Late Life Potential

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Contributions of Cognitive Training Research to Understanding Late Life Potential

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It is important to note that plasticity, and hence potential, as we have studied it, is an *intraindividual* phenomenon. The focus is on the range or magnitude of change that can be observed within the same individual, over time or across conditions (Willis & Baltes, 1980).

Our conceptions and knowledge base regarding individual potential have been significantly influenced by the types of experimental designs employed. Most experimental studies of potential have involved what may be called the "single slice" design, in which (a) the individual's level of functioning was examined immediately before and after a brief intervention, and (b) the magnitude of pre-posttest behavioral change was taken as an index of potential or plasticity (Baltes & Willis, 1982). The magnitude of change exhibited by a treatment group was compared with that of a control or comparison group.

When one is fortunate enough to have prior longitudinal data on subjects, potential can be examined from a broader developmental perspective. The subject's own prior history is used as the baseline for examining the magnitude of training effects and the level of performance achieved following training. Longitudinal data permit the examination of training effects in the context of different patterns of prior development (Willis, 1987a). In Figure 1, hypothesized cognitive training effects are presented within the context of three distinct patterns of development. Prior to training, some subjects (decliners) will have experienced age-related de-

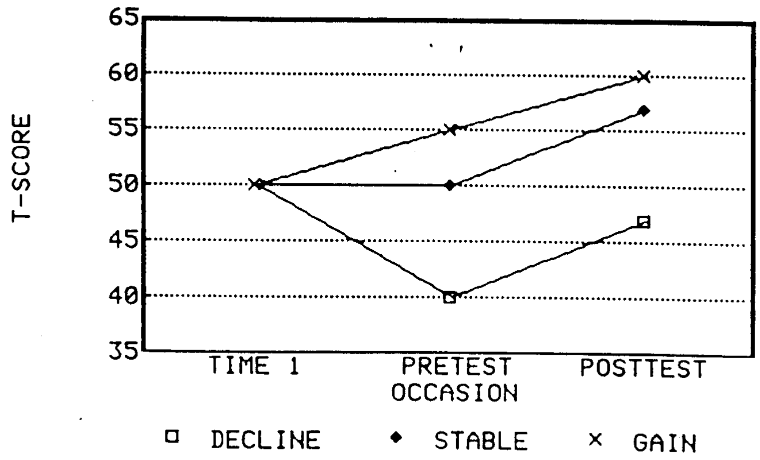


FIGURE 2.1. *Hypothesized cognitive training effects when considered within three different developmental patterns. Prior developmental pattern indicated stability, decline, or gain on target ability trained.*

cline on the target ability. Other subjects (stables) will have maintained a stable level of performance. A few subjects (gainers) will have shown reliable improvement over the period prior to training.

Training effects examine the potential for *remediation* of decrement for subjects experiencing prior age-related decline. For stable subjects and for subjects showing gain, the individual's potential for acquiring *new performance levels* as a function of training can be considered. The phenomenon of late life potential is examined, then, in the context of the individual's prior developmental history.

Cognitive Training Research Within the Seattle Longitudinal Study

We have examined training effects for subjects exhibiting differential patterns of prior development within the Seattle Longitudinal Study (SLS; Schaie, 1983). Training was conducted on two primary abilities, Inductive Reasoning and Spatial Orientation (Schaie & Willis, 1986; Willis & Schaie, 1986b). Here, the major focus will be on the training data for inductive reasoning ability. (See Willis & Schaie, 1988, for spatial orientation training results.)

Inductive reasoning involves the ability to identify rules governing a pattern of relationships within a problem-solving task, and the ability to

apply these rules in determining further instances of the pattern. Within the Cattell-Horn (Cattell, 1971) model of psychometric intelligence, inductive reasoning is defined as a fluid ability. Findings from longitudinal studies (Schaie, 1983) indicate that inductive reasoning shows a normative pattern of age-related decline, beginning in the mid-sixties. Inductive reasoning has been shown to be a significant correlate of performance on tasks of daily living, such as interpreting labels on medicine bottles or household goods (Willis & Schaie, 1986a; Willis, 1987b).

Description of Training Study on Inductive Reasoning

Subjects were 229 older adults (M=97; F=132) from the Seattle metropolitan area, who had been participants in the SLS since 1970 or earlier. Mean age in 1984 was 72.8 years (Range = 64-95). Mean educational level was 13.9 years. All subjects were community-dwelling.

