Recent Findings on Adult and Gerontological Intelligence

Changing a Stereotype of Decline

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Current beliefs among both laymen and professionals concerning adult intelligence tend to be based on a simple, biologically based age-decrement model. According to this model, as individuals pass through middle to old age, they become progressively less viable biological organisms and experience gradual but cumulative intellectual deterioration. In this paper such stereotypic views are challenged. We examine data on intellectual performance during the second part of the human life span and argue for the plasticity of adult and gerontological behavior.

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PLASTICITY OF ADULT INTELLECTUAL BEHAVIOR: THE STEREOTYPE DISARMED

In our view, intellectual functioning in adulthood involves multidimensional and multidirectional changes. This developmental perspective focuses particular attention on the impact of experiential and life history factors.

INTELLIGENCE: DEFINITION AND MEASUREMENT

To understand the evidence concerning plasticity in intellectual behavior in later adulthood, one must examine the manner in which intellectual functioning has commonly been described and assessed. In the present context, intelligence will be viewed from a psychometric rather than a cognitive perspective.

Intelligence: a unitary or a multidimensional construct? Historically, intelligence has been regarded as a largely fixed, global, or unidimensional trait, which was potentially quantifiable by a single numerical test score (Baltes and Labouvie, 1973; Matarazzo, 1972). Accordingly, much prior aging research has looked for a single universal age function as measured by omnibus scores on standardized tests. In contrast, a psychometric and developmental viewpoint (Horn, 1970) suggests that there are several dimensions of intellectual performance which may show differential quantitative and qualitative change patterns in adulthood. For example, Botwinick (1967) and Horn (1970) find that memory and spatial and reasoning abilities demonstrate the earliest and greatest performance decrement, while performance on verbal and social knowledge abilities tends to be maintained into advanced age.

In this vein, Horn (1970) and Cattell (1963) have elaborated a theoretical model specifying two major dimensions of intelligence, each with its own ontogenetic course. One factor, fluid abilities (e.g., Inductive Reasoning and Figural Relations), purportedly reflects primarily the integrity of neurophysiological functioning. The other factor, crystallized intelligence (e.g., Verbal Comprehension and Semantic Relations), is largely

the manifestation of cumulative acculturational and educational influences. Because the biological underpinnings of fluid intelligence are susceptible to neurological trauma over the life course, fluid abilities are predicted to decline with age beginning in early adulthood. Conversely, crystallized intelligence is relatively impervious to age-related neurophysiological changes and may continue to increase over much of the life span.

Extraneous variables: performance versus competence. The concept of intellectual functioning is further clarified by the distinction between competence and performance (Bandura, 1969). Competence variables include those specific to the intellectual ability of interest; performance variables are those extraneous to the ability but nevertheless related to test performance. For example, accuracy in transferring answers to a computerized answer sheet (a performance variable) is obviously unrelated to one's intrinsic ability to answer questions correctly; however, one's score is nonetheless influenced by it. The distinction between competence and performance is particularly important in making age comparisons since various age groups are differentially affected by different performance conditions.

Many such performance variables appear to be especially crucial in adult test taking. For example: (1) Older people have less experience in taking standardized tests than younger people and this can contribute to their relatively low test scores (e.g., Goulet, 1972; Jones, 1959). (2) Older people's motivation to apply relevant skills may be reduced because of the apparent meaninglessness of tasks such as nonverbal matrices and sorting objects (Arenberg, 1973). (3) Excessive anxiety and the reluctance to take risks may mitigate against the aged's quick and efficient processing of test information (Botwinick, 1969). (4) The slowing of behavior with age can put older people at a disadvantage in speeded measures like intelligence tests (see Birren, 1965). (5) Interference and fatigue can have a negative effect on the elderly's test performance (Furry and Baltes, 1973). In sum, performance measures of intelligence cannot be taken as pure indicators of intellectual competence.

Age- and cohort-specific test validity. The youth-oriented bias in current testing instruments poses still another conundrum to assessing adult intelligence. Traditionally, measures of intellectual performance have been validated on young adults, with academic achievement as the criterion for test validity. However, these criteria may not have predictive validity for most older persons (see Kogan, 1973) and may guarantee their relatively poor performance. In light of the current emphasis on the discontinuities between child and adult development (Neugarten, 1969), it is likely that intelligence tests do not measure identical processes and attributes across the life span. There is a clear need to determine what behaviors in mature adults' daily experience entail intellectual, problem-solving aspects, how such behaviors can be properly mapped by psychometric instruments, and to construct intelligence tests which do not assume age invariance of test validity, but provide for both age-convergent and age-divergent assessment strategies.

