The effect of Job Characteristics on Cognitive Abilities and Intellectual Flexibility

Ranjana Dutta

John E. Schulenberg

Tamra J. Lair

Human Development and Family Studies

The Pennsylvania State University

University Park Campus

State College, PA 16801

Presented at Eastern Psychological Association meeting, April 1986

The effect of Job Characteristics on Cognitive Abilities and Intellectual Flexibility

The literature on adult intellectual development has evidenced considerable variability both in the timing and rate of intellectual decline after the sixth decade of life. Concerted efforts to understand this phenomena have led to the identification of variables that are (a) situational i.e. salient to the time and process of measurement (Schaie, 1978); (b) organismic such as health and illness conditions (Hertzog et al., 1978), midlife ability status (Schaie & Hertzog, 1983), & cognitive styles (Schaie, 1984); and (c) contextual such as complexity of life styles (Gribbin, Schaie & Parham, 1980, Schaie, 1984). The present paper can be categorized in the last genre of research, and aims to provide evidence regarding the contribution of certain job characteristics to the maintainance or decrement of intellectual functioning in an elderly sample.

The central ideas of this paper stem from the research program of Melvin Kohn and Carmi Schooler over the past two decades (1969, 1978 & 1983). Based on both, cross sectional and longitudinal studies they demonstrate the consequences of complex work environments on psychological functioning of middle aged men.

In order to assess work environments they indexed occupations on more than 50 dimensions which broadly describe their principal facets (for details see Kohn 1969 :

244-253). The job characteristics that best meet their theoretical definition of environmental complexity are _ substantive complexity of work, routinization and closeness of supervision. Of these, substantive complexity emerges as the central element of occupational structure, and is measured through a detailed enquiry about how much time people spend and precisely what they do when working with data, with things and with people.

Intellectual flexibility is hypothesized by them as that aspect of psychological functioning which is most affected by environmental complexity and is based on answers to simple but highly revealing cognitive problems, perceptual tests, propensity to agree and disagree on questions and the impression made on the interviewer. Factor analysis of this data reveals two components of intellectual functioning -- one primarily 'perceptual' and the other 'ideational'.

In their longitudinal analysis Kohn and Schooler thus focus on the ideational component of intellectual functioning and substantive complexity of work environments. They test causal models allowing for both contemporaneous and lagged reciprocal effects and report that substantive complexity of work done has considerable contemporaneous effects

In a recent article, Schooler (1984) proposes a more general "thoery" of psychological consequences of complex environments during the life span. According to this theory, depending on the degree to which the environment systematically reinforces cognitive effort, individuals should be motivated to develop their intellectual capabilities and generalize the resulting cognitive processes to other situations. On the other hand simpler environments may not provide sufficient rewards to develop or continue high levels of cognitive functioning and lead to intellectual decline. However, if as per this theory complex environments do indeed facilitate self direction then such people may also be expected to actively create complexity and thus sustain their intellectual functioning. Indeed, our own data set has provided emperical evidence that cognitive style variables in midlife serve as moderate predictors of intellectual functioning at a later age.

While experimental manipulations intended to restrict environmental complexity in humans are hard to come by, we probably can view retirement as one such naturalistic transition to simpler environments.

The present paper thus seeks to address these issues by examining longitudinally the impact of job conditions on both, cognitive decline (a performance measure) and intellectual flexibility (a style measure) in a sample of retired and unretired elderly.

METHOD

Subjects

The individuals in this study represent a subsample of 73 adults (42 males, 31 females) who were gainfully employed in 1977. The mean age of this subsample in 1977 was 62.1 y. (Range = 57-77; SD = 4.4), the mean educational level was 13.9 years (Range = 6-20 years; SD = 3.0), and the mean income level was $19,878 (Range = $1000-33,000, SD = $8,520). Assignment to either early or late retirement status groups was based on 1981 work status i.e. early retirement group retired between 1977-1981 (n=44); late retirement group retired after 1981 or were still working in 1984 (n=32). It is important to note that the mean age of the two retirement groups were not significantly different.