As participants in the SLS, subjects had been assessed previously in 1970 and 1977 on the Thurstone primary mental abilities. Subjects' performance on the Thurstone inductive reasoning and spatial orientation measures was classified as having remained stable or having declined over the 14-year interval (1970-1984) prior to training. The statistical criterion for the definition of decline was one standard error of measurement or greater (Dudek, 1979; inductive reasoning = 4 points). Sixty-two percent of the subjects (N = 130) were classified as having remained stable on the inductive reasoning measure; the stable category includes subjects (54%) who showed no reliable change in performance, and a small number of subjects (8%) who demonstrated significant improvement in reasoning performance. Thirty-eight percent of the subjects had declined. As would be expected, decliners were significantly older than stables; however, decliners were significantly better educated than stables.

Subjects were assigned to the reasoning training program, based on their classification status. Subjects who had declined on reasoning but not on space were assigned to reasoning training. Subjects who had remained stable on both reasoning and spatial ability or had shown decline on both abilities were randomly assigned to reasoning or space training. Subjects who had declined only on space were assigned to space training. All subjects participated in an extensive pre-posttest assessment on a broad range of cognitive abilities. Subjects assigned to reasoning training participated in five one-hour individually conducted training sessions.

The data reported here are based on the PMA Letter Series test (Thurstone & Thurstone, 1949), as this is the inductive reasoning measure on which both longitudinal and training data are available. In this test, the subject is shown a series of letters and must select the next letter in the series from five answer choices.

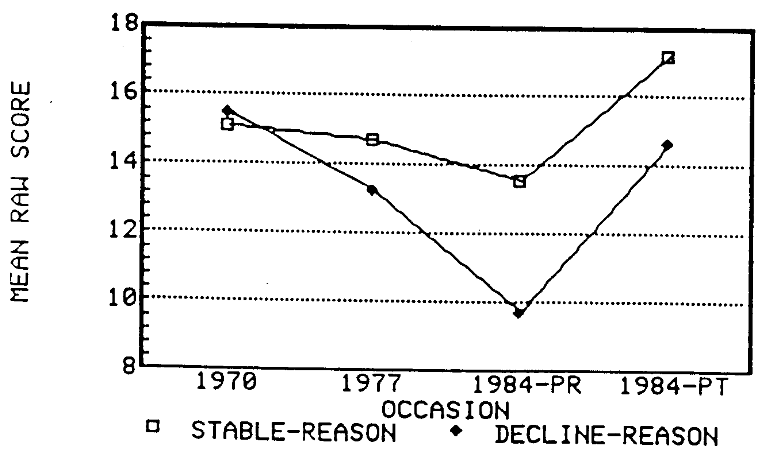
The reasoning training program focused on facilitating the subject's use of effective cognitive strategies, identified in previous descriptive research on inductive reasoning. The pattern description rules used in solution of reasoning test items were identified, and practice problems and exercises were developed based on these pattern description rules. For example, patterns of musical notes and travel schedules were devised based on these rules, and subjects were to identify the next note or destination in the series. Subjects were taught through modeling, feedback, and practice procedures.

Individual Differences in Training Improvement

Training effects have been examined with regard to two individual difference variables. First, the question of whether training was differentially effective for stable or decline subjects was considered. Second, training effectiveness was compared for three age/cohorts.

Training Effects for Stable and Decline Subjects

Figure 2 presents mean inductive reasoning scores for stable and decline subjects. On the left side of the figure is shown stable and decline subjects' performance over the 14-year period (1970-1984) prior to training. On the right side of the figure are the training data, showing performance improvement from pretest (PR) to posttest (PT) for stable and decline subjects trained on inductive reasoning. The performance of the stable group after training is, on average, above their 1970 level. The decline



IGURE 2.2. *Inductive reasoning performance of stable and decline subjects at four ·casions: Prior to training (1970, 1977); at pretest (1984-PR); and at posttest (1984-T).*

group's performance, following training, is almost at their 1970 level. For stable subjects, then, training was effective in raising their performance level above that previously demonstrated, while for decliners, there was partial remediation of age-related decline. (Recall that the stable group includes both subjects described as stables and as gainers in Figure 1).

Examining Training Effects at the Individual Level

Since potential is construed as an intraindividual phenomenon, assessment of training effects at the individual level is of particular interest. Two questions can be examined. First, what proportion of stable and decline subjects demonstrated significant training gain for pre- to posttest? Second, what proportion of decline subjects exhibited remediation to their 1970 score level? Significant training improvement was defined as one standard error of measurement (*SEM*) or greater. For the reasoning test, one *SEM* involved a raw score gain of 4 or greater points.

With regard to the first question, 60% of the decline subjects showed significant training improvement from pre- to posttest. There was no gender difference in effects; 60% of decline males and 60% of decline females exhibited significant pre-posttest training improvement. Likewise, 53.6% of the stable subjects showed reliable training gain (52% stable males; 54.8% stable females).