In addition to issues of age comparability, the validity of contemporary intelligence measures may be plagued by cohort effects. Looft (1970), for example, reported generational or cohort differences on vocabulary test items. To the extent that cohort differences are operating, test results, especially measures of general knowledge-information, must be interpreted in view of the temporal distance between a given testee and the cohort on which the test was standardized. The question of age versus cohort differences in test validity, however, is only one aspect of a larger set of questions involving the relationship between individual and social change.

ONTOGENETIC VERSUS HISTORICAL CHANGE

A second major area of research which has shaped recent thinking on the course of adult intelligence involves the relationship between cohort (historical) differences and ontogenetic (intraindividual) change in intellectual functioning. The issue, while well established in the social sciences (e.g., Riley et al., 1972), has only recently been dealt with in the behavioral sciences.

Longitudinal versus cross-sectional investigations. Perhaps the single most stunning blow to the stereotype of age-related intellectual decline was dealt by the conclusions ensuing from controversy regarding the incompatibility of results from longitudinal and cross-sectional investigations (Botwinick, 1973; Schaie, 1970). The cross-sectional method has been most frequently used. It entails measuring subjects of various ages at one point in time and comparing the scores of each age group on the designated variable (Baltes, 1968).

Most cross-sectional findings (Jones, 1959; Matarazzo, 1972) with respect to intellectual development indicate continuous growth in intelligence only up to early adulthood, and thereafter a leveling off and subsequent monotonic decrement. In contrast, longitudinal research measuring the same individuals periodically over time demonstrates that intellectual performance tends to remain stable, or, in fact, increases with age well into later adulthood (e.g., Glanzer and Glaser, 1959; Nesselroade et al., 1972; Owens, 1966; Schaie et al., 1973; Schaie, 1970).

It has been recognized that neither the cross-sectional nor the longitudinal method can accurately depict true age-developmental changes (Baltes, 1968; Schaie, 1965). To do this, controls must be introduced in both conventional methods. Notwithstanding the design complexities involved, the conflicting data provided by these two methods are largely reconciled when generational or cohort differences in intelligence are taken into account. In this regard, the definitive empirical work is provided by Schaie and his colleagues (e.g., Nesselroade et al., 1972) who examined *multiple cohorts* at *multiple adult age levels* on a battery of intelligence tests over a fourteen-year period.

One of their analyses (Nesselroade et al., 1972), for example, focuses on the 1956 to 1963 longitudinal age development for cohorts born from 1886 to 1935. Cross-sectional analysis of these data (e.g., age range 21 to 70 in 1956 versus 28 to 77 in 1963) supports the traditional age-decrement model of intelligence. It reveals a consistent downward trend in test scores from young adulthood onward for each of 4 dimensions of

intelligence: crystallized intelligence, measuring acculturational skills; cognitive flexibility, measuring the ability to shift between two familiar modes of thinking; visuo-motor flexibility, measuring the ability to shift from familiar to unfamiliar patterns in visuo-motor tasks; and visualization, measuring the ability to organize and process visual materials. However, when the same data are partitioned into a series of 7-year (1956 to 1963) longitudinal analyses separately for each of the cohorts, the age-related downward trend is evident for only one of the dimensions, i.e., visuo-motor flexibility. On the contrary, for the ability dimensions of crystallized intelligence and visualization, an increment in performance over the 7-year interval (from 1956 to 1963) was observed in even the most elderly group (age 70 to age 77).

These key outcomes have been substantiated by follow-up work extending over 14 rather than 7 years (e.g., Schaie et al., 1973). The data clearly suggest that a simple age-decrement model of adult intelligence is inadequate and that the nature and course of adult intellectual performance is much more plastic than previously assumed.