Measures

The three work characteristic scores (job complexity, routinization, and closeness of supervision) were constructed from interviews conducted in 1977 and were similar to Kohn's questions. Job complexity scores were based on the relative proportion of the time spent working with people, data, and things weighted according to the complexity of each activity (working with people is the most complex, and working with things is the least complex). Routinization scores were based on both the extent of repititon of work tasks and the amount of time involved in completing a project. Closeness of supervision scores were based on the amount of supervision provided by their supervisors. Given that the scores on these work characteristics may depend on level of education, a variable representing years of education was also included in the analysis.

Intellectual flexibility was ascertained in 1977 and 1984 according to scores on the Test of Behavioral Regidity (Schaie, 1958; Schaie and Parham, 1975). From this measure, factor scores were derived for three subscales : (1) Motor Cognitive Regidity (MCR); (2) Personality-Perceptual Regidity (PPR); and (3) Psychomotor Speed (PS).

Intellectual functioning was measured in 1977 and 1984 using two subscales of the SRA Primary Mental Abilities test (from AM, 11-17) (Thurstone and Thurstone, 1949) : Verbal Meaning (V) and Inductive Reasoning (R). As suggested by Thurstone (1958), a weighted composite of these two subscales was used to represent Educational Aptitude (EA) (i.e. 2V + R).

ANALYSIS

In order to ascertain the causal effects of work characteristics (and years of education) on intellectual flexibility and performance, structural equation (path analytic) models were constructed using LISREL VI (Joreskog & Sorbom, 1984). The measures were assumed to be free of measurement error; hence measurement models were not constructed. Covariance matrices among the twelve scales served as the data base (to facilitate interpretation of results, values were converted to a standardized metric after analyses were conducted). The three work characteristic measures, years of education, and the 1977 MCR, PPR, PS, and EA scores served as exogenous variables, and the 1984 MCR, PPR, PS, and EA scores were the endogenous variables. An acceptable model was first derived for the total sample, and then this model was tested simultaneously on the two retirement groups.

In order to detect mean level changes in the MCR, PPR, PS, and EA scores between 1977 and 1984 according to retirement status and work characteristics, ANOVAS were conducted.

RESULTS

Structural Equation

An initial structural equation model was tested in which the following parameters were freely estimated : all correlations among the exogenous variables; auto-regressive (stability) coefficients between the 1977 and 1984 markers of MCR, PPR, PS and EA; and all cross-lagged coefficients between the three work characteristics and years of education markers and the 1984 markers of MCR, PPR, PS, and EA. The fit was acceptable (X'=26.05, df=18, p <.10 ; GFI=.920; adjusted GFI=.815): however, it was clear that several of the cross-lagged coefficients were trivial. Model modification ensued, and in the accepted model, all but two of the original cross-lagged coefficients were set to zero, (Only the cross-lagged coefficient between complexity and EA and between complexity and MCR remained.) (and a new cross-lagged coefficient between MCR 1977 and PS 1984 was added.) This model fit the data quite well (X'=32.55; df=31, p<.40; GFI=.934, adjusted GFI=.835), and did not constitute a significant loss of fit compared to the initial model (Change in X'=6.50, df=13, p<.90). The accepted structural model is illustrated in Figure 1. As is evident, the auto regressive (stability) coefficients moderate amounts of stability. In addition, the cross-lagged coefficient from complexity to EA is significant and negative, indicating that complexity inversely influences EA (i.e., higher complexity scores predict lower EA scores). Finally, the cross-lagged coefficient from complexity to MCR is significant and positive, indicating that complexity influences MCR.

