STIMULUS OVERSELECTIVITY IN LEARNING DISABLED CHILDREN

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Stimulus overselectivity, a phenomenon exhibited by autistic and institutionalized retarded individuals, was examined in mildly handicapped and nonhandicapped public school children. Subjects were 16 young, educable mentally retarded, 16 learning disabled, 15 nonhandicapped first- and second-graders, and 16 older, educable retarded students. The children were trained on a 3-component visual discrimination task and then tested on individual elements to determine which element or elements were controlling subject responses. Nine of the young educable mentally retarded children and eight of the learning disabled students showed some overselectivity. The majority of overselective retarded children were controlled by only one of the three components of the training cue, whereas the majority of the overselective learning disabled children responded to the discrimination task on the basis of two of the three components. No overselectivity was exhibited by the nonhandicapped students. All three cue components were also functional in controlling the responding of 14 of the 16 older retarded students, but two children were under the control of only one cue. The research indicated that in terms of overselectivity, learning disabled children respond more like young, mildly retarded children than they do like nonhandicapped ones. The demonstration of stimulus overselectivity in a sizable portion of a learning disabled sample may have implications for a more empirically based approach to this handicapped population.

DESCRIPTORS: stimulus overselectivity, learning disabilities, reinforcement schedules, retarded children

Stimulus overselectivity, a phenomenon originally described by Lovaas, Schreibman, Koegel, and Rehm (1971) occurs when an individual, faced with a complex stimulus responds to only one or to a reduced number of relevant components. In their study, autistic, retarded, and normal children were trained to respond to a multidimensional cue containing auditory, visual, and tactual components. Following training the subjects were tested on individual components to assess which cue or cues had become functional in controlling their behavior. Autistic children responded primarily to only one of

the three components, whereas the nonhandicapped youngsters responded uniformly to all three. The retarded children functioned somewhere in between the highly overselective autistic subjects and the nonoverselective normal youngsters. In the years following the appearance of this first report on overselectivity, other researchers have determined that autistic subjects will overselect when presented with a stimulus containing a two modality cue (Lovaas & Schreibman, 1971) and that overselectivity is present when the cues are either in the same visual modality (Koegel & Wilhelm, 1973) or same auditory modality (Reynolds, Newsom, & Lovaas, 1974).

The majority of overselectivity studies have used autistic children as subjects. Wilhelm and Lovaas (1976), however, reported that overselectivity is exhibited by retarded children also and that the degree of overselectivity is posi-

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tively related to the degree of retardation. On the other hand, nonhandicapped youngsters of school age appear to have no difficulty in responding to a complex stimulus containing three or four cues (Lovaas et al., 1971; Olson, 1971; Schover & Newsom, 1976).

Until the present time, there have been no studies investigating whether stimulus overselectivity is a behavior peculiar to severely disturbed, developmentally delayed, or institutionalized individuals or whether it is a characteristic commonly exhibited by the far larger population of mildly handicapped, public school children. An institutionalized group of mildly retarded subjects was shown to be somewhat overselective (Wilhelm & Lovaas, 1976); however, no reports have included public school, educable mentally retarded children. In addition, overselectivity in learning disabled (LD) youngsters has not been studied. The learning disabled, a sizable group estimated to constitute 2-4% of the population (Gearheart & Weishahn, 1976) exhibit many of the academic and social deficits typical of youngsters classified as mildly retarded. Yet, LD children, by definition, have normal intelligence. It is unknown whether their performance on a test of overselectivity will be similar to high-functioning retarded children or will resemble responses given by nonhandicapped children of the same age.

Ross (1976) speculated that there may be a relationship between learning disabilities and what he termed selective "attention." Citing the research that indicates young children attend to one aspect of a stimulus or to a limited portion of the stimulus area until about age six, he noted that children who continue to restrict their response to a stimulus complex past the typical age when most youngsters move beyond this method of responding will display a range of learning handicaps. "It may be that one finds an extreme of this developmental retardation in children with early infantile autism and a milder form in certain reading disabilities" (Ross, 1976, p. 53). Because much learning involves the simultaneous pairing of stimuli, a child who

responds to only a small number of relevant cues will have severe learning problems. Stimulus overselectivity, unlike the presumed perceptual or neurological causations prevalent in the field of learning disabilities, is a phenomenon that can be empirically demonstrated. More fortunately, if overselectivity is demonstrated, learning environments can be created that permit learning to occur even if students respond in an overselective manner (Rincover, 1978; Schreibman, 1975). Also, there have been at least three studies in which overselectivity in autistic subjects was directly altered (Koegel & Schreibman, 1977; Koegel, Schreibman, Britten, & Laitinen, 1979; Schreibman, Koegel, & Craig, 1977).