The second question deals with the proportion of decline subjects showing complete remediation of prior age-related decline. To assess remediation of decline, we examined the proportion of decline subjects whose performance at posttest was equal to or greater than their score 14 years previously, in 1970. Forty-five percent of the decline subjects demonstrated total remediation to their 1970 performance level (50% of decline males and 40% of decline females).

Examining Training Effects at the Group Level

The preceding section reported training effects in terms of intraindividual change. However, it is also necessary to consider the consequences of training at the group level. While this is traditionally done by a comparison of pre- and posttest means, it is more informative to examine shifts in the total range of scores across occasions. Although there are statistically significant differences in pre-posttest means, there may still be considerable overlap between pre- and posttest score distributions. Therefore, the degree to which score distributions diverged as a function of decline and converged as a function of training was examined. To examine changes in score distributions, all scores were standardized to the 1970 base ($M = 50$, $SD = 10$). Figure 3 presents the score distributions in 1970, at pretest, and at posttest separately for stable and decline subjects trained on inductive reasoning.

As would be expected, the score distributions for stables in 1970 and at present are quite similar; at pretest, only 3.7% of the scores fall below the 1970 distribution. At posttest, 18% of the scores for stables are above

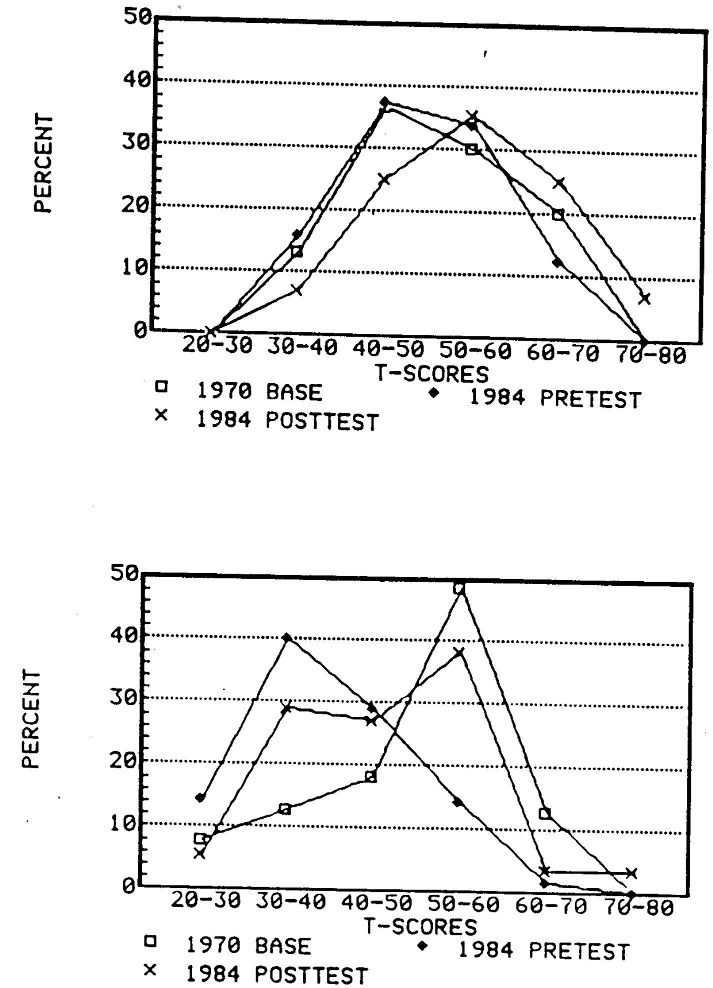


FIGURE 2.3. *Top: Distribution of t-scores for stable subjects trained on inductive reasoning at three occasions: at 1970 base, at 1984 pretest, and at 1984 posttest. Bottom: Distribution of t-scores for decline training subjects at three occasions: at 1970 base, at 1984 pretest, and at 1984 posttest.*

the 1970 distribution. In contrast, at pretest about 45% of the scores for decliners have fallen below the 1970 distribution. At posttest, approximately 30% of the scores have been returned to within the 1970 distribution, and 4% of the scores are above the 1970 distribution.