Fig. ~~Table~~ 1 about here

The accepted model was tested on the two retirement groups simultaneously (it should be noted that by dividing the total sample into two groups, sample sizes became rather small, and the following results should be viewed cautiously). The fit of these two group models was acceptable (X'=62.13, df=62, p<.50 ; GFI for early retirement group=.891; GFI for late retirement group=.882); however it was clear that the cross-lagged coefficient from complexity to MCR was trivial for the early retirement group. Thus, a second model was tested where this coefficient was set to zero, and this model was accepted (X'=62.57, df=63, p<.50; GFI for early retirement group=.891, GFI for late retirement group=.882; Change in X'=.47, df=1, p<.50). Finally, to determine whether differences existed in the magnitude of the regression coefficients between the two groups, the common regression coefficients were set equal across the two groups. This model fit rather well (X'=64.48, df=69, p<.65 ; GFI for early retirement group =.889, GFI for late retirement group=.887) and was accepted over the previous model (Change in X'=1.91, df=6, p<.90). (See Figure 2.). Thus with the exception of MCR being predicted for complexity for the late retirement group only, the structural regression coefficients were identical for the two retirement groups.

~~Table~~ Figure 2 about here

<u>Mean Levels</u>

To further understand the impact of job complexity and retirement status on intellectual flexibility and intellectual performance, the sample was grouped according to retirement status (early and late) and job complexity (high and low) and ANOVAS were conducted. Retirement status and job complexity were independent variables and difference scores between 1977 and 1984 MCR, PPR, PS, and EA served as the dependent variables.

For EA no significant effects were found; however, there was a trend for those with higher complexity scores to undergo more decline in EA than those with lower complexity scores. Upon further examination, using difference scores for Verbal Meaning and Inductive Reasoning (the components of EA, significant effects were found. Specifically, for Verbal Meaning, the high complexity group experienced significantly more decline than the low complexity group [$F(1, 69)=3.74, p<.05$]. As is illustrated in Figure 3, the two complexity groups are quite different in 1977, and then become more similar in 1984.

For Inductive Reasoning, a significant interaction between retirement status and complexity were found [$F(1, 69)=4.17, p<.05$]. As is evident in Figure 4, this significant pattern is due to the pattern in which the early retired/high complexity and the late retired/low complexity groups underwent decline, while the late retired/high complexity and the early retired/low complexity groups remained unchanged.

Figure 3 & 4 about here

Finally, in terms of intellectual flexibility only the ANOVA involving the MCR yeilded a significant pattern. Specifically, the high complexity group underwent significantly less decline than the low complexity group [$F(1, 69)=4.21, p<.05$]. This pattern is illustrated in Figure 5.

Figure 5 about here

DISCUSSION

In sum then let us see what do our data indicate? People who have high complexity jobs in 1977 are higher on motor cognitive flexibility in 1984. This is true, however,only if they have recently retired. Also we see that their mean level decline from 1977 to 1984 is less than that of those whose work environments are less complex indicating some sustaining impact of complex environments on the intellectual flexibility-regidity dimension.

In terms of intellectual performance i.e. the Verbal and Reasoning measures of Educational Aptitude these people start out at much higher mean levels much as compared to people in low complexity jobs. This probably explains the negative path coefficient between complexity scores in 1977 to EA scores in 1984 in Figure 1. On measures of verbal performance this decline is very prominent irrespective of retirement status, but on measures of inductive reasoning more complex environments again appear to sustain performance particularly for those recently retired. For those retired early the decline is greater and their mean levels are similar to early retired people from low complexity jobs.

Our results thus confirm the positive impact of complexity on flexibility (style measure) which is sustained at least for some time after retitrment. The impact of work complexity on intellectual performance is less clearly understood with subjects with high complexity jobs showing greater decline on verbal scores irrespective of retirement status, but less decline on reasononig measures depending on recency of retirements. Though based on self report data from one cohort only, this study adds to the literature emphasizing the role of environmental influences in socialization and consequent individual personality outcomes during the life span. As of now, we dont completely know why early and late retirement groups differ and need to explere other conditions like SES and health conditions which may lead to life-styles of very different complexity levels.

APPENDIX

Complexity

One thing we would like to be able to pin down particularly accurately is how much of your working time is spent in reading and writing, how much working with your hands, and how much dealing with people. We realize, of course, that you can be doing two or even all three at the same time.

1. First -- reading and writing. Here we would like to include any type of written materials-- letters, files, memos, books or blueprints. About how many hours a week do you spend reading, writing , dictating, or dealing with any kind of written materials on your job?

