THE LIMITS AND MOTIVATING POTENTIAL OF SENSORY STIMULI AS REINFORCERS FOR AUTISTIC CHILDREN

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This study investigated the reinforcing properties, limits, and motivating potentials of sensory stimuli with autistic children. In the first phase of the study, four intellectually retarded autistic children were exposed to three different types of sensory stimulation (vibration, music, and strobe light) as well as edible and social reinforcers for ten-second intervals contingent upon six simple bar pressing responses. In the second phase, the same events were used as reinforcers for correct responses in learning object labels. The results indicated that: (a) sensory stimuli can be used effectively as reinforcers to maintain high, durable rates of responding in a simple pressing task; (b) ranked preferences for sensory stimuli revealed a unique configuration of responding for each child; and (c) sensory stimuli have motivating potentials comparable to those of the traditional food and social reinforcers even when training receptive language tasks.

DESCRIPTORS: motivation, sensory reinforcement, discrimination training, autistic children

Although food is the most commonly used primary reinforcer in the behavioral treatment of autistic children, its use poses problems. Among these are the potential for rapid satiation and the general absence of food as a reinforcer in the natural environment. Frankel and Graham (1976) concluded that food may even have a deleterious effect on some subjects.

One alternative to food may be sensory reinforcers. Work with animals (Harlow & McCleary, 1954) and normal children (Antonis & Barnes, 1961) suggests that sensory events have both primary and secondary reinforcing properties. There have been a few clinical reports of the use of sensory rewards with handicapped children. Blake and Moss (1967) used colored lights to establish verbal behavior in a nonverbal child and Buddenhagen (1971) used music with

Down's syndrome youngsters. Sensory reinforcers have been used to elicit verbalizations from mute autistic children (cf. Fineman, 1968; Jellis, 1972) and to shape their speech (Hewett, 1965). Recently, Rincover, Newsom, Lovaas, and Koegel (1977) demonstrated the value of sensory rewards in maintaining a simple bar press response with autistic children.

The present study explored in greater depth the limits and potentials of sensory events as reinforcers for autistic children. Several different events including light, music, and vibration were compared to one another and to food and praise in the maintenance of a bar pressing response and the acquisition of a more complex object identification task.

METHOD

Participants

Four boys from the Douglass Developmental Disabilities Center, Rutgers University who met the NSAC criteria for autism participated in the study. They ranged in age from 7 yr 6 mo to 9 yr 2 mo. Each child demonstrated some stereotypic

Support for this research came in part from a grant from the National Institute of Mental Health (MH 29897-04) to the second author. The authors thank Alan R. Wiesenfeld and Richard K. Lore for their helpful suggestions. Requests for reprints should be sent to Michael Ferrari, Psychology Department, Douglass College, New Brunswick, New Jersey 08903.

behavior and gross deficiency in language and each was moderately to severely retarded.

During the study each child was routinely receiving social rewards and food for daily activities at the center. These activities ranged from language training to self-care. The study itself was done after school hours at each boy's home immediately prior to his usual dinner time.

Design and Procedure

The experiment consisted of two phases. The first involved recording the response rate of "nose pressing" on the face of a plexiglas clown that each stimulus maintained and identifying preferences for the different reinforcing stimuli. In Phase 2, the boys were taught 10 two-choice object discriminations. Each child's performance was assessed before and after training.

Three types of sensory stimuli were used as reinforcers. These included taped songs by contemporary musicians (Eagles, Seals & Crofts), a Globe model 900 strobe light set at 150 pulses per minute, and a Pollenex model B-1400 back massager. Food rewards, including fruit, candy, and cereal, and social rewards, statements such as "good work" and "that's terrific," were also used. All reinforcements were presented for 10 sec.

Phase 1. Several preexperimental sessions were used to ensure that the children were comfortable with the procedure. The experimenter modeled pressing the clown's nose and prompted the child to do so. Each child progressed from one response per reinforcing event to six responses per event (FR6) when the recording of data for analysis began and prompting was discontinued.

The sequence in which rewards were presented was randomized with only one form of reinforcement in a session. Each child participated in six 15-min sessions with each stimulus unless he failed to emit 12 responses to receive the reinforcement twice in a session. A maximum of two sessions were run in a single day with a 10-min rest in between. When all sessions

of Phase 1 were completed, there were two extinction sessions, run on separate days, in the same manner as all other Phase 1 sessions except that no reinforcements for nose pressing were given.

Phase 2. Each Phase 1 reinforcer was used to train two, two-choice object discriminations. To select appropriate objects for each child, items were placed on a small table, three at a time. The experimenter got the child's attention and asked him to touch one of the objects (e.g. "Touch the vase"). Responses were not reinforced, punished, or corrected, but the boys were praised periodically for good sitting and attentive behavior.

