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Age-Related Cognitive Decline During Normal Aging: The Complex Effect of Education

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The purpose of this study was to further analyze the effects of education on cognitive decline during normal aging. An 806-subject sample was taken from five different Mexican regions. Participants ranged in age from 16 to 85 years. Subjects were grouped into four educational levels: illiterate, 1–4, 5–9, and 10 or more years of education, and four age ranges: 16–30, 31–50, 51–65, and 66–85 years. A brief neuropsychological test battery (NEUROPSI), standardized and normalized in Spanish, was administered. The NEUROPSI test battery includes assessment of orientation, attention, memory, language, visuoperceptual abilities, motor skills, and executive functions. In general, test scores were strongly associated with level of educational, and differences among age groups were smaller than differences among education groups. However, there was an interaction between age and education such as that among illiterate individuals scores of participants 31–50 years old were higher than scores of participants 16–30 years old for over 50% of the tests. Different patterns of interaction among educational groups were distinguished. It was concluded that: (a) The course of life-span changes in cognition are affected by education. Among individuals with a low level of education, best neuropsychological test performance is observed at an older age than among higher-educated subjects; and (b) there is not a single relationship between age-related cognitive decline and education, but different patterns may be found, depending upon the specific cognitive domain. © 2000 National Academy of Neuropsychology. Published by Elsevier Science Ltd

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Mortiner (1988) proposed that education provides protection against dementia. He argued that "psychosocial risk factors" (i.e., no or low education) reduce the margin of "intellectual reserve" to a level where a minor level of brain pathology results in a dementia. He further argued that this effect of low education will be most strongly associated with late onset dementia of the Alzheimer type (DAT).

During the last decade, several studies have, in general, albeit not always, supported this hypothesis. A positive association between DAT and low education has been observed in research studied carried out in quite different countries: Brazil (Caramelli et al., 1997), China (Hill et al., 1993; Liu et al., 1994; Yu et al., 1989), Finland (Sulkava et al., 1985), France (Dartigues et al., 1991), Italy (Bonaiuto, Rocca, & Lippi, 1990; Rocca et al., 1990), Israel (Korczyn, Kahana, & Galper, 1991), Sweden (Fratiglioni et al., 1991), and the United States (Stern et al., 1994). Negative results, however, have been also reported (Christensen & Henderson, 1991; Knoefel et al., 1991; O'Connor, Pollitt, & Treasure, 1991).

Capitani, Barbarotto, and Laicana (1996) approached the question from a somewhat different perspective. They proposed that three different patterns of association could be expected between age-related decline and education: (a) Parallelism: The age-related decline runs the same course in different educational groups, that is, no interaction is observed; (b) Protection: The age-related decline is attenuated in well-educated participants; and (c) Confluence: The initial advantage of well-educated groups in middle age is reduced in later life. Capitani et al. administered a test battery consisting of five tests to 307 Italian participants aged 40 to 85 years. Mean level of education for the low and high educated groups was about 6 and 13 years, respectively. They reported that for some tests (verbal fluency, spatial memory, and Raven's Progressive Matrices) parallelism was found; whereas for other tests (visual attention and verbal memory) protection was shown. Confluence was not observed for any of their five tests. They concluded that the protective effect of education is not always observed but depends upon the specific cognitive ability that is measured.

Several proposals have been presented to explain this protective effect of education frequently found for at least some tests of neuropsychological functioning. Mortiner and Graves (1993) proposed three different mechanisms: (a) exposure to risk factors is related to low education level and to socioeconomic status in adult life; (b) brain reserve capacity is determined by fetal or early-life exposure to factors associated with socioeconomic status of the family or origin; and (c) lifelong mental stimulation associated with education affects neuronal growth. The author concluded that there is an intercorrelation among these mechanisms, and low education or another correlate of socioeconomic status may be the most significant risk factor of DAT described to date. Katzman (1993) proposed that, "education (secondary school as compared to no education) increases brain reserve by increasing synaptic density in neocortical association cortex, leading to a delay of symptoms by 4 to 5 years in those with AD (and probably, other dementing disorders) hence halving the prevalence of dementia." (p. 17). Katzman (1993) supports his hypothesis pointing out that increased synaptic density is expected in high-educated people. This increase synaptic density represents sort of brain reserve, capable to delay the onset of dementia by some 4 to 5 years.

Even though the diagnosis of dementia requires not only a psychometric but also a functional criterion (American Psychiatric Association, 1994), most often psychometric procedures are used. This approach may result in a penalization for low-educated individuals. Psychometric tests tap abilities that are strongly school-dependent (Ardila, 1995). It should be emphasized that in general cognitive changes observed in the dementia of the Alzheimer's disease (AD) and normal aging are alike, but in AD they are pathologically accelerated (Cummings & Benson, 1992).