THE EFFECT OF GENERATION ON

MEMORY FOR PERFORMED AND IMAGINED ACTIONS

IN YOUNG AND LATE ADULTHOOD

by

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ABSTRACT

The effect of self-generation on activity memory and reality monitoring proficiency was investigated in a sample of 32 young (18-30 yrs.) and 32 elderly (60+ yrs.) adults. Half of the subjects in each age group performed and imagined activities that they had generated themselves. The other half of the subjects performed and imagined activities that were provided by the experimenter. Memory performance and reality monitoring were assessed using two free recall and judgement-of-origin tests.

An analysis of variance using task (performed/imagined) and recall test (immediate/delayed) as repeated measures led to the finding of a generation effect for memory for activities. There were also significant age and task effects. Young adults recalled more actions than elderly adults, and performed activities were remembered better than imagined activities. A significant age group by recall condition interaction also emerged, which suggested that younger adults recalled significantly more actions than elderly adults in both immediate and delayed recall, with the difference between groups being greater in the delayed recall condition. An analysis of variance using error type (imagined misclassified as performed/performed misclassified as imagined) and recall test as repeated measures led to the finding that generation decreased the accuracy of reality monitoring.

Results were discussed in relation to their support for various theoretical perspectives of activity memory in adulthood and compared to recent investigations with similar designs. Implications for future steps in furthering an understanding of activity memory in adulthood were discussed.

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CHAPTER I

INTRODUCTION

The notion that active participation in the learning process produces better retention than passive observation has considerable support with respect to verbal material (McElroy & Slamecka, 1982). This phenemonon, known as the "generation effect" (Slamecka & Graf, 1978), refers specifically to the finding that verbal material that is self-generated at study is subsequently remembered better than material that is simply read. The effect has been demonstrated with various types of meaningful verbal material (see Glisky & Rabinowitz, 1985 for a review). It has also been demonstrated in both incidental and intentional learning situations and under a number of recall conditions (e.g. recognition, free recall, cued recall; see Glisky & Rabinowitz, 1985 for a review).

Active debate still surrounds the theoretical explanation for the generation effect. Some researchers (e.g. McElroy & Slamecka, 1982) focus on the role of semantic memory in producing the memorial benefits for generated items, whereas other researchers (e.g. McFarland, Frey & Rhodes, 1980) implicate the generational process itself. Current views (e.g. Glisky & Rabinowitz, 1985) favor an interactionist perspective, arguing that it is both the generation process (which is believed to produce a more extensive processing of the stimulus) and the activation of semantic memory that produces the memorial benefits for generated items.

Generational tasks have recently been employed in a number of aging studies (e.g. Backman & Karlsson, 1987; Warren & Crockard, 1985; Mitchell, Hunt & Schmitt, 1986). Generally, such tasks have been found to affect the memory performance of young and elderly adults to a qualitatively similar degree, with both age groups showing greater recall for generated, as opposed to non-generated items. Some researchers (e.g. Backman & Karlsson, 1987) however, have found that elderly adults benefit from generational processing to a disproportionally greater degree than younger adults, and argue that such processing acts as a compensatory memory mechanism in the aged.

Studies on reality monitoring have also yielded data supporting the superiority effects for self-generated verbal information in memory across the life-span. Reality monitoring (Johnson & Raye, 1981) refers to the process of distinguishing a past perception from a past act of imagination, both of which have resulted in memories. This model proposes that the memory trace contains both qualitative and quantitative information about generated and perceived events, which can then be evaluated and compared in order to make the judgement of source. For both types of events, encoding processes include information about cognitive operations and physical characteristics of objects and actions. The relative amount of such information differentiates generated from perceived events. Results from reality monitoring studies (e.g. Raye, Johnson & Taylor, 1980; Johnson, Raye, Wang & Taylor, 1979) have shown that under optimal conditions, subjects are more accurate in their origin-of-source and frequency-of-occurrence judgements for generated than for perceived memories. According to Johnson and Raye (1981), thoughts often have an advantage over perceptions in memory because more information about the cognitive operations involved in intentional generation is likely to be coded in the trace than is information about the processes involved in automatic perception. Hence, memories of thoughts are remembered better and are less suseptible to origin errors than are memories of perceptions.

Although the generational process has consistently been shown to affect the verbal memory performance of young and elderly adults, recent attempts to extend the generation effect beyond a purely verbal realm have met with little success (e.g. Anderson, 1984; Cohen & Faulkner, in press; Harsany, M., personal communication, August 30, 1986; Lichty, Bressie & Krell, 1987). However, some part of this lack of congruence between verbal and nonverbal memory studies stems from the failure of certain investigators (e.g. Anderson, 1984; Cohen & Faulkner, in press; Harsany, M., personal communication, August 30, 1986) to employ generational procedures analogous to those used in verbal generation studies (e.g. Graf, 1980; McElroy & Slamecka, 1982; Slamecka & Graf, 1978). As a consequence, many of the results from these studies are difficult to interpret within the conceptual framework of generation outlined by Slamecka and Graf (1978). On the other hand, the same criticism cannot be applied to Lichty et al. (1987) who used a "traditional" generation procedure to study the effect of generation on young and elderly adults' memory for activities. Despite this approach, their study investigated only memory for performed activities and did not address the potential effects that generation had on memory for imagined activities. Several investigators have recently called for additional developmental research on memory for imagined events (Backman & Nilsson, 1985; Cohen & Faulkner, in press). A renewed interest in this aspect of memory is significant both in its association with ecological validity (i.e. many of our memories are for events that never actually occurred, but were only planned, imagined or considered), and in its relevancy to questions about age-related differences in the nature of specific kinds of memory traces.

The intent of this study is to investigate the effect of generation on young and elderly adults' memory for performed and imagined actions. Several purposes will be served by such an attempt. First, it will add to the efforts that have already been made (Lichty et al., 1987) to study the generation effect for activities using a traditional generation procedure. As such, it will provide a useful contrast to previous work in this area. The major purpose of this research, however, is to increase the understanding of the nature of the age differences often found in episodic memory tasks. Specifically, the present study attempts to address the following questions.

1. What are the effects of generation on young and elderly adults' memory for activities?

2. To what extent does age interact with the generation variable to produce differences in immediate and delayed free recall performance?

3. Is there a difference between memory for performed and imagined actions under generate and non-generate conditions?

4. What effect does generation have on the proficiency of reality monitoring in early and late

adulthood?

A review of the related literature, theoretical framework and rationale for this research is presented in Chapter II. The methodology of the implemented study is described in Chapter III. Chapter IV presents the findings of the study, and the discussion follows in Chapter V.

CHAPTER II

REVIEW OF THE LITERATURE

A distinctive feature of memory performance in normal aging is the interaction between age and type of test (see Craik & Rabinowitz, 1984 for a review). Several decades of experimental research have provided much evidence concerning the kinds of episodic memory tasks which produce special difficulties for older adults. In general, research has shown age-related decrements to be greatest in situations where the person must initiate and carry out both encoding and retrieval operations with little support from the environment or the stimuli themselves; conversely, age losses are minimized when the task demands or the stimulus materials induce satisfactory encoding at the time of initial learning, and/or when effective retrieval cues are present at the time of test (Craik & Rabinowitz, 1984).

These findings are consistent with the concept of compensation recently introduced by Backman (1985a, 1985b) and colleagues (Backman & Nilsson, 1984;

1985). Specifically, they assert that elderly adults are at least partially able to compensate for deficits in episodic remembering by utilizing various types of environmental aids. Similarly, they have suggested that young adults, due to a superior ability for various recoding operations, are less dependent on contextual and cognitive support in order to remember successfully.

Categories of Compensation

Backman (1985b) has identified several categories of compensatory triggers which can be identified within the area of aging and memory.

Compensation Via Experimenter-Provided Support

The first category of compensation introduced by Backman (1985b) is labelled "compensation via experimenter-provided support" (CEPS). Studies considered relevant to this category are those which demonstrate compensatory memory behavior in the elderly by means of experimenter-provided support through instructions at encoding (e.g. imagery instructions, organizational strategies, verbal mediators; see Burke & Light, 1981 for a review) and/or through additional information at retrieval (e.g. recognition/copy cues or cued recall/category cues; see Burke & Light, 1981 for a review). Taken together, these studies have suggested that there are age differences with respect to the amount of environmental support needed to achieve maximal memory performance (i.e. the elderly need more than the young).

For young adults, the improvement in performance from non-guided memory tasks to guided memory tasks is less pronounced. The concept of spontaneous recoding (Backman & Nilsson, 1984) has been proposed to account for this lack of improvement. Spontaneous recoding refers to the cognitive processes responsible for changes in the originally coded event which occur when subjects use mnemonic devices or control processes in order to memorize the to-be-remembered information optimally. Backman and Nilsson (1984) have suggested that younger adults possess a superior ability for spontaneous recoding of the original material. Such a notion is in accordance with a large number of previous studies on aging and memory which have found an age by task interaction (see Craik & Rabinowitz, 1984 for a review, but see also Burke & Light, 1981 for an alternate view). Thus, the elderly compensate best for a memory deficit by means of the guidance provided at encoding and/or retrieval, whereas younger adults seem to perform the actual recodings spontaneously without explicit guidance and/or additional retrieval information, and therefore benefit from the instructions less than older adults (Craik & Rabinowitz, 1984).

Compensation Via Inherent Task Properties

The second type of compensation discussed by Backman (1985b) is "compensation via inherent task properties". This concept implies that the basis for memory compensation in the elderly can be found in the inherent task properties of certain contextually rich tasks. Several recent studies by Backman (1985a) and colleagues (Backman & Nilsson, 1984; 1985; Backman, Nilsson & Chalom, 1986) have demonstrated that the aging effect typically observed in free recall of verbal materials can be eliminated when the subjects are instructed to perform different acts successively for a later test of memory performance. This is accomplished by using a memory task introduced by Cohen (1981) which involves memory for so-called subject-performed tasks or SPTs. In SPTs, subjects are required to remember, for purposes of later recall, a series of acts which they have performed either with real-life objects (e.g. bounce the ball, ring the bell), or without any objects (e.g. stand up, clap your hands).