Training Effects for Three Age/Cohorts

Positive cohort trends have been reported for inductive reasoning in cohort-sequential research (Schaie, 1983). Assuming cohort differences in level of performance, there is the question of whether training effects would differ by age/cohort. Figure 4 shows reasoning performance data for four occasions (1970,1977, 1984-pretest, 1984-posttest) for three age/cohorts: the 1903 birth cohort shown at ages 67, 74, and 81 years; the 1910 birth cohort shown at ages 60, 67, and 74 years; and the 1917 birth cohort shown at ages 53, 60, and 67 years. Significant age-related decline on inductive reasoning has occurred for the 1903 and 1910 cohorts (left side of figure). The performance of the 1917 cohort was relatively stable over the 1970-84 period; they were middle-aged during most of this interval. Note that after training the 1910 and 1917 cohorts were performing, on average, at a level above their 1970 base. In contrast, for the 1903 cohort, remediation of age-related decline is not complete.

Note also that age/cohort differences in level of performance are present at all points of measurement. While training was effective in remediating decline, on average, for the two most recent age/cohorts, the magnitude of training effects was not sufficient to eliminate cohort differences. Indeed, there is a slight fanning out of the cohorts' performances across measurement occasions. Given that age and cohort are confounded, it is not possible to determine whether this increasing variability is attributable to age or cohort. However, given the data presented by Schaie

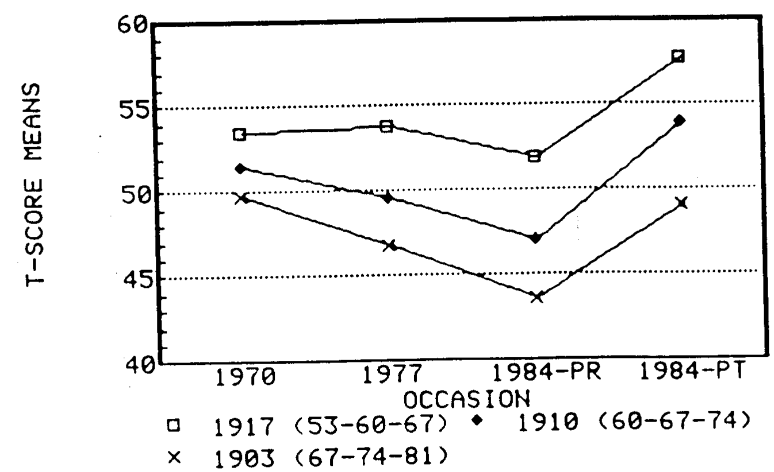


FIGURE 2.4. *Cohort differences in inductive performance for three birth cohorts (1903, 1910, 1917) at four occasions: Prior to training (1970, 1977); at pretest (1984-PR); and at posttest (1984-PT). Ages in 1970, 1977, and at pretest are shown in parentheses.*

(this volume), in which cohort differences were not evident for the oldest age group, it would appear that age may be the more significant factor.

Nature of Behavioral Changes: Age-Related Decline and Training

Further understanding of training effects requires examination of the nature of the behavioral changes that occur as a function of both age-related decline and of training. What types of behavioral changes are reflected in the drop in performance level associated with age-related decline? Does training improvement reflect a mirror-image of the behavioral changes associated with age-related decline? Also, do training effects reflect similar types of behavioral change for stables and decliners?

There are two somewhat competing theories in the literature regarding the nature of age-related decline. One approach argues that behavioral slowing is one, if not the most important, change occurring with age (Cunningham, 1980; Salthouse, 1985). Some researchers focus on a general slowing mechanism in the central nervous system, while others are exploring a multidimensional approach to behavioral slowing. In contrast, other researchers have focused on utilization of cognitive strategies as a central issue in cognitive aging (Craik & Trehub, 1982; Denney, 1980). A number of studies have shown older adults to be less likely to utilize spontaneously strategies shown to facilitate cognitive problem solving. As a result of limited strategy utilization, the cognitive performance of older people is often less accurate and less efficient. In an attempt to consider training data in the context of these two hypothesized explanations of age deficits, changes in accuracy versus speed of problem solving were examined. Accuracy was employed as an indirect index of effective strategy utilization.

Figure 5 shows the proportion of attempted inductive reasoning items that were answered correctly at three measurement occasions (1970, 1984-pretest, and posttest), for stable and decline subjects trained on inductive reasoning. In 1970, both stable and decline subjects were performing at a high level of accuracy (80% correct; 14% incorrect; 6% omits). Fourteen years later, at pretest, the accuracy level of the decline subjects had dropped to 57%, while the proportion of incorrect items had risen to 23%, and the proportion of omitted items had increased to 20%. In contrast, for the stable group, the proportion of correct, incorrect, and omitted items was 71%, 18%, and 11%, respectively. At posttest, following training, the accuracy rate of the decliners had recovered (stable = 85%; decline = 82%). Indeed, both stable and decline subjects were performing somewhat more accurately than they had in 1970.

