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First Language 1988; 8; 271
DOI: 10.1177/014272378800802405

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Children's understanding of referential messages produced by deaf and hearing speakers*

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ABSTRACT

Children 4 to 10 years of age were presented with referential messages that varied in message adequacy and speech quality and were required to choose the intended referent from a set of four alternatives. Following feedback regarding their choice, they evaluated the message as good or bad and provided reasons for their evaluation. Half of the messages had sufficient information to define the referent uniquely; half had insufficient or ambiguous information. Moreover, half of the messages were produced by hearing children and half by deaf children. Children's comprehension and evaluation of messages changed systematically with age, as did the basis for these evaluations. The 4- and 5-year-olds performed poorly on the picture selection task but evaluated most messages as good; 6-year-olds rated messages as good if they had chosen the correct referent, even by guessing. From 8 years of age, children judged the adequacy of messages independent of outcome and linked their justifications to relevant details of the messages. Messages that were fully intelligible to adults but had atypical speech quality resulted in poorer performance and evaluations than did messages with normal speech quality for children of all ages.

Effective verbal communication is a complex social-cognitive enterprise, depending not only on the competence of the speaker but also on that of the listener, who must discern the speaker's intentions (Deutsch & Pechmann 1982, McDevitt, Hess, Kashiwagi, Dickson, Miyake & Azuma 1987). Moreover, the speaker must be knowledgeable about and sensitive to the

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0142-7237/88/0803-0271 $2.00 © Alpha Academic.
information requirements of the listener, adjusting the message accordingly
(Whitehurst & Sonnenschein 1985). Indeed, experience in specific listener
roles heightens this sensitivity, leading to enhanced performance as speaker

Despite the importance of listener skills for effective communication,
young listeners are notably deficient in this regard. Central to this deficiency
is their inability to assess the communicative adequacy of messages (Asher
1976, Bearison & Levey 1977, Flavell, Speer, Green & August 1981,
Markman 1977, 1979, Patterson & Kister 1981, Robinson & Robinson 1976,
example, kindergartners and first graders express confidence about their
understanding of inadequate instructions (Flavell et al. 1981, Markman
1977). Even third-grade children have difficulty detecting explicit contradic-
tions in essays, professing comprehension of the material presented
(Markman 1977). Flavell (1977) has suggested that young children fail to
reflect on messages as cognitive objects and, therefore, have difficulty with
message analysis and evaluation. As a result, they are likely to judge
ambiguous messages on irrelevant criteria such as the listener’s fortuitous
identification of the intended referent (Robinson & Robinson 1977a, c) or
the speaker’s age (Ackerman 1983b, Sonnenschein 1986). Most of the
research on children’s message evaluation has manipulated the content of
messages as opposed to their form. Thus it is unclear how children might be
affected by messages with deviant speech quality or articulation, such as
those produced by children with severe or profound hearing losses. This is
an important consideration for researchers concerned with the mutual
implications of language and social-cognitive processes.

The speech of deaf children is typically characterized by distortions and
substitutions of consonant and vowel sounds (Hudgins & Numbers 1942,
Markides 1983), errors or rhythm and timing (John & Howarth 1965),
excessive breathiness (Hudgins 1946, Ling & Milne 1979), and atypical
pitch and intonation (Parkhurst & Levitt 1978, Weiss, Carney & Leonard
1985). These factors often result in reduced intelligibility, particularly if
contextual information is limited (McGarr 1983, Monsen 1983) or the
listener is unfamiliar with deaf speech (Boothroyd 1985, McGarr 1983,
Monsen 1983). However, even atypical speech that is fully intelligible for
inexperienced adult listeners may pose decoding difficulties for children.
For example, young listeners with limited inferential skills (Markman 1981,
Paris, Landauer & Cox 1977) may fail to recover the speaker’s intended
meaning from misarticulated utterances. Moreover, unusual speech quality
might interfere with children’s attention to message content. Even if such
speech were intelligible to child listeners, they might nevertheless infer
reduced overall competence on the part of speakers and evaluate such
messages negatively. In any case, it is important to establish the extent to which speech that is deviant but intelligible for adults has adverse effects on children's processing of messages.

