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Young Autistic Children's Listening Preferences in Regard to Speech: A Possible Characterization of the Symptom of Social Withdrawal[1]

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Autism is a childhood disorder diagnosed primarily in the presence of severe social unresponsiveness in the first 3 years of life (Volkmar, 1987). Since speech exerts a prepotent attraction on the attention of normally developing infants, hence facilitating social engagement, we designed a technique to examine whether this inborn reaction could be at fault in young autistic children. They were given a choice between their mothers' speech and the noise of superimposed voices (a sound effect obtained in a busy canteen). Data were obtained utilizing a specially designed automated and computerized device which recorded the children's responses in their own homes. In contrast to comparison groups of mentally retarded and normally developing children who showed the expected strong preference for their mothers' speech, the autistic children actively preferred the alternative sound or showed a lack of preference for either audio segment. These results suggest that such abnormal reactions to speech are a feature of these children's overall disregard to people.

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Clinical descriptions of autism (e.g., Kanner, 1943; Rutter, 1978) have consistently emphasized that severe impairments of social functioning constitute a defining feature of the disorder which is not solely accounted for by any associated mental retardation. Recent reviews (Cohen, Paul, & Volkmar, 1986; Fein, Pennington, Markowitz, Braverman, & Waterhouse, 1986; Volkmar, 1987), diagnostic (Dahl, Cohen, & Provence, 1986; Siegel Vukicevic, Elliot, & Kraemer, 1989), and epidemiological (Wing & Gould, 1979) studies have singled out social deficits as the central characteristic of autism. Although we know that the abnormalities of social relatedness reflect a continuum of severity ranging from aloofness to active, but odd, interaction (Volkmar, Cohen, Bregman, Hooks, & Stevenson, 1989; Wing, 1988), and that there is a developmental trend towards the milder end of the spectrum (Rutter, Greenfeld, & Lockyer, 1967; Volkmar, 1987), we know yet very little about autistic children's reactions to specific aspects of social stimulation.

For normally developing infants, the human voice appears to be one of the earliest and most effective stimuli conducive of social engagement (Alegria & Noirot, 1978; Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Eisenberg, 1979; Mills & Melhuish, 1974). This is evidenced in the effects of speech sounds upon their attention mechanisms: For example, when exposed experimentally to white noise and to speech sounds, neonates tend to change their behavior in order to minimize their experience of the former and to maximize their experience of the latter (Butterfield & Siperstein, 1972). Underlying this behavior is the fact that babies' responsivity to noncontingent nonspeech stimuli is directly related to the similarity of those sounds to speech in parameters such as the frequency spectrum (Eisenberg, 1969; Hutt, Hutt, Lenard, Bernuth, & Muntjewerff, 1968). In other words, infants attend particularly to speech, and they attend to nonspeech auditory events in proportion to how speechlike they are (cf. Butterfield & Cairns, 1976; Eisenberg, 1970).

Many authors have conjectured on the role played by infants' bias towards speech in the development of the affectional bond between parent and child, as well as in the increasing interest shown in communicative situations (e.g., DeCasper & Fifer, 1980; Eisenberg, 1976; Hutt et al., 1968; Sherrod, 1981). Human infants are born in a social environment in which adult as well as child actors talk incessantly to them with scant regard to the babies' current abilities to understand it. The babies' inborn attraction to the sounds of speech stimulates further verbal approaches from others, which, gradually, elicit more differentiated responses from the babies, and so forth, in a reciprocally reinforcing cycle which culminates in the child's socialization into the community's social norms and language. Therefore, such bias towards speech sounds appears to contribute to the engagement

of the child in experiences of social interaction out of which communicative skills and social understanding emerge (cf. Bates, Benigni, Camaioni, Bretherton, & Volterra, 1979).

Clinical (Clancy & McBride, 1969; Kanner, 1943; Prior & Gajzago, 1974; Rutter, 1968), anecdotal (e.g., Rowlands, 1972), and retrospective evidence (Ornitz, Guthrie, & Farley, 1977) suggests that young autistic children are often oblivious to the sounds of speech. This behavior is sometimes the first sign noticed by parents and professionals alike, often leading to a referral for audiological examination (Lowell, 1972). Yet, the suspicion of serious hearing impairment is usually discarded following parental reports as well as clinical observations that these children do attend to interesting auditory stimuli (such as sounds connected to sweets or snacks) or have, in the past, shown reactions of distress to certain sounds (such as the noise of a vacuum cleaner or a food mixer). Such auditory indifference appears, therefore, to be particularly noticeable in regard to the sounds of speech.