-------hours.

2. Second -- working with your hands, using rools, using or repairing machines. We should like to include everything that involves working with your hands -- operating a lathe or a dentists drill, moving furniture or playing the piano. About how many hours a week do you spend working with your hands on your job?

-------hours

3. Third -- dealing with people. Here we do not mean to include passing the time of the day, but only conversations necessary for the job; for example, talking to your boss, teaching, supervising, selling, advising clients. About how

many hours a week does your job require you to spend dealing with people?

--------hours.

Supervision

How closely does your boss supervise you?

----Does he/she decide what you do and how you do it?

----Does he/she decide what you do but let you decide how to do it?

----Do you have some freedom on deciding in both what you do and how you do it?

----Are you your own boss so long as you stay within the general policies of the firm/department?

Routinization

1. Does your work involve:

----Doing the same thing in the same way repeatedly?

----Doing the same kind of thing in a number of ways?

----Doing a number of different kinds of predictable things?

----Doing a number of different kinds of unpredictable things?

----Other (Specify)

2. What it takes to do a complete job varies from occupation to occupation. How long does it take you to complete a job?

----Less than one day

----One day to one week

----One week to a month

----More than a month

----Not applicable.

REFRENCES

Gribbin, K., Schaie, K. W., & Parham, I. A. (1980). Complexity of life style and maintainance of intellectual abilities. Journal of Social Issues, 36(2), 47-61.

Joreskog, K. G., & Sorbom, D. (1984). LISREL Users Guide: Version VI. Chicago: International Educational Services.

Hertzog, C., Schaie, K. W., & Gribbin, K. (1978). Cardiovascular diseases and changes in intellectual functioning from middle to old age. Journal of Gerontology, 33, 872-883.

Kohn, M. L., & Schooler, C. (1969). Class, occupation and orientation. American Sociological Review, 34, 659-678.

Kohn, M. L., & Schooler, C. (1978). The reciprocal effects of the substantive complexity of work and intellectual flexibility: A longitudinal assessment. American Journal of Sociology, 84, 24-52.

Kohn, M. L., & Schooler, C. (1983). Work and Personality: An inquiry into the impact of social stratification. Norwood, NJ: Ablex.

Schaie, K. W. (1978). Rigidity-Flexibility and intelligence: A cross sectional study of adult life span from 20 to 70. Psychological Monographs, 72, 9, No. 462.

Schaie, K. W. (1978). External validity in the assignment of intellectual development in adulthood. Journal of Gerontology, 33, 695-701.

Schaie, K. W. (1984). Midlife influences upon intellectual functioning in old age. International Journal of Behavioral Development, 7, 463-478.

Schaie, K. W. & Hertzog, C. (1983). Fourteen year cohort sequential studies of adult intellectual development. Developmental Psychology, 19, 531-543.

