that only rather abstract behavioral consequences of the habitat as a manpower system get examined. We could also learn much more about the *quality* of the human environments provided by Midwest and Yoredale had more psychological questions been asked and reported.

The book is important, and a qualified success, as a demonstration that closer attention to the environmental setting of social behavior is needed and pays off. In the division of labor that has become customary in the social sciences, most research at the level at which Barker and Schoggen have placed their claim will be done by social scientists calling themselves sociologists and anthropologists, not ecological psychologists. It would be a shame if members of these disciplines miss this potentially provocative book because of the authors' obstinate refusal to refer to relevant concepts and methods that sociologists and anthropologists honor. As for psychologists, the concepts of this book provide a framework within which the more essentially psychological aspects of man's relationships with his human environment remain to be explored.

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Critique of a Field

The Study of Behavioral Development. JOACHIM F. WOHLWILL. Academic Press, New York, 1973. xiv, 414 pp., illus. $19. Child Psychology Series.

Imagine the effect on an adolescent of being told by a psychiatrist: "You will (or ought to) have an identity crisis soon, and nearly all the strategies you have learned will simply be inadequate to cope with it." Wohlwill's penetrating critique of the science of human growth and development may have an analogous effect on workers in that field.

Developmental psychologists have rarely studied ontogenetic change per se, a fact Wohlwill attributes to their predilection for borrowing the attitudes, theories, and methodologies found successful in the experimental study of static behavioral events. Wohlwill proposes that the proper object of disciplines calling themselves developmental is the study of changes that occur over time. Accordingly, the most fruitful approach is to study development in the same manner as other time-based phenomena—forgetting, adaptation, habituation, and so on. The implication of this prescription is not apparent until one distinguishes between age differences and age changes. Wohlwill argues that contrasts in behavior between groups of subjects differing in age—and these have provided many of the data of developmental psychology—are far less germane to understanding development than are assessments of change over age within individuals. Since the rate and pattern of change embody age in their definition, "age" is incorporated in the dependent, not the independent, variable; thus debate over using age as an explanatory concept becomes irrelevant.

The force of Wohlwill's approach may be represented by a sampling of his observations on the contemporary mores of developmental psychology:

1) Developmental change is an inherent characteristic of behavior and takes place in a matrix of ongoing natural transitions. Consequently, experimenters can do less to produce (or accelerate) a developmental process than to retard it. Therefore we are unlikely ever to fully uncover the causes of developmental change per se; we can hope to isolate some necessary, but not the sufficient, determinants. While "enrichment" studies may serve pragmatic and therapeutic goals by improving skills, the enrichment procedures may be quite different from the processes nature invokes to accomplish the same end. (Does the regimen used to teach a second language tell us very much about the natural developmental processes of learning a first language?) If it is fruitless to pursue the sufficient causes of natural development through experiments with training or other strategies, the human developmentalist faces a genuine impasse: the deprivation experiment is the primary approach to determining the necessary causes of development, but it is socially and morally reprehensible. Even given an experimentally imposed deprivation, the interpretation of experimental results is more complicated when studying an ongoing developmental process than when these same procedures are applied to unchanging phenomena. For example, if a child suffers a temporary nutritional deprivation, his physical growth may slow during the period of adversity but accelerate beyond the normal rate immediately following. Traditionally, if the adversity were a manipulated experimental condition, we would suggest that the experience "caused" the observed consequences, but in this case is one to suggest that the "catch-up growth" is "caused" by the adversity, or by its termination?

2) Although longitudinal studies are currently maligned, there is simply no substitute for longitudinal data when studying change. Would a neurophysiologist investigating the habituation of response to repeated stimulation rely solely on a cross-sectional design in which one group of subjects was subjected to zero, another to 10, and another to 20 stimulus presentations? Despite its convenience and utility as a control procedure, the cross-sectional study of development is essentially static, relatively uninformative, and possibly misleading. Moreover, the proposed shortcuts to a complete longitudinal design (such as overlapping short-term studies) depend upon debatable assumptions and yield markedly less information.

3) "Developmentalists have, by and large, been content to bushwhack their way across the field they wanted to study" (p. 40) without adequate description of the dimensions along which development proceeds, the measurement scales appropriate to chart such processes, and the nature of developmental patterns. There needs to be a greater emphasis on description, especially when the basic phenomena are defined in terms of change. For example, the photopic-scotopic functions would not have been discovered as readily without the careful charting of the pattern of dark adaptation.

4) "A good case could be made for the proposition that correlational analysis, however denigrated in certain quarters, is the method par excellence for developmental study" (p. 240). But since development does not proceed along neatly isolated tracks, sophisticated multivariate methods must replace simple cross-age bivariate correlational techniques, which not only ignore developmental change entirely but can reveal only one type of developmental continuity.

Whatever his attitude toward these more controversial points, the developmental researcher will appreciate Wohlwill's balanced discussions of a variety of methodological and statistical approaches to developmental data. Particularly notable are his analyses of developmental stages versus sequences, of the liabilities of employing change scores, of the problems in using cross-lagged correlations to infer causality,

and of a variety of research strategies and methods of analysis (especially multivariate approaches) that have not been adequately explored with developmental data. Although the book is addressed principally to developmental psychologists, it contains material of interest to researchers in physical growth, developmental biology, pediatrics, education, developmental linguistics, and applied statistics.

