

Employing Electric Shock with Autistic Children

A Review of the Side Effects¹

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The use of electric shock in a punishment paradigm has continued to be a highly controversial issue in the treatment of autistic children. While the experimental literature argues for the effectiveness of the procedure for reducing maladaptive behaviors, some clinicians and researchers have expressed fear of possible negative side effects. The reported side effects of contingent electric shock were reviewed in an attempt to evaluate the validity of these fears. The review indicated that the majority of reported side effects of shock were of a positive nature. These positive effects included response generalization, increases in social behavior, and positive emotional behavior. The few negative side effects reported included fear of the shock apparatus, negative emotional behavior, and increases in other maladaptive behavior. The implication of these findings for the use of the shock procedure are discussed in terms of correct usage of the shock, therapist reservations, and alternative procedures.

The use of electric shock in the treatment of autistic children has proven to be one of the most hotly debated issues facing the researcher or clinician concerned with the welfare of these children. On one hand, some point out that it is an extremely effective method of reducing behaviors which pose an immediate threat to the child's welfare (e.g., self-destruction) and on the

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other hand, some express concern over possible negative side effects of the shock.

Actually, there are two main issues to be addressed. The first concerns the use of punishment per se and the second concerns the use of electric shock as the aversive stimulus in the punishment paradigm. Punishment refers to the operant conditioning procedure whereby an aversive stimulus is presented contingent upon the occurrence of a specified behavior for the purpose of decreasing the probability of the recurrence of that behavior. A formidable body of research exists which argues for the beneficial use of punishment (e.g., Azrin & Holz, 1966; Solomon, 1964), while there have been cautions voiced by others regarding the undesirable emotional side effects which may accrue to the recipient of punishment (Adler, 1930/1970; Maurer, 1974; Skinner, 1953; Yates, 1962). Additionally, the operant researchers have emphasized the temporary nature of response suppression by punishment (e.g., Estes, 1944; Azrin & Holz, 1966) and those representing psychodynamic theory predict symptom substitution (Freud, 1926/1959; Freud, 1946). Regarding autistic children in particular, warnings predicting various noxious side effects including worsening of the autistic withdrawal and decrease in social behavior continue to be voiced (Bettelheim, 1967).

A more specific issue pertains to the use of shock as an aversive stimulus with autistic children. Unlike the use of punishment, this area does not have the benefits of decades of research to help us evaluate its effectiveness on target behaviors and potential positive and negative side effects. However, there has been a considerable amount of recent work in this area and the facts are accumulating. It is the purpose of this paper to review the use of electric shock with autistic children in an attempt to evaluate the nature of any side effects it may produce.

Electric shock has been applied to autistic children as a punisher to eliminate self-destructive behaviors (Baroff & Tate, 1968; Browning, 1971; Bucher & Lovaas, 1968; Lovaas & Simmons, 1969; Merbaum, 1973; Tate & Baroff, 1966), aggression toward others (Birnbrauer, 1968; Browning, 1971; Risley, 1968), playing with electrical equipment (Bucher & King, 1971), self-stimulation (Baroff & Tate, 1968; Lovaas, Freitag, Kinder, Rubenstein, Schaeffer, & Simmons, 1966; Lovaas, Schaeffer, & Simmons, 1965; Tate & Baroff, 1966), attempts to leave the experimental setting (Bucher & Lovaas, 1968; Lovaas et al., 1965), climbing on furniture (Risley, 1968), whining and inattention (Simmons & Lovaas, 1969), destroying property and soiling pants (Birnbrauer, 1968), tantrum behavior (Lovaas et al., 1966; Lovaas et al., 1965), saliva holding (Baroff & Tate, 1968; Tate & Baroff, 1966), and clinging to people (Tate & Baroff, 1966).

This paper will survey those articles in which electric shock has been employed to promote the well-being of autistic children. The reported side effects of such treatments will be reviewed in order to evaluate the assertion that seriously undesirable, unintended effects result from the use of electric shock with these children. The selection of articles included in this review was somewhat arbitrary. This is due to the absence of general agreement regarding the definition of *autism*. Research with children labeled autistic, schizophrenic, or psychotic has been included while research with children identified as primarily mentally retarded has been omitted.