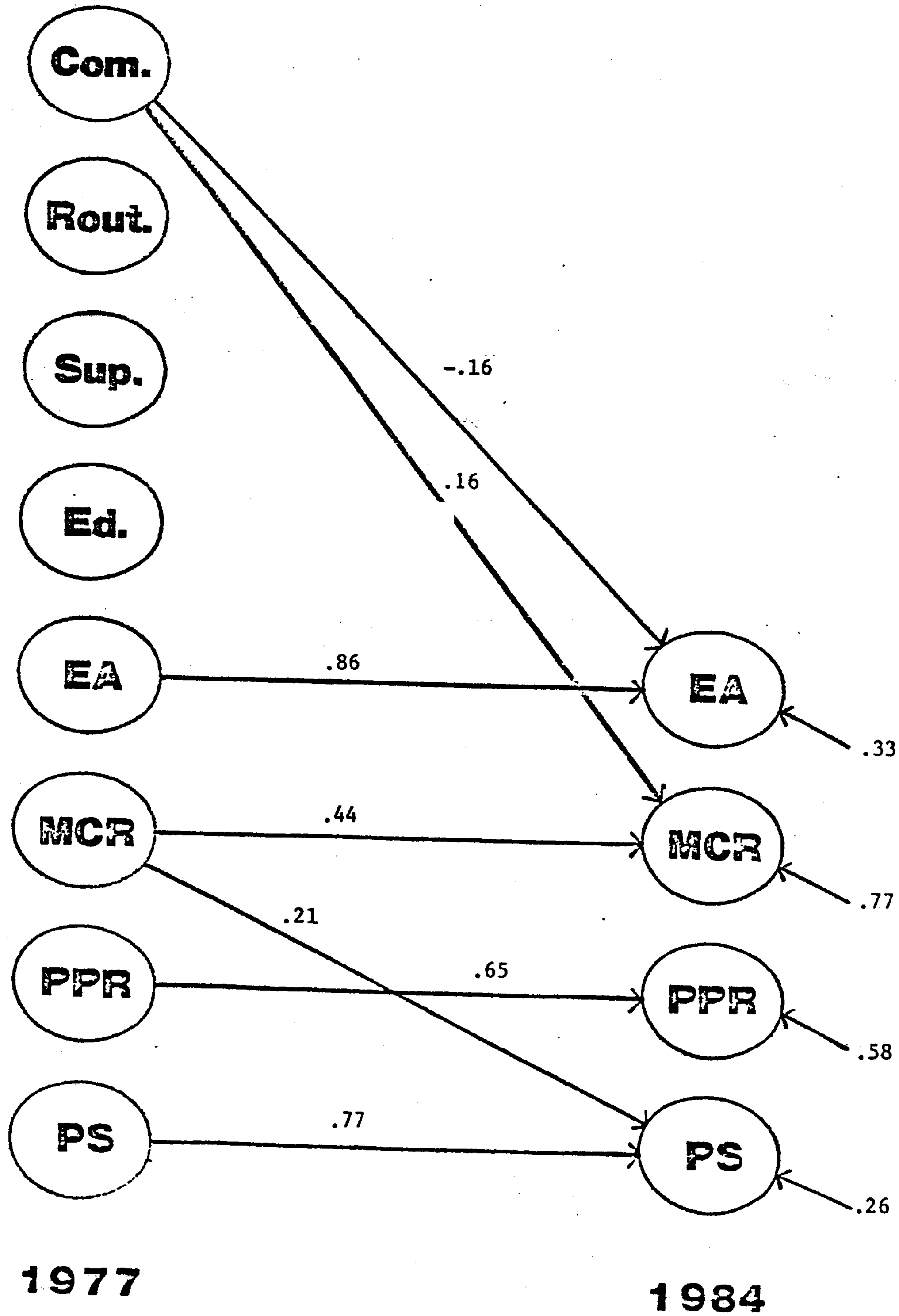
Schaie, K. W., & Parham, I. A. (1975). Manual for the test of Behavioral Rigidity, Palo Alto, CA: Consulting Psychologists Press.

Schooler, C. (1984). Psychological effects of compclex environments during the life span: A review and theory. Intelligence, 8, 259-281.

Thurstone L. L., & Thurstone, T. G. (1949). Examiner Manual for the SRA Primary Mental Abilities Test. Chicago, IL: science Research Associates.