We believe, therefore, that in an effort to explore the possibility that different aspects of social stimulation might fail to attract the attention of autistic children, one should give research priority to these children's reactions to speech. In order to explore this issue experimentally, we presented a preferential listening task to a group of young autistic children and compared their results with those obtained for a group of mentally retarded and normally developing children. The task involved the presentation of each child's mother's voice (talking to him or her) and an alternative sound composed of superimposed voices. The children's preferential listening responses were tested in a free-choice, naturalistic setting, in which the children's spontaneous play with a toy provided the data for the study. Our objective was to ascertain any differences in preferential responses to speech displayed by the three experimental groups.

The use of a preferential listening technique is justified on the basis of our knowledge of autistic children's auditory responses. Whilst their hearing thresholds might be normal, their *functional audition,* or the way they utilize auditory stimuli, appears to be abnormal, affecting, therefore, their general adaptive behavior (cf. Koegel & Schreibman, 1976). The functional relevance of an auditory stimulus can be inferred from the attraction exercised by it upon the attentional mechanisms of the child. Attention is primarily a preferential system. Our task is, therefore, to assess the child's preference, or absence thereof, for speech sounds in relation to another competing auditory stimulus. In order to obtain a measure of young autistic children's listening preferences that reflected their spontaneous reactions to speech sounds, the technique had to be appealing to the children so that they would perform the task voluntarily, with no mediation of an ex-

aminer nor time limits. An important limitation of this preferential listening technique lies in the very fact of its relevance to natural listening situations. The free-choice situation makes the resulting data an assessment of what the children *do* spontaneously in their listening rather that what they *can* do. In other words, the technique assesses listening preferences rather than discriminative abilities. Whilst preferential listening may imply an ability to make discriminations between the two auditory segments presented, lack of preferential listening does not imply that the child cannot make the discrimination. It does, however, imply that he or she does not act upon these discriminations in his or her ordinary reactions to the sounds in question, an observation of considerable importance in describing a child's individual adaptive strategies in regard to auditory stimuli.

METHOD

The preferential listening data were obtained through the children's spontaneous play with a two-choice audio feedback device, the "Playtest," which automatically recorded their self-selected listening responses.[3] The device, very much like a toy, contained two possible auditory segments: the mother's voice addressing the child and the sound of superimposed voices. The latter was obtained by recording the sound effect of a great number of voices and environmental noises of a busy canteen (hereinafter designated as "Babel" for brevity). This sound effect was devoid of any of the central characteristics of speech such as intonation, stress, and so forth. Rather, it sounded like a continuous and monotonous bustling noise. The presentation of the two alternative sounds was controlled for parity of sound level.

The child could release the audio segments by pressing their correspondent push buttons. In order to prevent the persistent pressing of one plate according to its physical location without apparent regard to the audio stimulus being played back, the connections of the push buttons with the audio segments were inverted periodically, every 5 min, so that in the case of no preference, the data recorded would have approximately equal value. In order to prevent that a push button was kept pressed continuously for a long period, a maximum 10-sec audio feedback was employed, cutting the playback if response exceeded this limit and forcing the child to release the push button and make another choice.

[3]The system used in this study is a computerized version of Friedlander's (1966) "Playtest."

Table I. Chronological Age (CA) and Nonverbal Mental Age (MA) for the Autistic, Mentally Retarded, and Normal Groups

	Autistic group	Mentally retarded group	Normal group
CA (months)			
M	63.5	66.3	40.9
SD	11.2	7.4	3.7
Range	49-79	56-78	36-48
n	12	8	10
MA (months)[a]			
M	54.0	47.0	45.0
SD	14.9	5.5	4.3
Range	30-78	42-58	38-53
n	10	6	10

[a]Two autistic children and two mentally retarded children did not achieve a basal level of performance on the Leiter International Performance Scale.

Subjects

Thirty children participated in this study, which involved a group of autistic children (n = 12, 10 boys and 2 girls), a comparison group of mentally retarded (n = 8, 6 boys and 2 girls), and normally developing children (n = 10, 7 boys and 3 girls). A summary of group data listing chronological age (CA) and nonverbal mental age (MA) is presented in Table I. MA was assessed through the Leiter International Performance Scale (Leiter, 1980). The a priori rationale for the comparison groups concerned (a) comparability of MA so as to prevent the possibility of attributing findings to the effects of mental retardation, and (b) the creation of a normative profile of results for a particular CA range. All 12 autistic children had been diagnosed by experienced clinicians at the time of contact, or were subsequently diagnosed following referral, using the DSM-III criteria for autism (American Psychiatric Association, 1980). (Sample formation occurred prior to DSM-III-R.) Five of the mentally retarded children had Down syndrome and three suffered from retardation of unidentified origin.