GENERAL CONSIDERATIONS

There were 12 such articles. Almost all of these employed shock in a punishment paradigm. That is, shock was delivered contingent upon a specified undesirable response with the intention of suppressing the response. The shock was usually delivered by a hand-held inductorium which delivered a painful localized shock. The amperage usually employed with autistic children is in the 4- to 5-mA range. Although this is subjectively experienced as painful, this is a safe level of current. It is important to remember that the pain of the shock is localized and is terminated immediately when the shock is discontinued. Unlike electroconvulsive shock, there are no convulsions, no loss of consciousness, and no tissue damage (Craven, 1970).

One major point is that in *all* of these studies, electric shock proved to be a highly effective therapeutic agent with autistic children. In all cases the target undesirable behavior was reduced or eliminated using the shock procedure. This is not to say that this treatment approach is described as a panacea. On the contrary, it has shortcomings. Birnbrauer (1968) stated dissatisfaction with the lack of long-term durability of the shock contingency effects following 120 days of satisfactory treatment by punishment. Other authors have reported that setting specificity of such beneficial results proved to be a frequent obstacle to an overall satisfactory therapeutic effect (Merbaum, 1973; Risley, 1968).

A few studies used shock in ways other than as a punisher. One article was devoted to the use of shock in an escape-avoidance paradigm. This was done with the intention of building social behaviors (Lovaas et al., 1965). In this study the children could escape, and later avoid, a shock to the feet if they responded to the experimenter's request to "come here." The procedure was successful in that the children soon learned to come when called, a response they had not shown prior to treatment. The threatened use of

shock was reported by Baroff and Tate (1968) and Tate and Baroff (1966) to reinstate eating behaviors in an avoidance paradigm.

SIDE EFFECTS

In two of the articles reviewed there was no mention of side effects (Browning, 1971; Lovaas et al., 1966). Of the articles that do mention side effects, these observations were only tangential to the main point of the study, which was the elimination of the undesirable behavior. In most of these studies, side effects were not directly measured but were reported as post hoc observations. It is possible that many side effects were not reported, either because they were not detected or because their occurrence was unrelated to the main interest of the research. Nonetheless, it is interesting to note that those side effects that have been reported show rather clear patterns.

Positive Side Effects

Response Generalization. Probably one of the most interesting and important of the reported positive side effects of shock was the occurrence of response generalization. The shock training apparently altered several behaviors which were not directly treated. In most cases these generalized responses led to reductions in other inappropriate behaviors.

In their treatment of self-destruction, Lovaas and Simmons (1969) reported that for one child, John, a decrease in self-abuse following shock was accompanied by a decrease in both whining and avoiding an attending adult. The authors speculated that self-destruction, whining, and avoiding might have been members of the same response class. Another child in the same study, Linda, also showed response generalization. There was a substantial decrease in both avoiding attending adults and whining. Lovaas et al. (1965), in their study using shock in an escape-avoidance paradigm, found that nurses who rated the children following the experimental (shock) sessions noted that as whining and avoiding adults decreased in the sessions, other pathological behaviors decreased in a different interpersonal setting. Tate and Baroff (1966) reported increases in interest in the environment, such as playing with toys, and decreases in episodes of whining and crying following the treatment for self-destructive behavior.

Social Behavior. Another side effect often reported is an increase in social behavior. Since one of the major characteristics of autistic children is their lack of social behavior, any approach that leads to an increase in such behavior is indeed worth study. In the Lovaas et al. (1965) shock-avoidance study cited above, it was found that in addition to learning to approach the

