

SENSORY DEPRIVATION VS. SENSORY STIMULATION
DURING EARLY DEVELOPMENT: A COMMENT ON
BERKOWITZ'S STUDY*

National Institutes of Health, Bethesda

JAMES W. PRESCOTT

The findings reported by Berkowitz (1) are extremely interesting, informative, and consistent with theoretical formulations and experimental results relating sensory deprivation to stimulus-seeking behaviors, (4, 5, 6, 7, 9, 10). It is the intention of this comment to suggest that Berkowitz's conclusion (1, p. 192) that "The results as a whole do not support optimal-arousal theory; nor do they fall under the exclusive domain of any other extant theory of the phenomena" is not entirely correct and that his remarks "while the present data favor a deficit-oriented more than an optimal-arousal stance, unilateral application of the former to the infantile experience and/or sensory reinforcement areas is premature" (1, p. 194) is, in fact, not consistent with the early deprivation and stimulation literature.

In the references listed above a theoretical formulation has been offered that sensory deprivation during early development leads to stimulus-seeking behaviors that are related to the sensory system that has been deprived; further, that hyperactivity, hyperreactivity, and increased violent-aggressive behaviors commonly reported following maternal-social deprivation in mammals represent forms of stimulus-seeking behaviors which are attributable to somato-sensory deprivation and not to deprivation of the other sensory systems. With respect to underlying mediating neural mechanisms, this writer has extended and emphasized the relevance of Cannon's Law of Denervation Supersensitivity (10) in accounting for the neural-behavior effects of early sensory deprivation, as initially observed by Riesen (14). Riesen (11, 12, 13, 14, 15) can be constructively consulted for a thorough analysis of the many aspects of early sensory deprivation upon neural-behavioral ontogeny. Additionally, Cannon and Rosenbleuth (2), Stavraký (17), and Sharpless (16) may be consulted for a thorough and systematic treatment of denervation supersensitivity phenomena. It is the contention of this writer that early experimental

* Received in the Editorial Office, Provincetown, Massachusetts, on December 21, 1970, and published immediately at 35 New Street, Worcester, Massachusetts. Copyright by The Journal Press.

sensory deprivation studies represent a special case of functional sensory deafferentation and, in particular, that the abnormal social-emotional behaviors resulting from maternal-social deprivation are due to partial functional *somatosensory* deafferentation. If early sensory deprivation is sufficiently severe, not only does denervation supersensitivity appear, but transneuronal agenesis and/or transneuronal degeneration effects can also be expected (6, 8, 9, 10).

The findings of Berkowitz (1) are very much consistent with the predictions derived from the above theoretical formulations and the experimental early deprivation literature. His report of a magnitude effect for both sensory system modalities (visual and auditory)—i.e., the most deprived group engaged in significantly more stimulus-seeking behaviors than the least deprived group—is a remarkable demonstration of the validity of the early sensory deprivation hypothesis, as are his findings that nonstimulated animals engage in significantly greater stimulus-seeking behaviors than the stimulated groups. A final comment on his failure to find a significant main effect with the sound treatment groups appears appropriate. Berkowitz's conclusion "that sound is simply not as potent a source of stimulation to rats as is light" (1, p. 192) appears premature and is not necessarily consistent with the findings of Tees (18) where a group of rats with ear plugs were compared with a group of rats reared with normal auditory input from the laboratory colony. He found that restricted and normal animals did not significantly differ in learning a frequency discrimination task; however, significant differences were obtained upon two auditory pattern discrimination tasks. Berkowitz (1) rightly points out that self-generated sounds in the home cages was an uncontrolled source of stimulation which undoubtedly contributed to the nonsignificant main effect in the sound treated group. The results of Tees (18) are supportive of that interpretation; however, the additional difference between pure frequency and complex pattern frequency stimulation and perception appear to be an additional but extremely important variable that was insufficiently emphasized by Berkowitz; i.e., test criteria utilizing pure tone frequencies may be generally too insensitive to detect treatment effects and that pattern stimulation criteria may be a requirement for an effective testing procedure.

