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# The stability of general intelligence from early adulthood to middle-age

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**Abstract**

Early cross-sectional studies suggested that cognitive functions begin to decline in young adulthood, whereas the first longitudinal studies suggested that they are mainly stable in adulthood. A number of more contemporary longitudinal studies support the stability hypothesis. However, drop out effects have the consequence that most longitudinal studies end up with relatively few subjects.

In the present study we determined absolute as well as differential stability in general intelligence *g*, and in verbal and arithmetic abilities, longitudinally for 4000+ adult male veterans drawn from the Vietnam Experience Study (VES). The subjects were given five cognitive tests in their early adulthood. Approximately 18 years later, 14 cognitive tests were administered. Two tests, one verbal and one arithmetic, were administered on both occasions. A Principal Axis Factor analysis was conducted separately on the tests from first and second testing in order to extract both a "$g_{young}$" and a "$g_{old}$" general intelligence factor. $g_{young}$ was then correlated with $g_{old}$ to determine the differential stability of *g*. The absolute scores from the recurrent tests were correlated to determine the differential stability and compared using an ordinary *t*-test in order to estimate the absolute stability.

The differential stability coefficients were: 0.85 for *g*; 0.79 for arithmetic; and 0.82 for verbal ability. With respect to absolute stability of the specific tests, we found a significant increase in verbal score (mean scores; 107.16, 116.52), but no change in arithmetic score. Problems associated with different concepts of stability, level of analysis and potential practice effects were discussed.


*Keywords:* General intelligence; Differential stability; Absolute stability

## 1. Introduction

Questions of stability and change are obviously central to the scientific study of adult psychological development. In particular, with respect to cognitive abilities, these questions have generated considerable interest as well as controversy (Jensen, 1980).

Whether age-related stability or change is best explained through a single general ability factor, *g*, or through different types of abilities that follow different developmental trajectories is of great consequences for theories of general intelligence (Jensen, 1998; Spearman, 1927) as well as for theories of multiple intelligence (Cattell, 1971; Horn, 1970; Horn & Cattell, 1966, 1967; Thurstone, 1938).

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The study of age-related stability in intelligence is not without problems, however. How do we best define stability, the proper level of analysis and type of empirical design?

The distinction between differential and absolute stability is obviously very important (Caspi & Bem, 1990). These kinds of stability are independent of each other and each contributes to the general picture of stability versus change. Differential stability thus sheds light on the relative change of subjects within a population, whereas the absolute change informs us of whether the group as unity gains or loses cognitive ability over time.

Moreover, choice of level of analysis may affect the outcome, since stability at the highest order factor level, *g*, might camouflage larger changes at the lower order group factor level and, in particular, at the specific factor level. It is, in other words, very important to distinguish between various levels of analysis, as cognitive change might be more important and pronounced at some than other levels.

Finally, generation effects may confound results, as they can easily be mistaken for age-related change in cross-sectional studies. These effects can be controlled by implementation of longitudinal designs. On the other hand, longitudinal studies tend to overestimate stability and growth because of practice and drop out effects (Salthouse, 1992; Siegler & Botwinick, 1979). The latter have the consequence that the majority of longitudinal studies covering longer stretches of time encompass relatively few subjects.

Research on adult psychological development was insufficient during the first half of the 20th century, because developmental psychologists focused primarily on early development (Schaie, 2000). However, the recruitment needs of the military during World War I did motivate researchers to construct mental tests suitable for adults, so that they could direct large numbers of young and middle-aged draftees into different military functions (Yerkes, 1921). The construction of psychometric assessment tools, such as the Army Alpha, provided the foundation for later empirical investigations of age differences in adulthood, such as the ones conducted by Jones and Conrad (1933). The early cross-sectional studies suggested that cognitive functions decline between young adulthood and middle-age.

Some years later Kuhlen (1940) pointed out that cultural change could be mistaken for age-related change when interpreting results from cross-sectional studies. During the 1950s and 60s researchers became increasingly aware of the necessity of studying the same individual over longer periods of time, in order to control for possible differences in the characteristics of different generations, the so-called cohort effect (Schaie, 1965). This marked the beginning of a major paradigmatic change in emphasis, from cross-sectional studies of adult development to longitudinal studies (Schaie, 2000). An early example of such longitudinal investigations illustrates the point well.

In 1950 Owens conducted the first longitudinal study of the development of mental abilities in adulthood (Owens, 1953; Owens & Clampitt, 1952), and retested 127 males, using the Army Alpha test, Form 6, with which these males had been tested when entering the Iowa State College as freshmen during the Winter Quarter in 1919. The Army Alpha, Form 6, consists of 8 subtests: Following Directions, Arithmetical Problems, Practical Judgement (common sense), Synonym–Antonym (verbal opposites), Disarranged Sentences, Number Series Completion, Verbal Analogies and Information. Individual differences in cognitive functions tended to remain stable over 30 years from early adulthood to approximately age fifty, with the exception of verbal analogies (significant increase) and Disarranged Sentences (significant decrease). In absolute terms Owens found no significant decrease on any subtest, but a significant increase on both the Total score and four of the subtests, namely; Practical Judgement, Synonym–Antonym, Disarranged Sentences and Information. Owens explained the differences in outcome between his cross-sectional and longitudinal studies with differences in length of education, which favoured the younger groups in cross-sectional studies and introduced a confounding cohort effect.

It is beyond the scope of this article to present a thorough review of the extensive longitudinal research that followed, so it will have to suffice to mention that several more recent studies have confirmed that individual differences in measures of mental ability are relatively stable in adulthood (Arbuckle, Maag, Pushkar, & Chaikelson, 1998; Deary, Whalley, Lemmon, Crawford, & Starr, 2000; Eichorn, Hunt, & Honzik, 1981; Hertzog & Schaie, 1986; Plassmann et al., 1995; Schwartzman, Gold, Andres, Arbuckle, & Chaikelson, 1987).

With respect to absolute change, results are somewhat more ambiguous. The Owens study shows an increase mainly in verbal skills and no significant increase on subtests such as Following Directions, Arithmetical Problems and Number Series Completion (Owens, 1953). Results from the Intergenerational study (Eichorn et al., 1981) show an increase in both verbal and non-verbal test scores. Results from the Concordia