A Study of Auditory Preferences in Nonhandicapped Infants and Infants with Down's Syndrome

Sheila M. Glenn, Cliff C. Cunningham, and Paul F. Joyce

While it is generally assumed that comprehension precedes the production of speech, few studies have considered the development of early receptive language abilities in either nonhandicapped or handicapped infants in the first year of life. Delay in expressive language is a significant characteristic of mental handicap, yet it is not known how this might relate to receptive language delays in such children. A major difficulty has been the availability of a suitable methodology for handicapped infants. Thus the present research aimed at developing a methodology to study the question of how nonhandicapped and handicapped infants monitor their linguistic environment.

Comprehension of speech presumes the ability to receive and discriminate speech sounds, and many studies have now demonstrated that normal infants, younger than 6 months, can discriminate a wide variety of simple speech stimuli (Eimas & Tartter 1979). However, it is necessary to investigate how they use these abilities in their natural environment. The study of perceptual preferences offers a potentially useful technique. If it can be demonstrated that an infant has a preference for one stimulus over another, it is possible to conclude not only that the infant can discriminate the two stimuli but also that she or he cares to do so.

Sachs (1977) has advanced a related argument. Reviewing current work on the characteristics of adult speech to young babies, she argued that one function of "baby talk" is to gain and hold the infant's attention, that is, that there are aspects of speech which are particularly salient for young infants. Consequently, if the tendency to find certain sounds particularly salient is damaged, it may contribute to later language delay (Butterfield & Cairns 1976).

Studies of speech discrimination in infants have typically employed the habituation/dis-habituation paradigm or operant learning procedures and have used only relatively simple, brief stimuli. There have been very few studies of infants' abilities to process more complex speech stimuli, although disturbances in such centrally mediated abilities, rather than receptive or sensory impairments, may underlie many cases of language delay (Cairns & Butterfield 1975). This scarcity of work may be related to the difficulty of establishing effective procedures.

The Playtest apparatus was developed by Friedlander (1968). With this, infants could choose to operate one of two manipulanda, each of which provided different auditory feedback, the infant's pattern of responding thus

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provided information about selective listening preferences. This apparatus has three unique advantages. First, auditory stimuli of any length and complexity can be used, second, the device is used in the home, and third, the device is a toy, which the child plays with completely voluntarily. The present study modified the Playtest to make it simpler for young nonmobile babies to operate (see Glenn, Cunningham, & Joyce, Note 1).

A basic question is whether infants respond preferentially to speech rather than to other auditory stimuli. Speech and nonspeech stimuli were matched for complexity by using the same nursery rhymes on both channels. On one channel the rhymes were sung by an unaccompanied female voice, and on the other they were played by a selection of three solo instruments. The voice was matched to each instrument for pitch, rhythm, and sound level. This does not completely equate complexity, but if infants do show preferential responding to the voice stimulus under these circumstances, one might conclude that this is a result of the voice versus instrumental variable.

The study aimed to investigate if (1) the procedures were within the capabilities of nonhandicapped and mentally handicapped infants, (2) such infants could demonstrate selective listening, (3) selective listening to speech could be demonstrated, and (4) there were systematic differences in response patterns between nonhandicapped and mentally handicapped infants.

The three criteria for inclusion in the study were that the baby (i) could reach smoothly and consistently, (ii) could sit in a stable position for relatively long periods, and (iii) had no severe hearing disorder. There were six male and five female infants with chromosomally confirmed Down's syndrome (all standard trisomy 21). The mean CA at the start of the project was 12.7 months, SD 2.0 months. The mean MA (Bayley Scales of Infant Development) was 9.2 months, SD 1.4 months. Six male and five female infants were matched individually to each infant with Down's syndrome for MA and sex. The average difference between the MAs of the two groups was 0.4 months and was never more than 1 month. The mean CA of the nonhandicapped group was 9.3 months, SD 1.1 months. The mean MA was 9.6 months, SD 1.9 months. The two groups were matched for number of siblings and social class based on father's occupation.

All the infants with Down's syndrome had an audiological assessment and had minimal losses (responding on a distraction test at raised levels of 30-40 dBA [decibels A weighting]). To control for fluctuation in hearing, the sound levels were set individually by setting the sound level at 65 dBA and increasing it until the infant oriented consistently. Routine hearing checks revealed no loss in the nonhandicapped infants. Ambient noise and stimulus loudness levels were measured using a Castle Associates (United Kingdom) CS17A meter. Ambient noise levels ranged from 28 dBA to 45 dBA for the Down's syndrome group and from 28 dBA to 38 dBA for the nonhandicapped group. Stimulus sound levels ranged from 70 dBA to 82 dBA for the Down's syndrome group and from 70 dBA to 80 dBA for the nonhandicapped group.

