

POSITIVE REINFORCEMENT AND BEHAVIORAL DEFICITS OF AUTISTIC CHILDREN

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Infantile autism, first described by Kanner (6), is a very severe psychotic disturbance occurring in children as young as 2 years. At least outwardly, this childhood schizophrenia is a model of adult schizophrenia. Speech and control by the social environment are limited or absent; tantrums and atavistic behaviors are frequent and of high intensity; and most activities are of a simple sort, such as smearing, lying about, rubbing a surface, playing with a finger, and so forth. Infantile autism is a relatively rare form of schizophrenia and is not important from an epidemiological point of view. The analysis of the autistic child may be of theoretical use, however, since his psychosis may be a prototype of the adult's; but the causal factors could not be so complicated, because of the briefer environmental history. In this paper, I should like to analyze how the basic variables determining the child's behavior might operate to produce the particular kinds of behavioral deficits seen in the autistic child. To analyze the autistic child's behavioral deficits, I shall proceed from the general principles of behavior, derived from a variety of species, which describe the kinds of factors that alter the frequency of any arbitrary act (3, 10). The general principles of behavior applied to the specific situations presumably present during the child's developmental period will lead to hypotheses as to specific factors in the autistic child's home life which could produce the severe changes in frequency as well as in the form of his behavior. As an example, consider the effect of intermittent reinforcement, many of the properties of which are comparatively well known from animal experiments. To find how intermit-

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tent reinforcement of the autistic child's behavior might produce deficits, we would first determine, in the general case, what specific orders of magnitude and kinds of schedules produce weakened behavioral repertoires. The factors in the child's home life could be examined to determine estimates of what kind of circumstances could conceivably cause schedules of reinforcement capable of the required attenuation of the child's behavior. The analysis will emphasize the child's performance as it is changed by, and affected in, social and nonsocial environment. As in most problems of human behavior, the major datum is the frequency of occurrence of the child's behavior. Although the account of the autistic child's development and performance is not derived by manipulative experiments, it may still be useful to the extent that all of the terms of the analysis refer to potentially manipulable conditions in the child's environment and directly measurable aspects of his performance. Such an analysis is even more useful if the performances and their effects on the environment were described in the same general terms used in systematic accounts of behavior of experimental psychology.

Some of our knowledge of the autistic child's repertoire must necessarily come from anecdotal accounts of the child's performance through direct observation. Although such data are not so useful as data from controlled experiments, they can be relatively objective if these performances are directly observable and potentially manipulable. A limited amount of experimental knowledge of the dynamics of the autistic child's repertoire is available through a program of experiments in which the autistic child has developed a new repertoire under the control of an experimental environment (5). These experiments help reveal the range and dynamics of the autistic child's current and potential repertoires. In general, the autistic child's behavior will be analyzed by the functional consequences of the child's behavior rather than the specific form. The major attempt will be to determine what specific effects the autistic child's performance has on that environment and how the specific effects maintain the performance.

SPECIFICATION OF THE AUTISTIC CHILD'S PERFORMANCE

We must first describe the current repertoire of the autistic child before we can describe possible environmental conditions that might produce gross behavioral deficits. A topographic description of the individual items of the autistic child's repertoire would not, in general, distinguish it from the repertoires of a large number of functioning and nonhospitalized children, except perhaps in the degree of loss of verbal behavior. The autistic child's behavior becomes unique only when the relative frequency of occurrence of all the performances in the child's repertoire is considered. In general, the usual diagnostic categories do not adequately characterize the children in the terms of a functional analysis of behavior. Hospitalization of a child usually depends upon whether the parent can keep the child in the home,

rather than a functional description of the role of the parental environment in sustaining or weakening the child's performance.

Range of Performances

Although the autistic child may have a narrower range of performances than the normal child, the major difference between them is in the relative frequencies of the various kinds of performances. The autistic child does many things of a simple sort—riding a bicycle, climbing, walking, tugging on someone's sleeve, running, etc. Nevertheless, the autistic child spends large amounts of time sitting or standing quietly. Performances which have only simple and slight effects on the child's environment occur frequently and make up a large percentage of the entire repertoire, for example, chewing on a rubber balloon, rubbing a piece of gum back and forth on the floor, flipping a shoelace, or turning the left hand with the right. Almost all of the characteristic performances of the autistic child may be observed in nonhospitalized children, but the main difference lies in the relative importance of each of these performances in terms of the total repertoire. Conversely, isolated instances of quite "normal" performances may be seen in the autistic child. Again, the relative frequency of the performances defines the autistic child.

Social Control over the Child's Performance

The major performance deficits of the autistic child are in the degree of social control: The kinds of performances which have their major effects through the mediation of other individuals.

