DOCUMENT RESUME

ED 139 129 EC 100 670

AUTHOR Devens, John S.
TITLE Noise as It Affects the Learning Disabled Child.
PUB DATE Oct 76
NOTE 12p.; Paper presented at the Annual Conference of the Texas Association for Children with Learning Disabilities (12th, Houston, Texas, October 27-30, 1976)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Acoustical Environment; *Audiometric Tests; *Auditory Discrimination; Auditory Tests; Elementary Secondary Education; *Learning Disabilities; Linguistic Performance
IDENTIFIERS *Noise

ABSTRACT

Audiological assessments were performed on 20 learning disabled students (6-16 years old). Results of Speech Reception Threshold testing and Discrimination Testing indicated that Ss generally scored lower on discrimination tasks, were more affected by the introduction of noise, and showed a greater variability in discrimination performance than 10 normal students. Results suggest the need for auditory figure-ground testing for learning disabled students. (CL)

NOISE AS IT AFFECTS THE LEARNING DISABLED CHILD

John S. Devens, Ph.D.
Assistant Professor
University of Houston
Victoria Campus

Presented at the Texas Association for Children with Learning Disabilities Convention, October, 1976.

Noise As It Affects the Learning Disabled Child

My purpose here this afternoon is to discuss some clinical and research observations I have made regarding the effect of environmental noise on the learning disabled child.

Human listening is one of the major sensory systems through which academic and incidental learning takes place. The development of language, under normal circumstances, is highly dependent upon an intact auditory system. If hearing sensitivity or ability to process information auditorally is deficient, language disabilities are likely to follow.

Much of the educational process in regular public schools assumes that a child brings knowledge of his language to the academic task. Where a language has been learned inaccurately or only partially, the impact on school performance may lead to both academic and social failure and to a variety of special education programs.

Subtle impairments to the processing of spoken language are often difficult to detect. Perhaps the most obvious manifestation of the effect on language may be a child's failure to learn, failure to read, failure to understand directions or failure to behave properly.

Research produced by speech and language pathologists and audiologists clearly demonstrate that signal-to-noise conditions, as well as reverberation time, have strong influences on auditory comprehension and intelligibility, yet a review of the literature dealing with school architecture--acoustics of school buildings, planning of school buildings, noise and vibration control and with journals familiar to most workers in the field of education yield relatively little information regarding recommendations for the classroom acoustical environment.

Studies by McCroskey and Devens (1974, 1975) demonstrated that the sound pressure level in unoccupied classrooms range from a mean of 40 dBA to a mean of 55 dBA when the classrooms were compared on the basis of the year of construction. In this same study, mean reverberation times were reported as ranging from 0.47 seconds to 1.21 seconds with the newer buildings having the shorter reverberation times.

McCroskey and Devens (1976) report that elementary school teachers maintain a +6 dB signal-to-noise ratio over a rather wide range of classroom listening conditions. Signal-to-noise ratios found by Sanders (1965) ranged from +1 dB in kindergarten rooms to a +5 dB in elementary classrooms.

Before discussing the effect of the acoustical environment on learning disabled children, we should consider research dealing with normal individuals. Crum and Tillman (1973) report on a study in which they utilized a laboratory chamber designed to simulate reverberant conditions commonly found in classrooms. Signal-to-noise and distance from the speaker were varied in this laboratory chamber resulting in a comparison of discrimination ability under varying conditions of reverberation, signal-to-noise and speaker-listener distance. Comparing the optimum discrimination of 100% measured at a low reverberation time in a quiet room at any distance from the speaker to the 57% discrimination score measured in an average classroom with a 1.2 second reverberant time, at a +6dB signal-to-noise ratio and a speaker-listener distance of 12 feet, one can see that the normal classroom's acoustic environment is far from ideal for even the normal child.

McCroskey and Devens (1976) found that elevating the ambient sound level from 40 dBA to 55 dBA resulted in a reduction in performance on two educationally related tasks. Three classrooms of elementary age children were exposed to five days of normal environmental noise (40 dBA) and five days of their normal environmental noise elevated by 15 dB (55 dBA). Each child was evaluated at the close of each school day with a test measuring auditory discrimination, visual motor performance and visual discrimination. Performance on the auditory and on the visual discrimination tasks were found to be poorer on the days during which the noise level was elevated.

Mills (1975) reports that "children require greater signal-to-noise ratios than adults to achieve the same performance level." Marsh (1973) reported that children's performance improved from the age of 5 years to the age of 9 years on a speech reception task in which spondaic words were mixed with noise. McCroskey and Davis (1976) found evidence to support the hypothesis that as the auditory system matures, it is capable of handling acoustic events in a more efficient manner. They measured auditory flicker fusion and found that as the age of the child increased, his ability to recognize shorter off times of a pulsed tone increased.

