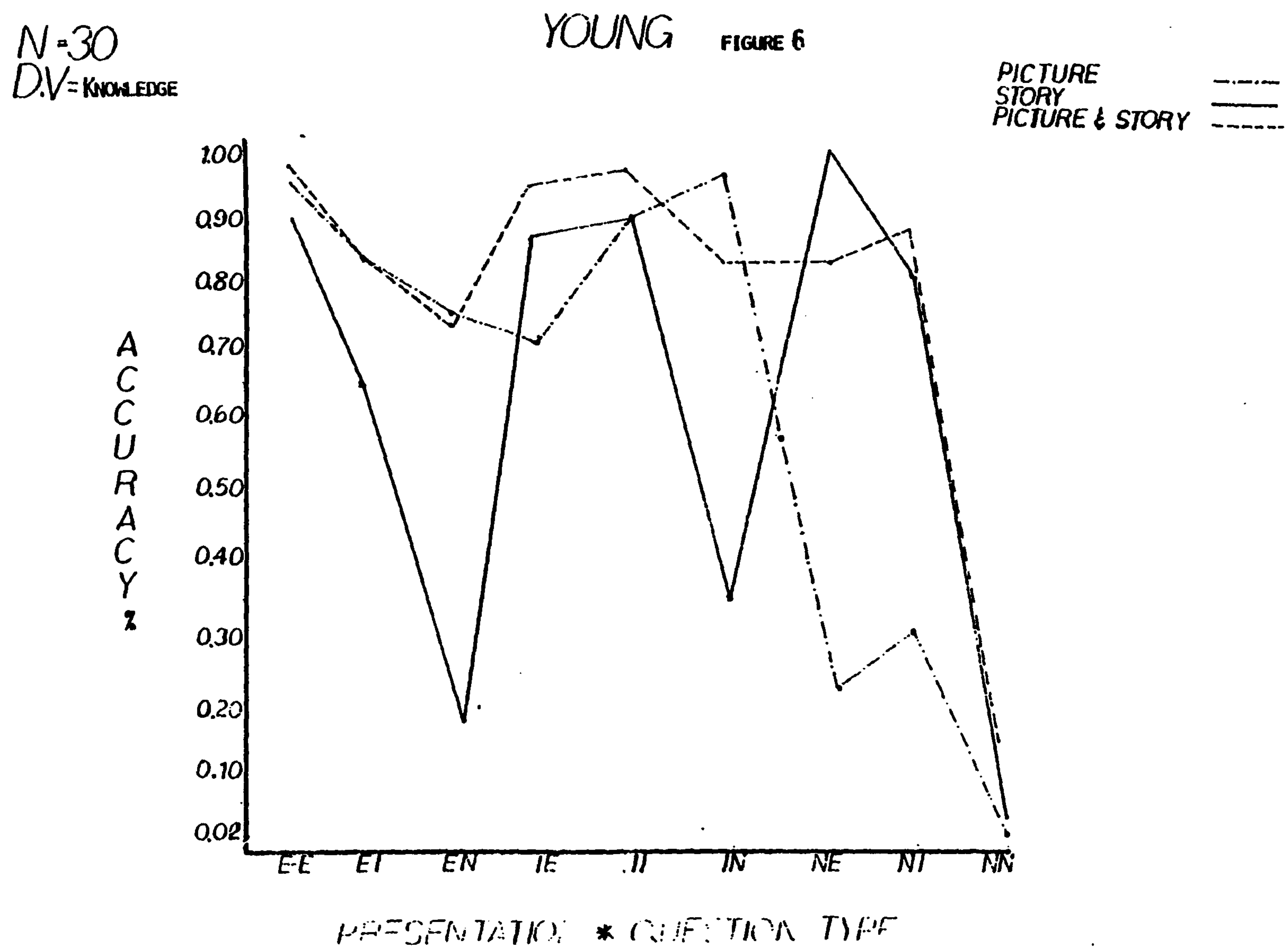


FIGURE 5
Story Condition




N=30
D.V=KNOWLEDGE
YOUNG
FIGURE 6
PICTURE
STORY
PICTURE & STORY
ACCURACY %
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.02
E-E
EI
EN
IE
II
IN
NE
NI
NN

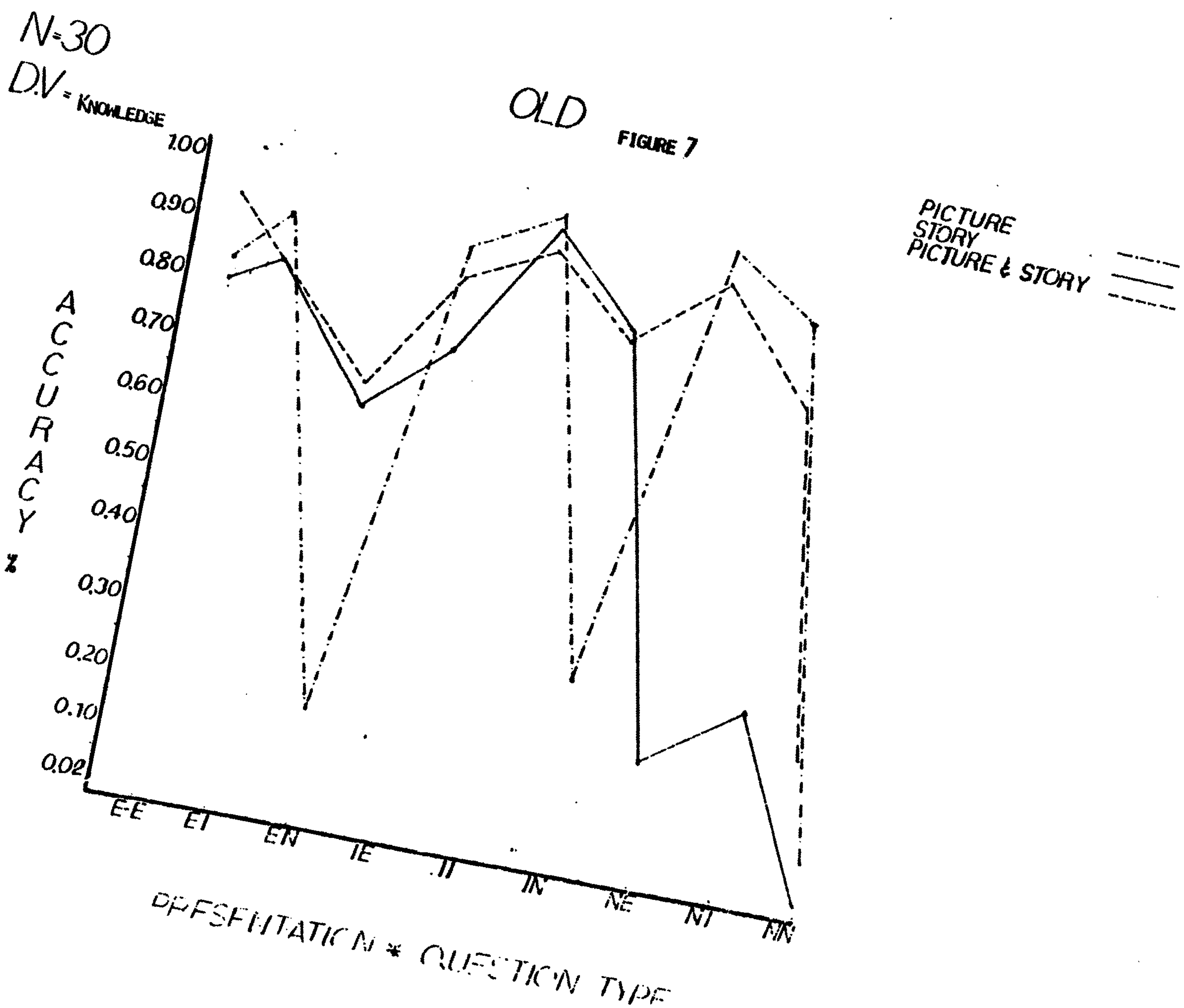

N=30
D.V = KNOWLEDGE
OLD
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.02
ACCURACY %
E-E
EI
EN
IE
II
IN
NE
NI
NN
PRESENTATION * QUESTION TYPE
PICTURE
STORY
PICTURE & STORY