The main avenue of social control in a normal repertoire is usually through speech, a kind of performance that is unique because it produces the consequences maintaining it through the mediation of a second person (12). Autistic children almost always have an inadequately developed speech repertoire, varying from mutism to a repertoire of a few words. Even when large numbers of words are emitted, the speech is not normal in the sense that it is not maintained by its effect on a social environment. When normal speech is present, it usually is in the form of a *mand* (12). This is a simple verbal response which is maintained because of its direct reinforcement, e.g., "Candy!" "Let me out." The main variable is usually the level of deprivation of the speaker. It lacks the sensitive interchange between the speaker and listener characteristic of much human verbal behavior, as for example, the *tact* (see below). The reinforcement of the mand largely benefits only the speaker. In the case of the autistic child, it frequently affects the listener (parent), who escapes from the aversive stimulus by presenting a reinforcing stimulus relevant to the child's mand. At suppertime, the child stands at the door screaming loudly and kicking the door because the ward attendants in the past have taken the child to supper when this situation became aversive enough. Sometimes, the form of the mand is nonvocal, although still verbal, as when the mand involves tugging at a sleeve, push-

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ing, or jostling. The dynamic conditions which could distort the form of a mand into forms most aversive to a listener will be described below. In contrast to the mand, the tact (12) is almost completely absent. This form of verbal behavior benefits the listener rather than the speaker and is not usually relevant to the current deprivations of the speaker. This is the form of verbal behavior by which the child describes his environment, as, for example, "This is a chair"; "The mailman is coming." This latter kind of verbal control is generally absent or weak, as with other kinds of verbal behavior except an occasional mand.

Atavisms

Tantrums, self-destructive behavior, and performances generally aversive to an adult audience are relatively frequent in the autistic child's repertoire. Most autistic mands depend on an aversive effect of the listener for their reinforcement. To the extent that social behavior is present at all, its major mode is through the production of stimuli or situations which are aversive enough so that the relevant audience will escape or avoid the aversive stimulus (often with a reinforcer). For example, on the occasion of candy in the immediate vicinity, the child screams, flails about on the floor, perhaps striking his head, until he is given some candy. There is evidence that much of the atavistic performance of the autistic child is operant, that is, controlled by its consequence in the social environment. The operant nature of the autistic child's atavisms is borne out by experiments where a child was locked in an experimental space daily for over a year. There was no social intervention, and the experimental session was usually prolonged if a tantrum was underway. Under these conditions, the frequency of tantrums and atavisms declined continuously in the experimental room until they all but disappeared. Severe tantrums and attempts at self-destruction still occurred when sudden changes in the conditions of the experiment produced a sudden change in the direction of nonreinforcement of the child's performances. Severe changes in the reinforcement contingencies of the experiment produced a much larger reaction in the autistic than in the normal child. Consequently, we learned to change experimental conditions very slowly, so that the frequency of reinforcement remained high at each stage of the experiment. Much of the atavistic behavior of the autistic child is maintained because of its effect on the listener.

Reinforcing Stimuli

The reinforcers maintaining the autistic child's performance are difficult to determine without explicit experimentation. Small changes in the physical environment as, for example, direct stimulation of the mouth, splashing water, smearing a sticky substance on the floor, breaking a toy, or repeated tactile sensations, appear to sustain the largest part of the autistic child's repertoire. Nevertheless, these may be weak reinforcing stimuli which appear to be strong, because the response produces its reinforcement continu-

ously and because alternative modes of responding are also maintained by weak reinforcers. The durability and effectiveness of a reinforcer can usually be determined best by reinforcing the behavior intermittently or by providing a strong alternative which could interfere with the behavior in question. In the controlled experiments with autistic children, most of the consequences we supplied to sustain the children's performance, such as color wheels, moving pictures, music, and so forth, were very weak reinforcers compared with food or candy. Food generally appeared to be an effective reinforcer, and most of the performances associated with going to the dining room and eating are frequently intact. In contrast, the normal children could sustain very large amounts of behavior through the nonfood reinforcements. It is difficult to guess the potential effectiveness of new reinforcers, because the estimate depends upon some performance being maintained by that reinforcer.

In the everyday activities of the autistic children, little behavior was sustained by conditioned or delayed reinforcers. But, in a controlled experimental situation, such activities could be sustained by explicit training. For example, (a) The sound of the candy dispenser preceding the delivery of candy served as a conditioned reinforcer. The fine-grain effects of the schedules of reinforcement show this. The difference in performance produced by two different schedules of reinforcement could have occurred only if the effective reinforcer were the sound of the magazine rather than the delivery of a coin. The actual receipt of the coin or food is much too delayed to produce the differences in performances under the two schedules without the conditioned reinforcer coming instantly after a response. (b) With further training, the delivery of a coin (conditioned reinforcer) sustained the child's performances. The coin, in turn, could be used to operate the food or nonfood devices in the experimental room. (c) Still later, coins sustained the child's performance even though they had to be held for a period of time before they could be cashed in. The child worked until he accumulated five coins, then he deposited them in the reinforcing devices. (d) Even longer delays of reinforcement were arranged by sustaining behavior in the experimental room with a conditioned reinforcer as, for example, a towel or a life jacket which could be used later in the swimming pool or in water play after the experimental session terminated. The experimental development of these performances shows that, even though the usual autistic repertoire is generally deficient in performances sustained by conditioned reinforcement and with delay in reinforcement, the children are potentially capable of developing this kind of control.

