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

the apparatus of probability-generating functions or Laplace transforms is used to derive even the most elementary results, apparently on the theory that if the reader can be trained to hold his seat on the easy rides he has a chance to hold it through the tougher rides encountered elsewhere in the book.

The authors' decision to restrict themselves to a certain core set of mathematical techniques and to limit themselves to substantive problems capable of being efficiently treated by these techniques results in uneven coverage. Methods based on differential equations or generalized, age-dependent branching processes are ignored. Despite its important contributions to the investigation of family building, microsimulation is neglected except as an occasional source of numerical illustration of points derived analytically. The detailed treatment of fecundability is nowhere balanced by a close consideration of the variables of gestation, anovulation, reproductive length, or competing pregnancy outcomes. This asymmetry is awkward because the last six chapters deal with pregnancy and birth intervals whose behavior depends as much on these other aspects as on fecundability. In fairness, however, it should be observed that the book's unevenness simply mirrors the unequal development of these topics in the literature.

A basic work for any investigator interested in the mathematics of human reproduction, the present volume should also appeal to the general scientist who is looking for additional examples of nontrivial applications of probability theory to basic human issues.

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Ethology Today

Perspectives in Ethology. P. P. G. BATESON and PETER H. KLOPFER, Eds. Plenum, New York, 1973. xiv, 336 pp., illus. $17.50.

The publication of this book was most timely, being nearly coincident with the awarding of the Nobel Prize to Konrad Lorenz, Niko Tinbergen, and Karl von Frisch for their development of the field broadly known as ethology. In some circles the term ethology is more narrowly applied to the theoretical framework erected by Lorenz and Tinbergen to account for the freely occurring behavior of animals. Both these men set great store by descriptive studies, and both organized their findings around the principles of Darwinian evolutionary biology. Consequently heritability became an important issue and was embodied in such concepts of perception as releaser and releasing mechanism. The stereotyped responses of animals also were regarded as genetic in origin, with the units or chains of behavior being products of highly specific drives. But since evolution also demands adaptation at a more immediate level, the door was swung open for the environment, as witnessed by the elaboration of concepts such as imprinting and the interlacing of instinct and learning.

The ethological view of behavior evoked a vigorous response and virtual condemnation from some other investigators of animal behavior, such as T. C. Schneirla and his student D. S. Lehrman. Some have labeled this group environmentalist, but if such simple labels must be used I prefer to call them developmentalist. Likewise some have characterized the ethologists as instinctivist, though I think they are more fairly described as phyleticist.

There followed a long and often confused argument between these groups, turning mainly on the durable nature-nurture issue. One view is that this debate has been injurious and obfuscating. I believe, on the contrary, that it has been beneficial to all concerned and that its ramifications will continue for some time.

With Tinbergen and Lorenz now joining von Frisch in retirement, it seems appropriate to assess the state of ethology today. Obviously the field has changed enormously since the 1940's and '50's when many of the central themes were laid down. Now one does well to ask Who is an ethologist? It is difficult to say. The scope of the field has increased with its popularity, for more practitioners mean more division of topics and more points of view. And the boundaries between it and other fields have been fading as earlier ideas change, disappear, or develop into fields of their own. The distinguishing feature of an ethologist remains a focus on naturally occurring behavior. Yet many who count themselves ethologists work under laboratory conditions strict enough to please the most demanding experimental psychologist. Most of them have never systematically observed their animals in the wild or even under simulated natural conditions, but still they are making meaningful contributions dealing with the problems traditionally of importance in ethology.

A reading of *Perspectives in Ethology* will not completely satisfy any felt need to know where ethology is headed today, although the reader will make progress in that direction. The book samples a wide range of topics. It illustrates both the breadth of the field and, for better or for worse, the current state of thinking on some of the problems of more enduring concern. In fairness one should note that it was not the editors' intent to provide an overview of ethology. But their motivation comes from an appreciation of the historical development of ethology. They recognize that after a period of theoretical flowering there had to follow a phase of consolidation and quantification. Their aim is now to encourage new or controversial theories, even at the risk of relaxing requirements about substantiation. To this end they invited several contributions; they received some unsolicited ones as well.

A number of the articles are concerned with the organization of behavior, for example with its causation or motivation. Among these, the chapter on sequences by P. J. B. Slater is representative of quantification and consolidation in ethology. In a more theoretical vein, and after a thoughtful introduction, M. J. A. Simpson reflects at length on the inadequacies of existing models dealing with social organization. He establishes that they are often simplistic and can be misleading, and points to the need to consider individuality and the history of social relationships.

The article by Keith Nelson is a delightful romp across partially new vistas as he declares himself full-out for holism. It is a refreshingly open and chatty article about some difficult problems of detecting organization in behavior. Nelson uses as a springboard