Baseline assessments consisted of 18 trials, each object being requested six times in a random sequence. Objects for training were selected from those a child failed to identify more than 33.3% of the time. Object sets were then formed randomly; however, items grouped in units during assessment were not grouped in training sets. During training the experimenter faced the child and placed two objects side by side 20 cm (8 in.) apart in front of him. The child was instructed to touch one of the objects. If he responded correctly, the experimenter presented the reinforcer being used for that set. If incorrect, the experimenter prompted the correct response and gave verbal reinforcement. Requests for objects and their position on the table were randomized with each object requested equally. The criterion for mastery was 85% correct responding over 20 trials. If criterion was not reached after 100 trials, training on that set of objects was discontinued. Training sessions lasted 25 min.

Following each successful discrimination or the 100 trials maximum, a new set of objects with a different reinforcer was trained. The order in which the reinforcers were used was randomized so that each of the first five sets of objects was trained with a different reinforcer. After training the 10 sets of objects, a posttraining baseline was conducted. Each object was put in the original pretraining set and randomly requested six times.

Fig. 1. Mean response per session for each child with each reinforcing event in Phase 1.

RESULTS

Phase 1

Although there were similarities among them, each boy presented a unique pattern of response to the five reinforcers (Fig. 1). The vibration stimulus emerged as an important stimulus for all children, but it was not uniformly the most preferred. Similarly, light and music did not generally maintain high response rates, but this was not true for all children. John preferred vibration (mean = 364), with music a second choice (mean = 248.3), and the other stimuli eliciting lower rates of responding (food, mean = 144.2; light, mean = 123.8; social, mean = 107.7). Bill responded with enthusiasm to vibration (mean = 519.7); no other event rivaled his effort for this stimulus (food, mean = 214.3; social, mean = 206.7; music, mean = 105.7; light, mean = 90). Carl worked hard for food

(mean = 279.3) with social praise (mean = 212.3) and vibration (mean = 198.5) close behind and light (mean = 103.8) and music (mean = 56.8) having less impact on his behavior. Chuck's data showed the most uniform responding across stimuli with food highest (mean = 223) and music lowest (mean = 41.5; vibration, mean = 182.5; social, mean = 146.7; light, mean = 129.2). His indifference to music was such that he did not complete all six sessions with this event.

During the extinction sessions all children showed a marked drop in responding. During the second extinction session, John's total responses declined to 32, Bill's to 68, Carl's 50, and Chuck's 18.

In an attempt to identify a tendency toward satiation with any of the stimuli, an analysis of variance was performed on the inter- and intra-session (3-min intervals) response rates for each

event. No significant decreases in responding were found for any of the stimuli nor did visual inspection of the data reveal any individual patterns of satiation.

Phase 2

As a group, the greatest increases in performance were seen for vibration and food. Nevertheless, as in Phase 1, each child had a distinctive pattern. John showed the best retention for items trained with vibration (mean = 79.3%) or music (mean = 71%); his performance for food (mean = 49.9%), social (mean = 39.5%), and light (mean = 32%) reinforcers was not as great. Bill similarly responded well to vibration (mean = 66.6%) and food (mean = 70.8%), but also to social rewards (mean = 58%). He showed no evidence of learning for music (mean = 33%) or light (mean = 27.1%). Carl demonstrated relatively little acquisition in any category (light, mean = 34.5%; vibration, mean = 29.2%; social, mean = 16.6%; music, mean = 20.8%) but his best performance was for food (mean = 41.7%). Chuck's data show a distinct response to every reward but music (mean = 33.3%) where there was no evidence of learning. His best retention was with food (mean = 79.1%), vibration (mean = 79.1%), and light reinforcement (mean = 70.8%); social reward was somewhat less potent (mean = 58.2%).

The boys differed in the mean trials to criterion for each stimulus. John required the fewest trials for food (57), music (65), and vibration (65); light (81); social (85). Bill learned most quickly with social praise (29) and food (31); vibration (43); light (66); music (97). Carl's data reveal that only with food (92) did he master any of the material; criterion was not reached for all other reinforcers. Chuck responded to all stimuli except music (100) showing a preference for food (51) and vibration (56); social (66); light (83).

To identify the relationship between a child's performance in Phases 1 and 2, Pearson correlations were done. A highly significant positive

correlation, $r(18) = .5638$, $p < .01$, was found between mean number of pressing responses for each event in Phase 1 and percentage above chance levels (33.3%) in the posttraining baseline for object sets trained with the same reinforcer. A significant negative correlation was found between the mean rate of responding in Phase 1 and mean trials to criterion for object sets trained with the same reinforcer in Phase 2, $r(18) = -.4968$, $p < .05$.