Little of the autistic child's behavior is likely to be maintained by generalized reinforcement, that is, reinforcement which is effective in the absence of any specific deprivation. A smile or parental approval are examples. The coins delivered as reinforcements in the experimental room are potentially generalized reinforcers, since they make possible several performances under the control of many different deprivations. However, we

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do not know whether the coin has actually acquired the properties of a generalized reinforcer.

Stimulus Control of Behavior

It is very difficult to determine the stimulus and perceptual repertoire of autistic children. When a child responds to a complex situation, it is not usually clear what aspect of the situation is controlling the child's behavior. In most cases, it is difficult to determine to what extent these children can respond to speech discriminatively, since the situations are usually complex and many stimuli may provide the basis for the simple performances. Similarly with visual repertoires. Controlled experiments showed unequivocally that behavior can come under the control of simple stimuli when differential effects of the performances were correlated with the different stimuli. When a coin was deposited in a lighted coin slot, it operated the reinforcing device. Coins deposited in unlighted slots were wasted. The children soon stopped putting coins in the unlighted slots. The previously developed stimulus control broke down completely when these stimuli were placed in a more complicated context, however. A new vending machine was installed with eight columns, eight coin lights, and eight coin slots, so the child could choose a preferred kind of candy. The slight increase in complexity disrupted the control by the coin light, and it took several months and many experimental procedures before the stimulus control was reestablished. A better designed procedure, in view of the minimal perceptual repertoire of these children, would have been a gradual program by which variations in the specific dimensions of the coin slot and coin light were changed while the reinforcement contingency was held constant in respect to the essential property.

In summary, the repertoire of the autistic child is an impoverished one. Little is known about the perceptual repertoire, but the available evidence suggests that it is minimal. The absolute amount of activity is low, but this deficit is even more profound if the specific items of activity are evaluated in terms of whether they are maintained by significant effects on a social or even nonsocial environment. Most of the child's performances are of a simple sort, such as rubbing a spot of gum back and forth, softening and twisting a crayon, pacing, or flipping a shoelace. Those performances in the child's repertoire having social effects frequently do so because of their effects on the listener as aversive stimuli. Atavisms and tantrums are frequent.

THE EMERGENCE OF PERFORMANCE DEFICITS DURING THE EARLY DEVELOPMENT OF THE AUTISTIC CHILD

Having characterized the autistic child's repertoire, the next step is to determine the kinds of circumstances in the early life of these children which could bring about the behavioral deficits. The general plan is to

state how the major behavioral processes and classes of variables can drastically reduce the frequency of occurrence of the various behaviors in the repertoire of any organism. Then, the parental environment will be examined to determine circumstances under which the actual contingencies applied by the parental environment to the child's behavior could weaken the child's performance similarly. The datum is the frequency of occurrence of all of the acts in the child's repertoire, and the independent variables are the consequences of these acts on the child's environment, particularly the parental environment. All of the terms in such a functional analysis are actually or potentially directly observable and manipulable. In general, the performances in the child's repertoire will be simultaneously a function of many factors, each contributing to changes in the frequency of the relevant performances. It is important, therefore, to consider relative changes in frequency rather than simple presence or absence of various performances. The datum is the frequency of occurrence of the behavior. In the same vein, singly identifiable factors may be interrelated and functioning simultaneously.

The major paradigm for describing the behavior of an organism is to specify the consequences of the act (reinforcement) which are responsible for its frequency. In this sense, the major cause of an instance of behavior is the immediate effect on the environment (reinforcement). The continued emission of the verbal response "Toast" depends on its effect on the parent in producing toast. Every known behavioral process influencing the frequency of a positively reinforced performance is relevant to the problem of defining conditions under which we may produce a behavioral deficit. Given the variables which maintain it, a performance may be weakened by their absence or by changing the order of magnitude. It is perhaps surprising to discover that large behavioral deficits are plausible without any major appeal to punishment or suppression of behavior by aversive stimuli.

Intermittent Reinforcement and Extinction

Intermittent reinforcement and extinction are the major techniques for removing or weakening behavior in a repertoire. The most fundamental way to eliminate a kind of behavior from an organism's repertoire is to discontinue the effect the behavior has on the environment (extinction). A performance may also be weakened if its maintaining effect on the environment occurs intermittently (intermittent reinforcement).¹ Behaviors occurring because of their effects on the parent are especially likely to be weakened by intermittent reinforcement and extinction, because the parental

¹ The reader may suggest at this point an apparent contradiction with the fact that extinction after intermittent reinforcement is more prolonged than after continuous reinforcement. This aspect of intermittently reinforced behavior's durability is not a general proposition, however, and does not hold for behavior which is still being maintained. Behavior reinforced intermittently will, in general, be emitted less frequently and be more easily weakened by emotional factors, changes in deprivation, punishment, and physiological disturbances than continuously reinforced behavior.

