

The Motivation of Self-Injurious Behavior: A Review of Some Hypotheses

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The literature on self-injurious behavior suggests five major hypotheses concerning the motivation of such behavior: (a) self-injurious behavior is a learned operant, maintained by positive social reinforcement (positive reinforcement hypothesis); (b) self-injurious behavior is a learned operant, maintained by the termination of an aversive stimulus (negative reinforcement hypothesis); (c) self-injurious behavior is a means of providing sensory stimulation (self-stimulation hypothesis); (d) self-injurious behavior is the product of aberrant physiological processes (organic hypothesis); and (e) self-injurious behavior is an attempt to establish ego boundaries or to reduce guilt (psychodynamic hypotheses). Data bearing on each hypothesis are reviewed and evaluated. Effective treatment may depend on a recognition of the different motivational sources of self-injurious behavior and the developmental relationships existing among these sources. Animal analogue experiments may provide clues to the motivation of self-injurious behavior in cases in which human experimentation is ethically indefensible.

Self-injurious behavior is perhaps the most dramatic and extreme form of chronic human psychopathology. Self-injurious behavior involves any of a number of behaviors by which the individual produces physical damage to his or her own body (Tate & Baroff, 1966). Some individuals engage in scratching, biting, or head banging to the point at which bleeding occurs and sutures are required. Others may engage in self-inflicted punching, face slapping, or pinching, thereby producing swellings and bruises over large areas of their bodies.

Self-injurious behavior is most frequently reported in individuals labeled autistic, schizophrenic, retarded, or brain damaged. The frequency of occurrence of such behavior has been reported to be about 4-5% in psychiatric

populations (Frankel & Simmons, 1976; Phillips & Alkan, 1961). Interestingly, self-injurious behavior, particularly head banging, is also seen in young normal children (Ilg & Ames, 1955). Here, the frequency of occurrence has been reported to be 11-17% at ages 9-18 months and 9% at 2 years of age (Shintoub & Soulairac, 1961). De Lissovoy (1961) reported the incidence of self-injurious behavior to be 15.2% in a normal population aged 19-32 months.

Despite the relative infrequency of self-injurious behavior, the behavior has commanded a great deal of attention from clinicians because of its life-threatening nature and because of the barrier it poses to normal social and intellectual development. Treatment efforts, which have been numerous, have been summarized in comprehensive review articles by Smolev (1971), Bachman (1972), and Frankel and Simmons (1976).

The focus of the present article is on the motivation, rather than the treatment, of self-injurious behavior. The major reason for this focus stems from the fact that treatment interventions have not always been successful (e.g., Romanczyk & Goren, 1975; Seegmiller, 1972). It is very likely that self-injurious be-

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havior, like most complex human behavior, may be under the control of a number of motivational variables and that different treatment interventions may be required to eliminate each source of motivation. For this reason, it would be important to identify what the different motivational variables might be. With this consideration in mind, a review of several hypotheses pertaining to the motivation of self-injurious behavior is undertaken.

A search of the literature indicates that the most noteworthy hypotheses, in terms of frequency of citation and/or amount of empirical support, are the following: (a) self-injurious behavior is a learned operant, maintained by positive social reinforcement (positive reinforcement hypothesis); (b) self-injurious behavior is a learned operant, maintained by the termination or avoidance of an aversive stimulus (negative reinforcement hypothesis); (c) self-injurious behavior is a means of providing sensory stimulation in the absence of adequate levels of tactile, vestibular, and kinesthetic input (self-stimulation hypothesis); (d) self-injurious behavior is the product of aberrant physiological processes (organic hypothesis); and (e) self-injurious behavior is an attempt to establish ego boundaries or to reduce guilt (psychodynamic hypotheses). The evidence bearing on each of these hypotheses is reviewed and evaluated, and some directions for future research are discussed.

Positive Reinforcement Hypothesis

This hypothesis states that self-injurious behavior is a learned operant, maintained by positive social reinforcement, which is delivered contingent upon performance of the behavior (Lovaas, Freitag, Gold, & Kassorla, 1965). This hypothesis suggests that the frequency of self-injurious behavior should decrease when the social consequences that presumably maintain the behavior are withdrawn. There is a substantial body of literature indicating that the complete removal of social consequences can in fact greatly reduce or eliminate self-injurious behavior (Bucher & Lovaas, 1968; Ferster, 1961; Hamilton, Stephens, & Allen, 1967; Jones, Simmons, & Frankel, 1974; Lovaas & Simmons, 1969; Tate & Baroff, 1966; Wolf, Risley, Johnston, Harris, & Allen,

1967; Wolf, Risley, & Mees, 1964). In a representative study, Hamilton et al. (1967) treated several severely retarded institutionalized individuals, using a time-out procedure. This procedure prescribes that access to all forms of reinforcement be removed from an individual for a fixed period of time, contingent upon the emission of a response. In the present example, the procedure consisted of confining the individual to a chair for a fixed period of time, contingent upon each instance of self-injurious behavior. Because the chair was located in an isolated area of the ward, the procedure effectively removed all opportunity for reinforcement (including social reinforcement) for the fixed period. Under these conditions, self-injurious behavior decreased precipitously to negligible levels. One interpretation of these data is that self-injurious behavior decreased because social reinforcement, the variable maintaining the behavior, was removed each time the behavior occurred. Curiously, in this study and others like it, there was no measurement of the frequency of occurrence of social reinforcement. There was thus no demonstration that ward staff, for example, were in fact attending to such behavior at any time. Yet, when self-injurious behavior occurs at a high frequency, the assumption is often made that somebody must be attending to such behavior, thereby reinforcing it. Because this assumption is a prevalent one, it would be important, in future research, to include measures of the frequency of adult social reinforcement before, during, and after treatment intervention. In this manner, the role of social reinforcement in maintaining self-injurious behavior could be more adequately assessed.