In Backman and Nilsson's (1984) study, the comparison of interest was between a condition in which movements of objects were described in phrases (e.g. comb your hair, lift the spoon) and a condition in which subjects actually carried out the actions. In subsequent immediate and delayed free-recall tests, young subjects remembered more spoken phrases than older adults, but the old group performed as well as the young group in the action condition. Informal interviews with the participants afterwards revealed that many of the subjects (regardless of age) reported that they had remembered the SPT items by imagining that they had performed them once again. This suggested to Backman and Nilsson (1984) that the high degree of visual and motor components associated with the subject-performed task items might make them more comparable to a verbal task with explicitly provided imagery instructions. To investigate this possibility, they tested young and old adults on immediate and delayed free-recall of sentences, of sentences with imagery instructions and of subject-performed tasks. Although age differences emerged on the former two tasks, no age differences were reported for the free-recall of SPTs. According to Backman and Nilsson (1984), the hypothesis that visual imagery played a critical role in the elderly subjects' high performance on the SPTs gained no support.

As an alternate hypothesis, they suggested that the SPTs and the verbal control tasks differed in two fundamental ways. First, they considered the SPTs to be multimodal in the sense that several or all sensory systems could be activiated during the performance and registration of the task material. Second, they considered SPTs to be characterized by a richness of aspects on which encoding could be based. That is, in addition to the verbal aspects, memory registration could be established on the basis of color, shape, texture, taste and motor aspects of the to-be-remembered information. In addition, they considered the multimodal and contextually rich properties of the SPTs to be brought about by the fact that real-life objects were used as the to-be-remembered information and that the subjects acted motorically.

To investigate the relative importance of the use of real-life objects and the active manipulation of these objects in the elderly's success on free-recall of SPTs, Backman (1985a) devised a study whereby the presence of real-life objects was kept constant while subjects' motor activity was varied during encoding. Thus, two types of tasks were employed. In one condition, subjects were presented with both the objects and the verbal information (e.g. "break the chalk"), but were not allowed to respond motorically. In the second condition, subjects were presented with the objects and the verbal information and were required to respond motorically. In both types of tasks, the real-life objects served as the to-be-remembered information. For the third time, no age differences emerged for immediate and delayed free-recall of SPT items, whereas the young adults outperformed the elderly adults when the subjects were not allowed to manipulate the objects. The main conclusion drawn from this experiment was that the critical prerequisite for the elderly subjects' high performance on SPTs was the activation of the tactual modality and the presence of motor aspects.

<u>Compensation Via Cognitive Support Systems</u>

The third category of compensation discussed by Backman (1985b) is "compensation via cognitive support systems" (CCSS). Backman considers CCSS to be more a hypothetical construct since practically no research has addressed the presumptive basis for compensatory memory behavior among elderly adults. However, as applied to aging, CCSS can be used to embrace several potential sources of compensation in the aged. For example, some memory studies report reduced or eliminated age differences when semantic tasks are used, although some of the tasks, in which effortful types of processing are required to achieve a successful solution, show age differences in favor of young adults (see Rabinowitz & Ackerman, 1982 for a review). Aside from these exceptions however, it would appear that at least some of the cognitive abilities assumed to be important for successful performance in semantic memory tasks remain invariant across the adult life span (Backman, 1985b).

Generation as Cognitive Support: Within the context of CCSS, the findings from studies of the "generation effect" (Slamecka & Graf, 1978) would also appear to support Backman's (1985b) view that certain memory abilities remain stable with age. The generation effect refers to the finding that verbal material that is self-generated at study is subsequently remembered better than material that is simply read. The effect has been found for related word pairs (Slamecka & Graf, 1978), meaningful sentences (Graf, 1980; Kane & Anderson, 1978), single words from anomalous sentences (Graf, 1980) and single words from word fragments (Backman & Karlsson, 1987; Glisky & Rabinowitz, 1985). It has been demonstrated in free and cued recall and recognition and in both incidental and intentional learning situations. Moreover, it has been extended to include information only covertly generated by the subject and to retention intervals as long as 10 days

(Johnson, Raye, Foley & Foley, 1981). The theoretical explanation for the generation effect is a matter of some dispute (e.g. Glisky & Rabinowitz, 1985; Graf, 1982; McElroy & Slamecka, 1982), however the role of semantic memory has been necessarily, though not sufficiently, implicated in a number of studies (e.g. Graf, 1982; McElroy & Slamecka, 1982). Previous research has demonstrated that the encoding of meaning is not always involved in generating. For example, Slamecka and Graf (1978) found that the magnitude of the generation effect was independent of the encoding rule used (i.e. semantic or rhyme). However, the fact that nonwords amd anomalous sentences have shown no recognition advantage when generated implies that the knowledge system must be involved and that the act of generating cannot in itself be responsible for the effect (McElroy & Slamecka, 1982). Glisky and Rabinowitz (1985) have recently argued that both processes are involved. Specifically, they argue that it is the interaction between the generational process (which they believe induces a more extensive processing of the stimulus) and the activation of semantic memory that produces the memorial benefit for generated items.

Although active effort and self-generation at encoding has been shown to affect the recall and recognition performance of college-aged students (McFarland, Frey & Rhodes, 1980) and children as young as 7 years (Ghatala, 1981; McFarland, Duncan & Bruno, 1983), the empirical pattern is far from unequivocal. For example, Zacks, Hasher, Sanft and Rose (1983) failed to find an effect of encoding effort in a series of experiments on younger adults. These and similar findings (e.g. Anderson, 1984) have led some investigators to suggest that cognitive effort during encoding may not be as important a factor for memory performance in younger adults (e.g. Zacks et al., 1983). With respect to older adults, far less research has been conducted on the effects of generation and increased effort on subsequent memory performance.

One of the first attempts to determine the effects of effort and self-activity on older adults' memory performance was carried out by Kausler and Hakami (1983). Their study required young and elderly adults to perform a series of tasks varying on the cognitive effort dimension (perceptual-motor tasks, verbal learning tasks, semantic memory tasks, problem-solving tasks). These investigators found no age differences in recall of highly effortful activities (e.g. problem-solving tasks), whereas pronounced age differences in favor of young adults were observed for recall of less effortful activities (e.g. perceptual-motor tasks). These results suggested to the investigators that cognitively demanding activities yielded more distinctive memory traces than did less demanding activities because the cognitive effort per se enhanced the distinctiveness, and thus the retrievability of the ensuing trace. Viewed within the context of compensation, these results suggest that older adults have the ability to compensate for an age-related decline when they are forced to invest a substantial amount of effort in the task (Backman & Karlsson, 1987).

McFarland, Warren and Crockard (1985) were also interested in the effect of self-generation on elderly subjects' subsequent memory performance. Specifically, they were interested in determining whether elderly subjects' memory performance could be improved by providing elaborate encoding through self-generation of the to-be-remembered words. Although younger subjects recalled and recognized more generated and read (experimenter-provided) words than did the elderly subjects, the elderly subjects benefitted from the stimulus generation activity to the same degree as college-aged students. Thus, the operation of stimulus generation clearly appeared to play an important role in establishing a durable memory trace for both young and elderly adults. In contrast to the previous study however, the investigators emphasized that cognitive effort per se was not responsible for the effect. For example, in the rhyme condition, subjects were required to do nothing more taxing than generate a word that rhymed with a given word and began with a given letter.

In their study of word fragment completion and adult recall, Backman and Karlsson (1987) found that completing word fragments versus simply reading words had a differential effect on the recall performance of a group of young subjects, a group of 73 year-old adults and a group of 82 year-old adults. First, the recall level of young adults was generally higher than that of 73 year-old and 82 year-old adults. Second, the 73 year-old adults recalled more words than the 82 year-old adults. This finding suggests that there are age-related changes in memory performance during the eighth decade of life in normal aging (Backman & Karlsson, 1987). Most importantly however, was the finding that the two older groups of adults recalled more word fragments than words in contrast to the younger group of adults. This improvement was statistically reliable only for the group of 82 year-olds, however the results were in the same direction for the 73 year-olds as well. These findings provided support for Backman and Karlsson's (1987) claim that older adults would benefit disproportionally from cognitive support in the form of problem-solving activity during the encoding of verbal information. Furthermore, the finding that the young adults' memory performance was not substantially improved by the problem-solving activity supported Backman's (1985a, 1985b) earlier claim that young adults possess a superior ability for self-initiated recoding operations and that the additional contribution of problem-solving activity on recall was of less importance to this group.

Mitchell, Hunt and Schmitt (1986) also examined memory for internally generated verbal information (i.e. sentence completion) with a group of young adults, a group of healthy, older adults (mean age= 65.6 years) and a group of subjects diagnosed as having dementia of the Alzheimer's type (DAT). Although the group of healthy, older adults was used primarily as a control group for the DAT patients, useful information concerning the role of normal aging in memory was obtained. Specifically, their data pointed to some major differences between the effects of normal aging and dementia on memory performance. Although healthy, older adults showed lower levels of recall for both read (experimenter-provided) and generated items, their performance in terms of the generation effect was not qualitatively different from that of the younger adults. The magnitude of the effect in the young adults may have been limited by a ceiling effect, however. On the other hand, the DAT patients' cued recall revealed no significant benefit from generational processing. Their overall recall of generated items was reliably lower than that of the nondemented adults, whereas their recall of read items was not significantly different. Since there was no evidence of floor effects, this latter finding is in accordance with previous studies (e.g. Rabinowitz & Ackerman, 1982) which have found a normative age-related factor affecting episodic memory. The finding that the healthy, older adults' recall was differentially affected by self generation however, indicated to Mitchell et al. (1986) that normal aging did not adversely affect semantic memory functioning. That is, basing their conclusion on earlier experimental evidence (e.g. Graf, 1982; McElroy & Slamecka, 1982), these authors emphasized the importance of retrieval from semantic memory in explaining the memorial benefit for generated words.

The results from the previously cited studies clearly provides evidence that elderly adults' memory performance can be improved by the generational process and/or increased effort at encoding. With respect to younger adults however, the picture is somewhat more ambiguous. Why young adults would benefit to the same degree as elderly adults in some tasks (e.g. McFarland et al., 1985; Mitchell et al., 1986) and not others (e.g. Backman & Karlsson, 1987; Zacks et al., 1983) is not entirely clear.

With respect to the concept of compensation, the lack of consistency in the findings regarding the effects of increased encoding effort and the generation effect becomes an important issue. As Backman (1985b) notes, the term compensation refers to a disproportional improvement in a certain group of individuals as a function of some experimental manipulation. If increased encoding effort or self generational activity truly serves as a compensatory memory trigger in the aged, then the young should not show similar improvements to the elderly in such tasks. If they do, such outcomes tell us much about the sensitivity of young and elderly adults to such a manipulation, but nothing about the compensatory capabilities of elderly adults per se.