In the present investigation, we explored children's developing comprehension and assessment of referential messages with deviant speech quality. In an era that favours mainstreaming in the education of exceptional children, it is of considerable practical significance to monitor the efficacy of deaf children's communication and its impact on hearing peers.

We presented children 4 to 10 years of age with spoken referential messages from hearing children and from orally-educated deaf children. These messages varied in the adequacy of their content and in overall speech quality. Half of the messages were adequate, in the sense that they defined the referent uniquely and half were ambiguous, referring to two or more of four potential referents. In addition, half of the messages had normal speech quality and half had deviant speech quality that did not compromise its intelligibility for adult listeners. On the basis of previous research (Ironsmith & Whitehurst 1978, Whitehurst & Sonnenschein 1985), we expected that adequate messages from deaf and hearing speakers would yield more correct identification of the referent than would ambiguous messages by 6-, 8-, and 10-year-old listeners but perhaps not by 4- and 5-year-olds. The younger children (4-, 5-, and possibly 6-year-olds) were expected to have more difficulty with messages from deaf children than from hearing children, presumably because of additional information-processing demands associated with the decoding of atypical speech.

We also requested confidence ratings associated with the choice of referent, expecting older children to be more confident in the case of adequate messages and less so for ambiguous messages. If younger children fail to monitor their own comprehension (Markman 1981), no difference should be evident in their confidence ratings for adequate and ambiguous messages. Following feedback regarding their choice of referent (correct or incorrect), we asked children to evaluate the quality of the preceding message. Older children were expected to have differentiated evaluations of adequate and inadequate messages, in contrast to younger children, who were expected to provide uniformly positive evaluations, except as noted below. Following Robinson and Robinson's (1977a,c) findings, younger children's evaluations were expected to be linked to their success or failure in selecting the intended referent as opposed to message quality per se. In view of Sonnenschein's (1986) finding that young children value the inferred competence of the speaker more than the objective features of the message, we anticipated that younger children would evaluate the messages of deaf speakers more negatively than those of hearing speakers.

Finally, we solicited justifications for particular ratings of messages.
Criteria underlying such judgments would shed light on children's understanding of the communication process in general and the role of speaker and listener in particular.

METHOD

Subjects
There were 15 children at each of 4 years (3;11-4;2; mean = 4;0), 5 years (4;11-5;3; mean = 5;0), 6 years (6;0-6;5; mean = 6;2), 8 years (8;0-8;4; mean = 8;2), and 10 years (9;11-10;6; mean =10;1), with approximately equal numbers of boys and girls at each age level. All children were from middle-class families and had normal hearing. Each child received a small prize at the end of the testing session.

Apparatus
Audio-visual recordings were edited from videotapes of referential messages provided by deaf and hearing children in an earlier investigation (MacKay-Soroka 1985, MacKay-Soroka, Trehub & Thorpe 1987). Each of two sets of messages consisted of eight trials, which varied along two dimensions – messages content (adequate, inadequate) and speech quality (normal, deviant). Of the eight trials, four had adequate messages that permitted selection of the intended referent by a competent receiver; four had messages with ambiguous content, in that they referred to more than one potential referent. Messages were similar in length, complexity and degree of redundancy. As well, four of the eight messages had normal speech quality (i.e., hearing children as speakers); four had deviant but intelligible speech quality (i.e., spoken by orally-educated deaf children with a hearing loss of 90 dB or greater). Thus, each message set consisted of eight trials with four different types of messages: 1) two hearing/good (HG), with normal speech and adequate content; 2) two hearing/poor (HP), with normal speech and ambiguous content; 3) two deaf/good (DG), with deviant speech and adequate content; and 4) two deaf/poor (DP), with deviant speech and ambiguous content. The two message sets were simply two versions of the same task that included different children and a different random ordering of message types to control for order effects.