Another methodological point pertaining to time-out studies relates to the possibility that time-out procedures may actually constitute aversive stimuli, that is, self-injurious behavior decreases, not because of the removal of social reinforcement, but because of the punishing aspects of being confined to a chair or being forced to wait in a barren room. From this standpoint, time-out studies are poor tests of the positive reinforcement hypothesis because reinforcement withdrawal and punishment are confounded. A purer test can be found in those studies involving the use of extinction. Extinc-

tion is a procedure in which the reinforcement for a previously reinforced behavior is discontinued. In the present example, extinction would involve the brief discontinuation of social reinforcement contingent upon each occurrence of self-injurious behavior. Since the extinction procedure does not involve placing the individual in a physically aversive situation, punishment effects are presumably minimized, and any reduction in self-injurious behavior can be attributed directly to the removal of social reinforcement. Interestingly, Lovaas et al. (1965) and Tate and Baroff (1966) found that simple extinction had no effect on the frequency of self-injurious behavior. Superficially, it would thus appear that social reinforcement is not an important variable. The results are difficult to interpret, however, because no measure of adult attending behavior was reported in either study. It is entirely possible that the adults inadvertently attended to the self-injurious behavior on an intermittent basis. This situation is likely because of the difficulty of ignoring an individual when that individual is engaging in dangerous high-frequency head banging or face slapping.

Because of the above problems, many researchers have employed a noncontingent time-out procedure to study self-injurious behavior. In this procedure, the individual is placed in an isolation room. The isolation, however, is not contingent upon the occurrence of self-injurious behavior. Instead, each day, a period of time is set aside during which the individual is physically and socially isolated. Since the procedure is noncontingent, the punishment aspect is controlled for, while at the same time, inadvertent social reinforcement (such as might occur during simple extinction) is eliminated because no adult is present. Using this procedure, several investigators (Jones et al., 1974; Lovaas & Simmons, 1969) have reported that self-injurious behavior gradually declined to negligible levels. Corte, Wolf, and Locke (1971), however, reported that noncontingent social isolation did not change the rate of self-injurious behavior for their two subjects. But, as the authors themselves pointed out, the procedure was in effect for a sum total of 12 hours, probably too short a time for any effect to show. On balance, then, the above evidence is

consistent with the hypothesis that social reinforcement may play a role in maintaining self-injurious behavior.

Finally, on the topic of noncontingent social isolation, Lovaas and Simmons (1969) and Romanczyk and Goren (1975) presented data, both anecdotal and experimental, showing that at the beginning of isolation, there was an increase (over pretreatment levels) in the intensity and frequency of self-injurious behavior. This increase is apparently identical with the *extinction burst* phenomenon, frequently reported in the animal literature (Skinner, 1938, p. 74). Skinner noted that in rats, following the discontinuation of reinforcement for a previously reinforced response, there was typically an initial but temporary increase in the frequency and/or magnitude of that response. Thus, the demonstration of a self-injurious behavior extinction burst at the start of the isolation procedure may also be taken as support for the positive reinforcement hypothesis. Parenthetically, it might be noted that a frequent byproduct of extinction is aggressive behavior (Azrin, Hutchinson, & Hake, 1966). The occurrence of aggressive behavior during the extinction of self-injurious behavior would thus be noteworthy, since such a finding would tend to support the positive reinforcement hypothesis. Such research remains to be done.

Another corollary of the positive reinforcement hypothesis is that self-injurious behavior should increase when positive reinforcement is made contingent upon the behavior. Lovaas et al. (1965) and Lovaas and Simmons (1969) demonstrated that when comforting remarks or preferred activities were made contingent on the occurrence of self-injurious behavior, self-injurious behavior increased dramatically. Such evidence supports the above hypothesis. In addition, the fact that activities may also serve to reinforce self-injurious behavior suggests that social reinforcement is not the only variable maintaining self-injurious behavior. Thus, the positive reinforcement hypothesis may have to be broadened to include activity reinforcers or perhaps even material reinforcers as sources of motivation for self-injurious behavior.

Another property of self-injurious behavior, consistent with the positive reinforcement

hypothesis, is that such behavior can come under rather powerful stimulus control. Several studies have shown, for instance, that self-injurious behavior rates may be rather low when the child is alone but very high when adults are present (Bucher & Lovaas, 1968; Romanczyk & Goren, 1975; Hitzing & Risley, Note 1). These findings are predictable within the framework of the positive reinforcement hypothesis: The children, over time, discriminate that self-injurious behavior results in positive reinforcement in the presence of adults but not in their absence and thus engage in self-injurious behavior primarily when adults are present. This notion might be tested further by measuring self-injurious behavior rates in the presence of familiar versus unfamiliar adults. One expectation would be that the rates might be higher in the presence of the familiar adults, since the child presumably has a history of social reinforcement for self-injurious behavior in their presence (but not in the presence of the unfamiliar adults).

Several other studies in the literature are pertinent to a discussion of the stimulus control of self-injurious behavior. Lovaas et al. (1965) demonstrated that for one child, the withdrawal of positive social reinforcement (i.e., adult attention) for singing and dancing to a set of songs was discriminative for high rates of self-injurious behavior. Similarly, Corte et al. (1971) and Peterson and Peterson (1968) demonstrated that high rates of self-injurious behavior occurred when a blanket or mittens were taken away from the children whom they were treating. There was some indication that the blanket and mittens functioned as positive reinforcers. These three studies taken together suggest that the operation of reinforcement withdrawal can be discriminative for high rates of self-injurious behavior. Lovaas et al. (1965) suggested a way to understand this type of stimulus control in the context of the positive reinforcement hypothesis. They speculated that, over time, a child can learn that when a positive reinforcer is withdrawn, it may be possible to get the reinforcer reinstated, simply by emitting a bout of self-injurious behavior. Parenthetically, it might be noted that such speculation has a close conceptual similarity to the notion that self-injurious behavior is a learned

response to frustration, frustration being operationalized in terms of reinforcement withdrawal (Baumeister & Forehand, 1973; Dollard, Miller, Doob, Mowrer, & Sears, 1939, pp. 46-49). To test the hypothesis, it would be necessary to arrange experimentally for a variety of positive reinforcers to be reinstated each time a child engaged in self-injurious behavior. The child should soon learn to engage in high rates of self-injurious behavior in the reinforcement withdrawal situation. Such a demonstration has never been made because, of course, it is ethically indefensible. Perhaps the relationship between frustration and self-injurious behavior could best be studied experimentally by using lower organisms, such as monkeys. In this regard, recent demonstrations that self-injurious behavior occurred in some monkeys following frustration produced by extinction of a lever-pressing response are noteworthy (Gluck & Sackett, 1974).