FIGURE 7

N=20
D.V.=KNOWLEDGE

FIGURE 8
PICTURE CONDITION

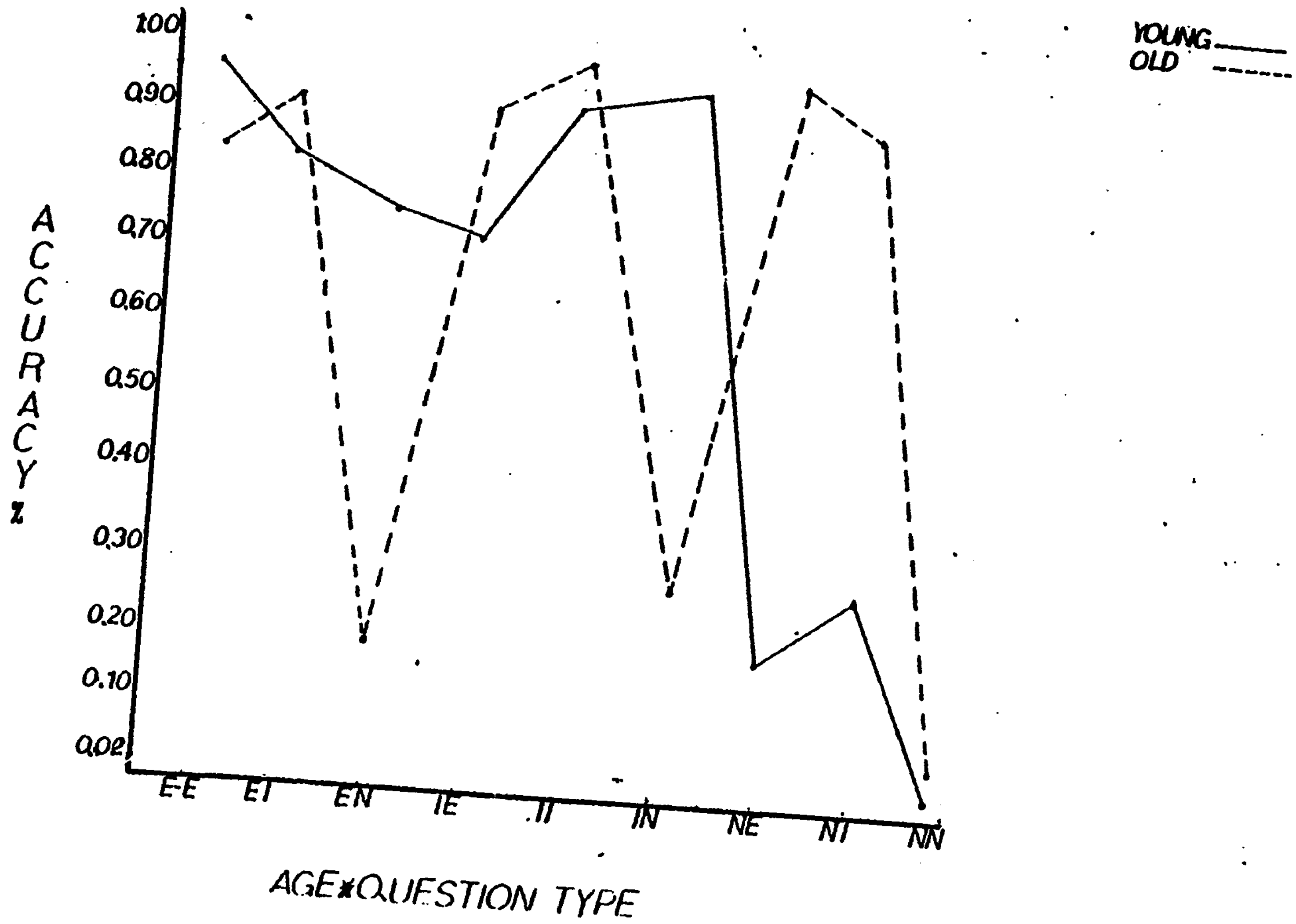


FIGURE 9

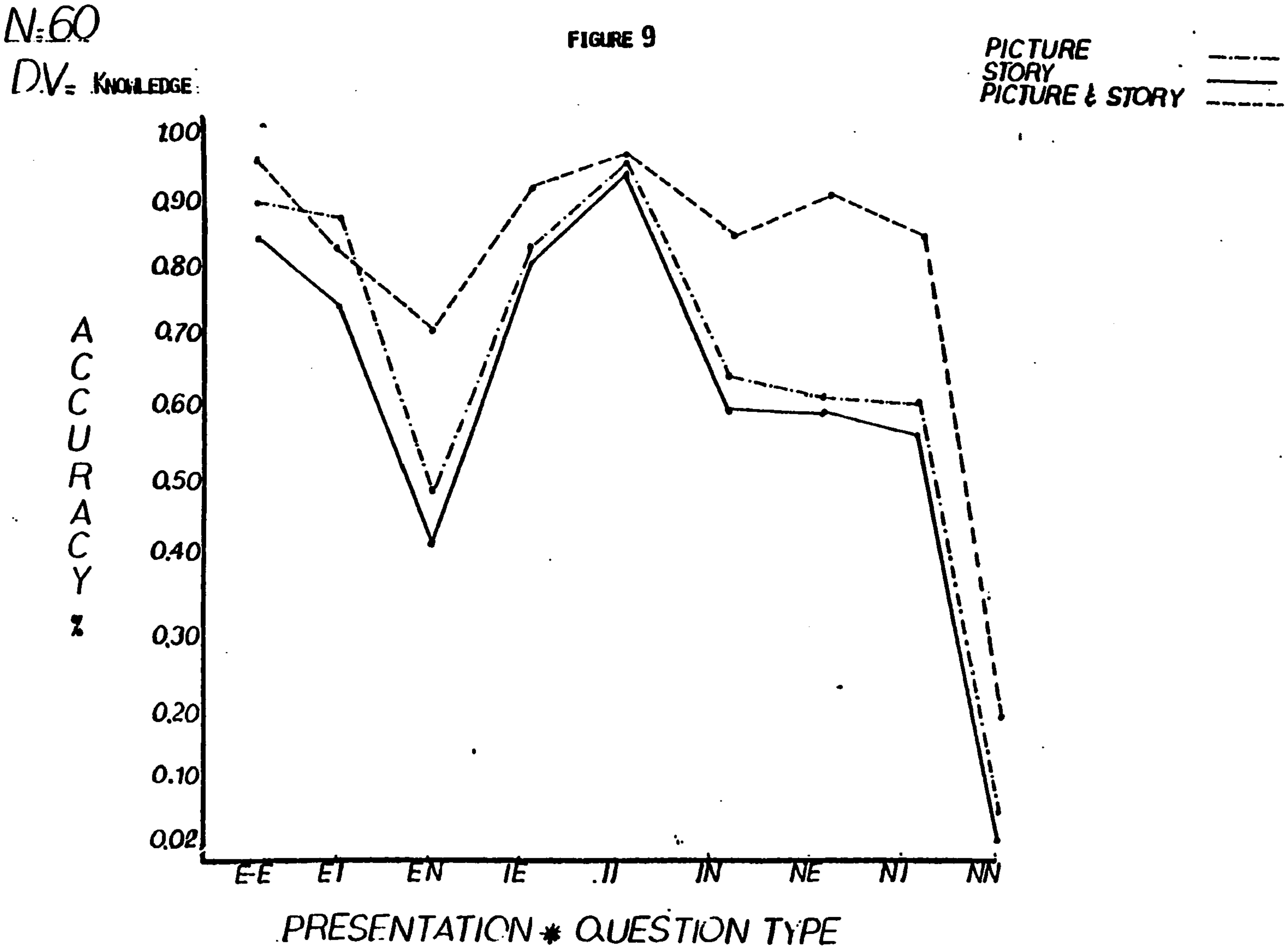
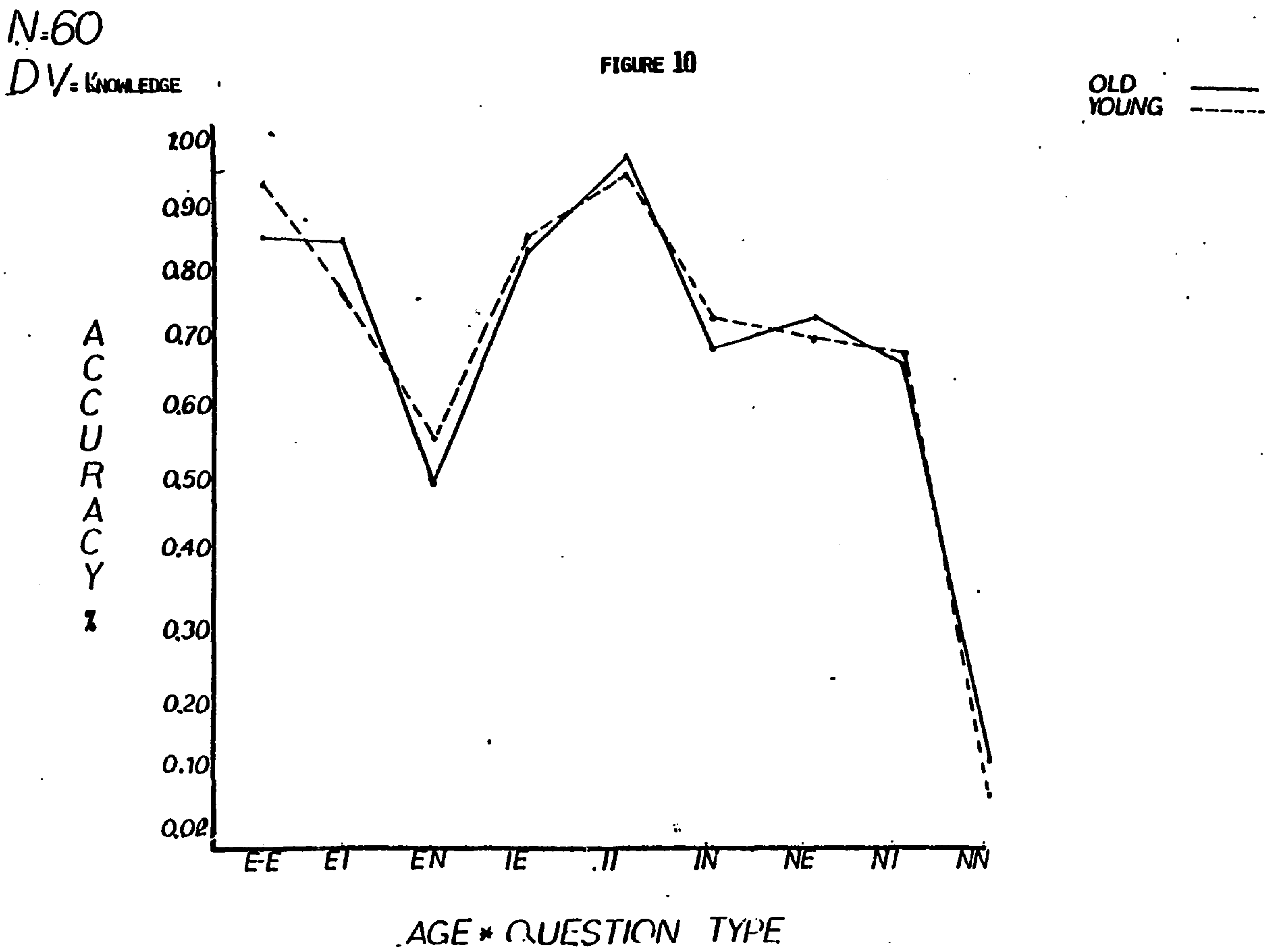

N=60
DV= KNOWLEDGE
PICTURE
STORY
PICTURE & STORY
ACCURACY %
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.02
E-E
EI
EN
IE
II
IN
NE
NI
NN
PRESENTATION * QUESTION TYPE

FIGURE 10


N=60
DV= KNOWLEDGE
OLD
YOUNG
ACCURACY %
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.02
E-E
EI
EN
IE
II
IN
NE
NI
NN
AGE * QUESTION TYPE

Correct Knowledge

This dependent variable, like the first correct knowledge, disregards the correct admission of no knowledge. It also disregards the question types for which the subjects' correct responses had to be "I don't know." For example, in the story presentation condition, response to the question types of N-E, N-I, and N-N can only be credited if subjects' response was "I don't know." For the same reason, question types of E-N, I-N, and N-N in the picture presentation condition were also not considered in this analysis. Subjects' response under story and picture combined condition was averaged for the E-N, I-N, N-E, and N-I question types in order to adjust the data for picture and story "single" conditions. ANOVA summary table is included in Appendix F, Table 3. Main effects of presentation condition, F (2, 54) = 5.38; question types x presentation condition F (10, 270) = 3.98; age x question type, F (10, 270) = 3.42 were also significant at $p < .01$ (See Figures 11-14). These interactions are exclusively discussed in the next chapter.