The apparatus consisted of two red boxes (22.8 X 20.25 X 15.2 cm), each with a yellow manipulandum (a touch-sensitive switch diameter 2.55 cm) projecting to a depth of 1.9 cm and a loudspeaker (diameter 6.35 cm) situated directly above the manipulandum. A control box, situated at a distance from the infant, recorded both the frequency and duration (in seconds) of responses. Auditory feed back was triggered whenever the appropriate manipulandum was touched and ceased when the hand was removed from the manipulandum. Activation of one manipulandum automatically excluded the other. For the first phase of the experiment, "Somebody Come and Play" from "Sesame Street" versus a repetitive piano tone (middle C, frequency 900 mm) were used. In the second phase the nursery rhymes were either played by a flute, guitar, or trumpet or sung by an unaccompanied female voice, matched to the instruments for pitch, rhythm, and sound level.

Testing was carried out entirely in the infant's home. At the first session the manipulanda were placed on the floor and the baby was seated midway between them. The experimenter demonstrated the use of the device to the baby, and in all cases this instantaneous reaching for the yellow buttons. When the baby reached to both manipulanda simultaneously, the manipulanda were moved out of reach alternately until the child learned to reach for one at a time. This training was complete by the end of the first session. Mothers were trained to use the procedure and reported that it was rarely necessary. The positions of the manipulanda were alternated daily to control for position habit.

Mother was
asked to let the child play with the toy at least once a day. She was asked to leave the child to play alone and not to influence his or her choice. A session was terminated when the child stopped responding—often accompanied by fretfulness. The minimum listening time for a session to be recorded was 60 sec, but no upper limit was set. The mother wrote down the figures recorded by the event and time recorders at the end of each session on a standard scoring sheet. The experimenter checked the mother's recording technique at the first session and thereafter twice each week. On average, it took 7 days to test each pair of stimuli.

One nonhandicapped infant (CA 9 months, MA 9 3 months) failed to maintain responding for more than 20 sec for any of the seven sessions and was excluded. Apparatus failure excluded results for phase 2 for one infant with Down's syndrome. Using the Wilcoxon matched-pairs signed rank test, we compared responses to the two channels over sessions for each individual. In phase 1 all 11 children with Down's syndrome and 10 out of 11 nonhandicapped infants had a significant preference for the children's rhyme with the measure of response duration. Ten infants with Down's syndrome and seven nonhandicapped infants had a significant preference for the children's rhyme with the measure of response frequency. A further measure was taken of average duration of response (ADR), that is, duration divided by frequency over all sessions. All 11 children with Down's syndrome and 10 nonhandicapped infants had a higher ADR for the children's rhyme than for the repetitive tone. In phase 2, eight out of 10 infants with Down's syndrome and six out of 10 nonhandicapped infants had a significant preference for the sung nursery rhymes with the measure of response duration, two nonhandicapped infants had a nonsignificant preference for the sung nursery rhymes. Two nonhandicapped infants and two infants with Down's syndrome had a nonsignificant preference for the instrumental nursery rhymes. Two infants with Down's syndrome and two nonhandicapped infants had a significant preference for sung nursery rhymes with the measure of response frequency.

One nonhandicapped infant had a significant preference for the instrumental nursery rhymes. Nine infants with Down's syndrome and six nonhandicapped infants had a higher ADR to the sung nursery rhymes than to the instrumental nursery rhymes. Mean results are shown in Table 1.

Two-way repeated-measures analyses of variance were used to compare mean results of response duration, response frequency, and ADR. For phase 1 there were significantly larger response durations, $F(1,19) = 43.1, p < .001$, significantly higher response frequencies, $F(1,19) = 28.2, p < .001$, and significantly longer ADRs, $F(1,19) = 48.8, p < .001$, for the children's rhyme than for the tone. Infants with Down's syndrome had significantly

