Rigidity, anxiety, and the older learner

by

Kathryn Dohrmann Rindskopf

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major: Psychology

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Department

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa

1976

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Introduction

A current and long overdue trend in education is an increasing emphasis on a life-span approach to learning. Just as developmental psychologists have begun to emphasize the need for knowledge of human development throughout life, so educators are beginning to see the need for educational research and technology geared to mature and older learners as well as to children and adolescents. Weg (1972) notes that educators, students, and society at large are calling for a "learning society" at all ages. No longer does it appear to be true that a "terminal philosophy" of education, with its assumptions that an individual can be taught enough in his youth to last a lifetime and that only the young can learn, is appropriate (Jacobs, Mason, & Kauffman, 1970).

This change in emphasis has arisen from a variety of social, historical, and economic phenomena. An early impetus came after World War II when the passage of the GI Bill enabled millions of "mature" males to obtain higher education (Charles, 1971a). Birren and Woodruffe (1973) discuss a number of other reasons that have since hastened the change. One reason has to do with the changing age structure of society. Because of a falling birth rate, a low level of immigration, and a reduction in the death rate, the United

States is no longer a young country (in terms of the average age of its population). For example, since 1900 the proportion of persons who are 65 or older has doubled (Charles, 1971a).

Coupled with an increase in the proportion of older persons in the society has been a decrease in the average age of retirement. According to Claque (1971), an axiom of modern economic doctrine is that people are living longer and working less. He states that when men and women are in their late forties or early fifties, they are very likely to favor exchanging work time for additional leisure. As an outgrowth of private industry pensions, more workers are exercising their option to retire early. By age 65, slightly more than 72% of males and nearly 90% of females are not in the labor force. It seems desirable that educational institutions adapt to the tremendous amount of leisure time available to these individuals.

Another social change reported by Birren and Woodruffe is the declining enrollment of undergraduates. They report that current applications to college by young persons are showing a reduction in size above and beyond that which can be attributed to a reduction in the size of their age group. For an increasing number of colleges and universities continued viability may be dependent upon their success in involving middle-aged and older adults in higher education.

An additional reason proposed by Birren and Woodruffe comes from evidence indicating that future cohorts of mature and older individuals will be increasingly interested in continuing education. Research has shown that the more education an individual has, the more likely it is that he will seek further education. By 1981, it is predicted that 61% of those persons over age 65 will have at least a high school education (compared with 29.3% in 1970). Research indicates a greater interest in adult education courses among persons in the cohort 30-39 years than in the current 65 and over cohort (despite the fact that the latter have lived longer and have had more opportunity to take adult education courses). This suggests that the older individuals of tomorrow will not only be better educated than those of today, but also that they will be more interested in educational opportunity.

The acceleration of change in our culture also points to the necessity for continuing education over the lifespan. In past times social change was slow enough that there was little noticeable change during an individual's life and formal learning in addition to that received early in life was not necessary. But as Birren and Woodruffe point out, every possible index (including urbanization, scientific advances, and economic growth) points to a phenomenal acceleration of change. This implies that successful

adaptation to our culture will require new learning at many points along the lifespan.

The impact of rapid change can also be seen in career patterns. Both jobs and job skills can quickly become obsolescent and training for multiple careers then becomes necessary. Birren and Woodruffe suggest that in addition to discarding the notion that an individual's education will last a lifetime, we should also discard the notion that occupational skills will automatically last a lifetime.

A final factor suggested by these writers has to do with the changing roles and demands of women in our society. They state that if a lifespan approach to education results in less prejudice and fewer barriers for mature learners, women especially will benefit. This is because many women will temporarily drop out of the educational system to raise children and reenter school later for advanced and professional degrees. Thus the changing status of women may result in greater needs for lifelong educational opportunities.

For these reasons and others the educational institutions of the future will be serving a much wider range of ages than they have in the past. This leads to a major problem in terms of planning and technology. The problem is that neither educational research nor training has been geared toward mature and older learners. Educational

research abounds, but the bulk of this research has been done with children and adolescents and is not automatically applicable to an age group whose needs and abilities may be very different. Charles (1971b) states that "research in the instructional process and on effective teaching techniques for grownups is virtually non-existent." He goes on to state the following:

> We as educators, especially as trainers of teachers, have done almost nothing to prepare to teach this large segment of the population that needs, and is ready to profit from, education at many levels. We do not train teachers to teach grownups; thus classes for adults may be taught as if the students are like children or adolescents. They are not; they are demonstrably different, and presumably need different instructional techniques.

He also stresses the need for more detailed studies on learning processes in older adults.

A considerable amount of research is needed to understand the characteristics of mature learners and to develop ways of promoting their optimal learning. Although a considerable amount of "pure" laboratory based learning studies have been done with adults, especially in the areas of cognition and memory, the application of these findings to educational settings has been largely neglected. The present study was conceived in part as a response to this need.

One aspect of the behavior of older individuals which has received a considerable amount of attention is rigidity. Rigidity refers in general to a lack of ability to "unlearn

that which is already integrated into well-established thought and behavior systems" (Botwinick, 1973, p. 71). It is a commonly held belief that older persons behave more rigidly than younger persons. This belief has received some empirical support, but there appears to be not only a number of different kinds of behavioral rigidity, but also wide differences in the extent to which they are manifested. Another commonly held belief is that rigidity in older persons is intrinsic to the biological process of aging. Evidence suggests however that experiential rather than maturational variables may be the crucial factors.

The intent of the present paper is to explore more fully the dynamics of rigid behavior in older persons. An attempt will be made to influence the amount of rigidity shown by manipulating environmental variables which are thought to be important in its development. Since a life-span approach to education implies a life of continual relearning, it is hoped that the results of this research will be useful to those persons involved in promoting maximum learning throughout the life-span.

Do the Data Fit the Stereotype?

The stereotype held by young and old alike is that older persons are rigid and resistant to change. Testing the truth of the stereotype means that the construct of rigidity must

be operationalized; this is a task which has inspired diverse methods and approaches. Depending upon the interests and backgrounds of individual investigators, almost any task which appeared to involve resistance to change has been used as a measure of rigidity. This amalgam of tasks can be classified under the following labels: studies of perceptual set, problem solving set, verbal learning, concept formation, and habit reversal in laboratory and natural settings. If one is to ascertain the extent to which older persons show more behavioral rigidity than younger persons, studies in each of these areas must be examined. The following section is a review of studies in which the performance of different age groups has been compared on tasks designed to measure behavioral rigidity.

One reason why older persons seem less modifiable by new experience and more rigid may be that they do not respond to new information adequately. Botwinick (1973) uses stimulus persistence theory as a model to understand this inadequacy. Studies of reaction time in older persons indicate that stimulus traces persist longer in the nervous systems of old people than in young people, leaving them less able to respond to subsequent stimuli. Since older people take longer to process and respond to sensory information, they may not be as responsive to new information and may respond to it inadequately. This lack of responsiveness to new

information is seen as rigidity. Data from studies of perceptual set are used to fit this model. One of the earliest studies of perceptual set was done by Korchin and Basowitz (1956). Korchin and Basowitz were interested in the relative ability of older persons to switch from one percept to another. They tested 60 young adults between the ages of 22 and 33 and 60 adults over 65 years of age on the Cat-Dog test. This test is comprised of thirteen line drawings which gradually change from the figure of a cat to the figure of a dog. Older persons were significantly more likely to make the final shift from calling the figure a cat to calling the figure a dog later in the series; they were more likely to vacillate between cat and dog after they had made their first shift; and they were more likely to give the same response to all of the cards. In addition, decision time was significantly slower for the older subjects. This slower decision time seemed to be the result of not only stimulus clarity but also of situational novelty (it was higher for the first few pictures than for the last few). Situational novelty did not appear to affect the decision times of young subjects while stimulus clarity did.

Botwinick (1962) used the Cat-Dog Test, but modified the instructions used in its administration. In contrast to the Korchin and Basowitz study, Botwinick's approach was to highly structure the situation by emphasizing the need to

shift as well as the nature of the shift required. Once the shift had been made, the series was terminated, giving no opportunity for vacillation. Under these conditions, older subjects did not have difficulty in modifying the percept, and in fact tended to shift sooner than young subjects. To Botwinick, these results indicated that slowness or unsureness in shift behavior reflected situational uncertainty rather than perceptual deficit.

Perceptual set in older persons has also been studied with another technique. One study by Botwinick, Brinley, and Robbin (1959) used Boring's ambiguous illustration of "my wife" and "my mother-in-law." In this study, subjects were male and were divided into two age groups, one with a mean age of 71 years and one with a mean age of 25 years. Subjects were shown the ambiguous figure, asked to report what they saw, told that there was another "picture" in the figure, and asked to identify it. If the alternate percept could not be discerned, it was pointed out with a less ambiguous figure and the subject was again presented with the ambiguous figure. Older subjects were significantly less likely than younger subjects to report the alternate percepts; it was concluded that they were less able to modify initial percepts.

Botwinick (1961) noted that in the study above, nearly all of the older subjects reported seeing the wife first.

This suggested that the mother-in-law may have been too difficult a percept for the older subjects and a study was designed in which the alternate percepts were more nearly equal in difficulty. The alternate percepts now became "my husband" and "my father-in-law," and subjects of both sexes were tested. This modification of stimuli did not alter the obtained results. Older males and older females were both less likely to change percepts than were young subjects of both sexes.

In summary, early studies of perceptual set indicate that older subjects are less able to reorganize or change initial perceptions than are young subjects. Evidence indicates that this may be a function of the stimuli, the situation, or both. A different approach to flexibility of perception was taken in a much more recent study by Long and Looft (1973).

Long and Looft were interested in the differential effects of perceptual set across the life-span. In their first study, normative data was obtained on 20 subjects from each of five age groups: 7-9 years, 13-17 years, 20-30 years, 40-50 years, and 60 years and over. Subjects were shown ten geometric figures and asked to name objects that they associated with these figures. No sex differences were obtained in object associations, but significant age differences were found. The greatest number of associations

were produced by the 20-30 year old group; the least number were produced by the oldest group. This finding is one sense unexpected, since the greater years of experience of older subjects should have given them more associations. It is expected on the basis of past research, however, which indicates that peak fluency or cognitive flexibility is found in subjects in their early twenties (Schaie & Strother, 1968a; Nesselroade, Schaie, & Baltes, 1972).

A new sample from a similar population was used in a second study by the same investigators. In this study, perceptual set was induced by exhibiting three photos prior to the presentation of the geometric figures. These photos were examples of dominant associations for each object (for example, a ball was presented with the circular geometric figure). The induction of perceptual set had a depressing effect upon the production of asssociations for all age groups. With one exception, a significantly lower but parallel response rate to that obtained in the first study was obtained in this study. The exception was that in this sample, the 40-50 years olds gave a slightly higher number of associations than the 20-30 year old group. The authors noted that several of the youngest and oldest subjects had considerable difficulty naming objects other than those used to induce set.

The age differences in perceptual associations observed in these two studies were explained on the basis of experiential factors. The authors believe that young adults are in the process of being educated, making life commitments, relearning and adapting to constant changes. In later life commitments are made, there is little demand for adjustment or change of habit, and physical disability may restrict contact with the environment. Long and Looft state that "such conditions may favor the concomitant development of diminution of flexibility of thought" (p. 9).

Heglin (1956) investigated the performance of young, middle-aged, and older subjects of both sexes on tests of problem solving set. Problem solving set was defined as the tendency to continue the use of a given method in problem solving, whether or not it is appropriate. Heglin presented his subjects with two kinds of problems. One type of problem was the Luchins Water Jars Test. In this test the subject is given three hypothetical water jars, each holding a different amount of water, and is asked to get a prescribed amount of water. The second type of problem was the alphabet maze test developed by Cowen, Wiener, and Hess (1953). In this task the subject is instructed to find a continuous path of words from the upper right hand corner to the lower left hand corner in a matrix of letters. In both of these tasks an habitual mode of response is established on a preliminary

series of problems. Then "critical" problems are introduced which can be solved either by the habitual mode or by a simpler, more direct solution. With these types of tasks, both susceptibility to set and ability to surmount set can be assessed. In four analyses of variance, Heglin found significant age differences on both susceptibility and surmounting scores for both tasks. The older group in general revealed more set on all measures, the middle-aged group showed less set than the older group, and the young subjects showed the least set of all. After a training procedure designed to help subjects break set, the middle-aged group performed the best of all three groups. The older subjects improved the least with training.

In contrast to the age differences found by Heglin were the results of a study by D. K. Smith (1967). Using the Water Jars Tests as a measure of problem solving set, Smith tested 100 young (aged 16-18) and 100 older (aged 54-67) females who were subdivided according to the number of set-inducing problems they were exposed to the training session. Analysis of the results showed that there was a positive relationship between number of set inducing problems and susceptibility to problem solving set, but there were no significant age differences and no age by training interaction effects. Smith stated that because previous studies failed to control for ability differences between age

groups and also employed inadequate statistics, artifacts of method rather than age were the salient features responsible for obtained age differences in set. Because Smith's results and critique are presented only in summary form (in Dissertation Abstracts) rather than in a complete journal article, this argument is difficult to evaluate.

A number of investigators have used verbal learning paradigms to investigate rigidity-flexibility in older learners. These investigations can be categorized under two headings: associative strength and habit reversal.

According to Arenberg (1973), studies of the relationship between associative strength and age should have the following rationale: preexisting linguistic habits should be stronger for older than for younger learners (on the basis of number of years of practice). These stronger habits should make older learners more susceptible to proactive interference (learning lists where response competition is high).

The usual procedure in these studies is as follows: subjects are asked to learn a paired-associate word list where response competition is high. Response competition is obtained by breaking up high associative strength word pairs, and re-pairing each stimulus word with a response word from another pair. Because the stimulus word more easily elicits a response word other than that with which it is currently

paired, the interference of previous habits with new learning can be assessed.

Lair, Moon, and Kausler (1969) used old and middle-aged subjects to study age differences in learning two paired-associate lists: one a list where there was high response competition and one a list of zero-strength pairs. Although the middle-aged group performed better on both tasks, age differences were much larger for the list high in response competition than for the zero-strength list. These results suggest that preexisting habits may make older individuals more resistant to new learning.

Another method used to assess rigidity is to ask the subject to perform a task in a manner counter to a long-practiced habit. Monge (1969) asked older subjects to do just that in a pilot study. The subjects were asked to learn a list of paired-associate words under two conditions: in one condition the stimulus word was on the left and the response word on the right. In the other condition, the stimulus word was on the right and the response word was on the left. The latter condition was predicted to be more difficult because it disrupted well established left-to-right reading habits. As predicted, the performance of the older subjects was worse on the right-left presentation than on the left-right presentation.

In 1971, Monge reported a series of three studies which were designed to further explore this problem. In the first study, 40 education graduate students ranging in age from 21-54 years (mean age was 28.5 years) learned a list of 16 paired-associates under conditions similar to those described above. Performance, in terms of number of trials to criterion, was significantly better under the traditional, left-right presentation. A second study used 32 females in each age decade of 20, 30, 40, and 50. In addition to the treatment used in previous studies, a new experimental treatment was added. This treatment consisted of paired-associate list where the stimulus word was an adjective and the response word a noun; in some instances presentation was from left to right and in other instances presentation was from right to left. For both an analysis of variance and an analysis of covariance (with educational level covaried) only the main effects of condition and age were significant. The young group performed significantly better under all treatments and the adjective-noun lists were more difficult than the regular paired-associate list. A third experiment used male and female college students as subjects. These subjects were asked to learn lists of paired-associates in a left-right or a right-left presentation order. Although females performed significantly better under both conditions, there was no significant main

effect due to treatment.

In discussing the results of all of these studies, Monge concluded that the effects he had obtained in the pilot study (1969) and in the first study in the sequence described above (1971) were not reliable. He stated that "...further trafficking with the manipulation is not likely to have a high yield" (p. 328).

Korchin and Basowitz (1957) also looked at age differences in verbal learning when they gave old (mean age 78.1 years) and young (mean age 26.8) subjects three paired-associate learing tasks which differed in the degree to which prior experience might be expected to facilitate or interfere with present learning. These tasks consisted of familiar word pairs, nonsense equations composed of letters, and false equations composed of numbers.

Main effects for age and task were obtained, with young subjects performing better on all tasks, and with both age groups performing best on the familiar word pairs. The latter finding illustrates that in some cases prior experience is a help rather than a hindrance. Within groups, no significant difference was found in performance on the nonsense and false equation tasks. The false equation task was designed as a measure of the interference of previous learning, but neither group had more difficulty with this "interference" task than with the nonsense equation task. In

that sense, the older subjects in this study were not more rigid.

In discussing the results of this study, the authors noticed that older subjects tended to either respond correctly or not at all. For the older group, the proportion of "no response" errors remained high throughout learning. These errors of omission were interpreted by Korchin and Basowitz as a personality defense in which recognition of inadequacy is avoided.

Although a number of cross-sectional studies of concept attainment exist, not all of these are relevant to a discussion of rigidity. Those which are relevant are studies where shifting or changing of concepts is required.

An early study was done by Kay (1951). Ten subjects in each decade from 10 through 70 learned a particular sequence of keys which extinguished a series of lights. The appropriate sequence was frequently varied and new sequences were often combinations of old sequences. On all learning series, the older subjects performed worse in terms of time required, number of trials to criterion, and number of errors made. An analysis of the errors showed that older subjects exaggerated the repetitive tendencies typical of all age groups. The author concluded that, in general, rigidity was higher in the older age groups.

Wetherick (1965) presented young, middle-aged, and old male subjects with a series of cards upon which there were four letters. The subject's task was to find out which category the card belonged in based upon which attribute the letters of a particular card represented. When the subject had given ten correct responses in a row, he was shifted to a new concept.

Although subjects were matched on non-verbal intelligence and reached criterion with little difficulty, the proportion of good performances fell with age. Old subjects appeared to find the shifts much more difficult than young subjects; on all four concepts presented the old group showed a disinclination to change an established concept, even when it was demonstrated to be incorrect. Wetherick felt that their inflexibility in shifting was due to a failure to correctly use negative instances (mistakes) in forming judgements. He concluded that the stereotype of the rigid older person was clearly upheld.

The long history of the study of rigidity is demonstrated in a study by Ruch (1934). Ruch presented 40 subjects from three age groups (12-17 years, 34-59 years, 60-82 years) with a number of motor and verbal tasks that called for direct inhibition of previously learned behavior, use of previously formed habits, or neither. The motor tasks consisted of direct-vision rotor pursuit (representing an old

habit) and a mirror-vision rotor pursuit (representing a reorganization of an old habit). The deficits of the old age group were clearly apparent on the mirror-vision task. The verbal tasks included learning nonsense and false equations; performance on false products showed the greatest decline with age.