While these data are interesting in that they indicate that both age-related decline and training improvement are associated with shifts in

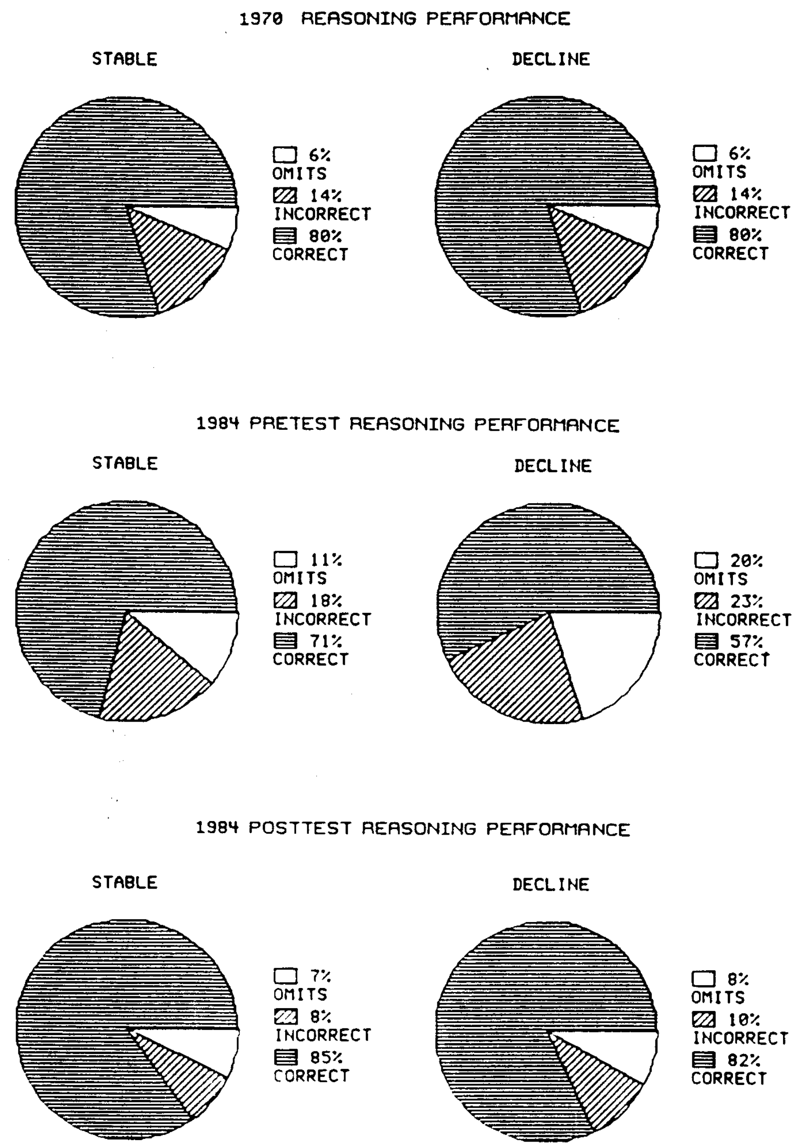


FIGURE 2.5. *Proportion of attempted inductive reasoning test items that were classified as correct, incorrect, or omits, for stable and decline training subjects at three occasions: 1970, Pretest (1984), and Posttest (1984).*

accuracy, they do not allow us to consider changes in accuracy in conjunction with changes in speed of problem solving. The number of items attempted varied across occasions and between stable and decline groups.

In our recent work, changes in accuracy and problem solving speed have been examined, taking into account changes in the number of items attempted both across occasions and across groups. Figure 6 presents change scores for the 1970-1984 interval and for pre-posttest. On the left side of the figure is shown the magnitude of age-related decline for stable and decline subjects. The part of the change score attributed to a decline in accuracy versus a decline in speed of problem solving is shown. As can be seen, the small amount of decline occurring for stable subjects is attributable primarily to a decline in accuracy. In contrast, for decline subjects the decrement is due about equally to a drop in accuracy and in speed of problem solving.

On the right side of the figure is shown pre-posttest training gain for stable and decline subjects. While the magnitude of training gain is somewhat larger for decline subjects, most of the training improvement for both stable and decline subjects is attributable to increased accuracy of performance. Note that the decliners recovered virtually all of the drop in score attributed to a decrease in accuracy, but only part of the decline attributed to speed of problem solving.