Procedure

The children and their families were visited a minimum of three times during which the experimental procedure and an assessment of the children's nonverbal MA were conducted. The experimental procedure

took place in three consecutive visits: On the first one the mother's voice was recorded; on the second visit the Playtest was introduced to the child, and on the third visit the toy was collected.

During the recording of their voices, the mothers were instructed to "pretend" that their child was present, talking, therefore, in a typical and spontaneous way during a 2-min period. Typical conversation sequences involved familiar situations at home (e.g., dinnertime, bedtime) or usual questions asked when coming to collect the child from a play group or nursery class. This recording was then taken back to the laboratory where silences and hesitations were edited out in order to produce a 1-min, continuous audio segment of the mother's speech. This editing process was necessary in order to prevent gaps of silence in the audio segments which might diminish the important, continuous reinforcement exercised by the contingency between child's response (the press of a push button) and the release of the auditory stimulus. Therefore, even though the present study was designed with the intent of maximizing ecological validity (Bronfenbrenner, 1979), the continuous presentation of speech could not be avoided.

On the second visit, the Playtest was introduced to the child in the presence and, usually, with the help of the mother or both parents. After installing the main equipment, the toy was placed near the child who, typically, would promptly start interacting with it. In the cases in which the child showed hesitation, the investigator and/or the mother would encourage the child by demonstrating how to release the sounds by pressing repeatedly the push buttons and by emphasizing their contingent connection with the audio segments. During this familiarization session and continuing throughout the first day, the pair of auditory segments consisted of a children's song on one track ("The Snowman" sung by the Children's Choir of St. Paul's Cathedral, London) and a synthetic hum on the other track, obtained by recording a 100-Hz sine wave. This familiarization session also served as a control task (see below).

At the end of the first day, if the child showed control over and interest in the toy, the mothers were instructed to change the demonstration cassette, usually at night when the child was asleep, replacing it by the second one, which consisted of the mother's speech on one track and the superimposed voices (Babel) on the other. This cassette was usually kept for a minimum of 1 day, and on a few occasions for as long as 2 or 3 days due to the families' absence from home or other reason preventing the child from interacting with the toy. Finally, on the third visit, the toy was collected.

The Playtest was installed in the area in which the child was most likely to play with other toys, in an attempt to interfere as little as possible with the child's familiar environment. In this sense, the Playtest was just another toy in the child's play environment, available at all times. In order to ensure that the only responses recorded were those of the child taking part in the study, the following built-in mechanism and procedural arrangement were incorporated in the procedure: A recording on/off switch interrupted the recording of data so that the mother could let siblings or friends play with the toy without altering experimental results. In three cases where a younger sibling could have interfered with the results, the toy was installed in the child's own room.

RESULTS

The results were analyzed as pertaining to two different tasks: a control task and an experimental task. In the control task (the familiarization session), the children were choosing between a children's song on one track and a synthetic hum on the other. The purpose of this task was to verify whether the children were capable of showing selective responding to one auditory stimulus vis-à-vis another. In the experimental task, each child was choosing between his or her mother's voice on one track and Babel (see above) on the other.

Control Task

The autistic (n = 12), mentally retarded (n = 8), and normally developing (n = 10) children interacted with the toy for 8,721 sec (M = 727, range = 350–1348), 6877 sec (M = 859, Range = 229–1412), and 9,989 sec (M = 999, range = 482–1516), respectively, during the control task. All children surpassed a 70% level of listening preference for the children's song (i.e., listened to the song for more than 70% of the total time they were listening to either song or hum). The average percentages of listening preference for the song were 75% (range = 72–83), 78% (Range = 71–80), and 85% (range = 78–91) for the autistic, mentally retarded, and normally developing children, respectively. These results showed that all children taking part in this study were capable of responding selectively to a preferred auditory stimulus. Group differences were not significant.

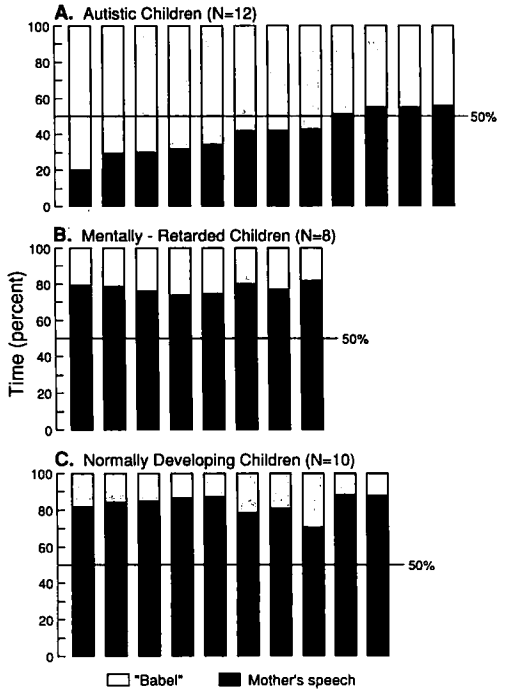

Fig. 1. Percentage of total time spent listening to mother's speech and to Babel.