A number of other studies find similar results for tasks involving motor skills. Snoddy (1926) had subjects trace a figure directly and from a mirror-image (where left-right relationships are reversed). He reported the mirror-vision tracing was particularly difficult for older subjects. Welford (1951) reported that age deficits were apparent when subjects were asked to trace numerals directly and indirectly via a mirror image. The mirror image numerals were particularly difficult for the older group. Botwinick (1959) reported an unpublished study where young and old groups were asked to trace a six-pointed star directly and indirectly with a mirror. His results were similar to those obtained in other studies.

British researchers in particular have long been concerned with the problems of rigidity in old age. Studies in this area range from anecdotal to experimental, and the "older" subject referred to can be anyone over 35 years of age.

An early industrial study was carried out by Shooter, Schoenfield, King, and Welford (1956). The industrial task of interest was a program in which tram drivers were being retrained as bus drivers. During a three week training program, records were kept of exam scores, staff ratings, length to criterion performance, and measured progress at the actual task. Unless they had had previous experience with motor vehicles, the older persons in this program learned more poorly. In particular, they tended to pass too widely or too narrowly, indicating that habits learned while driving trams were persisting into the new situation. The authors concluded that those persons involved in the retraining of older workers should be aware that training this age group for a new job may be difficult because it requires the modification of deeply ingrained habits.

A later study by Shooter explored the difficulties involved with changing from horse-drawn to mechanical transportation for a particular company. Workers were differentiated on the basis of age and previous experience. Shooter found that up to the age of forty, previous experience with horse-drawn transportation helped in learning the new task. After the age of forty, previous experience with horses interfered with the acquisition of skills necessary for mechanized transportation.

Speakman (1954) describes a natural experiment which gave different results than those obtained in the two studies just described. In 1951, the British government redistributed the colors of some of the British postage stamps. This redistribution provided a good way to test the influence of previous habits in different age groups in overcoming the now inaccurate associations linked with each color. Two years after the redistribution, approximately 10 persons in six age decades from 20 to 86 years were tested on six stamps, each of a different color and with the numerical value obscured. The results were surprising: memory for the old values declined with age and knowledge of the new values did not appear to be related to age. Although these results did not support the hypothesis that older persons are more rigid, Botwinick (1959) points out that the two year time span between the change and the testing may have been too long. He suggested that a better test of rigidity in this situation would have been to test persons two months after the change rather than two years after.

In a more recent review, Chown (1972) reported the results of several studies in which an attempt was made to determine if tests of flexibility-rigidity were useful indicators of performance in real-life situations. Her battery of rigidity tests included measures of fluency, problem-solving, personality, speed, and motor habit

modification. Not all of these tests were used in each study. In addition to providing evidence for the validity of various measures, several of these studies examine age differences in degree of rigidity in real-life situations.

In the first investigation, men ranging in age from 26 to 62 years were placed in a new department where they were required to adapt to the automation of a chemical processing procedure. Success in adaptation was determined by foremen's ratings. Measures of speed and adaptive flexibility (fluency) were positively related to ratings for quickness to learn and good workmanship; age was negatively correlated with each of these factors.

The second investigation was concerned with the output rate of complaint clerks in a mail-order firm, a job requiring skillful handling of a wide range of problems every day. The workers were women aged 17-54 whose productivity was assessed over a six-week period. Productivity was positively related to speed of writing, positively associated with ability to modify writing habits, and negatively associated with age; rate of improvement was positively associated with fluency.

In a third investigation, subjects were asked to follow alternating simple and complex patterns of putting electrical sockets into boxes. Subjects were 16 men from each of three age groups with median ages of 25, 45, and 65 years. Using

simple packing speed as a criterion, Chown found that those who were quick at packing tests tended to be young, of above average non-verbal intelligence, high scorers on measures of speed, and high scorers on measures of motor habit modification.

In the final investigation in this series, Chown considered the relationship of spontaneous flexibility (fluency) to performance in learning from a programmed text. She hypothesized that despite the decline of non-verbal intelligence with age (which she said detrimentally affected flexibility) individual differences in spontaneous flexibility exist independently of age and intelligence. Since flexibility and programmed text scores are correlated (according to the author), if subjects were matched for non-verbal intelligence, then ability to profit from programmed instruction would be unrelated to age and intelligence but would be related to performance on tests of spontaneous flexibility.

Subjects were females divided into four groups equated for scores on tests of non-verbal intelligence and vocabulary. Two of the groups had an average age of 54 and two had an average age of 28. All groups were composed of ten subjects and all were told that the method of instruction rather than personal ability was being tested. One group from each age used the programmed text in the manner in which

it had been constructed; the other two groups used the text written in a conventional manner. A test of knowledge gained from the test was correlated with several tests of spontaneous flexibility. Although age differences were found in ability to profit from programmed instruction (with older subjects in this group learning the least of any group), success in programmed instruction was unrelated to non-verbal intelligence, vocabulary, and three of the four flexibility tasks. The hypothesis that spontaneous flexibility would be related to ability to profit from programmed instruction was not upheld.

In attempting to give some meaning to this smorgasbord of settings, methods, and findings, Chown suggested the following: in selecting individuals for tasks for predicting their behavior in other settings, it would be wiser to select on the basis of rigidity scores than on the basis of chronological age--the size of the correlations indicating the relationship of age with job criteria were smaller than those correlations for rigidity scores and job criteria.

The implications of this review can be discussed under two headings: the nature and the extent of rigidity among older learners. It is clear that rigidity is not a unidimensional construct. Chown (1959), in a review of the rigidity literature, pointed this out by titling her review, "Rigidity--A Flexible Concept." Botwinick (1973) also

emphasizes the varieties of rigidity by titling a chapter, "Multidimensional Rigidity." One definite trend in the rigidity literature has been a change from viewing rigidity as a global construct to viewing it as differentiated.

The extent to which rigidity is a characteristic of the older person is difficult to clearly evaluate. Although many studies show expected age differences, others do not. These discrepancies are perhaps not too surprising considering the heterogeneity of subjects, methods, and measures employed. Age differences appear most readily on motor and perceptual tasks, but the evidence for other areas is more ambiguous.

The next section of this paper discusses rigidity as a multidimensional construct. It will consider not only what dimensions or factors characterize rigidity in older learners, but also age differences in performance on the tasks that comprise these factors.

Rigidity as a Multidimensional Construct

Two major investigators interested in rigidity from a developmental and a multidimensional point of view have been Sheila Chown and K. Warner Schaie. Both have emphasized the structure of rigidity at different ages as well as age differences and changes in rigid behavior.

The purpose of Chown's (1961) study was to examine the relationship between rigidity and age. This examination

involved three stages: (a) discovering the factorial structure of tests included in rigidity battery; (b) discovering whether the factorial structure obtained changed with age; and (c) discovering if age affected performance on different tests of rigidity.

Sixteen tests of rigidity and two tests of intelligence (Progressive Matrices and Mill Hill Vocabulary) were administered to 200 males who ranged in age from 20-82 years. Administration time was two-and-a-half hours. Scores on the vocabulary tests were higher among older subjects until the 70 year age group while scores on the Ravens rose until the 30's and then fell off linearly.

One principal components factor analysis was carried out on data for the entire sample. In this analysis, the factors of non-verbal intelligence and age accounted for 20% and 9.8% of the variance respectively. After age and intelligence were partialed out, five distinct rigidity factors remained. These factors included: (a) Spontaneous Flexibility, representing such tests as Brick Uses, Unusual Uses, Object Naming, and accounting for 7.8% of the variance; (b) Personality Rigidity, as measured by the Wesley Rigidity Inventory, and accounting for 5.2% of the variance; (c) Speed, accounting for 7.2% of the variance; and (d) two Disposition Rigidity factors, one representing writing backwards and one representing writing capitals and small

letters alternately, accounting for 5.5 and 4.8% of the variance respectively.

Separate principal components factor analyses were conducted on the data from young (mean age 26.4 years), middle-aged (mean age 40.7 years), and old (mean age 60.7 years) subsamples drawn from the main sample. Although Chown noted that the size of these samples was too small for any results to be conclusive, findings indicated that Non-verbal Intelligence, Spontaneous Flexibility, and Personality Rigidity were factors which were highly similar in all age groups. A factor characterized by liking for detailed work emerged only in the old group. Another change was in the Speed factor, which was distinct in the young group and diffuse in the old group, loading primarily on Non-Verbal Intelligence (but also on others).

Age appeared to have an effect on rigidity scores. On the six tests making up the Spontaneous Flexibility factor (which is thought to measure the ability to think in different ways), average performance increased with age into the 40's and decreased after the late 50's. On the six tests comprising the Speed factor (which is thought to measure the rate of performing usual and unusual motor habits), average performance showed a slight increase with age into the early 60's and then fell off markedly. Scores on Disposition Rigidity factors (thought to measure motor rigidity) did not

show a consistent decline with age. Non-verbal Intelligence showed a consistent age decline.

A finding emphasized by Chown was that only a very small number of tests (primarily measures of Disposition rigidity) displayed a relationship with age as distinct with a relationship with intelligence. These tests included matches, hidden figures, writing letters double, and liking for habit. The author concluded that the effects of low intelligence seemed to be much more far-reaching than the effects of age per se. A second major multivariate study of rigidity was a longitudinal project conducted by Schaie and his coworkers. In the first study, Schaie (1958) tested a sample of 500 subjects, representing quotas of 25 males and 25 females from each 5-year age interval from 21-70 years. This stratified sample was drawn from a population base consisting of 18,000 members of a prepaid medical plan. The rigidity battery was composed of four tests: a test where capitals were substituted for lower case letters and vice-versa when copying a paragraph; a test where synonyms were given to words from a list when the word was in lower case and antonyms when the word was in capitals; and two tests which involved the assessment of opinion. Significant age decrements were found for each of the three factors extracted. These three factors, listed in order of onset of decline, were labeled Motor-Cognitive rigidity (referring to

the ability to shift readily in the use of familiar patterns of response), Personality-Perceptual rigidity (referring to the acquisition of new modes of responding in interpersonal contexts), and Psychomotor Speed (referring to speed of emission of familiar responses). In a sample of subjects aged 70-86 years, similar results were obtained both in terms of factors obtained and in terms of an age decrement (Strother, Schaie, & Horst, 1957).

The subjects from this first cross-sectional study were retested after seven years (Schaie & Strother, 1968). This follow-up permitted the investigators to estimate composite longitudinal gradients. Comparison of the estimated longitudinal gradients with the cross-sectional gradients revealed that the cross-sectional data had underestimated the age decrement for Psychomotor Speed, indicating that response speed and fluency are declining not only maturationally within generations, but also in successive generations. No longitudinal decrement was found for motor-cognitive rigidity, indicating that the cross-sectional findings reflected differences between generations rather than maturational changes. Thus it seems that life-long practice may make people more flexible in dealing with familiar situations, and that this flexibility is increasing in successive generations. Some decrement was also found in the longitudinal analysis of Personality-Perceptual rigidity.

A factor analytic study of rigidity in middle-aged subjects was done by Mangan and Clark (1958). The factor analysis was performed on four reasoning tests, three Einstellung tests, two motor rigidity tests, and two perceptual rigidity tests. The test battery was administered in two sessions of one hour each to 30 women and 20 men in the age range 40-55 years. One factor obtained was a reasoning factor, two factors were minor factors of motor and perceptual rigidity, and a fourth factor was described as a general "attitude toward test-taking factor." The latter factor accounted for the largest portion of the variance (28%) and was probably a composite of cognitive rigidity or Einstellung factor, and of the general anxiety and apprehension of middle-aged subjects in the testing situation.

One conclusion that can be drawn from these multivariate studies is that rigidity is a construct composed of several dimensions. Some of these appear to be perceptual-motor and decline with age is usually apparent. Another common component appears to be a fluency or flexibility factor. Age differences in this factor are less clear. A final factor, and one which is important for the present study, is the "attitude toward test-taking factor" proposed by Mangan and Clark (1958). This factor, which possesses both cognitive and personality components, is found in middle-aged

subjects--its presence in other age groups has not yet been demonstrated. A summary of these studies is found in Chown (1972).

Both the univariate and multivariate studies partially support the stereotype of the rigid older learner, but the nature and extent of this rigidity appear to vary widely. The purpose of the forthcoming section is to examine a variety of hypotheses which might account for the appearance of rigid behavior in old age. In keeping with the emphasis of the present study, the major focus will be on behavioral rather than personality rigidity.

Hypotheses Concerning the Origins of Rigidity

The first hypothesis suggests that rigidity results from changes in or damage to the nervous system of the older individual. That brain deterioration does accompany old age is well documented (Horn, 1970), but the influence of that deterioration on rigidity is not yet established.

This hypothesis has intrigued a number of theorists. Hebb (1958) has offered a biological explanation of rigidity based on the concept of phase sequences. Hebb states that when an individual is faced with a problem, there is a tendency to use an already established phase sequence in the solution, whether appropriate or not. Hebb adds that the older an organism is, the more practiced and tenacious

existing phase sequences become.

Many early personality theorists conceived of rigidity from a biological viewpoint. Luchins (1959) considers several major theorists in detail and the descriptions of theories presented here are taken from his discussion. Goldstein investigated the effect of brain injury on personality and differentiated two types of rigidity: primary and secondary. Primary rigidity refers to the inability to change from one set to another and is observed in persons with subcortical lesions. Secondary rigidity refers to an impairment in the capacity for abstract thinking and is observed in persons suffering from cortical damage.

Werner's comparative-developmental approach also has a biological flavor. In Werner's system, rigidity is a lack of differentiation between the organism and the environment. This lack of differentiation, which results in non-adaptability, occurs mainly in children, but it is also observed in individuals with damaged or diseased brains. Lewin's topological approach to rigidity is based upon the permeability of neural "regions" which undergo changes with age.

The theories are primarily speculative rather than empirical. Reid and Reitan (1963) and Fitzhugh, Fitzhugh, and Reitan (1964) have explored the question of the relationship between neurological damage and ability and have

demonstrated the patients, both old and young, with brain damage and epileptic-like disorders have impaired problem solving capacities. They have not looked at the effects of these conditions on rigidity nor have they established whether the neural condition of their patients is equivalent to that which occurs as part of the aging process. This is an area in need of further research.

Another way of judging the usefulness of a biological decrement hypothesis is to consider rigidity in aging members of other species. These studies should be especially useful because observed age differences and/or changes should reflect maturational change rather than cohort effects.

A number of animal studies of rigidity have been conducted. Birren (1962) had pubescent, middle-aged, and elderly rats swim a two-choice water maze. The correct route through the maze was then reversed. Birren found no age differences in ability to learn the reversal. Kay and Sime (1962a, 1962b) studied shape discrimination in young and old rats. Animals learned to respond to one member of a pair of shapes (for a spaghetti reward) and then had to respond to the other member. Kay and Sime reported several variations on this procedure, but found no age differences in either shape discrimination or reversal learning. Botwinick, Brinley, and Robbin (1962) used old, middle-aged, and pubescent rats in a single and a double unit maze. Age

differences in reversal learning were unreliable. Although the overall performance of the old rats was poorer, they were not significantly more rigid than the young rats (in that their performance on the reversal conditions was little different from their performance on the original learning trials).

The studies of aging rats provide little evidence for rigidity due to purely biological aging. A study by Bernstein (1961) with aging chimps also failed to provide evidence. Bernstein did a series of studies to investigate reversal learning and response bias in young adult and aged chimps. He found no age differences in perseveration scores, and concluded that individual differences within the age groups were of such magnitude as to mask any age differences that might have existed.

In summary, animal studies do not support the hypothesis of increased rigidity in old age as a result of biological deterioration. Although further research with human subjects may find support for this hypothesis, it does not appear to be a fruitful one for the present study. As Schaie's (1968) sequential analysis reveals, most age-rigidity differences reflect cohort differences rather than maturational change (Psychomotor Speed appears to be an exception to this).

The second hypothesis suggests that older persons behave more rigidly because of generational differences in

childrearing and educational practices. Younger persons may behave less rigidly because of experience with open classrooms and inductive methods of discipline. In other words, older persons are more rigid because they have learned to be that way.

The primary proponents of the theory that rigidity is learned are Rotter and Schroeder (1954). Rotter and Schroeder hypothesized that rigidity is a learned behavioral tendency which, because of a long history of association with reinforcement, persists despite the availability of more adaptive alternatives. They suggest that it should be fruitful to consider rigidity not as a global trait but rather as a behavior triggered by the reinforcement history of the individual and contemporaneous events. This theory does not deal specifically with aging and most of the research it has generated has been done will college age samples. Both Grant and Berg (1948) and Buss (1952) examined the effects of different amounts and schedules of reinforcement on rigid behavior in college students. A more recent study by Bry and Nawas (1969) compared fixed ratio, fixed interval, and direct reinforcement for high and low rates of responding on frequency of rigid behaviors in a concept formation task, again using college students as subjects.

It appears that two studies approaching rigidity from a learning viewpoint have been done with older subjects. Jamieson (1969) attempted to test Schroeder and Rotter's hypothesis that conditions of prior learning which demand changes in response result in positive transfer to a subsequent task, permitting flexible responding. Jamieson tested 52 subjects over the age of 40 (mean age 55) and 52 subjects under the age of 40 (mean age 29) on card sorting task. One group from each age group underwent learning trials in which only one solution was correct. Another group from each age group underwent learning trials in which the correct solution varied. On the criterion trials, shifting solutions was required. The method of prior learning had a significant effect on subsequent performance; both older and younger subjects were more likely to give flexible responses (to try different methods of grouping) if their prior learning had been of this nature. Although the younger subjects showed distinct superiority on both learning and criterion trials, for both age groups the ability to shift or give flexible responses was not related to non-verbal intelligence (as measured by Progressive Matrices). The author cautioned that this study dealt strictly with the capacity of various subgroups to behave flexibly under certain conditions, and not with the issue of whether these subgroups are inherently less flexible.

A second study (K. K. Coleman, 1963) examined the modification of preexisting rigidity in hospitalized Veterans Administration hospital patients. The purpose of Coleman's study was to determine if rigidity in aged subjects could be modified through operant procedures. Rigidity was operationally defined as the error score achieved on a simple concept formation task. This score reflected the ability of subjects to shift their attention among randomly presented concepts of color, shape, and size. The types of rewards given for shift behavior were verbal praise, pennies, or the sound of a bell. A control group received no reward. Subjects were 72 geriatric-psychiatric patients who had been diagnosed as either chronic brain syndrome or psychotic. Generalization of training was assessed by the use of a second and similar concept formation test.