experimenter, the children became more affectionate and seeking of the adult's company. The attending nurses, after the experimental sessions, also noted increases in affection-seeking behaviors. In employing shock to eliminate severe head banging, Merbaum (1973) found that after shock, the child's reaction to the therapist was one of approach and desire for closeness. Also, the child responded warmly to the therapist's attention. Simmons and Lovaas (1969) reported the case of Stanley, who received shock contingent upon whining and inattention. Although he temporarily showed a marked aversion to the experimenters, he soon developed an extremely affectionate response to them, permitting physical contact and eye contact, and displaying smiling and hugging in their presence. Risley (1968) also reported an increase in eye contact between the child and the experimenter concomitant with the decrease in the target behavior (bookcase climbing). Birnbrauer (1968) applied shock to eliminate destruction of property, soiling of pants, and physical aggression toward others. He reported a decline in all offenses and a general increase in sociability and cooperation. Bucher and Lovaas (1968) reported the case of Kevin, to whom response-contingent shock was delivered for persistently covering his ears and attempting to leave his chair during language training. The investigators reported that Kevin immediately initiated very good eye contact with the attending adult. (Also of interest is that by the end of the first day he performed 100% correctly on the tasks where he had not improved during the preceding four months.) Increases in general sociability by the target child were also described by Tate and Baroff (1966) as self-destructiveness decreased.

Positive Emotional Behavior. In contrast to the predictions of severe emotional damage advanced by some clinicians, it appears that several positive emotional changes have occurred following the use of shock. In the Lovaas et al. (1965) shock-avoidance study, the experimenters reported that, somewhat surprisingly, during successful shock avoidance the children seemed more alert, smiled, and appeared happy. Simmons and Lovaas (1969) found that Stanley (shocked for whining and inattention) smiled in their presence. In addition, Tate and Baroff (1966) described their work with a self-destructive child and reported that following the shock, the child became calm. Soon thereafter he was sitting in a chair and smiling with apparent pleasure. In the Merbaum (1973) study, the mother used shock to reduce self-abusive behaviors of her child. Once these were eliminated, the mother reported the child appeared quieter and happier.

Negative Side Effects

Fear of Shock Apparatus. Most of the negative side effects of shock reported in these studies appear to be direct emotional responses to the

shock device itself. Baroff and Tate (1968) reported that the only deleterious effect observed in their successful use of shock was a phobic response to buzzing sounds. In the Simmons and Lovaas (1969) study, where a child was shocked contingent upon inattention and whining, the authors reported that while the target behaviors decreased, the child showed marked aversion to the sight of the hand-held shock stick, which soon had to be replaced with a remote-control device. Merbaum (1973) reported that after using shock to eliminate severe head banging, the child showed an immediate fear of the shock device. Similarly, a fear response by the child was noted by Bucher and King (1971) as the experimenter approached with the shock device, in their treatment to reduce hazardous play.

Negative Emotional Behaviors. In addition to fear responses to the shock apparatus itself, a few other negative emotional behaviors have been reported following the use of shock. Bucher and Lovaas (1968) reported that when Kevin was shocked for covering his ears and leaving his chair, he would cry and shiver. Bucher and King (1971) reported that their child became quiet and sullen. Similarly, Lovaas et al. (1965) observed a decrease in happiness and contentment as reported by the attending nurses.

Increase in Other Undesirable Behaviors. Some authors report that when response contingent shock was used to eliminate one undesirable behavior, another undesirable behavior increased in frequency. While psychodynamicists might interpret such increases as due to "symptom substitution," the available data indicate that increases in other undesirable behaviors might be attributed to an attempt on the child's part to reinstate the reinforcer previously available for the shocked behavior. Bucher and Lovaas (1968) reported that when one child was shocked for self-abuse, her aggression toward other children on the ward increased at a later time. The authors attributed this increase to the fact that the reinforcers which maintained the self-destruction were still operating in the child's environment (but now in favor of aggressive behaviors). Since she had not learned another, more acceptable, behavior she returned to a form of behavior which led to large quantities of attention. Risley (1968) used shock to eliminate dangerous bookcase climbing in an autistic child. He noted a concomitant increase in chair climbing as the rate of bookcase climbing decreased. However, this too was subsequently eliminated by the contingent use of shock and no similar increase in undesirable behavior was noted. Lovaas et al. (1965) reported increased dependency behaviors according to nurses' reports, following experimental sessions to increase social approach.