Experimental Task

The autistic (n = 12), mentally retarded (n = 8), and normally developing (n = 10) children interacted with the Playtest for 5,459 sec (M = 455, range = 115–977), 3,709 sec (M = 464, range = 184–876), and 8,305 sec (M = 830, range = 284–1682), respectively, during the experimental task.

The percentage of the total listening time that each child spent listening to his or her mother's speech and to Babel is presented in Figure 1. Since the two channels were alternating every 5 min, a lack of preference for either sound would result in both percentages approaching the 50% mark. Figure 1 gives a general profile of the listening preferences displayed by the different children. If a 60% cutoff is adopted in order to signify preference for one of the two audio segments (as suggested by Friedlander, 1979), then 5 autistic children favored Babel, whereas the remaining 7 autistic children exhibited a lack of preference for either audio segment (Figure

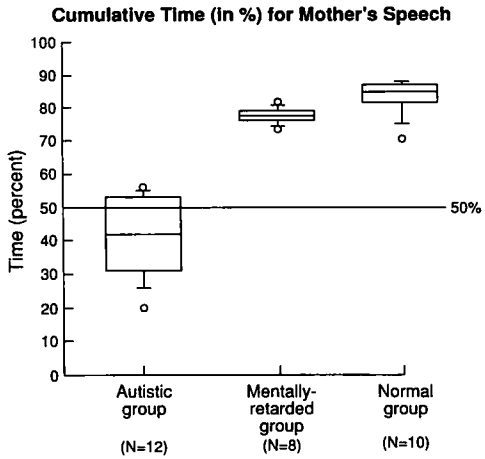

Fig. 2. Box plot display for the listening time (in %) to mother's speech for the 3 experimental groups.

1A). In the mentally retarded and normal groups, all children preferred to listen to their mothers' speech (Figure 1, B and C).

Group results revealed a marked difference between the autistic group on the one side, and the mentally retarded and normal groups on the other side. This difference is clearly delineated in Figure 2. This figure expresses the distribution for the three groups of the percentage of time spent listening to mother's speech. In the box plot (Tukey, 1977), the five horizontal lines show the 10th, 25th, 50th, 75th, and 90th percentile. The values above and below the 10th and the 90th percentile are represented as data points. An interesting aspect of Figure 2 concerns the fact that, once the absolute values (of listening time for mother's speech) were converted into percentages, the results for the mentally retarded and normal groups were surprisingly similar. In other words, although the normal group spent almost twice as much time listening to mother's speech as the mentally retarded group, the degree of listening preference for this audio segment was very similar for both groups. In contrast, the results for the autistic group differed markedly from both.

The means and standard deviations of listening time to mother's speech were 41.0 ± 11.84%, 77.5 ± 2.44%, and 83.1 ± 5.21% for the autistic, mentally retarded, and normal groups, respectively. A Kruskal-Wallis test revealed a statistically significant difference between the three groups ($H = 23.38, p < .001$). A multiple-comparison test with control for Type I error (Siegel & Castellan, 1988, pp. 213-214) showed a statistically significant difference between the autistic group and the mentally retarded group, and

between the autistic group and the normal group ($p < .05$). The difference between the mentally retarded group and the normal group was not statistically significant ($p < .05$).

DISCUSSION

The results in the experimental task revealed that five autistic children preferred to listen to the Babel noise, whereas the remaining seven showed no listening preference for either Babel or speech sounds. In contrast, the whole sample of mentally retarded and normally developing children displayed a strong listening preference for their mothers' speech. There was no overlap of individual results between the autistic children on the one hand, and the mentally retarded and normally developing children on the other hand. Group results revealed a marked difference between the autistic group on the one side and the mentally retarded and normally developing children on the other side.