Results indicated that rewarding flexible behavior resulted in significant decrease in the amount of rigidity shown. All three types of reward were equally effective. No generalization of flexible behavior to the second task was evidenced. There was no effect of diagnosis (psychotic versus chronic brain syndrome), but the variables of age and intelligence were both directly related to higher error scores. The correlation with age indicated that the older the subject (all subjects were over age 65), the greater the rigidity. The author interpreted the correlation of rigidity

and IQ as indicating that with increased rigidity, intellectual efficiency decreases.

The studies reviewed in this section indicate that environmental contingencies do affect rigid behavior. With operant procedures, the frequency of rigid behavior can be manipulated. The question of whether age differences in rigidity are due to learning is still open. Experimental evidence that rigid behavior can be both induced and reduced does not necessarily imply that older persons who are more rigid learned to be that way. No one has yet identified specific events in the reinforcement histories of older individuals that would establish the learning hypothesis as a strong one.

The third hypothesis suggests that the reason more rigid behavior is observed in older persons is because rigid persons tend to outlive non-rigid persons. Selective survival implies that some behavior patterns of a species are more adaptive than others (a paradox in the case of rigidity) and that members of the species who exhibit the patterns will outlive those who do not. As far as the writer can determine, the selective survival value of rigidity has not been studied in any species.

There is evidence that individual differences in adaptability and rigidity exist beginning early in life. The longitudinal research of Thomas, Chess, Birch, Hertzig, and

Korn (1963) indicates that slowness or quickness to adapt to new experiences is a fairly consistent behavioral style, beginning in early infancy and persisting at least into adolescence. Blum (1959) found evidence for individual differences in perceptual set in childhood. He used the Children's Transition Test, which involves a series of five figures gradually changing from a cat to dog. Children were ranked according to how soon their judgment of "cat" or "dog" shifted, and according to how many shifts were made. Some children made many, early shifts; others made few shifts or no shifts at all. As noted above, there is no evidence as to whether these individual differences persist into old age or have any selective advantage during that time.

There has been one brief longitudinal study with older adults which is relevant to this hypothesis. Riegel and Riegel (1972) first tested 190 males and 190 females between 55 and 70 years of age. Upon retesting five years later, 202 subjects participated, 110 refused to be tested, and 60 had died. Retesting again ten years later revealed that more of the retestees were still alive and that non-survivors at all age levels had higher rigidity levels. In this case rigidity had a selective disadvantage (until age 75 where all differences disappeared.

Although a longitudinal study covering a greater portion of the lifespan would provide more information on the

survival value of rigidity than the brief study by Riegel and Riegel, this hypothesis does not appear to be supported.

A major question in studies of rigidity in old age has concerned whether lower intelligence or "g" is responsible for greater rigidity. The fact that on the average older persons have a lower overall IQ and are less adept at problem solving and critical thinking has been well-documented (Friend & Zubek, 1958; Verhage, 1965).

The primary proponent of the argument that rigidity is the result of lower intelligence (especially the problem solving kind) rather than age per se is Chown (1961). In discussing the results of her factor analytic study of rigidity, Chown stressed the point that the subject's level of non-verbal intelligence played a part in his performance on most kinds of rigidity tests except those of dispositional rigidity. In light of the high proportion of variance accounted for by intelligence in her analysis, she concluded that the effects of low intelligence "seemed to be more far-reaching that an increase in age as such" (p. 362).

Support for Chown's position has come from a number of other investigators. Brinley (1965), who found rigidity factors accounting for slightly more of the variance in a young group than in an old group, attributed greater rigidity in later life to a decline in general ability. He suggested that rigidity tasks are intrinsically more difficult than

non-rigidity tasks. D. K. Smith (1967) found that when subjects were similar on non-verbal intelligence, there were no age differences in performance on Luchin's Water Jars Test. Esbenshade (1960) tested young and old subjects on the Water Jars Problem and on the Wisconsin Card Sorting Task and Administered Raven's Progressive Matrices Test. She found that dull subjects of both ages were more rigid than bright subjects and that rigidity bore no significant relationship to age, per se.

There is also considerable support for the notion that age differences in rigidity exist over and above age differences in intelligence. A major proponent of this argument is Schaie (1958). In his cross-sectional study, Schaie found that age differences in rigidity remained even after the results were covaried for scores on Thurstone's Primary Mental Abilities Test. Schields (1958) gave young and old adult females four tests of "ideational" rigidity and statistically removed scores on a test of verbal intelligence from scores on the rigidity measures. She found that the two age groups were still quite different in terms of rigidity, even when the effects of intellectual functioning were discounted. Her conclusion was that age was a more important determiner of rigidity than was intelligence. In a study of perceptual set discussed earlier, Korchin and Basowitz (1956) checked the influence of intelligence by comparing scores of

the young group (who were brighter on the average than old group) with a matched subsample from the older group. Despite this equation for intelligence (as determined by a vocabulary test), age differences in rigidity still persisted.

In actuality, as Chown (1959) admits, the argument is circular. This is because it is difficult to tell whether lower capacity makes older persons more rigid or whether increased rigidity negatively influences performance on intelligence tests. The best solution would seem to be to equate young and old groups on some index of intelligence (such as a test of reasoning or vocabulary, or for yars of education) so that the influence of other variables on rigid behavior can be more clearly explored.

The fourth hypothesis suggests that an intervening state, such as anxiety or arousal, rather than age is responsible for the apparent increase in rigidity seen in older individuals. The older person may become anxious in a formal learning or problem solving situation because of lack of recent experience in academic settings. Many subjects, tested at the age of 60 or 70, have been away from formal learning experiences for 50 or 60 years. Investigators often try to get around this problem by equating young and old subjects for number of years of education, but as Jones (1959) points out, groups equated for years of education are

not always equal since quality of education may have changed over time. In this case, lack of recent familiarity or experience may cause older subjects to feel uncomfortable or anxious.

Older persons have also been demonstrated to behave somewhat rigidly in industrial situations where new skills are taught. Again, this rigidity may be due to the pressures of the situation. A middle-aged or older person has much at stake in a learning situation. If he does not learn the new skills successfully, he is faced with the frightening prospect of loss of a job or demotion to a less skilled, lower paying position. In many cases, he is in competition with workers many years younger than he, and he may feel threatened by his perception of them as more competent and more desired by his employer. Shooter, Schoenfield, King, and Welford (1956) emphasize the point that when retraining older workers care should be taken to avoid such threatening situations.

Other investigators have offered similar speculations with regard to laboratory learning. Monge (1969) believes that rigidity in older persons can be attributed to deficiencies in learning set. Because of lack of recent experience with a variety of circumstances requiring new learning, learning habits or sets deteriorate. The older subject forgets how to learn (in terms of how to study, pay

attention, organize work, etc.) and his awareness of this deficiency is threatening. According to Monge, the older person may react with anxiety to this awareness, and the anxiety manifests itself in the form of rigid behavior. As a result of a series of serial rote learning studies with older subjects (where fast stimulus pacing was found to result in an increase in errors of omission), Eisdorfer (1965, 1970) suggests that older individuals structure their responses in order to avoid experiencing failure or anxiety.

Two lines of evidence are necessary to substantiate the speculations just discussed. First, there should be evidence that older learners are indeed more anxious in learning situations. Second, there should be evidence for a correlation between situational stress (presumed to result in anxiety) and rigid behavior.

Are Older Learners More Anxious?

The primary evidence for anxiety in older learners comes from a series of studies done by Eisdorfer and his coworkers at Duke University. Eisdorfer was interested in the role of internal arousal in learning, especially as manifested by the process of lipid mobilization. It appears that the level of free fatty acids (FFA) in the plasma component of the blood is closely related to the level of arousal of the autonomic nervous system. To assess arousal during serial rote

learning studies, Eisdorfer placed indwelling needles in subjects' forearms to collect blood samples. He stated that the needle caused no pain or "undue" discomfort.

The subjects in the first study to be discussed (Eisdorfer, 1968) were hospital patients. Subjects were excluded in cases where physical problems, such as obesity, disorders of fat metabolism, and central nervous system impairments, might confound results. There were 48 subjects divided into two groups (all males). The young group had a mean age of 38.1 years; the old group had a mean age of 71.4 years. Subjects were required to learn eight lists of eight five-letter words, with exposure time to words in the list varied. A trial consisted of all eight lists, and there were fifteen trials. Blood samples were taken on the following occasions: 30, 15, and 0 minutes prior to testing; after the 5th, 10th, and 15th trials; every 15 minutes for an hour after testing.

Results indicated that FFA levels were significantly higher for old subjects at all points of testing. Both groups showed an FFA decline during the resting phase prior to trials and a rise in FFA at the beginning of the test. The peak FFA for young subjects was after the fifth trial and levels declined thereafter. The peak FFA for old subjects came 15 minutes after the learning session was over and remained elevated throughout the final rest period.

Eisdorfer cites a number of other studies which have also found higher and longer arousal in older subjects. Two are of particular interest from the standpoint of situational anxiety. Powell, Eisdorfer, and Bogdanoff (1964) hypothesized that as a result of being told the day before about being in an experiment, subjects came to the experimental situation in a state of high arousal. Accordingly, in a second study (Troyer, Eisdorfer, Bogdanoff, & Wilkie, 1967) an attempt was made to manipulate arousal. Serial rote learning under fast (4 sec.) and slow (10 sec.) pacing was administered to six groups of males all over age 60 under three levels of experimental stress. The conditions of stress were as follows: a no stress condition in which subjects were tested without being attached to physiological equipment; a maximum stress condition in which subjects were fasted before testing and attached to a variety of physiological apparatus during testing; and a reduced stress condition where subjects brought to the laboratory the day before testing, given a different task to perform, and given a chance to become adapted to the physiological apparatus which would be used the next day. The latter condition was designed to reduce the stress associated with the experimental situation.

A main effect for exposure time was obtained, with learning errors greatest for all groups under the four second

exposure time. More important for the purposes of this discussion was an obtained interaction between exposure time and experimental treatment. For the no stress and reduced stress groups, the longer exposure time (10 seconds) significantly decreased mean total errors. In the maximum stress group, the longer exposure time had no significant effect on error rate--as many mistakes were made under slow presentation as under the fast presentation.

These results suggest that familiarizing the subjects with aspects of the experimental setting which are threatening (in this case physiological apparatus) improves performance as much as a condition in which threat is minimal.

A further attempt to minimize arousal so as to improve performance was a study by Eisdorfer, Nowlin, and Wilkie (1970). They hypothesized that feedback to the central nervous system from the effects of autonomic arousal might be a factor interfering with learning in older persons under stress. To test this, one group of old experimental subjects was given an injection of propanolol immediately before participating in a learning experiment. Propanolol blocks autonomic receptor sites in the peripheral nervous system, but does not affect central processes. One of the effects of this blockage should be heart slowing with decreased blood pressure and blood flow. A control group of subjects

received a placebo injection. Measures of galvanic skin response, heart rate, and free fatty acids were taken while subjects performed a serial list learning task.

The experimental group made significantly fewer errors, had significantly lower heart rate, and had significantly lower FFA than the control group. The authors reached two primary conclusions: (a) the modification of the autonomic nervous system with pharmacologic agents can improve the performance of older persons and (b) that a state of increased "autonomic end-organ arousal" may account for a significantly large portion of the learning deficit seen in older learners.

This series of studies provide the most direct evidence that older learners find certain experimental situations and procedures anxiety-provoking, and that a reduction in perceived threat or autonomic arousal improves performance. The evidence concerning autonomic arousal in general in elderly subjects is far from clear however. Thompson and Marsh (1973), in a review of evidence concerning measures of autonomic arousal in the aged, find that with the exception of FFA, other indices of autonomic arousal such as heart rate and blood pressure, vasomotor reactivity, skin potential, and skin temperature reflect less autonomic reactivity in older subjects (in contrast to younger subjects) during states of focused attention and increased activation. In light of

these findings, it is difficult to understand how a lowering of FFA would improve performance. Thompson and Marsh offer a number of speculations to account for this discrepancy. One hypothesis is that in older persons traditional autonomic measures may not accurately reflect arousal; another is that since different autonomic end organs show differential change with age, measures of autonomic arousal may show increasing variability and divergence in old age. A third hypothesis is that because of differential deterioration, feedback from peripheral end organs to the central nervous system might be distorted, causing some systems to undergo minimum change while other systems might undergo maximum change. Other explanations are offered, but the only clear conclusion reached in this discussion is that while autonomic processes may play a more important role in cognition in older adults than had been realized, the nature of this arousal needs extensive research.

There is little direct evidence other than that offered by Eisdorfer and his colleagues regarding the degree of anxiety in older learners. The literature on general anxiety in the aging population is not extensive. Chown (1968) cites a study in which anxiety (as measured by Cattell's 16 PF test) increased with age in persons between 6 and 90 years of age. She speculates that anxiety may decrease until late middle age and then increase, but she cautions that different

samples will yield different results. In another review, Kuhlen (1959) summarizes available evidence by stating that anxiety varies little with adult age as long as life is reasonably normal, but aging losses will be evident when the individual is faced with threatening or stressful situations. In another study using Cattell's 16 PF Test, Byrd (1959) found that for an older sample (ages 65-90) higher anxiety for the older subjects was found on all questionnaire factors scored for the anxiety dimension except for the factor of anxiety control.

Indirect but relevant evidence comes from a variety of other sources. Botwinick (1973) devotes an entire chapter in his review to personality and cognition in cautious behavior. One frequently observed response in the elderly is a tendency to make errors of omission. This tendency not to respond has been seen in older subjects in the contexts of intelligence testing, paired-associate and serial learning, and perceptual learning. Errors of omission are interpreted by Botwinick as a reflection of the decreased self-confidence of older persons. As self-confidence decreases, the need for certainty increases. Omission errors may arise from a desire for certainty. In other words, it may be better not to respond than to be wrong, because avoidance of response delays failure and saves self-esteem. This explanation of errors of omission is supported by studies showing that older

persons respond better in structured situations (where uncertainty is minimized) than in unstructured situations. Botwinick goes on to suggest that anxiety may be part of the cautiousness associated with feelings of inadequacy resulting from declining abilities and general cultural expectations. He states that errors of omission and similar behaviors can be seen as a general withdrawal associated with a high level of anxiety.

At this stage, evidence for the hypothesis that older learners are more anxious than younger learners is neither extensive nor entirely clear. Some studies, especially those by Eisdorfer, do suggest however that anxiety in older learners may be a reality and may play a role in their poorer performance.

The Relationship Between Stress and Rigidity

The effect of anxiety on problem solving rigidity has been documented in both human and animal subjects. Kimble and Garmezy (1968) reported a relevant series of studies conducted by Norman Maier in the 1940's. Maier frustrated rats (presumably making them more anxious) in the following manner: rats were placed on a Lashley jump stand, where they learned to jump toward one of two discriminable stimuli. If they jumped toward the correct one, they hit an unlocked door which led to a food reward. If they jumped toward the

incorrect stimulus, they hit a locked door and fell into a net below the jump stand. Maier made this discrimination problem unsolvable by randomly rewarding choice of either stimuli, so that neither was "correct." The rats were flexible at first in this situation, seeming to try a number of hypotheses, but they finally refused tc jump at all. Maier then forced the animals to jump by shocking, prodding, or blasting with a shot of air. This resulted in the development of a fixated or rigid response, in most cases a position response toward either the right or the left side. This rigid, stereotyped response persisted for hundreds of trials, despite punishment. Kimble and Garmezy (1968) illustrate the extreme inflexibility of this responding when they describe how rats continued to jump toward their preferred side, even when the alternative side had the door open and the food in plain sight. They report that Maier believed the stereotyped responding to be a means of anxiety reduction. Another example of rigidity in the animal literature might be the "learned helplessness" phenomenon discussed by Maier, Seligman, and Solomon (1971). In learned helplessness studies, an animal is placed in a hurdle box, where ordinarily it can jump over a separating hurdle from one side of the box to the other. The floor of the box is an electrified grid. In this case, however, the hurdle is too high for the animal to jump over and it is given an

inescapable shock. After a number of these inescapable shocks, the animal adopts a passive response of cringing and whimpering, meanwhile making no attempt to jump. Subsequently, when the opportunity for an avoidance jump is made possible, the animal refuses, instead relying on the behavior that appears to have been most adaptive in the original situation. This "masochism" is an example of extreme rigidity, wherein an organism persists in behaving in a manner now maladaptive in a situation associated with stress. A final example from the animal literature comes from Berkson (1966), who reported that chimpanzees were more likely to display stereotyped behaviors when they were aroused or excited.

Studies of the effects of stress on human behavior have used children and college students as subjects. In a series of studies where water jar tests were given to school children under varying conditions of stress, such as speeded instructions, Luchins (1959) found greater problem solving rigidity than under non-stressed conditions. He also summarized a number of early studies done with college students, reporting that the greater the ego threat (such as solving problems under evaluative conditions) the greater amount of rigid behavior was shown. In another study using water jars problems, Pally (1955) found that college students who experienced failure by fictitious norms showed

significantly more rigid behavior. Howard (1972), again using a form of the water jars tests, found greater rigidity in students who experienced induced failure expectancy.

Ausubel, Schiff, and Goldman (1969) studied the effect of anxiety on what they termed "improvising ability." Improvising ability referred to the capacity to use varied, extemporaneous, or unfamiliar responses in the solution of novel problems. In other words, it is the ability to free one's self from the perseverative influence of previously learned behavior patterns which are now maladaptive. Ausubel, Schiff, and Goldman used 285 college students (the majority of whom were female) as subject in an experiment with two tasks. The first task required the tracing of a six pointed star via a mirror. This task required the abandonment of established eye-hand coordination. The second task involved learning a stylus maze blindfolded. This task required the subject to solve a problem in spatial orientation without the customary visual cues. The subjects were given a number of Rorschach stimuli to determine level of anxiety, and results indicated that those subjects low in anxiety were more able improvisers. The authors interpreted their findings as "indicative of a deficiency in improvising ability in the high anxiety group brought about by a response set to reduce anxiety by adhering to familiar and stereotyped responses in a novel learning situation."

In a somewhat similar situation, Beier (1949) found that when anxiety was induced in female graduate students (by the use of structured Rorschach interpretations), they performed more rigidly than matched controls on sorting and mirror drawing tasks. Because these students had been equated for age, education, adjustment, abstract reasoning ability, and intelligence, Beier felt that the rigid performance of the stressed group was not related to capacity, but rather to the induced threat.