It is interesting to note that increased effort and generation effects are often treated as instances of the same phenomenon (e.g. Backman & Karlsson, 1987). However, results from experiments on the generation effect (see McElroy & Slamecka, 1982 for a review) have generally been more robust than those on the effort effect (see Backman & Karlsson, 1987; Craik & Rabinowitz, 1984 for reviews). As noted earlier, much debate still surrounds the theoretical explanation for the generation effect, and it is far from clear that the memorial benefits obtained with self-generated material are caused solely by the generational process itself (Glisky & Rabinowitz, 1985). As certain researchers (e.g. Zacks et al., 1983) suggest then, it may be important to maintain a clearer distinction between effort and generation until a better conceptualization of either effect can be delineated.

Recent experiments on reality monitoring (Johnson & Raye, 1981) have been helpful in distinguishing between generated and nongenerated memories and have also helped in more adequately conceptualizing the generation effect.

Reality Monitoring

Reality monitoring (Johnson & Raye, 1981) refers to the process of distinguishing a past perception from a past act of imagination, both of which have resulted in memories. The model assumes that both perceptual events and internally generated events produce persistent memory traces. In addition, it is assumed that any memory potentially consists of many types of information or attributes. The types of potential attributes considered by Johnson and Raye (1981) to be of particular importance for reality monitoring include information about the sensory characteristics of the stimulus presentation, the types of cognitive processing engaged (e.g. imagery), the semantic content, and the amount of contextual information (e.g. spatial and temporal information).

Specific Dimensions Proposed As Discriminators

It has been proposed (Johnson & Raye, 1981) that internally (self-generated) and externally (perceived) memories differ from each other along the following dimensions: First, externally derived memories are proposed to have more spatial, temporal and contextual attributes coded in the representation of an event than do internally derived memories. Second, it has been proposed that they have more sensory attributes than do internally derived memories. Third, it has been suggested that externally derived representations are more semantically detailed in that they contain more information or more specific information than internally derived memories (which are assumed to be more schematic). Finally, it has been proposed that internally derived memories typically have more cognitive operational attributes associated with them. Cognitive operations are the mental operations that went on at the time a memory was established and include such things as search and decision processes, imagery and mental comparisons. The notion that internally derived memories contain more cognitive operations information than externally derived memories is consistent with the assumption made by Hasher and Zacks (1979) that perception is somewhat more "automatic" than imaginal processes (Johnson & Raye, 1981). This set of inter-related hypotheses has been tested in a number of studies (e.g. Johnson, Raye, Foley & Foley, 1981; Johnson, Raye, Hasher & Chromiak, 1979; Johnson, Raye, Wang & Taylor, 1979) and there is now sufficient evidence to suggest that internally and externally derived memories do differ along these dimensions.

Empirical Evidence

Experiments designed to test the reality monitoring model have yielded data that demonstrate sensory information to be greater for perceived than imagined items (e.g. Johnson, Raye, Foley & Foley, 1981), and contextual information to be greater for perceived items (e.g. Johnson & Raye, 1981). Consistent with these results, subjects participating in these studies have tended to mention sensory cues more often with respect to identifying experimenter-provided items (e.g. "I could visualize you saying it", "I differentiated words which you said by remembering your pronunciation") and cognitive processing more in association with subject-generated items (e.g. "I made the decision by knowing what my train of thought was during the excercise", "If the word only seemed slightly familiar, I would say it was the experimenter's word", Johnson et al., 1981).

Another line of evidence supporting the view that externally and internally derived memories differ is the superiority effects for self-generated information (i.e. the generation effect, Slamecka & Graf, 1978) mentioned earlier. In a study designed to investigate the role of cognitive operations information as a potential cue for discriminating the origin of a memory, Johnson, Raye, Foley & Foley (1981) manipulated the amount of external control over subjects' generated responses. Their findings supported the view that cognitive operations information serves as a powerful cue for discriminating a particular event as internal. First, the items that subjects generated were recalled better than the experimenter-provided items. Second and most important, they found that the more a generated response was determined by external (experimenter-provided) cues, the less the memory included information about cognitive operations that took place when the memory was established and the less accurate was recall and subsequent reality monitoring judgements. In other words, the more automatic and less voluntary the response, the fewer cognitive operations there were stored with the trace, and the less distinctive was the resultant memory trace.

<u>Reality Monitoring and Nonverbal Memory</u>

As with studies on the generation effect, most of the research that has been developed to test the reality monitoring model has focused on subjects' abilities to discriminate between internally and externally derived verbal memories. Several investigators (e.g. Anderson, 1984; Cohen & Faulkner in press; Harsany M., personal communication, August 30, 1986) have recently attempted to extend the reality monitoring model to nonverbal thoughts and actions. All of these studies have focused on subjects' abilities to discriminate in memory between performed, imagined and watched events.

Anderson (1984) used a tracing task to investigate some of the memory and decision processes involved in distinguishing between memories of doing and memories of imagining doing. As each item, typically a line drawing of a common object, was presented, subjects traced or imagined tracing the outline of the item or simply looked at the item. After a distractor task, subjects were tested for their ability to recognize each item and to identify the activity performed on it. Across experiments, subjects either performed all three activities or various combinations of two of the three activities, one activity per item. Although her conclusions were generally more pertinent to the reality monitoring literature, one major conclusion regarding the generation effect emerged. Specifically, imagining an item being traced (defined by Anderson as a self-generated activity) did not affect item recognition. In other words, memory for imagined events was no better than memory for performed or watched events. Although these results were inconsistent with the results obtained in earlier generation studies using verbal material (e.g. McFarland et al., 1985; Mitchell et al., 1986), the results were consistent with the notion of spontaneous recoding put forth by Backman and Nilsson (1984).

Harsany (personal communication, August 30, 1986) employed the same paradigm developed by Anderson (1984) to study the effects of age, mood and personality variables on memory for activity. With respect to the age variable, younger adults were found to be superior in memory performance to older adults. In addition, imagining to trace was the task least well remembered by both young and old subjects. The presence of an age by activity interaction showed age differences to be limited to the look and imagine activities and not to extend to the trace task. Since the raw data were not included in the summary, it was impossible to determine if ceiling effects accounted for the lack of age differences on the trace task. However, the results would appear consistent with Backman and Nilsson's (1984) conclusion that older adults benefit more than younger adults when they are allowed to respond motorically in the task.

Cohen and Faulkner (in press) were also interested in the effects of aging on perceived and generated memories. Their experiment was designed to test the hypothesis that elderly people have more difficulty than younger people in distinguishing between what they actually did, what they watched someone else do, and what they only thought about doing. To investigate the problem, Cohen and Faulkner (in press) had young, middle-aged and elderly subjects either perform, imagine or watch certain actions. These actions consisted of moving everyday objects arranged on a grid (e.g. " put the stamp on the book", "put the spoon next to the toothbrush"). On perform trials, the subject was instructed to perform the designated action; on watch trials, the experimenter performed the action, the subject being instructed to watch carefully; and on imagine trials the subject was told to look at the objects and imagine performing the action specified by the experimenter. After a distractor task, subjects were presented with a written checklist of all 36 actions randomly mixed with 18 distractor items. Subjects were asked to identify the origin of each item on the checklist as performed, imagined, watched or new. Although the results were again discussed primarily with respect to the reality monitoring model, several important conclusions regarding the generation effect emerged. First, the imagine task (defined by Cohen & Faulkner as a self-generated activity) was the least well remembered activity for all age groups. The oldest age group was particularly disadvantaged at this task and was much more likely to confuse imagined actions with performed or watched actions. In addition, all three age groups were prone to making forgetting errors (i.e. classifying an action as a new event). Interestingly, this effect was most pronounced for imagined and watched actions and was only seen for performed actions in the young group. If one examines the overall accuracy patterns of memory for activity, the results are again consistent with Backman and Nilsson's (1984) conclusion regarding subject-performed tasks. That is, when the subjects were allowed to actively manipulate the objects, the older age groups performed at a level consistent with the young group. However, when subjects were not allowed to interact with the objects, both of the older groups performed at lower levels than that of the young group. This effect was especially pronounced in the oldest group, whose overall accuracy for imagined actions was 37% as compared with 54% for the middle-aged group and 60% for the young group.

The three previously cited studies, though in no way directly testing the concept of compensation, certainly lend much support to Backman & Nilsson's (1984) hypothesis that elderly individuals benefit from a multimodal encoding context. Age differences in memory performance were completely eliminated in both Harsany's (personal communication, August 30, 1986) and Cohen and Faulkner's (in press) study when elderly subjects engaged motorically in the task. Not quite so consistent with earlier studies (e.g. McFarland et al., 1985; Mitchell et al., 1986) however, were the results regarding the generation effect. In all three studies, and for all age groups observed, the imagine activity (defined as a self-generated activity) remained the least well remembered and its accuracy level in terms of origin judgements was far below even that of watched events. How are these discrepancies with earlier generation studies explained?

In explaining the lack of a generation effect found with her college-aged students, Anderson (1984) raised the possibility that not all self-generated activity yielded a memory advantage over all perceptual activity. Instead, her data suggested that people searched selectively for evidence of motor action attributes when distinguishing between memories of doing and memories of imagining doing. In addition, since she found imaginal information to be more suseptible to multiple interpretation than overt action information, she concluded that the presence of motor action attributes might be more informative than the attributes associated with imaginal representations.

In Cohen and Faulkner's (in press) conclusion, their discussion is limited to the performance of the elderly subjects they tested and this group's increased susceptibility for confusing imagined actions with performed or watched actions. Specifically, they suggested that, in old age, generated memories are less distinctive and less robust and sometimes liable to be confused with perceived memories. They linked this age-related deficit in memory to Craik and Rabinowitz's (1984) suggestion that, "age differences are slightest when the processes are driven by the stimulus or are strongly determined or supported by the environment; age differences are greatest, on the other hand, when the task requires the subject to go beyond the information, where the processes must be self-initiated" (p. 482). This conclusion is in contrast with earlier suggestions (e.g. Backman & Karlsson, 1987; Kausler & Hakami, 1983) that self-generation and/or increased effort at encoding enhances the distinctiveness and thus the retrievability of the ensuing trace.

