HEALTH AND RIGIDITY PREDICTORS OF COGNITIVE CHANGE AND TRAINING GAIN.

A. L. Gruber-Baldini, S. L. Willis, & K. W. Schaie.
Department of Human Development and Family Studies,
The Pennsylvania State University, University Park, PA 16802.

Many previous studies have shown the influence of illness, especially cardiovascular disease (CVD), on cognitive abilities in adulthood (Goldman, Keinman, Snow, Bidus, & Korol, 1974; Hertzog, Schaie, & Gribben, 1978; Stone, 1980). Studies have also shown that having flexible attitudes decreases the chance of cognitive decline with age (Schaie, 1983).

However, prior studies have not investigated how these variables may influence cognitive training in adults. Results from the ADEPT study (Baltes & Willis, 1982) and from the Seattle Longitudinal Study (Schaie & Willis, 1986; Willis & Schaie, 1986) have indicated that training can remedy much of the cognitive decline in older adults on measures of Inductive Reasoning and Spatial Orientation. Yet, we do not know whether variables which influence stability or decline might also effect the magnitude of training gain.

This study attempts to identify whether medical status, rigidity-flexibility, and various demographic variables previously associated with ability decline also influence training gain. Results from this study are helpful in elucidating which subjects benefit from training.

Method

Subjects

This study employs a training sample from the Seattle Longitudinal Study (Schaie, 1983, Schaie & Willis, 1986; Willis & Schaie, 1986). All subjects were studied in 1977 and 1984, training was conducted in 1984. Subjects included 101 people trained on Inductive Reasoning (Reasoning--60 females and 41 males) and 99 people trained on Spatial Orientation (Space--55 females and 44 males). Subjects ranged in age from 65 to 92 in 1984 (mean=73). The sample had a mean educational level of 14.0 years for the Reasoning Sample and 13.9 years for the Space sample. The overall mean income level of the samples in 1984 was approximately $20,000.

Measures

Subjects were assessed in 1977 and 1984 on the Primary Mental Abilities (PMA--Thurstone & Thurstone, 1949), and the Test of Behavioral Rigidity (TBR--Schaie, 1955; Schaie & Parham, 1975). For this study, PMA Inductive Reasoning and PMA Spatial Orientation were the target cognitive measures used to assess ability decline and training improvement. Three TBR subscales assesed were: Motor-Cognitive Rigidity, Personality-Perceptual Rigidity, and Psychomotor Speed. For all subjects, a proportional change score (using natural logarithms) was computed for the amount of change from 1977 to 1984 (pretest), and the amount of gain from training for Reasoning and Space scores (pretest to posttest).

Medical records were available for all subjects from 1977 to 1984, based on ICDM-8 diagnostic classifications (USPHS, 1968). From this data, a number of variables were constructed, including: presence or absence of CVD, total number of visits to a physician (total medical incidents), total number of hospital days not related to CVD, and number of hospital days related to CVD. Cardiovascular disease was defined as any cardiovascular-related condition excluding such benign conditions as hemorrhoids and varicose veins (see Table 1 for more information). Hypertension was included as having CVD.

Results

Path models were conducted to predict ability change and training gain for both Space and Reasoning. Included in the models were: age of subject, educational level, sex, presence or absence of cardiovascular disease (CVD) from 1977 to 1984, number of CVD-related hospital visits from 1977-1984, total number of doctor visits from 1977 to 1984 (total medical incidents), Motor-Cognitive Rigidity in 1977, Personality-Perceptual Rigidity in 1977, and Psychomotor Speed in 1977. Originally, non-CVD-related hospital visits were also included--but it was not a significant predictor and was highly correlated to total medical incidents (r=.56 for the Reasoning sample and r=.64 for the Space sample--p<.001).

The results of the path models can be seen in Figures 1 (for Reasoning) and Figure 2 (for Space). In all models, prior decline on an ability predicted greater training gain. For the Reasoning sample: higher age and higher education were the best predictors of Reasoning decline (R^2=.23, F=3.04**), while prior decline on Reasoning, lower education, more Motor-Cognitive Rigidity, and absence of CVD predicted greater gain (R^2=.30, F=3.77***).

For the Space sample: more physician visits was predictive of greater decline on Space abilities (R^2=.17, F=2.03*). Greater decline on Space predicted greater training Space gain (R^2=.69, F=13.05***).

Results highlight the importance of maintaining flexible attitudes and good health in order to minimize cognitive decline and maximize training gain in later life. In all cases, prior decline on the ability was the best predictor of training gain--suggesting that training interventions were particularly effective with decline subjects.