Cowen (1950) tested the hypothesis that increasingly stressful psychological atmospheres would tend to elicit increasingly rigid problem-solving behavior. In a brief review of the literature, he noted that various studies with human subjects, using stress stimuli such as electric shock, fear of failure on a test, frustration, sudden cold showers, time pressures, and anxiety resulting from the interpretation of a Rorschach, had produced perseveration, stereotyped behavior, loss of abstract ability, and delayed time of response to a problem requiring a new task approach. This study was an attempt to look at the stress-rigidity phenomenon more systematically.

Three groups of college students were randomly assigned to non-stress, mild stress, or strong stress groups. The non-stress and mild stress group were treated almost identically in that tasks (Luchins' water jar problems) were

administered under informal, friendly conditions. The mild stress group was given an insoluble puzzle (presented as soluble) after they had completed the set-inducing problems. The strong stress group was treated in a cold and business-like fashion and was told that since their performance on projective tests taken earlier indicated the presence of certain maladaptive personality features, the purpose of the current testing was to check the correctness of the previous diagnosis. On a number of dependent measures, such as the number of problems solved by an indirect rather than a direct solution and time of response to the test series, it was found that the three groups were significantly different in the predicted direction. The non-stress was significantly less rigid than the mild stress group, and the mild stress group in turn was significantly less rigid than the strong stress group. An attitude questionnaire given post-experimentally revealed an overall relationship between order of magnitude of stress as presented by the experimenter and the perception of stress by the subject. Cowen interpreted these results in a dynamic framework, using Goldstein's notion of catastrophic situations. He believed that the strongly stressed subjects encountered experiences with which they were unable to cope and felt very inadequate, helpless, and psychologically insecure. The rigid responses while incorrect, provided a

"pseudo-security" because they had been successful in the past.

In another review of the literature concerned with stress and rigidity (primarily in college students), Kuhlen (1959) declared that regardless of age, individuals who are anxious, insecure, and under stress differ from non-anxious individuals in many of the same ways that older adults differ from younger adults. Kuhlen felt that the resemblance of differences between anxious and non-anxious subjects to differences in rigidity between age groups was too remarkable to be dismissed as coincidence.

The evidence cited above provides support for a hypothesized relationship between rigidity and anxiety in older individuals. This implies that rigidity may be associated with age because of greater anxiety during the latter part of life. There are a number of theoretical approaches which could be used to explain this and these will be discussed in the following section.

Theoretical Approaches

Historically, a popular explanation of rigidity has been a psychodynamic one. Rigid behavior is viewed as a defense against anxiety which arises from threats to self-esteem, feelings of inadequacy, and powerlessness. The study by Cowen (1950) described in the preceding section is a good

example of research conducted within this theoretical framework. The functionality of rigid responding could also be discussed from the framework of learning theory, in that inaccurate stereotypical responding may be more reinforcing than not responding at all. While this may occur in some cases, the literature on errors of omission in verbal learning studies would suggest that older subjects prefer not to respond rather than to respond incorrectly (Botwinick, 1973).

Another theoretical approach can be found in Hullian learning theory and its application to anxious subjects by Taylor and Spence (1952). In Hull's (1943) formulation, under conditions of high arousal and high task difficulty, previously learned or overlearned behavior is facilitated and the production of new more adaptive responding is inhibited. This is because performance is viewed as a function of both habit and drive. For a difficult task, such as a set-breaking task, incorrect responses are more probable than correct responses, especially under conditions of high drive or arousal. High drive facilitates correct responses only on simple or overlearned tasks. In terms of rigidity, since learning situations are perceived as stressful by older persons, their subsequent arousal may interfere with flexible, adaptive responding.

The adequacy of the Taylor-Spence formulation, especially in regard to test anxiety, has been questioned by Saltz (1970). According to the latest version of the Spence and Spence theory (1966), shock during learning of material which involves massive interference should disrupt the performance of highly anxious subjects in comparison to the performance of low anxious subjects; shock during the learning of material in which the correct response is dominant should facilitate the learning of highly anxious subjects in comparison to low anxious subjects. Studies which have examined the interaction between amount of shock or pain and difficulty of materials have not borne out these predictions. Instead several investigators have found that shock produces poorer learning in low anxious subjects under conditions of massive interference and under conditions where incorrect responses are dominant. Another arousal technique thought to interfere with the performance of highly anxious subjects has been failure communication. Although, as Saltz points out, a number of studies have found that telling subjects that they are doing poorly negatively affects the performance of high anxious subjects more than it does the performance of low anxious subjects, other studies have not obtained these results. In some cases, failure communication has disrupted the performance of high and low subjects equally.

Saltz hypothesizes that a more adequate statement of the relationship between anxiety and learning would be as follows: the performance of high anxious subjects is disrupted by threat of failure, but it is not necessarily disrupted by the threat of pain. High and low scores on a scale of manifest anxiety may not indicate differences in level of anxiety, but rather differences in susceptibility to different sources of anxiety.

Although Saltz's hypothesis would be an interesting one to test, especially in terms of the anxiety of older learners, the present study does not appear to be an appropriate place to make such a test. One reason for this is the difficulty involved in obtaining subjects with extremely high and extremely low anxiety scores (as is the usual procedure in these studies), especially in the older age groups. The other difficulty is an ethical one in that it does not seem wise to actually shock or even threaten to shock older subjects.

An alternative theoretical approach comes from the area information processing and is best described by the approach of Biggs (1971). Biggs states that under conditions of high arousal or drive, knowledge of one's emotional state takes up space in immediate memory span (IMS). Effective, adaptive problem solving requires as much memory space as possible, implying that feedback from emotions and drive states should

be minimal. In situations where solutions must be changed and where arousal is high, emotional feedback may use up so much space that it is difficult to formulate new solutions and old solutions are therefore used instead.

A theory which fits this model nicely has been proposed by Wine (1971). Wine's theory is derived from the test anxiety literature which shows that high test anxious persons are negatively affected by stressful, evaluative conditions (or in Saltz's view, conditions that imply threat of failure). Wine believes that while the low test anxious person is focusing on task relevant variables during performance, the high test anxious person is internally focused on self-evaluative, deprecatory thoughts and on his autonomic responses. The high test anxious person does not perform adequately because his attention is divided between internal cues and task cues.

Wine cites a number of studies showing that high anxious subjects are indeed more self-focusing, in that they are more preoccupied during testing, less content, more likely to blame themselves for failure, more likely to devalue their own performance, more pessimistic about outcomes, and less likely to show conditioning under praise than low anxious subjects. There is also evidence that high test anxious persons do not utilize the full range of cues available in learning situations: high arousal serves to reduce

incidental learning and attention to peripheral stimuli.

Wine views test anxiety as composed of two parts: worry and emotionality. Worry refers to cognitive concern over performance, to attention being divided between self and task, to fears of inadequacy and feelings of failure. It is this ruminative, self-evaluative, worry component that Wine believes is the major interference in the performance of highly test anxious subjects. The emoticnality component refers to the distractions caused by the subject's autonomic activity. Wine does not believe the contribution from emotionality to be as important as the contribution from worry. This belief comes from studies of colleqe students which have shown that the worry scale devised by Liebert and Morris (1967) is predictive of course grades while their emotionality scale is not significantly related to course grades. Wine hypothesizes that autonomic arousal, or emotionality, is attention diverting only at extremely high levels of arousal.

Wine's formulations seem especially appropriate for the present study. Many authors have remarked upon the self-deprecating and ruminating tendencies of clder subjects (Welford, 1951, is an example). It may be possible that older learners are more rigid because concerns over personal adequacy and ability divert attention from the task at hand. Their attenticn may be further diverted by concern over

autonomic arousal, especially since older persons tend to be concerned with bodily processes. A logical way to test these hypotheses would be to put older learners in situations where emphasis on personal adequacy and performance is maximized in some cases and minimized in others, and to determine whether this manipulation of arousal or involvement affects the amount of rigid behavior which older subjects show. There exists a large body of psychological literature dealing with the influence of psychological threat on performance in a variety of situations. The major findings of this literature (which has generated primarily from research with college students) will be reviewed and its implications for older learners will be examined.

Experimental Manipulation of Stress

Examination of the influence of psychological threat on learning has generally involved experimentally induced variations in situational stress. "Ego-involvement" or "motivational" instructions are terms commonly used to describe these manipulations. Typical ego-involving or motivational instructions may include one or more of the following techniques: telling a subject that task performance will reflect intelligence or ability, that failure is probable, or that scores wil be compared; in addition, feelings of failure may be induced by the use of

false norms or by presenting impossible tasks under the pretense that they are possible. Typical situations designed to keep motivation low and ego-involvement to a minimum generally emphasize a lack of evaluation, interest in the properties of the task rather than in the performance of the subject, anonymity, or establishing success by the use of false norms. When children are subjects in this type of experiment, ego involvement is often manipulated by administering tasks under test-like conditions (with time limits and implied evaluation) versus game-like conditions.

Whether or not ego-involving instructions affect performance appears to depend upon individual differences in subjects and upon the nature of the task involved. The primary individual difference variable has been test anxiety. Wine (1971) states that studies varying instructional conditions have usually found an interaction between level of test anxiety and ego-involvement. In general (but not always, as Saltz, 1970, pointed out), the following results occur: (a) high test anxious subjects perform more poorly under ego threatening conditions than under non-ego threatening conditions--the opposite occurs with low test anxious subjects; (b) given highly motivating instructions, low test anxious subjects perform better than high test anxious subjects--under low motivating instructions, high test anxious subjects outperform low test anxious subjects;

(c) after neutral task instructions, high and low test anxious subjects perform at a level intermediate to their performance under evaluative and non-evaluative conditions. Sarason (1960) summarizes the literature in a similar fashion, pointing out that highly motivating instructions appear to be more detrimental to the performance of high anxious that low anxious subjects, even when they are matched for ability.

Task variables have also been found to be important. According to Martin (1961), the tasks most likely to be affected by stress are learning and memory tasks which include novel and poorly learned responses in competition with stronger, incorrect responses. Another type of task likely to be detrimentally affected by stress are perceptual tasks in which conditions are imposed that make appropriate discriminations impossible. Task complexity may be another variable. Sarason (1960) states that some studies have found high anxious subjects to be superior to low anxious subjects on simple tasks while low anxious subjects are superior to high anxious subjects on complex tasks. Other studies do not verify these findings. Sarason hypothesizes that this discrepancy may arise because for certain tasks, simplicity is confounded with task stressfullness. In other words, difficult tasks may be ego-involving. He suggests that the use of highly threatening instructions and difficult tasks

may lead to larger differences in the performance of high anxious and low anxious subjects than the manipulation of either variable in isolation.

Considering the anxiety of older learners and the nature of the tasks in this study, this experimental paradigm appears to be an appropriate method for probing the influence of perceived threat on adult performance. Because much of the research discussed has been done with college students, a question arises as to the possible effectiveness of this experimental manipulation with subjects of different age groups. For example, it is possible that instructions which are highly ego-involving for one age group would have little arousal value for another. Kogan (1973) states that it is likely that an interaction between age and context of test administration will be the rule rather than the exception.

Although Kogan is dealing specifically with the effects of evaluative versus permissive conditions on obtaining a distinction between creativity and intelligence, his discussion seems relevant to other ego-involving paradigms. He suggests that for children of nursery-kindergarten age, a contrast between evaluative and permissive assessment would not be salient, since for the most part they have not experienced the use of tests for evaluative purposes. A study by Williams and Fleming (1969) supports his argument since Williams and Fleming were able to obtain a

creativity-intelligence distinction with preschoolers in both testing contexts (theoretically it should have been obtained only under the permissive condition). Kogan feels that for adolescents the permissive context would be received with great suspicion (with attempts to uncover the experimenter's deception), but that for older children the evaluative-permissive contrast would be quite believable. The latter point was supported in a study by Nicholls (1971). Employing a within-subjects design in which one group of children was tested under both permissive and evaluative conditions, Nicholls obtained the predicted creativity-intelligence distinction under game-like, but not under test-like conditions.

Earlier in this review, an attempt was made to document the hypothesis that older learners appear to be anxious about their performance in learning situations. A credible non-evaluative testing context might be a crucial factor in improving their performance, but given the results obtained with other age groups, it is difficult to predict how older learners might perceive and react to this kind of instruction. It might be that any learning situation, in spite of instructional set, would be perceived as threatening.

Research on ego-involving instructions with mature and older subjects is quite limited. One relevant study was done

by Ross (1968). Using male subjects in the age ranges of 18-26 and 65-75, Ross assessed performance on paired-associate learning tasks under neutral, supportive (task-centered), and challenging (performance-centered) instructions. Her analysis indicated that the elderly subjects did least well in the acquisition phase of learning under challenging instructions and best on this phase under supportive instructions. There was no effect of instruction on relearning the task, but the difference between young and old subjects on number of trials to mastery was significantly smaller under the supportive condition than under the evaluative condition. Ross's study suggests that the contrast between ego-involving and supportive instructions is salient for older learners.

A somewhat different study was done by Ganzler (1964). Ganzler was trying to test whether the observed decline in psychological efficiency with age was due to a concomitant decline in motivation. He tested male Veterans Administration patients in the age ranges 25-35 and 65-75 on tests of visual organization and abstraction. His low motivating instructions were task-oriented. The high motivating instructions involved telling the subjects that by doing well on these tasks they could prove to the hospital administrators that even though they were receiving Veterans Administration benefits they were not the malingerers they

had been accused of being. The tests were administered anonymously however and no time limits were imposed. Results indicated that both young and old highly motivated groups worked longer than the low motivated groups and that both young and old highly motivated groups scored higher on the visual organization tasks. There was no age by instruction interaction.

As far as this writer can determine, there are no other studies which have manipulated ego-involvement with older learners. The two studies cited give discrepant results, although this does not seem too surprising when differences in tasks used and subject populations are taken into consideration. In addition, by administering the highly motivating instructions anonymously and with no time limits, Ganzler may have confounded his instructional conditions. The results of the Ross study lend support to the use of the ego-involving paradigm with older subjects.

Finally, Kogan (1973) lists a number of factors which may influence the results obtained when ego-involving instructions are used. These include group versus individual testing, unlimited versus restricted amounts of time, atypical versus home setting for completing the task, and authoritative, demanding versus relaxed and supportive examiners. He notes that various combinations of these factors have been used in every study. For example, in the

Ross study subjects were tested individually while in the Ganzler study they were tested in a group. Unfortunately, it does not appear that a systematic review of the effects of these factors has been carried out.

Assessing the Effectiveness of Ego-Invclving Instructions

There are a number of ways in which the effectiveness of the ego-involving paradigm with older learners can be assessed. The primary test of the hypothesis that rigidity results from anxiety generated by stressful learning situations is change occurring in the degree of rigidity shown on rigidity tasks.

Subjects given ego involving instructions should show more rigidity than subjects given supportive or non-ego involving instructions. Performance on tests of behavioral rigidity (as described in the Method section) is the major concern of this investigation.

There are other, less direct, ways of assessing the effects of experimental instructions. One method would be to determine the subject's perception of his own anxiety, as suggested by Krause (1961). Subjects in non-evaluative conditions should report less apprehension, tension, and fear than subjects in the more stressful, evaluative conditions. An appropriate indicator of such perceptions is the state-anxiety (A-State) scale of the State-Trait Anxiety

Inventory (STAI). The A-State scale consists of twenty statements asking people to describe how they feel at a specific moment in time.

This scale was constructed on the basis of Spielberger's (1966) theory of trait-state anxiety. In Spielberger's conception, state anxiety is a transitory condition composed of heightened autonomic activity and subjective feelings of tension and apprehension. The A-State scale measures the subject's perceptions of consciously perceived apprehensions and autonomic arousal. In this theory, trait anxiety refers to individual differences that determine a person's susceptibility to stress or his anxiety proneness. It describes how likely it is that an individual will perceive situations as threatening and respond with elevations in A-State.

Internal consistency for the A-State scale is substantial under normal testing conditions (with alpha ranging from .80 to .85) and higher still when administered under stressful conditions (with alphas of .90 to .95 obtained). Item-remainder correlation coefficients are moderately high under normal conditions and somewhat higher when the scale is administered under stressful conditions. Test-retest reliabilities are relatively low, as would be expected from a measure intended to assess transitory feelings. For example, college students were given the

A-State scale, and then exposed to a difficult IQ test and a distressing movie. When given the A-State scale again an hour later. test-retest reliability was .33 for males and .16 for females. A more detailed discussion of the reliability of the A-State scale is found in Spielberger, Gorsuch, and Lushene (1968).

Spielberger, Gorsuch, and Lushene (1968) also present evidence on validity of the A-State scale. It appears that scores on the scale vary with experimental conditions. A-State scores have been found to increase from rest periods to stress periods (failure-threat and shock threat), have been higher when students are solving difficult problems than when they are solving easy problems, and varied predictably for sailors exposed to varying degrees of isolation. Concurrent validity is found in correlations of .56 for males and .72 for females with the Today Form of the Zuckerman Anxiety Scale (Zuckerman, 1960), a scale also designed to measure transitory anxiety.

A third and less direct method of assessing the effectiveness of ego-involving instructions would be to measure changes in physiological arousal. Traditional measures of autonomic arousal inclued heart rate, blood pressure, galvanic skin response, free fatty acid level, and so on. There are a number of problems with the physiological approach. First, as Eisdorfer (1968) pointed out, older

subjects tend to be especially sensitive, in a negative sense, to the apparatus involved in physiological measurement. Second, since subjects will be tested in field rather than in laboratory settings, extensive use of equipment is not practical. One new method of physiological assessment which circumvents both of these problems is the palmar sweat bottle technique being developed by Strahan, Todd, and Inglis (1974). In the sweat bottle technique, a sweat sample is obtained by inverting a small bottle of distilled water over the palm or a fingertip for a few seconds. The amount of sweat entering the bottle changes its ionization; the conductivity of the solution can then be measured later (Strahan, Todd, & Connolly, 1974). According to Edelberg (1972), palmar sweat is an index of electrodermal activity. The sweat glands on the palmar and plantar surfaces respond primarily to emotional and ideational stimuli while the sweat glands over the remainder of the body respond primarily to thermal stimuli. The palmar response increases rapidly, but there is disagreement as to whether it is a phasic or continuous response.

The validity of the palmar sweat bottle technique as an indicator of arousal is still under investigation. Strahan, Edwards and Todd (1973) report significant increases in sweat bottle levels with a mental arithmetic-electric shock stressor and significant positive correlations with

subjective estimates of perceived sweatiness. Palmar sweat has also been shown to increase with a number of other stressor stimuli. Although much research is still needed on the validity of the technique, its reliability has been extensively studied. Strahan, Todd, and Inglis (1974) report that both test-retest and alternate form (different finger or palms) reliabilities are high, ranging from .73 to .93.