There were eight picture sets for the eight trials, each set consisting of four separate pictures, which were brightly coloured hand-drawn scenes. Each of the pictures in a set was similar to the others in the same set, but different along one or more dimensions. Miniature line drawings of sample sets are illustrated in Figure 1. For the two versions of the recording, different message types (e.g., adequate or inadequate) corresponded to
Fig. 1. Miniature line drawings of sample stimulus sets.

different picture sets or trials. A 48-cm Panasonic television monitor was used to display the video recordings to participants.

Procedure
The child was seated facing the television monitor. The experimenter introduced the study as a game, describing the rules simply. A second experimenter provided a written account of the child's responses during the test session and simultaneously recorded the session on audiotape for later transcription. Children were assigned randomly to one of the two videotapes, with the constraint that approximately the same number of children at each age level received each tape.
The experimental session consisted of a training period followed by the eight trials of the reception task. The child was instructed to watch and listen very carefully to the video message and to choose the intended referent from the array of four pictures provided on each trial. After choosing a picture, the child was asked to give a confidence rating for the choice (sure, not so sure, guessing) and to tell why that picture had been selected. The child was then informed as to whether the choice was correct or incorrect, and in the case of incorrect choices, the child was shown the intended referent. Message evaluations were elicited from all children, regardless of whether they had selected the correct picture. While holding up the intended referent, the experimenter asked, ‘Do you think he (or she) did a good job of describing this picture or was it not-so-good?’ After receiving a reply, the experimenter asked, ‘Why do you think it was good/not-so-good?’ Seven adults were tested with the same procedure to verify the intelligibility of messages from the deaf children.

Fig. 2. Message comprehension: percentage of pictures chosen correctly at each age level.
RESULTS

Message Reception

All adults chose the correct pictures for all DG messages, providing confirmation that these messages were both intelligible and adequate. Figure 2 displays the percentage of pictures that children chose correctly for each message type and age level.

The categorical nature of the data violates the assumption of normality required for an analysis of variance, but this assumption is robust, particularly when there is homogeneity of variance. On the basis of equal cell sizes, homogeneity of variance was assumed and later confirmed by Hartley’s test statistic. For these reasons, a two-way analysis of variance, message type by age level, was conducted, with message type as a repeated measure. This analysis yielded a significant main effect of message type, $F(3,210) = 35.44, P<0.001$, qualified by a significant message type by age level interaction, $F(12,210) = 2.64, P<0.01$. Tukey comparisons indicated that the number of correct picture selections varied significantly across age levels for the HG

![Graph](http://fla.sagepub.com)

Fig. 3. Confidence ratings: percentage of choices rated as *sure* at each age level.
messages only. Specifically, 8- and 10-year-olds made significantly more correct picture selections for HG messages than did 4- and 5-year-olds (0.05 level). Also, 4-year-olds differed significantly from 6-year-olds.

Contrast analyses applied to message type revealed that the number of correct picture selections for HG messages differed significantly from HP, DG and DP messages, $F(1,70) = 54.45, P<0.001$; $F(1,70) = 19.98, P<0.001$; and $F(1,70) = 103.68, P<0.001$; respectively. The number of correct picture selections for DG messages also differed significantly from HP and DP messages, $F(1,70) = 13.6, P<0.001$; and $F(1,70) = 24.90, P<0.001$; respectively.

Confidence Ratings
Adults rated 12 of the 14 DG messages and the same number of HG messages as sure. Figure 3 shows the percentage of messages that children rated sure for each message type and age level.

Equal cell sizes and Hartley’s test statistic confirmed the assumption of homogeneity of variance; thus a two-way repeated measures ANOVA was used to determine the relations among confidence ratings (i.e., number of choices rated sure), type of message and age level. This analysis yielded a significant main effect of message type, $F(3,210) = 35.94, P<0.001$, and a significant interaction of message type and age level, $F(12,210) = 4.68, P<0.001$. Tukey comparisons indicated that the number of messages rated sure varied significantly across age levels for the HG and DP messages. For the HG messages, 6-, 8-, and 10-year-olds gave significantly more sure ratings than did 4-year-olds. For DP messages, 10-year-olds gave significantly fewer sure ratings than 4- and 5-year-olds.