Key Words: **150b. Cognition–problem solving/reasoning**
150d. Cognition–visual/spatial processing
260a. Developmental Changes–intellectual
120. Cardiovascular and Pulmonary Systems
290a. Disease–conditions, processes, results

References

Baltes, P.B., & Willis, S. L. (1982). Plasticity and enhancement of intellectual functioningin old age: Penn States's Adult Development and Enrichment Project (ADEPT). In F. I. M. Craik & S. E. Trehub (Eds.), Aging and cognitive processes (p. 353-389). New York: Plenum Press.

Goldman, H., Kleinman, K. M., Snow, M. Y., Bidus, D. R., & Koral, B. (1974). Correlation of diastolic blood pressure and signs of cognitive dysfunction in essential hypertension. Disease of the Nervous System, 35, 571-572.

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

Schaie, K. W. (1955). A test of behavioral rigidity. Journal of Abnormal and Social Psychology, 51, 604-610.

Schaie, K. W. (1983). The Seattle Longitudinal Study: A 21-year exploration of psychometric intelligence in adulthood. In K. W. Schaie (Ed.). Longitudinal studies of adult psychological development (pp. 64-135). New York: Guilford.

Schaie, K. W., and Parham, I. A. (1975) Manual for the test of behavioral rigidity (2nd ed.). Palo Alto, Calif.: Consulting Psychologists' Press.

Schaie, K. W., & Willis, S. L. (1986). Can intellectual decline in the elderly be reversed? Developmental Psychology, 22, 223-232.

Stone, V. (1980). Structural modeling of the relations among environmental variables, health status and intelligence in adulthood. Unpublished doctoral dissertation, University of Southern California.

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

U. S. Public Health Service (1968). Eighth revision of the international classification of diseases, adapted for use in the United States. Public Health Service Publication No. 1693. Washington: Government Printing Office.

Willis, S. L., & Schaie, K. W. (1986). Training the elderly on the ability factors of spatial orientation and inductive reasoning. Psychology and Aging, 1, 239-247.

Table 1: CVD Group Classifications

ICDA Code	Description
	Hypertension
401	Essential Hypertension
403	Renal hypertension
	Atherosclerosis
410.9	Acute myocardial infarction
411.9	Acute ischemic heart disease
412.9	Chronic ischemic heart diseas
413.9	Angina pectoris
426	Pulmonary heart disease
427.0	Congestive heart failure
427.1	Left ventricular failure
427.2	Cardiac Arrest
427.3	Other heart block
428	Other myocardial insufficiency
440.0	Arteriosclerosis of aorta
440.9	Arteriosclerosis (generalized)
	Hypertension and Atherosclerosis
402	Hypertensive heart disease
411.0	Acute ischemic heart disease, with hypertension
412.0	Chronic ischemic heart disease, with hypertension
413.0	Angina pectoris, with hypertension
	Cerebrovascular Disease
430.0	Subarachnoid hemorrage, with hypertension
431.9	Cerebral hemorrage
431.0	Cerebral hemorrage, with hypertension
432.9	Occlusion of precerebral arteries
432.0	Occlusion of precerebral arteries, with hypertension
433.9	Cerebral thrombosis
433.0	Cerebral thrombosis, with hypertension
434.9	Cerebral embolism
435.9	Transient cerebral ischemia
436.9	Acute, ill-defined cerebrovascular disease
436.0	436.9, with hypertension
437.9	Generalized ischemic cerebrovascular disease
438.9	Other ill-defined cerebrovascular disease
438.0	438.9, with hypertension

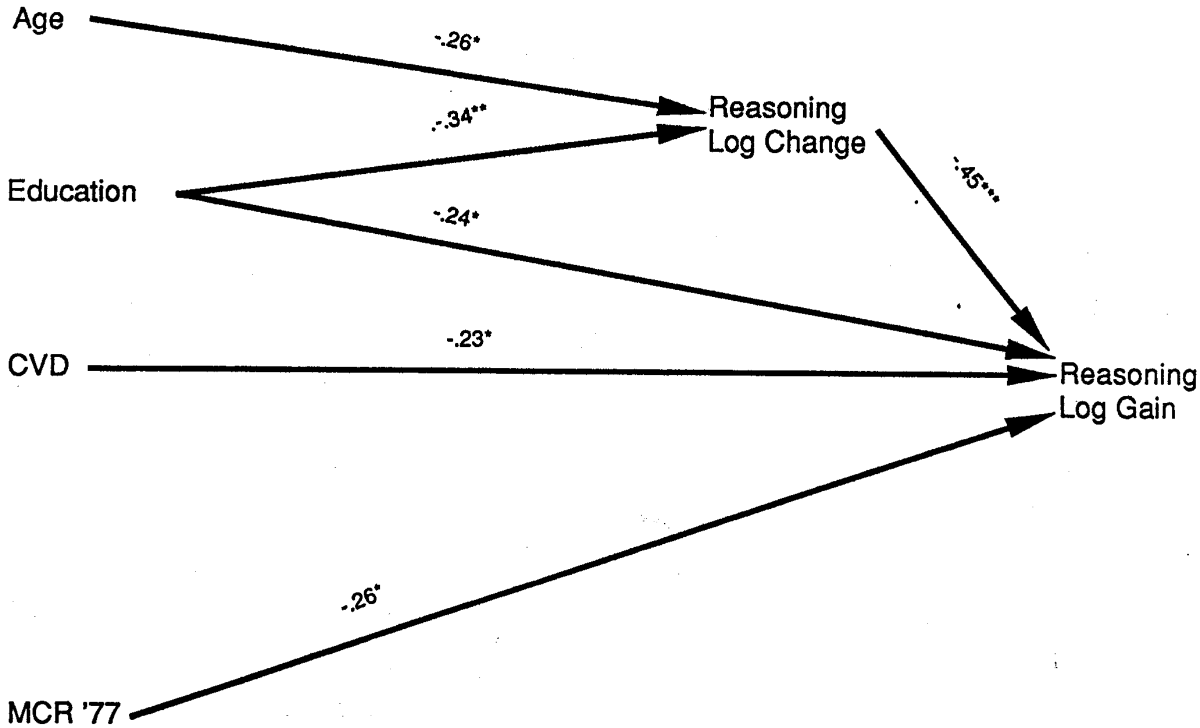
Table 1: CVD Group Classifications (continued)

