Bloom's Developmental Formula

A Methodological Note

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Bloom [1964, p. vii] presents the formula

$$I_t = I_i + E(\%), \quad (1)$$

where I represents quantitative measures of a characteristic at two points in time and E represents the relevant environmental characteristics during the intervening period. Bloom [1964, p. 192] further states that, 'The correlation between measurements on the same characteristic at two different times will approach unity when the environment in which the individuals have lived during the intervening period is known and taken into consideration.' This statement is less restrictive, and assuming linearity, is a necessary but not sufficient condition for formula 1 to hold. In the following, only the implications of Bloom's verbal statement will be discussed. If Bloom's statement is interpreted causally [which Bloom himself appears to do to some extent, Bloom, 1964, p. 192, point 3], it implies that change in many psychological characteristics is determined mainly by environmental factors after some early stage in development. A similar view can be traced in the writings of many investigators performing studies with change as the dependent variable [Rees and Palmer, 1970, p. 2]. In fact, such a view can in some situations be one reason for the interest in studying correlates of change in nonexperimental settings. If change is decided mainly by the environmental characteristics during the intervening period, one may venture a causal interpretation of the correlation coefficients.

It is well known that development in most psychological characteristics must be viewed as an inseparable interactive process between the genes and the environment [Thompson and Grusec, 1970, p. 633]. Consequently, we cannot normally ascribe change in a psychological characteristic to mainly environmental factors. One aspect of this is illustrated by the following example using IQ. A causal interpretation of Bloom's statement predicts that two individuals having equal true (i.e., measured without error) initial IQs would obtain the same true final IQs, if the relevant environmental characteristics were the same during the intervening period.

Consider the case of two individuals having equal true initial IQs, one coming from a very favorable, and the other coming from a

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very unfavorable environment with regard to intellectual development. If both were subjected to the same very favorable environment during the intervening period, it seems reasonable to believe that the one coming from the very unfavorable environment would obtain the higher final true IQ. This example illustrates the fact that individuals being phenotypically equal in some

characteristic may have widely different genotypes, and that there appears to be no compelling reason why they should react in the same way to the same environment.

The conclusion appears to be that, when studying potential determinants of a characteristic, it is often better to avoid an uncritical use of change concepts, and instead approach the problem open-mindedly as an estimation problem within the framework of nonexperimental causal analysis [Cronbach and Furby, 1970].

Suppose Bloom's statement is interpreted descriptively, and can be shown to hold empirically for a certain characteristic. The value of such a piece of knowledge may be doubtful, since many of the environmental variables used to take the intervening environment into consideration presumably are related to genetic factors. It appears fairly trivial that the relationship between two measurements approach unity, if, broadly speaking, both the genes and the environment are accounted for.

Walberg [1972] attempted to examine Bloom's statement empirically. Walberg used four posttest learning criteria in physics as the dependent variables, and he concluded that: 'The multiple correlations of individual measurements at two points in time do approach unity when the intervening environment is accounted for in the prediction equation' [p. 73]. This statement appears not to be supported by his data. The only multiple correlation being close to unity (0.96 after correction for unreliability) had not increased significantly when the intervening environment was accounted for. The learning criterion 'achievement' showed the largest increase in multiple correlation, increasing from 0.73 to 0.75 (without correction for unreliability), when the intervening environment was accounted for.

Bloom's formula and verbal statement appear to be oversimplified, whether they are regarded causally or descriptively. This point is worth making, since similar views can be traced in many change studies. It should also be pointed out that this criticism of Bloom's formula and verbal statement is not relevant to his and his associates' attempts to find more refined environmental indicators.

References

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