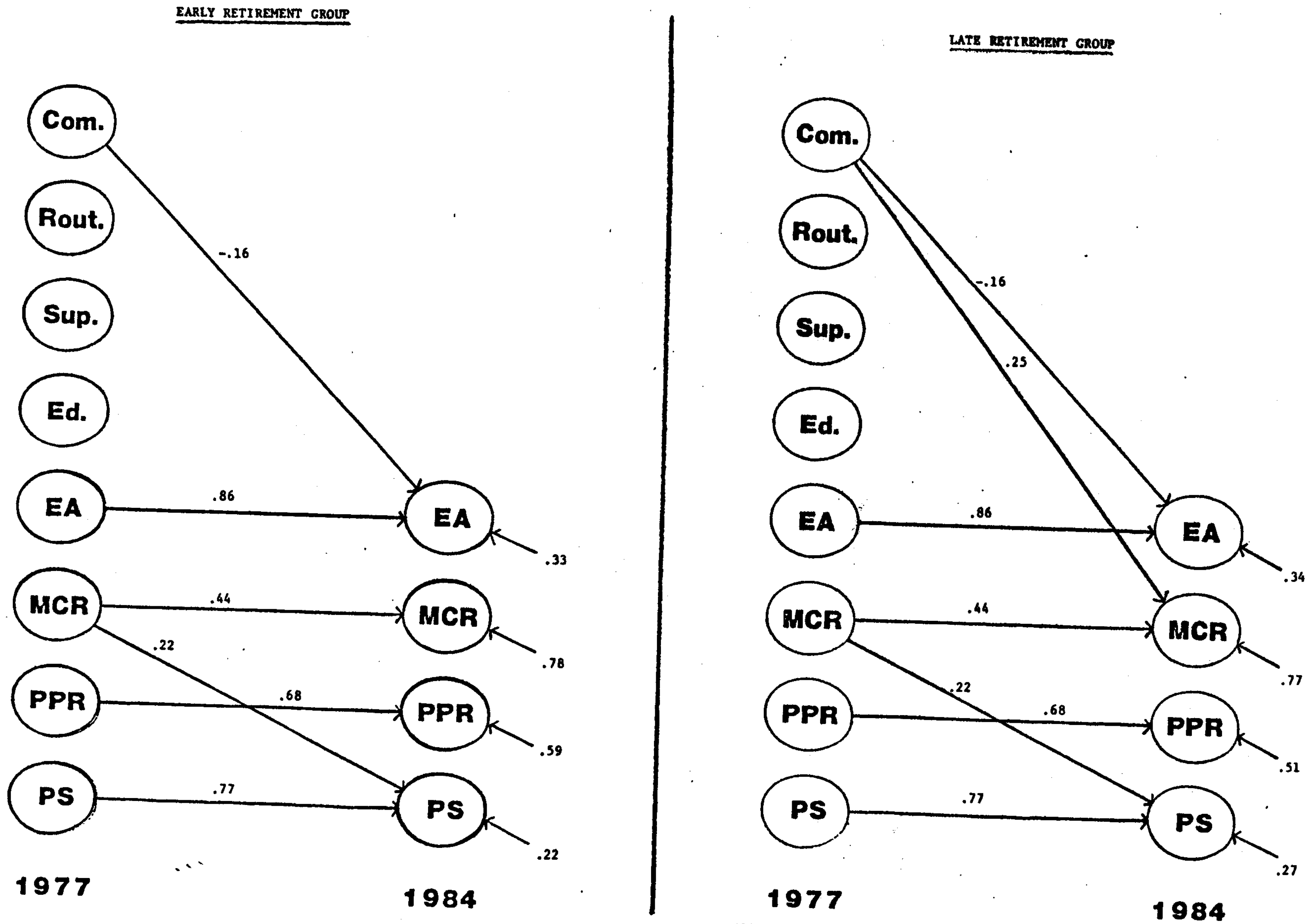
Thurstone, T. G. (1958). Manual for SRA Primary Mental Abilities 11-17. Chicago: Science Research Associates.

Figure 1. Representaion of Accepted Structural Model Among Job Characteristics, Intellectual Functioning, and Intellectual Flexibility for the Total Sample.



Note: Correlations among 1977 variables are presented in Table 1.
The above values were rescaled from covariance metric to standardized metric.
Fit: $\chi^2(31)=32.55$; GFI=.934 (adj. GFI=.835)

Figure 2. Representation of Accepted Structural Model Among Job Characteristics, Intellectual Functioning, and Intellectual Flexibility by Retirement Status



Note: Correlations among 1977 variables are presented in Table 2. The above values were rescaled from covariance metric to standardized metric. Fit: $X^2(69)=64.48$; GFI for Early Retirement Group = .889, GFI for Late Retirement Group = .877.