If self-injurious behavior depends on positive social reinforcement for its maintenance, one would expect that deprivation and satiation of social reinforcement should influence the rate of self-injurious behavior. The small amount of data pertaining to this question is equivocal. Lovaas and Simmons (1969) found that following 1-day periods of either social reinforcer satiation (the child had been given continuous attention) or social reinforcer deprivation (the child had been left alone in his room), no systematic changes in the rate of self-injurious behavior were observed. On the other hand, Lovaas et al. (1965) found that following several sessions of social extinction (a deprivation operation), reinstatement of social attention contingent on self-injurious behavior produced the highest rates of that behavior recorded in their study. This situation presumably arose because the deprivation operation enhanced the potency of the social reinforcement. Perhaps the conflicting results obtained in these two studies were a function of procedural differences. In the Lovaas and Simmons (1969) study, the effects of the deprivation and satiation operations on self-injurious behavior were studied while the child was in isolation. No adult was present. By contrast, in the Lovaas et al. (1965) study, the child's self-injurious behavior was examined while an adult was present. Thus, it may be that the

sensitizing effects of the deprivation and/or satiation operations are not apparent unless an adult is present to dispense social reinforcement.

If the positive reinforcement hypothesis has merit, the reinforcement schedule applied to self-injurious behavior might also be expected to influence the rate of this behavior. As a test of this notion, Lovaas et al. (1965) delivered supportive remarks on either a continuous reinforcement schedule (each instance of self-injurious behavior was reinforced) or on a variable-ratio schedule (every fifth instance of self-injurious behavior, on the average, was reinforced). There was some indication that the variable-ratio schedule generated higher rates, but no direct comparisons of the two schedules were made. Other studies have demonstrated that the differential reinforcement of behavior other than self-injurious behavior (i.e., a DRO schedule) can produce a decrement in the rate of self-injurious behavior (Corte et al., 1971; Peterson & Peterson, 1968; Repp, Deitz, & Deitz, 1976; Weiher & Harman, 1975). Weiher and Harman, for example, delivered reinforcement only after a given amount of time had elapsed during which there were no instances of self-injurious behavior. They found that on the DRO schedule, the rate of self-injurious behavior decreased dramatically to negligible levels, a finding that parallels the effects of DRO reported in the animal learning literature (Reynolds, 1961). One possible danger of using a DRO schedule should be noted: This schedule does not specify that a particular, desirable response should be reinforced, but only that reinforcement must be withheld until a given time period has elapsed during which self-injurious behavior has not occurred. Therefore, it is conceivable that on this schedule one could potentially reinforce some other undesirable high-frequency behavior, such as tantrums, a behavior that might well be occurring after the specified DRO time interval has elapsed. The clinician must be wary of this pitfall when using DRO to treat self-injury.

A potential avenue for future research might be to explore the use of differential reinforcement of low rates (DRL) schedules to produce decreases in self-injurious behavior frequency. That is, one might explicitly reinforce only low rates of self-injurious behavior, with the

goal of making the behavior occur so infrequently as to be relatively innocuous. This strategy might be particularly desirable when the complete elimination of self-injurious behavior by other means has proven impossible. DRL schedules have already been used successfully to control various classroom misbehaviors in retarded and normal populations (Deitz & Repp, 1973, 1974). Extending the use of DRL schedules to the control of self-injurious behavior would have clear clinical and theoretical significance. Taken as a whole, then, the literature reviewed above does suggest that the rate of self-injurious behavior can be influenced by changes in the reinforcement schedule applied to that behavior. This fact is consistent with the positive reinforcement hypothesis.

There is evidence that the topography of self-injurious behavior, at least in the case of lower organisms, can be shaped by using positive reinforcement (as one might expect if reinforcement were an important controlling variable). Schaefer (1970), for example, successfully shaped head hitting in two rhesus monkeys by using food reinforcement. The only attempt at influencing the topography of self-injurious behavior in humans was reported by Saposnek and Watson (1974). By utilizing positive reinforcement procedures, these investigators were able to shape a child's head slapping into the more benign behavior of slapping the therapist's hands. Of course, hand slapping can be an aggressive behavior and might well become a clinical problem in itself. An alternative tactic that might be clinically useful (as well as providing data on the validity of the positive reinforcement hypothesis) would be to shape the intensity of self-injurious behavior into a low-magnitude and therefore less dangerous response. Herrick (1964) and Notterman and Mintz (1962) have shown that with lower organisms, the intensity of an operant can be shaped by differential reinforcement procedures. Perhaps it might also be possible to alter the intensity of self-injurious behavior, that is, low-intensity self-injurious behavior would be reinforced while high-intensity self-injurious behavior would be subjected to extinction. Such research remains to be done.

In summary, the positive reinforcement hypothesis receives considerable empirical sup-

port from studies demonstrating that (a) self-injurious behavior rates can be reduced when social reinforcers are withdrawn, (b) self-injurious behavior rates can be increased when positive reinforcement is made contingent upon the behavior, and (c) self-injurious behavior can come under the control of stimuli in whose presence self-injurious behavior is positively reinforced. Data on the effects of deprivation and satiation variables, reinforcement schedules, and shaping procedures on the rate of self-injurious behavior are equivocal or incomplete. Considerable additional experimentation (possibly utilizing lower organisms when ethically required) therefore remains to be done.

Despite the power of the positive reinforcement hypothesis in accounting for much self-injurious behavior, there remain many instances in which the behavior appears to be a function of different variables. Some of these motivational variables are discussed next.

Negative Reinforcement Hypothesis

This hypothesis states that self-injurious behavior is maintained by the termination or avoidance of an aversive stimulus following the occurrence of a self-injurious act (Carr, Newsom, & Binkoff, 1976). The small amount of literature on this topic centers almost exclusively on the role of escape motivation in the maintenance of self-injurious behavior, and the present discussion therefore focuses on escape factors.