The meaning of cohort effects. Cohort effects of the magnitude reported in recent research on adult-gerontological intelligence are novel to developmental psychologists. Therefore, it is not surprising that classical development psychological theory has little to offer when it comes to interpreting the substantive meaning and origin of such cohort effects (Nesselroade and Baltes, 1974; Buss, 1974). In the broadest sense, cohort effects are typically seen as representing a new interindividual-differences variable similar to age, race, or sex, all of which need explication by subsequent analytic and process-oriented research. However, the cohort variable is distinct from sex and race (but similar to chronological age) in that it is intrinsically related to time and, therefore, to development and change.

Cohort effects are here interpreted as reflecting differences and commonalities in life histories involving both environmental-experiential and/or genetic sources or processes. But at

present, delineation of the substance of cohort effects with regard to intellectual functioning is a highly speculative if not Sisyphean task. The multidimensional and multidirectional developmental character of adult intelligence suggests that the developmental sources of cohort effects may be different for various intellectual abilities such as crystallized versus fluid intelligence. Moreover, societal changes productive of cohort effects may originate at various periods in the life span and produce both quantitative (more or less) and qualitative (different forms) effects on the course of adult intelligence. Further, explanations for the origin of cohort effects in adult and gerontological intelligence may relate to population genetics and a host of variables associated with acculturation experiences involving educational, occupational, and aging-associated health phenomena.

One salient difference among generations, for example, accounting for a sizable portion of the variance in adult intellectual functioning appears to be level of education. Since the beginning of the twentieth century, successive generations of persons are on the average better educated, both in the number of years spent in a classroom and in the quality of education. The relationship between poor intellectual performance and low educational status has been empirically demonstrated by Lorge (1955; also Blum and Jarvik, 1972). Further, Granick and Friedman's (1967) cross-sectional research on older adults found that performance on 27 out of 33 perceptual, cognitive, and psychomotor tasks declines with age of respondent. However, when education was partialed out, only 19 tests—primarily measures of psychomotor speed and perceptual flexibility—continued to show age-related deficits. The implication is that educational level, which varies among cohorts, may be an equally powerful predictor of intellectual performance as is chronological age, particularly regarding crystallized abilities.

We can also isolate dramatic changes in the quality and delivery of health care which have occurred across generations. For example, the potential impact of prenatal and perinatal medical care (Stone et al., 1973) on later intellectual functioning has been documented. Similarly, recent medical advances have proposed treatment for hypertension, excessive autonomic arousal, and cerebral hypoxia (Jacobs et al., 1971; Eisdorfer et al., 1970) which have been related to depressed cognitive functioning in later adulthood. In fact, the entire texture of life has altered dramatically and rapidly with respect to nearly every facet of daily activity. The impact of such massive sociocultural change may be so great that many phenomena (e.g., sex differences, developmental tasks) usually described within a maturational-developmental framework need to be subjected to a contextual analysis to ascertain the influence of cohort-related environmental variables. In our view, the rapidity of biocultural change may be particularly problematic for the most elderly cohort in the present century as it is those members of the population for whom early life history is most discrepant from the current cultural mode.

Variability within elderly cohorts. While cohort effects are generally discussed as interindividual differences-variables with respect to the population as a whole, there is also pronounced variability in cognitive and personality dimensions *within* age cohorts. Indeed, interindividual differences have been reported to increase dramatically with age (Bortner, 1967; Britton and Britton, 1972), which suggests there is a cumulative effect of interindividual differences in genetic and environmental influences with age (e.g., Baltes and Willis, 1976).

Not only will the specific environmental or biological variables influencing intellectual functioning vary among individuals, but also timing and interactional patterns for such variables will show interindividual variability. For example, the phenomenon of "terminal drop" involving a significant decrement in intellectual functioning one to five years preceding "natural" death (Jarvik, 1975; Riegel and Riegel, 1972) is less related to chronological age per se than to the unique environmental and biological events which define a given individual's life history and trajectory. Thus, the fact that terminal drop drastically affects the intellectual functioning of some members of a cohort, but not others, results in increased variability within a cohort (see Baltes and Labouvie, 1973, for

illustration). Marked and increasing interindividual variability within aged cohorts is also supported by longitudinal analyses of individual life patterns which indicate that, within a cohort, there are individuals who gain, some who lose, and others who remain stable in intellectual functioning (Schaie et al., 1973).