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reinforcements are a function of other variables and behavioral processes usually not directly under the control of the child. The reinforcement of the verbal response, "Give me the book," may go unreinforced because of many factors which determine the behavior of the listener. He may be preoccupied, listening to someone else, disinclined to reinforce, momentarily inattentive, etc. In contrast, the physical environment reinforces continuously and reliably. Reaching for a book is usually followed by the tactile stimulation from the book. Verbal behavior, particularly, depends entirely for its development and maintenance on reinforcements supplied by an audience (usually a parent). Because of the possibility of prolonged extinction and infrequent, intermittent reinforcement, speech and social behavior are the most vulnerable aspects of the child's repertoire. The young child is particularly vulnerable to the extinction and intermittent reinforcement occurring in social reinforcement because only the parental environment mediates nearly all of the major reinforcers relevant to his repertoire. Large parts of the child's repertoire are reinforced by first affecting a parent who in turn produces the reinforcer for the child. The 2-year-old child who asks for a cookie from a parent and gets no response usually has no alternative audience who will reinforce this vocal behavior. The result will either be the extinction of the child's verbal behavior or the reinforcement of nonvocal verbal forms when the child produces a cookie by a tantrum from which the parent escapes by giving the cookie.

Factors in the Parental Repertoire Affecting the Frequency of Reinforcement of the Child's Performances

To find the conditions under which the child's repertoire will be weakened, therefore, we must look for conditions influencing the parents' behavior, which will alter the parental performances, in turn providing reinforcement of the child's performances. These might be:

1. The general disruption of the parental repertoire. Any severe disruption of the parental repertoire will severely affect the frequency with which the parent reinforces the behavior of the child. Consider, for example, the depressed parent whose general level of behavior is very low. One consequence of this low level of behaving will be a lessened frequency of reacting to the child. Therefore, many items in the child's repertoire will be less frequently reinforced in the depressed than the normal parent. The verbal responses, "May I have some bread" or "I want to go outside," might go unreinforced or be emitted many times without reinforcement. Various kinds of somatic disturbances, such as alcoholic "hangover," drug addiction, severe headache, somatic diseases, etc., could also produce large changes in the over-all reactivity of the parent to a child. To the extent that the child's performances occur because of their effect on the parent, the severely weakened parental repertoire may correspondingly weaken the child's behavior. If the parental extinction of the child's behavior is systematic and periodic, much of a child's behavior could be eliminated.

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2. Prepotency of other performances. Whether or not a parent reinforces a child's performance also depends upon the alternative repertoire available to the parent. For example, the parent who is absorbed in various kinds of activities such as housecleaning, a home business, social activities and clubs, active telephoning, and so forth, may at various times allow many usually reinforced performances to go unreinforced. In general, the likelihood of omitting reinforcement would depend upon the strength of the prepotent repertoire. As an example of a prepotent repertoire, the housewife absorbed in a telephone conversation will not be inclined to answer a child or comply with a request. Housecleaning might be another repertoire controlling some parents' behavior so strongly that it is prepotent over behavior in respect to the child. In both cases, the essential result is the nonreinforcement of the child's behavior in competition with the prepotent parental repertoire. Mothers of autistic children often appear to have strong repertoires prepotent over the child. This may be at least a partial reason why mothers of autistic children are so often well-educated, verbal, and at least superficially adequate people. *ERIC D. WHYME*

3. A third factor producing intermittent reinforcement of the child's behavior is related to the first two factors listed above. If the parent finds other reinforcers outside of the home more rewarding than dealing with the child, the child becomes an occasion on which the significant elements of the parental repertoire cannot be reinforced. A parent changing diapers, or otherwise taking care of a child, cannot telephone a friend, be out socializing, be on a job, or doing whatever the autistic mother finds rewarding. The child acquires the properties of a conditioned aversive stimulus because it is an occasion which is incompatible with the parents' normal repertoire. This is of course the major method of aversive control in human behavior—the discontinuation of positive reinforcement. Another basis for establishing the child as a conditioned aversive stimulus to the parent is the emergence of atavisms and a large degree of aversive control of the parent by the child. To the extent that the parent is reinforced by escaping from the child because of his conditioned aversive properties, the frequency of the parental reinforcement of the child's behavior is further reduced.

The development of the atavistic behavior in the child by the parent is necessarily a very gradual program in which the beginning steps involve small magnitudes of behavior such as whining, whimpering, and crying. As the parent adapts to these or becomes indifferent to them because of the prepotence of other kinds of activity, then progressively larger orders of magnitude become reinforced. The large-magnitude tantrum may be approximated or "shaped" by gradual differential reinforcement. The parents of one autistic child, for example, at one period took turns all night standing in the child's room because one step out of the room would immediately produce a severe tantrum in the child. When the child functions as a conditioned aversive stimulus for the parent, the parent is less likely to reinforce the child's behavior positively. This lack of positive reinforcement,

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in turn, emphasizes the atavistic responses on the child's part as the major mode of affecting the parent.

The usual limiting factor in preventing excessive development of tantrums is the emergence of self-control on the part of the parent in escaping from the aversive control by the child rather than reinforcing it. Here, again, the repertoire of the parent is relevant. The development of self-control requires a highly developed repertoire which depends for its development on the ultimate aversive consequences of the child's control of the parent. The child's control becomes more aversive to the parent if it interrupts strong repertoires. Specifically, a parent engrossed in a conversation will find a child's interruption more aversive than a parent who is simply resting. If, in fact, there is no strong behavior in the parent, then the child's control is not likely to be aversive, and there is no basis for developing self-control.