There are several anecdotal reports concerning children who injure themselves, presumably to terminate an aversive situation. Freud and Burlingham (1944, pp. 74-75), for example, described one institutionalized girl who would bang her head against the bars of her crib when put to bed against her wishes. She did so presumably to escape from the crib. Similar cases have been cited by Goodenough (1931, p. 139). More recently, Jones et al. (1974), Myers and Deibert (1971), and Wolf, Risley, Johnston, Harris, and Allen (1967) noted that demands were very likely to set off self-injurious behavior in children. Following such behavior, the adult therapists who were working with the children would typically stop making demands. Reports such as these

imply that demands may constitute aversive stimuli and that self-injurious behavior may be an escape response, maintained by the termination of such stimuli. The experimental evidence relevant to this problem is reviewed next.

Carr et al. (1976) demonstrated that levels of self-injurious behavior were high in demand situations (such as a classroom) and low in conversational and free-play situations (which did not contain demands). If demands are aversive stimuli and self-injurious behavior is an escape response, one would expect that (a) self-injurious behavior should cease upon the onset of a stimulus correlated with the termination of demands (i.e., upon the presentation of a so-called safety signal) and (b) self-injurious behavior should, under certain circumstances, show the schedule properties exhibited by other behaviors under aversive control. Both of the above features were observed by Carr et al. First, when the child was presented with the safety signal, "O.K., let's go," a stimulus that normally terminated the classroom (i.e., demand) period, the child abruptly stopped hitting himself. In contrast, when the child was presented with a neutral stimulus such as, "The sky is blue" (a stimulus that was never used to terminate the classroom sessions and therefore could not have become a safety signal), the child's rate of self-injurious behavior remained high. Second, the child's rate of self-injurious behavior during the demand sessions showed a scalloped pattern, that is, the rate gradually increased during the course of a given session. This is the pattern of responding that is generally obtained on fixed-interval schedules of escape with lower organisms (Azrin, Hake, Holz, & Hutchinson, 1965; Himeline & Rachlin, 1969). The scalloping was thought to evolve as follows: Each demand session was of fixed length (10 min.); hitting that occurred at the end of the session would be negatively reinforced, since such hitting would be correlated with the termination of the demands. Conceptually, this situation corresponds to a fixed-interval schedule of escape, a schedule that typically generates a scalloped pattern of responding.

Demands may not be the only aversive stimuli that can function to maintain self-injurious behavior. Ross, Meichenbaum, and Humphrey

(1971) reported a case in which an adolescent girl would wake herself up each night, whenever she was having nightmares, by banging her head against the bed. (Oswald, 1964, cited a similar case). Ross et al. assumed that the self-injurious behavior was maintained by the negative reinforcement that resulted from the termination of the aversive dreams. On the basis of this assumption, they proceeded to desensitize their patient to the content of her nightmares and by this procedure were able to eliminate her self-injurious behavior altogether. It should be noted that covert stimuli other than dreams, for example, hallucinations or compulsive thoughts, might also play some role in escape-motivated self-injurious behavior. At present, however, this remains an unresearched area, except for a brief report (Cautela & Baron, 1973) of an individual whose self-injurious behavior was always preceded by a compulsive thought that he must poke or bite himself.

The above studies support the hypothesis that self-injurious behavior can be motivated by escape factors and also suggest several additional studies for future research. First, if the frequency of self-injurious behavior is controlled by the termination of aversive stimuli, one would expect that counterconditioning and desensitization procedures that were applied with respect to such stimuli should reduce the rate of self-injurious behavior. The desensitization study by Ross et al. (1971) was a preliminary test of this notion. In addition, Carr et al. (1976) reported that counterconditioning procedures (e.g., presenting the demand stimuli in the context of a positive, entertaining conversation known to be discriminative for appropriate social behaviors) could also be used to reduce escape-motivated self-injurious behavior. These two studies, though preliminary, suggest that additional research with these procedures might yield effective management techniques. Second, if self-injurious behavior is escape behavior, then it should be possible to eliminate it by ensuring that the occurrence of self-injurious behavior no longer has the consequence of terminating the aversive stimulus. That is, the demands would not be withdrawn as long as the child was engaging in self-injurious behavior. This procedure corresponds to *escape extinction* as reported in the animal

literature (Catania, 1968, p. 187). Finally, the notion of self-injurious behavior as escape responding suggests some plausible research that is relevant to the role of restraints in the control of self-injurious behavior. Many children exhibiting self-injurious behavior are put in physical restraints to protect themselves from injury. Removing such a child from restraints usually sets off a bout of self-injurious behavior (e.g., Romanczyk & Goren, 1975; Tate, 1972). It is plausible that restraints could, over time, become a safety signal for such children, indicating that few or no demands will be placed on them. Typically, a child in restraints is allowed to lie passively, spread-eagled on a bed, or to sit alone, hands bound. Although such a child is unlikely to receive much social reinforcement, the social isolation is, in a sense, more than compensated for by the absence of even the most minimal demands. It is only when demands need to be made on the child (e.g., the child must be fed, clothes must be changed, or he must be taken to the washroom) that the child is taken out of restraints. An important research problem, with clear treatment implications, centers on the question of whether the safety signal value of the restraints could be altered by making them discriminative for high levels of demands. That is, as long as the child is restrained, he would be showered with demands; when unrestrained, he would be permitted to sit or lie passively, free to do anything he wished. Under this condition, one might predict that the restraints should lose their positive value. The above three questions, though not exhausting the research possibilities relevant to the negative reinforcement hypothesis, would provide some significant tests of such a hypothesis.