Summary

The results from the reality monitoring studies might seem to suggest that the generation effect cannot be extended to include nonverbal information. In contrast to Johnson and Raye's (1981) finding that cognitive operations played an important role in maintaining the durability of generated verbal memory traces, Anderson (1984) found that the presence of motor action attributes associated with perceptual events was far more informative than imaginal action information. Cohen and Faulkner (in press) conclude that generating images requires substantial processing effort and that elderly individuals are particularly disadvantaged at this task. The major problem with these two conclusions however, is that neither set of investigators employed a true generational task to study the durability of generated memories (i.e. the subjects in all cited studies were provided with both the stimuli and the responses to those stimuli). Instead of validly addressing a generation issue then, these investigators essentially studied memory for imagined and performed activities in young adults (Anderson, 1984) and the durability of these memories as a function of age (Cohen & Faulkner, in press; Harsany, M., personal communication, August 30, 1986). Basically, this paradigm is similar to the one used by Backman and Nilsson (1984) in their investigation of the effects of imagery and motor action on the subsequent memory peformance of young and elderly adults.

Employing generational procedures similar to those employed in earlier studies (e.g. Backman & Karlsson, 1987; McFarland et al., 1985; Slamecka & Graf, 1978) is important for a number of reasons. First, it allows for more reliable comparisons between generation studies using verbal material and those using nonverbal material. Second, as noted by Johnson et al. (1981), allowing the subject to generate his/her own response increases the chances that cognitive operations information will be available at the time of recall. Third, true generational procedures have more ecological validity in that they more closely approximate the episodic memory tasks that adults deal with in their everyday life. Rarely is real world performance of activities dictated by another person. When we plan or perform an activity, we usually do so without being explicitly told.

Nonverbal Generation Studies

To date, only one study has used the traditional generation procedure to study its effect on memory for activities. Lichty, Bressie and Krell (1987) recently investigated the effects of age, generation and bizarreness of subjects' responses on the recall of memory for activities. Memory in young and old adults was investigated with actions using everyday objects such as a cup and saucer. Four conditions were presented at each age level: 1) Provided-Ordinary (PO) in which task instructions for a commonplace action were given (e.g. "put the cup on the saucer"); 2) Generated-Ordinary (GO) in which

2 objects were presented and the person generated an ordinary action; 3) Generated-Unusual (GU) in which unusual actions were generated (e.g. place the saucer on the cup); and 4) Provided-Unusual (PU) in which participants were yoked to GU participants and thus performed the same actions as their GU counterparts. The results showed a robust age effect, with overall memory being superior for young adults. Thus, Backman and Nilsson's (1984) hypothesis that the elderly are able to compensate for memory deficits by utilizing multimodal and contextually rich information was not supported. Rather, the results were consistent with the notion that the elderly are particularly disadvantaged at utilizing contextual information (Burke & Light, 1981). In addition, the investigators found that ordinary actions yielded more distinctive memory traces than bizarre actions, regardless of age. Finally and most importantly, there was an absence of a main effect for generation. Even when subjects were allowed to generate their own responses, the resultant memory trace was no more distinctive than the nongenerated trace. This result then strongly

supports the contention made by other investigators (e.g. Anderson, 1984) that the generation effect cannot be extended to include memory for actions. Furthermore, it suggests that cognitive operations information may not play a role, or at least as important a role, in maintaining the distinctiveness of the generated activity trace.

Prolegomenon To The Experiment

The effect of self-generation on memory for activities in elderly adults has only recently begun to be investigated. To date, only one unpublished study (Lichty et al., 1987) has used generational procedures analogous to those used in earlier verbal memory studies (e.g. Graf, 1982, McElroy & Slamecka, 1982; Slamecka & Graf, 1982) to study the effect of generation on memory for activities.

The present study used familiar objects and meaningful actions to assess the effect of self-generation on the subsequent memory performance of young and elderly adults. Meaningful actions were used for two reasons. First, individual variation in activity generation could be reduced by having subjects generate familiar actions to commonplace objects. Second, by having familiar objects and meaningful, goal-directed actions to encode, it was felt that the memory task would be made more stimulating and less artificial from the point of view of the elderly. Several investigators (e.g. Avron, 1982; Backman, 1985b) have argued that older adults are often disadvantaged in psychological experiments with respect to the unfamiliarity of the experimental material and the laboratory situation in general. If the notion is valid, it seems reasonable to suggest that the overall disadvantage of the elderly would be reduced by providing them with memory tasks that are more meaningful.

Another general purpose of the present experiment was to explore for the presence of a generation effect for imagined, as opposed to only performed, actions in young and elderly adults. Several studies have shown the elderly to benefit from instructions to use visual imagery (e.g. Treat & Reese, 1978). Other investigators (e.g. Backman & Nilsson, 1984; Cohen & Faulkner, in press) have found there to be no memorial benefit for the elderly when they are instructed to use visual imagery. Several hypothetical outcomes with respect to this factor were considered then. In laboratory investigations of memory for imagined activities, the participants have always been provided with the actions to be imagined (e.g. Anderson, 1984; Cohen & Faulkner, in press; Harsany, M., personal communication, August 30, 1986). By allowing subjects to generate their own image responses to the stimuli, it was hypothesized that the generated images might be more distinctive (because of the associated increase in cognitive operations information) than their non-generated counterparts. In a similar vein, it was hypothesized that requiring subjects to generate their own image responses might force the participants, and in particular the elderly, to produce more effective images. If, on the other hand, the elderly have less distinctive generated memories than the young (Cohen & Faulkner, in press) it would be expected that they would remember fewer imagined actions than performed actions, regardless of whether they were generated or not.

The present study was also designed to investigate the effect that multimodal and contextually rich information has on the elderly's subsequent memory performance. Backman (1985a, 1985b) and Backman and Nilsson (1984, 1985) contend that the elderly are able to compensate for deficits in episodic remembering by utilizing the contextual rich aspects of the subject-performed tasks. Recent evidence (Lichty et el., 1987) however, suggests that the elderly show a reduction in memory for activities because they are deficient in encoding contextual information. If Backman's (1985a, 1985b) and Backman and Nilsson's (1984, 1985) notion of compensation is valid, it is expected that elderly subjects will recall more performed actions than imagined actions (at least in the non-generation condition) and that young subjects will not show a similar improvement. In contrast, Lichty et al.'s (1987) conclusion will be supported if the elderly do not benefit from performing the action.

A final objective of the study was to investigate adult age differences in the ability to discriminate between the imagining of activities and the actual performance of those activities. Of particular interest in this study was the effect of generation on subsequent reality monitoring judgements. Diminished proficiency of reality monitoring in late adulthood has been reported by a number of investigators (e.g. Cohen & Faulkner, in press; Harsany, M., personal communication, August 30, 1986) employing nongenerational procedures. It was hypothesized that the use of generational procedures would improve the quality of the cue information associated with both internally and externally derived memories, thereby making subsequent reality monitoring judgements more accurate.

Subjects were tested for both immediate and delayed free recall of the activities they performed and imagined. Both encoding and retrieval time was self-paced. This was done in order to ensure that the elderly participants were not penalized by an insufficient amount of time in either learning or retrieving the information. For example, it has been shown the failure of the elderly to elaborate and encode contextually specific information may be a result of insufficient time in some circumstances (Craik & Rabinowitz, 1984).

Two groups of subjects were used: (1) Young

(18-30 years) and (2) elderly (60-71 years). Since the use of both prescription and over-the-counter drugs is critically important in any consideration of mental functioning in the elderly, and utilization of drugs of all kinds is much higher in those over 65 years (Avron, 1982), subjects were screened (with a self-report inventory) for motor/cognitive disturbances caused by medication.

CHAPTER III

METHOD

Subjects

A total of 64 subjects divided evenly into 2 age groups participated in the experiment. The 32 young subjects (6 males, 26 females; age range 18-27 years, mean age = 21.7 years) were undergraduate students recruited through the university subject pool. The 32 elderly subjects (14 males, 18 females; age range 60-71 years, mean age = 66.7 years) were community residents recruited through advertisements in the local newspaper. Participation in the experiment was voluntary and no subjects were paid for their time.

Descriptive data on the mean age, years of education and vocabulary score for each age level by condition are presented in Table 1. Across condition, the mean and standard deviation for years of formal education were 14.2 and 1.09 for the young adults and 13.6 and 2.56 for the elderly adults. The variance between the two groups was not homogeneous, and the difference in means was not significant. For the purpose of general comparison of the age groups, each subject was given a 54-item vocabulary test from the Kit of Factor-Referenced Cognitive Tests (Ekstrom et al., 1976). This test consisted of Vocabulary Test II (Part 1), Advanced Vocabulary Test I (Part 1) and Advanced Vocabulary Test II (Part 2). The means and standard deviations for the vocabulary scores were 34.9 and 5.63 for the young adults and 43.9 and 9.77 for the elderly adults. The variance between the groups was not homogeneous, and there was a significant difference in means favoring the elderly adults, $t(49.54) = 4.50$, $p < .05$.

With regard to health, the only requirements were physical mobility, adequate sensory (vision, hearing) ability and freedom from any cognitive or motor disturbances caused by medication. In each age group, the participants were asked to provide a subjective evaluation of their overall health, eyesight and hearing, as compared with other people their age. In addition, they were asked to report any medications they were taking and any symptoms associated with these medications. The majority of the individuals in both age groups reported fair or better health, eyesight and hearing (range, 78.1 to

Table 1

Mean Age, Years of Education and Vocabulary Score For Each Age Level by Condition Group

	Variable		
Age Level by Condition Group	Age	Education (years)	Vocabulary *
Young, Generate (N = 16)	21.9 (4.86)	14.1 (1.08)	35.3 (5.61)
Young, Nongenerate (N = 16)	21.6 (4.88)	14.3 (1.10)	34.6 (5.65)
Old, Generate (N = 16)	66.2 (4.31)	13.3 (2.43)	45.8 (7.94)
Old, Nongenerate (N = 16)	67.1 (3.89)	13.9 (2.71)	42.1 (11.6)

* Maximum vocabulary score = 54
Standard deviations appear in parentheses

100%) and all subjects reported freedom from medicational disturbances.

Design

Each age group was randomly divided into two groups, one which participated in the generation condition, and the other which participated in the non-generation condition.

Two random orders of object presentation were constructed so that half of the subjects in each age group and each experimental condition were presented with one of the orders, whereas the other half of the subjects were presented with the second order.

Task was a within-subject variable, such that each individual performed half of the actions and imagined the other half of the actions. The counterbalancing of task across age group and condition ensured that the actions that were performed by one half of the subjects were imagined by the other half.

All subjects were administered both the immediate and the delayed free-recall memory tests.