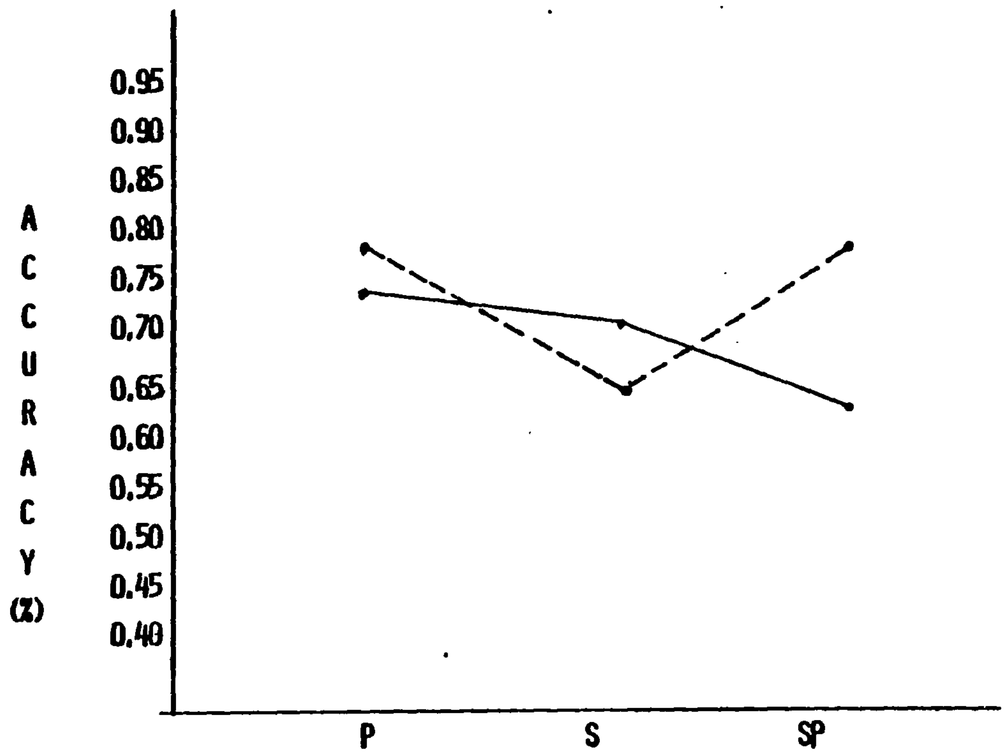
Correct admission of no knowledge: No main effect of interaction affect was signficant for this dependent variable.

N= 60

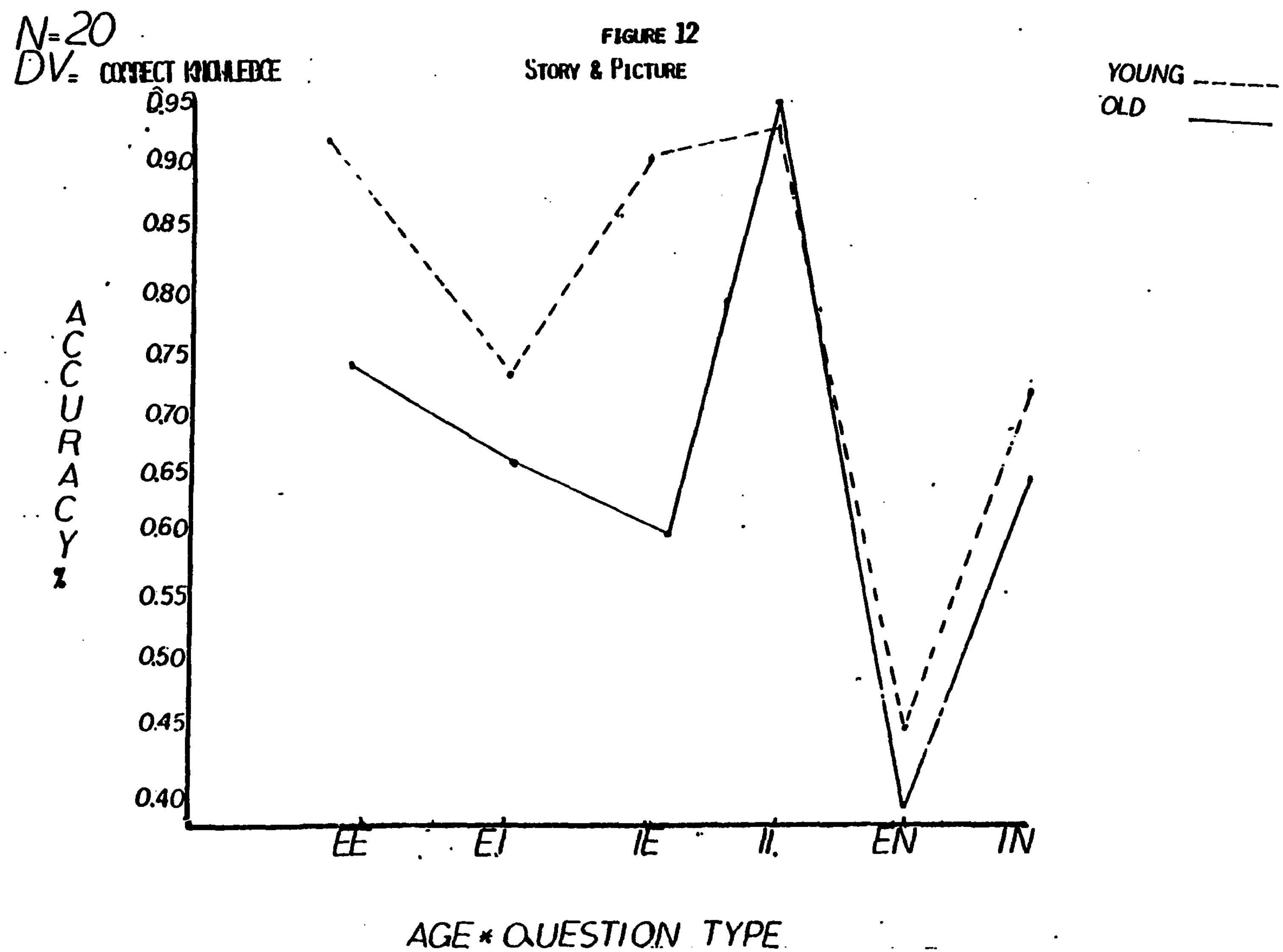
D.V. = Correct Knowledge

FIGURE 11

Young ————
Old ————



AGE X PRESENTATION CONDITION


N=20
DV= CORRECT KNOWLEDGE
FIGURE 12
STORY & PICTURE
YOUNG
OLD
ACCURACY %
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
EE
EI
IE
II
EN
IN
AGE * QUESTION TYPE

N= 20
D.V = CORRECT KNOWLEDGE

FIGURE 13
STORY CONDITION

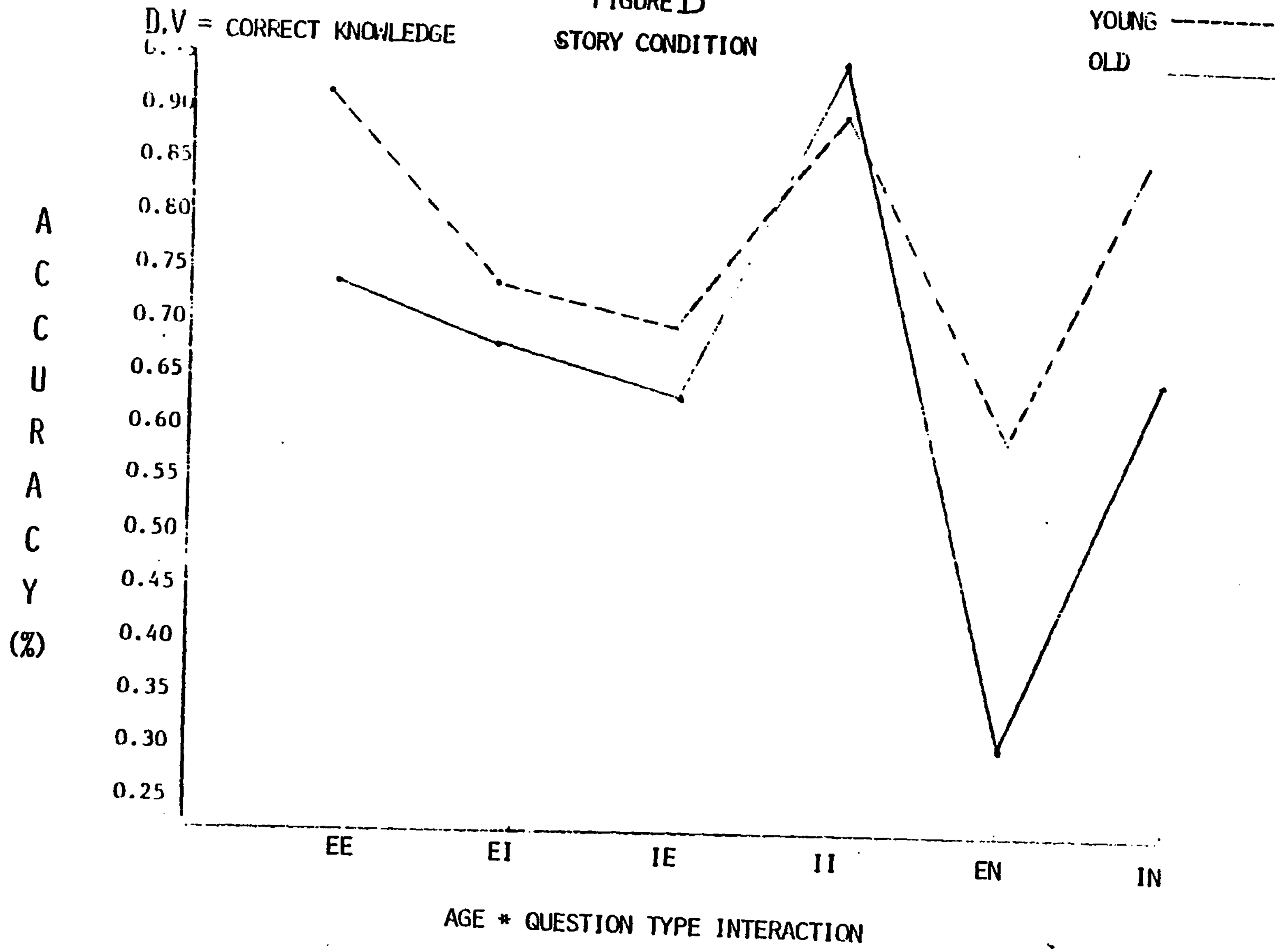
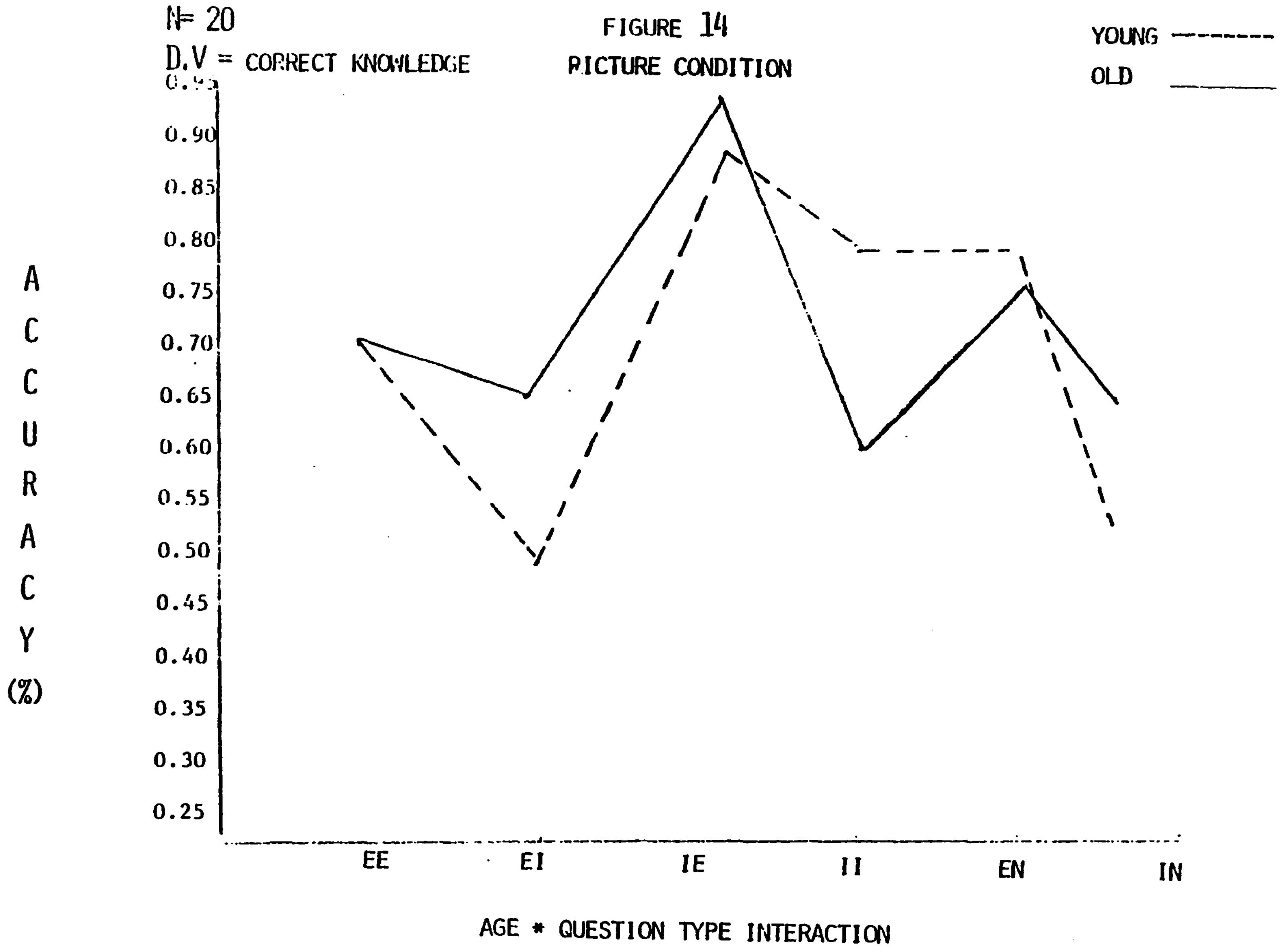