Figure 3. Mean 1977 and 1984 Verbal Scores for Job Complexity (high, low) Groups

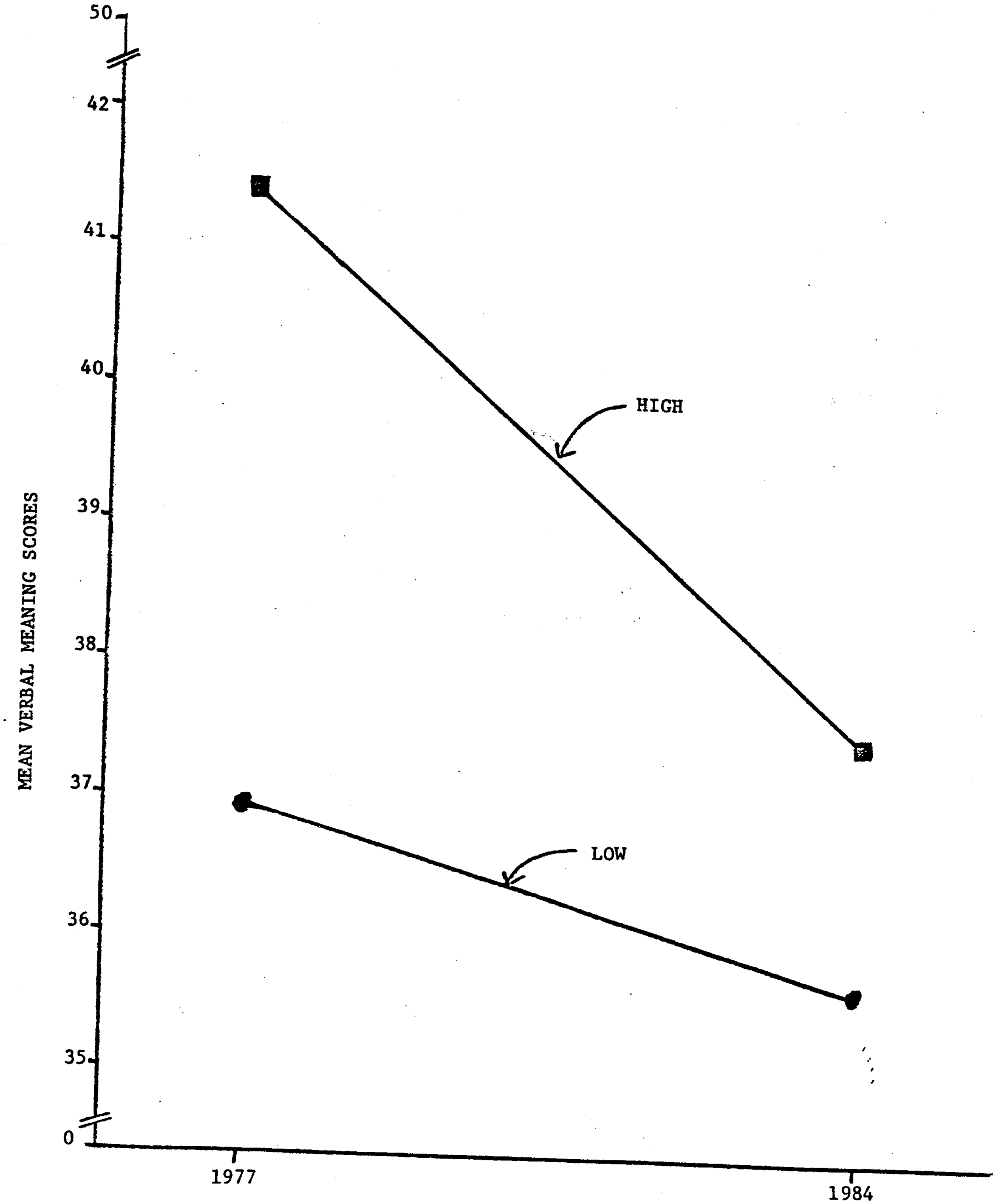


Figure 4. Mean 1977 and 1984 Reasoning Scores for Retirement (early,late) by Job Complexity (high,low) Groups.