METHOD

Students and Setting

Four groups of students were selected on the basis of age, IQ, and educational placement. Appropriate informed consent was required for participation in the study. Group 1 consisted of 16 young, educable mentally retarded children whose mean chronological age was 7 yr, 2 mo at the time of testing. The mean IQ for Group 1 was 67. Group 2 consisted of 16 learning disabled children whose mean CA was 7 yr, 1 mo, and whose mean IQ was 94. A third group was comprised of 15 randomly selected, nonhandicapped first- and second-graders. Their mean CA was 7 yr, 2 mo and their mean IQ was presumed to be 100 or higher. Exact IQ scores for this group of students were not available since the school system does not administer IQ tests to nonhandicapped children of these ages. There were 16 older, educable mentally retarded students in Group 4 whose mean CA was 10 yr, 7 mo, and whose mean IQ was 68. The mean mental age for this group was 7 yr, 1 mo.

All handicapped students were selected from self-contained, public school classrooms for either EMR or LD children. The nonhandicapped children were drawn from the same

suburban school system as the members of Groups 1, 2, and 4. The author conducted the research in a quiet room located within each student's building.

Materials

Training stimuli. Training stimuli consisted of two white index cards, each 12.75×12.75 cm, containing a cue complex composed of three color pictures. The pictures, taken from Whitman sticker books, were approximately 3.5×3.5 cm in size and were mounted equidistance on the cards which were then laminated. One card was designated the discriminative stimulus or S+; the other was the S— or card not associated with reinforcement. Half of the students in each group used one card of the pair as the S+; for the other students, the S+ and S— designations were reversed. The top portion of Figure 1 illustrates the appearance of the training cards.

Test stimuli. Test stimuli consisted of six white index cards, each 12.75×12.75 cm in size. Each card contained one of the stimuli

used on the training cards. The single picture was centered on the card. A card containing a single S+ component was presented with a card containing a single S— component. There were nine (3×3) possible pairings of the S+ and S— components. Nine other pairings controlled for left/right positions. The bottom portion of Figure 1 illustrates three of the possible 18 combinations and left/right positions for test stimuli. To permit comparison of results across disabilities, the appearance of both test and training stimulus cards were similar to those used by Wilhelm and Lovaas (1976).

Procedure

Training. The student was seated in a quiet room at a table or desk opposite the experimenter. The experimenter simultaneously presented the two training stimuli (i.e., the S+ complex and the S— complex). The left/right position of the cards was controlled by a randomly selected Gellerman order (Gellerman, 1933). Placement of the cards was 15 cm apart to allow for easy scoring of responses.

The experimenter gave the command, "Touch the correct card." If the child touched the S+, the trainer responded "good" and delivered a small edible. If the child touched the S—, the trainer said "no" and removed eye contact from the child for five seconds. After the response was scored, a new trial began. It is estimated that at least one trial was presented every 10 sec. The criterion for the first portion of the training phase was eight consecutive correct trials using a schedule of continuous reinforcement.

Following criterion under a CRF schedule, both social and tangible reinforcement was delivered on a VR 2 schedule. The nonreinforced training trials were designed to build subject tolerance for upcoming nonreinforced test trials. Criterion for the VR 2 schedule was 10 consecutive correct responses.

Testing. Once the child had mastered the discrimination on the CRF schedule and maintained it during the VR 2 schedule, test trials

Fig. 1. Upper portion shows training stimuli. The bottom portion presents three of the possible 18 combinations and left/right positions for test stimuli.

began. As noted above, 18 test trials were necessary to control for left/right alternation and to allow for all combinations of the individual S+ and S- components. In addition, the test procedure was presented twice, thus 36 test trials were presented to each child. The test trials were nonreinforced; therefore, the child received no relevant feedback on these trials. Reinforcement was continued for presentation of the complex stimulus (S+ training card). Training trials were included in the testing phase in order to maintain responding. During the training period, reinforcement had been delivered on a rather rich schedule (CRF and VR 2). To present 36 nonreinforced test trials alone without interspersing some reinforced training trials might lead to response extinction on the part of very young and handicapped children. Because the test trials were interspersed on a 1:1 basis with training trials, 72 trials were given (36 test trials randomly mixed with 36 training trials). If an error occurred on the presentation of the training cards, the child was retrained to a criterion of five consecutive correct responses, VR 2, before testing resumed.