It is difficult to predict expected results for the palmar sweat measure in relation to the ego-involving paradigm. One reason for this is that age changes in physiological activation are unclear at this time, as discussed earlier in this paper (Thompson and Marsh, 1973). Another is that physiological responses to stress tend to be highly idiosyncratic, depending upon the individual's characteristic response to threat, the specific situation, and his learning history (Grinker, 1966; Lazarus & Opton, 1966). The use of the palmar sweat bottle in this study should be seen as primarily exploratory.

A final assessment of the effectiveness of the ego-involvement paradigm is to directly question subjects as to the nature of their thoughts and experiences under different treatment conditions. Lazarus and Opton (1966) state that one of the key theoretical concepts in the psychological stress literature is that of appraisal or cognitive evaluation of threat. Their research indicates

that "objectively" distressing stimulus events are viewed with varying stress reactions, depending upon how the nature of these events are interpreted to subjects. The same situation may or may not be stressful to different individuals; its stressfulness depends upon its significance for them. One of the hypotheses upon which this study is based is that older learners perceive learning situations as stressful. The accuracy of this assumption will be determined in part by post-experimental questionnaires (described in Appendix E). In addition, questions about the intrusion of worry and emotionality into the learning situation will be included. An example of such a question is taken from Mandler and Watson (1966). Mandler and Watson asked subjects to rate on a ten point scale the question, "How often during testing did you find yourself thinking how well, or how badly, you seemed to be doing?" High anxious college students tend to report the occurrence of such thoughts more frequently.

Summary and Hypotheses

The relationship between age and rigidity has been a popular research topic for gerontologists, both recently and historically. The construct of rigidity has been operationalized in many ways: researchers have used tasks involving perceptual set, problem solving set, concept

formation, paired-associate learning, motor skills learning, and habit reversal in natural and laboratory settings. Rigidity has been sought in a wide variety of older persons, ranging from tram drivers to businessmen, and from eighth grade graduates to the highly educated.

From this research come no absolutely clear results. In many situations, older persons have been found to be more rigid than younger persons, but there have been many exceptions to this finding. Perhaps one of the most obvious conclusions is that there is more than one kind of rigidity and that some kinds of rigidities are more age-related than others.

There are a number of explanations for why rigidity might be an age-related phenomenon. Observed age differences might be due to changes occurring with the process of aging, such as biological deterioration or a constricting and narrowing of experience. They might also be due to generational differences. Older persons might have been socialized to be more rigid, or there might exist cohort differences in education or intelligence which would influence flexibility of thought and behavior. Perhaps age differences in rigidity could be attributed to methodological artifacts. For example, higher average rigidity might be observed in older groups because of a selective survival of rigid individuals.

Each of these explanations was examined. Some lacked empirical support, some were logically weak, and others were not feasible for the present study.

One explanation which seems especially fruitful is that an intervening state, such as anxiety or arousal, rather than age, is responsible for greater rigidity in older individuals. This explanation suggests that certain aspects of learning and testing situations are stressful for older persons. This stress creates anxiety, which in turn, produces behavioral rigidity. Several aspects of this explanation were examined. There is evidence which implies that older persons are indeed more anxious in learning settings, but this evidence is suggestive rather than conclusive. A large body of research supports a relationship between stressful treatment conditions and increased rigidity.

There are also a number of theoretical approaches which could help understand why rigidity might be more apparent in stressful situations. The most promising approach comes from Wine (1971). This is an information processing point of view and the problem is seen as one of divided attention. In a stressful situation, the anxious person focuses on self-derogatory thoughts and worries and on his autonomic arousal rather than on the task. This division of attention between the self and the task makes flexible problem solving

difficult.

The present study is an attempt to explore the relationship between age, anxiety, and rigidity. Young, middle-aged, and older women will be tested in situations which are designed to produce either anxiety or relaxation. The effects of this experimental manipulation will be observed on a variety of tests of behavioral rigidity.

This study will test the following hypotheses:

1. There is a positive relationship between age and rigidity: older subjects will show more rigidity than middle-aged subjects, and middle-aged subjects will show more rigidity than younger subjects.

2. There is a positive relationship between age and anxiety: older subjects will be more anxious than middle-aged subjects, and middle-aged subjects will be more anxious than young subjects.

3. There will be an age by treatment interaction: the evaluative treatment will produce anxiety and rigidity more in older subjects than in middle-aged subjects, and more in middle-aged subjects than in young subjects.

METHOD

Introduction

In this section the design and prccedures of the study and the rationale which underlies them will be discussed in depth. The nature of the subject population, the nature of the dependent and independent variables employed, the procedures fcllowed, and the statistical analysis will be examined.

Subjects

Subjects were 90 females, divided into young, middle-aged, and old groups of 30 subjects each. The mean age for the young group was 19.3 years, with a range of 17 to 25 and a standard deviation of 1.64. The mean educational level of young subjects was 13.7 years, with a range of 13 to 17, and a standard deviation of of 1.05. Young subjects were recruited from freshman and sophomore level psychology courses at Iowa State University and received course credit for participation.

Middle-aged subjects had a mean age of 40.7 years with a range of 35 to 47 and a standard deviation of 3.49. Their mean educational level was 15.6 years, with a range of 12 to 20 and a standard deviation of 2.25. These subjects were

recruited primarily from the Ames, Iowa area. Two were members of the Iowa State University faculty, a few were housewives, and the remainder were employed full or part-time in a variety of occupations, including student, teacher, secretary, nurse, artist, and recreation worker. These subjects were recommended to the author by colleagues and friends as persons who might be interested in participating, and all were tested entirely on a volunteer basis. Subjects were contacted by phone and asked if they would be interested in participating in a dissertation project dealing with women's reactions to learning situations.

Old subjects had a mean age of 68.7 years, with a range of 57 to 86, and a standard deviation of 6.92. Their mean educational level was 14.3 years, with a range of 8 to 19, and a standard deviation of 2.60. The majority were members of the Retired Senior Volunteer Program in Des Moines, Iowa, and were recruited in the following manner. The program director chose 90 persons from the organization's 600 member file. These were persons whom she considered to be the most able and potentially interested. A letter was sent to these individuals (a copy of this letter is included in Appendix A) and those willing to participate returned a postcard which had been included with the letter. Twenty-six subjects responded and were tested. The remaining old subjects were recruited in the way that middle-aged subjects had been. Old

subjects were tested entirely on a volunteer basis. Almost all were active in some way in their community, either as volunteers, students, or employees. Many of these individuals had been employed earlier in their lives in a wide variety of occupations (including teacher, nurse, commercial artist, secretary, receptionist, counselor, and professor). All were in good physical and mental health, with the exception of one individual with severe arthritis (writing was done for her). None were institutionalized, although a number lived in retirement communities. No attempt was made to systematically test minority group members in this study, but a few were represented in each age group. The young group contained a Black and a Chicano, the middle-aged group contained two Blacks and an East Indian, and the old group contained two Blacks. Table 1 contains the means, ranges, and standard deviations for age and educational level for each subject group.

Measures

Three tests of behavioral rigidity were given. One was a test of verbal fluency and cognitive flexibility designed by Long and Looft (1973). This test is discussed in more detail in a previous section concerning age differences in rigidity. In this test, subjects are asked to give as many associations as they can to five geometric figures; subjects

write associations for each figure for two minutes. In Long and Looft's original test, 10 figures were used. Only five were used in the present study, primarily to prevent fatigue on the part of the older subjects. These five were chosen by the author to represent a range from simple to complex. The figures used are contained in Appendix B. Subjects received two scores on this test: a fluency score and a flexibility score. The fluency score consisted of the absolute number of responses written. All responses were counted because in no case did it appear that a subject wrote responses at random. The flexibility score consisted of the number of different categories or classes of responses written. A class was considered to be those responses forming a group by reason of common attributes, characteristics, qualities, or traits.

The second test of behavioral rigidity was the alphabet mazes task described by Heglin (1956). It requires subjects to find a path of words through a maze of letters and to shift paths. It is designed to be a measure of problem solving set. The complete test, with instructions, is given in Appendix C. Because subjects were tested individually, time to solution on every maze was recorded. Subjects received two scores on this test. The first was amount of time required to solve the last maze, a maze which had a solution completely different than any solution previously found by subjects. The second score was the number of short

solutions found by subjects on the four mazes which had both short and long solutions. Subjects had been instructed to choose the short solution if there was more than one solution to a maze.

The third test of behavioral rigidity was a modification of the shift tasks used by Brinley (1965). This test is divided into two sections: a shift section and a non-shift section. In the shift section, speed at changing various overlearned, simple operations (finding synonyms, antonyms, and rhymes) is measured. In the non-shift section, speed at performing these overlearned operations without shifting among them was measured. An example of this test is included in Appendix D. Subjects received three scores on this test: speed on the shift section, speed on the non-shift section, and a ratio of speed on the shift section divided by speed on the non-shift section. The ratio was used in an attempt to control for individual differences in speed which might mask ability to shift among simple operations.

Two measures of situational or state anxiety were used. One measure was Form X-1 of the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1968). Form X-1 asks subjects to describe their feelings at the present moment by ranking a series of statements such as "I am worried" or "I feel comfortable" on a scale from "not at all" to "very much." In the present study, subjects were asked to rank

each statement by putting an "X" or checkmark on a line to the right of the statement. This line had the number one on the left end, the number nine on the right end, and a small perpendicular mark in the middle. The ends of the lines were also marked with "not at all" and "very much." In a previous study with older subjects (Rindskopf & Charles, 1974) it was observed that many older subjects had difficulty using numbered rating scales. The present approach was an attempt to alleviate that problem. The subject's mark on the line was given a number ranging from one to nine by placing a metric ruler on the line. Each item on the scale was then transformed from a number between one and 99 to a standard normal deviate. For example, a score of one would be transformed to a z score of -2.33 because one per cent of the area under a standard normal curve corresponds to a z score of -2.33. An anxiety score was then computed according to instructions given for the uses of Form X-1 as a measure of state anxiety (Spielberger, Gorsuch, & Lushene, 1968). To control for the operation of an acquiescence set, Form X-1 was constructed as a balanced scale in which there are as many reversed items, for which low scores indicated high anxiety, as there were items for which high scores indicated high anxiety. A state anxiety score was obtained by subtracting the reversed items (items 1, 2, 5, 8, 10, 11, 15, 16, 19, and 20) from the non-reversed items and adding a

constant of 120. The higher the final score, the higher the stated anxiety. A copy of this scale is included in Appendix E.

A second measure of transitory anxiety was the palmar sweat bottle technique developed by Strahan, Todd, and Inglis (1974). With this technique, a small bottle of distilled water is inverted on the palm for a few seconds. Ions from any sweat on the palm (primarily sodium and chloride ions) are collected and increase the conductivity of the water. The more sweat, the greater conductivity of the solution. Later measurement of conductivity in the laboratory provides an index of the amount of sweating.

In the present research, 120 cc polyethelene bottles with neck diameters of 17 mm were used (available from the Dynalab Corporation, P. O. Box 112, Rochester, New York). The bottles were filled with 30 cc of distilled water and applied to unprepared skin. Bottle application was for five seconds, the bottle was shaken gently during application, and residual drops were collected with a scraping motion after the bottle was removed.

The amount of sweat collected was assessed by passing a small, alternating current through the solution and measuring the voltage drop across the solution (described in more detail in Strahan, Todd, & Inglis, 1974). Reciprocals of sweat conductivity measurements (to permit expression in

conventional conductance units) were then analyzed. Bottles were measured at times varying from a few days to several weeks after collection (Strahan, Todd, & Inglis, 1974, have shown that bottles may be stored indefinitely without change in conductivity).

A final measure was a posttest questionnaire designed by the author to further explore subjects' reactions to the experimental treatment and to the experimental tasks. A copy of this questionnaire is included in Appendix F. Most of the items dealt with some aspect of either intrusive thoughts or physical reactions during testing. The questionnaire was verbally administered.

In the following discussion of procedures, these abbreviations are used: Fluency (to represent the fluency and flexibility task); Mazes (to represent the alphabet maze task); and SA (to represent Form X-1 of the State-Trait Anxiety Inventory).

Procedure

Subjects were tested individually. All young subjects were tested in a Psychology Department laboratory. Five middle-aged subjects were also tested in this laboratory, three were tested at their place of employment, and the remainder were tested at home. All old subjects were tested at home. The testing location was determined by its

convenience to the subject.

At the beginning of testing, the subject was reminded of the general nature of the study as had been previously described to her by letter or telephone. She was then administered the first SA questionnaire and the first sweat bottle. These two measures were administered in a counterbalanced order, so that half of the subjects received the questionnaire first and half received the bottle first. The order of administration was determined by the toss of a coin, and the order of the first administration was retained in subsequent administrations to the same subject. To allay any fears and aid cooperation in the use of the sweat bottle, the subject was told the following: (a) the bottle contained only distilled water from the grocery store; (b) the bottle would definitely not cause any pain or harm; and (c) an explanation of the bottle's purpose would have to be postponed until the session was finished.

The subject was then assigned either an evaluative or a supportive experimental treatment. Treatments were assigned on the basis of a toss of a coin for the first subject in each age group; thereafter, treatments were alternated on the basis of order of appearance. The instructions for each of the experimental treatments were as follows:

Evaluative: I am interested in how well women of different ages can learn. I am going to give you a number of

different tests designed to measure different kinds of abilities. These include your ability to solve problems, to use your imagination, and to use words. It would be helpful to me if you would try to do your best so that I can get an accurate picture of age differences in learning ability.

Supportive: I am interested in how women of different ages react to learning situations. I am going to have you do some different tasks, and both while you are doing them and after you are done, I will be asking you how you feel about them. I am not worried about how well you do or if you get things right or not. I am mainly interested in how you react to them.

After these instructions, the subject was given the three experimental tasks. Tasks were administered in one of three different orders: (1) Fluency, Shift, Mazes; (2) Shift, Mazes, Fluency; or (3) Mazes, Fluency, Shift. Task order was assigned randomly. Ten subjects in each age group (these were divided into half receiving evaluative instructions and half receiving supportive instructions) received each order. The figures in the fluency tasks were given in a random order to each subject and the shift and non-shift sections of the shift task were counterbalanced.

After the first two tasks had been completed, the subject was asked to fill out another SA questionnaire and another sweat bottle measure was taken. The subject then

completed the final tasks and answered the posttest questionnaire. At this point, the subject was told that all tasks had been finished and was given a final SA questionnaire and sweat bottle administration. All subjects were then debriefed.

Instructions for each subject were read aloud by the author and all testing was done by the author. Testing time varied from half an hour to an hour and fifteen minutes. The majority of subjects were tested in approximately 50 minutes.

Statistical Analysis

The design was a 3 X 2 factorial, with three levels of age (young, middle-aged, and old) and two levels of treatment (supportive and evaluative). The measures of behavioral rigidity were analyzed with analysis of variance. The posttest questionnaire items were analyzed with either analysis of variance or chi square, depending upon the nature of the item (whether it was continuous or dichotomous). More details about the analyses will be found in the Results section.

RESULTS

In the following presentation of results, two kinds of abbreviated terminology will be used. A "3 X 2 analysis of variance" refers to a 3 X 2 factorial analysis of variance, with three levels of age (young, middle, and old) and two levels of treatment (supportive and evaluative). The term "descriptive statistics" refers to means and standard deviations.

1. Fluency task: The total number of associations given for all five figures was analyzed in a 3 X 2 analysis of variance. No significant main effects or interactions were obtained. The analysis of variance table for this task is shown in Table 2. The means, standard deviations, and ranges for age groups, treatment groups, and treatment within age groups are presented in Table 3.

2. Flexibility task: The total number of classes or categories of associations to all five figures was analyzed in a 3 X 2 analysis of variance. No significant main effects or interactions were obtained. The analysis of variance for this task is shown in Table 4. The means, standard deviations, and ranges for age groups, treatment groups, and treatment within age groups are presented in Table 5.

Two raters scored the responses to this task according to the definition of "class" given in the Method section.

One rater scored 52 protocols and the other rater scored 53 protocols, resulting in an overlap of 15 protocols between raters. The inter-rater reliability for those 15 protocols was .98. Since the differences between the raters were not consistent in either direction, subjects were randomly assigned one of the two raters' scores.

3. Alphabet maze task (short solutions): The dependent variable for this task was the number of times (out of four) that the subject chose a short rather than a long solution to a maze. No significant main effects or interactions were obtained in a 3 X 2 analysis of variance. The results of this analysis are presented in Table 6. The descriptive statistics are presented in Table 7.

4. Alphabet maze task (final solution time): The dependent variable in this analysis was the number of seconds required to solve the final alphabet maze. A 3 X 2 analysis of variance resulted in a significant main effect for age. (F = 10.66, df = 2/84), $p<.001$) The mean time to solution was 39.70 for young subjects, 85.07 for middle-aged subjects, and 124.37 for old subjects. All means were found to be significantly different by the Newman-Keuls Sequential Range Test, with alpha set at .05. The analysis of variance and descriptive statistics for this task are found in Tables 8 and 9 respectively.

5. Shift task: The dependent measure was the number of seconds used to complete the shift section of the synonym-antonym-rhyme task. Because scores were positively skewed, the data were transformed with a square root transformation. The transformed data were analyzed with a 3 X 2 analysis of variance. A significant main effect for age was obtained ($F = 28.42$, $df = 2/84$, $p < .001$).

The transformed means were tested with a Newman-Keuls test. This analysis indicated that the old group was significantly slower than both the middle-aged and young groups. The middle-aged and young groups did not significantly differ. The means (in square-root of seconds) were 12.35 for the old group, 9.67 for the middle-aged group, and 8.87 for the young group. The analysis of variance and the descriptive statistics are in Tables 10 and 11 respectively.

6. Nonshift task: The dependent measure was the number of seconds used to complete the nonshift section of the synonym-antonym-rhyme task. These data were also transformed with a square-root transformation. A 3 X 2 analysis of variance yielded a significant main effect for age ($F = 19.26$, $df = 2/84$, $p < .001$) and a significant age by treatment interaction ($F = 3.84$, $df = 2/84$, $p < .025$).

Transformed age group means were tested with a Newman-Keuls test. This analysis indicated that the old

group was significantly slower than both the young and middle-aged groups. The middle-aged and young groups did not significantly differ. The means (in square root of seconds) were 9.8 for the old group, 7.7 for the middle-aged group, and 7.6 for the young group.