FIGURE 14

PICTURE CONDITION



CHAPTER IV

DISCUSSION

Although the typical dependent variable in experimental studies of memory is the number of correct responses, due to the nature of this dissertation which has studied the prose memory in a life-span perspective, discussion of other dependent variables, such as correctness, knowledge that measure subjects' generated knowledge of the given information, seems to be necessary. The variables are discussed here in the same order as in the result section.

Correctness

Correctness of response, as defined by the experimenter's predetermined criteria, varied with specific presentation mode. If an answer was available in a particular condition, then the correct response was expected to be recalled by the subject in that group. The results as analyzed for this dependent variable led to several conclusions.

Young subjects' overall performance was significantly more correct than the older subjects as was evidenced by the main age effect for correctness. However, there was no age effect when a subset of correct response, correct admission of no knowledge, was separately considered. Age groups exhibited the same skill admitting "I don't know" but the older subjects made more errors when answering questions that they should have been able to recall from the stimulus materials. These errors were similar to the omission errors typical of older subjects during verbal learning experiments.

Both young and older subjects performed equally well in the picture presentation, 75% and 73% for old and young subjects, respectively. But young adult's correct recall was better than the older subjects' for auditory story presentation. Younger subjects also recalled more of the information that was redundantly available from both versions of the story, 74% and 64% for young and older adults, respectively. Older subjects' recall of pictorial information was better when they saw only the picture than when information was redundantly available for them, 75% and 64% recall for picture and story-picture presentation conditions, respectively. Thus, both age groups were confused by unuseful information, since they responded less accurately to those questions regarding only the heard story information if they had also viewed the pictures. For example, there was 72% recall for those type of questions after hearing only the story but 40% recall of the same questions after hearing the story and seeing (in this case) unuseful story information. This confusion, however, was more dramatic for the older adults than younger adults.

The significant interaction between question types and presentation condition required a new look at the performance of both age groups for different question types. In general, both groups benefited from redundantly available explicit information (E-E condition). This difference was well evidenced when Explicit Picture Presentation was compared with explicit redundantly available of story and picture information, 68% and 86% for Picture-Explicit and Story-Picture-Explicit, respectively. When Auditory-Explicit and Visual-Implicit information were available, subjects' correct recall was less than if Auditory-Implicit and visual-explicit was available. (Compare auditory-explicit--63% and visual-implicit--58% to auditory-implicit--81% and visual explicit--63%. The more natural mode of story telling may involve the concrete visual cues and the dialogue involves elaboration and extension of the theme. Both age groups' performance would support this idea.)

Knowledge

The dependent variable of knowledge as previously defined discounts the correct "I don't know" responses and considers what subjects produce as their knowledge. For example, for the dependent variable of correctness, if subjects in picture presentation condition were asked a question that was only available in story condition, they had to say "I don't know" in order to get credit. The dependent variable of knowledge disregards admission of no knowledge as a correct answer in order to tap only the admission of knowledge (correct or incorrect knowledge).

Surprisingly, no age main effect was observed. However, for this dependent variable, both young and older adults recalled more when verbal and pictorial information were redundantly available than in the other two presentation conditions. There was 79% recall of information available from both sources; 65% recall of the same information available only from the visual picture; 61% recall of some information available only from auditory version.

Both young and older adults were less confused in comparison with dependent variable of correctness by unuseful information whether seen or heard. For example, there was 80% recall for these type of questions after hearing only the story but 82% recall of the same questions after hearing the story and seeing (in this case) unuseful story information. These findings suggest that decrease of the correct recall in the dependent variable of correctness could have been caused by a subject's confusion between what she thought was not available and what was actually available but not recalled.

In general, the young subjects' overall recall of redundant explicitly available information (E-E) was better than those of the older adults, 94% and 86% for young and older adults, respectively. However, no difference was found between recall of young and older adults in redundant implicitly available information (I-I), 95% and 94% for older and young subjects, respectively. Nevertheless, older subjects' recall was found to be impaired for I-I questions in comparison to E-E question types, 86% and 95% for E-E and I-I, respectively.

Correct Knowledge

The dependent variable of correct knowledge as previously defined discounts the correct "I don't know" as well as incorrect knowledge. The dependent variable was selected in order to tap on the information that were recalled correctly from the provided "story" and "picture" information.

Young subjects' overall recall was significantly better than those of the older subjects, 73% and 69% for young and older subjects, respectively. Younger subjects benefit more from the redundant presentation of verbal and pictorial information, 78% and 65% for young and older subjects, respectively (see the results section for the statistical description of this effect). This superiority in recall of redundantly available information was consistent across all question types, except for I-I question type wherein old and young subjects performed equally, 94% and 96% correct recall for young and older subjects, respectively. Older adults' performance in all three presentation conditions was better in I-I questions than E-E question type.

Although young subjects' recall of redundantly explicit available information (E-E) was better than those of the older subjects, young and old subjects seem to have benefited proportionately the same. The young and the elderly adults' recall of picture and story condition were 92%, 86%, and 70%, 70%, respectively. For the redundant condition (SP), recall was 92% and 74% for young and older subjects, respectively.

Both age groups responded equally to the Explicit-Verbal (E,_) and Implicit-Pictorial (_,I) information, 70% and 60% for young and older adults, respectively. The elderly subjects recalled more Implicit-Verbal (I,_) and Explicit-Pictorial (_,E) information (when the information were not combined), than in the I-E combined condition, 80% and 78% for story-implicit and picture-explicit type of question, 58% for I-E question type. Although younger subjects' recall of story-implicit (I,_) and picture-explicit (_,E) information were less than of the older subjects, 74% and 68% respectively, the recall was significantly improved when these information were redundantly provided, 90% and 72%, respectively.

Basically, what seems to be happening is that younger subjects' greater recall in combined condition must have been caused by the verbal implicit information; since existence of this variable by itself (in single condition) did not show substantial increase of young subjects' recall, it seems to be logical to suggest that interaction between verbal-implicit and picture-explicit might have caused the observed differences.

Young subjects recalled more picture information in comparison to older subjects (in picture only condition). This superiority was evidenced in E-E questions, 92% and 70% for young and older subjects, respectively. However, both age groups performed equally in I-I question type, 90% and 94% for young and older subjects, respectively. The older subjects recall of story only information was slightly better than of the younger subjects, 71% and 64% for old and young subjects, respectively. The older subjects' recall of story information was slightly better than younger subjects in most question types, but in the E-E condition, younger subjects correctly recalled 86% and older subjects recalled 70%.

In general, young subjects' recall in most question types was significantly better than older subjects, except when information was implicitly provided in both story and picture. Hence, both young and older adults benefited from redundant implicit information. Yet, redundantly of the type of question was not cause of monotations of recall for young and older subjects since young subjects far exceeded the older subjects for redundantly explicit information.

General Conclusion & Implication

The present study was conducted to investigate possible age changes in the encoding strategies of adults when presented with verbal and pictorial information. The "deficit" in memory processing (encoding) of older adults may be related to poor use of imagery mediators when verbal information is also being encoded. On the basis of the obtained results, this hypothesis--that the elderly adults do not utilize imagery mediators--is confirmed. The older groups of subjects in comparison to the younger adults did not recall as much information that was explicit and susceptible to imagery mediations. When the older adults recalled explicitly available verbal information, they seemed less accurate than the younger adults. However, this observed deficit was significantly attenuated when the redundant pictorial information of the verbal information was imposed upon this group during stimulus presentation. Regarding these findings, there is the "deficit" with increasing age in memory-recall (cued recall) of the imagery related information, since older adults' memory of explicit imagery-related information did not improve even when an image was imposed. This "deficit" seemed attributable to a change in the memory encoding system. Hence, the developmental difference is attributable to shift in strategies during encoding rather than shifts in strategies during retrieval of information.

The second major hypothesis of this study (equivalent recall of non-imagery information for both young and older adults) was also confirmed. Throughout all the major dependent-variables of correctness, knowledge, and correct knowledge, age differences in recall of implicit information was found to be statistically nonsignificant. It is concluded that there is a distinction between encoding imagery-related information (explicit) and encoding non-imagery information (implcit) for older adults, since the older group of subjects in this study always recalled significantly more implicit information than explicit information. These distinctions are strategically sound for older adults presented with story or textual information. Older adults recalled more implicit information because they have not attended to the explicit information that was not essential for encoding and understanding of the gist of the story (Till & Walsh, 1980). We conceive of the elderly's memory system as a strategic system which efficiently attends to what is most beneficial for distilling the content of the given story information. This also suggests that the elderly adult's memorial system should function in such a way to first screen out the non-essential information and second, well encode the most essential information.

