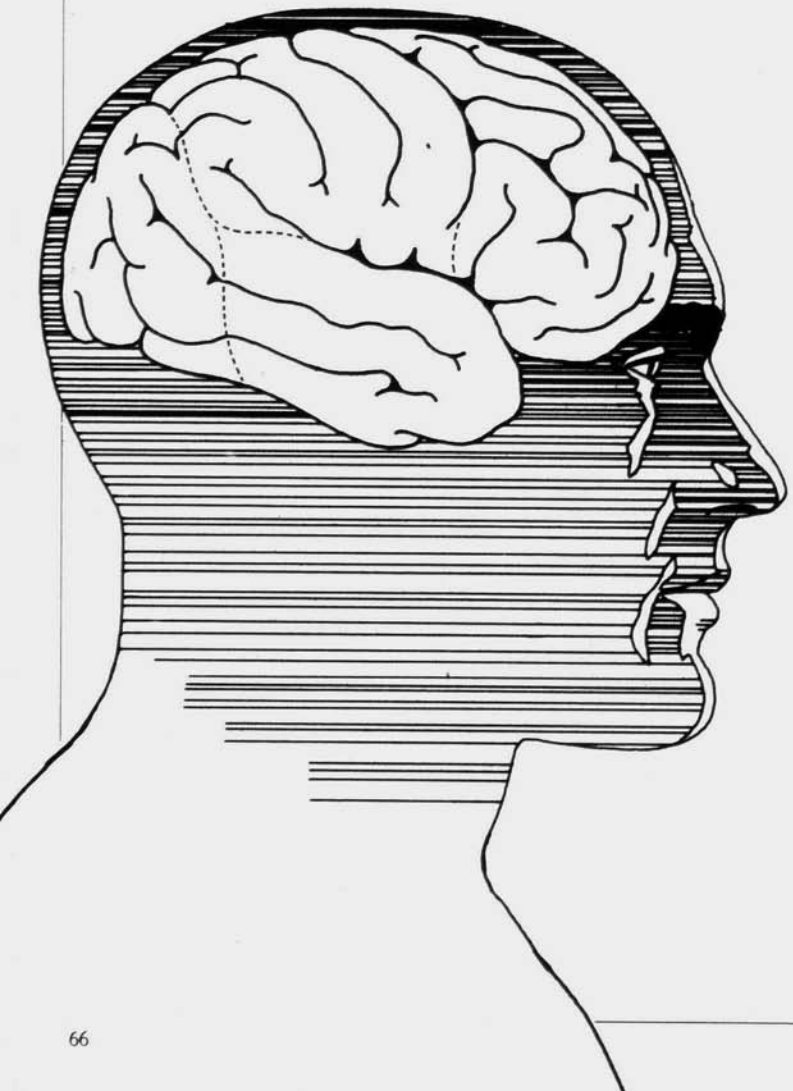

Few scientists other than Epstein take seriously his claim that the brain grows in spurts. The implications that children cannot learn at certain ages is dangerous.

Recent years have brought a strong interest in the brain and cognitive sciences on the part of both researchers and practitioners, including school people who want to understand children and help them learn more effectively. Areas of special interest to educators include split-brain theory, biochemical processes, and brain growth.

Spurts and Plateaus in Brain Growth: A Critique of the Claims of Herman Epstein

RICHARD MCQUEEN

Several years ago I found Herman Epstein's contentions about brain growth periodization of considerable interest. At the time, I believed they brought together and helped me understand a number of puzzling factors about schooling and children. But only in the winter of 1982—in connection with a project being considered by my agency intended to help 5th- and 6th-graders take advantage of increased learning potential during their "brain growth spurt"—did I look intensively and critically at Epstein's claims and the basis for his work.

To my surprise, I found that Epstein's *best* data sources do not support his brain growth periodization notions. Moreover, his use of the data is careless and misleading. For example,

- In his use of the Matoušek (1973) EEG data and the Nellhaus (1968) head circumference data, Epstein made arithmetic mistakes that have important implications for his claims.
- From the Berkeley Growth Study (1978) he selected data for only 15 girls growing up in the 1930s to support his hypotheses about the differences between girls' and boys' brain (really head circumference) growth. (Dorothy Eichorn, researcher and co-author of the Berkeley Study, told me it is not proper to draw such inferences from head- or brain-size data.)