The positive and negative side effects described above are summarized in Table I. A total of 25 positive and 13 negative side effects were described in the studies included in this review. As mentioned, of the 13 undesirable effects, 8 were basically fear reactions to the shock apparatus. To be effec-

Table I. Positive and Negative Side Effects of Electric Shock on Autistic Children Reported in 10 Studies

Study	Side effects	
	Positive	Negative
Baroff and Tate (1968)		1. fear of buzzing sounds (+) ^a
Birnbrauer (1968)	1. sociability (+) 2. cooperation (+)	
Bucher and King (1971)		1. fear of shock device (+) 2. quietness (+) 3. sullenness (+)
Bucher and Lovaas (1968)	1. eye-to-face contact (+) 2. imitation skills (+)	1. aggression (+) 2. crying (+) 3. shivering (+)
Lovaas et al. (1965)	1. alertness (+) 2. affection (+) 3. sociability (+) 4. happiness (+) 5. pathological behaviors (-) 6. affection-seeking behaviors (+)	1. happiness-contentment (-) ^b 2. dependency (+)
Lovaas and Simmons (1969)	1. avoiding social contacts (-) 2. whining (-)	
Merbaum (1973)	1. sociability (+) 2. quietness (+) 3. happiness (+)	1. fear of shock device (+)
Risley (1968)	1. eye contact (+)	1. chair climbing (+)
Simmons and Lovaas (1969)	1. affection (+) 2. eye contact (+) 3. smiling (+) 4. hugging (+)	1. temporary aversion to experimenter (+) 2. aversion to shock stick (+)
Tate and Baroff (1966)	1. calmness (+) 2. smiling (+) 3. sociability (+) 4. playfulness (+) 5. whining and crying (-)	

^aThe + denotes an increase in the behavior.

^bThe - denotes a decrease in the behavior.

tive, the shock had to be painful. Therefore, the whining, crying, and fearfulness which sometimes occurred evidenced the potency of the contingency and could be considered as the autistic child's ability to discriminate and respond appropriately to unpleasant stimuli. Consequently, these 8 changes might more appropriately be interpreted as direct responses to aversive stimulation rather than "side effects." With this interpretation of reported responses, the ratio of positive to negative side effects was 25:5.

DISCUSSION

The reported side effects of shock with autistic children do not appear sufficient to rule out the use of this method of treatment. Although there is evidence to support the various contentions concerning temporary suppression, negative emotional effects, and increase in other undesirable behaviors, such evidence is minimal and does not characterize this treatment modality. The majority of unintended effects reported were of a positive nature. These included response generalization, increase in social behavior, and positive emotional behavior.

No evidence was found to support the fear that enduring or severe emotional damage occurred. On the contrary, as has been reported earlier in this paper, several authors report positive changes in the children including happiness, social behavior, affection, and calmness. This is consistent with Lovibond's (1970) conclusion in reviewing aversive techniques in therapy that "the danger of producing emotional disturbance, even with severe aversive stimulation, is quite remote" (p. 83). This opinion is shared in other review articles by Smolev (1971) and Tanner (1973). This is in direct contrast to the predictions of those speculating that severe emotional damage would result from the use of shock.

Thus, we have strong evidence indicating that response-contingent shock is a powerful, effective technique for suppressing undesirable behaviors and that the side effects of shock in these situations tend to be of a clinically desirable nature. However, just to say that the procedure works and does not typically produce negative side effects is not necessarily a blanket approval for its use. One must consider other factors. For example, one must remember that shock is a powerful treatment procedure but that it must be used correctly in order to be effective. That is, the shock must be delivered *immediately* after the target response. It also must be delivered *consistently* so that the child clearly discriminates the occasion for the punishment. Perhaps one should be more concerned about the *direct* effects of misapplication of such a powerful procedure, rather than worrying about fictitious negative side effects.

Also, as we have seen in our review, shock serves only to temporarily suppress the target behavior. In order to avoid reappearance of the behavior or an increase in another undesirable behavior, one must teach the child other more appropriate behaviors that will lead to reinforcement. In addition, we know that the effects of shock often do not generalize to other situations nor other therapists (cf. Lovaas & Simmons, 1969). Thus one may need to have other therapists deliver the response-contingent shock in other environments in order to provide for stimulus generalization. Thus the reported problems of temporary suppression, lack of stimulus generalization, and increases in other undesirable behaviors can be controlled for by the clinician. Given that the clinician is cautious and correct in the use of shock, he can expect positive results.