Contrast analyses applied to message type revealed that the number of messages rated sure for HG messages differed significantly from HG, DG and DP messages, $F(1,70) = 27.24, P<0.001$; $F(1,70) = 39.25, P<0.001$; and $F(1,70) = 122.52, P<0.001$; respectively. The number of DP messages rated sure also differed significantly from the number of HP messages, $F(1,70) = 21.14, P<0.001$, and from DG messages, $F(1,70) = 17.61, P<0.001$.

Message Evaluations
Almost all of the adequate messages were rated good by adults, regardless of speech quality. In only one instance did an adult rate an HG message as bad; the remaining adults rated the same message as good. There were two such instances for DG messages. These occurred for different messages, and for each, all other adults rated the same message as good. Figure 4 shows the percentage of messages that children rated good for each message type and age level.
Equal cell sizes and Hartley's test statistic confirmed the homogeneity of variance assumption; thus a two-way repeated measures ANOVA was conducted to specify the relations among message evaluation (i.e., number of messages evaluated as good), message type and age level. This analysis yielded a significant main effect of message type, $F(3,210) = 26.40, P<0.001$, and a significant main effect of age level, $F(4,70) = 6.84, P<0.001$, both qualified by a significant message type by age level interaction, $F(12,210) = 4.31, P<0.001$. Tukey comparisons indicated that the number of messages evaluated as good varied significantly across age levels for HP and DP messages. For HP messages, 8- and 10-year-olds gave significantly fewer good evaluations than did 4- and 5-year-olds. The 4-year-olds also differed significantly from the 6-year-olds. For DP messages, 8- and 10-year-olds gave significantly fewer good evaluations than 4-, 5- or 6-year-olds.

Contrast analyses applied to message type revealed that the number of HG messages evaluated as good differed significantly from the number of HP, DG and DP messages, $F(1,70) = 43.51, P<0.001$; $F(1,70) = 17.07, P<0.001$; and $F(1,70) = 77.56, P<0.001$; respectively. The number of DG
messages evaluated as *good* also differed significantly from the number of HP messages so rated, $F(1,70) = 10.78, P<0.002$, and DP messages, $F(1,70) = 15.04, P<0.001$.

**Explanations**

Responses to the question, 'Why do you think it was a good/not-so-good message?', were assigned to five categories: 1) *'I don’t know’*; 2) *Irrelevant* (e.g., 'because I liked it’); 3) *outcome dependent* (e.g., ‘because I got it right’); 4) *content dependent* (e.g., ‘She described the picture quite well—the shape of the heads and the bodies’); and 5) *speech quality dependent* (e.g., ‘She talked funny’). Figure 5 shows the number of responses in each category at each age level. Since chi-square analyses revealed no relations between message type and response category, responses were collapsed across message types. Separate one-way ANOVAs yielded significant effects for age for all categories except outcome dependent responses, $F(4,70) = 1.85, P>0.10$. There was a significant decrease with age in ‘don’t know’ responses, $F(4,70) = 4.01, P<0.01$, and irrelevant responses, $F(4,70) = 5.61, P<0.001$, and a significant increase with age in content dependent responses, $F(4,70) = 24.67, P<0.001$, and speech quality dependent responses, $F(4,70) = 3.91, P<0.01$.

![Fig. 5. Evaluation criteria: reasons for evaluating messages as *good* or *not-so-good* at each age level.](http://fla.sagepub.com)
DISCUSSION

To summarize the findings, adequate messages produced by normally hearing children led to age-related improvement in correct picture selection. This was not the case for deaf children’s adequate messages, which were more successful than inadequate messages but less successful than hearing children’s adequate messages. The confidence ratings of 4- and 5-year-olds were undifferentiated whereas those of older children were higher for messages from hearing than from deaf children, and higher for adequate than for inadequate messages. Similarly, 4- and 5-year-olds evaluated messages in a relatively favourable and undifferentiated manner whereas older children downgraded the messages of deaf children as well as ambiguous messages in general. Justifications for message evaluations were typically based on irrelevant factors for 4- and 5-year-olds, on the success or failure of picture selection for 6-year-olds, and the presence or absence of relevant differentiating features for 8- and 10-year-olds. Older children also justified some of their negative evaluations of messages on the basis of poor speech quality.