Self-Stimulation Hypothesis

This hypothesis holds that a certain level of stimulation, particularly in the tactile, vestibular, and kinesthetic modalities, is necessary for the organism, and that, when such stimulation occurs at an insufficient level, the organism may engage in stereotyped behaviors, including self-injurious behavior, as a means of providing sensory stimulation (Baumeister & Forehand, 1973; Cain, 1961; Cleland & Clark,

1966; Green, 1967, 1968; Kulka, Fry, & Goldstein, 1960; Lourie, 1949; Rutter, 1966, p. 80; Silberstein, Blackman, & Mandell, 1966). Kulka et al. (1960) postulated the existence of a kinesthetic drive and on this basis predicted that overrestriction of motoric activity would result in self-injurious behavior. In support of this prediction, Levy (1944) noted several cases of head banging among institutionalized orphans who were restricted to their cribs without toys. When the infants were given toys to play with, self-injurious behavior disappeared, presumably because of the increased tactile and kinesthetic stimulation. Similarly, Dennis and Najarian (1957), working with a group of institutionalized orphans left to lie alone in their cribs because of understaffing, observed self-injurious behavior, such as self-slapping, in several children and attributed such behavior to "stimulation hunger" (p. 11). Collins (1965) reported head banging in a restrained, isolated, retarded adult. Treatment consisted of exposing the adult to a great deal of sensory stimulation in the form of toys, activity, and radio. The consequent elimination of self-injurious behavior was attributed to the increase in tactile and kinesthetic stimulation during treatment. De Lissovoy (1962) and Kravitz, Rosenthal, Teplitz, Murphy, and Lesser (1960) noted that the normal young children in their sample banged their heads primarily at bedtime, before falling asleep. To the extent that lying in bed in a dark room, alone, and without anything to do, represents a state of diminished stimulation, the above observations are consistent with the self-stimulation hypothesis. The studies cited thus far, though suggestive, are limited by the fact that they are based solely on anecdotal or correlational accounts. The experimental evidence bearing on the self-stimulation hypothesis provides a more meaningful test and is reviewed next.

Some of the more interesting data relating to the hypothesized self-stimulatory nature of self-injurious behavior come from the animal analogue experiments conducted by Harlow and his associates (Cross & Harlow, 1965; Harlow & Griffin, 1965; Harlow & Harlow, 1962, 1971). Monkeys were studied under two rearing conditions. One group was reared with their mothers, in a playpen situation in which

other young monkeys were also present. A second group was reared in partial social isolation. They could see and hear other monkeys but could not make physical contact with them. They were thus deprived of the opportunity to play with their peers and to cuddle with their mothers. In addition, they were raised in small cages and thus had limited opportunity to move around. The typical finding was that many of the partially isolated monkeys engaged in a variety of repetitive, stereotyped acts, such as rocking, cage circling, staring into space, and most importantly, self-injurious behavior in the form of self-biting. Monkeys reared with their mothers in the playpen situation rarely exhibited such behaviors. One interpretation of the anomalous behaviors is that the cage-reared isolates, being deprived of tactile and kinesthetic stimulation, generated their own stimulation through self-injurious behavior and other repetitive, stereotyped behaviors.

An implication of the self-stimulatory hypothesis, supported by the animal literature cited above, is that a barren unstimulating environment would be much more conducive to the maintenance of self-injurious behavior and other stereotyped behaviors than would an environment that provided opportunities for stimulation in the form of play activities. Several studies with mental retardates are relevant to evaluating this implication. Berkson and Mason (1964) studied the stereotyped behaviors (e.g., head banging, rocking, and complex hand movements) of mental retardates under two conditions. In the no-objects condition, the subject was brought into a room, barren except for an observer, and his behavior was recorded for a period of 400 sec. The objects condition was identical with the preceding, except that several objects (e.g., a rubber ball, plastic train, string, furry toy dog) were left lying on the floor of the room. Stereotyped behaviors (including head banging) occurred at a higher level in the no-objects condition than in the objects condition. Furthermore, there was a negative correlation between frequency of object manipulation and frequency of stereotyped behaviors. This negative correlation, which has been found in several other studies as well (Berkson & Davenport, 1962; Berkson & Mason, 1963;

Davenport & Berkson, 1963), led Berkson (1967) to conclude that such stereotyped behaviors may be self-stimulatory in nature, occurring primarily in the absence of adequate stimulation. When adequate stimulation is provided (e.g., in the form of play activities), the stereotyped behaviors are no longer required as a source of stimulation, and disappear.

The self-stimulation hypothesis is, on occasion, evoked as an explanation of self-injurious behavior when no other explanation is available. It should be clear that this argument by exclusion does little to advance our understanding. An adequate evaluation of the self-stimulation hypothesis must take into consideration several methodological problems inherent in the above research. First, the data on self-injurious behavior were typically grouped together with the data on other stereotyped behaviors, and we therefore do not know how self-injurious behavior per se changed as a function of the different experimental conditions. In the few studies in which data on self-injurious behavior have been reported separately from data on other stereotyped behaviors (Hollis, 1965a, 1965b), the frequency of self-injurious behavior did not change as a function of the different conditions of stimulation. We cannot be certain whether or not this relationship was also obtained in the other studies noted above. Second, in all of the reported studies, only group data on self-injurious behavior were presented, and we therefore do not know how an individual subject's self-injurious behavior changed across stimulus conditions. Third, the self-stimulation hypothesis is particularly open to the criticism of circularity. If a subject is engaging in self-injurious behavior, there is said to be a lack of adequate stimulation, but if the subject is not engaging in self-injurious behavior, the amount of stimulation is said to be adequate. One way out of this tautology is to define adequate stimulation in terms of the physical parameters of the stimulus rather than in terms of the occurrence or nonoccurrence of self-injurious behavior. Myerson, Kerr, and Michael (1967), for example, studied the effects of vibration (as a source of sensory stimulation) on the level of self-injurious behavior of their autistic patient. They suggested that the child engaged in self-injurious be-

havior because he was deprived of tactile stimulation. They reasoned that if an alternative form of tactile stimulation (such as vibration) were provided, self-injurious behavior would decrease. There was some indication that the sensory stimulation that they used decreased the duration of self-injurious behavior from what it was at baseline, but their results were inconclusive because they ran only two treatment sessions. The study is noteworthy, however, in that the authors defined the level of sensory stimulation provided in physical terms (i.e., the amount of vibratory stimulation), as opposed to inferring the level of stimulation from the level of self-injurious behavior. Finally, in many of the reported studies, social attention from adults was introduced simultaneously with toys and other sources of physical stimulation. Such a procedure, of course, confounds the effects of social reinforcement with the effects of sensory reinforcement. These two sources of reinforcement must be separated for an adequate test of the self-stimulation hypothesis.