DISCUSSION

The results demonstrated that different sensory events can maintain high rates of bar press responses across sessions with autistic children. Furthermore, these stimuli also have reinforcing value in teaching object discriminations to the same youngsters. Satiation to these stimuli, if it does occur, requires longer exposure than was available in this research; the children showed no trend toward diminishing responses over time. Nonetheless, there were important variations in the power of the reinforcers for different children. This finding of idiosyncratic responding is similar to that of Rincover et al. (1977) who reported that three of the four autistic children in their study had a clear preference for one sensory stimulus and in each case it was a different sensory event.

Food and praise, both traditional reinforcers for autistic children, did have a generally rewarding effect. However, for two boys, these common events were not the most preferred rewards, and for none of the boys were they strikingly more powerful than the sensory stimuli. In comparing the sensory stimuli, it is of interest to note that all the children responded to vibration, but not as consistently to music or light. This might have been due to stimulus novelty because vibration was never used at the center and does not typically occur in the natural environment. An attractive feature of vibration was its ease of delivery. The back massager is commercially available, is easily set up, and can be turned on and off without distracting other children who

work nearby. It is a very practical choice for the therapist.

The results of the present study have useful implications for work with autistic children because sensory reinforcers can have a reward value comparable to, or in some cases exceeding that of, food or praise. The data suggest that the therapist may have available a wider range of potential reinforcers than is typically employed in treatment. Praise is clearly the most attractive incentive from the therapist's perspective because it closely parallels what is available in the natural environment, and can be delivered easily; nonetheless, it is helpful to have a broad repertoire of alternative rewards. Identifying reinforcing experiences can be a major obstacle in the treatment of autistic children. Some of these youngsters do not like food, most are initially indifferent to praise, and all can challenge the ingenuity of the most devoted clinician in identifying suitable incentives for performance. However, even sensory reinforcers need to be evaluated carefully because slight alterations in the sensory event may make the difference between an effective and ineffective reinforcer. Finding practical and effective methods of reinforcing desirable behavior, especially in the early stages of treatment when social reinforcers may have minimal impact, is important to the education of these youngsters.

Clinically, one would do well to assess different reinforcers with a child and select those that are potent motivators for an individual. The comparison of the performance of youngsters in Phases 1 and 2 of the present study suggests that a simple learning situation is predictive of reinforcing power in more complex tasks. Therefore, one could do a rapid assessment of a variety of stimuli with a simple learning paradigm and reasonably expect the findings to have implications for more important learning.

A closing note of caution: The sensory reinforcements explored in the present research all pose limits in that they, like food, are not part of the natural environment. Hence, like food, they should be consistently paired with praise and affection to strengthen the reward value of social interaction.

REFERENCES

- Antonis, J. J., & Barnes, G. W. Group operant behavior: An extension of individual methodology to a real life situation. *Journal of Genetic Psychology*, 1961, **98**, 95-111.
- Blake, P., & Moss, T. The development of socialization skills in an electively mute child. *Behaviour Research and Therapy*, 1967, **5**, 349-356.
- Buddenhagen, R. *Establishing vocalizations in mute mongoloid children*. Champaign, Ill.: Research Press, 1971.
- Fineman, K. R. Visual color reinforcement in establishment of speech by an autistic child. *Perceptual and Motor Skills*, 1968, **26**, 761-762.
- Frankel, F., & Graham, V. Systematic observation of classroom behavior of retarded and autistic preschool children. *American Journal of Mental Deficiency*, 1976, **81**, 73-84.
- Harlow, H. F., & McClearn, G. E. Learning and satiation of response in intrinsically motivated complex puzzle performance by monkeys. *Journal of Comparative and Physiological Psychology*, 1954, **47**, 73-76.
- Hewett, F. M. Teaching speech to an autistic child through operant conditioning. *American Journal of Orthopsychiatry*, 1965, **35**, 927-936.
- Jellis, T. The back projection of kaleidoscope patterns as a technique for eliciting verbalizations in an autistic child: A preliminary note. *British Journal of Disorders of Communication*, 1972, **7**, 152-162.
- Rincover, A., Newsom, C. D., Lovaas, O. I., & Koegel, R. L. Some motivational properties of sensory stimulation in psychotic children. *Journal of Experimental Child Psychology*, 1977, **24**, 312-323.

Received September 8, 1980

Final acceptance January 13, 1981