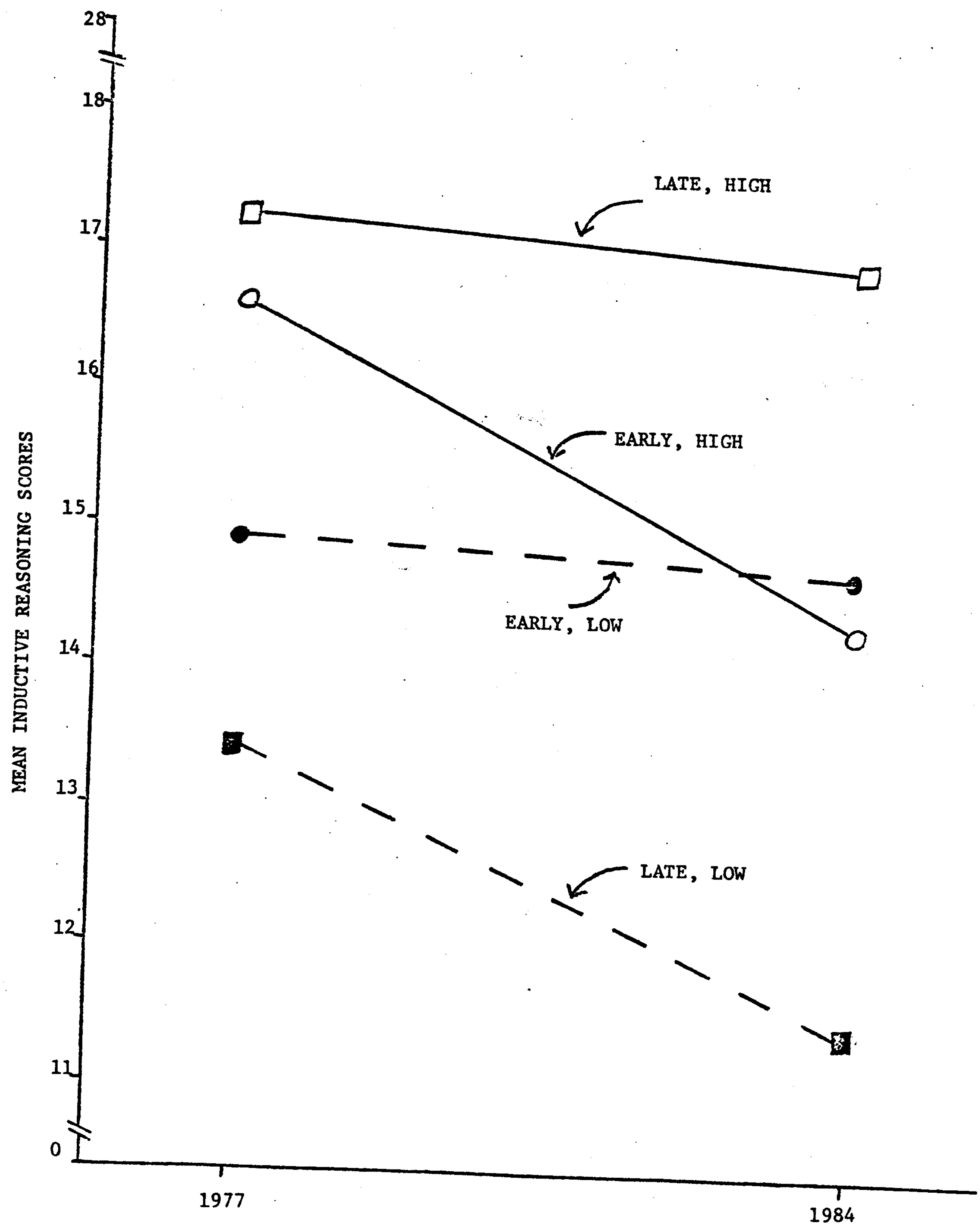


Figure 5. Mean 1977 and 1984 MCR Scores for Job Complexity (high,low) Groups