The review of the literature thus suggests that future research should (a) stress the measurement of self-injurious behavior independently of other stereotyped behaviors, (b) attempt to present data on individual subjects rather than continuing to report only group means, (c) specify the level of sensory stimulation provided in terms of physical parameters, and (d) separate social reinforcement effects from sensory reinforcement effects. Until such research is carried out, the self-stimulation hypothesis of self-injurious behavior remains plausible but untested.

Organic Hypothesis

The organic hypothesis states that self-injurious behavior is the product of aberrant physiological processes. Available evidence implicates either a genetically produced aberration (as in the Lesch-Nyhan and de Lange syndromes) or a nongenetic aberration (possibly involving elevated pain thresholds or such medical problems as otitis media, a middle ear infection). Data bearing on each of these conditions are reviewed next.

Lesch-Nyhan syndrome is a rare form of cerebral palsy that is X linked and found only

in males (Nyhan, Pesek, Sweetman, Carpenter, & Carter, 1967; Seegmiller, 1972). The syndrome results from a genetic flaw in purine metabolism that results in a deficiency of the enzyme hypoxanthine-guanine phosphoribosyl-transferase. Manifestations of the disease include muscle spasticity, choreoathetosis, mental retardation, and hyperuricemia (Lesch & Nyhan, 1964). More pertinent to the present review is the observation that self-injurious behavior is also part of the syndrome and almost invariably takes the form of compulsive, repetitive biting of the tongue, lips, and fingers (Dizmag & Cheatham, 1970; Hoefnagel, 1965; Hoefnagel, Andrew, Mireault, & Berndt, 1965; Lesch & Nyhan, 1964; Nyhan, Oliver, & Lesch, 1965; Nyhan, Pesek, Sweetman, Carpenter, & Carter, 1967; Seegmiller, Rosenbloom, & Kelley, 1967). Because of the homogeneity of symptoms across cases, it has been proposed that the self-injurious behavior is directly produced by the specific biochemical abnormality (Seegmiller, 1972; Seegmiller et al., 1967). On this basis, one might expect that a chemical cure would be possible. In support of this viewpoint is a recent report (Mizuno & Yugari, 1975) of the apparently successful elimination of self-injurious behavior in Lesch-Nyhan disease with L-5-hydroxytryptophan. Unfortunately, the report had several methodological flaws: There was no measurement of interobserver reliability, the recording procedure was inadequately specified, and the nurses who acted as observers were not blind to the drug condition in effect. Further, there was considerable variability in the frequency of self-injurious behavior during the treatment intervention. Finally, Nyhan (1976) reported discouraging results using L-5-hydroxytryptophan to control self-injurious behavior. More promising results were obtained using a combination of carbidopa and L-5-hydroxytryptophan, but no systematic data were presented. Successful treatment using the combination of drugs would tend to support the organic hypothesis.

Also relevant to the organic hypothesis is a proposal by Hoefnagel (1965) that the proximal cause of self-injurious behavior in the Lesch-Nyhan syndrome may be the irritation produced by an elevated uric acid level in the saliva, a fact that might explain why the self-

injurious behavior is directed to the area of the mouth. Hoefnagel's hypothesis seems unlikely, however, in light of data demonstrating that prevention of elevated uric acid levels through early administration of allopurinol did not block the eventual appearance of self-injurious behavior (Marks, Baum, Keele, Kay, & MacFarlen, 1968).

Several lines of evidence mitigate against a purely organic explanation of the motivation of self-injurious behavior. First, there are reports that self-injurious behavior may be lacking altogether in Lesch-Nyhan (Nyhan, 1968; Seegmiller, 1969, 1972) or that it may take atypical forms, such as head banging or eye gouging (Dizmag & Cheatham, 1970; Duker, 1975; Hoefnagel et al., 1965). Second, operant treatment techniques such as extinction, time-out, and differential reinforcement of behavior other than self-mutilation can be effective in eliminating the self-injurious behavior (Duker, 1975; Anderson & Herrmann, Note 2). One would not expect such procedures to be effective if self-injurious behavior were directly controlled by a biochemical abnormality. Finally, there are observational reports that self-injurious behavior can be brought under stimulus control, becoming more likely in the presence of certain adults (Duker, 1975; Anderson & Herrmann, Note 2). These authors intimated that the children learned to mutilate themselves more frequently in the presence of adults who attended to such behavior. The organic hypothesis would have predicted that, since self-injurious behavior is biochemically determined, its occurrence should therefore be relatively independent of external stimulus conditions. It is possible, of course, that a behavior can be brought under stimulus control and yet still have organic involvement. Nevertheless, these observations on stimulus control, if verified experimentally, would be significant insofar as they are consistent with the other evidence cited above, evidence that suggests that self-injurious behavior, even in Lesch-Nyhan syndrome, may have an operant component.

Another organic condition, of possibly genetic origin (Jervis & Stimson, 1963) and involving self-injurious behavior (Bryson, Sakati, Nyhan, & Fish, 1971), is the de Lange syndrome. The self-injurious behavior in the two cases re-

ported by Shear, Nyhan, Kirman, and Stern (1971) took the form of self-scratching and biting of the fingers, lips, shoulders, and knees. One child could dislocate his hips while standing. Shear et al. (1971) reported that for one of the children, an operant therapy program including aversive stimulation was useful in controlling the self-injurious behavior. On this basis, it seems again unlikely that self-injurious behavior is simply the product of aberrant physiological processes.