Results of this study (especially that there is better encoding of implicit information than explicit information) contradicts the developmental extension of Craik and Lockhart (1972) that hypothesized a depth of processing deficit. Craik and Tulving (1975) suggested that older adults are less able to perform "deep" mental operations, where "depth" is associated with "degree of semantic involvement." Encoding of implicit information is <u>at least</u> one step deeper than that necessary for explicit information. Encoding and comprehension of implicit information involves logical implication from given information. The older adults' recall of this type of information was "incidently" greater than of the more "surface" information.

In general, it seems that the elderly's encoding strategies have shifted in a functional way to insure equilibriation between what is to be encoded and what is judged to be essential and central. This type of memorial system is not as reliant on imagery strategies as the memory system of younger adults.

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APPENDIX A

Joe's Story

It was a rainy day. Joe put on his black hat and walked toward the hospital. It was only last year that he lost his wife in an airplane accident. Now all his thoughts were concentrated on how to earn money for his 10-year-old daughter's surgery because of lung cancer.

While he was crossing the street he was searching for a solution to his problem; he heard a frightening noise as a car approached him from the right side of the street. It was too late for Joe to do anything. The car hit him and Joe was thrown 4 feet into the air.

When Joe opened his eyes, he found himself in a room surrounded by light blue curtains. A young nurse with a striped hat was standing beside him, and his daughter's doctor, who was wearing a brown suit, walked in. The doctor turned toward Joe with a happy face and said "Joe, you will stay at the hospital for 5 days and your daughter is now healthy enough to take care of you," then he added "you know, Joe, doctors sometimes make mistakes in their diagnoses.

Appendix B

Table of Agreement's Percentage of Pilot Study

on Two Types of Explicit and Implicit Informations

Question #	Types of Info in 2 Conditions S P	Total of Ss 9 Agreed (P&S)	Total of Ss 8 Agreed (S)	Total of Ss 8 Agreed (P)	Total Percentage of Agreements
1	E - E	9	8	8	100%
2	I - I	8	8	8	96%
3	E - E	9	8	8	100%
4	E - I	9	7	7	92%
5	I - I	8	7	7	88%
6	E - I	8	7	7	88%
7	E - N	9	8	8	100%
8	I - N	9	8	8	100%
9	I - N	9	8	8	100%
10	E - N	8	8	8	96%
11	E - N	9	7	8	96%
12	N - E	9	8	8	100%
13	N - E	9	8	8	100%
14	I - E	8	7	7	88%
15	N - E	9	8	8	100%
16	E - E	9	8	8	100%
17	E - E	9	8	8	100%
18	E - I	8	7	6	84%
19	E - I	9	7	6	88%
20	I - I	9	7	7	92%
21	I - E	8	8	7	92%
22	N - I	9	8	8	100%
23	N - I	8	7	8	92%
24	I - N	8	6	6	80%
25	N - I	9	7	8	96%
26	N - I	8	7	8	92%
27	E - E	9	8	8	100%
28	N - N	9	8	8	100%
29	I - E	8	8	8	96%
30	N - E	8	7	8	92%

Appendix B

Page 2

Question #	Types of Info in 2 Conditions S P	Total of Se 9 Agreed (P&S)	Total of Ss 8 Agreed (S)	Total of Ss 8 Agreed (P)	Total Percentage of Agreements
31	N - E	9	8	8	100%
32	I - E	8	7	7	88%
33	I - I	8	7	7	88%
34	E - N	9	8	8	100%
35	N - I	8	8	8	96%
36	E - I	7	8	6	84%
37	I - I	7	7	6	80%
38	N - N	9	8	8	100%
39	N - N	9	8	8	100%
40	E - N	9	8	8	100%
41	I - N	9	7	7	92%
42	I - E	8	7	7	88%
43	I - N	7	8	7	80%
44	N - N	9	8	8	100%
45	N - N	9	8	8	100%

Appendix C

		S	P	Acceptable Answers
1.	How was the weather on the day of the accident?	E	E	rainy, showers
2.	How cold was the weather on the day of the accident?	I	I	pretty cold, not too cold
3.	What color was the man's (Joe's) hat?	E	E	black, gray, brown
4.	Where was the man (Joe) going when he crossed the street?	E	I	to the hospital, across the street, to work
5.	Was Joe sad when he was crossing the street?	I	I	yes he was, no he was not, (anything in between)
6.	What was he thinking about when he crossed the street?	E	I	his daughter's surgery, his financial status, someone in the hospital
7.	How did Joe (man) lose his wife?	E	N	in an accident, airplane crash
8.	What was Joe's (man's) financial status?	I	N	not too good, not good, bad, don't know
9.	How old was Joe's (man's) daughter when she lost her mom?	I	N	9 years, don't know
10.	How old was Joe's daughter?	E	N	10 years, don't know
11.	What was the original diagnosis of Joe's (man's) daughter's illness?	E	N	lung cancer, don't know
12.	How many people were in the street or sidewalks?	N	E	don't know, between 6 and 8
13.	How many cars were in the street?	N	E	don't know, between 2 and 3
14.	What parts of Joe's (man's) body were injured?	I	E	his legs, hands, face, he had some broken bones
15.	What color was the vehicle parked in front of the hospital?	N	E	don't know, white
16.	What happened to the man (Joe) when he was crossing the street?	E	E	he was hit by a car (car description)
17.	From which side did the vehicle approach him?	E	E	right side, right side of him, or street
18.	What did the man (Joe) do when he saw the approaching car?	E	I	he did nothing, he had no time to do anything, he screamed
19.	How far was Joe (man) thrown into the air?	E	I	4 feet, about 10 feet, not too high
20.	What happened to the man (Joe) after the accident?	I	I	he was taken to a hospital, emergency room

APPENDIX B

		S	P	Acceptable Answers
21.	How far was the hospital from the place of the accident?	I	E	very close, across the street
22.	How big was the town?	N	I	don't know, any size indication
23.	What time of the day did the accident occur?	N	I	don't know, any time indication
24.	What hospital was Joe (man) taken to after the accident?	I	N	the same hospital as his daughter was in, don't know
25.	How many people saw the accident?	N	I	don't know, between 6 and 8
26.	How old was Joe (man)?	N	I	don't know, about 35-45
27.	What color was the hospital room's curtain?	E	E	light blue, blue
28.	How long was Joe (man) unconscious when he was hit by the car?	N	N	don't know
29.	What color was Joe's (man's) suit?	I	E	gray, black, brown
30.	What medical equipment was available to Joe (man) when he was in the hospital?	N	E	don't know, bed, pills
31.	What color was the car that hit Joe (man)?	N	E	don't know, orange, red
32.	Where did the accident occur?	I	E	very close to the hospital, on his way to the hospital, in the intersection across from the hospital
33.	Was Joe's (man's) life in danger when he was hit by the car?	I	I	it was, it was not really, somewhat
34.	How old was the nurse?	E	N	very young, young, don't know
35.	How old was the doctor?	N	I	don't know, about 40-50
36.	Why was the doctor happy?	E	I	he knew that Joe's daughter is healthy and Joe was O.K. because the accident was not very serious
37.	Was Joe seriously injured?	I	I	yes he was, no he was not
38.	What did Joe (man) do the day before the accident?	N	N	don't know
39.	When did Joe (man) sell his car?	N	N	don't know
40.	How long did the doctor say Joe needed to stay in the hospital?	N	N	for 5 days, don't know
41.	Was the doctor's message good to Joe (man) about his daughter?	E	N	yes it was, don't know

APPENDIX C

		S	P	Acceptable Answers
42.	Was the doctor smiling at Joe (man)?	I	E	yes he was, yes he was smiling
43.	Were the doctors accurate in their diagnoses?	I	N	no they were not
44.	How much did they charge Joe (man) to stay in the hospital?	N	N	don't know
45.	Who did the doctor call after the accident?	N	N	don't know

APPENDIX D

Group Y O
Code #
Date of birth
Education Un Gr
Readung Habit Always Sometimes Don't Usually
Type of Job

AN-A Sc
AN-B Sc
HE Sc

Question #	Subject Response	Confidence level
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
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27		
28		
29		
30		
31		
32		
33		

Page 2 Data

Code #

APPENDIX D

Question#	Subject's Response	Confidence level
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		

APPENDIX D

IMAGERY TASK

Code #

Total

Average

Read the following words and try to develop an image of each one. Use score of 1(low image) through 7 (high image) to demonstrate your image formation associated with these words

Words	Low 1	2	3	4	5	6	High 7
1-Replacement							
2-Abasement							
3-Headlight							
4-Air							
5-Exertion							
6-Hint							
7-Equity							
8-Madness							
9-Banality							
10-Toast							
11-Candy							
12-Pledge							
13-Unit							
14-Macaroni							
15-Speech							
16-Newspaper							
17-Winter							
18-Amount							
19-Disconnection							
20-Forest							
21-Position							
22-Freedom							
23-Heaven							
24-Suppression							
25-Corn							
26-Fact							
27-Reaction							
28-Child							
29-Velocity							
30-Chance							
31-Accordion							
32-Elephant							
33-Investigation							
34-Shotgun							
35-Orchestra							
36-Gender							
37-Bereavement							
38-Contract							
39-Origin							
40-Potato							
41-Deduction							
42-Moment							
43-Village							
44-Obsession							
45-Session							

Total

Average

Rank

APPENDIX E

ANOVA TABLE "CORRECTNESS"

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	F-RATIO	PROB
AGE	1	0.6000	0.6000	16.7818**	0.00032
PRESENTATION	2	0.2804	0.1402	3.9220*	0.02498
AGE X PRESENTATION	2	0.5071	0.2536	7.0919**	0.00220
Ss X AGE X PRESENT	54	1.9307	0.0358		
QYESTION TYPE	8	8.9120	1.1140	32.5932**	0.0000
QUESTION TYPE X AGE	8	0.3680	0.0460	1.3459	0.2180
QUESTION TYPE X PRES	16	3.8556	0.2410	7.0503**	0.0002
QUESTION X PRESENT X AGE	16	0.7569	0.0473	1.3841	0.1448
Ss X QUESTION X PRESENT X AGE	432	14.7653	0.0342		

**SIGNIFICANT PROB LESS THAN 0.01

*SIGNIFICANT PROB LESS THAN 0.05

APPENDIX E

ANOVA TABLE " KNOWLEDGE"

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	F-RATIO	PROB
AGE	1	0.0214	0.0214	0.4879	0.50518
PRESENTATION	2	2.9991	1.4996	34.1767**	0.00001
AGE X PRESENTATION	2	0.2441	0.1221	2.7822	0.06910
Ss X AGE X PRESENT	54	2.3693	0.0439		
QUESTION TYPE	8	32.0427	4.0053	145.7139**	0.000000
QUESTION X AGE	8	0.4433	0.0554	2.0157*	0.042790
QUESTION X PRESENT	16	1.2675	0.0792	2.8821**	0.00031
QUESTION X PRESENT X AGE	16	15.0652	0.9416	32.2544**	0.00000
Ss X QUESTION X AGE X PRESENT	432	11.8747	0.0275		

**SIGNIFICANT PROB LESS THAN 0.01

*SIGNIFICANT PROB LESS THAN 0.05

APPENDIX E

ANOVA TABLE " CORRECT KNOWLEDGE"