All three of the above factors—over-all disturbances in the parental repertoire, prepotent activities, and escape from the child because of his aversiveness—reduce the amount of parental reinforcement of the child's performances. The over-all effect of the nonreinforcement on the repertoire of the child will depend upon the length of time and number of items of the child's repertoire that go unreinforced, as well as the existence of other possible social environments that can alternatively maintain the child's behavior (*see below*).

Differential Reinforcement of Atavistic Forms of Behavior by the Parent

The schedule by which the parent reacts to the child is also relevant to the development of atavistic behavior. Initially, a tantrum may be an unconditioned consequence of parental control as, for example, sudden non-reinforcement or punishment. Eventually, however, the child's tantrums may come to be maintained by their effect on the parental environment, because they present an aversive situation that can be terminated if the parent supplies some reinforcer to the child. The reinforcer presented by the parent to escape from the aversive consequences of the tantrum also increases the subsequent frequency of atavistic responses.

The effect on the parent of the given form and intensity of tantrums will vary from time to time, depending on the conditions maintaining the parents' behavior. This variation in sensitivity of the parent to aversive control by the child results in a variable-ratio schedule of reinforcement of the child's tantrum by the parent—a schedule of reinforcement potentially capable of maximizing the disposition to engage in tantrums. This is the schedule of reinforcement that produces the high frequencies of performances as in gambling (10). The sensitivity of the parent to aversive control by the child will depend on the general condition of the parental repertoire as discussed above. The same factors in the parental repertoire that tend to produce nonreinforcement of the child's behavior—general disruption of the parent or other behaviors prepotent over the child—correspondingly

produce reinforcement of large-order-of-magnitude tantrums. The parent whose total repertoire is severely enough disrupted to interfere with the normal reinforcement of the child's behavior will also react only to tantrums that are of large order of magnitude of aversiveness. A range of sensitivity of the parent to aversive control by the child produces ideal conditions for progressively increasing the intensity or frequency of tantrums. A high sensitivity to aversive control guarantees that some tantrums will be reinforced at least periodically. A low sensitivity differentially reinforces tantrums of large orders of magnitude. At one extreme, the parent may be hypersensitive to the child and, at other times, so depressed that only physical violence will produce a reaction. The schedule by which the parent's behavior terminates the tantrum is a second factor which will increase the range of reactivity of the parent. As more behavior is required of the parent to terminate the tantrum, the parent's inclination to do so will fall. When the parent is less inclined to reinforce a given intensity of tantrum, any variation in tantrum intensity is tantamount to differential reinforcement of extreme forms, if the parent now reacts to the larger-order-of-magnitude tantrum.

How much the parent differentially reinforces tantrums in the child depends, in part, upon the child's other positively reinforced repertoires. When, for example, a child's performance suddenly goes unreinforced, as when a parent may refuse a request, the likelihood and severity of a tantrum will in part depend on the parent's ability to "distract" the child. This, in turn, depends upon whether alternative modes of behavior are in fact available to the child. When conditions are present for the progressive reinforcement of more and more severe tantrums, the process is potentially non-self-limiting. Autocatalysis is likely to occur, particularly if the parent has little disposition to reinforce the general items in the child's repertoire for reasons other than terminating the aversive demands of the child.

Nonsocial Reinforcers

Some of the child's behavior is maintained by his direct effect on the physical environment without the intervention of other individuals. In general, very small effects on the environment will sustain performances with which the parent usually has little reason to interfere. For example, the child plays with his own shoelace, moves his fingers in his own visual field, emits minimal nonverbal, vocal responses, and so forth. Larger effects on the physical environment as, for example, moving objects about the house, speaking to the parent, playing with toys, touching and handling usual household objects, are more likely to enter upon the parental repertoire and so may produce a response whose effect is to discontinue the behavior or interfere with its reinforcement. The punishment aspect of the parental interference with the child's activities will be dealt with separately below. The relative possibility of parental interference and nonreinforcement of the hierarchy of performances may account for the large part of

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the autistic child's repertoire, which consists of behaviors having small, limited effects on the physical environment. Occasionally, even behaviors that are maintained by the most simple effects on the environment are extinguished or punished when they occur in the presence of a parent. For example, the father of one autistic child reports that the child reached for a chandelier while he was holding him. The father instantly dropped the child, with a reaction of considerable disapproval because "You should pay attention to me when you're with me." Aside from the secondary effect on the child, the immediate result of the incident is the nonreinforcement of the child reaching for a common physical object.

The existence of "nonverbal" vocal behavior in some autistic children may be related to forms of vocal behavior with which the parent will or will not interfere. Vocal behavior maintained by its effect on a parent (verbal) is susceptible to weakening by parental extinction. A parent interferes less easily with vocal behavior maintained by its direct effect (nonverbal) comparable with making noise by rubbing a stick over a rough surface. Further, such nonverbal vocal responses can emerge readily at any stage of the child's life, unlike verbal behavior, because it does not depend on a generalized reinforcement.