Several reports in the literature have described an association between self-injurious behavior and certain other problem conditions. Goldfarb (1958), for example, reported on the pain reactions of 31 schizophrenic children observed over a 1- to 3-year period. Twenty-three of the children showed aberrant pain reactions (e.g., failing to show defensive behavior when a finger was caught in the door and bleeding). Seven of the children also exhibited self-injurious behavior with no evidence of apparent pain behavior. One child would bite his hand until it bled and another mutilated his hand using scissors, but neither child gave any indication of a pain reaction. It was suggested that perhaps such children had elevated pain thresholds. This hypothesis seems unlikely in view of the fact that the children's pain reactions to a pin prick test were normal. Also, it is clear that even if such children have elevated pain thresholds, that fact alone would not explain what motivates self-injurious behavior, but only why there is an absence of pain reaction.

A study involving nongenetic organic pathology was carried out by de Lissovoy (1963). He compared the incidence of painful middle ear infection (otitis media) in a group of 15 head bangers with that in a control group (matched for age, sex, etc.) of 15 children who did not engage in self-injurious behavior. There was a higher incidence of otitis in the head-banger group (6 out of 15) than in the control group (1 out of 15). De Lissovoy (1963, 1964) concluded that head-banging was a form of pain relief. The data are difficult to interpret, however, because the question remains as to why nine of the children in the head-banger group, who did not have otitis, banged their heads anyway. Despite this difficulty, a recent study of self-mutilation in mice lends some

credibility to de Lissovoy's hypothesis. Harkness & Wagner (1975) found that many mice in their colony produced severe head lacerations as a result of self-scratching. They discovered that all mice engaging in such behavior suffered from otitis media. The interpretation was somewhat complicated by the fact that some additional mice who had otitis did not mutilate themselves. The authors suggested that self-injurious behavior was most likely to occur when the otitis was severe enough to inflame sensory nerve fibers. Such inflammation acted as a painful stimulus that elicited self-injurious behavior, a behavior that functioned as a form of pain relief. Parenthetically, it might be noted that this suggestion, if verified by further research, would lend additional support to the negative reinforcement hypothesis discussed above. This study also serves to emphasize the utility of animal research in testing hypotheses concerning the motivation of self-injurious behavior.

Taken as a whole, the evidence reviewed above indicates that self-injurious behavior is sometimes correlated with a number of conditions of demonstrated or plausible organic origin. The available studies on humans have suffered from too heavy a reliance on subjective, anecdotal, or retrospective accounts. There have been no conclusive demonstrations of a causal relationship between organic pathology and self-injurious behavior. Where systematic observations have been made, the evidence suggests that self-injurious behavior may be an operant. Adequate experimental analyses of self-injurious behavior that is correlated with organic conditions have yet to be made. Perhaps when they are made, the organic pathology may turn out to be a contributing factor to the initial development of self-injurious behavior, a behavior that, at a still later period in its development, is maintained by social reinforcement in the form of adult attention.

Psychodynamic Hypotheses

A number of hypotheses concerning the motivation of self-injurious behavior can best be grouped together under the term psychodynamic. Several theorists, for example, have suggested that some individuals have difficulty

in distinguishing the self from the external world (Hartman, Kris, & Loewenstein, 1949) and that self-injurious behavior arises as an attempt to establish "body reality" (Greenacre, 1954, p. 38) or to trace the "ego boundaries" (Bychowski, 1954, p. 67). No attempt is made here to review such viewpoints in depth. The interested reader can consult Cain (1961) for a review of the psychoanalytic literature on self-injurious behavior. The major problem with such theories lies in the difficulty of operationalizing constructs such as "body reality" or "ego boundaries." This difficulty might account for the lack of empirical tests of these hypotheses. One exception to this lack of testing comes from a study by Lovaas et al. (1965) that sought to evaluate the psychodynamic hypothesis that individuals attempt to alleviate their guilt through self-injury (Beres, 1952; Frankl, 1963). Lovaas et al. (1965) reasoned that on the basis of the guilt hypothesis, it should be possible to reduce self-injurious behavior by making guilt-alleviating statements such as, "I don't think you're bad," each time that the child hit herself. What they found, however, was that such statements actually increased the frequency of self-injurious behavior, a fact that suggests that the comments were functioning as social reinforcers. The guilt hypothesis would thus seem to be disconfirmed. Of course, it could be argued that such statements as those mentioned above are not adequate to alleviate guilt. Such arguments, however, only serve to emphasize the difficulties inherent in operationalizing constructs such as guilt or guilt alleviation. Until some consensus can be reached on how best to operationalize these constructs, empirical testing of psychodynamic hypotheses remains all but impossible. In the absence of such tests, the utility of these hypotheses in understanding the motivation of self-injurious behavior is moot.

Treatment Implications

This review of the literature on self-injurious behavior suggests that such behavior is multiply determined, that is, it seems unlikely that a single factor is responsible for the motivation of all self-injurious behavior. Instead, one could profitably make a distinction between

two broad sets of motivational factors underlying the maintenance of self-injurious behavior. On the one hand, there are several forms of *extrinsic reinforcement* for the behavior. Both social and negative reinforcement, as described in this article, are examples of extrinsic reinforcement. The occurrence or non-occurrence of such reinforcers are controlled by individuals other than the client. On the other hand, there are several forms of *intrinsic reinforcement* for self-injurious behavior. Specifically, the self-stimulation and organic hypotheses seem to imply that the source of reinforcement for self-injurious behavior may be inherent in the behavior itself. Individuals other than the client himself cannot directly control the occurrence of such sources of reinforcement.

The dichotomy between extrinsically and intrinsically motivated self-injurious behavior has several important treatment implications. First, to the extent that self-injurious behavior appears to be extrinsically motivated, treatment would consist largely of redefining the contingencies of reinforcement. For example, if the self-injurious behavior is being maintained by social reinforcement, then one might expect that techniques such as extinction or time-out would be effective, in that these techniques result in a removal of the social reinforcers maintaining the behavior (Hamilton et al., 1967; Lovaas & Simmons, 1969). These same techniques, however, should be ineffective in dealing with intrinsically motivated self-injurious behavior, for which the maintaining variables are presumably biochemical or sensory. As a further example, if the self-injurious behavior is an escape behavior in response to demands, the treatment would again consist of redefining the reinforcement contingencies, in this case, so that the client would not be permitted to escape from demands simply by engaging in self-injurious behavior (Carr et al., 1976). In this manner, the extrinsic negative reinforcement resulting from escape would be terminated.