It has been demonstrated that children with learning disabilities require a longer time to integrate and understand a spoken message than normal children (McCroskey and Thompson, 1973). It has also been demonstrated that children who exhibit reading disorders require more time to comprehend spoken messages than do those who do not exhibit reading disorders (McCroskey and Nelson, 1973). The general literature in the field of special education contains a large number of references to the relatively poor auditory abilities of children exhibiting various learning disabilities (Aten and Davis, 1968; Deutsch, 1970; Zigmond, 1970; Katz and Illmer, 1972; Swartz and Tracy, 1972; Nober and Nober, 1975; Devens, 1975).

Katz and Illmer (1972) point out that approximately 75% of the learning disabled children they see have significant auditory perceptual problems and approximately 60% of the learning disabled children show poor performance on auditory figure-ground tasks. They suggest these problems may be due to binaural incoordination of the auditory system resulting from the child's inability to capitalize on small time differences in the information arriving at each ear.

Attempts to study the binaural function of the auditory system have included dichotic listening, static localization, dynamic localization (auditory tracking), and auditory figure-ground tasks. Berlin (1973) and Faires (1974) using a dichotic listening procedure have shown ear disparity for children and adults. Devens (1975) reports that learning disabled children are less accurate than normal children in tracking a moving auditory signal. Tarnopol (1969) and Ramp (1972) draw attention to the inability of learning disabled children to handle competing auditory signals and Katz and Illmer (1972) report studies which indicate that learning disabled children do not perform in the same manner as normal children in tests of both dichotic listening and signal-in-noise detection.

The importance of measuring a learning disabled child's ability to perform auditory figure-ground tasks is emphasized by Katz and Barge (1971) and by Tarnopol (1969) who lists auditory figure-ground as one of the tests which should be given in a battery for learning disabled children. This is further supported by Clements (1969) who describes a learning disabled child as one who is drawn to irrelevant stimuli in his environment.

Swarts and Tracy (1972) suggest that an assessment of an individual's auditory figure-ground ability is optimumly conducted in a two-room, sound-treated suite wherein stimulus-figure and noise-ground are electronically controlled. They go on to say that this is not feasible outside a clinical setting.

Auditory figure-ground evaluations as described by Swartz and Tracy can be done in facilities which offer complete audiological evaluations. This testing should be completed by a certified audiologist such as is often found in private practice, speech clinics, university speech and hearing programs and in some hospitals.

During the 1975-76 school year, I performed a number of audiological evaluations which included the assessment of the auditory figure-ground function. The data I will now present will be based on evaluations performed on individuals with normal hearing sensitivity in both ears. Ten of the subjects exhibited normal academic functioning while twenty subjects were referred to me with the complaint that they were performing below expectations in one or more academic areas.

The subjects for this report were selected from my clinical case load. At the time the evaluations were performed, I was not planning to use the data in a report such as this and for that reason, I failed to record some information that would be of interest in this report. For this same reason, the subjects were not randomly chosen nor has there been any attempt at matching the two groups to control variables such as age, sex, race or grade level. All subjects seen during the 1975-76 school year who were referred because they were performing below academic expectations and who exhibited normal hearing sensitivity have been included in this report. Projections based on this report must necessarily be limited due to the factors mentioned above.

All testing was performed in a sound isolated room conforming to ANSI specifications. All speech reception threshold tests were done using either the CID W-1 or the Children's Spondee List recorded on cassette audio tape by Auditec of St. Louis. The discrimination testing was done using either the CID W-22 lists or the PBK-50 lists recorded on cassette audio tape by Auditec of St. Louis.

The evaluations were done using a Grason Stadler 1704 audiometer to deliver the signals. Speech noise was used for evaluating the discrimination in the sound field in noise situations (S/N=10dB). The subjects were all seated facing the sound field speaker at a distance of six feet. The signal and noise were mixed and presented from the same speaker for the signal-in-noise test.

Table I presents the raw data from the normal subjects. From this table, it can be seen that none of the normal subjects' discrimination fell below 80% in any situation. It can also be seen that a slight reduction in discrimination does occur when tested in the noise situation.

Table I. Results of Speech Reception Threshold testing (SRT) and Discrimination testing (Disc.) for the right ear (R), for the left ear (L), in the Sound Field (SF), and in the Sound Field with a 10dB signal-to-noise ratio (10dB S/N) for Normal subjects.