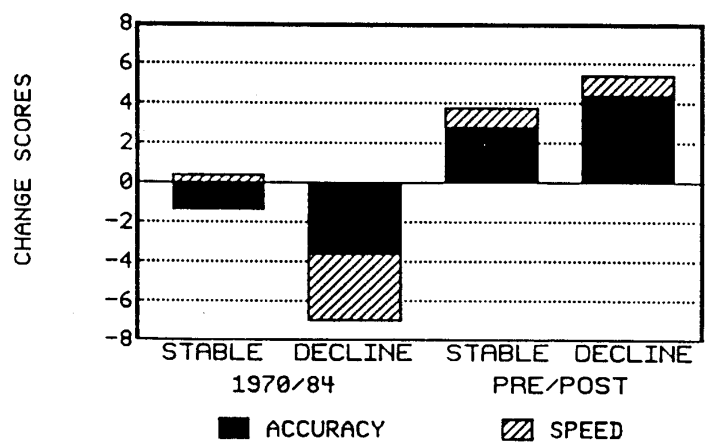


FIGURE 2.6. ***Changes in accuracy and speed of inductive reasoning performance for stable and decline training subjects: 1970-1984 change prior to training; Pre-posttest change.***

These data suggest that the behavioral changes associated with training are not a complete mirror image of changes associated with age-related decline. Whereas age-related decline reflected decreases in both accuracy and speed of problem solving, improvement due to training was associated primarily with increased accuracy.

Several possible interpretations of these differences in patterns of behavioral change can be suggested. First, decline subjects are somewhat older than stables. The behavioral slowing associated with advancing age may limit training efforts directed at increasing speed of problem solving. This limitation may be particularly evident for decline subjects. Whereas stable subjects showed an increase in number of items attempted as a function of training, decline subjects did not. For decline subjects, remediation efforts may need to focus primarily on raising accuracy level.

Alternatively, these findings may be a function of the particular training procedures employed in this study. In our reasoning training program, emphasis was given to utilization of cognitive strategies in problem solution and, thus, on accuracy. Although most subjects tended to speed up as a function of the practice associated with training, the procedures did not directly emphasize responding quickly. Different patterns of behavioral change might have been observed if training procedures focusing on problem-solving speed had been employed.

Training Transfer

Training effects have been found to occur at the *latent construct level*, and to be *ability-specific*.

Training effects at the latent construct level. The focus of training effects is the cognitive construct or latent variable (e.g., induction ability), not improvement on a particular test. However, latent constructs can only be indirectly assessed via observable measures that have been shown empirically to represent that construct. Training gains, if assessed solely at the level of observable measures, represent a confound of variance common to the latent construct and variance that is unique to that specific measure. It is change associated with common rather than unique variance that is of primary interest in training. If training effects reflected primarily change associated with unique variance, then the critique of "teaching the test" would be valid. When training studies rely on only one measure to assess training gain, it is impossible to disentangle change associated with common vs unique variance.

It is only when subjects' performance is assessed on multiple measures, representing the latent construct of interest, that change associated with common variance can be examined; factor scores, obtained via factor analytic procedures, are one index of the common variance associated with a latent construct. Significant training effects on inductive reasoning were found at the factor score level (Figure 7).

Individual Differences in Potential

A fourth implication for the study of potential focuses on individual differences. As there are wide individual differences in the rate and pattern of intellectual decline in old age, so potential must also be considered in terms of individual differences. Recall that approximately 47% of the individuals had remained stable on space and induction abilities, 22% had declined on both abilities, and 15% had declined on one of the abilities, but not on the other. Although the two abilities studied have been shown to exhibit early normative patterns of decline, the data indicate wide individual differences in the rate and pattern of decline. So, too, there are wide individual differences in the type and nature of cognitive potential in later adulthood. For a given individual, cognitive potential in some abilities or skills may need to be defined in terms of growth or maintenance, while for other abilities, potential may be more aptly considered in terms of remediation.

Conclusions

In this chapter the effectiveness of cognitive training on reasoning ability was examined for remediating age-related decline and improving individuals' performance in old age. Significant training effects were found both for subjects who had suffered prior cognitive decline, and for those who had shown no prior decline. The magnitude of training improvement was on the order of two-thirds of a standard deviation. Approximately 40% of decline subjects were remediated to their individual performance level 14 years previously. These findings based on data analyses at the individual level were further supported by examination of shifts in score distributions at the group level. At posttest, approximately 18% of the scores for stables were above the 1970 score distribution. While 44% of the scores for decliners had fallen below the 1970 distribution, approximately 30% were returned to the 1970 base distribution following training. Thus, training gain for stables reflected improvement beyond prior levels of functioning, while training effects for decliners reflected remediation to baseline performance levels.

Training effects were examined for three seven-year cohorts. Significant training effects were observed for all three cohorts, and there was total remediation of cognitive decline, on average, for two of the three cohorts. However, cohort differences in level of performance occurred at all data points.