Failure to Develop Conditioned and Generalized Reinforcers

The normal repertoire of the child consists almost entirely of sequences of behavior that are maintained, in a chain or sequence, by conditioned and generalized reinforcers (10). An example of a chain of responses would be the behavior of the child moving a chair across the room and using it to climb to a table top to reach a key which in turn opens a cupboard containing candy. This complicated sequence of behavior is linked together by critical stimuli which have the dual function of sustaining the behavior they follow (conditioned reinforcement) and setting the occasion for the subsequent response. The chair in the above example is an occasion on which climbing onto it will bring the child into a position where reaching for food on the table top will be reinforced by obtaining food. Once this behavior is established, the chair in position in front of the table may now be a reinforcer, and any of the child's behavior which results in moving the chair into position will be reinforced because of the subsequent role of the chair in the later chain of behaviors. A minimal amount of behavior is necessary before a chain of responses can develop. The development of the control by the various stimuli in the chain, both as discriminative stimuli setting the occasion for the reinforcement of behavior and as reinforcers, depends upon a high level of activity, so that the responses will occur and come under the control of the stimuli. This is even more true for the development of the generalized reinforcer. When the child has moved enough objects about the house and achieved a variety of effects on his environment relative to a range of deprivations and reinforcers, simply manipulating the physical environment may become a reinforcer without reference to a

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specific level of deprivation. This, of course, is the uniquely human reinforcer that makes possible much of verbal behavior, education in general, and self-control. Again, large amounts of behavior—many chains of behavior with many different kinds of conditioned reinforcers—are a necessary condition for the emergence of a generalized reinforcer. To the extent that the child's repertoire becomes weakened by intermittent reinforcement and extinction, as mentioned above, and punishment and aversive control (*see* below), the possibility of the development of generalized reinforcers, and hence more complex behavior, becomes less and less likely. Parental "attention" is probably one of the most important generalized reinforcers normally maintaining the child's behavior. Parental attention is an occasion upon which the child's performances may have an important effect on the parent. Inattention is an occasion on which the child's responses are likely to have little effect. Hence, the parents' performances in smiling, saying, "Right," "Good boy," or "Thank you," all come to function as conditioned reinforcers. Their emergence as generalized reinforcers again depends upon the existence of a large behavioral repertoire. A large number of chains of responses will produce important positive effects when the parent smiles or says, "Good boy." Lower frequencies of reinforcement follow for these same activities when the parent is frowning or says, "Bad boy."

Any large reduction in the child's over-all performance will interfere with the initial development of conditioned reinforcers or their continued effectiveness. The control by the environment over the child's behavior depends first upon the emission of the behavior. This follows from the manner in which the environment comes to control the child's performance: the successful execution of an act on one occasion, coupled with the unsuccessful act in its absence. Until a child climbs on chairs, as in the previous example, a chair has little chance of becoming a discriminative stimulus. Without the development of stimulus control, conditioned reinforcers cannot develop. The reinforcing effect of the chair in the above example depends upon its being the occasion on which further performances may be reinforced. In this way, a low general level of behavior may impede the enlargement of the child's repertoire because it does not allow stimulus control and in turn prevents reinforcement of new behavior. A limited development of simple conditioned reinforcers in turn prevents the development of a generalized reinforcer. Parental responses, such as smiling, "Good," or "Right," can have little effect on the child if there is not a history by which many different forms of the child's performance have produced various reinforcers on these occasions. Without parental generalized reinforcement, educational processes and positive parental control are all but impossible. This control is normally carried out by the use of praise and parental attention, coupled with mild forms of threats of discontinuing the reinforcers. Even after a generalized reinforcer has acquired its function, its continued effectiveness depends on the various stimuli continuing to stand in a significant relation to the child's performance. The actual form of the parents' generalized

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reinforcer is not nearly as important as the parents' subsequent reinforcement practices with the child. The reinforcing effects of the smile derive from the reinforcing practices associated with it. A smile usually functions as a generalized reinforcer in most people because a smiling person is more likely to reinforce. The correlation between smiling and reinforcement is by no means inevitable, however. Some individuals may be more disposed to punish than reinforce when smiling in some situations. In a similar vein, if the child has no behavior in his repertoire that will be more likely to be reinforced on the occasion of a parental smile, it matters little what the parent's reinforcing practices are when smiling as against when frowning.

STIMULUS CONTROL

The specific occasions on which a child's performances have their characteristic effects on the environment will subsequently determine whether the child acts. In the absence of the characteristic circumstances under which the behavior is normally reinforced, the child will be less disposed to act in proportion to the degree of similarity with the original situation. Changing a stimulus to one which has not been correlated with reinforcement is another way of weakening a repertoire. New stimuli also elicit emotional responses and general autonomic effects that may interfere with established performances. Here, simply repeated exposure to the stimuli may produce adaptation to the stimuli and eliminate their emotional effects. Ordinarily, the infants' performances are under the control of a limited range of stimuli, usually one or two parents in a limited part of a specific home environment. The discriminative repertoire broadens as the child grows older and other individuals come to be occasions on which his performances have significant effects. The parental environment of the very young child narrows the control of the child's performance to a limited range of stimuli, largely because the parent mediates almost all of the important events affecting the child. A major factor which brings the child's behavior more narrowly under the control of the parent is the nonreinforcement of much of the child's behavior in the absence of the parent. The close control of the child's behavior by the parent weakens the child's repertoire in the absence of a parent much more when there has been explicit differential reinforcement than when there has been simply a limited reinforcing environment.