Whereas the treatment strategy for dealing with extrinsically motivated self-injurious behavior would center largely on redefining the contingencies of reinforcement as described above, the strategy for dealing with intrinsically motivated self-injurious behavior would

consist of an attempt to negate or attenuate the reinforcers themselves. Thus, if it is thought that a child is injuring himself in an attempt to reduce the pain inherent in a middle ear infection (otitis media), one might expect that a direct medical intervention designed to cure the infection and thereby attenuate the pain should result in a decrease in self-injurious behavior. Sometimes, of course, it is not possible to attenuate the reinforcers for self-injurious behavior. For example, some children might be hitting themselves to generate tactile and kinesthetic stimulation (Berkson, 1967). A technology does not currently exist for attenuating the reinforcement inherent in such stimulation. In such cases, the therapist could consider an alternative tactic, one that would involve providing reinforcers to compete with the reinforcers maintaining the self-injurious behavior. The use of toys as a source of competing tactile and kinesthetic reinforcement has been explored by Berkson and Mason (1964). Presumably, toys might be effective in two ways: first, by providing a competing

source of reinforcement, and second, by setting the occasion for play behaviors that compete with the occurrence of the self-injurious behavior itself.

Clearly, the treatment issues described above are complex, but the present review of the literature does suggest a plausible sequence of steps that the clinician may wish to follow in determining the possible motivation (and therefore the treatment) of self-injurious behavior. Table 1 lists the screening sequence. As the psychodynamic hypotheses do not currently rest on a firm data base, they have not been included in the table.

The outlined screening procedure is by no means definitive, but it does reflect our current, rudimentary state of knowledge. As a guide for assessment, it should provide a useful beginning and a basis for deciding which treatment procedures might be appropriate. Reviews of some current treatment interventions for dealing with self-injurious behavior have been provided by Azrin, Gottlieb, Hug-hart, Wesolowski, and Rahn (1975), Bachman (1972), Frankel and Simmons (1976), Seeg-miller (1976), and Smolev (1971).

Table 1

A Screening Sequence to Determine the Motivation of Self-Injurious Behavior

Step 1

Screen for genetic abnormalities (e.g., Lesch-Nyhan and de Lange syndromes), particularly if lip, finger, or tongue biting is present.

Screen for nongenetic abnormalities (e.g., otitis media), particularly if head banging is present.

If screening is positive, motivation may be organic.

If Step 1 is negative, proceed to Step 2.

Step 2

Does self-injurious behavior increase under one or more of the following circumstances:

(a) When the behavior is attended to?

(b) When reinforcers are withdrawn for behaviors other than self-injurious behavior?

(c) When the child is in the company of adults (rather than alone)?

If yes, motivation may be positive reinforcement.

Does self-injurious behavior occur primarily when demands or other aversive stimuli are presented?

If yes, motivation may be negative reinforcement.

If Step 2 is negative, proceed to Step 3.

Step 3

Does self-injurious behavior occur primarily when there are no activities available and/or the environment is barren?

If yes, motivation may be self-stimulation.

Summary and Evaluation

This review has suggested the possibility that self-injurious behavior may be multiply determined. One important direction for future research would seem to center on the question of what, if any, are the relationships between the different motivational sources of self-injurious behavior. De Lissovoy (1962, 1963, 1964) observed that a large percentage of head bangers had, early in life, engaged in certain rhythmical activities such as rocking and head rolling. Green (1967) hypothesized that during the course of such activities, the infant might accidentally strike his head. In this manner, the sensory stimulation of rocking, for example, would become associated with self-injurious behavior, endowing the latter with self-stimulatory properties. However, as Green noted, other factors soon come into play: Parents observing the head banging are likely to attend to the child. Over time, the behavior may come under the control of social stimuli and the associated positive reinforcement (i.e., adult attention). Empirical studies should be carried out to determine if such sequential relationships, as described

above, do indeed exist between the various motivational sources of self-injurious behavior.

Yet another example implying a sequential progression is that concerning the organic control of self-injurious behavior. Children suffering from the Lesch-Nyhan syndrome may, at least initially, mutilate their fingers and lips as part of a reaction to a biochemical abnormality (Seegmiller, 1972). In time, however, such behavior evokes much attention from parents and nursing staff. At this point, the behavior may be, at least partially, under social control (Dizmag & Cheatham, 1970; Duker, 1975; Anderson & Herrmann, Note 2). Again, a sequential relationship among the different sources of motivation is intimated. Developmental studies, now lacking, could provide information on such relationships.

Research into the motivation of self-injurious behavior could also profit from an increased use of animal analogue experiments. Such studies avoid the ethical problems stemming from human experimentation and at the same time provide useful information on motivational hypotheses. A start has already been made in this direction. For example, head banging in monkeys has been shaped, brought under stimulus control, and extinguished using operant conditioning procedures (Schaefer, 1970). Pigeons have been taught to peck a key in order to receive mild punishment, provided that such punishment has, in the past, been correlated with food reinforcement (Holz & Azrin, 1961). (Here, the analogy to humans is clear: Perhaps some individuals engage in self-injurious behavior because such behavior has, at one time, been correlated with positive reinforcement.) Frustration in monkeys (Gluck & Sackett, 1974) and certain organic factors in mice (Harkness & Wagner, 1975) have been demonstrated to be potentially important in the control of self-injurious behavior. Finally, a number of bizarre and stereotyped behaviors (including self-injurious behavior) have been observed in monkeys who have had a history of prolonged social and sensory isolation (Cross & Harlow, 1965; Harlow & Harlow, 1971). It should be possible to manipulate positive reinforcement variables, level of sensory stimulation, and length of social deprivation, as well as organic and frustrative factors, to study the effects of each of these variables on the frequency, intensity, and topography of self-injurious behavior in lower organisms. The

results of such studies could help to form a basis for assessing the validity of the various hypotheses pertaining to the motivation of self-injurious behavior and thereby bring us closer to eradicating this dangerous form of human psychopathology.

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