Transformed age group by treatment group means were also tested. The nature of this interaction is as follows: the means for the young and middle-aged groups were not significantly different; old subjects in the evaluative treatment condition were significantly slower than all other groups; old subjects in the supportive treatment condition were significantly slower than all of the younger groups except for middle-aged subjects in the supportive condition.

The analysis of variance and the descriptive statistics for this variable are shown in Tables 12 and 13, respectively.

7. Ratio: The dependent measure was a ratio of the transformed shift scores divided by the transformed non-shift scores. The ratio is an attempt to control for speed of response. A 3 X 2 analysis of variance yielded a significant main effect for age ($F = 3.475$, $df = 2/84$, $p < .034$).

Average ratios for age groups were tested with a Newman-Keuls test. The mean for the young group was significantly different from the other two groups. The larger the ratio, the greater the relative slowness. Since

the mean ratio for the young group was 1.17, while the mean ratio for the middle-aged and old groups were 1.26 and 1.27 respectively, this test indicates that the middle-aged and old groups were both relatively slower than the young group. The analysis of variance and the descriptive statistics for this variable are in Table 14 and Table 15 respectively.

8. State anxiety questionnaire: The dependent measure for this analysis was the score on Form X-1 of Spielberger's State-Trait Anxiety Questionnaire. A 3 X 2 X 3 (Age X Treatment X Time) repeated measures analysis of variance was performed. Responses were transformed as described in the Method section of this paper. There was a significant main effect for age (F = 5.33, df = 2/84, $p < .01$) and a significant three-way interaction (F = 6.44, df = 4/168, $p < .01$). The main effect for age indicated that the young subjects were significantly more anxious than the middle-aged and old subjects. The three-way interaction indicated the following: a) for young subjects, the supportive and evaluative group means were equal at Time 1 and Time 2, but at Time 3 the supportive were more anxious than the evaluative; b) for middle-aged subjects, those receiving evaluative treatment were more anxious than those receiving supportive treatment at all three times; c) for old subjects, supportive and evaluative group means were equal at Time 1, but subjects in the evaluative group were more anxious than

those in the supportive group at Times 2 and 3.

The analysis of variance and the descriptive statistics are presented in Tables 16 and 17, respectively.

9. Palmar sweat measure: The dependent measure was the reciprocal of the palmar sweat bottle reading, multiplied by 100. A 3 X 2 X 3 (Age X Treatment X Time) repeated measures analysis of variance revealed significant main effects for Age (F = 31.24, df = 2/83, $p < .01$) and Time F = 3.98, df = 2/166, $p < .05$). Young subjects sweated significantly more than either middle-aged or old subjects and with each administration of the sweat bottle, subjects sweated less. Sweat bottle data for one older subject is missing because it was collected after the author no longer had access to scoring apparatus.

Table 18 contains the analysis of variance summary table for this measure and Table 19 contains the descriptive statistics (a high inverse score implies high anxiety).

10. Post-test questionnaire: There were six questions asked of subjects at the conclusion of the experiment. The responses to each of these questions were analyzed separately. Five of the variables were analyzed using chi-square tests. For these tests, the variables were recoded to dichotomize responses into two almost equal parts on each variable. For self-intrusive thoughts and other-intrusive thoughts, subjects answering 1 or 2 were put

in one category, those answering 3 or more were put in the other category. For self-insults and physical symptoms, those answering 0 were separated from those answering 1 or more. The difficulty variable was already dichotmozied, so no recoding was necesary.

10a. Self-intrusive thoughts: The dependent measure was the frequency with which subjects reported thoughts about how well or how poorly they were doing during testing. Responses were coded as follows: None = 1, Rarely = 2, Occasionally = 3, Frequently = 4, Almost Always = 5. The chi square test for independence of age and treatment showed a significant interaction between these two variables (χ^2 = 6.36, df = 2, $p < .05$). There was no main effect for either treatment (χ^2 = .81, df = 2, $p < .37$) or age (χ^2 = 3.76, df = 2, $p < .15$).

10b. Other-intrusive thoughts: The dependent measure was the frequency with which subjects reported wondering how other people might perform on the experimental tasks. Responses were coded as follows: None = 1, Rarely = 2, Occasionally = 3, Frequently = 4, Almost Always = 5. A chi-square test showed that age was not independent of treatment (χ^2 = 7.82, df = 2, $p < .05$). Neither age (χ^2 = 2.62, df = 2, $p < .27$) nor treatment (χ^2 = .75, df = 1, $p < .39$) main effects were significant.

10c. Difficulty: The dependent variable was the subject's response when asked if any of the tasks were difficult. A chi-square test showed that treatment interacted with age (χ^2 = 7.39, df = 2, p < .05), but neither the treatment (χ^2 = 1.14, df = 1, p < .29) nor age (χ^2 = 4.74, df = 2, p < .09) main effects were significant.

10d. Expectation of success: The dependent measure was how well the subject expected to perform on the experimental tasks. Subjects were asked to rate themselves on a scale from 1 (not very well) to 9 (extremely well). The scores were recoded in the following way: a score of 1 was coded as 0, a score of 9 was coded as 10, and the other scores were left unchanged. This transformation was done to make the means and standard deviations independent. A 3 X 2 analysis of variance was done on the recoded data. This analysis revealed a significant main effect for age (F = 9.88, df = 2/84, p < .05). A Newman-Keuls test showed that old subjects did not expect to do as well as middle-aged and young subjects did. A summary of the analysis of variance is presented in Table 20 and the descriptive statistics are in Table 21.

10e. Physical symptoms: The dependent measure was the number of physical symptoms (tension, perspiration, etc.) reported. A chi-square test showed a significant interaction

between age and treatment (χ^2 = 8.57, df = 2, p < .05), but no significant main effect for either age (χ^2 = 5.63, df = 2, p < .06) or treatment (χ^2 = .04, df = 1, p < .83).

10f. Self insults: The dependent measure was the number of times that subjects made self-deprecating remarks during testing. A chi-square test showed that age and treatment were not independent (χ^2 = 23.67, df = 2, p < .01). This result must be interpreted with caution, since half the cells had expected values less than 5. The reason for this is that so few people made self-deprecating remarks. There was no main effect for treatment (χ^2 = 2.74, df = 1, p < .05), but there was a large age effect (χ^2 = 15.22, df = 2, p < .01). The middle-age and older subjects made self-insulting remarks (27 and 29 times respectively) more often than younger subjects (18 of whom made such remarks).

Except in the case of self-deprecating remarks, no chi square analyses for age or treatment were significant. A number of interactions were significant. The cell frequencies for these variables were visually inspected in an attempt to determine the origins of the interactions. In three cases, these frequencies presented a relatively clear picture. For the question "How frequently did you wonder about how other people might perform on these tasks?," old

people in both treatment conditions tended to report such worries less often than persons in other groups. Subjects in the old evaluative group tended to report fewer physical symptoms than would have been expected. Old subjects in the evaluative treatment group tended to make more self-deprecating remarks than did other groups; the opposite was true of young subjects in the supportive group, who tended to make fewer self-deprecating remarks than would have been expected.

11. Intercorrelation of rigidity measures: Scores on the seven measures of rigidity were intercorrelated. Out of the 21 correlations, 8 were significant at the .05 level and 6 were significant at the .01 level. Only 1 and 0, respectively, would be expected to be significant on the basis of chance.

The correlation between fluency and flexibility was .957, showing that these measures were essentially redundant. Flexibility and fluency were inversely related to nonshift performance (r = -.30, $p < .01$, and r = -.2790, $p < .05$).

Nonshift and shift performance were highly related (r = .79, $p < .01$) and these were both related to maze solution time (r = .29, $p < .01$, and r = .39, $p < .01$). Shift-nonshift ratio was related to shift performance (r = .44, $p < .01$) and maze time (r = .23, $p < .01$).

12. Correlations of age and education with rigidity measures: The seven measures of rigidity were intercorrelated with age and education. For all groups, fluency and flexibility seemed to be related to educational level. For young subjects, $r = .29$, $p < .059$, and $r = .32$, $p < .04$; for middle-aged subjects, $r = .39$, $p < .01$, and $r = .48$, $p < .003$; for old subjects, $r = .29$, $p < .059$, and $r = .29$, $p < .06$. However, fluency and flexibility were related to age only for the middle-age subjects; $r = -.30$, $p < .05$, and $r = -.31$, $p < .05$.

For middle-aged and older subjects, age was related to short maze solutions ($r = -.38$, $p < .02$, and $r = -.45$, $p < .006$). Maze time was related to age in the older group ($r = .395$, $p < .02$), but it was related to education in the middle-aged group ($r = .375$, $p = .02$). Shift and nonshift performance were related to education in the older group ($r = -.38$, $p < .02$, and $r = .57$, $p < .001$). These intercorrelations are shown in Table 22.

13. Intercorrelations of anxiety scores: Intercorrelations of anxiety questionnaire scores with sweat bottle readings were computed for the group of subjects as a whole as well as pooled within age groups. Results indicate that the relationship of these measures within groups was the same as that between groups. This finding indicates that the positive relationship between these two measures is not due

to artifacts of age differences, but that the relationship holds within as well as between groups. These intercorrelations are included in Table 23.

DISCUSSION

Several features of the nature and results of this research deserve discussion. Much of this discussion will follow the organization of the review of literature presented earlier in the paper. The nature and extent of age differences in rigidity will be considered first. This will be followed by an analysis of age differences in anxiety. Finally, the effects of the experimental manipulation will be examined. Once this sequence has been completed, other important aspects of the present research and implications for future research will be considered.

A major finding was the lack of significant age differences on three dependent variables associated with rigidity: fluency, flexibility, and number of short solutions to alphabet mazes. For fluency and flexibility in particular, this finding stands in contrast with previous literature. Long and Looft (1973), in the cross-sectional study from which this task was taken, found the greatest number of responses produced by the twenty to thirty year old group; this result was congruent with other research indicating peak cognitive flexibility in the same age range (Schaie & Strother, 1968a; Nesselroade, Schaie, & Baltes, 1972). Findings from a repeated measures analysis (Schaie & Labouvie-Vief, 1974) and from an independent samples analysis

(Schaie, Labouvie, & Buech, 1973) of a large scale cross-sequential study have been inconsistent, with conflicting reports of age-related decline, gain, or no change for fluency (as measured on the Primary Mental Abilities test).

The studies just cited are not directly comparable to the present research because it appears that the older subjects were not as highly educated as the subjects in this study. A study of healthy college graduates of advanced age (Schaie & Strother, 1968b) is more directly applicable and corroborates the present findings. Using the word fluency test from the Primary Mental Abilities test (where the subject is asked to write as many words as possible beginning with a specific letter), results indicated that these healthy, well-educated individuals performed very similarly to a young comparison group.

The influence of education and experience receives support from other research in the domain of verbal ability. Owens (reported in Charles & Looft, 1973), in a longitudinal study of male college graduates, found an increase in verbal skills (as measured on a synonym-antonym task and on an information task) from the twenties through the fifties, and no important change from that point into the sixties.

The present findings on number of short sclutions to alphabet mazes also stand in contrast to previous literature.

Research on age differences in response to the alphabet mazes (Heglin, 1956) found a linear increase in susceptibility to set from the young to the old groups. Again, age differences in education were not controlled. In a study using another type of set-inducing task, the water jars problems, D. K. Smith (1967) found no age differences in susceptibility to set and attributed previous findings to a failure to control for ability differences between age groups.

Long and Looft (1973) believed that the age differences obtained in their research were due to experiential factors. Young adults were seen as being involved in the process of being educated, making life commitments, and relearning and adapting to constant changes. Older adults were seen as having little need to adjust or change habits and as having fewer opportunities for environmental interaction. The latter conditions were seen as diminishers of flexibility of thought.

The middle-aged and older subjects in the present research were similar to the young adults in Long and Looft's study. In addition to a high level of education, most were involved in career or volunteer work. Many were taking adult education or college courses. Nearly all were interacting with many kinds of people and situations in their environment. Given the unwillingness of many older

individuals to participate as research subjects, these subjects were further distinguished by their high degree of motivation and willingness to volunteer. Such conditions and characteristics should be favorable to the enhancement of flexibility of thought. The present findings suggest that this is so. Significant correlations between fluency and flexibility and education in all three groups give this argument added support.

These findings suggest that given a life of education, stimulation, and enrichement, coupled with high motivation, flexibility of thought should remain relatively untouched by the process of aging. It is likely that the age differences seen in earlier research reflect experiential differences between generations rather than ontogenetic age changes.

A related point of interest is a finding which is somewhat difficult to interpret given the above conclusions. There is a negative correlation between fluency and flexibility and age within all three age groups. Although significant only for the middle-aged group, all six correlations are negative (if the true correlation is zero, the probability of this occurring by chance alone is one in 64).

This finding is paradoxical. The paradox lies in the fact that analyses of variance on these two measures revealed no significant age effects, leading to an interpretation of

little or no age decrement. Yet within groups, especially the middle group, there appears to be a trend toward older individuals obtaining lower scores. No obvious explanation is immediately apparent to the author, but if the reader will permit a flight of fancy, the following explanation may be plausible.

The structure of this study is somewhat analagous to a cross-sequential design. It is ostensibly cross-sectional since women of different ages are tested. Each age group could be considered an identifiable cohort, since the difference between average group ages for the young and middle groups is slightly more than twenty years, and for the middle and older groups is nearly twenty-five years. If each age group is a cohort (in terms of education and stimulation), perhaps the downward trend within groups is indicative of ontogenetic changes with age that might be occurring for that generation. Thus the within group analysis is analagous to a longitudinal approach. If the last statement is assumed to be true, then we have a situation where cross-sectional and longitudinal gradients can be compared to obtain an estimate of ontogenetic or maturational changes.

Given this, it would appear that the cross-sectional results may underestimate maturational age decrement. Schaie and Strother (1968a), using a real rather than fanciful

cross-sequential design, obtained just such a result for the factor they labeled Psychomotor Speed. As further support for this approach, the close to significant F ratio ($p = .08$) for the Age factor obtained in the present research in the analysis of fluency is also suggestive. Perhaps if more subjects had been tested, stronger age effects would have been obtained. Of course, much stronger support for this interpretation would be possible with a real cross-sequential study of these particular rigidity variables.

On the whole, especially in the light of the statistical significance of only two of the six negative correlations between these measures and age, the first interpretation of the findings for fluency and flexibility seems safer to accept. To summarize, this interpretation proposes that previously observed age differences for these variables were due to a confounding of cohort differences in education and other relevant experiences with age differences. Given equal education (insofar as that is possible), a life of rich experience, and high motivation, there should be little decline in this type of flexibility with advancing age.

Age differences in performance on tasks involving speed as a dependent variable were a second major finding of this research. To briefly summarize findings presented in the results section, age differences were found on the shift task, the nonshift task, the ratio of these two tasks, and on

time to solution on the final alphabet maze. A linear decline in response speed with age was found on the alphabet maze task; on the shift and nonshift tasks no slowing was observed until old age; on the ratio score slowing began in middle age. An interaction was found on the nonshift task for age and treatment. Two issues will be emphasized in the present discussion. The first concerns the apparent contradiction between age trends obtained for the shift and nonshift tasks and the age trend observed for the ratio score. The second issue concerns the relevance of the present findings to the psychological literature on speed and aging.

The shift section of the synonym-antonym-rhyme task was conceived as a measure of ability to shift among simple overlearned operations. No time limits were imposed (each subject was encouraged to work at her own pace), but time to completion was recorded. The nonshift section is also composed of synonyms, antonyms, and rhymes, but instead of shifting among them, the subject does all of the synonyms first, all of the antonyms second, and all of the rhymes third. It was designed to be a measure of speed of working when shifting was not required. The ratio score was conceived as a way of removing the influence of speed from the ability to shift operations. It is difficult to understand why on one hand the shift and nonshift scores show

no slowing of response until old age while on the other hand the ratio shows this slowing as beginning in middle age.

The discrepancy may lie in the possibility that the ratio score is essentially meaningless. From a postexperimental perspective, the nonshift task does not appear to be purely a speed task. Instead it appears to be a more simple shift task. Despite the fact that the operations on the nonshift task were blocked, a number of subjects appeared to have difficulty in performing. For example, subjects were observed making erasures on a section and then saying, "I keep forgetting that now I am supposed to be finding antonyms" or something in a similar vein. Changing operations from one block to another appeared to require an active change of set, at least for some subjects. Thus the use of the nonshift score as a measure of pure speed does not seem warranted. And for this reason, the ratio score does not seem especially meaningful.

The findings of age differences in speed confirm the results of extensive gerontological research. Comprehensive reviews of the interaction between speed and age (Birren, 1964; Botwinick, 1973; and Surwillo, 1968) generally agree that response speed slows with age. This slowing can be observed on tasks such as simple and choice reaction time, and on more demanding tasks such as tachistoscopic judgement, solving percpetual mazes, and learning paired-associate word

lists. It appears that response times become proportionately slower as complexity of judgement increases. The age of onset of this decline is more controversial, with some studies reporting linear decline from the third through the eighth decade and other studies finding decline only after middle age.

These reviews suggest that differential onset of age decline may be a function of task difficulty. The present research tends to agree with this. On the shift and nonshift task, age decrement was not apparent until old age; on the time required for final maze solution, there was a significant linear decline from the young to the middle to the old groups. This discrepancy may be related to apparent task difficulty. Formal statistical analyses revealed no significant differences for any age or treatment groups in terms of overall perception of the experimental tasks as difficult. However, informal inspection of the data revealed that if a speeded task was perceived as difficult, it was very likely to be the mazes rather than the shift and nonshift tasks. Subjects gave a number of reasons for the difficulty. Most of these dealt with having to read words backwards and with having to change paths after one path had become a habit. The task also looked more difficult. Thus task complexity may account for differential age onset of slowing. Loss of speed may not be apparent in middle age for

simple tasks; it may be more likely to appear in complex tasks.

That slowing should appear at advanced ages even in healthy, educated subjects such as those in this study is supported by other research. In Schaie and Strother's (1968b) study of healthy, college graduates of advanced age, slower response times on tests such as the Wechsler Memory Scale, the Primary Mental Abilities test, and the Test of Behavioral Rigidity were obtained (in comparison with a young reference group). Slowing was significant for both sexes, although more apparent for males. A study of healthy older men conducted by the National Institute of Health found similar trends (Foulds & Ravens, 1948). Slowing appears to be a characteristic of even healthy, well educated older groups.