It had been anticipated that the younger children would have difficulty decoding the speech of deaf children, given the necessity of greater concentration and the availability of limited processing resources (Whitehurst & Sonnenschein 1985). What was surprising, however, was the minimal age-related change in the comprehension of atypical speech and that this difficulty was not resolved by 10 years of age.

Markman (1981) has suggested that it is sometimes necessary to transform, elaborate and extend the information provided in a communicative situation, making inferences when details are omitted by the speaker. Perhaps such inferencing skills, which may be critical to the task of decoding phonologically irregular speech, are less developed in 10-year-olds than in adults. Relatively intelligible utterances by deaf speakers often contain one or more words that are difficult to comprehend in isolation but which can be disambiguated in the context of other information in the message (McGarr 1983, Sitler, Schiavetti & Metz 1983) or situation. One such example in the present study involved an ‘adequate’ but phonologically deviant message that might be heard as follows: ‘The goat is walking away from the wish.’ The corresponding set of four pictures had no elements related to goat or wish; rather, each picture depicted a Hallowe’en scene with a ghost and witch and, in one of these, a ghost was walking away from a witch. In this context, adults had no difficulty inferring the child’s intended reference to ghost and witch. For some reason, however, this inference from incomplete phonological details to the speaker’s intended meaning was beyond the
capability of many 10-year-olds. Although inferential processes improve between 6 and 12 years of age, children younger than 11 fail to construct inferences consistently, as do adults (Paris & Landauer 1976, Paris et al. 1977). In the present study, little change was evident between 4 and 10 years of age in the number of correct choices resulting from adequate messages by deaf speakers, suggesting that the relevant inferential skills were still inadequate for the task at hand, even at 10 years of age.

Phonological irregularities in the speech of deaf children may have provided unexpected distraction from more relevant aspects of the message and the overall task. The novelty of such speech could have diverted attention from the content of such messages to their superficial form. In any case, it seems clear that even the performance of 10-year-olds is affected adversely by factors that have little impact on adult listeners. This is not to suggest that further experience listening to deaf speech or specific training of listener skills (e.g., Anderson et al. 1984) could not resolve some or all of these difficulties.

Confidence ratings and evaluations provided further information on the development of metacommunication skills, including comprehension monitoring. The increase in rated confidence with age suggests a growing awareness of the process of comprehension and its relation to properties of the message. What was unexpected, however, was the relatively low confidence ratings associated with adequate messages from deaf speakers and the minimal age-related changes in such ratings. Nevertheless, these results are consistent with developing metacommunication skills because the messages of deaf children posed comprehension difficulties for children of all ages. In fact, inspection of the individual performance profiles of 8- and 10-year-olds revealed that the lower confidence ratings for deaf children’s adequate messages were, indeed, associated with incorrect choices.

Younger children (4- and 5-year-olds) evaluated all message types similarly, and, for the most part, gave favourable evaluations, confirming the lack of awareness of their own comprehension. After 5, children became more adept at detecting and downgrading ambiguous messages. It was not until 8 years of age, however, that they seemed to understand the possibility of a correct guess, even with a poor message [e.g., ‘He could have said the shape of the flower’ (8, 4); ‘It just said witch, ghost, pumpkin . . . there’s a witch, ghost, and pumpkin in all of them’ (10, 6)]. For 4-, 5- and 6-year-olds, messages that were guessed correctly, whether adequate or ambiguous, were rated as good, in line with previous findings of Robinson & Robinson (1977a, b, c).

Children’s justifications for rating messages as good or not-so-good lend further support to the notion of increasing understanding of communication processes with age. Responses unrelated to the message were most common
for 4- and 5-year-olds but decreased dramatically with age. These irrelevant explanations reflect a poor understanding of the factors related to message quality and their connection to communicative success (Beal & Flavell 1982, Patterson & Kister 1981, Robinson & Robinson 1978). Responses linked to differentiating aspects of the message were rarely observed at younger ages but increased significantly after 6 years of age, becoming the modal response for 8- and 10-year-olds. The 6-year-olds characteristically based their evaluations on the success or failure of their choice of picture. Robinson & Robinson (1977a, c) have also noted the importance of outcome in the message evaluation of 6-year-olds, suggesting that this is an early stage in the child’s understanding of the role of the message in successful communication.