The fact that changes in behavior occur in addition to the expected change in the target behavior merits attention in its own right aside from the issue of positive and negative valence. The model of man in which a rigidly delineated, autonomous response is tied to a similarly defined stimulus is simplistic and questionable. It appears that classes of responses covary with the application of single or multiple stimuli. This notion has been experimentally demonstrated (Nordquist, 1971; Wahler, 1975; Wahler, Sperling, Thomas, Teeter, & Luper, 1970), and calls for the therapist to plan for multiple effects of any therapeutic intervention. Thus, an effect may be termed a *side effect* only as long as our ignorance delimits our ability to anticipate more than one direct effect (Willems, 1974). Such planning usually entails the teaching of alternative, appropriate behaviors.

Another factor which must be considered is that the use of shock itself is a powerful conditioned stimulus eliciting strong emotional behavior on the part of the therapist using the shock. That is, many people find it difficult or impossible to use shock because of their own strong adverse philosophies. Risley (1968) gives us some insight into this problem: "Observers of the sessions in which shock was applied reported that, on the basis of observable autonomic responses such as flushing, trembling, etc., the subject recovered from the shock episodes much faster than the experimenter" (p. 25). This points to a crucial issue. No matter how effective shock may be for suppressing undesirable behavior in autistic children, it is useless in those situations where people refuse to use it. Yet, punishment is the most effective procedure when one seeks the immediate reduction in a severely disruptive behavior. Thus, effective alternatives to shock as the aversive stimulus in the punishment paradigm would be desirable.

Although the area is still young, research employing other forms of aversive consequences in a punishment procedure have been shown to be effective in many instances where shock has previously been employed. A few examples will serve as illustrations. Overcorrection is a procedure by

which the subject is required to engage in a long series of aversive behaviors (e.g., restoring a "disturbed" environment by cleaning, washing, sweeping, and repeatedly practicing correct behaviors by doing exercises or maintaining uncomfortable positions) contingent upon a target maladaptive behavior. This procedure has reportedly been effective in reducing self-stimulation (Azrin, Kaplan, & Foxx, 1973; Foxx & Azrin, 1973) and aggressive-disruptive behavior (Foxx & Azrin, 1972). Another alternative aversive stimulus was employed by Tanner and Zeiler (1975). They used aromatic ammonia in a punishment paradigm to successfully eliminate self-injurious behavior in an autistic woman.

To conclude, contingent electric shock has proven to be an effective treatment procedure for autistic children. Also, the reported side effects have proven to be of a generally positive nature. Treatment for autistic children, regardless of modality, is usually slow and difficult. We cannot afford to abandon any therapeutic approach with this population without a careful analysis of the costs and benefits. The decision to use electric shock as a therapeutic agent should be evaluated according to objective criteria including the child's needs, the feasibility of using the procedure in the child's environment, and available alternatives. The decision to use or to avoid the use of shock is often made on emotional grounds of the therapist rather than on any well-founded fears. It appears that the correct use of shock in a punishment paradigm leads to both positive direct effects and positive side effects.

REFERENCES

- Adler, A. [*The education of children*] (E. Jensen & F. Jensen, Trans.). Chicago: Regnery, 1970. (Originally published, 1930.)
- Azrin, N. H., & Holz, W. C. Punishment. In W. K. Honig (Ed.), *Operant behavior*. New York: Appleton-Century-Crofts, 1966.
- Azrin, N. H., Kaplan, S. J., & Foxx, R. M. Autism reversal: Eliminating stereotyped self-stimulation of retarded individuals. *American Journal of Mental Deficiency*, 1973, 78, 241-248.
- Baroff, G. S., & Tate, B. G. The use of aversive stimulation in the treatment of chronic self-injurious behavior. *Journal of the American Academy of Child Psychiatry*, 1968, 7, 454-470.
- Bettelheim, B. *The empty fortress*. New York: The Free Press, 1967.
- Birnbrauer, J. S. Generalization of punishment effects—a case study. *Journal of Applied Behavior Analysis*, 1968, 1, 201-211.
- Browning, R. M. Treatment effects of a total behavior modification program with five autistic children. *Behaviour Research and Therapy*, 1971, 9, 319-327.
- Bucher, B., & King, L. Generalization of punishment effects in the deviant behavior of a psychotic child. *Behavior Therapy*, 1971, 2, 68-77.
- Bucher, B., & Lovaas, O. I. Use of aversive stimulation in behavior modification. In M. R. Jones (Ed.), *Miami symposium on the prediction of behavior, 1967: Aversive stimulation*. Coral Gables, Florida: University of Miami Press, 1968.