Sudden shifts in the child's environment may or may not produce major performance deficits. At one extreme, a sudden shift of the stimuli in the child's controlling environment will have little influence if the child already has been reinforced on the occasion of a wide range of circumstances and individuals. At another extreme, a repertoire can be eliminated almost completely if the child has had a history in which major kinds of performances have gone unreinforced except on the occasion of a single person

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in a specific environment. The sudden shifts in the situations and persons controlling the child's behavior may occur under a variety of circumstances, such as a sudden change in a constant companion, death of a parent, or a sudden shift in the physical environment. A sudden shift in the environment of one of the subjects reported in the previously mentioned experiment could conceivably have been the major factor in her autistic development. Many of the activities of the child's mother were prepotent over dealing with the child, and she solved the problem by hiring a teenage baby sitter as a constant companion and nursemaid. After a year, the baby sitter left, suddenly and abruptly, leaving the child with the mother. Within four months, the child began to behave less in general, lost speech, and showed increasing frequency of atavisms. The child's repertoire possibly was under such close control of the baby sitter that the very sudden change to the mother created an environment which in the past had been correlated with nonreinforcement. If the child's behavior were under very narrow control by the baby sitter, because of the nonreinforcement on all other occasions, a sudden shift, as in the loss of the baby sitter, could produce a dramatic deficit in the child's repertoire.

Disruptive Effect of Sudden Stimulus Changes and the Amount, Durability, and Range of Behavior

A novel reinforcing environment will not sustain a child's performance unless the repertoire contains behavior of a sufficient range and durability. The new environment weakens the performance because it nearly always requires slightly different forms of behavior. For example, a new person entering a child's home is not so likely to respond successfully to the incompletely developed verbal behavior of a child as the parent. The possibility of the child's affecting the stranger will depend upon his having verbal responses different from those usually reinforced by the parent and, also, durable verbal behavior that will continue to be emitted under the intermittent reinforcement that is likely to occur. If the child's repertoire is durable and extensive enough so that the verbal response may be repeated several times and supplemented by auxiliary behavior, the child has a greater chance of affecting the new person or of being shaped by him. Similarly with other kinds of social behavior. The wider the range of behavior and the greater the disposition to emit it the more likely that the child's performance will be within the range of responses potentially reinforcing by the new environment.

For a stimulus to acquire control over behavior, the child must first emit behavior in the presence of the stimulus. Consider, for example, the performance of a child at a children's party at which there are lots of toys and games, such as bicycles, swings, and so forth. The likelihood of the child's behavior coming under the control of any of the other children as reinforcers is minimal if the new environment suppresses or makes the

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child's entire repertoire unavailable because it is a novel stimulus and is an occasion on which the child's behavior has never been reinforced. If the behavior of playing with a swing or riding a tricycle is sufficiently strong that it may be emitted even under the adverse conditions of the very strange party environment, then the simple emission of the previously developed behavior provides a situation under which other children at the party may potentially reinforce or otherwise affect the child's repertoire. Simply the acts of eating cake, candy, or ice cream, or picking up a toy put some of the child's behavior under the control of the new environment. Each new performance which can potentially occur at the party provides a basis for the child's reinforcing some behavior of other children at the party or of his coming under the control of the other children's reinforcers. On the other hand, a sudden exposure to a new environment with a weak and narrow repertoire may produce a severe behavioral deficit. In any case, the child will be much less disposed to go to the party if he had behaved unsuccessfully in the new environment. This lower disposition to attend and engage in the party would in turn make it less likely that the child will emit behavior that would be reinforced in the party environment.

Adaptation

The emotional and elicited autonomic effects of novel environments may also interfere with a child's performances. Adaptation to new environments occurs with gradual exposure. A sudden exposure to a new environment will produce gross emotional and autonomic responses which will in turn interfere with, or even completely suppress, the emission of possible operant behavior potentially reinforcing by the new environment. The rate at which the child is exposed to the new environments will determine the magnitude of disturbance. Exposure to a new environment and adaptation of the emotional responses do not necessarily create the potential basis for responding, however. A repertoire that will make contact with the new environment is also necessary.

Amount of Prior Nonreinforcement

The more closely controlled the child's performances are by specific stimuli, the more likely a sudden shift in the environment will produce a cessation of responding. For example, the child receiving minimal care from a parent probably will be less affected by a sudden shift in environment than a child closely affected and controlled by parental response. It is paradoxical that the parent who responds sensitively to the child's performance may be potentially weakening it more than the parent who exerts little control over the child. It is the alternate reinforcement and nonreinforcement that place the child's behavior narrowly under the control of very specific stimuli so that it is much more vulnerable to sudden changes. The range of stimuli in whose presence the child's behavior goes unreinforced will determine the narrowness of the stimulus control.