Birren (1975), Botwinick (1973), and Surwillo (1968) have reviewed theories which attempt to account for age decrements in speed. Most theorists agree that peripheral factors such as speed of peripheral nerve conduction, time for activation of sense organs, and motor time account for little of the variance involved in speed reduction. The blame appears to lie with central factors, although the nature of the mechanism involved is not yet clear. Surwillo (1968) believes that slowing is due to the slowing of the body's master timing mechanism, the alpha rhythm. Botwinick

(1973) presents animal data demonstrating age-related slowing in spinal synapses. Birren (1975) presents evidence showing a slowing of central processing time in perceptual and memory processes.

Birren (1975) points out that the exact location or physiological basis of central nervous system slowing is not yet known. A relevant finding is that slowing is enhanced by stress related diseases (such as cardiovascular problems and disorders of the sympathetic nervous system). It also appears that slowing can be prevented or at least reduced by a high level of physical fitness. Spirduso (1975) compared chronically active older men (who played racquet sports and handball two to three times a week during the past twenty years) with inactive older men, and with active and inactive college students. On tests of simple reaction time, the active group of older men performed on a par with both of the two young groups. Only the inactive old men were significantly slower. Results were in the same direction, but not as pronounced for discrimination reaction time.

It would be interesting to administer some of the tasks used in the present study to physically fit older men and women. Perhaps manipulation of the fitness varibale might begin to chip at the edges of the strongly supported belief that slowing is an inevitable feature of the aging process.

In summary, on the basis of the discussion thus far, what do the data say about aging and rigidity? They seem to imply that on speeded tasks (especially difficult ones) most middle-aged and older individuals will be slower than their younger counterparts. On tasks where speed is not a crucial factor, healthy, educated, motivated older individuals should be as flexible as younger persons.

A final aspect of the subject of age differences in rigidity is the relationship between various measures of rigidity and the variables of age and education. Several of these have been discussed, but some deserve additional comment. In the old group, speed on the shift and nonshift tasks was significantly related to age. This was not true for the young or middle-aged groups. This finding may indicate that the age differences in speed obtained for this task may be complicated by some sort of cohort difference in word familiarity or experience for the old group. The particular content of these items may be less familiar to older individuals as a result of educational experiences peculiar to their generation. Another interesting finding is the significant correlation between number of short maze solutions and age in both the middle and old groups. Part of this may be related to the effects of speed, but these effects were not strong enough to yield age differences in the analysis of variance for this variable. Since this task

appears to be perceptual as well as verbal, age changes in perception may account for this within group relationship. As noted above, Birren (1975) has found evidence for a slowing of central perceptual processes with age. It appears that the verbal aspects of this particular variable may outweigh the speed and perceptual components which it also appears to require.

The second major area which deserves discussion is the finding of age differences in anxiety. Again, a brief review of the results section seems helpful. Significant age differences were found for the questionnaire measure of state anxiety and for the sweat bottle readings. The age trends for both of these measures were the same: young subjects reported themselves as more anxious and showed more palmar sweat than did the middle-aged and old groups; the latter two groups did not significantly differ on these variables. The only other significant age effect which seems particularly relevant is the number of self-insulting or self-deprecating remarks made by subjects during testing. Older subjects were significantly more likely to make such comments than were the young and middle-aged groups.

The findings of the state anxiety questionnaire and the palmar sweat readings suggest that middle-aged and older individuals were less anxious than young subjects. As the review of literature indicated, conflicting results had been

obtained in previous studies with both questionnaire measures and physiological indices. Some questionnaire measures indicated that older persons were more anxious; others reported them as less anxious. Assessment of free fatty acids pointed to a higher arousal in older subjects; all other physiclogical assessments (including palmar sweat measured by traditional methods) indicated a depressed affect or arousal. These findings seem to imply that when select middle-aged or older persons are tested, they are less anxious in the testing situation than typical college students.

There are a number of reasons why middle-aged and older individuals are less anxious or aroused in this setting. One factor may be a perceived lack of relevance of the experimental situation to situations that the subject considers important in real life. One older subject reported that if the test had been for a job or admission to school, she would have felt that they were more crucial. In no case did it appear that a subject was working carelessly or halfheartedly, but the results suggest a lack of emotional involvement on the part of the older subjects.

This lack of involvement is supported by other kinds of comments from middle-aged and older subjects. Several made remarks to the effect that now they they were old, they did not worry about how well they did or how they compared to

other people, but that instead they just tried to do their best. In essence, one possible explanation of why middle-aged and older people were less anxious was because of the combination of the experimental situation as having no import in terms of real life and a general attitude towards tests as lacking relevance.

Another related possibility is the fact that the experimental testing location was confounded with age group. All young subjects were tested in a psychology laboratory. Nearly all middle-aged and older subjects were tested in their homes. A home situation is bound to be less threatening than sitting in a barren psychological laboratory. Although this confound was of necessity, it was unfortunate in terms of the present research. Perhaps if young subjects had been tested in a dormitory room rather than a laboratory, they too would have been less anxious. Research suggests that physiological apparatus alone appears to raise the arousal level of older subjects. Does being tested in a laboratory have the same effect? Using the present paradigm with middle-aged and older subjects in a laboratory would help provide an answer to this question.

Another reason for less anxiety among the older subjects may be related to sampling. These individuals were outstanding in terms of education and health; perhaps they were also unusual in terms of personality characteristics.

The old subjects, especially, were highly selected. First they were chosen from a file of 600 active senior volunteers. Out of this selection of ninety individuals, twenty-five responded by agreeing to let the author visit them in their homes. The willingness to participate and the willingness to let a stranger come to their residence may be indicative of a generally low level of anxiety. This willingness also implies a liking for new situations and experiences, a characteristic which would not be expected in an anxious person. The young subjects in this group were far less selected; the young group was composed mainly of students seeking extra credit. A few young students did report that they were new in school and and wanted to see what an experiment was like, but it is likely that most of the young group was composed of subjects participating for other, more expected reasons.

A final possibility which is suggested by this data has to do with the experimenter. One fact is that she is female and would probably be perceived as less authoritative and less frightening than a male experimenter. A discussion of artifacts in behavioral research (Rosenthal & Rosnow, 1968) supports this hypothesis.

A variety of evidence suggests that experimenters showing greater dominance or a greater degree of professionalism in their behavior were likely to show greater

effects with their experimental manipulations. They add that research suggests that it is reasonable to suppose that, in general, male experimenters are more likely to be viewed as dominant than female experimenters. It is also possible that the experimenter was perceived as a supportive, relaxing person, either because of her sex or because of personal characteristics. Rosenthal and Rosnow (1968) present tentative support for this hypothesis also. Analyses of filmed male and female experimental presentations indicated that females were perceived as more friendly on the visual (but not the auditory) track. The authors suggest that this may be due to a real difference in visual communication, but it may also be due to a difference in expectancy. People may expect females to be friendlier.

Explaining low anxiety on the basis of experimenter sex does not aid in understanding why young subjects were more anxious, since they too were tested by a female. It is possible that the experimenter was differentially friendly to persons in different age groups. The author was concerned that subjects in the middle-aged and older groups should feel positive about psychological research, both in terms of future participation and in terms of the discipline's reputation. Since younger subjects were taking psychology courses, this concern may not have seemed as relevant when testing them. In addition, middle-age and old subjects were

difficult to obtain and the author's gratitude may have been effectively apparent.

In summary, a number of hypotheses are available to account for lower anxiety in middle and old subject groups. These include lack of real life import of the situation, lack of import of psychological tests in general, confounding of place of testing with age group, sampling biases, and sex of experimenter. Further research could systematically test these hypotheses.

One finding which apparently contradicts low anxiety in older learners was the fact that older subjects made significantly more self-insulting comments during testing. These were comments such as "I am dumb," "old but not wise," or "I don't do as well on this kind of thing as I used to." If old subjects were not especially anxious, why did they make these kinds of remarks? One reason is that they may have believed their statements to be true, but were not concerned about their performance. The analysis of expectations of success supports this interpretation. When asked to judge how well they had expected to perform, older subjects had lower expectations than did middle-aged and young groups. Perhaps older subjects believe cultural stereotypes about themselves as aged persons to be true. Research on obesity suggests that obese persons view themselves in the same, negative ways as the stereotypes of

nonobese persons portray them. On the other hand, subjects may have made these kinds of self-deprecating remarks defensively, so that if they performed badly they would not be disappointed. Alternatively, subjects may have made such remarks because they felt that such comments were expected.

Whatever the reason, the lack of relationship between self-insulting comments and anxiety has two implications. One, it suggests that such comments are not necessarily indicative of anxiety, as has been suggested in earlier research. And, two, it suggests that subjects who make such comments are not necessarily lacking in ability and that inferences about ability should not be made from such remarks.

A third area deserving discussion, an area which has been the central theme of this research, concerns the differential effect of treatment on both rigidity and anxiety. It was hypothesized that there would be less rigidity and lower anxiety in the supportive treatment condition than in the evaluative treatment condition, and that the magnitude of the treatment effects would be positively related to age. However, treatment effects in this study were meager and often difficult to interpret. There were, in fact, no main effects for treatment. Only in a few, isolated instances were treatment effects involved in interactions.

An age by treatment by time of measurement interaction was obtained for the state anxiety questionnaire. This interaction indicated the following: a) for young subjects, supportive and evaluative groups were equal at times one and two, but subjects in the supportive group were more anxious than subjects in the evaluative group at time three; b) for middle-aged subjects, individuals in the evaluative group were more anxious than those in the supportive group at all three times of measurement; c) for old subjects, supportive and evaluative groups were equally anxious at time one, but those persons in the evaluative group were more anxious at times two and three. In the first instance, results were opposite to what was predicted. In the second instance, it appeared that subject groups were different initially, rather than as a result of treatment. Only in the third instance, with old subjects, did the treatment function as would have been predicted.

Another age by treatment interaction was found on the nonshift speed variable. This interaction indicated that old subjects in the evaluative group were the slowest; old subjects in the supportive group were the next slowest and were slower than all other subject groups except for the middle-age supportive; and the young and middle groups did not differ in any condition. Thus treatment predictions are upheld only in the older group.

A final interpretable treatment difference was seen for the frequency with which self-insulting remarks were made. It appeared that old subjects in the evaluative condition made these kinds of remarks more often than would be expected. In addition, young subjects in the supportive group made these remarks less often than might be expected. These results are in line with predicted treatment effects.

On the whole, these results are not impressive. An attempt was made to predict means for the nonshift variable from means on the state anxiety questionnaire using drive theory as a basis of prediction. This proved fruitless. Although the old group occasionally responded as would have been predicted, as often as not predicted trends for one age group are contradicted by other age groups for the same variable or by the same age group for different variables.

Explanations for this failure are difficult to formulate. The reviews of Wine (1971) and Saltz (1970) suggest that high test anxious subjects respond negatively to threatening instructions. It is possible that subjects in this study were not anxious enough to respond as predicted to the evaluative instructions. As discussed earlier in this section, a number of features of the experimental situation (including lack of relevance, home testing, personality characteristics, and a female experimenter) may have made the setting quite nonthreatening. These features may have

overridden any experimental treatment effect. Support for this interpretation comes from the main effect of time of measurement obtained for the palmar sweat measure. Subjects showed less palmar sweat with each sweat bottle administration. This might indicate that they grew progressively more relaxed through the experiment.

Another relevant point comes from Kogan (1973). He notes that a number of factors such as group versus individual testing, atypical versus home setting, and authoritative, demanding versus relaxed, supporting examiners may influence the effects of ego-involving instructions. He does not elaborate on the ways in which these variables operate, but the individual testing, home atmosphere, and female experimenter surely may have operated to mediate the effects of ego-involving instructions.

A final relevant approach comes from work on test difficulty. Sarason (1960) hypothesizes that task simplicity may be confounded with task stressfulness. In other words, difficult tasks may be ego-involving. A majority of subjects in the present study did not report finding any experimental tasks difficult. A frequent remark made in response to the alphabet mazes was that they were a lot easier than they looked. It is possible that the experimental tasks were so simple to most subjects that their simplicity outweighed differential conditions.

Of course, individual differences rather than situational variables may have outweighed treatment effects. Individual differences in general or situational anxiety might have been important (it would be possible to analyze the data for the latter if a large enough range of scores were available). Individual differences in achievement motivation might be another factor.

None of the hypotheses tested in this study received convincing support. Middle-aged and older subjects were not more anxious; they were, in fact, less anxious than young subjects. Neither were they more rigid, although they were slower on rigidity tasks where speed was a factor. Finally, the experimental manipulation failed tc seriously affect any dependent variable.

A more demanding experimental situation might have made the evaluative treatment more stressful; so might more difficult tasks. In reality, it does not seem ethical to make experimental instructions in a laboratory setting more threatening. It might be possible to find a realistic life situation where subjects could take rigidity tests as part of job interviews or for promotion. To require such tests ethically would mean that they should be related to job performance; there is little evidence to support such a requirement. This appears to be a difficult problem to overcome.

Use of more anxious subjects might be possible. However, it is likely, especially in the older groups, that anxiety about performance might be closely tied to ability. This could have a number of negative effects: less able subjects might not be able to complete the experimental tasks, they might not have the verbal skills necessary for competitive performance on the fluency tasks, and making tasks more difficult to create stress would doubly handicap these individuals. Again, this is a complex, difficult problem.

The findings of the present research make it difficult to assess whether anxiety and rigidity are related. These variables may be related in older individuals who are less able or less motivated; they may also be related when tasks are more stressful.

Although the present study does not confirm the hypotheses which it predicted, it does offer clarification of a number of importnat life-span developmental issues. It suggests that when experiential or generational factors are controlled, older persons can be as flexible as younger persons. It suggests that control of these factors does not affect the variable of speed. Even well-educated, healthy, and involved older individuals can be expected to be slower than their younger counterparts. Finally, it suggests that middle-aged and older persons do not necessarily respond

anxiously to a learning situation. The possibilities for future research, as alluded to in this discussion, are many.

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ACKNOWLEDGEMENTS

I am indebted to many persons for their support of this dissertation. I am grateful to the ninety women who volunteered as subjects and to the friends and colleagues who helped me find these women. For their time and guidance, thanks are also due to my doctoral committee members: Professors Thomas Bartsch, Frederick Brown, Gordon Bultena, Edwin Lewis, and Leroy Wolins. Professor Wolins was especially helpful with the statistical analysis.

Two special notes of acknowledgement are in order. The first is to my major professor, Don C. Charles, who has been and, I hope, will continue to be, my teacher and my friend. He is a master at balancing patience and inspiration; he has been unstinting in his help.

The second is to my husband, David. He, too, has been a generous statistical consultant. He spent many hours programming, keypunching, running computer programs, and proofreading. He has been an unfailing source of moral support and encouragement at a time when his own dissertation made demands. He was the person who helped me believe that a doctoral degree was within my grasp.

APPENDIX A. RECRUITMENT LETTER

IOWA STATE UNIVERSITY

Department of Psychology
Old Botany Hall
Ames, Iowa 50010

Telephone: 515-294-1742

June 12, 1975

Dear

A current educational trend in the United States is for many mature and older persons to return to the classroom as students. These persons return to the classroom for many reasons: for pre-retirement training, for adult education, to learn new hobbies and develop new interests, and to learn for the sake of learning.This trend points up an important problem. In the past, most students have been either children or teenagers. We have a considerable amount of information available about how to teach young people, but we have almost no information about how to teach the older student. It is very important that the needs and characteristics of older students be studied.

I am a graduate student in psychology and I am interested in the problems of older learners in particular and older persons in general. For my doctoral dissertation, I am doing a project which involves the best ways to teach older persons. To carry out this project, I need your help! To help with this project, you don't need to be a student now or have any interest in becoming one. You need only be interested in the problems of older persons like yourself in the classroom. Let me explain what is involved.

I would like to visit you in your home for about one hour. During this hour we will carry out activities typical of those that an older person might encounter in a classroom. Then we will discuss your reactions to and opinions about these activities.I believe you will find this "pretend" classroom to be interesting and enjoyable. The results of my visit to your home and to the homes of many other persons over the age of sixty will be used to help plan better educational programs for older persons. Naturally, everything will be completely anonymous.

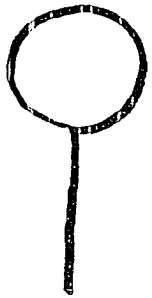
I sincerely hope that you will consider helping with this project. I have enclosed a postcard on which you can indicate whether or not you are interested in participating. Please return this as soon as possible. If you are interested, I will phone you in a few days. If you have some questions to ask before you decide, please say so on the postcard and I will discuss these questions with you so that you can make your decision. Thank you for your time--I am hoping to hear from you and I am looking forward to meeting you.

Sincerely,

Kathryn Rindskopf

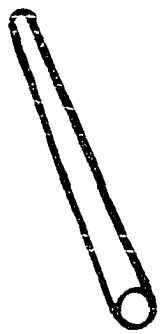
Kathryn Rindskopf
Department of Psychology

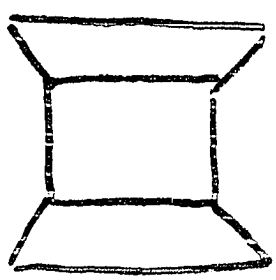
APPENDIX B. FLUENCY TASK

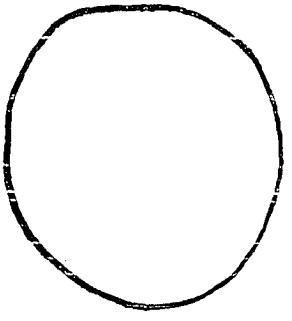


FIGURES

Inside this booklet are some geometric figures. For each one, write all the objects that the figure reminds you of on the lines underneath the figure. For example, if you saw a figure that looked like a square, it might remind you of a box, or a block, or a window, and so on. There will be five figures. You will have two minutes to write about each one. I'll tell you when to go on to the next figure.





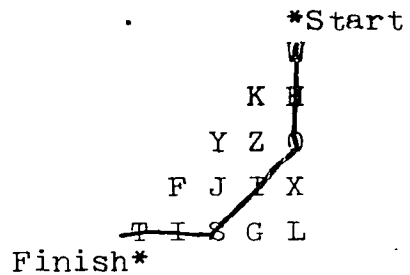


APPENDIX C. ALPHABET MAZE TASK

In each of the following items, you will see a number of squares. Each square contains a letter of the alphabet. Start with the letter in the upper right hand corner. You are allowed to move one square at a time in any direction, as long as the move helps to spell out a word. Work from one word to another to the finish point, so that the last letter of the last word is in the lower left hand corner.

In the first sample on the next page, the path is marked for you. To get from start to finish, follow the letters down the right side, spelling "who." Then go diagonally to spell "is." From there to the finish is the word "it."