A writer on methodology and data analysis risks either losing his reader in the difficulty of the material or insulting him with oversimplification. Wohlwill chose to be polite. Many readers will rejoice at the omission of statistical details and formulas (the book is a methodological critique, not a statistics text), but occasionally the brief summaries of statistical techniques are heavy reading and more explanation and detail would be helpful to the researcher in following the subsequent discussion of their utility and appropriateness. One sometimes wishes for more positive guidance, for advice about what approaches to use rather than only which ones to avoid. In some of these cases, statistical answers are not available or are still in the art-form stage, but in other contexts a summary of steps for the researcher to follow would have been helpful.

I found Wohlwill's critique comprehensive, timely, and courageous, and admirably free of ad hominem overtones. Undoubtedly many readers will argue with some of his points. But clearly, Wohlwill's challenging and informative analysis has done the field a great service and cannot be ignored. One reads with the feeling that this book could provoke a renaissance in developmental research strategy.

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Family-Building Theory

Mathematical Models of Conception and Birth. MINDEL C. SHEPS and JANE A. MENKEN with the assistance of Annette P. Radick. University of Chicago Press, Chicago, 1973. xxiv, 428 pp., illus. $18.50.

Human reproduction is being usefully studied as a stochastic process. For this purpose, a reproductive history is viewed as a succession of random sojourns in three states: fecundable and subject to impregnation, pregnant, and temporarily infecundable (anovulatory following termination of pregnancy). Passage from the fecundable to the pregnant state marks the event of conception; passage from pregnancy to a postdelivery state signalizes the occurrence of a pregnancy outcome—live birth, stillbirth, or abortion. Mathematical functions of these states typically recognized by family-building theory are the probability of conception per unit of time during the fecundable state, probability distributions of gestational length conditional to pregnancy outcome, the corresponding probability distributions for anovulation, probabilities of the pregnancy outcomes, and length of the reproductive period.

These biological factors have proved to be strategic ones because social and economic variables have to operate through them to affect fertility. The point is illustrated by the four main avenues of fertility control: contraception operates by modifying fecundability, abortion practices affect the index of early fetal death, sterilization truncates the reproductive period, and delayed marriage foreshortens the reproductive period.

For mathematical tractability—and in particular, to gain access to renewal, Markov chain, and Markov process theory—proper simplifying assumptions have to be made. These assumptions have prevented the theory from closely representing any living population but still have allowed a number of important insights to be gained. For example, introducing a large, abrupt change in one parameter (such as a sharp drop in the abortion rate) while holding other factors constant does not produce a prompt, simple change in the birth rate, but rather a damped series of oscillations reflecting changes in the distribution of women among fecundable and infecundable states.

Family building as a field of investigation dates back to the work of two French demographers, Louis Henry and Paul Vincent, in the early 1950's. Subsequently it has acquired many contributors and a scattered literature. Credit for systematizing the mathematics of family building by application of standard techniques of mathematical statistics and probability theory goes largely to the late Mindel Sheps, who in latter years drew much benefit from her collaborations with Jane Menken, coauthor of the book under review. The book is a comprehensive and masterly statement of this work through 1972.

Substantively, the book has three main parts. A long, detailed chapter on fecundability describes methods of parameter estimation applicable to realistic study designs. The authors' rigorous use of estimation theory contrasts with the casual estimation procedures commonly practiced by investigators of human fertility. Three middle chapters address family-building models of varying complexity, culminating in an improved explication of the Perrin-Sheps model of human reproduction as a Markov renewal process. This model features four pregnancy outcomes (including induced abortion) and quite general distribution functions for sojourns in the fecundable, gestational, and anovulatory states. The vitality of this model is attested by several current efforts to refine and generalize it.

Most original, and perhaps most important, are the last three chapters. Here the authors' skilled and inventive notation comes to the fore. Many demographers have hoped that from duration variables, such as pregnancy or birth intervals, could come indices that would register more quickly and surely than conventional fertility rates changes in basic parameters, such as a reduction of average fecundability by family planning. Sheps and Menken make it devastatingly clear how sensitive are these distributions of intervals to several aspects of study design, including type of population (cohort, stationary, or stable), time reference of interval (retrospective, "straddling," or prospective), and the method of ascertainment (rules by which particular intervals are measured and judged as members of the sample or not). The models of this section are more general and abstract than ones treated earlier in the volume. Additional factors encompassed are marriage, death of the woman, widowhood, and divorce, though not remarriage. Given a finite reproductive period, truncation effects can be studied in detail.

In order to provide a text as well as a reference work, the authors devote one entire chapter and several sections of other chapters to mathematical prerequisites. Care is taken to develop both the discrete and continuous-time versions of most models discussed. Exercises follow five of the nine chapters, with several of the problems challenging the reader to reformulate and execute by more general mathematical techniques analyses published in the literature by other investigators.

The text is not an easy one, since