

# This Week's Citation Classic

Cravioto J, DeLicardie E R & Birch H G. Nutrition, growth and neurointegrative development: an experimental and ecologic study. *Pediatrics* 38:319-72, 1966. [Hospital Infantil de Mexico, Mexico City, Mexico; Department of Pediatrics, Albert Einstein College of Medicine, Bronx, NY]

The paper presents the results of an ecologic study documenting that malnutrition in children influences the development of effective interrelations among the separate sense systems as it influences the child's physical size. With the exception of mother's education, none of the demographic factors present in the malnourished environment influenced neurointegrative development. [The SC® indicates that this paper has been cited over 165 times since 1966.]

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"In 1961 it was apparent that treatment based on our knowledge of the biochemical pathology of malnutrition had markedly increased the number of survivors. Since malnutrition could not only decelerate certain aspects of biochemical maturation but also was capable of producing retrogressions to earlier age-specific patterns, we became concerned with the possibility that significant lags in nervous system maturation might also have occurred. It was decided to first document if the reductions in body size characteristic of survivors of early malnutrition were associated with reduced mental development. This decision was based on the consideration that a negative finding would indicate that the lower performance found in malnutrition was a transient phenomenon which disappeared with nutrition rehabilitation. On the other hand, if children, years after the severe episode, still exhibit significant lags, the implications for policy making and national economic planning would be of such an importance that a systematic investigation of the intervening nutritional and non-nutritional factors ought to be carried on. On a personal

basis this would mean leaving the laboratory of biochemistry to enter the realm of behavioral sciences, starting from scratch to learn psychology and social anthropology.

"At the end of 1962 it was clear that in survivors of early severe malnutrition, decreased body size was associated with lower intelligence test scores. The time was now ripe for the examination of some of the primary mechanisms underlying cognitive growth since the psychological tests used only partially suggest the manner in which the nervous system functioning is altered to result in lower levels of intelligence. While searching for a meaningful procedure for measuring brain function, Voronin and Guselnikov's paper on the phylogenesis of internal mechanisms of the analytic and synthetic activity of the brain<sup>1</sup> attracted our interest; the problem was how to make operational for the child an experimental study of phylogenesis. In deciding how to devise an appropriate test, Herbert C. Birch's monograph on intersensory development answered our dilemma. Now we could ask if in humans, malnutrition influences neurointegrative development as it influences body size. But how to control for the non-nutritional variables that affect mental growth? Since our knowledge on relevant and irrelevant factors was not good enough to make a meaningful selection we opted for including a question on the role of the socioeconomic deprivation generally present in the context of malnutrition.

"Birch was invited to review a draft of the paper and to join us as co-author. His positive response started a truly rewarding association with a most whose untimely death science and affection.

"Perhaps the many questions raised and left unanswered in the paper, its review of the literature available in English and other languages, a non-intervention research design, the first attempt to test for brain function without intelligence tests, and data documenting that in underprivileged societies bigger is better while in affluent societies bigger is irrelevant, are our guesses as to why this work is frequently cited. The paper motivated high caliber scientists to enter the field; this to us is its primary value. "

1. Voronin L G & Guselnikov V I. On the phylogenesis of internal mechanisms of the analytic and synthetic activity of the brain. *Zh. Vyss. Nerv. Deyat. Pavl. SSSR* 13: 193-202. 1963.
2. Birch H G & Lefford A. Intersensory development in children. *Monogr. Soc. Res. Child Develop.* 28:5 Serial No. 89, 1963.