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F-RATIO	PROB
AGE	1	0.1323	0.1323	2.3809	0.12483
PRESENTATION CONDITION	2	0.4084	0.2042	3.6761*	0.03094
AGE X PRESENTATION	2	0.5982	0.2991	5.3844**	0.00754
Ss X AGE X PRESENTATION	54	2.9995	0.0555		
QUESTION TYPE	5	6.1475	1.2295	36.5539**	0.0000
QUESTION X AGE	5	0.8346	0.1669	4.9626**	0.0042
QUESTION X PRESENTATION	10	1.3399	0.1340	3.9338**	0.0012
QUESTION X PRESENTATION X AGE	10	1.1515	0.1151	3.4235**	0.0050
Ss X QUESTION X AGE X PRESENTATION	270	9.0815	0.0336		

**SIGNIFICANT PROB LESS THAN 0.01

*SIGNIFICANT PROB LESS THAN 0.05

Appendix E

Table 4

Single Effect Analysis of Significant Effects for Correctness Variable

Story Presentation

Taped story (74%) VS Story & Picture (70%) F (1,38)= 3.00, $p < .05$

Picture (75%) VS Story & Picture (70%) F (1,38)= 3.02, $p < .05$

Age x Presentation condition

Old:

Taped story (69%) VS Picture (75%) F (1,18)= 4,56, $p < .05$

Picture (75%) VS Story & Picture(64%) F (1,18)=4.98, $p < .05$

Young:

Taped story (80%) VS Picture (73%) F (1,18)= 2.51, $p < .05$

Taped Story:

Old (69%) VS Young (80%) F (1,18)= 5.56 $p = < .01$

Story & Picture:

Old (64%) VS Young (75%) F (1,18) = 3.21,$p = < .05$

APPENDIX F

YOUNG SUBJECTS

STORY & PICTURE

D.V. Knowledge

PAGE 1

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	1.00	1.00	0.80	1.00	1.00	1.00	0.80	1.00	0.00	0.84444	0.32830
2:	1.00	1.00	1.00	0.80	1.00	1.00	0.80	0.80	0.40	0.84667	0.20000
3:	0.80	1.00	0.60	1.00	1.00	0.80	1.00	1.00	0.20	0.82222	0.27285
4:	1.00	0.80	0.60	1.00	1.00	0.80	1.00	1.00	0.20	0.82222	0.27285
5:	1.00	0.80	0.60	1.00	1.00	0.60	1.00	1.00	0.20	0.80000	0.28284
6:	1.00	0.60	0.60	1.00	1.00	0.60	1.00	0.80	0.00	0.73333	0.33166
7:	1.00	0.60	0.80	1.00	0.80	0.80	0.60	1.00	0.00	0.73333	0.31623
8:	1.00	1.00	0.60	1.00	1.00	1.00	0.60	1.00	0.00	0.80000	0.34641
9:	1.00	1.00	0.80	1.00	1.00	0.80	1.00	0.60	0.40	0.84444	0.21858
10:	1.00	0.60	1.00	0.80	1.00	1.00	0.60	0.80	0.20	0.77778	0.27285
COL. MEANS:	0.98000	0.84000	0.74000	0.96000	0.98000	0.84000	0.84000	0.90000	0.14000		
STD. DEV.:	0.06325	0.18379	0.16465	0.08433	0.06325	0.15776	0.18379	0.14142	0.15776		

APPENDIX F

YOUNG SUBJECTS

PICTURE

D.V. KNOWLEDGE

PAGE 2

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	1.00	0.08	0.06	1.00	1.00	0.06	1.00	1.00	0.02	0.58000	0.49830
2:	0.08	0.08	0.00	1.00	1.00	0.04	1.00	1.00	0.00	0.46667	0.50675
3:	1.00	0.06	0.02	1.00	1.00	0.04	1.00	1.00	0.00	0.56889	0.51140
4:	0.08	0.02	0.00	0.08	0.06	0.02	1.00	0.04	0.00	0.14444	0.32230
5:	0.06	1.00	0.00	0.08	1.00	0.04	0.08	1.00	0.00	0.36222	0.47921
6:	1.00	0.08	0.02	0.08	1.00	0.06	1.00	1.00	0.00	0.47111	0.50241
7:	0.08	0.06	0.04	0.08	1.00	0.02	1.00	1.00	0.00	0.36444	0.47737
8:	1.00	0.06	0.02	1.00	1.00	0.04	1.00	0.04	0.02	0.46444	0.50821
9:	1.00	0.06	0.02	0.08	0.08	0.04	1.00	1.00	0.00	0.36444	0.47737
10:	1.00	0.04	0.02	0.08	0.08	0.00	1.00	0.04	0.00	0.25111	0.42557
COL. MEANS:	0.63000	0.15400	0.02000	0.44800	0.72200	0.03600	0.90800	0.71200	0.00400		
STD. DEV.:	0.47770	0.29785	0.01886	0.47509	0.44766	0.01838	0.29093	0.46372	0.00843		

APPENDIX F

OLD SUBJECTS

PICTURE

D.V KNOWLEDGE

PAGE 3

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0.80	0.80	0.20	0.80	0.80	0.60	0.80	0.40	0.00	0.57778	0.30732
2:	1.00	1.00	0.00	1.00	1.00	0.60	1.00	1.00	0.20	0.75556	0.39721
3:	0.80	1.00	0.20	1.00	1.00	0.20	1.00	1.00	0.20	0.71111	0.38873
4:	0.60	1.00	0.20	1.00	1.00	0.20	1.00	1.00	0.00	0.66667	0.42426
5:	1.00	1.00	0.60	0.80	1.00	0.20	1.00	1.00	0.20	0.75556	0.34319
6:	0.80	0.80	0.20	1.00	1.00	0.20	1.00	0.80	0.00	0.64444	0.39721
7:	0.40	0.80	0.00	1.00	1.00	0.40	1.00	1.00	0.00	0.62222	0.42947
8:	1.00	0.80	0.00	0.80	1.00	0.40	1.00	0.80	0.00	0.64444	0.40961
9:	1.00	1.00	0.20	0.80	1.00	0.00	1.00	1.00	0.00	0.66667	0.45826
10:	1.00	1.00	0.40	1.00	1.00	0.20	1.00	1.00	0.20	0.75556	0.37118
COL MEANS:	0.84000	0.92000	0.20000	0.92000	0.98000	0.30000	0.98000	0.90000	0.08000		
STD. DEV.:	0.20656	0.10328	0.18856	0.10328	0.06325	0.19437	0.06325	0.19436	0.10328		

APPENDIX F

OLD SUBJECTS

STORY

D.V KNOWLEDGE

PAGE 4

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0.80	1.00	0.80	0.80	1.00	0.80	0.40	0.00	0.20	0.66667	0.34641
2:	1.00	1.00	0.80	0.20	1.00	0.80	0.40	0.60	0.00	0.64444	0.37118
3:	1.00	1.00	0.60	0.80	1.00	1.00	0.00	0.20	0.00	0.62222	0.44096
4:	0.80	1.00	0.60	0.60	0.80	1.00	0.40	0.00	0.00	0.57778	0.38006
5:	0.80	0.60	0.20	1.00	1.00	0.60	0.00	0.40	0.00	0.51111	0.39873
6:	1.00	0.80	0.80	0.80	1.00	0.80	0.40	0.00	0.00	0.62222	0.39299
7:	0.20	0.60	0.60	0.80	0.80	1.00	0.00	0.80	0.00	0.53333	0.37417
8:	1.00	0.60	1.00	0.60	1.00	0.80	0.20	0.80	0.00	0.66667	0.36055
9:	0.80	1.00	0.20	0.60	1.00	0.80	0.00	0.40	0.00	0.53333	0.40000
10:	0.60	0.80	0.60	0.80	1.00	0.60	0.00	0.20	0.00	0.51111	0.36209
COL MEANS:	0.80000	0.84000	0.62000	0.70000	0.96000	0.82000	0.20000	0.34000	0.02000		
STD. DEV.:	0.24944	0.18379	0.25734	0.21602	0.08433	0.14757	0.23094	0.31340	0.06325		

APPENDIX F

OLD SUBJECTS

STORY & PICTURE
D.V. KNOWLEDGE

PAGE 5

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	1.00	0.60	1.00	0.40	0.80	0.80	0.80	0.20	0.20	0.64444	0.31269
2:	1.00	1.00	0.60	0.80	0.80	0.60	1.00	0.80	0.00	0.73333	0.31623
3:	1.00	1.00	0.20	0.80	1.00	0.60	1.00	0.80	0.00	0.71111	0.37565
4:	0.80	1.00	0.40	0.80	0.80	1.00	0.60	0.40	0.00	0.64444	0.32830
5:	1.00	1.00	0.40	0.80	1.00	0.60	1.00	1.00	0.20	0.77778	0.30732
6:	0.80	0.80	0.40	1.00	0.80	0.80	1.00	1.00	0.20	0.75556	0.27889
7:	0.80	0.80	0.80	1.00	1.00	1.00	1.00	0.80	0.20	0.82222	0.25386
8:	1.00	0.80	0.60	1.00	1.00	1.00	1.00	0.60	0.20	0.80000	0.28284
9:	1.00	0.60	0.60	1.00	1.00	0.80	0.80	1.00	0.40	0.80000	0.22361
10:	1.00	0.80	0.80	1.00	1.00	0.80	1.00	1.00	0.00	0.82222	0.32318
COL MEANS:	0.94000	0.84000	0.58000	0.86000	0.92000	0.80000	0.92000	0.76000	0.14000		
STD. DEV.:	0.09661	0.15776	0.23944	0.18974	0.10328	0.16330	0.13984	0.27968	0.13499		

APPENDIX F

YOUNG SUBJECTS

STORY

D.V. KNOWLEDGE

PAGE 6

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	1.00	0.06	0.08	0.06	0.06	1.00	0.02	0.02	0.00	0.25556	0.42282
2:	1.00	0.08	0.06	1.00	1.00	1.00	0.04	0.02	0.02	0.46889	0.50419
3:	0.08	0.08	0.06	0.08	1.00	1.00	0.02	0.00	0.00	0.25778	0.42207
4:	1.00	1.00	0.06	0.08	1.00	0.08	0.04	0.02	0.00	0.36444	0.47737
5:	1.00	1.00	0.08	0.06	0.08	1.00	0.02	0.08	0.00	0.36889	0.47414
6:	0.08	0.06	0.08	0.06	0.08	0.08	0.00	0.00	0.00	0.04889	0.03756
7:	1.00	1.00	1.00	0.06	1.00	1.00	0.02	0.06	0.00	0.57111	0.50893
8:	1.00	0.08	0.08	0.06	1.00	1.00	0.04	0.04	0.00	0.36667	0.47560
9:	1.00	0.08	0.08	0.08	1.00	1.00	0.00	0.06	0.00	0.36667	0.47603
10:	1.00	1.00	0.08	0.08	1.00	1.00	0.02	0.00	0.00	0.46444	0.50890
COL MEANS:	0.81600	0.44400	0.16600	0.16200	0.72200	0.81600	0.02200	0.03000	0.00200		
STD. DEV.:	0.38791	0.47859	0.29319	0.29461	0.44746	0.38791	0.01476	0.02867	0.00632		