The design was a 2 (age group) by 2 (condition) by 2 (order) by 2 (task) by 2 (recall condition) mixed analysis of variance with repeated measures on the last two factors.

Materials/Procedure

The materials for the study consisted of 80 everyday objects, chosen so that when they were presented either alone or in pairs, they elicited relatively automatic, familiar and common action responses (e.g. putting toothpaste on a toothbrush, lighting a candle with matches). Index cards, each containing the task command 'imagine' or 'perform' were also used. Subjects were randomly assigned to one of two conditions; generation or non-generation. Regardless of the condition a subject was assigned to, each had the opportunity to view the objects neccesary to carry out or to imagine carrying out a particular action. In some instances, only one object was presented (e.g. bell) and in other instances two naturally paired objects were presented (e.g. pencil and pencil sharpener). No object was ever presented to the subject in more than one context. Two random orders of object presentation were constructed so that half of the subjects in each age group and each condition were presented with one of the orders, whereas the other half of the subjects were presented with the second order.

Participants were tested individually. The course of the experiment for all participants was: demographic questionnaire, instructions, experimental tasks, immediate free-recall of experimental task items, vocabulary test and unexpected delayed free-recall of experimental task items. The demographic questionnaire required subjects to provide information on their age, education, general health and medicational status. The vocabulary test was from the Kit of Factor-Referenced Cognitive Tests (Ekstrom et al., 1976) and consisted of 54 items. This test served as a distractor task between the immediate and delayed free-recall tests and subjects were allowed 10 minutes to complete the test.

The instructions varied according to the experimental condition. For both conditions, subjects were told that the experimenter would be presenting them with a number of everyday objects. They were also told that upon presentation of these objects, the experimenter would be simultaneously turning over an index card which would contain either the command 'perform' or the command 'imagine'. For perform trials, the subjects were instructed to perform an action with the given objects. For imagine trials, the subjects were instructed to look at the objects and then close their eyes and visualize themselves carrying out the intended action. Both perform and imagine trials were self-paced for all subjects.

The difference between the two conditions was that in the non-generation condition, subjects were asked to imagine carrying out an action or to carry out an action which had been prescribed by the experimenter; conversely, subjects in the generation condition were asked to imagine carrying out an action or to carry out an action which they had generated themselves. The instructions for the generation condition emphasized that the subjects were to try to generate very familiar and common actions, ones which they thought most people would generate in a similar kind of a situation. In addition, subjects in the generate condition were instructed to verbalize the action to the experimenter once they had either imagined or performed it (e.g. "I put the key on the keyring"). The reason for having the subjects verbalize their responses was so the experimenter was aware of the action being generated in the generate-imagine condition. Finally, subjects were informed that their memory for both the performed and imagined actions would be tested after the experimental session. They were not informed however, that they would be required to provide origin judgements on the actions they recalled, or that there would be another memory test to follow the vocabulary survey.

Once the final action was completed, subjects were provided with a blank sheet of paper and asked to recall as many of the experimental actions as possible. For all the actions they could remember, they were also asked to specify whether the action was performed or imagined. Subjects were allowed as much time as they needed for this test, and were instructed to inform the experimenter when they reached a point when they could remember no more actions. A record was made of the time each subject took to complete the test. No mention was made to the subjects of the total number of actions to be recalled or the total number of objects originally presented.

Upon completion of the immediate free-recall test, subjects were asked to complete the vocabulary survey. They were allowed 10 minutes to complete this test.

An unexpected delayed free-recall test was then administered. Subjects were again provided with a blank sheet of paper and asked to recall as many actions as possible. They were also asked to specify whether each action was performed or imagined. As with the earlier recall test, subjects were allowed as much time as they needed for recall and a record was made of each subject's recall time.

Summary

This study examined the effects of generation on young and elderly adults' subsequent memory for performed and imagined actions. Two age groups were used: (1) young adults (18-30 years) and (2) elderly adults (60-71 years). The additional subject variables of education, vocabulary (verbal ability), health, vision, hearing and medicational status were also assessed. Subjects were required to recall the actions they performed and imagined under two test conditions: immediate free-recall and delayed free-recall. In addition, they were required to make origin-of-source judgements for the actions they recalled in both tests. Subjects were aware that their memory would be tested immediately after the last experimental task. They were not informed however, that they would be required to provide origin judgements on the actions they recalled, or that there was a second memory test to follow the vocabulary survey.

CHAPTER IV

RESULTS

Reliability of Task Items

In order to estimate the reliability of the actions as measurements, Pearson Correlation coefficients were computed between the 42 actions across the two age samples and separately for each age sample in each recall condition. These analyses indicated a low to moderate degree of relationship between the recall performance of the actions for each separate age group and for the combined sample in immediate free-recall (combined sample, total positive correlations = 97; range, .2070 to .4786; *M* = .2847; young sample, total positive correlations = 60; range, .2956 to .6879; *M* = .3922; old sample, total positive correlations = 65; range, .2981 to .5204; *M* = .3613). The results for the combined sample and each separate age group were similar for delayed free-recall (combined sample, total positive correlations = 129; range, .2141 to .4587; *M* = .2791; young sample, total positive correlations = 62; range, .2966 to .6286; *M* = .4086; old sample, total correlations = 77; range, .2952 to .6279; *M* = .3811). Summary statistics appear in Table 7.

Immediate and Delayed Free-Recall

The recall data of the present study was based on a lenient scoring criterion; that is, responses were regarded as correct if the response protocol contained only a partial description of the action and/or the objects involved in the action (e.g. "I put the teabag into something"). However, the response protocols were also scored according to a strict criterion, accepting as correct only those responses which contained the appropriate action and the objects involved in that action. Generally, the pattern of data was the same, regardless of the criterion used. There was a slightly lower level of performance (about 1% for immediate free-recall and 1.5% for delayed free-recall) when the strict criterion was employed, but otherwise the results were the same as those obtained using the lenient criterion.

The overall pattern of the recall data is presented in Table 2. Memory performance (expressed as the mean number of actions recalled) is presented

Table 2

Memory Performance (Mean Number of Actions Recalled) as a Function of Age Group, Condition, Task and Recall Condition

Age Group	Recall Condition: Immediate	Recall Condition: Delayed
Young		
Generate		
Perform	13.50 (3.32)	14.56 (2.72)
Imagine	11.94 (2.39)	12.75 (2.60)
Nongenerate		
Perform	13.69 (2.34)	14.13 (2.10)
Imagine	10.81 (2.73)	11.88 (2.70)
Old		
Generate		
Perform	11.75 (3.28)	11.81 (3.16)
Imagine	9.81 (3.29)	9.63 (3.43)
Nongenerate		
Perform	9.50 (2.09)	9.31 (2.54)
Imagine	8.63 (3.45)	8.31 (3.04)

* Standard deviations appear in parentheses.

as a function of condition (generate/nongenerate) and task (perform/imagine) for each age group (young/old) in each recall condition (immediate and delayed). The recall data were analyzed using a 2 (age group) by 2 (condition) by 2 (order) by 2 (task) by 2 (recall condition) analysis of variance (ANOVA) with repeated measures on the last two factors. Age, condition, and order varied between subjects, whereas task and delay (recall condition) were within subject variables. No effects of order were obtained and hence, the data were collapsed over this variable.

The ANOVA revealed significant main effects of age, $\underline{F}(1,60) = 28.72$, $\underline{p} < .000$, $r^2 = .30$; condition, $\underline{F}(1,60) = 4.32$, $\underline{p} < .042$, $r^2 = .045$ and; task, $\underline{F}(1,60) = 24.70$, $\underline{p} < .000$, $r^2 = .28$. Younger adults ($\underline{M}$ = 25.81) recalled significantly more task items than elderly adults ($\underline{M}$ = 19.69); generated task items ($\underline{M}$ = 23.94) were recalled better than nongenerated task items ($\underline{M}$ = 21.56) and; performed actions ($\underline{M}$ = 24.56) were recalled better than imagined actions ($\underline{M}$ = 20.94). There was also a significant interaction between age group and delay, $\underline{F}(1,60) = 8.32$, $\underline{p} < .005$, $r = .11$. An a posteriori Newman-Keuls analysis was employed to trace the source of the age group by delay interaction. The test showed that the young adults' memory performance was higher than the elderly adults' memory performance in both immediate free-recall (*M* young = 24.96, *M* old = 19.84) and delayed free-recall (*M* young = 26.66, *M* old = 19.53), with the difference increasing in delayed free-recall. No other comparisons reached statistical significance.

A summary of the analysis of variance can be found in Table 3.

Reality Monitoring Judgements

Reality monitoring was assessed by analyzing erroneous judgement of source identifications. Basically, two types of errors could be made by a subject. The first type of error that could be made was one in which an action that was actually performed was misclassified as having been imagined (performed as imagined or PI). The second type of error that could be made was one in which an imagined action was misclassified as having been performed (imagined as performed or IP). The mean number of errors presented as a function of age group

Table 3

Summary Table on Recall Performance for a 2 (Age Group) by 2 (Condition) by 2 (Task) by 2 (Recall Condition) with Repeated Measures on Task and Recall Condition ANOVA

Source	SS	*df*	*F*
Age Group	600.25	1	28.72 *
Condition	90.25	1	4.32 **
Age Group X Condition	25.00	1	1.20
Recall Condition	7.56	1	3.93
Age Gp. X Recall Condition	16.00	1	8.32 **
Condition X Recall Condition	.56	1	.29
Age Gp. X Condition X Recall Condition	.00	1	.00
Task	210.25	1	24.70 *
Age Group X Task	6.25	1	.73
Condition X Task	.25	1	.03
Age Gp. X Condition X Task	16.00	1	.18
Recall Condition X Task	.00	1	.00
Age Gp. X Task X Recall Condition	.56	1	.35
Condition X Task X Recall Condition	1.00	1	.62
Age Gp. X Condition X Task X Recall Condition	.56	1	.35

* $p < .001$ ** $p < .05$

(young/old), condition (generate/non-generate), error type (PI/IP) and delay (immediate free-recall/delayed free-recall) are presented in Table 4. These data were analyzed using a 2 (age group) by 2 (condition) by 2 (order) by 2 (task) by 2 (delay) ANOVA with repeated measures on the last two factors. Since no effects of order were obtained, the data were again collapsed over this variable. The ANOVA revealed a significant main effect for condition, $F(1,60) = 4.13$, $p < .043$, $r^2 = .063$, with confusions being higher in the generate condition ($M = .547$) than in the nongenerate condition ($M = .342$). No other effects were significant.