His representation of the Boyd brain weight data (Epstein, 1974) shows that such data is far too erratic to be used to demonstrate periodic growth, and moreover, that brain growth has nearly stopped by age eight, with only a small percent of the brain's growth remaining, [not enough to account for the Epstein spurt at ages 10–12 and 14–16].

- He uses the 1939 Shuttleworth Report of the Harvard Growth Study to show that mental growth correlates with head growth (Epstein, 1974)—but a careful examination of the Shuttleworth data shows that mental growth is not dependent on head size or sex. If anything, it is dependent on age.
- He uses the standard deviations from the 1937 Stanford-Binet norms as published by Quinn McNemar to show spurts and plateaus in mental growth (Epstein, 1974), against the better judgment offered by Professor McNemar and without acknowledging that McNemar disagreed with such an interpretation.
- He produced what Jay Gould, author of *The Mismeasure of Man*, described as a "disgracefully fudged chart" to show that head circumference relates to "vocational status" (Epstein, 1978). The chart also contains two errors and an improper citation, these being the least important problems. Professor Epstein now claims he was misinterpreted when he stated:

> The ordering of people according to head size yields an entirely plausible ordering according to vocational status. It is not at all clear how the impression has been spread that there is no such correlation.

And earlier in the same article:

> Data I have found seem to show clearly that there is a substantial connection between brain size and intelligence [(1978)].

- He cites many sources, each containing up to hundreds of pages of very detailed tables, graphs, and technical discussion, for specific data support (Epstein, 1974) without saying just where in the report this support can be found.

In my conversations with the scholars whose work Epstein cited I found almost no support for his ideas. J. McVicker Hunt, not wishing to be unpleasant toward Epstein, nevertheless told me he could not substantiate Epstein's claims (1978) supposedly based on Hunt's publications with respect to compensatory efforts at ages two to six.

Epstein's formulation of the Nellhaus data points to a middle school plateau. As Nellhaus explained his findings to me, however, his data indicate a pronounced head growth spurt centering at age 12.5, preceded by a plateau at 11 and followed by a gradual decline starting at 14. This phenomenon is not substantiated by other data sources, however. Needless to say, Nellhaus is perplexed that his data would be cited to support a quite different interpretation.

Unlike nearly every other scientist I contacted in an extensive search, UCLA neurobiologist Harry Jerison not only knows of Herman Epstein but knows him and his work well. Since he finds the possibility of brain growth spurts

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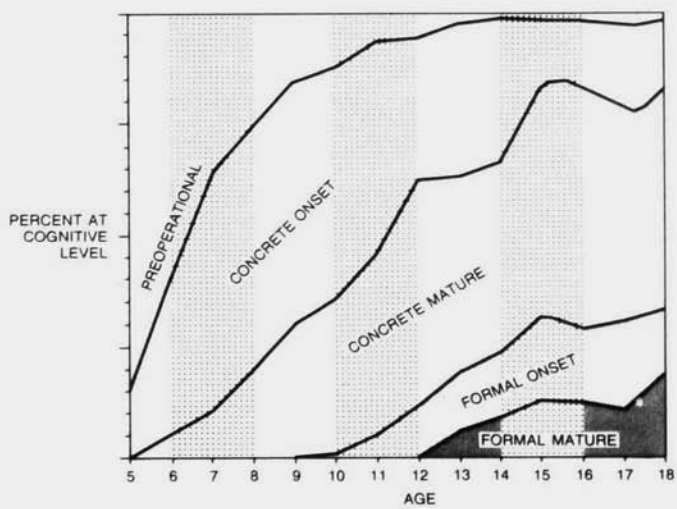
interesting, his first inclination (as with other scientists) was to do nothing to stifle the idea. However, he was unaware of the attention Epstein's work was attracting in schools. When I told him about it, Jerison advised against any practical application of research findings in an area such as brain science, where the research is at a very rudimentary stage. This is particularly true of Epstein's work which, Jerison says, other scientists do not find to be credible or even heading in the right direction. Jerison's best judgment is that the brain's growth for individuals and for populations is gradual, but he does not believe that available data are sufficient to show either periodization or gradual growth.