When it comes to cohort-related changes in interindividual variability of intellectual behavior, we are at a loss for data. Whether the degree of heterogeneity—which currently shows aging-related increments—is changing with cohort membership is an interesting but as yet unexplored question. What is clear, however, is that any changes toward increasing interindividual heterogeneity in intellectual performance (both with regard to life stage and cohort) can be taken as additional evidence for the plasticity of adult and gerontological intelligence.

FROM HINDSIGHT TO FORESIGHT

The key conclusions presented are: (1) the course of adult and gerontological intelligence exhibits large interindividual differences both within and between cohorts and across ability domains, and (2) the potential range of intelligence in aging cohorts is largely unexplored due to the existence of narrow biocultural boundary conditions and the stereotypic belief in decrement held by most psychogerontologists which has favored one research posture over another.

IMPLICATIONS FOR RESEARCH

From our examination of the nature of adult intellectual functioning, certain generalizations can be drawn which may be applicable to many areas of gerontological research as well.

First, the multidimensionality of adult intelligence suggests that a multidimensional approach to many constructs in aging would be useful. For example, even with topics such as death and dying, it would seem promising to take a multidimensional view in which death or dying is considered in light of a number of dimensions (e.g., social, interpersonal, psychological, legal,

political, economic, and so on) all of which interact and influence an individual's terminal behavior. Terminal behaviors, thus, are not generically "undesirable," but may exhibit a variety of properties both from an affective, intellectual, and adaptive viewpoint.

Second, the importance of cohort analyses for all areas of developmental-psychological research cannot be overemphasized. Recognition of the interplay between individual development and societal change leads to an emphasis on examining the biocultural and historical-evolutionary antecedents of behavior. Hence, the impact of historical-cultural change on individual development suggests that adult development is a dynamic, ever-changing field of study.

Third, a recognition of the ontogenetic and evolutionary plasticity of adult development and aging lays the conceptual groundwork for interventive and manipulative research. Adult development and aging does not only exist as we observe it in unobtrusive settings of a particular American ecology. Its external validity in principle is undefined (Baltes and Willis, 1976). An exploration of the range of development and modifiability in many gerontological domains is desperately needed, as is study of optimal intervention methods and approaches in order to gain a fuller understanding of the potential universe of aging behavior.

Fourth, the inadequacy of current measurement instruments in many areas of adult development and aging must be recognized. Naturalistic study of adult behavior in many domains is desirable to provide external and predictive validity for gerontological behaviors. It is likely that, in many instances, a redefinition of constructs may be necessary (e.g., see Kogan, 1973, on creativity from a life-span perspective).

A final implication concerns the effect of stereotyping on the selection of research topics deemed worthy of pursuit by researchers. The imposition of middle-age, middle-class values on the activities and attitudes of our elders can prevent us from pursuing uniquely gerontological research topics. For example, the ancient, development concept of wisdom in old age remains lamentably underexplored, regrettably unoperationalized (e.g.,

Clayton, 1975). Stereotyping also keeps the scientist from recognizing the need to scrutinize all developmental constructs in an effort to determine their applicability to the elderly. Developmental psychologists appear to be chronic believers in the invariance of developmental trends, and apart from operant and cross-cultural child psychologists, ignorant of the importance of biocultural change processes.

IMPLICATIONS FOR SOCIAL PLANNING

Although the data provided on adult and gerontological intelligence in themselves do not provide a sufficient base, they represent a core illustration of a rationale to instigate the redesigning of social policy in light of new findings on adult development and aging.

A major implication of our approach is that the potential of the aging population and the magnitude of interindividual differences are such that a lifelong and flexible approach to the design of life trajectories in education, family life, work, and leisure appears to be essential for future societal planning and policy. In this sense, the disarmed stereotype of intellectual decline may have a counterpart in the disintegration of a stereotype associated with a belief in the widespread usefulness of a social system based on relatively firm age and/or cohort structures.

One final cautionary statement seems warranted. It is in the nature of cohort effects and historical change that the data presented are restricted to the culture and generations studied. Cultural change over the last decades has been rapid. Accordingly, the relative deprivation of the current elderly and the relative contribution of cohort effects may be particularly pronounced at this point in historical time. However, such cautions do not imply that the stereotype of general intellectual decline remains accurate or appropriate. In fact, concern with the historical centrism (e.g., Keniston, 1971) of the present data is apt to emphasize even further the significance of a dynamic and dialectic approach (Riegel, 1975) to the study of adult development and aging and to the design of social policy.

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