CUMULATIVE EFFECTS OF A BEHAVIORAL DEFICIT

The continuous development of more and more complex forms of a child's behavior is normally achieved because the parents and community approximate the required performances. At each stage of the child's development, the community reinforces the child's current repertoire even though it is more disposed to react to small increments in the child's performance in the direction of the required complex performances. Should any of the above processes produce a deficit in performance or an arrest in the development of the child's performance, further development of a repertoire would depend upon the community's relaxing its requirements and reinforcing performances in an older child that it normally accepts only from a younger one. Ordinarily, the reinforcing practices of the community are based on the chronological age and physical development of the child.

Only between the ages of 1½ to 4 years does the parent have sufficient control of the child to weaken his performance to the degree seen in infantile autism. This is a critical period in the child's development during which his behavior is especially susceptible to extinction, because the traditional social pattern in the usual family restricts the child's experience to one or two parents. Before the age of 1½, the child has few performances with which the parent will interfere or that have important effects on the parent. Much of the infant's behavior is maintained by simple and direct effects on its environment. As the child approaches 2 years, the rapid development of a behavioral repertoire, particularly social and verbal behavior, makes possible extinction and other forms of weakening. The effectiveness of the parental environment in weakening the child's repertoire depends upon the availability of concurrent audiences for the child's behavior. In general, the 2-year-old child is limited to the home and comes into increasing contact with other environments as he grows older, perhaps reaching a maximum at school age. The presence of an older sibling might appear to preempt the possibility of a sufficient degree of isolation to account for an aversive behavioral deficit. A sibling could provide an alternative to the parent as a reinforcing environment. The behavioral or functional influence of a sibling would depend on the amount and nature of interaction between the children. For example, an older child might possibly completely avoid the younger one or tend to have the same patterns of reaction as the parent. In many cases, the older sibling has playmates outside the home to the complete exclusion of the younger child. The older sibling, in many circumstances, punishes as well as extinguishes the younger child for any attempted participation in his play. There are very few facts as to the exact nature of the interactions in most cases.

The parent as the sole maintainer of the child's behavior is perhaps even more likely when the child is raised in a rural or isolated community, and perhaps with one of the parents largely absent. The above analysis suggests that a survey of severely autistic children would, in general, show them

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to be first-born children; or, if other siblings were available, they would have provided little interaction with the child. It also suggests that the child would be raised in a house physically or socially isolated from other families or children such that there were no alternative social environments that could provide reinforcement for the child's behavior. When the child was exposed to both parents, it would be expected that both parents were consistent in their nonreinforcement of the child's performances.

AVERSIVE CONTROL AND PUNISHMENT

It has been possible to describe conditions which might produce major behavioral deficits without dealing with punishment or aversive control. A similar account might present a functional analysis of how performance deficits might occur as a result of aversive control. Many writers have already described some of these factors by extending general principles of aversive control to human behavior (7, 8, 11). For the purposes of the analysis presented in this paper, I should like to restrict the discussion of aversive control to its relation to positive reinforcement. Much of human aversive control is carried out by discontinuing or withdrawing reinforcement (3, 10). For example, a frown or criticism may function as an aversive stimulus because these are occasions on which reinforcements are less likely to occur. Even when corporal punishment is given, it is not clear as to whether the resulting effect on the child's behavior is due to a slap or to the lower inclination of a punishing parent to reinforce. Most parents who spank a child will be indisposed to act favorably toward the child for some period of time subsequently. As a result, one major by-product of frequent punishment may be a larger order of interference with the child's normal repertoire along the lines of the positive reinforcement deficits described above.

The obvious effectiveness of punishment in some kinds of human control appears to contradict experimental findings with animals which show punishment to have only a temporary effect on behavior (1, 2, 9). The role of positive reinforcement factors helps resolve the dilemma. The effectiveness of punishment depends on how strongly the punished behavior is maintained by positive reinforcement. The apparent effectiveness of punishment in the control of children may occur when weak repertoires are punished or when the punishment indirectly produces extinction. Most animal experiments using electric shock as an aversive stimulus have used strongly maintained positively reinforced operant behavior as the base-line performance to be punished. The aversive control might be more effective when the performances to be punished are less strongly maintained.

CONCLUSION

As might be expected from the relatively low frequency of infantile autism, the combination of circumstances hypothesized above would occur only rarely. The above hypothesis provides a framework for investigating

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the circumstances surrounding the development of the autistic child. All of the variables that might weaken the behavior of a child are directly or potentially observable. The data required are the actual parental and child performances and their specific effects on each other, rather than global statements such as dependency, hostility, or socialization. Not all of the factors responsible for a child's performance may be present currently. Using retrospective accounts, however, makes it difficult to determine the actual correspondence between the verbal statements of the parent and their actual practices in raising the child. The alternatives are, first, an objective assessment of the child's repertoire in a wide enough range of environments so as to allow an assessment of the nature of the environmental control of the child's current behavior; and, second, actual home observations of the specific social consequences of the child's performances early in the development of the disease.

The same kind of functional analysis can be made for the performance of the adult psychotic although the specific deficits observed in autistic children and their manner of occurrence may not be relevant. In particular, the analysis of the adult's behavior would be more concerned with the factors which weaken behavior already in the repertoire rather than the development of new repertoires as with the analysis of the autistic child's behavior. Maintaining already-established behavior is more at issue in the adult than the initial development of a performance as in the case of the child (3).

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