APPENDIX F

OLD SUBJECTS

STORY & PICTURE

D.V. KNOWLEDGE

PAGE 7

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	Mean	S:DEV
1:	1.00	0.60	0.60	0.20	0.80	0.60	0.40	0.20	0.55000	0.27775
2:	1.00	0.20	0.60	0.80	0.80	0.40	0.80	0.60	0.65000	0.25635
3:	0.80	0.40	0.20	0.60	1.00	0.60	0.60	0.80	0.62500	0.24928
4:	0.60	0.80	0.40	0.80	0.80	0.60	0.20	0.00	0.52500	0.30119
5:	1.00	0.00	0.00	0.40	1.00	0.20	0.60	0.80	0.50000	0.41404
6:	0.80	0.80	0.20	1.00	0.80	0.60	0.20	0.80	0.65000	0.29761
7:	0.80	0.60	0.20	1.00	1.00	0.80	0.60	0.80	0.72500	0.26049
8:	0.60	0.60	0.40	0.80	1.00	0.60	0.20	0.60	0.60000	0.23905
9:	1.00	0.40	0.20	1.00	1.00	0.60	0.20	0.80	0.65000	0.35051
10:	0.80	0.40	0.20	0.80	1.00	0.40	0.60	0.80	0.62500	0.27124
COL MEANS:	0.84000	0.48000	0.30000	0.74000	0.92000	0.54000	0.44000	0.62000		
STD. DEV.:	0.15776	0.25298	0.19437	0.26750	0.10328	0.16465	0.22706	0.28983		

APPENDIX F

YOUNG SUBJECTS

STORY & PICTURE

D.V. KNOWLEDGE PAGE 8

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	Mean	S.DEV
1:	1.00	1.00	0.60	1.00	0.80	1.00	0.20	0.80	0.80000	0.28284
2:	1.00	1.00	0.60	0.80	0.80	0.80	0.60	0.60	0.77500	0.16690
3:	0.80	1.00	0.20	0.80	1.00	0.60	0.40	0.80	0.70000	0.28284
4:	0.80	0.80	0.40	1.00	1.00	0.60	0.80	0.80	0.80000	0.15119
5:	1.00	0.60	0.40	0.80	1.00	0.20	0.60	0.80	0.67500	0.28158
6:	0.80	0.60	0.20	0.80	1.00	0.60	0.60	0.60	0.65000	0.23299
7:	1.00	0.60	0.40	1.00	0.80	0.80	0.40	0.80	0.72500	0.23755
8:	0.80	0.60	0.20	1.00	1.00	0.80	0.20	0.80	0.67500	0.31960
9:	1.00	0.60	0.40	1.00	1.00	0.80	0.80	0.40	0.75000	0.25635
10:	1.00	0.60	1.00	0.80	1.00	1.00	0.60	0.80	0.85000	0.17728
COL MEANS:	0.92000	0.74000	0.46000	0.90000	0.94000	0.72000	0.52000	0.72000		
STD. DEV.:	0.10328	0.18974	0.25033	0.10541	0.09661	0.23476	0.21499	0.13984		

APPENDIX F

YOUNG SUBJECTS

PICTURE

D.V. CORRECT KNOWLEDGE

ROW	E-F	E-I	E-N	I-E	I-I	I-N	MEAN	S.DEV
1:	0.80	0.80	1.00	1.00	0.80	0.80	0.86667	0.10328
2:	0.60	0.40	1.00	1.00	1.00	0.20	0.70000	0.35214
3:	0.60	0.60	0.80	1.00	0.80	0.80	0.76667	0.15055
4:	0.60	0.00	0.80	0.60	0.60	0.20	0.46667	0.30111
5:	0.60	0.40	0.40	1.00	0.40	0.80	0.60000	0.25298
6:	0.80	0.60	0.80	1.00	0.80	0.80	0.80000	0.12649
7:	0.40	0.60	0.80	1.00	0.80	1.00	0.80000	0.17889
8:	0.80	0.60	1.00	1.00	1.00	0.20	0.76667	0.32042
9:	1.00	0.60	0.60	0.60	0.80	0.80	0.73333	0.16330
10:	0.60	0.40	0.80	0.80	1.00	0.00	0.60000	0.35777
COL MEANS:	0.70000	0.50000	0.80000	0.90000	0.80000	0.56000		
STD. DEV.:	0.14142	0.21602	0.18856	0.16997	0.18856	0.36271		

APPENDIX G

YOUNG SUBJECTS

STORY

D.V. CORRECT KNOWLEDGE   PAGE 10

ROW	F-F	F-I	E-N	I-E	I-I	I-N	MEAN	S.DEV
1:	1.00	0.60	0.80	0.40	0.60	1.00	0.73333	0.24221
2:	1.00	0.60	0.40	1.00	1.00	1.00	0.83333	0.26583
3:	0.80	0.80	0.40	0.60	1.00	1.00	0.76667	0.23381
4:	1.00	0.80	0.60	0.80	1.00	0.80	0.83333	0.15055
5:	1.00	1.00	0.40	0.60	0.60	0.80	0.73333	0.24221
6:	0.60	0.40	0.60	0.60	0.80	0.60	0.60000	0.12649
7:	1.00	0.80	0.80	0.60	1.00	1.00	0.86667	0.16330
8:	0.80	0.80	0.60	0.60	1.00	1.00	0.80000	0.17889
9:	1.00	0.60	0.60	0.80	1.00	0.60	0.76667	0.19664
10:	1.00	1.00	0.80	0.80	1.00	1.00	0.93333	0.10328
COL MEANS:	0.92000	0.74000	0.60000	0.68000	0.90000	0.88000		
STD. DEV.:	0.13984	0.18974	0.16330	0.16865	0.16997	0.16865		

APPENDIX F

OLD SUBJECTS

PICTURE

D.V CORRECT KNOWLEDGE PAGE 11

ROW	E-E	E-I	E-N	I-E	I-I	I-N	MEAN	S.DEV
1:	0.80	0.60	0.80	0.80	0.40	0.20	0.60000	0.25298
2:	0.80	0.80	0.80	1.00	0.80	0.80	0.83333	0.08165
3:	0.60	0.60	1.00	0.80	0.60	0.60	0.70000	0.16733
4:	0.60	0.60	1.00	1.00	0.60	0.80	0.76667	0.19664
5:	0.60	0.60	0.60	0.80	0.60	0.40	0.60000	0.12649
6:	0.60	0.80	0.80	1.00	1.00	0.80	0.83333	0.15055
7:	0.80	0.60	1.00	1.00	0.40	0.80	0.76667	0.23381
8:	0.80	0.80	0.80	1.00	0.60	0.80	0.80000	0.12649
9:	0.60	0.60	0.40	1.00	0.60	0.80	0.66667	0.20656
10:	0.80	0.60	0.60	1.00	0.40	0.60	0.66667	0.20656
COL MEANS:	0.70000	0.66000	0.78000	0.94000	0.60000	0.66000		
STD. DEV.:	0.10541	0.09661	0.19889	0.09661	0.18856	0.21187		

APPENDIX F

OLD SUBJECTS

STORY

D.V. CORRECT KNOWLEDGE PAGE 12

ROW	E-E	E-I	E-N	I-E	I-I	I-N	MEAN	S.DEV
1:	0.80	1.00	0.40	0.40	1.00	0.60	0.70000	0.27568
2:	1.00	0.80	0.60	0.20	1.00	0.80	0.73333	0.30111
3:	0.80	1.00	0.40	0.60	1.00	1.00	0.80000	0.25298
4:	0.80	1.00	0.40	0.60	0.80	0.80	0.73333	0.20656
5:	0.60	0.20	0.20	0.80	1.00	0.40	0.53333	0.32660
6:	1.00	0.40	0.40	0.60	1.00	0.40	0.63333	0.29439
7:	0.20	0.40	0.00	0.80	0.80	0.60	0.46667	0.32660
8:	1.00	0.20	0.80	0.60	1.00	0.60	0.70000	0.30331
9:	0.60	1.00	0.00	0.60	1.00	0.60	0.63333	0.36697
10:	0.60	0.60	0.20	0.60	1.00	0.60	0.60000	0.25298
COL MEANS:	0.74000	0.66000	0.34000	0.58000	0.96000	0.64000		
STD. DEV.:	0.25033	0.34059	0.25033	0.17512	0.08433	0.18379		

APPENDIX F

INCORRECT RESPONSES -- CONDITION PICTURE & STORY -- YOUNG

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0	0	2	0	1	1	1	1	2	0.88889	0.78174
2:	0	0	2	1	0	1	3	1	1	1.00000	1.00000
3:	1	0	0	0	0	1	1	1	1	0.55556	0.52705
4:	0	1	2	1	0	2	2	1	1	1.11111	0.78174
5:	1	0	3	1	0	0	2	1	0	0.88889	1.05409
6:	0	0	2	0	0	0	1	1	0	0.44444	0.72648
7:	1	2	2	0	0	1	2	1	0	1.00000	0.86603
8:	0	2	2	0	0	0	1	1	2	0.88889	0.92796
9:	0	0	0	0	0	0	0	0	0	0.00000	0.00000
10:	1	0	2	0	0	2	1	1	1	0.88889	0.78174
COL MEANS:	0.40000	0.50000	1.70000	0.30000	0.10000	0.80000	1.40000	0.90000	0.80000		
STD. DEV.:	0.51640	0.84984	0.94868	0.48305	0.31623	0.78881	0.84327	0.31623	0.78881		

APPENDIX F

INCORRECT RESPONSES -- CONDITION STORY -- OLD

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0	0	2	2	0	1	3	0	1	1.00000	1.11803
2:	0	1	1	1	0	0	1	3	0	0.77778	0.97183
3:	1	0	1	1	0	0	0	1	0	0.44444	0.52705
4:	1	0	1	0	0	1	2	0	0	0.55556	0.72648
5:	1	2	0	1	0	1	0	2	0	0.77778	0.83333
6:	0	2	2	1	0	1	2	0	0	0.88889	0.92796
7:	0	1	3	0	0	2	0	0	2	0.88889	1.16667
8:	0	2	1	0	0	1	0	0	0	0.44444	0.72648
9:	1	0	1	0	0	1	0	0	0	0.33333	0.50000
10:	0	1	2	1	0	0	0	1	0	0.55556	0.72648
COL MEANS:	0.40000	0.90000	1.40000	0.70000	0.00000	0.80000	0.80000	0.70000	0.30000		
STD. DEV.:	0.51640	0.87560	0.84327	0.67495	0.00000	0.63246	1.13529	1.05935	0.67495		