A summary of the analysis of variance can be found in Table 5.

Recall Time

As mentioned in the method section, both recall tests were self-paced, but the time required by the subjects for recalling the actions was registered by the experimenter. A 2 (age group) by 2 (condition) by 2 (order) by 2 (recall condition) ANOVA with repeated measures on the last factor revealed no significant effects for recall time. Although the

Table 4

Mean Number of Reality Monitoring Errors as a Function of Age Group, Condition, Error Type and Recall Condition

Age Group	Recall Condition: Immediate	Recall Condition: Delayed
Young		
Generate		
PI	.313 (.445)	.375 (.499)
IP	.063 (.177)	.188 (.531)
Nongenerate		
PI	.063 (.177)	.063 (.177)
IP	.000 (.000)	.250 (.436)
Old		
Generate		
PI	.375 (.610)	.250 (.463)
IP	.188 (.409)	.438 (.527)
Nongenerate		
PI	.188 (.409)	.438 (.640)
IP	.125 (.232)	.250 (.436)

Note: Standard Deviations appear in parentheses.

Table 5

Summary Table on Reality Monitoring Errors For a 2 (Age Group) by 2 (Condition) by 2 (Error Type) by 2 (Recall Condition) with Repeated Measures on Error Type and Recall Condition ANOVA

Source	SS	*df*	*F*
Age Group	.66	1	3.20
Condition	.88	1	4.27 *
Age Gp. X Condition	.04	1	.17
Recall Condition	.32	1	1.39
Age Gp. X Recall Condition	.00	1	.02
Condition X Recall Condition	.10	1	.43
Age Gp. X Condition X Recall Condition	.66	1	2.90
Error Type	.66	1	3.59
Age Gp. X Error Type	.00	1	.02
Condition X Error Type	.04	1	.19
Age Gp. X Condition X Error Type	.00	1	.02
Recall Condition X Error Type	.32	1	2.42
Age Gp. X Recall Condition X Error Type	.00	1	.03
Recall Condition X Condition X Error Type	.10	1	.75
Age Gp. X Condition X Error Type X Recall Condition	.47	1	3.61

* $p < .05$

results were not statistically reliable, elderly adults generally took less time than younger adults in both immediate free-recall (M young = 13.08, M old = 11.87) and delayed free-recall (M young = 12.39, M old = 11.27, see Table 6).

Summary

The recall peformance and reality monitoring proficiency of young and elderly adults was examined through analysis of variance. Analysis of variance on the mean number of actions recalled was performed to determine the effects of age, condition (generate/non-generate), task (performed/imagined) and delay (immediate/delayed). A main effect for age was found, such that younger adults recalled a significantly higher number of actions than elderly adults. A main effect for condition was found, such that a significantly greater number of generated than nongenerated actions were recalled. A main effect for task also emerged. Performed actions were recalled significantly more than imagined actions. An interaction between age group and delay (recall condition) was shown: Younger adults recalled significantly more actions than elderly adults in both immediate and delayed free-recall, with the difference between the groups being greater in the delayed recall condition.

Analysis of variance on the mean number of erroneous origin-of-source judgements was performed to determine the effects of age, condition (generate/non-generate), error type (PI/IP), and delay (immediate/delayed). A main effect for condition was found, such that a significantly greater number of confusions were made in the generate condition. No other significant effects emerged in this analysis.

Finally, analysis of variance on the mean recall time was performed to determine the effects of age group, condition (generate/non-generate), and delay (immediate/delayed). No significant effects emerged in this analysis.

Table 6

Mean Recall Time (in Minutes) as a Function of Age Group, Condition and Recall Condition

Age Group	Recall Condition: Immediate	Recall Condition: Delayed
Young		
Generate	13.04 (3.61)	13.33 (2.43)
Nongenerate	13.11 (3.43)	11.45 (2.92)
Old		
Generate	12.07 (2.36)	11.71 (2.03)
Nongenerate	11.67 (3.55)	10.83 (2.96)

Note: Standard deviations appear in parentheses.

Table 7

Pearson Correlation Coefficients For The 42 Actions Across Age Samples and Within Young and Elderly Samples-Range and Mean Values

Sample	Recall Condition: Immediate	Recall Condition: Delayed
Total		
(+) Correlations	.2070-.4786 (.2847)	.2141-.4587 (.2791)
(-) Correlations	.2058-.2876 (.2217)	.2141-.3177 (.2463)
Young		
(+) Correlations	.2956-.6879 (.3922)	.2966-.6286 (.4086)
(-) Correlations	.2981-.4952 (.3130)	.2966-.4330 (.3722)
Old		
(+) Correlations	.2981-.5204 (.3613)	.2952-.6279 (.3811)
(-) Correlations	.2966-.4569 (.3467)	.2956-.4780 (.3671)

Note: Mean values appear in parentheses.

CHAPTER V

DISCUSSION

The present investigation was a study of variables affecting memory for activities in young and elderly adults. The first purpose of the study was to determine the effects of generation on young and elderly adults' subsequent memory for actions. This was accomplished using a generational procedure similar to that employed by previous researchers studying the effects of generation on memory for verbal material (e.g. Backman & Karlsson, 1987; McFarland et al., 1985; Mitchell et al., 1986), and to that employed by Lichty et al. (1987) in their study of memory for activities. The second aim was to test for the presence of a generation effect for imagined, as opposed to only performed, actions in young and elderly adults. The third purpose of the research was to investigate further the effect that the multimodal and contextually rich properties of the subject-performed tasks had on the subsequent memory performance of young and elderly adults. A final objective of the study was to investigate the effects of generation on the ability of young and elderly adults to discriminate between actions they had performed and those which they had only imagined.

Discussion of Results

Effects of Generation

A guiding premise of the present study was that the use of generational procedures similar to those employed in earlier verbal generation studies (e.g. Backman & Karlsson, 1987; McFarland et al., 1985; Mitchell et al., 1986) might improve young and elderly adults' memory for performed and imagined actions. One of the key assumptions made was that previously employed generational studies which required subjects to generate responses dictated by the experimenter, did not permit subjects the opportunity to acquire an adequate base on which cognitive operations information could be established and resorted to in subsequent retrieval situations. In contrast, it was believed that by allowing subjects to generate their own responses, the chances were better that related information about cognitive operations associated with generation would be available at recall. Similarly, it was proposed that requiring subjects to generate their own responses might force the participants, the elderly in particular, to devote more attention to the task at hand and thereby produce more distinctive memory traces. Although this argument loses strength in light of Lichty et al.'s (1987) study which found no effect of generation on memory for performed activities, it seemed warranted to attempt replicating these results, and to extend the generation paradigm to memory for imagined activities.

In the present study, subjects assigned to the generation condition were required to generate common action responses (imagined and performed) to everyday objects. This was in contrast to the subjects assigned to the non-generation condition who were required to perform and imagine common actions prescribed by the experimenter. The results of the study showed there to be a significantly greater number of performed and imagined actions recalled when the subjects were allowed to generate their own actions as opposed to when they were required to imagine or perform an action prescribed by the experimenter. This finding is inconsistent with the results of earlier studies on memory for activities that employed a different procedure to study the effect of generation on subsequent memory performance (e.g. Anderson, 1984; Cohen & Faulkner, in press; Harsany, M., personal communication, August 30, 1986).

It would be tempting at this point to speculate that the difference in findings reflects a basic difference in the generational procedure used. However, the fact that the results are also inconsistent with those of Lichty et al. (1987) rules out this possibility. Instead, it must be emphasized that despite the basic difference in the theoretical focus between the present study and that of Lichty et al. (1987), the generational procedure employed in both studies was exactly the same. That is, in the present study and in the generate-ordinary condition of the Lichty et al.(1987) study, subjects were required to generate common and familiar actions to everyday objects. Although both studies required subjects to generate familiar actions, it is not unlikely that the actions used by either researcher still differed on a number of dimensions. In fact, the finding that many of the actions used in the present study were only marginally correlated with each other suggests that there may have been inherent differences between the task items that influenced their recallibility.

One such difference might have been the complexity of the action, both in mental (cognitive) and physical (motor) terms. Actions might be thought to differ along a cognitive-motor continuum, in which at one end are situated actions which involve a heavy motor component and light cognitive demand and at the other end are situated actions that involve a light motor component and heavier cognitive demand. With respect to the generation effect, it has already been argued that the more "automatic" a response is to a stimulus, the less likely that memory will include information about cognitive operations that took place when the memory was established and the less successful will be subsequent retrieval attempts (Johnson et al., 1981). Although the specific actions used by Lichty et al. (1987) are not known to the present investigator and the explanation offered at this point can only be tentative, the possibility exists that on the whole, the objects that Lichty et al. (1987) used in their study triggered more "automatic" type action responses than the objects used in the present study.

Another task characteristic that may have varied both within the present study and between the present study and that of Lichty et al. (1987) was the time required to carry out a particular action. The relation between activity duration and memory for subject-performed (non-generated) tasks was recently investigated by Kausler, Lichty, Hakami and Freund (1986). Their results indicated that variation in activity duration did not have an effect on either the overall level of recall or the magnitude of the age deficit in recall. These results suggested to the investigators that activity duration and the later recall of the performance of that activity were mutually independent. Specifically, they argued that the memory trace of an activity's performance is largely the product of the operationalization of the program for performing that activity. Continuation of that program in the form of maintaining the performance on the task contributes little to the enhancement of the memory trace, regardless of age. If it is correct that the activity memory trace is largely a product of the operations related to the production and planning of the activity, one might indeed expect generation to have an effect on the quality of the memory trace left by such operations. Furthermore, it would seem plausible that activity duration would have an effect on those activities that were generated, since more time would be spent in the production and planning of longer activities. Again, without knowing what kinds of "ordinary" actions Lichty et al. (1987) had their subjects perform, the possibility exists that on the whole, the actions the subjects had to generate in the present study were generally of a longer duration, and that this in turn contributed to an overall generation effect.

Regardless of the validity of either argument concerning the differences between studies, it seems important that future research more adequately address the issue of the influence of different task variables on the generation process and memory for activities. This would seem especially critical in aging studies where certain task characteristics (e.g. motor/cognitive demand, activity duration) might interact with the age variable to differentially affect the generation process.