Martin Hahn, editor of Epstein's 1979 paper, has told me that he has been unable to replicate the rodent brain growth data advanced by Epstein in that paper; and why he (Hahn) had been misunderstood earlier in the matter. Hahn's findings mirror those of Marion Diamond, Mark Rosenzweig, and many colleagues in the departments of anatomy, physiology, and psychology at the University of California at Berkeley. Diamond has told me that the cerebral cortex retains its plasticity at *all* ages, and that nerve cells are designed to receive stimuli. These factors make possible weight changes in the cerebral cortex by as much as 10 percent, attributable to environmental factors including intellectual stimuli. But she contends that the meaning for educators in these findings, contrary to many Epsteinian notions, is to keep trying with *all* children at *all* ages.

A recent article by Brooks and others, "Cognitive Levels Matching" (*Educational Leadership*, May 1983), raises the brain growth periodization issue again. I have no quarrel with the general theme of the article, but the authors' respectful citation of Epstein's work damages their credibility. For example, they reproduce a table supposedly demonstrating the relationship between Epstein's findings and Piagetian developmental levels apparently without noticing that the only clear fit between the two is the lack of movement into concrete-mature at ages 12 to 14. To be sure, this set of data suggests some perplexing things about children's intellectual growth as measured in this way, but it supports Epstein less than might be expected by pure chance.

Figure 1 is another way to examine the same data. Each Piagetian substage is shown as a bounded area, so that a line shows the percentage of children at

Figure 1. A Comparison of Piagetian Substages and Epstein Spurt Years



that stage *and* at higher stages. Epstein spurt years are in dots. "Spurts" at ages 6–8, 10–12, and 14–16, and plateaus at 8–10, 12–14, and 16–18 are inconsistent or nonexistent.

Out of 19 positions on the graph, I find clear support for Epstein at only one position, and marginal support at 4–6 others, for a score of well below 50 percent. Further, I have examined the published and unpublished data developed by Michael Shayer, from which this comes, and have talked and corresponded with Shayer, and find his base data to be much more complex and inconclusive than even the Brooks' article implies. And when other Piagetian data are added, the picture becomes even more confusing.

Barbel Inhelder has told me that Piaget did *not* believe that Epstein's findings provided a biological basis for the Piagetian stages. In fact, no Piagetian scholar I have contacted (among dozens, including all I could find who were in any way associated with Epstein's work) takes that position. And most are very alarmed at the potential implications concerning children's learning capabilities at certain ages.

For example, Sheldon White of Harvard's Department of Psychology, a close acquaintence of Epstein's, wrote, "I am startled and dismayed at the way Epstein has traveled into the educational system." And at another time, "I am sad to see it [Epstein's theory] moving around the country as it is."

Kurt Fischer of the University of Denver, who has studied some of Epstein's sources (Fischer, 1984), finds the possibility of brain and learning growth spurts interesting and is helping to write a report on school-age children expected to be released by the National Academy of Sciences later this year. Fischer has told me that a relationship between head growth and cognitive development is not supported by the data Epstein has put forward. He concedes that there is some support for a relationship between physical development and cognitive development for populations, but that there is no close correlation between head growth and development of intelligence.

Joseph Novak of Cornell University wrote, "Epstein was at least intemperate in making claims about brain growth stages, and at worst, downright fraudulent" (1983).

If "cognitive matching" were the only use being made of the theory it would perhaps be harmless at worst and helpful at best. But I find significant numbers of educators using brain growth periodization to prejudge students' lack of learning capabilities at ages designated by Epstein as brain growth (and learning) plateaus. This is alarming.

Every once in a while a really crazy idea comes along that seems to make sense. In education they come frequently. Teachers learn to hear speeches about them and then go back to their teaching and forget about them. Epstein's brain growth spurt-plateau theory is such an idea. But it seems to be continuing to infect increasing numbers of educators and to be going beyond the

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(continued on p. 71)

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"interesting idea for a speech" level, threatening to exert considerable influence on the ways we try to teach children.

Teachers should not begin thinking that some of their students may be unable to learn because they are in brain growth plateaus (including kindergarten, grades 3–4, 7–8, and 11–12). Such an assumption is invalid and inappropriate. Common sense and research agree that if we decide children can't learn, they *won't* learn. And these losses may never be regained.