The above comments are offered to indicate that there does exist an extant theory of exclusive domain which can account for the findings of Berkowitz (1) and, further, that the developmental sensory deprivation theory is quite specific with respect to expected effects of differing sensory system deprivation during early development. Far from being premature this point of view has sufficiently matured to provide a useful explanatory system to account for the marked variations in the quality and quantity of early sensory experiences in understanding the developing brain and behavior.

REFERENCES

1. BERKOWITZ, E. L. The effects of visual or auditory stimulation given in infancy upon subsequent preference for stimulation of both modalities. *Genet. Psychol. Monog.*, 1970, 81, 175-196.
2. CANNON, W. B., & ROSENBLEUTH, A. The Supersensitivity of Denervated structures. New York: MacMillan, 1949.
3. LINDSLEY, D. B. The ontogeny of pleasure: Neural and behavioral development. In *The Role of Pleasure in Behavior*, R. G. Heath, Ed. New York: Harper & Row, 1964. Pp. 3-22.
4. LINDSLEY, D. B., WENDT, R. H., LINDSLEY, D. F., FOX, S. S., HOWELL, J., & ADEY, W. R. Diurnal activity, behavior and EEG responses in visually deprived monkeys. *Ann. N.Y. Acad. Sci.*, 1964, 117, 564-567.
5. PRESCOTT, J. W. Central nervous system functioning in altered sensory environment (S. I. Cohen). Invited commentary in *Psychological Stress*, M. H. Appley & R. Trumbull, Eds. New York: Appleton-Century-Crofts, 1967. Pp. 113-120.
6. ———. The psychobiology of maternal-social deprivation and the etiology of violent-aggressive behaviors (Unpublished manuscript). Colloquium presented at McGill University, Montreal, 1967.
7. ———. Early social deprivation. In *Perspectives on Human Deprivation: Biological, Physiological and Sociological* (Chap. IV: Biological Substrates of Development and Behavior), D. B. Lindsley & A. H. Riesen, Eds. Bethesda, Md.: Nat. Inst. Child Health & Hum. Devel. DHEW, 1968.
8. ———. Development of violence and pleasure in man. Workshop proceedings, Esalen Institute, Big Sur, California, October, 1969.
9. ———. A developmental psychophysiological theory of autistic-depressive and violent-aggressive behaviors. *Psychophysiol.* 1970, 6, 628-629 (Abstract).
10. ———. Early Somatosensory Deprivation as an Ontogenetic Process in the Abnormal Development of the Brain and Behavior. In *Medical Primatology*, I. E. Goldsmith & J. Moor-Jankowski, Eds. Basle, London, New York: S. Karger, 1971, in press.
11. RIESEN, A. H. Effects of stimulus deprivation on the development and atrophy of the visual sensory system. *Amer. J. Orthopsychiat.*, 1960, 30, 23-36.
12. ———. Stimulation as a requirement for growth and function. In D. W. Fiske & S. R. Maddi, *Functions of Varied Experience*. Homewood, Ill.: Dorsey Press, 1961.
13. ———. Effects of visual deprivation on perceptual function and the neural substrate. In *Deafferentation Experimentale et Clinique*, J. d'Ajuriaguerra, Ed., Geneva, Symposium Bel Air II, 1964, pp. 47-66.
14. ———. Sensory deprivation. In *Progress in Physiological Psychology*, (Vol. 1), E. Stellar & J. M. Sprague, Eds. New York: Academic Press, 1966.
15. ———. Sensory deprivation. In *Progress in Physiological Psychology*, E. Stellar & J. Stellar, Eds. New York: Academic Press, 1967.
16. SHARPLESS, S. K. Isolated and deafferented neurons: Disuse supersensitivity. In *Basic Mechanisms of the Epilepsies*, Jasper, Ward, & Pope, Eds. New York: Little, Brown, & Company, 1969. Pp. 329-355.
17. STAVRAKY, G. W. Supersensitivity Following Lesions of the Central Nervous System. London, Ontario: Univ. Toronto Press, 1961.
18. TEES, R. C. Effects of early auditory restriction in the rat on adult pattern discrimination. *J. Comp. & Physiol. Psychol.*, 1967, 63 (3), 389-393.

*Growth & Development Branch
National Institute of Child Health
and Human Development*

*National Institutes of Health
Bethesda, Maryland 20014*