The nature of behavioral changes occurring with age-related decline and training improvement on inductive reasoning was examined. Age-related decline involved approximately equal decrements in both accuracy and speed of problem solving. However, training effects reflected primarily an increase in accuracy.

In summary, training research suggests that there is considerable cognitive potential in later life. Potential must be examined in the context of the individual's prior developmental history and may involve gain, stability, or remediation. Potential is not a "sky's the limit" phenomenon. There are boundaries and limits, and it is important that these boundary conditions be studied within a developmental framework. Understanding the individual's prior gains and losses will contribute significantly to our understanding of potential in later life.

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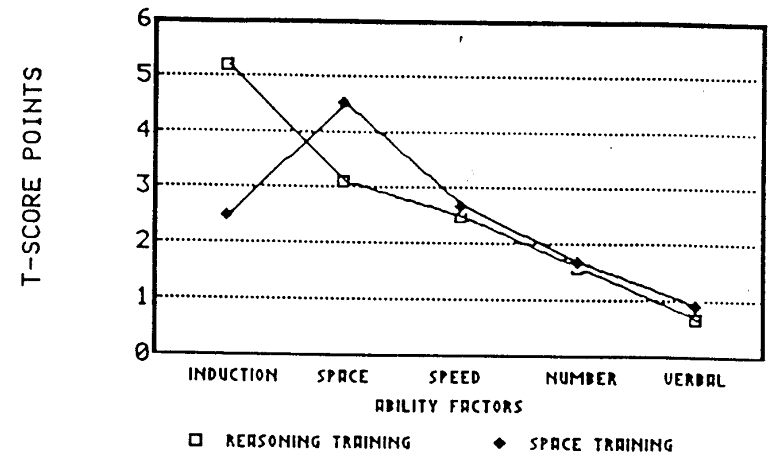

FIGURE 2.7. *Pre-posttest training gains in t-score points for the inductive reasoning and spatial orientation training groups on the five ability factors.*

Ability-specific nature of training effects. Training effects were specific to the ability (Induction) trained. No significant training transfer was found to other ability factors, although there was somewhat greater transfer to other fluid ability factors (Space, Perceptual Speed), than to crystallized factors (Number, Verbal). Demonstration of ability-specific effects requires two conditions: (a) training effects must be shown for multiple measures of the ability, and (b) no significant training effects should occur for measures of other abilities. Because induction ability was the sole focus of the training program and only strategies associated with inductive reasoning were trained, it is important to demonstrate whether or not training effects were limited to induction measures. If transfer had occurred to verbal ability, for example, interpretation of the nature of the training would have become much more difficult.

Subjects' Perceptions of Ability Performance Change

The primary focus in cognitive training research has been on demonstration of observable changes in subjects' performance on ability measures. Less attention has been given to subjects' perceptions of changes in ability performance. Since psychometric ability measures generally are rather abstract, having little "face validity," it would appear difficult for subjects to monitor their performance on such measures.

Two questions related to the induction training study arise. First, did subjects accurately perceive the changes occurring in their ability performance over the 14-year period prior to training? That is, could subjects accurately rate themselves as having declined or having remained stable over the 1970-1984 period? Second, could subjects accurately rate whether or not they improved significantly as a function of cognitive training?

Subjects' perceptions were accurate in both instances. When asked to rate the direction of change (decline, stable, improve) in their inductive reasoning performance over the 1970-1984 period on a 5-point scale, ratings of subjects who had remained stable were significantly higher than ratings of subjects who had declined; these findings were observed with regard to both inductive reasoning and spatial abilities. Likewise, subjects who had significantly improved as a function of training had higher ratings than those who had not improved.

Implications of Training Research

This review of findings from cognitive training research suggests four implications for the study of potential in late life. First, there is need to study potential within a life-span context. Second, potential in later life needs to be considered as a multidimensional phenomenon. In old age, there is potential for growth, potential for maintenance (stability), and potential for remediation of decline. Third, there is suggestive evidence that cognitive plasticity may diminish somewhat in very old age. Fourth, potential in later life must be considered with regard to individual differences.

Potential Within a Life-Span Context

First, potential needs to be studied from a developmental perspective. That is, the individual's potential must be considered within a life-span context. The individual's current potential should be examined in the context of that individual's level of functioning at previous developmental periods. This perspective has been the basis for our approach to the evaluation of cognitive training research in late life. The older adult's intellectual performance at an earlier period serves as the baseline for assessing the developmental nature of training effects. This perspective permits us to define the developmental directionality of training effects, as representing gain or remediation.