APPENDIX F

INCORRECT RESPONSES -- CONDITION STORY -- YOUNG

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0	0	0	0	0	0	1	1	0	0.22222	0.44096
2:	0	1	0	0	0	0	2	1	1	0.55556	0.72648
3:	0	0	1	1	0	0	1	0	0	0.33333	0.50000
4:	0	1	0	0	0	0	2	1	0	0.44444	0.72648
5:	0	0	2	0	1	1	1	3	0	0.88889	1.05409
6:	1	0	1	0	0	1	0	0	0	0.33333	0.50000
7:	0	1	1	0	0	0	1	2	0	0.55556	0.72648
8:	1	0	1	0	0	0	2	1	0	0.55556	0.72648
9:	0	1	1	0	0	2	0	0	0	0.44444	0.72648
10:	0	0	0	0	0	0	0	0	0	0.00000	0.00000
COL MEANS:	0.20000	0.40000	0.70000	0.10000	0.10000	0.40000	1.00000	0.90000	0.10000		
STD. DEV.:	0.42164	0.51640	0.67495	0.31623	0.31623	0.69921	0.81650	0.99443	0.31623		

APPENDIX F

INCORRECT RESPONSES -- CONDITION PICTURE -- OLD

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0	1	1	0	0	2	2	1	0	0.77778	0.83333
2:	1	1	0	1	0	2	1	1	1	0.88889	0.60093
3:	1	2	1	0	1	1	2	2	1	1.22222	0.66667
4:	0	2	1	0	0	0	2	1	0	0.66667	0.86603
5:	2	2	3	1	1	1	2	3	1	1.77778	0.83333
6:	1	0	1	1	0	0	0	0	0	0.33333	0.50000
7:	1	1	0	0	0	1	3	1	0	0.77778	0.97183
8:	1	0	0	0	0	2	2	0	0	0.55556	0.88192
9:	2	2	0	2	0	0	2	1	0	1.00000	1.00000
10:	1	2	2	2	0	0	3	2	1	1.44444	1.01379
COL MEANS:	1.00000	1.30000	0.90000	0.70000	0.20000	0.90000	1.90000	1.20000	0.40000		
STD. DEV.:	0.66667	0.82327	0.99443	0.82327	0.42164	0.87560	0.87560	0.91894	0.51640		

APPENDIX F

INCORRECT RESPONSES -- CONDITION PICTURE -- YOUNG

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	2	0	1	1	0	2	1	1	0	0.88889	0.78174
2:	1	1	0	0	0	0	2	1	0	0.55556	0.72648
3:	0	3	0	0	0	2	2	1	0	0.88889	1.16667
4:	1	1	0	0	0	2	1	1	0	0.66667	0.70711
5:	1	0	2	0	0	0	1	0	0	0.44444	0.72648
6:	1	0	1	0	0	1	0	1	1	0.55556	0.52705
7:	0	0	0	1	1	2	1	2	0	0.77778	0.83333
8:	2	0	0	0	0	0	0	2	0	0.44444	0.88192
9:	2	2	0	0	0	0	0	4	0	0.88889	1.45297
10:	1	0	2	0	0	2	1	1	1	0.88889	0.78174
COL MEANS:	1.10000	0.70000	0.60000	0.20000	0.10000	1.10000	0.90000	1.40000	0.20000		
STD. DEV.:	0.73786	1.05935	0.84327	0.42164	0.31623	0.99443	0.73786	1.07497	0.42164		

APPENDIX F

INCORRECT RESPONSES -- CONDITION STORY & PICTURE -- OLD

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0	0	2	1	0	1	2	0	1	0.77778	0.83333
2:	0	3	0	1	0	1	1	1	0	0.77778	0.97183
3:	1	3	1	1	0	0	2	0	0	0.88889	1.05409
4:	1	1	0	0	0	2	2	2	0	0.88889	0.92796
5:	0	5	2	2	0	2	2	1	1	1.66667	1.50000
6:	0	1	1	0	0	1	4	1	1	1.00000	1.22474
7:	0	1	3	0	0	1	2	0	1	0.88889	1.05409
8:	2	2	0	1	0	2	4	0	0	1.22222	1.39443
9:	0	1	2	0	0	1	3	1	2	1.11111	1.05409
10:	1	2	3	1	0	2	2	1	0	1.33333	1.00000
COL MEANS:	0.50000	1.90000	1.40000	0.70000	0.00000	1.30000	2.40000	0.70000	0.60000		
STD. DEV.:	0.70711	1.44914	1.17379	0.67495	0.00000	0.67495	0.96609	0.67495	0.69921		

APPENDIX F

INCORRECT I DON"T KNOW

Age: old

Presentation Condition: Picture & Story

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0.00	2.00	0.00	3.00	1.00	1.00	1.00	4.00	0.00	1.33333	1.41421
2:	0.00	0.00	2.00	0.00	1.00	2.00	0.00	1.00	0.00	0.66667	0.86603
3:	0.00	0.00	3.00	1.00	0.00	2.00	0.00	1.00	0.00	0.77778	1.09291
4:	1.00	0.00	3.00	1.00	1.00	0.00	2.00	3.00	0.00	1.22222	1.20185
5:	0.00	0.00	3.00	1.00	0.00	2.00	0.00	0.00	0.00	0.66667	1.11803
6:	1.00	0.00	3.00	0.00	1.00	1.00	0.00	0.00	0.00	0.66667	1.00000
7:	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.44444	0.52705
8:	0.00	0.00	3.00	0.00	0.00	0.00	0.00	2.00	0.00	0.55556	1.13039
9:	0.00	2.00	2.00	0.00	0.00	1.00	1.00	0.00	0.00	0.66667	0.86603
10:	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33333	0.50000
COL MEANS:	0.30000	0.60000	2.10000	0.60000	0.40000	1.00000	0.40000	1.20000	0.00000	0.73333	
STD. DEV.:	0.48305	0.84327	1.10050	0.96609	0.51640	0.81650	0.69921	1.39841	0.00000		1.00337

APPENDIX F

INCORRECT I DON'T KNOW

Age: old

Presentation Condition: Story

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	1.00	0.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00	0.44444	0.52705
2:	0.00	0.00	1.00	3.00	0.00	1.00	0.00	0.00	0.00	0.55556	1.01379
3:	0.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.33333	0.70711
4:	0.00	0.00	2.00	2.00	1.00	0.00	0.00	0.00	0.00	0.55556	0.88192
5:	1.00	2.00	4.00	0.00	0.00	2.00	0.00	0.00	0.00	1.00000	1.41421
6:	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.33333	0.50000
7:	4.00	2.00	2.00	1.00	1.00	0.00	0.00	0.00	0.00	1.11111	1.36423
8:	0.00	2.00	0.00	2.00	0.00	1.00	0.00	0.00	0.00	0.55556	0.88192
9:	1.00	0.00	4.00	2.00	0.00	1.00	0.00	0.00	0.00	0.88889	1.36423
10:	2.00	1.00	2.00	1.00	0.00	2.00	0.00	0.00	0.00	0.88889	0.92796
COL MEANS:	0.90000	0.80000	1.90000	1.40000	0.20000	0.80000	0.00000	0.00000	0.00000	0.66667	
STD. DEV.:	1.28668	0.91894	1.28668	0.84327	0.42164	0.78881	0.00000	0.00000	0.00000		0.99437

APPENDIX F

INCORRECT I DON"T KNOW

Age: old

Presentation Condition: Picture

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	3.00	0.00	0.88889	0.92796
2:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00000
3:	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11111	0.33333
4:	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22222	0.66667
5:	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.11111	0.33333
6:	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.33333	0.50000
7:	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22222	0.44096
8:	0.00	1.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.33333	0.50000
9:	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.11111	0.33333
10:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00000
COL MEANS:	0.60000	0.40000	0.00000	0.40000	0.10000	0.00000	0.20000	0.40000	0.00000	0.23333	
STD. DEV.:	0.69921	0.51640	0.00000	0.51640	0.31623	0.00000	0.42164	0.94609	0.00000		0.52037

APPENDIX F

INCORRECT I DON"T KNOW

Age: young

Presentation Condition: Picture & Story

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0.00	2.00	0.00	1.00	0.00	0.00	2.00	1.00	0.00	0.66667	0.86603
2:	0.00	0.00	1.00	0.00	0.00	1.00	0.00	2.00	0.00	0.44444	0.72648
3:	0.00	0.00	2.00	0.00	0.00	0.00	2.00	0.00	0.00	0.44444	0.88192
4:	0.00	2.00	1.00	0.00	1.00	1.00	2.00	0.00	0.00	0.77778	0.83333
5:	0.00	2.00	1.00	0.00	0.00	2.00	0.00	1.00	0.00	0.66667	0.86603
6:	0.00	1.00	1.00	0.00	0.00	2.00	0.00	0.00	0.00	0.44444	0.72648
7:	0.00	1.00	2.00	0.00	0.00	1.00	0.00	0.00	0.00	0.44444	0.72648
8:	1.00	0.00	2.00	0.00	0.00	1.00	0.00	0.00	0.00	0.44444	0.72648
9:	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.22222	0.44096
10:	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.22222	0.44096
COL MEANS:	0.10000	0.80000	1.10000	0.10000	0.10000	0.80000	0.80000	0.50000	0.00000	0.47778	
STD. DEV.:	0.31623	0.91894	0.73786	0.31623	0.31623	0.78881	0.91894	0.70711	0.00000		0.72248

APPENDIX F

INCORRECT I DON"T KNOW

Age: young

Presentation Condition: Story

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.22222	0.44096
2:	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.33333	0.50000
3:	0.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.44444	0.72648
4:	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.22222	0.66667
5:	0.00	0.00	2.00	1.00	0.00	1.00	0.00	0.00	0.00	0.44444	0.72648
6:	1.00	1.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.55556	0.72648
7:	0.00	1.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44444	1.01379
8:	0.00	2.00	1.00	3.00	2.00	0.00	0.00	0.00	0.00	0.88889	1.16667
9:	0.00	0.00	1.00	2.00	1.00	0.00	0.00	0.00	0.00	0.44444	0.72648
10:	1.00	3.00	1.00	2.00	1.00	1.00	0.00	0.00	0.00	1.00000	1.00000
COL MEANS:	0.20000	0.90000	1.30000	1.50000	0.40000	0.20000	0.00000	0.00000	0.00000	0.50000	
STD. DEV.:	0.42164	0.99443	0.82327	0.84984	0.69921	0.42164	0.00000	0.00000	0.00000		0.79676

APPENDIX F

INCORRECT I DON'T KNOW

Age: young

Presentation Condition: Picture

ROW	E-E	E-I	E-N	I-E	I-I	I-N	N-E	N-I	N-N	MEAN	STD. DEV.
1:	0.00	2.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.44444	0.72648
2:	0.00	2.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.55556	1.13039
3:	1.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.44444	0.72648
4:	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.22222	0.44096
5:	2.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.44444	0.72648
6:	1.00	4.00	0.00	1.00	2.00	0.00	0.00	3.00	0.00	1.22222	1.48137
7:	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22222	0.66667
8:	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22222	0.44096
9:	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11111	0.33333
10:	0.00	3.00	0.00	1.00	1.00	0.00	0.00	3.00	0.00	0.88889	1.26930
COL MEANS:	0.50000	1.80000	0.00000	0.60000	0.40000	0.00000	0.10000	0.90000	0.00000	0.47778	
STD. DEV.:	0.70711	1.13529	0.00000	0.51640	0.69921	0.00000	0.31623	1.44914	0.00000		0.88974