Subject	1	2	3	4	5	6	7	8	9	10
Age	10	9	11	13	17	11	10	7	8	9
Sex	F	M	F	M	M	M	M	F	M	M
SRT-R in dB	4	8	4	0	8	8	4	6	6	8
SRT-L in dB	10	6	6	0	6	16	8	4	6	6
SRT-SF in dB	6	6	6	0	6	8	0	4	8	6
Disc-R in %	100	84	100	100	92	96	88	92	92	96
Disc-L in %	96	88	100	92	96	96	92	92	88	92
Disc-SF in %	100	88	100	100	92	96	88	92	96	92
10dB S/N in %	88	80	92	96	92	80	84	88	84	88

Table II presents the raw data from the group of subjects described as having learning problems. It should be noted that six of the subjects in this group did not differ significantly from the normal subjects. Generally, it can be seen that the discrimination scores for this group vary over a much larger range than the normal group with many more low scores and a greater drop in discrimination caused by the introduction of noise. This observation is supported by the data reported in Table III which provides the means and standard deviations for both groups on each evaluation. From this table, one can see that the means and standard deviations are nearly the same for the speech reception thresholds. A noteable difference can be seen when a comparison is made between the groups based on means and standard deviations of the discrimination scores. These scores support the observation that the children with learning problems generally scored lower on tests of discrimination, were effected to a greater extent by the introduction of noise and showed a much greater variability in discrimination performance.

Table II. Results of the Speech Reception Threshold testing (SRT) and Discrimination Testing (Disc.) for the right ear (R), for the left ear (L), in the Sound Field (SF), and in the Sound Field with a 10 dB signal-to-noise ratio (10 dB S/N) for subjects identified as having learning problems.

Subject	1	2	3	4	5	6	7	8	9	10
Age	7	9	11	8	13	13	6	6	10	8
Sex	F	M	F	F	M	M	F	M	M	M
SRT-R in dB	8	8	4	12	4	4	6	10	8	0
SRT-L in dB	12	6	4	12	12	6	8	8	12	8
SRT-SF in dB	10	4	4	10	6	4	6	10	6	0
DISC-R %	96	84	92	88	88	88	84	44	96	84
DISC-L %	96	84	88	92	92	80	92	52	100	84
DISC-SF %	96	84	96	96	92	88	92	48	84	96
10 dB S/N %	92	64	72	72	92	76	84	40	72	80
Subject	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Age	7	6	6	16	8	14	6	7	8	10
Sex	M	M	F	M	M	M	F	F	M	M
SRT-R in dB	10	6	8	4	4	4	4	14	6	12
SRT-L in dB	8	4	8	6	4	6	8	14	8	18
SRT-Sf in dB	10	2	6	6	4	6	6	12	8	10
DISC-R %	88	84	76	92	96	100	88	84	80	84
DISC-L %	84	72	76	88	88	84	84	84	84	76
DISC-SF %	84	88	80	92	96	100	84	88	100	80
10 dB S/N %	68	60	70	56	76	80	72	72	80	70

When considering this data one must be aware that this is a report of clinical findings and is not intended as a research study. Some selection has taken place through the referral source since all children with learning problems were not referred nor was a random sample referred. Probably the referring source suspected an auditory problem prior to making the referral. The normal subjects were not randomly chosen nor were they seen in the clinic through a referral source but were chosen on the basis of convenience and availability.

Although I have mentioned this data should be regarded with caution I feel some of the clinical observations I have made may help the teacher recognize the child with an auditory figure - ground problem. Listed in Table IV are twelve characteristics of children known to have auditory figure - ground problems. These characteristics were identified through clinical observation and through interviews with parents and teachers of the children I have evaluated. They are offered here as warning signs and are not meant to be considered definitive of the auditory figure - ground problem. It is felt that when one or more of these symptoms is observed one should consider the possibility of an auditory figure - ground problem and clinical evaluation may then be appropriate.

Table III. Mean and standard deviation of scores, on the speech reception threshold and discrimination tests.

	NORMAL		LEARNING PROBLEMS	
	MEAN	S.	MEAN	S.
SRT-R	5.6	2.6	6.8	3.5
SRT-L	6.8	4.2	8.3	3.7
SRT-SF	5.0	4.5	6.8	3.1
Disc-R	94.0	5.4	85.8	11.5
Disc-L	93.2	3.8	84.0	10.1
Disc-SF	94.4	4.7	88.2	11.3
10 dB S/N	87.2	5.3	72.7	11.9

In conclusion I have attempted to demonstrate that the acoustic environment of the average classroom is far from desirable with a 40 to 50 dBA sound level, reverberation times that may exceed 1.0 second, and speech-to-noise ratios ranging from +1 dB to +6 dB. Studies have been reported that indicate the normal child does not perform at his maximum when exposed to the acoustic conditions of the average classroom, and the learning disabled child is less capable of handling competing auditory signals than is the normal child. A number of authors have suggested the need for auditory figure-ground testing with the learning disabled child.