Although the performance of the youngest children is consistent with no understanding whatsoever of message quality and its role in communication, this may not be the case. Many 4- and 5-year-olds gave signs of puzzlement after an ambiguous message, and were uncharacteristically slow in choosing a referent. Once their choice was made, however, they then described the message as a good one, even if their selection had been incorrect. Other investigators have also noted nonverbal indicators of problem detection by young children (Beal & Flavell 1982, Bearison & Levey 1977; Flavell et al. 1981, Markman 1985, Patterson & Kister 1981). If young children are aware of ambiguities, why do they fail to register such awareness in their evaluations? It is unlikely that memory is the problem (Flavell et al. 1981, Markman 1979) but rather a more fundamental deficit in their knowledge of communication processes (Beal & Flavell 1982). They seem to be unaware of the connection between ambiguous messages and communicative failure (Patterson & Kister 1981) but they may simply be incapable of reporting or acting on detected problems in particular contexts (Ackerman 1983a; Markman 1985). Their fleeting puzzlement, when faced with ambiguous messages, may signal the onset of metacognitive experiences (Flavell 1979).

One of the unanticipated findings of the present investigation was the increased focus on speech quality with increasing age and the devaluation of messages with atypical speech. Children 4, 5 and 6 years of age rarely spoke about speech quality, and, when they did so, they tended to comment favourably on messages from hearing as well as deaf speakers (e.g., ‘I could hear her’; ‘She talked loud’). By 8 and 10 years of age, however, children mentioned speech quality three times as frequently as did younger children, primarily to comment unfavourably on the messages of deaf children (e.g., ‘She talked funny’). Sonnenschein (1986) has suggested that, when children lack adequate knowledge of the procedural rules of communication, they attend to irrelevant aspects of the message. It is not surprising, then, that the younger children focused on irrelevant aspects of the message or task. What is
surprising is that the older children were also affected by seemingly irrelevant aspects of messages, in this case, speech quality. As noted, however, speech quality may have been irrelevant to message quality from an adult point of view but was, indeed, relevant to children's comprehension.

These findings raise important issues about exclusively oral training in deaf children, and about evaluations of the success of such training. It must be emphasized that the deaf children who provided messages for the present investigation had highly intelligible speech by all prevailing standards, and were unusually proficient articulators compared to their peers with comparable hearing losses. Moreover, the ability to formulate adequate referential messages is considerably delayed in deaf children compared to their hearing age-mates, and in orally-communicating compared to bimodally-communicating (i.e., speech and sign) deaf children (MacKay-Soroka et al. 1987). Thus, the present findings imply that even the best messages that can be achieved by deaf children are still insufficient to guarantee adequate comprehension on the part of their hearing peers. Such messages must be even less adequate, one must imagine, for their hearing-impaired peers who typically experience receptive difficulties under optimal conditions (MacKay-Soroka, Trehub & Thorpe 1988). Our findings also call into question the standard practice of evaluating the intelligibility of deaf speech solely with reference to adult listeners, whether by nominal ratings (Conrad 1979, Schiavetti, Metz & Sitler 1981, Trybus 1980), direct magnitude estimates (Metz, Samar, Schiavetti, Sitler & Whitehead 1985) or the proportion of words or utterances identified verbatim (Boothroyd 1985, Markides 1980).

It is clear that by 10 years of age, children have a relatively sophisticated understanding of communication processes, appropriately differentiating aspects of the message and of their own behaviour that contribute to successful communication. The present study indicates, however, that even for 10-year-olds, this understanding is fragile and can be undermined by unusual aspects of the communicative situation that pose no difficulty for adults. We challenge other researchers to explore the age at which children's skill and understanding become more resistant to such perturbation and to determine whether training or experience can be effective in this regard.

REFERENCES


UNDERSTANDING REFERENTIAL MESSAGES