Effects of Age

In the present study, a robust age effect was observed, with young adults recalling significantly more actions than elderly adults. This result is consistent with the age effects reported in previous studies investigating the durability of generated activity memories in young and elderly adults (e.g. Cohen & Faulkner, in press; Harsany, M., personal communication, August 30, 1986; Lichty et al., 1987). Furthermore, it suggests that although the elderly adults' memory performance in terms of the generation effect is not qualitatively different from that of the young adults, the quantitative distinction which remains rules out the possibility that the elderly are "compensating" for a memory deficit by engaging in a generational activity task. If the notion is valid that generational tasks require more effortful types of processing than nongenerational tasks, then the hypothesis that the elderly compensate when they engage in such processing (e.g. Backman & Karlsson, 1987) is not supported in this context. On the other hand, the results do not support Cohen and Faulkner's (in press) conclusion that the elderly are particularly disadvantaged at the types of tasks that require "self-initiated" processing. Clearly, the elderly adults in the present study were able to benefit from self-initiated activity generation, though not to any compensatory degree.

To reiterate an earlier argument, further theoretical and empirical work on the relationship between increased encoding effort and generation is sorely needed. It is still not clear, for instance, whether generation involves just an increased attentional component, whether it involves a type of "effortful processing" component, or whether it is the interaction between the two components that produces the effect. Certainly, the characteristics of the task play a role in determining whether effortful processing is engaged in or not. The fact that both young and elderly adults benefitted from stimulus generation in the present study, but that the elderly still showed a memory deficit raises a number of issues.

If the generation process serves only to guide attention toward the task (and this in turn increases the chances that information about cognitive operations will be available at retrieval), then both young and elderly adults should benefit from a generational task. That is, it is expected that the increased attentional guidance will result in a more meaningful analysis of the task material, which in turn should lead to better recall for both young and elderly adults. If generational tasks (regardless of their characteristics) demand effortful or controlled processing, then the performance predictions for the young and elderly will be influenced by one of two theoretical perspectives. One perspective is that elderly adults, because they have fewer processing resources than younger adults, are particularly disadvantaged at effortful processing, especially to the extent that this processing requires manipulation or transformation of the material (Craik & Rabinowitz, 1984). Conversely, Backman and Karlsson

(1987) argue that older adults benefit disproportionately from cognitive support in the form of problem-solving (effortful) activity during encoding. Assuming that generation always requires effortful processing then, elderly adults could either be expected to recall fewer generated activities than the young (Craik & Rabinowitz, 1984) or conversely, they could be expected to recall disproportionately more generated activities than the young (Backman & Karlsson, 1987). Finally, one could take the position that generation serves to guide subjects' attention toward the critical stimulus features and requirements of the tasks, but that effortful processing per se is engaged in only as a function of the specific task itself. In other words, to the extent that generation requires effortful processing, it is the interplay between the task characteristics and the generational process that determines such processing and not the generational process alone.

The data from the present study would certainly support this latter view. Specifically, elderly adults were clearly able to benefit from generating their own activity responses to the stimuli. However, the finding that their memory performance was still lower than that of the young, even in the generate condition, suggests that they may have been penalized by those activity generations that required more effortful types of processing. Again, it must be emphasized that no task analysis was carried out on the actions used in the present study and that this explanation is only offered tentatively at this time. However, it re-emphasizes the neccesity for future studies to address the issue of what kinds of task varibles influence the effectiveness of generation in young and elderly adults.

Task Effects

The purpose of the task manipulation in the present study was to test a number of hypotheses. First, support was sought for the hypothesis that elderly individuals are able to compensate for deficits in memory by utilizing the multimodal and contextually rich properties of the subject-performed tasks (Backman & Nilsson, 1984). Second, evidence was sought for the hypothesis that by increasing the quality of cognitive operations information associated with the imagined task, the differences typically found between imagined and performed activities (e.g. Anderson, 1984; Cohen & Faulkner, in press) would be eliminated. No support for either hypothesis was found.

Specifically, the finding of robust age and task effects and the absence of an age by task interaction contradicts Backman (1985a, 1985b) and Backman and Nilsson's (1984, 1985) hypotheses regarding the concepts of compensation in the aged and spontaneous recoding in the young. Performed actions were recalled significantly better than imagined actions by both young and elderly adults, but the young consistently recalled more actions, even when those actions were performed. This finding supports the view held by Burke and Light (1981) that the elderly are more inefficient than the young at encoding relevant contextual information and contradicts the view held by Backman and colleagues (1984, 1985, 1985a, 1985b) that multimodal information enables the elderly to compensate because of its contextual richness. In addition, the finding that the young recalled more subject-performed actions than imagined actions contradicts the notion that they have a superior ability for the spontaneous recoding of less rich information and that they benefit less from the subject-performed task properties of multimodality and contextual richness.

Alternatively, the results suggest that the memory traces of performed actions are more distinctive than the memory traces produced by imagined events. This is true even when the quality of the images is increased through the generational process. The fact that memory for imagined events was improved by allowing subjects more control over the images they produced supports Johnson and Raye's (1981) hypothesis that cognitive operations information (in this case, imagery) is more readily established when the response is not fully dictated by the experimenter. The fact that generated-performed actions were remembered better than generated-imagined actions however, suggests that the additional information (e.g. sensory and contextual information) acquired by performing the act is more informative than the cognitive operations information alone.

In their discussion of the differences between externally and internally derived memories, Johnson and Raye (1981) emphasize that all memories include several types of information. Which components of memories will be most important in subsequent retrieval attempts may depend on the nature of the events being judged. As they suggest, cognitive operations may be an especially important cue for the retrieval of language, especially words or sentences given in isolation. Conversely, sensory information may be a more powerful cue for the retrieval of visual and motor information, such as actions. In this regard, the additional cognitive operations information established as a result of generation may be of less importance in retrieving activity information. This is in direct conflict with Kausler et al.'s (1986) hypothesis that the memory trace of an activity's performance is the product of the operationalization of the program for performing the action, and not the product of the performance per se. However, it is somewhat consistent with the idea put forth by Backman (1985a, 1985b) and Backman and Nilsson (1984, 1985) that individuals (in this case, both young and elderly) benefit from a multimodal and contextually rich encoding context. In addition, it supports Anderson's (1984) contention tha motor action attributes are more informative than the attributes associated with imaginal representations.

When investigating memory for imagined actions, the possibility cannot be overlooked that subjects may be failing to engage in effective imagery for many, or all of the tasks. Though every precaution was taken to ensure that subjects actually imagined the actions, the tendency to visualize and produce effective images may have been more likely for the less routinized actions (e.g. putting a thread through the eye of a needle) than for the actions that were more automatic in nature (e.g. putting a teacup on a saucer). The presence of a generation effect for imagined actions does not totally rule out the possibility that only some of the actions were being effectively generated. This kind of an effect would have then artificially masked the magnitude of the generation effect for imagined actions. On the other hand, the likelihood that ineffective images were being produced was even higher in the non-generate condition, where subjects could merely listen to the verbal imperatives. In this respect, the nongenerate-imagine task may have become more analogous to a verbal task. This could have in turn produced what looked to be a generation effect, but what was in fact just a "production of images" effect.

Assuming that these effects, if present, affected young and elderly adults equally, the fact remains that the elderly still recalled fewer generated-imagined actions than the young. Thus, even when the elderly adults' attention was adequately guided toward the task of producing effective images, they continued to remember fewer imagined actions than the young. This would suggest that either the quality of the cognitive operations information associated with the task (in this case, imagery) is less distinctive and informative in old age or that the elderly are failing to spontaneously utilize this information at the time of recall. Since the present design does not allow for a separation of production vs. utilization of visual images, the issue must await future consideration.

However, if the former suggestion is true, Cohen and Faulkner's (in press) assertion that generated (imagined) memories are less distinctive and less robust in old age would be supported.

Some mention should also be made of the observed age group by delay (recall condition) interaction observed in the present study. The differences in memory performance between young and elderly adults were significant in both immediate and delayed free-recall and this difference increased in the delayed free-recall condition. Although no significant differences in memory performance were observed within either age group across recall conditions, one trend is worth noting. Specifically, the memory performance of the young adults increased fractionally in the delayed free-recall condition.

This finding raises the issue of administering more than one recall test to a subject. Ideally, separate groups of subjects should have received the immediate and delayed free recall tests. However, this was not the case in the present study and instead, all subjects received both tests. The potential effects that the first recall test had on the second should be considered then, at least with respect to the young sample. The beneficial effects of initial recall on subsequent recall have been shown in several studies (see Rabinowitz & Craik, 1986). As noted by Smith (1980) however, elderly individuals tend to benefit less from their initial retrieval attempts because they use information that is less effective for subsequent retention. The results from the present study support Smith's (1980) conclusion. In addition, they emphasize the need to consider multiple recall tests as a between-subjects variable, especially in aging studies.

Another perplexing aspect of the data, though not significant, was the trend towards an age effect in time taken for retrieval. Contrary to expectation, elderly adults tended to take less time to retrieve generated and non-generated actions in both immediate and delayed free-recall conditions. Whether this finding reflects a general lack of persistance on the part of the elderly or a difference in metamemorial functioning is again open to question. The question has important implications for overall memory functioning however, since either factor might exaggerate any differences that exist.

Reality Monitoring

Several recent studies on reality monitoring (e.g. Cohen & Faulkner, in press; Harsany, M., personal communication, August 30, 1986) have reported robust age differences in the ability to distinguish between performed and imagined actions. Using non-generational procedures, these investigators have reported a decline in the proficiency of reality monitoring with increasing age, with confusions in the elderly group generally being greater for imagined memories. One of the hypotheses of the present study was that the quality of the information associated with the imagined memory trace could be improved by allowing subjects to generate their own images. That is, by employing a generational procedure, it was believed that the opportunity for subjects to utilize cognitive operations information as a cue for discriminating a particular memory code as imagined would be increased.

Contrary to expectation however, the opposite occurred. Specifically, young and elderly adults made more erroneous origin judgements in the generate condition. This is an extremely puzzling finding, given that the overall memory performance was better in the generate than in the non-generate condition. Why would generated memories be more susceptible to confusion in memory than non-generated memories? One explanation may be that the memory code of generated-performed and generated-imagined actions contain certain attributes that can be interpreted as evidence for either activity. For example, consider the memory trace of a generated-imagined action. If generation serves to improve the quality of the image, the resultant memory trace might contain a greater degree of sensory and contextual information, which might then be interpreted as evidence of having had performed the activity. Conversely, the memory traces of generated-performed actions might contain certain attributes (e.g. imagery processes related to the planning and production of the action) which could also be interpreted as evidence of imagining. This type of error would seem most likely when the information associated with performing the activity was also qualitatively poor (i.e. tasks lacking sensory and contextual richness).