	Miscellaneous CVD
394.0	Mitral valve disease, rheumatic
395.0	Aortic valve disease, rheumatic
396.0	Both 394.0 and 395.0
398	Rheumatic heart disease
424.1, 424.9	Chronic disease of endocardial structures
427.4-427.9	Disorders of heart rhythm
429.0	Cardiac enlargement and hypertrophy
429.9	Other ill-defined heart disease
440.2	Arteriosclerosis of extremities
441.2	Aneurysm of abdominal aorta
443.0, 443.9	Peripheral vascular disease
444.4, 444.9	Embolism and thrombosis of minor arteries
445	Gangrene
447	Other diseases of arteries and arterioles
448	Diseases of capillaries
450	Pulmonary embolism and infarction
451.0, 451.9	Phlebitis and thrombophlebitis
453	Other venous embolism and thrombitis
458.0	Hypotension
	Benign CVD
454.0-454.9, 456.1	Varicose veins (assorted sites)
455	Hemorrhoids
458.9	Other and unspecified circulatory disorders

From Hertzog, Schaie & Gribbin, 1978.

All codes except Begnign CVD were counted as having CVD.

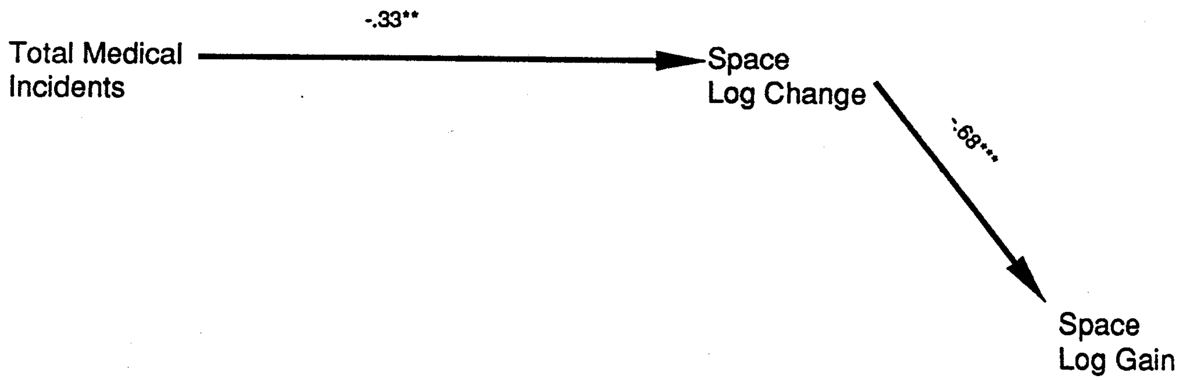
Figure 1: Path Model for Reasoning Training Subjects (n=101).



Standardized Betas reported.
Only paths significant at p<.05 reported.
* P<.05 **p<.01 ***p<.001

For predictors of Reasoning Log Change: F=3.04** R-Squared=.23.
For predictors of Reasoning Log Gain: F=3.77*** R-Squared=.30

Figure 2: Path Model for Space Training Subjects (n=99).



Only Standardized Betas reported
Only paths significant at $p<.05$ reported.
* $P<.05$ ** $p<.01$ *** $p<.001$

For predictors of Space Log Change: $F=2.03^{*}$ R-Squared=.17.
For predictors of Space Log Gain: $F=13.05^{***}$ R-Squared=.60.