### Table 1

**Mean Results per Session for Phase 1 and Phase 2 on the Measures of Response Duration, Response Frequency, and ADR**

<table>
<thead>
<tr>
<th></th>
<th>Response Duration (Sec)</th>
<th>Response Frequency</th>
<th>ADR (Sec)</th>
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<tbody>
<tr>
<td><strong>Phase 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DS</td>
<td>CR</td>
<td>Tone</td>
<td>CR</td>
</tr>
<tr>
<td></td>
<td>387 6</td>
<td>87 6</td>
<td>53 9</td>
</tr>
<tr>
<td>NH</td>
<td>143 1</td>
<td>74 1</td>
<td>33 9</td>
</tr>
<tr>
<td><strong>Phase 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DS</td>
<td>SNR</td>
<td>INR</td>
<td>SNR</td>
</tr>
<tr>
<td></td>
<td>268 9</td>
<td>139 7</td>
<td>27 3</td>
</tr>
<tr>
<td>NH</td>
<td>120 1</td>
<td>85 5</td>
<td>25 6</td>
</tr>
</tbody>
</table>

*Note.—Phase 1 = children's rhyme (CR) vs tone, phase 2 = sung nursery rhyme (SNR) vs instrumental nursery rhymes (INR), DS = Down's syndrome, NH = nonhandicapped*
longer response durations, $F(1,19) = 11.3, p < 0.01$, and ADRs, $F(1,19) = 6.3, p < 0.025$, than the nonhandicapped group, but the groups did not differ significantly in response frequency. Significant interactions were found for response duration, $F(1,19) = 15.9, p < 0.001$, response frequency, $F(1,19) = 7.3, p < 0.025$, and ADR, $F(1,19) = 8.5, p < 0.01$. Inspection of the results indicates that on all measures there is little difference between the two groups for the repetitive tone stimulus, whereas the difference is most apparent for the children's rhyme.

For phase 2, there were significantly longer response durations, $F(1,18) = 11.0, p < 0.01$, significantly higher response frequencies, $F(1,18) = 5.4, p < 0.025$, and significantly longer ADRs, $F(1,18) = 14.8, p < 0.01$, for the sung nursery rhymes than for the instrumental nursery rhymes. Infants with Down's syndrome had significantly longer response durations, $F(1,18) = 4.6, p < 0.05$, and ADRs, $F(1,18) = 7.3, p < 0.025$, than the nonhandicapped group, but the groups did not differ significantly in response frequency. There were no significant interactions.

With reference to the four main aims of the experiment, it can be stated, first, that mentally handicapped babies and nonhandicapped babies are able to operate this equipment satisfactorily. Second, all the infants, with the exception of one nonhandicapped infant who did not respond to the equipment, demonstrated a selective preference to different auditory stimuli. This is particularly interesting as Friedlander and Wisdom (Note 2) found that only 12 out of 16 of a group of normal and superior infants (CA 13.2 months, range 9–18 months) demonstrated significant preferences for nursery rhymes over electronic noise. Unfortunately, their report does not provide separate data for the four infants who did not show a preference, so it is unclear whether this is because they did not learn how to use the equipment or because they could use the equipment but showed no preference. As our apparatus modifications have produced a device which is easier for babies to use, this may be the reason for the apparently superior performance of developmentally younger infants. The success of these first two aims suggests that this apparatus provides a useful method for assessing and investigating the perception of auditory stimuli of varying length and complexity in prelinguistic infants. Third, the majority of nonhandicapped infants and infants with Down's syndrome prefer to listen to the human voice rather than to musical instruments. This would seem to be an important prerequisite for the development of receptive language and would suggest that at this stage there is no support for the notion that a lack of saliency for speech stimuli per se is a major factor in the language problems of children with Down's syndrome.

Fourth, the most striking result is the significant interaction demonstrated between subjects and type of stimulus for all measures of variable 1. For the repetitive tone there is little difference between the responses of infants with Down's syndrome and those of nonhandicapped infants. For the children's rhymes, infants with Down's syndrome respond slightly more often and for a much longer duration than do nonhandicapped infants. For variable 2, on the other hand, there is no significant interaction between subjects and type of stimulus for any measure. Infants with Down's syndrome have a longer duration of response for both channels than do the nonhandicapped children, although there is no difference between the nonhandicapped and handicapped subjects' frequency of responding. These results suggest that it is not differences in motor ability that are distinguishing the two groups of subjects, since there are minimal differences between the two groups in response to the tone stimulus and no differences in frequency of response to variable 2. Rather, it is in the processing of more complex auditory input where a difference is apparent between nonhandicapped infants and infants with Down's syndrome, that is, there is an interaction between mental handicap and stimulus complexity. A study which specified more closely the stimulus variables, especially those relating to complexity, is necessary to elucidate the relationship.

Reference Notes

1. Glenn, S M, Cunningham, C C, & Joyce, P F. An automated system for the study of auditory perception in infants (Infant Project Paper 10) Manchester Hester Adnan Research Centre, Manchester University, 1979

References


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