Scoring. Following exposure to the 36 test trials, the experimenter scored the responses of each child in order to determine whether a cue was functional in controlling the responding of that child. The present study used a 75% correct responses as the criterion for considering a component functional. Each of the three S+ components appeared 12 times; thus, a child had to respond correctly 9 or more times of the 12 presentations for a component to be considered functional. A student had either a score of 1 (responded on the basis of only 1 cue), a score of 2 (somewhat overselective), or a score of 3 (not overselective). For example, if the complex S+ contained pictures of a book, a kitten, and a girl, a student had to respond correctly to at least 9 of the 12 test presentations of book for it to be scored as functional in controlling the child's responding behavior. If responses to the test presentation of book and kitten reached the 75% criterion, but test pre-

sentations of girl fell below the 75% level of correct responses, a student would have a stimulus overselectivity score of 2.

Reliability. Reliability was conducted by a second observer during both the training and testing phases for the nonhandicapped, the learning disabled, and the young educable mentally retarded children. There was 100% agreement between the experimenter and the observer during reliability checks. Due to this level of agreement and to the discrete and unambiguous nature of the responses being scored, the measurement of reliability was omitted for the older group of educable mentally retarded students.

RESULTS

All 63 students acquired the training discrimination within one brief session. A statistical analysis of the testing data revealed a significant difference in the mean use of cues, $F(3, 59) = 5.66, p < .01$. A Newman-Kuels procedure indicated that there were significant differences between the young retarded students (Group 1) and the nonhandicapped and older retarded students (Groups 3 and 4). Group 1 did not differ from the learning disabled students (Group 2) at a statistically significant level. Learning disabled children, who did not respond differently than did older retarded students, did differ from nonhandicapped children.

Although the statistical analysis indicates significant and reliable differences among the groups, a more complete picture of the results is shown in the raw data for individuals. Figure 2 represents the data for all 63 students. The percentage of correct responding for each of the three components is presented on the ordinate for each student. Other researchers (Koegel & Wilhelm, 1973; Lovaas et al., 1971; Wilhelm & Lovaas, 1976) have presented the response rates for the complex stimulus along with the percentages for each component. However, because only one student, a learning disabled child, ever made more than one incorrect response to

Fig. 2. Percentage of correct responses to presentations of test stimuli for young EMR, LD, nonhandicapped, and older EMR students. The student's identification number is above each cluster of bars.

the complex stimulus during the testing phase, these data are omitted due to the large number of students involved in the study.

Of the 16 younger retarded students, seven children showed no evidence of overselectivity as measured by the present task. Of the nine youngsters who were overselective to some degree, three responded to two cues (students number 105, 110, and 108). The other six children made their responses on the basis of only one component cue (students 106, 113, 116, 107, 109, and 111).

In the learning disabled group, exactly half of the 16 students were not overselective and half were overselective to some extent. With this group, six students responded on the basis of two cues (students 202, 205, 208, 215, 204,

and 207). Only one cue was functional for the other two overselective children (students 206 and 216).

The nonhandicapped first- and second-graders gave no evidence of overselectivity at all, but responded uniformly to all three stimulus components. In the final group of students, the older retarded children, 14 of the 16 were not overselective. However, two students (students 410 and 407) responded on the basis of only one cue.

All students to the left of the vertical line in Figure 2 used the card with the pictures of the sun, bird, and foot as the S+. For students to the right of the line, the card bearing the pictures of the book, kitten, and girl was associated with reinforcement.

Mental Age and Degree of Overselectivity

In Figure 3 the relationship between each student's mental age and degree of overselectivity can be examined. In general, as MA increased, overselectivity decreased within the learning disabled group. The mean MA for the two totally overselective LD students was 74 mo; the mean MA for the six somewhat overselective LD children was an almost identical 73 mo. However, the mean MA for the eight learning disabled youngsters who did not overselectively respond was nearly 86 mo. Within the group of young, educable mentally retarded students there was a positive, but weak relationship between MA and overselectivity. The students in the educable retarded group who used only one cue had a mean MA of 55.5 mo; the children within this group who responded on the basis of two cues had a mean MA of 57 mo. The nonoverselective educable children had a mean MA of 59 mo. There were only two older educable retarded students who showed any overselective responding. However, one of the students who responded on the basis of only one cue, had the highest MA of all 63 students in the study.