This focus on intraindividual change is not to deny the utility of examining individual differences in cognitive potential, such as age differences in training effects. However, if the primary goal of training research is to examine plasticity, it is important that data on age differences in training effects be examined in reference to issues of intraindividual developmental change.

Multidimensional Nature of Potential: Growth, Stability, and Remediation

Second, since cognitive development within a life-span approach is conceptualized as being multidimensional and multidirectional, intellectual potential needs to be conceptualized in an analogous manner. Whereas the stereotypic view of cognitive aging is one of unremitting, universal decrement, the longitudinal research we have presented on inductive reasoning ability suggests that some individuals remain stable, while others decline. From the perspective of cognitive training research, we might conceptualize potential along three directions: potential for *growth*, potential for *stability* (maintenance), and potential for *remediation* of decline.

Potential for growth involves the individual's ability to demonstrate further quantitative or qualitative increases in knowledge base or skill beyond those shown at an earlier age. For example, the capacity of the stable subjects in our training study to achieve significant training gain is evidence for the potential for cognitive growth or gain, even in late life.

Potential for maintenance involves aging individuals' capacity to maintain the same level of skill or performance as they progress from midlife into young-old and old-old age. Indeed, maintaining one's current level of functioning appears to be *the* major goal of many older adults! While much discussion of potential has tended to focus on gains or remediation, elderly people's potential to maintain their current level of functioning with advancing age needs further consideration.

Finally, potential for remediation involves the capacity to remediate partially or completely a skill or performance level that has shown previous age-related decline. Potential for remediation of cognitive decline in elderly persons is evidenced by the fact that approximately 45% of the decline subjects were able to recover prior levels of performance following training.

Qualitative Nature of Potential

It is important that discussion go beyond quantitative and directional issues, to consideration of the *qualitative* nature of cognitive potential. That is, analyses need to progress beyond examination of the magnitude and direction of gain or loss, and to consider the qualitative nature of behavioral changes associated with each.

1. *Potential in-kind.* Behavioral changes may be in-kind. For example, stability in inductive reasoning performance may reflect little change in accuracy or in speed of problem solving—there has been little change in the behavioral components of reasoning performance. If remediation were to occur in-kind, the outcomes of intervention efforts would be a complete mirror image of the pattern of behavioral changes shown in age-related decline.

2. *Potential and compensation.* Alternatively, potential may involve some form of *compensation.* For example, the individual may need to compensate for behavioral slowing by becoming more accurate. Increased accuracy may involve the more efficient use of cognitive strategies.

Compensation has traditionally been thought of as a response made in reaction to becoming less competent as part of the aging process. Individuals may consciously develop compensating strategies at the time they begin to expect or perceive age-related changes. However, compensation may be more broadly defined to include the individual's application of previously acquired expertise in order to cope with age-related deficits. This expertise may be acquired prior to the onset of an age-related deficit, rather than in reaction to the deficit. For example, the aging court stenographer may be able to "fill in" a word or phrase not clearly comprehended, given an extensive knowledge base regarding courtroom procedures, developed over the worklife. The mature worker may draw increasingly on this previously acquired expertise to compensate for slight age-related deficits.

3. *Potential and external aids.* Finally, potential in later life may involve the use of *external aids.* The term compensation, as used in this chapter, involves the employment of intrinsic or endogenous strategies or procedures for maintaining or remediating cognitive behavior: for example, the elderly's increasing use of mnemonic strategies to facilitate memory span deficits. In contrast, utilization of aids involves employing external, exogenous devices or procedures to facilitate effective cognitive functioning in the elderly. While prosthetic devises, such as eyeglasses and hearing aids, are well-recognized external aids, cognitive researchers are beginning to study the use of external memory aids (e.g., lists, timers, medicine reminders, wandering devices) to maintain or remediate the elderly's level of cognitive functioning (West, 1989).

Diminishing Potential in Very Old Age

There is suggestive evidence that with advancement into very old age, many individuals' potential for growth and maintenance of cognitive functioning may diminish. Recall that when training effects were examined separately for three age/cohorts, the two youngest groups (age 67 and 74 at time of training) showed training improvement beyond their baseline performance 14 years previously. In contrast, for the oldest group (mean age 81 at time of training), training efforts were not sufficient to remediate age-related loss.

One might argue that more intensive training procedures than those utilized could have resulted in further remediation for the old-old. Alternatively, the use of external aids may become increasingly advantageous in maintaining cognitive functioning in advanced old age. Nevertheless, the current evidence does suggest some diminished plasticity in cognitive functioning in advanced old age or with increasing nearness to death.