Critical Note

CALORIE INTAKE AND INTELLIGENCE,
By J. K. HOWARD
(This Journal, April, 1966)

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Observations of laboratory animals and human subjects have demonstrated that nutritional inadequacies adversely affect physical growth. However, as Howard (1966) quite rightly points out in his recent paper, little is known about the effects of dietary deficiencies upon the development of cognitive abilities. It is therefore encouraging to note that an attempt has been made in this country to examine the relationship which might exist between diet and intellectual functioning.

However, it is suggested that certain points should be kept in mind when examining Howard's paper. The first of these relates to his description of the nature of intelligence. It is a description which appears to have the
dynamic properties of a brain model, but lacks the explicitness characteristic of such approaches. The position he adopts with regard to the interactive relationship between heredity and environment is accepted as being irrefutable. Unfortunately he does not delineate those aspects of "intelligence" the growth of which are either subverted or facilitated by environmental variables such as nutrition. Indeed, when considering his remark that "it is only the non-verbal type test which dispenses with specific abilities," the implication appears to be that it is possible to gain access to the innate cognitive propensities of the organism. Should this be so, his belief runs contrary to that generally accepted amongst contemporary psychologists and which has been put succinctly by Hebb (1958) as follows:

"Intelligence" at best is not very precise, but even so it happens to be used in two quite different senses: (a) it is what one is born with, the innate quality of brain function quite apart from the question of what knowledge or skill the subject may acquire by experience; and (b) it is the average level of comprehension, problem solving, of intellectual function in general, in the half-grown or fully-grown subject.

"We may then define intelligence A as an innate potential for the development of intellectual functions. Intelligence B is the average level of that development at some later date. Intelligence A cannot be tested, B can, though a rough estimate of A is possible in certain circumstances. The student should recognise that A and B are not two different things entirely separate: on the contrary, A enters into and is a necessary feature of B. What we are distinguishing here are two different ways in which the word intelligence is used."

There is another aspect of his description which requires comment. This relates to the status he accords "intelligence." The impression is given that it is a general quality possessed by all individuals to a greater or lesser degree. This is reinforced by reference to factors, which by comparison are described as being "specific cortical activities" and "subsidiary qualities." Yet Howard argues that such factors can be clearly separated from "intelligence" itself and that tests exist which dispense with specific abilities. With the same stroke he both expands and de-limits the boundaries within which "intelligence" might be considered. Just what status "intelligence" has in this description it is difficult to discern.

Perhaps the impasse is more imaginary than real if we think of Hebb's intelligence B as being made up of a number of relatively independent unidimensional abilities or components. While not a component itself, "intelligence" would represent an approximation of the average level of cognitive functioning. In this sense, then, Howard would be justified in stating that the test he employed as his dependent variable could be interpreted as providing a measure of one of the many relatively independent intellectual components or abilities. The word "relatively" is used deliberately because factor analytic studies conducted in this country and elsewhere indicate quite clearly that such non-verbal tests have factors in common with other types of tests, generally including those of the verbal variety. Intelligence should not be defined.

In the present state of our knowledge it retains many of the qualities of a statistical artifact.

Let us now turn to an evaluation of some of the experimental and statistical aspects of Howard's study. He states that his schoolgirl sample (N = 48) was randomly selected from entrants to a Zambian secondary school. It is acknowledged that the use of sampling statistics depends on the assumption that sampling has been random, i.e., every individual in the population has had an equal chance of being chosen. However, the fact that the mean score obtained on the non-verbal test was known to be nine points higher (when rounded) for both the sample under investigation and the population from which it was drawn indicates the contaminating effects of bias. The lack of representativeness of the sample should therefore have been emphasised. It would have been preferable to have determined which variables might be considered important in sampling—socio-economic status comes to mind immediately—and then to have used the stratified-random sampling technique, which, as the term implies, requires the investigation to undertake a random selection of cases within each of the defined sub-populations. Such a technique is a step in the direction of experimental control. Failing this, an attempt could have been made to control the effects of specified unwanted variables via a co-variance design. This in turn would have meant paying close attention to sampling problems in order to preclude the possibility of having unequal cell frequencies.

Howard's statistical analyses are difficult to follow, probably because insufficient data have been provided. It is stated that the results were analysed in order to see whether there was
any significant difference between the means obtained. This suggests that a parametric test, say $t$, was used. Although $t$ has been found to be robust even in conditions where non-parametric tests have in the past been recommended, it is hazardous to apply it where $N < 10$. On the other hand, the manner in which the data are presented indicates that perhaps chi-square served as the test of the null hypothesis. If this is so, any discussion of the statistical significance of differences between means becomes irrelevant. Maybe neither of these was used. It is a pity that the reader is left to wonder.

The most serious weakness of Howard's paper concerns his finding that "There was no significant difference between the means statistically, but it is felt that the tendency to higher scores in the groups with better diets is suggestive that poor diet may be a limiting factor in the development of intelligence potential."

The use of the term "suggestive" is most inappropriate. It behoves the investigator to choose a level of significance, say .05 or .01, and to determine whether the null hypothesis is to be sustained or rejected by reference to one or other of these pre-determined criteria.

Feelings should not enter into an evaluation of hypothesis testing. The rules of statistical inference are quite clear. Should the null hypothesis be sustained following commitment to one or other of the fiducial limits, only one conclusion is possible, i.e., in this study any differences apparent in the data are due to chance. Such a conclusion does not, of course, suggest that no relationship exists in the population between the variables chosen for scrutiny. To the zealous researcher it should instead represent a throwing down of the gauntlet. An examination of such things as the instruments employed, and the experimental design and statistical methods used, might reveal deficiencies which could be ameliorated in later studies.

The great virtue of Howard's study is that it highlights the need of continuing the exploration of the web of variables in this particular field—one, incidentally, in which the skills of medical practitioner and psychologist are profitably combined. It is to be hoped that his results will in fact "stimulate further studies, using large groups and more accurate methods of determining calorie intake. . . ."

REFERENCES