- Craven, W. F. Protecting hospitalized patients from electrical hazards. *Hewlett-Packard Journal*, 1970, 21 (7), 11-17.
- Estes, W. K. An experimental study of punishment. *Psychological Monographs*, 1944, 57 (3, Whole No. 263).
- Foxx, R. M., & Azrin, N. H. Restitution: A method for eliminating aggressive-disruptive behavior of retarded and brain damaged patients. *Behaviour Research and Therapy*, 1972, 10, 15-27.
- Foxx, R. M., & Azrin, N. H. The elimination of autistic self-stimulatory behavior by over-correction. *Journal of Applied Behavior Analysis*, 1973, 6, 1-14.
- Freud, S. [Inhibitions, symptoms and anxiety.] In J. Strachey (Ed. and trans.), *The standard edition of the complete psychological works of Sigmund Freud* (Vol. 20). London: Hogarth, 1959. (Originally published, 1926.)
- Freud, A. *The ego and the mechanisms of defense*. New York: International Universities Press, 1946.
- Lovaas, O. I., Freitag, G., Kinder, M. I., Rubenstein, B. D., Schaeffer, B., & Simmons, J. Q. Establishment of social reinforcers in two schizophrenic children on the basis of food. *Journal of Experimental Child Psychology*, 1966, 4, 109-125.
- Lovaas, O. I., Schaeffer, B., & Simmons, J. Q. Building social behavior in autistic children by use of electric shock. *Journal of Experimental Research in Personality*, 1965, 1, 99-109.
- Lovaas, O. I., & Simmons, J. Q. Manipulation of self-destruction in three retarded children. *Journal of Applied Behavior Analysis*, 1969, 2, 143-157.
- Lovibond, S. H. Aversive control of behavior. *Behavior Therapy*, 1970, 1, 80-91.
- Maurer, A. Corporal punishment. *American Psychologist*, 1974, 29, 614-626.
- Merbaum, M. The modification of self-destructive behavior by a mother-therapist using aversive stimulation. *Behavior Therapy*, 1973, 4, 442-447.
- Nordquist, V. M. The modification of a child's enuresis: Some response-response relationships. *Journal of Applied Behavior Analysis*, 1971, 4, 241-247.
- Risley, T. The effects and side effects of punishing the autistic behaviors of a deviant child. *Journal of Applied Behavior Analysis*, 1968, 1, 21-34.
- Simmons, J. Q., & Lovaas, O. I. Use of pain and punishment as treatment techniques with childhood schizophrenics. *American Journal of Psychotherapy*, 1969, 23, 23-36.
- Skinner, B. F. *Science and human behavior*. New York: The Free Press, 1953.
- Smolev, S. R. Use of operant techniques for the modification of self-injurious behavior. *American Journal of Mental Deficiency*, 1971, 76, 295-305.
- Solomon, R. L. Punishment. *American Psychologist*, 1964, 19, 239-253.
- Tanner, B. A. Aversive shock issues: Physical danger, emotional harm, effectiveness, and "dehumanization." *Journal of Behavior Therapy and Experimental Psychiatry*, 1973, 4, 113-115.
- Tanner, B. A., & Zeiler, M. Punishment of self-injurious behavior using aromatic ammonia as the aversive stimulus. *Journal of Applied Behavior Analysis*, 1975, 8, 53-57.
- Tate, B. G., & Baroff, G. S. Aversive control of self-injurious behavior in a psychotic boy. *Behaviour Research and Therapy*, 1966, 4, 281-287.
- Wahler, R. G. Some structural aspects of deviant child behavior. *Journal of Applied Behavior Analysis*, 1975, 8, 27-42.
- Wahler, R. G., Sperling, K. A., Thomas, M. R., Teeter, N. C., & Luper, H. L. The modification of childhood stuttering: Some response-response relationships. *Journal of Experimental Child Psychology*, 1970, 9, 411-428.
- Willems, E. P. Behavioral technology and behavioral ecology. *Journal of Applied Behavior Analysis*, 1974, 7, 151-165.
- Yates, A. J. *Frustration and conflict*. New York: Wiley, 1962.