DISCUSSION

Four groups of children were trained to respond to a three-component stimulus card and

Fig. 3. The number of functional cues used by individuals within each of the four groups. The student's estimated mental age in months is plotted on the abscissa.

were tested to determine whether their responding was under the uniform control of all three components. The young EMR and the LD children were overselective to a degree that was significantly different from their nonhandicapped peers, none of whom were overselective. The mean use of cues by older EMR students did not differ at a statistically significant degree from the use of cues by LD and normal students. However, there were two of the 16 older EMR students who responded on the basis of only one cue; their low scores may have altered the mean enough to make it appear as though the group as a whole did not differ from the LD group.

The results of the present study demonstrate clearly that a significant portion of a learning disabled sample had some difficulty in responding to all of the relevant dimensions of a complex stimulus. In this regard they were much more similar to high-functioning retarded students than they were to a nonhandicapped sample that showed no overselectivity. Approximately half of the learning disabled and the young retarded students overselectively responded. When the raw data for individuals within each of these two groups were compared, one difference emerged. The majority of the overselective LD youngsters made the discrimination on the basis of two cues, whereas the majority of the young EMR children who were overselective were controlled by only one component from the complex stimulus.

The degree of overselectivity shown by the present EMR students is inconsistent with the degree of overselectivity exhibited by retarded children in the Wilhelm and Lovaas (1976) study. In that earlier report, the participants were 10 individuals with a mean IQ of 66, a mean CA of 14.3 yr, and a mean MA of 9.4 yr. They responded, on the average, to 2.1 components of a 3-component stimulus complex. In the current study, the young EMR group (mean IQ 67, mean CA 7.2, mean MA 4.8) used an average of 2.2 cues. The older EMR group in the present study, which was still several years

younger than the Wilhelm and Lovaas children, had 14 nonoverselective members and two completely overselective members, for an average cue use of 2.75 components. Thus, when one compares the retarded children across these two investigations, the degree of overselectivity differs. Children from the first study were inpatients of an institution for mentally retarded persons; the 32 retarded participants in this report were all public school children residing at home. Although the children have measured IQs that are nearly identical, the present groups of public school children may differ from the institutionalized group in other ways that affect overselectivity.

Overselectivity and Mental Age

The current investigation is in general accord with the findings of Schover and Newsom (1976) that as mental age increases, overselectivity decreases. However, there is enough variability in the data to suggest that the relationship may be a weak one, especially across differing disabilities. Figure 3 shows that there are only very small differences in MAs among young retarded students who use one, two, or three cues, although the differences are in the predictable direction.

Mental age more conclusively differentiated overselective LD children from the nonoverselective LD students. As Figure 3 illustrates, all children who used three cues in the discrimination task had a higher MA (mean 85.5 mo) than those children who used only one or two components (mean 73 mo). The differences in MA between students using one or two cues are uncertain, probably due to the fact that few LD students in this sample responded to only one cue. The nonhandicapped students showed no variability in overselectivity. Thus, one can conclude that normal children who are of school age had no problem with this task because a pronounced ceiling effect appeared to be present.

The responses of individuals within the final group, the older retarded children, are interesting and illustrate the need for inspection of

data for each individual. Generally the older EMR group was not overselective; they had an estimated MA similar to the nonhandicapped and only 6 mo higher than the LD children. However, curiously enough, the child with the highest MA (96 mo) of all 63 students was completely overselective. The only other older EMR student who was overselective had a MA of 81 mo. At that age there were no overselective LD students. The findings suggest that, typically, students with an older MA will not overselectively respond. Occasionally, a retarded or learning disabled child remains overselective beyond the mental age of approximately 6 yr. The striking difference in responding between these two students and their 14 counterparts is completely missed in an inspection of mean scores.

Figure 3 appears to suggest that EMR children can use three cues at a somewhat lower MA than can LD children. This is one of the least expected and most inexplicable findings of the present study. Additional studies that compare overselectivity in learning disabled and educable mentally retarded children are needed to explain why, as these data suggest, EMR children come under the control of three cues at a lower mental age than do LD children.

Implications for Treatment

Training strategies. Ross' (1976) statement regarding autistic children who overselect seems applicable to LD students who respond to too few cues. "If one could discover techniques to teach these children the skill of attending to all relevant aspects of a stimulus in a learning situation, one would contribute significantly to their education" (p. 54). In this study, the differences between the response patterns of LD and nonhandicapped children are not as extreme as the differences witnessed by other researchers between the responses of autistic and normal children. Yet, if overselectivity is a factor in even mild learning problems, it is important to develop treatment strategies.

There have been two approaches to the

treatment of overselectivity with autistic children. The first, reported by Schreibman (1975), permitted learning to occur on a discrimination task. The training involved the exaggeration of the relevant cue and the removal of other irrelevant cues. Over time the exaggeration was faded out and the irrelevant cues were faded in. By using this procedure, Schreibman's subjects learned but were not required to respond to multiple cues.