With respect to the more general area of neurological-cognitive research, it is time for us to stand back awhile and await the findings of cautious researchers and scholars. There are such people in our local colleges and universities in the biology, anthropology, and psychology departments, and in our medical schools. Scholars of national and international reputation are willing to talk with school people on matters such as these. (They did to me).

These people tell me that the past ten years have constituted the childhood and beginning growth of the neurosciences, that information is proliferating exponentially, but that the information is becoming more difficult to interpret. They say that trying to apply it to classroom practice and educational policy at this point is irresponsible. I agree.□

References

Arnold, John. "New Dogma or Old Tricks (A Critique of Brain Growth Periodization)." Tape of an address, National Middle School Association Annual Conference, 1981. Speedy Tape, Box 39053, Denver, CO 80239 ($9.50).

Diamond, Marion; Krech, David; and Rosenzweig, Mark. "The Effects of an Enriched Environment on the Histology of the Rat Cerebral Cortex." *Journal of Comparative Heurology* 123 (1964) 111–120.

Eichorn, Dorothy, and Bayley, Nancy. "Growth in Head Circumference from Birth Through Young Adulthood." *Child Development* 33 (1962): 257–71.

Epstein, Herman T. "Phrenoblysis: Special Brain and Mind Growth Periods." *Developmental Psychobiology* 7 (1974): 207–24.

Epstein, Herman T. "Growth Spurts During Brain Development: Implications for Educational Policy." *1978 Yearbook of the National Society for the Study of Education*. Edited by J.S. Chall and A.F. Mirsky. Chicago: University of Chicago Press, 1978.

Epstein, Herman T. "Correlated Brain and Intelligence Development in Humans." In *Development and Evolution of Brain Size: Behavioral Implications*. Edited by M.E. Hahn, C. Jensen, and B.C. Dudek. New York: Academic Press, 1979.

Epstein, Herman T. "EEG Developmental Stages." *Developmental Psychobiology* (1980): 629–31.

Fischer, Kurt, and Larzeson, Arlene. "Research: Brain Spurts and Piagetian Periods." In *Human Development from Conception to Adolescence*. New York: W.H. Freeman & Co., 1984.

Gould, Stephen J. *The Mismeasure of Man*. New York: W.W. Norton and Company, 1981.

Hahn, Martin E., and DeLuca, John. "Brain Growth in Young Mice: Evidence on the Theory of Phrenoblysis." *Developmental Psychobiology* 16 (1983): 377–383.

Hunt, J. McVicker. "Reflections on a Decade of Early Education." *Journal of Abnormal Child Psychology* 3 (1975): 275–336.

Hutson, Barbara Ann. "Brain Based Curricula: Salvation or Snake Oil?" *Midwestern Educational Researcher* 3 (1982): 1–33.

Matoušek, Miloš, and Peterson, Ingeman. "Frequency Analysis of the EEG in Normal Children and Adolescents." In *Automation of Clinical Electroencephelography*. Edited by P. Kellaway and I. Peterson. New York: Raven Press, 1973.

McNemar, Q. *The Revision of the Stanford-Binet Scale*. Boston: Houghton-Mifflin, 1942.

McQueen, Richard E. *Brain Growth Periodization: Analysis of the Epstein Findings*. Portland: Multnomah County Education Service District Education Association, 1982.

Nellhaus, Gerhart. "Head Circumference: Composite International and Interracial Graphs." *Pediatrics* 41 (1968): 106.

Novak, Joseph D. "A Need for Caution In Use of Research Claims to Guide Biology Teaching." *American Biology Teacher* 44 (October 1982): 393.

Novak, Joseph D. "Brain Growth Stages." *Science Scope* (March 1983): 4.

Shuttleworth, Frank K. "The Physical and Mental Growth of Girls and Boys, Age Six to Nineteen in Relation to Age at Maximum Growth." *Monographs of the Society for Research in Child Development* 4 (1939): 1–291.

Toepfer, Conrad. "Continuing Research in Brain Growth Periodization." Tape of an address, National Middle School Association Annual Conference, 1979. Speedy Tape, Box 39053, Denver, CO 80239 ($7.00).