The autistic children's results cannot be attributed to the effects of mental retardation since the whole sample of mentally retarded children preferred to listen to their mothers' speech. Conversely, a high (nonverbal) IQ on the part of some autistic children did not guarantee a preferential choice for their mothers' speech. For example, two autistic children had, at the time of the experiment, IQs (nonverbal) of 152 and 107. Also, the results obtained in the control task minimized the probability that the lack of preference exhibited by seven autistic children could be attributed to learning difficulty specific to them. These seven children, as well as all of the others taking part in this study, learned the control task and expressed a preferential choice, thus showing evidence of an ability to respond selectively to an audio stimulus.

This study involved a small number of children. The findings obtained require the corroborative evidence that only a larger sample could produce, however clear the results of the present study appear to be. More important, however, are two methodological questions that must be carefully addressed in order to assess the validity of the present study.

First, there is the possibility that the present findings were related to the specific auditory properties of the stimuli. The Babel noise might have been somewhat aversive to the normally developing and mentally retarded children, and, therefore, the preference for their mothers' speech might not have been so much preference as an avoidance of that sound. If, for whatever reason, autistic children did not find this sound distasteful, then they might be less likely to show a preference, not so much due to lack of interest in their mothers' speech but to being able to tolerate this sound.

This suggestion might be raised in reference to those autistic children who showed a lack of auditory preference for either stimuli, even though it seems unlikely that these children should exhibit more tolerance to this sound than the comparison groups. On the contrary, in our contacts with the families of autistic children, the comment that some of them would sometimes cover their ears when in the same room with adults talking was often made. Moreover, for this suggestion to be raised in reference to those autistic children who actively preferred the sound of Babel, one would have to assume that they were somehow attracted to it because of its intrinsic nature, a somewhat unlikely possibility. Nonetheless, a future replication of this study might resolve this issue by utilizing alternative auditory stimuli coupled with the sounds of speech.

Second, due to the fact that a standardized assessment of the children's receptive language abilities could not be conducted, there is a possibility that the autistic children's preferences for the Babel sound or lack of preference for either Babel or mother's voice simply reflected their inability to understand speech. Even though future research will have to correlate the results obtained through the present procedure with standardized assessments of receptive language, there are reasons not to overemphasize this reservation in the present context: (a) The documented attraction to the human voice concerns the *sounds* of speech and not its semantic value; (b) there was no reason to assume that the receptive language skills of this particular group of mentally retarded children (average MA = 47 months) exceeded those of the autistic group (average MA = 54 months). Although in the autistic sample, 7 of the 12 did not have any speech, the same was true for 4 of the 8 mentally retarded children, and the receptive skills of the other 4, with one exception, did not appear to be superior to those of the remaining 5 autistic children; and (c) a child who was referred to us as presenting autistic features was subsequently diagnosed as suffering from developmental receptive language disorder. Nevertheless, he completed the experimental procedure. His results were similar to those obtained for the mentally retarded children and in sharp contrast to those of the autistic group. A description of this occurrence as well as a more detailed account of individual results can be found elsewhere (Klin, 1988).

If, however, the present findings are substantiated, the issue of whether the lack of attraction to speech sounds is a *feature* of, or a *contributory factor* to, autistic children's overall social unresponsiveness, will have to be examined. This can be done by a systematic study of these children's reactions to different aspects of social stimulation. For example, the present system accommodates the replacement of the loudspeakers with video screens. The employment of visual stimuli could provide us with in-

sights as to these children's visual preferences in regard to, for example, human faces. If a general lack of interest in people pervades their reactions to all social stimuli, one should obtain results similar to the ones in the present study in a different modality (e.g., facial gestures) and within the auditory modality (e.g., speech sounds and songs/melodic nursery rhymes).

At present, there is some indication as to the singularity of speech. Within the auditory modality, we found that all of the autistic children showed a strong listening preference for the children's song vis-à-vis the nonhuman synthetic hum (in the control task of this study). This is an interesting finding which appears to give some credence to a comment made by several mothers participating in this study, according to which, they were often more successful in engaging their children (i.e., in attracting their attention and in making eye contact) when they *sang* rather than when they *talked* to them, particularly during infancy and early childhood. If substantiated experimentally, this finding would not support the notion that autistic children simply shut off all social auditory stimulation. Rather, it would suggest that neurological research involving the processing of speech and musical sounds might be an interesting avenue to explore and further characterize the autistic child's early aloofness. In the visual modality, an early experiment by O'Connor and Hermelin (1967) showed that autistic children were not different from mentally retarded and normal controls in that, when exposed to a human face and a geometric form, they preferred to look at the former rather than the latter. They *did* look less at the face than the other children, but that was because they looked less at everything else, suggesting an abnormality of fixation or attention rather than an abnormality of preference patterns. This finding contrasts with our results: The autistic group listened to sounds as much as the mentally retarded group but their preferential listening pattern was markedly different.

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