Rather than creating a special learning procedure, as was the case in the Schreibman study, attempts to teach the child to respond to multiple cues might also be tried. If successful, approaches from this direction can be considered "normalizing" in that they would permit the student to learn through more traditional instructional methods. Additionally, some types of more complex learning may require the child to respond to multiple cues in order to learn in the most efficient manner or even to learn at all (Koegel & Schreibman, 1977).

The research of Koegel and Schreibman (1977) determined that, indeed, autistic children could be trained to respond to multiple cues. Many more trials were required by the four autistic children than by the normal children to achieve the final discrimination because, in the early trials, the autistic children typically responded at a higher level to one of the two component cues which made up the complex cue. The authors also tested whether an autistic child could learn a set to respond to multiple cues. The girl was first pretrained on a stimulus complex (containing an auditory and a visual cue) and then tested to see whether she would respond on the basis of both cues or if training was required. Initially, training was necessary for the child, but by the third of nine discriminations she had learned to approach the tasks on the basis of both the cues available during pretraining. Although these results involved only one autistic child in a highly controlled experimental situation, optimism over the chances of training LD children to respond to multiple cues, in a briefer period of time, and under less

structured conditions does not appear unreasonable.

Schedules of reinforcement and overselectivity. Schreibman et al. (1977) suggested that changing the schedule of reinforcement during the testing procedure might influence the degree of overselectivity of a subject. Koegel et al. (1979) directly analyzed the effects of changing the schedules of reinforcement during a training phase on the degree of subsequent overselectivity. Their results indicated that overselectivity was greatly reduced when the continuous reinforcement present during the initial training phase was followed by a variable reinforcement schedule (VR 3) overtraining phase rather than by a continuous reinforcement (CRF) overtraining phase.

The findings from these two studies are consistent with Trabasso and Bower's (1968) conclusion that a change from a continuous to a variable reinforcement schedule broadens a subject's responding to multiple cues. The child "interprets" the unreinforced correct trial as an error and increases the number of cues he responds to on subsequent trials. It is possible that, in the current experiment, the change from a CRF to a VR 2 schedule during the training phases accounted for a reduction in overselectivity among the students. Future research might determine whether CRF schedules are responsible for increased levels of overselectivity and/or whether a thinner variable schedule could further reduce overselective responding among LD students.

Special educators are often instructed to use repetition and overlearning to ensure that their students master learning tasks. As Koegel et al. (1979) state, "overtraining will have its greatest effect on reducing overselectivity if it involves a partial reinforcement schedule, and it may have little influence if a CRF schedule is used throughout training" (p. 394).

Other Directions for Research

Because this study represents the first known attempt to look at the phenomenon of overselectivity

tivity in learning disabled children, an attempt at replication should be conducted. If the results of subsequent investigations are in agreement with the current findings, certain subject characteristics need to be examined. The informed consent forms that were given by parents for the children used in this study permitted the author to have only limited access to the psychoeducational files of the students. However, with future studies other researchers may want to examine the relationship, if any, between a specific type of learning disability and stimulus overselectivity. The learning disabled are a very heterogeneous group; overselectivity may be linked to receptive problems but not to expressive deficits. Or, a student with an arithmetic reasoning disability may differ in degree of overselectivity from a student whose disability lies in reading.

The current LD literature and accepted teaching practice makes frequent reference to auditory and visual encoding and decoding problems. Studies that use multiple modalities to test for overselectivity would be informative. Experiments in overselectivity with LD children who respond selectively may demonstrate that these children do have an impaired sense modality or that one modality is "preferred." Theories of similar sensory deficits in autistic children have been disproved, however, largely due to the work of Lovaas and his colleagues (Lovaas & Schreibman, 1971; Lovaas et al., 1971). Multiple modality studies using LD subjects may reveal that, like the findings from the initial study with autistic children, a cue from a different sense modality that had been nonfunctional can be established as functional when trained separately. The optimism of Koegel and Schreibman (1977), Koegel et al. (1979), Lovaas, Koegel, and Schreibman (1979), Schreibman and Koegel (in press), and Schreibman et al. (1977) over the development of an experimentally derived technology of teaching may extend to mildly handicapped children as well as to autistic youngsters.

Finally, this demonstration of stimulus over-

selectivity does not lend support to rigid categorical placement of children in special education classes according to diagnostic labels because the overselectivity phenomenon does not appear to be unique to a particular disability. Differences in overselectivity between mildly retarded and learning disabled students appear to be differences in degree and not in kind.

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