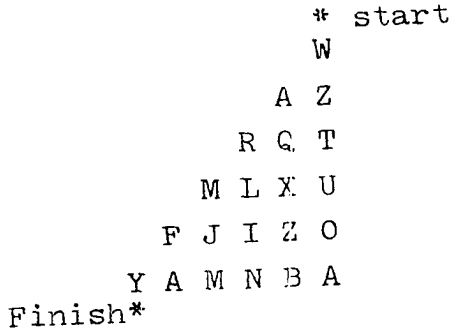
The whole path, from start to finish, spells "who is it." You will find this on you answer sheet in the correct place after number "1" .



Now look at the next sample on the next page.

It is a little harder, but the method is the same. Just find a path of words from the starting letter to the finish letter at the lower left.

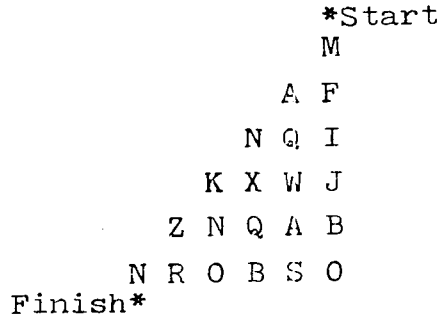
The answer to the second maze is "warm in May." Write this on the line opposite the number "2" on the answer sheet.

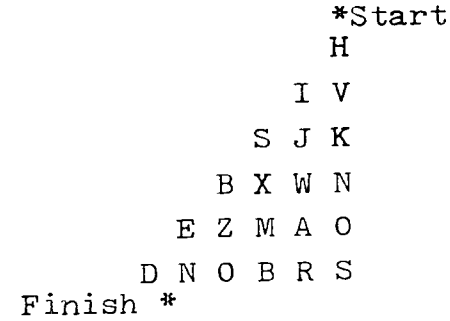


Go on to the next page.

On the following pages, you will find more mazes, on which the path has not been marked. Work each one and write your answer on the sheet provided. Do not mark on this booklet in any way. All of the solutions will be fairly meaningful phrases. In case there is more than one path that will take you from start to finish, the correct solution is the path that uses the fewest squares. As you finish each item, turn the page and do not turn back to the item. Once you go on to the next page, consider the item done and do not return to it.

Do not turn this page until told to do so.


*Start
M
A F
N Q I
K X W J
Z N Q A B
N R O B S O
Finish*


*Start
H
I V
S J K
B X W N
E Z M A O
D N O B R S
Finish *

```
          *Start
          T
        W F
      O M B
    Q Z P X
  J K Z E L
S T A C T P
Finish*
```



```
          *Start
          L
        E S
      T Q E
    C Q H F
  W F Z I C
G N I S M B
Finish*
```

```
          B
        U H
      Y F D
    X Q T M
  L N Z H O
E K A Q E
```

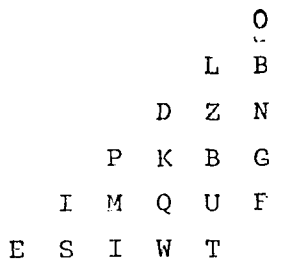
```
          W
        I P
      N Q C
    V Z F G
  Z Y K O L
M E H T R
```

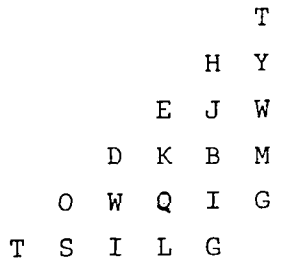
page 12

				H
			I	Z
		S	Z	V
	H	Y	T	J
A	G	Q	A	V
T	I	U	S	N

page 11

					O
				U	K
			R	Z	Q
		C	Z	H	V
	U	X	Q	O	E
P	U	O	S	T	


O
L B
D Z N
P K B G
I M Q U F
E S I W T


T
H Y
E J W
D K B M
O W Q I G
T S I L G

Stop!

Wait for signal before turning this page.

*Start
S
O E
M Q E
Z Q I Y
J U T C X
W O N G E
Finish*

Now, close the booklet and put it aside.

Do not return to any of the items.

Answer Sheet

1. Who is it
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____

APPENDIX D. SHIFT TASK

WORDS AND NUMBERS

Selection (For each item below, check the appropriate response. It will be a synonym, an antonym, or a rhyme)

Hard	First ( )	Beat ( )	Soft ( )
Quiet	Better ( )	Find ( )	Silent ( )
Wide	Lied ( )	Bitter ( )	Careful ( )
Pretty	Last ( )	Ugly ( )	Rough ( )
Bold	Joyous ( )	Brave ( )	Closed ( )
Neat	Seat ( )	Smooth ( )	Bright ( )

Direction (check the appropriate word as instructed in the parenthesis)

Sweat (antonym)	Beat ( )	Sugary ( )	Sour ( )
Bare (synonym)	Covered ( )	Naked ( )	Wear ( )
Bad (rhyme)	Wicked ( )	Add ( )	Good ( )
Ill (antonym)	Healthy ( )	Dill ( )	Sick ( )
Sad (synonym)	Joyful ( )	Mad ( )	Unhappy ( )
Raw (rhyme)	Rough ( )	Jaw ( )	Smooth ( )

Memory (In sequence, check a synonym, then an antonym, then a rhyme, etc.)

Over	Above ( )	Under ( )	Clever ( )
Tiny	Small ( )	Huge ( )	Shiny ( )
Kind	Dined ( )	Friendly ( )	Cruel ( )
Odd	Sawed ( )	Even ( )	Strange ( )
Often	Frequently ( )	Never ( )	Coffin ( )
Fair	Prejudiced ( )	Impartial ( )	Chair ( )

SYNONYMS

Deep	Shallow ( )	Steep ( )	Profound ( )
Tall	High ( )	Short ( )	Fall ( )
Late	Early ( )	Date ( )	Tardy ( )
Hasty	Tasty ( )	Slow ( )	Hurried ( )
Lame	Sound ( )	Crippled ( )	Tame ( )
Fowl	Towel ( )	Dirty ( )	Clean ( )

ANTONYMS

Ending	Lending ( )	Beginning ( )	Completing ( )
Dry	Wet ( )	Cry ( )	Arid ( )
Danger	Peril ( )	Ranger ( )	Safety ( )
Jolly	Sad ( )	Trolley ( )	Happy ( )
Rash	Reckless ( )	Careful ( )	Hash ( )
Right	Bright ( )	Wrong ( )	Correct ( )

RHYMES

Rough	Rugged ( )	Tough ( )	Smooth ( )
Weak	Frail ( )	Strong ( )	Creek ( )
Shy	Cry ( )	Bashful ( )	Brave ( )
Sunny	Cloudy ( )	Clear ( )	Funny ( )
Puny	Weak ( )	Looney ( )	Strong ( )
Worried	Hurried ( )	Apprehensive ( )	Calm ( )

APPENDIX E. STATE ANXIETY SCALE

SELF-ANALYSIS QUESTIONNAIRE

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then make an X on the line to the right of the statement to indicate how you feel right now, that is, at this moment.

There are no right or wrong answers. Do not spend too much time on any one statement, but give the answer which seems to describe your present feelings best.

	NOT AT ALL (1) — VERY MUCH (9)
1. I feel calm	
2. I feel secure	
3. I am tense	
4. I am regretful	
5. I feel at ease	
6. I feel upset	
7. I am presently worrying over possible misfortunes	
8. I feel rested	
9. I feel comfortable	
10. I feel self-confident	
11. I feel nervous	
12. I am jittery	
13. I feel anxious	
14. I feel "high strung"	
15. I am relaxed	
16. I feel content	
17. I am worried	
18. I feel over-excited and rattled	
19. I feel joyful	
20. I feel pleasant	

APPENDIX F. POSTTEST QUESTIONNAIRE

POSTTEST QUESTIONNAIRE

How often during the testing did you find yourself thinking about how well, or how poorly, you seemed to be doing?

Never--Rarely--Occasionally--Frequently--Almost Always

How often during the testing did you find yourself thinking or wondering about how other persons might perform on these test?

Never--Rarely--Occasionally--Frequently--Almost Always

When you started working on the tests, how well did you expect to do (on a scale from one to nine)?

Did you find any of the tasks difficult? If yes, which of these factors do you believe the difficulty was due to?

1. Unclear instructions
2. Poor attitudes on the part of the person in charge
3. Not trying hard because the task was not interesting or challenging
4. Nervousness
5. Having to work in front of someone

6. Don't know

7. Other

Describe your physical feelings while you were taking the tests (for example, sweaty hands, heart pounding, harder breathing, tense). Did you react strongly to any particular event?

Which of the tasks was most interesting for you? Which was least interesting?

APPENDIX G. TABLES

Table 1. Age and educational level of subjects.

	Mean	Standard Deviation	Range
Young			
Age	19.30	1.64	17-25
Education	13.7	1.05	13-17
Middle age			
Age	40.77	3.49	35-37
Education	15.63	2.25	12-20
Older			
Age	68.73	6.92	57-86
Education	14.30	2.60	8-19

Table 2. ANOVA summary table for fluency.

Source	SS	df	MS	F	p
Age (A)	707.222	2	353.611	2.521	.085
Treatment (T)	17.778	1	17.778	.127	.999
A X T	148.422	2	74.211	.529	.999
Error	11783.733	84	140.283		
Total	12657.156	89			

Table 3. Descriptive statistics for fluency.

		Mean	Standard Deviation	N
Young		35.43	10.98	30
	Supportive	34.20	8.70	15
	Evaluative	36.67	13.06	15
Middle age		39.43	13.87	30
	Supportive	40.80	11.15	15
	Evaluative	38.07	16.43	15
Older		32.60	9.96	30
	Supportive	31.13	10.25	15
	Evaluative	34.07	9.79	15
Treatment				
	Supportive	35.38	10.67	45
	Evaluative	36.27	13.17	45

Table 4. ANOVA Summary Table for Flexibility.

Source	SS	df	MS	F	p
Age (A)	300.067	2	150.033	1.537	.219
Treatment (T)	4.444	1	4.444	.046	.999
A X T	84.689	2	42.344	.434	.999
Error	8197.200	2	42.344		
Total	8586.400	89			

Taole 5. Flexibility descriptive statistics.

		Mean	Standard Deviation	N
Young		32.70	9.17	30
	Supportive	32.13	8.26	15
	Evaluative	33.27	10.25	15
Middle age		33.57	11.15	30
	Supportive	34.67	10.51	15
	Evaluative	32.47	12.01	15
Older		29.33	8.80	30
	Supportive	28.13	9.74	15
	Evaluative	30.53	7.90	15
Treatment				
	Supportive	31.64	9.72	45
	Evaluative	32.09	10.03	45

Table 6. ANOVA Summary Table for Short Maze Solutions.

Source	SS	df	MS	F	p
Age (A)	1.867	2	.933	.395	.999
Treatment (T)	.000	1	.000	.000	.999
A X T	5.600	2	2.800	1.185	.311
Error	198.533	84	2.363		
Total	206.000	89			

Table 7. Descriptive Statistics for Short Maze Solutions.

		Mean	Standard Deviation	N
Young		1.333	1.503	30
	Supportive	1.20	1.424	15
	Evaluative	1.607	1.624	15
Middle age		.800	1.375	30
	Supportive	.467	.990	15
	Evaluative	1.13	1.641	15
Older		1.067	1.701	30
	Supportive	1.333	1.759	15
	Evaluative	.800	1.656	15
Treatment				
	Supportive	1.000	1.446	45
	Evaluative	1.000	1.610	45

Table 8. ANOVA Summary Table for Final Mazetime.

Source	SS	df	MS	F	p
Age (A)	107710.689	2	53855.344	10.655	.001
Treatment (T)	90.000	1	90.000	.018	.999
A X T	8725.267	2	4362.633	.863	.999
Error	424555.867	84	5054.237		
Total	541081.822	89	6079.571		

Table 9. Descriptive Statistics for Maze Solution Time.

		Mean	Standard Deviation	N
Young		39.700	37.774	30
	Supportive	39.533	32.874	15
	Evaluative	39.867	43.299	15
Middle age		85.067	62.991	30
	Supportive	98.667	61.907	15
	Evaluative	71.467	63.169	15
Older		124.367	97.720	30
	Supportive	113.933	108.315	15
	Evaluative	134.800	88.402	15
Treatment				
	Supportive	84.044	77.111	45
	Evaluative	82.044	77.111	45

Table 10. ANOVA summary table for shift task.

Source	SS	df	MS	F	p
Age (A)	200.4	2	100.2	28.42	.001
Treatment (T)	.3	1	.3	.09	
A X T	11.6	2	5.8	1.6	
Error	295.7	84	3.5		
Total	507.7	89			

Table 11. Descriptive statistics for shift task.

		Mean	Standard Deviation	N
Young		8.87	1.57	30
	Supportive	9.12	1.59	15
	Evaluative	8.61	1.56	15
Middle age		9.67	1.21	30
	Supportive	10.03	1.14	15
	Evaluative	9.30	1.19	15
Older		12.35	2.59	30
	Supportive	11.91	2.72	15
	Evaluative	12.80	2.46	15

Table 12. ANOVA summary table for nonshift task.

Source	SS	df	MS	F	p
Age (A)	90.4	2	45.2	19.3	.001
Treatment (T)	0.0	1	0.0	0.0	
A X T	18.01	2	9.01	3.84	.025
Error	197.2	84	2.347		
Total	305.6	89			

Table 13. Descriptive statistics for nonshift task.

		Mean	Standard Deviation	N
Young		7.62	1.20	30
	Supportive	7.72	1.08	15
	Evaluative	7.51	1.34	15
Middle age		7.77	1.23	30
	Supportive	8.26	1.54	15
	Evaluative	7.29	.49	15
Older		9.82	2.11	30
	Supportive	9.22	1.83	15
	Evaluative	10.41	2.27	15

Table 14. ANOVA summary table for shift-nonshift ratio.

Source	SS	df	MS	F	p
Age (A)	.185	2	.092	3.475	.034
Treatment (T)	.003	1	.003	.104	
A X T	.03	2	.015	.566	
Error	2.233	84	.027		
Total	2.45	89			

Table 15. Descriptive statistics for shift-nonshift ratio.

		Mean	Standard Deviation	N
Young		1.17	.137	30
	Supportive	1.19	.166	15
	Evaluative	1.15	.103	15
Middle age		1.26	.147	30
	Supportive	1.24	.160	15
	Evaluative	1.28	.136	15
Older		1.27	.194	30
	Supportive	1.29	.131	15
	Evaluative	1.25	.246	15

Table 16. State Anxiety Questionnaire ANOVA.

Source	SS	df	MS	F	p
Age (A)	1948.33	2	974.16	5.33	.05
Treatment (Trt)	178.05	1	178.05	.98	
A X Trt	1033.93	2	516.96	2.83	
Subjects	15346.81	84	182.70		
Time	93.40	2	46.70	3.62	.05
A X Time	41.78	4	10.44	.81	
Trt X Time	7.76	2	3.88	.30	
A X Trt X Time	332.15	4	83.04	6.44	.01
Error	2167.67	168	12.90		
Total	21149.86	269			

Table 17. Means for State Anxiety Questionnaire.

	Time 1	Time 2	Time 3
Young			
Supportive	11.61	11.52	11.53
Evaluative	9.86	7.98	7.09
Middle			
Supportive	.63	1.85	.82
Evaluative	9.16	7.42	5.77
Old			
Supportive	5.53	3.17	1.23
Evaluative	2.51	7.35	5.37

Note: Higher scores indicate greater anxiety.

Table 18. Sweat Bottle ANOVA.

Source	SS	df	MS	F	p
Age (A)	159.01	2	79.50	31.24	.01
Treatment (Trt)	1.29	1	1.29	.51	
A X Trt	2.88	2	1.44	.52	
Subjects	211.23	83	2.55		
Time	10.48	2	5.24	3.98	.05
A X Time	10.79	4	2.70	2.05	
Trt X Time	.32	2	.16	.12	
A X Trt X Time	4.11	4	1.03	.79	
Error	218.65	166	1.31		
Total	598.75	266			

Table 19. Sweat Bottle Means.

Age Group	
Young	3.804
Middle	2.164
Old	2.188
Treatment Group	
Supportive	2.788
Evaluative	2.659
Time of Measurement	
Time 1	2.965
Time 2	2.708
Time 3	2.482

Table 20. ANOVA summary table for success.

Source	SS	df	MS	F	p
Age (A)	19.756	2	9.878	3.434	.036
Treatment (T)	1.344	1	1.344	.467	
A X T	14.689	2	7.344	2.554	
Error	241.6	84	2.876		
Total	277.39	89			

Table 21. Descriptive statistics for success.

		Mean	Standard Deviation	N
Young		6.80	1.85	30
	Supportive	6.13	2.13	15
	Evaluative	7.47	1.25	15
Middle age		7.06	1.91	30
	Supportive	7.06	1.98	15
	Evaluative	7.06	1.91	15
Older		5.97	1.35	30
	Supportive	6.27	1.53	15
	Evaluative	5.67	1.11	15

Table 22. Age, education, and task intercorrelations.

Variable	Age Correlation	p	Education Correlation	p
YOUNG				
Shift	.031	.47	.114	.27
Nonshift	-.149	.22	-.012	.47
Ratio	.299	.05	.117	.27
Short Maze	-.044	.40	.200	.15
Mazetime	.280	.07	.136	.235
Fluency	-.029	.44	.291	.059
Flexibility	-.053	.39	.321	.04
MIDDLE-AGED				
Shift	.209	.13	.053	.39
Nonshift	.088	.32	.205	.14
Ratio	.069	.36	-.107	.29
Short Maze	-.383	.02	-.046	.40
Mazetime	-.096	.30	.375	.02
Fluency	-.301	.05	.399	.01
Flexibility	-.31	.05	.488	.003
OLD				
Shift	.116	.30	-.384	.02
Nonshift	.099	.30	-.565	.001
Ratio	-.071	.35	.139	.231
Shirt Maze	-.499	.006	.299	.054
Mazetime	.395	.015	-.096	.306
Fluency	-.157	.204	.292	.059
Flexibility	-.115	.271	.286	.063

Table 23. Correlation matrices for anxiety measures.

STATE ANXIETY QUESTIONNAIRE

	Time 1	Time 2	Time 3
Time 1	-	.764	.738
Time 2	.776	-	.891
Time 3	.751	.906	-

SWEAT BOTTLE READINGS

	Time 1	Time 2	Time 3
Time 1	-	.460	.388
Time 2	.607	-	.579
Time 3	.486	.643	-

Note: Pooled within correlations are above the diagonal, while overall correlations are below the diagonal.