Since these types of discrimination errors could occur without affecting subjects' recall scores per se, the apparent paradox between recall performance and error rate in the generation condition becomes less puzzling. Clearly though, further research is needed to determine what kinds of conditions cause contextual, semantic or sensory information from imagination to be unusually high, or from performed activities to be unusually low.

Although no other significant effects emerged in the reality monitoring data, two trends are worth noting. One was the bias towards an age effect in the total number of confusions made. Elderly adults tended to make more reality monitoring errors than the young adults. This finding is consistent with the results reported by Cohen and Faulkner (in press).

The other noticeable trend in the data was that of an error type effect. Performed actions tended to be misclassified as imagined actions more often than the opposite. Interestingly, this finding is inconsistent with the results of earlier studies that found imaginal representations to be more suseptible to confusion in memory than perceived events (e.g. Anderson, 1984; Cohen & Faulkner, in press). It is not entirely clear why such a trend would emerge in the present study, given that memory for performed actions was so much better than memory for imagined actions in both age groups. The recall data from the present study certainly supports the hypothesis that motor attributes are more informative than the attributes associated with imaginal representations. Accordingly, there should have been less tendency to confuse performed actions in memory. A tentative explanation might be that subjects were adopting a strict criterion when assessing their memory codes for motor attributes. If only strong evidence of "doing" appeared acceptable, then uncertain origins might have been more readily attributed to imagination. Caution must be taken in interpreting the effect too strongly though, since it only approached significance. However, it does raise interesting questions about the metamemory assumptions and decision processes adopted in different reality monitoring situations.

Summary

Memory for one's own activities is an important component of the everyday operations of the episodic memory system. Investigations of activity memory in adulthood are relatively recent in the long history of research on age differences in learning and memory. Moreover, in the majority of laboratory investigations of memory for activities, the participants have always been provided with the actions to perform and imagine. The present study represented an attempt to extend the generation effect to memory for activities.

The effects of generation on recall performance and reality monitoring were assessed through an immediate and delayed free recall/origin-of-source test for young and elderly adults. The actions selected for study represented an attempt to increase the ecological validity of the study, through the use of commonplace objects and meaningful, goal-directed actions.

A clear effect for generation was found. Young and elderly adults who generated their own actions

recalled significantly more of these actions in both recall tests than subjects whose responses were provided by the experimenter. However, an age-related performance deficit was also found. Elderly adults recalled significantly fewer actions than younger adults. Thus, the effect of generation was qualitatively similar for young and elderly adults, but elderly adults still exhibited a deficit in episodic memory. Finally, performed actions were recalled significantly better than imagined actions by both age groups. This finding clearly contradicted earlier views (e.g. Burke & Light, 1981) that elderly adults are particularly disadvantaged at encoding contextual information. However, combined with the age effect, it did support Burke and Light's conclusion that elderly adults remember less contextual information than young adults. The absence of an age by task interaction in the present study also contradicted Backman's (1985a, 1985b) and Backman and Nilsson's (1984, 1985) views of compensation in the aged and spontaneous recoding in the young.

A second question of the study addressed the potential effects of generation on subsequent reality monitoring judgements. Contrary to expectation, generation was found to decrease the proficiency of origin-of-source judgements. It was suggested that generation might produce more confusion by increasing the similarity of the attributes associated with internally and externally derived memories.

Since at present, there seems to be no apriori way of determining which "generation" manipulations will influence retention and which will not, it was also suggested that future studies more adequately operationalize the nature of the task materials to be generated and remembered.

References

Anderson, R.E. (1984). Did I do it or did I only imagine doing it? Journal of Experimental Psychology: General, 113(4), 594-613.

Avron, J. (1982). Studying cognitive performance in the elderly: a biopsychosocial approach. In F.I.M. Craik & Sandra Trehub (Eds.). Aging and Control Processes. Plenum Press, N.Y.

Backman, L. (1985a). Compensation and recoding: a framework for aging and memory research. Scandinavian Journal of Psychology, 26, 193-207.

Backman, L. (1985b). Further evidence for the lack of adult age differences on free-recall of subject-performed tasks: the importance of motor action. Human Learning, 4, 79-87.

Backman, L. & Karlsson, T. (1987). Effects of word fragment completion on free-recall: a selective improvement of older adults. Comprehensive Gerontology, B-1, 4-7.

Backman, L. & Nilsson, L. G. (1984). Aging effects in free recall: an exception to the rule. Human Learning, 3, 53-69.

Backman, L. & Nilsson, L.G. (1985). Prerequisites for lack of age differences in memory performance. Experimental Aging Research, 11, 67-73.

Backman, L. Nilsson, L.G. & Chalom, D. (1986). New evidence on the nature of encoding action events. Memory and Cognition, 14(4), 339-346.

Burke, D.B. & Light, L.L. (1981). Memory and aging: the role of retrieval processes. Psychological Bulletin, 90, 513-546.

Cohen, R.L. (1981). On the generality of some memory laws. Scandinavian Journal of Psychology, 22, 267-282.

Cohen, G. & Faulkner, D. (in press). The effects of aging on perceived and generated memories. In L. Poon, D.C. Rubin & B.A. Wilson (Eds.). Everyday Cognition in Adulthood and Old Age. Cambridge: Cambridge University Press.

Craik, F.I.M. & Rabinowitz, J.C. (1984). Age differences in the acquisition and use of verbal information. A tutorial review. In H. Bouma and D.G. Bouwhis (Eds.). Attention and Performance X: Control of Language Processes., Erlbaum, Hillsdale, N.J.

Ekstrom, R.B., French, J.W., Harman, H.H. & Derman, D. Manual for kit of factor referenced cognitive tests. Princeton, N.J.: Educational Testing Service, 1976.

Ghatala, E. (1981). The effect of internal generation of information on memory performance. American Journal of Psychology, 94, 443-450.

Glisky, E.L. & Rabinowitz, J.C. (1985). Enhancing the generation effect through repetition of operations. Journal of Experimental Psychology: Learning, Memory and Cognition, 11, 193-205.

Graf, P. (1980). Two consequences of generating: increased inter and intraword organization of sentences. Journal of Verbal Learning and Verbal Behavior, 19, 316-327.

Graf, P. (1982). The memorial consequences of generation and transformation. Journal of Verbal Learning and Verbal Behavior, 21, 539-548.

Hasher, L. & Zacks, R.T. (1979). Automatic and effortful processes in memory. Journal of Experimental Psychology: General, 108, 356-388.

Johnson, M.K. & Raye, C.L. (1981). Reality monitoring. Psychological Bulletin, 88, 67-85.

Johnson, M.K., Raye, C.L., Foley, H. & Foley, M.A. (1981). Cognitive operations and decision bias in reality monitoring. American Journal of

Psychology, *94*, 37-64.

Johnson, M.K., Raye, C.L., Hasher, L. & Chromiak, W. (1979). Are there developmental differences in reality monitoring? *Journal of Experimental Child Psychology*, *27*, 120-128.

Johnson, M.K., Raye, C.L., Wang, A.Y. & Taylor, T.H. (1979). Fact and fantasy: the roles of accuracy and variability in confusing imaginations with perceptual experiences. *Journal of Experimental Psychology: Human Learning and Memory*, *5(3)*, 229-240.

Kane, J.H. & Anderson, R.C. (1978). Depth of processing and interference effects in the learning and remembering of sentences. *Journal of Educational Psychology*, *70(4)*, 625-635.

Kausler, D.H. & Hakami, M.K. (1983). Memory for activities: adult age differences and intentionality. *Developmental Psychology*, *19(6)*, 889-894.

Kausler, D.H., Lichty, W., Hakami, M.K. & Freund, J. (1986). Activity duration and adult age differences in memory for activity performance. *Journal of Psychology and Aging*, *1(1)*, 80-81.

Lichty, W., Bressie, S. & Krell, R. (1987, August). When a fork is not a fork: recall of performed activities as a function of age, generation and bizarreness. Paper presented at the conference on: *Practical Aspects of Memory*. Swansea, Wales.

McElroy, L. & Slamecka, N. (1982). Memorial consequences of generating nonwords: implications for semantic-memory interpretations of the generation effect. *Journal of Verbal Learning and Verbal Behavior*, *21*, 249-259.

McFarland, C.E., Frey, T.J. & Rhodes, D.D. (1980). Retrieval of internally- versus externally-generated words in episodic memory. *Journal of Verbal Learning and Verbal Behavior*, *19*, 210-225.

McFarland, C.E., Duncan, E.M. & Bruno, J.M. (1983). Developmental aspects of the generation effect. Journal of Experimental Child Psychology, 36, 413-428.

McFarland, C.E., Warren, L. & Crockard, J. (1985). Memory for self-generated stimuli in young and old adults. Journal of Gerontology, 40, 205-207.

Mitchell, D., Hunt, R. & Schmitt, F. (1986). The generation effect and reality monitoring: evidence from dementia and normal aging. Journal of Gerontology, 41, 79-84.

Rabinowitz, J.C. & Ackerman, B. (1982). General encodingof episodic events by elderly adults. In F.I.M. Craik and Sandra Trehub (Eds.). Aging and Cognitive Processes. Plenum Press, N.Y.

Rabinowitz, J.C. & Craik, F.I.M. (1986). Prior retrieval effects in young and old adults. Journal of Gerontology, 41(3), 368-375.

Raye, C.L., Johnson, M.K. & Taylor, T.H. (1980). Is there something special about memory for internally generated information? Memory and Cognition, 8(2), 141-148.

Slamecka, N. & Graf, Peter (1978). The generation effect: delineation of a phenemonon. Journal of Experimental Psychology: Human Learning and Memory, 4, 592-604.

Smith, A.D. (1980). Age differences in encoding, storage, and retrieval. In L.W. Poon, J.L. Fozard, L.S. Cermak, D. Arenburg & L.W. Thompson (Eds.). New Directions in Memory and Aging. Lawrence Erlbaum Associates, Hillsdale, N.J.

Treat, N.J. & Reese, H.W. (1976). Age, pacing and imagery in paired associate learning. Developmental Psychology, 12, 119-124.

Zacks, R., Hasher, L., Sanft, H. & Rose, K. (1983). Encoding effort and recall: a cautionary note.

Journal of Experimental Psychology: Learning, Memory and Cognition, *9(4)*, 747-756.

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