Developmental age and the critical period for imprinting

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Developmental age is widely accepted as a more sensitive baseline than posthatch age for the determination of the critical period for imprinting. The original data upon which this hypothesis is based were reexamined and found to have been analyzed in a meaningless way. There seems to be no objective data supporting the idea that developmental age provides a more sensitive baseline.

While summarizing an experiment regarding the critical period for imprinting, Gottlieb (1961) stated that "developmental age is more sensitive than posthatch age as a baseline for the determination of the critical period in imprinting [p. 427]." In his comprehensive review of the research concerning imprinting, Sluckin (1965) concludes a description of Gottlieb's experiment by stating: "It would appear that the critical period for imprinting might be more sharply defined in terms of developmental age than in terms of conventional age [p. 77]." Similar statements, based upon Gottlieb's work, are made in several of the major textbooks in the area of animal behavior (e.g., Hinde, 1970; Marler & Hamilton, 1966). Developmental age, age measured from the beginning of incubation, was suggested as a better baseline because various factors may cause birds to hatch at slightly different stages of maturational development. In view of the widespread acceptance and dissemination of Gottlieb's idea, it is essential that it have a firm empirical foundation. Upon reexamination of Gottlieb's data, the foundation appears to be quite flimsy.

To insure equivalent developmental stages at the beginning of incubation, Gottlieb refrigerated eggs for a period of time prior to the beginning of incubation. At various ages after hatching, he exposed 65 Peking ducklings to a male mallard decoy for 20 min in a typical circular runway. At 27 to 30 h after hatching, each S was exposed simultaneously to the male decoy and to one painted with female coloration. The amount of time spent following each decoy was recorded, and those Ss which followed the male decoy longer were considered to have been imprinted. Results of this testing session are presented in Fig. 1. (The top panels illustrate the data as presented in two figures by Gottlieb; the lower panels present the same data converted into percentages to facilitate comparisons.) Analysis of the data consisted of demonstrating that there were no significant differences in the

amount of imprinting among the groups trained at various ages after hatching (if, and only if, one ignores the 3-7-h group in which there was no imprinting), but that there was a significantly greater tendency for those Ss trained on the 27th day of developmental age to become imprinted. Describing these data, Gottlieb said: "In terms of posthatch age, then, no critical period is evident. When the occurrence of imprinting is plotted with developmental age as the baseline, however, a critical period is evident [p. 424]." Is this a reasonable conclusion based upon a meaningful comparison? The basic time unit used for posthatch age is 5 h. Developmental age data are plotted based upon 12-h intervals, and developmental age data are analyzed according to 24-h periods. Is a critical period really more sharply defined when it occurs primarily in a single 24-h period than when it occurs

throughout four consecutive 5-h periods? Obviously, it is not.

Klopfer & Gottlieb (1962) conducted an experiment which could have clarified the situation but, unfortunately, did not. It was primarily a study of visual and auditory imprinting, but data were presented in terms of both developmental and posthatch ages. Three groups differing in posthatch age, but all between 10 and 20 h, did not differ. Once more, analysis of developmental age was in terms of days. Data were presented for developmental age broken into 4-h intervals, but these data were not analyzed statistically. The authors did suggest, however, that "8 to 23 hr. was the most critical period during day 27 [p. 129]." Incidentally, these data and this conclusion did not really apply to imprinting. They were based upon whether the S followed during the training session; there is an indication in Gottlieb's 1961 article that following during training does not necessarily correspond with imprinting.

Although the concept of developmental age might be useful in this context, and quite possibly in others, acceptance of Gottlieb's concept of usefulness should be based upon meaningful data. Perhaps Gottlieb's failure to find a clearly defined critical period, measured in terms of posthatch age, resulted from a technique for measuring imprinting which lacked sensitivity rather than from the lack of a meaningful,

Fig. 1. Following and imprinting as a function of posthatch age and developmental age (from Gottlieb, 1961).

sensitive baseline. Others, such as Ramsay & Hess (1954), have found a well-defined critical period when using a stringent criterion for imprinting. There are several other aspects of Gottlieb's study that are subject to criticism, but they are basically irrelevant to the issue of developmental vs posthatch age. What is of utmost importance to psychology is that many people during the past decade have accepted Gottlieb's idea, which does sound quite reasonable, and have passed his idea on to others

without considering its underlying foundation of data. Either meaningful data should be collected which indicate that the concept of developmental age is useful in this context or the myth of its usefulness should be discarded.

REFERENCES

- GOTTLIEB, G. Developmental age as a baseline for determination of the critical period in imprinting. *Journal of Comparative & Physiological Psychology*, 1961, 54, 422-427.
 HINDE, R. A. *Animal behavior: A synthesis*

- of ethology and comparative psychology*. New York: McGraw-Hill, 1970.
 KLOPFER, P. H., & GOTTLIEB, G. Imprinting and behavioral polymorphism: Auditory and visual imprinting in domestic ducks and the involvement of the critical period. *Journal of Comparative & Physiological Psychology*, 1962, 55, 126-130.
 MARLER, P., & HAMILTON, W. J. *Mechanisms of animal behavior*. New York: Wiley, 1966.
 RAMSAY, A. O., & HESS, E. H. A laboratory approach to the study of imprinting. *Wilson Bulletin*, 1954, 66, 196-206.
 SLUCKIN, W. *Imprinting and early learning*. Chicago: Aldine, 1965.