- Ornitz, E. M., Forsythe, A. B., & de la Pena, A. The effect of vestibular and auditory stimulation on the rapid eye movements of REM sleep in autistic children. *Archives of General Psychiatry*, 1973a, 29, 786-791.
- Ornitz, E. M., Forsythe, A. B., & de la Pena, A. The effect of vestibular and auditory stimulation on the rapid eye movements of REM sleep in normal children. *Electroencephalography and Clinical Neurophysiology*, 1973b, 34, 379-390.
- Ornitz, E. M., & Ritvo, E. R. Perceptual inconstancy in early infantile autism. *Archives of General Psychiatry*, 1968, 18, 76-98.
- Ornitz, E. M., Ritvo, E. R., Brown, M. B., LaFranchi, S., Parmelee, T., & Walter, R. D. The EEG and rapid eye movements during REM sleep in normal and autistic children. *Electroencephalography and Clinical Neurophysiology*, 1969, 26, 167-175.
- Ornitz, E. M., Ritvo, E. R., Panman, L. M., Lee, Y. H., Carr, E. M., & Walter, R. D. The auditory evoked response in normal and autistic children during sleep. *Electroencephalography and Clinical Neurophysiology*, 1968, 25, 221-230.
- Ornitz, E. M., Ritvo, E. R., & Walter, R. D. Dreaming sleep in autistic and schizophrenic children. *American Journal of Psychiatry*, 1965, 122, 419-424.
- Ornitz, E. M., Wechter, V., Hartman, D., Tanguay, P. E., Lee, J. C. M., Ritvo, E. R., & Walter, R. D. The EEG and rapid eye movements during REM sleep in babies. *Electroencephalography and Clinical Neurophysiology*, 1971, 30, 350-353.
- Parmelee, A. H., & Stern, E. Development of states in infants. In C. Clemente, D. Purpura and F. Mayer (Eds.), *Sleep and the maturing nervous system*. New York: Academic Press, 1972.
- Petre-Quadens, O., & De Lee, C. Eye-movements during sleep: A common criterion of learning capacities and endocrine activity. *Developmental Medicine and Child Neurology*, 1970, 12, 730-740.
- Petre-Quadens, O., De Lee, C., & Goffe, B. Analyse stochastique des mouvements oculaires du sommeil et syndromes neurologiques. *Acta Neurologica Belgium*, 1973, 73, 20-24.
- Petre-Quadens, O., De Lee, C., & Remy, M. Eye movement density during sleep and brain maturation. *Brain Research*, 1971, 26, 49-56.
- Rechtschaffen, A., & Kales, A. (Eds.). *A manual of standardized terminology, techniques and scoring system for sleep stages of human subjects*. Washington, D.C.: National Institute of Health, Publication 204, U.S. Government Printing Office, 1968.
- Roffwarg, H. P., Muzio, J. N., & Dement, W. C. Ontogenetic development of human sleep-dream cycle. *Science*, 1966, 152, 604-619.
- Tanguay, P. E., Ornitz, E. M., Forsythe, A. B., Lee, J. C. M., & Hartman, D. Basic rest-activity cycle rhythms in the human auditory evoked response. *Electroencephalography and Clinical Neurophysiology*, 1973, 34, 593-603.
- Thomas, J., Houzel, D., Parot, S., Benoit, O., Lille, F., Kujas, M., & Chataignier, C. Evolution de la fréquence des mouvements oculaires au cours des P.M.O. chez l'homme normal. *Revue Neurologique (Paris)*, 1970, 122, 523-524.
- Villablanca, J., & Marcus, R. Sleep-wakefulness, EEG and behavioral studies of chronic cats without neocortex and striatum: The "diencephalic" cat. *Archives Italiennes de Biologie*, 1972, 110, 348-382.
- Villablanca, J., & Salinas-Zeballos, M. E. Sleep-wakefulness, EEG and behavioral studies of chronic cats without the thalamus: The "athalamic" cat. *Archives Italiennes de Biologie*, 1972, 110, 383-411.