Table IV. Characteristics frequently associated with children known to have auditory figure-ground problems.

1. Short attention span.
2. Distractible
3. Behavior problems
4. Inconsistent responses to auditory stimuli
5. Failure to follow directions
6. Reading problems
7. Hyperactive
8. Known to have other perceptual problems
9. Tense when exposed to noise
10. Irritable when exposed to noise
11. Isolates self from noise
12. Complains about noise

Clinical observations suggest that from 60% to 70% of the children with learning referred to audiologists have auditory figure-ground problems. It is suggested that the clinical audiologist may be a valuable resource in the educational management of the learning disabled child by offering clinically controlled conditions for the measurement of auditory figure-ground performance.

REFERENCES

Aten, J. and Davis, J. Disturbances in the perception of auditory sequence in children with minimal cerebral dysfunction. J. of Speech and Hearing Research, 11, 236-245, 1968.

Berlin, C. W. Dichotic right ear advantage in children. Cortex, 9, 394-402, 1973.

Clements, S. D. The psychologist and case finding. In L. Tarnopol (Ed.) Learning Disabilities Introduction to Educational and Medical Management. Springfield: Charles C. Thomas, 1969.

Crum, M. and Tillman, T. Eighth Annual Report of Auditory Research Laboratories. Northwestern University, Evanston, Ill., 1973.

Deutsch, C. P. and Schumer, F. Brain-damaged Children: A Modality Oriented Exploration of Performance, N. Y.: Brunner/Mazel, 1970

Devens, J. S. Dynamic Auditory Tracking Skills Among Normal and Learning Disability Children. Unpublished Doctoral Dissertation, Wichita State University, 1975.

Devens, J. S., Hoyer, E. A. and McCroskey, R. L. Technical note: An apparatus for exploring dynamic auditory localization. The J. of the Am. Audiological Society, Vol. 2, No. 2, 1976.

Faires. W. Dichotic listening ability of the cerebral palsied child. Paper given at the American Speech and Hearing Association Convention, Las Vegas, 1974.

Katz, J. and Barge, C. Auditory perception training for children with learning disabilities. Memorah Medical J., 2, 18-29, 1971.

Katz, J. and Illmer, R. Auditory perception in children with learning disabilities. In J. Katz (Ed.) Handbook of clinical Audiology. Baltimore: Williams and Wilkins Co., 1972.

Marsh, D. J. Auditory figure-ground ability in children. Am. J. Occup. Ther., 27, No. 5, 218-225, 1973.

McCroskey, R. L. and Davis, S. Auditory Fusion in Children. Scientific exhibit at the American Speech and Hearing Association Convention, Houston, 1976.

McCroskey, R. L. and Devens, J. S. Acoustic characteristics of public school classrooms constructed between 1890 and 1960. Paper given at the American Speech and Hearing Association Convention, Las Vegas, 1974.

McCroskey, R. L. and Devens, J. S. Acoustic characteristics of public school classrooms constructed between 1890 and 1960. Proceedings of the Technical Program NOISEXPO'75, 101-103, 1975.

McCroskey, R. L. and Devens, J. S. The effects of noise on the learning process. Unpublished manuscript, 1976.

McCroskey, R. L. and Nelson, N. W. Comprehension of rate-controlled sentences of varying linguistic complexity by children with reading disorders. Paper presented to the American Speech and Hearing Association, Detroit, 1973.

McCroskey, R. L. and Thompson, N. W. Speech expansion and compression: Effects on comprehension by children with learning problems. J. of Learning Disabilities, 6, 621-627, 1973.

Mills, J. H. Noise and children: a review of literature. J. Acoust. Soc. Am., Vol. 58, No. 4, 767-779, 1975.

Nober, L. W. and Nober, E. H. Auditory discrimination of learning disabled children in quiet and classroom noise. J. of Learning Disabilities, Vol. 8, No. 10, 57-60, 1975.

Ramp, D. L. The behavioral characteristics of children exhibiting auditory processing disturbances. Proceedings of the Memphis State University's First Annual Symposium on Auditory Processing and Learning Disabilities, Las Vegas, 97-107, 1972.

Swartz, G. A. and Tracy, N. L. Language - Learning System and Learning Disability. Simon and Schuster, New York, 1972.

Tarnopol, L. Testing children with learning disabilities. In L. Tarnopol (Ed.) Learning Disabilities Introduction to Educational and Medical Management, Springfield: Charles C. Thomas, 1969.

Zigmond, N. K. Auditory processes in children with learning disabilities. In L. Tarnopol (Ed.) Learning Disabilities Introduction to Educational and Medical Management, Springfield: Charles C. Thomas, 1969.