Intonation Training as a Facilitator of Intelligibility

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Abstract

The literature indicates that intonation and intelligibility may be paired functions. Subjects for this study were two preschool children with severe intelligibility problems. Each child received two treatments in varying order: (1) intonation training and (2) phonological processes training. Untrained listeners identified utterances and intonation patterns before and after each intervention. The results indicate that increase in perception of intelligibility is more facilitated by training of intonation features than by training of phonological processes. The implications for intervention are discussed.

Introduction

For children with severe intelligibility problems, two types of intervention suggested are (1) phonological processes training (Hodson, 1978; Hodson and Paden, 1981; Hodson and Paden, 1983) and (2) targeting improvement of prosodic patterns such as declaration, interrogation, and exclamation (Shadden, Asp, Tonkovich, and Mason, 1980). The purpose of this study was to initiate research in comparing the efficacy of (1) phonological processes and (2) intonation intervention strategies in increasing intelligibility in young children. A multitreatment design was used to evaluate the effects of two intervention strategies for severe intelligibility (Tawney and Gast, 1984). Specific research questions investigated were: (1) Is greater improvement in intelligibility demonstrated following one of the intervention strategies?, and (2) Is greater improvement in intelligibility demonstrated according to the presentation order of the intervention strategies?

Phonological processes are the simplifications of the adult language that children use during language development. These strategies are a natural part of every child's phonological development. A young child will employ these simplification strategies in predictable ways. Children with severe intelligibility problems appear to deviate from the normal processes in one of three ways. First, the child may be generally delayed in acquiring the natural processes. Second, the child may acquire the natural processes, but use them differently. Third, the child may acquire some deviant processes which are unique. The phonological processes training takes advantage of the predictable nature of speech simplifications that children use. Rather than focusing on individual sound errors, the phonological processes approach focuses on the phonological patterns to be acquired (Ingram, 1976).

Suprasegmental skill acquisition may be a determinant of the intelligibility level of the child. Some researchers believe the feature intonation is an innately determined and innately structured element of language (Leiberman, 1980; Halliday, 1975; Menyuk, 1969; Tonkova-Yampol'skaya, 1973). Early utterances are characterized by particular intonations. Infants in the period from six to nine months begin using vocal sounds consistently and systematically, developing some kind of constant relation between sounds and meaning. Through babbling and experimenting with voice, the infants are learning that speech sounds can make contact with people and can satisfy personal needs. Infants use consistent patterns in asking for, pointing to, or getting an action or object. These patterns are recognized by adults. The infants learn to act and interact in meaningful ways in some social context. Children may derive their concept of "sentence" from observations about and production of sound strings with differing intonations. Children store in memory the functional relationships of the features of rising and falling intonation patterns. During maturation, children expand and alter structural descriptions of these features to more closely approximate the adult language.

Some researchers argue that children do not learn to use prosodic patterns in their speech until after they learn that grammatical distinctions of the language are signaled by word order (Weeks, 1972; Brown, 1973; Bloom 1973; Nettelbladt, 1982). They further argue that rising and falling intonation patterns in single word utterances are not distinctive in the same way as rising and falling intonation patterns are in the adult language. These researchers report that children appear to mimic superficial aspects of adult speech without obvious intent or motivation. Cruttenden (1982) suggested that while the use of some forms of intonation may be present in the babbling stage, the understanding of the complexity of the adult intonation patterns is still developing in children aged ten and older. It may be that children need to learn prosodic distinctions as suprasegmental features of syntax, as they have also learned to motorically produce the segmental features.

Children with severe intelligibility problems frequently demonstrate limited range and variation in intonations patterns of speech (Shadden et al., 1980) The relationship between suprasegmental perception, imitation, and production in spontaneous speech is not known. Skills at these three levels of suprasegmental development, as phonological processes development, may not increase in a uniform manner (Shadden et al., 1980).

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Speech acquires its communicative intent, structure, and emotional nuances through the feature of intonation with suprasegmental features constituting part of the meaning of whole utterances. Wingfield, Lombardi, and Sokol (1984), in a study of accelerated speech, noted that intonation had a significant effect on speech intelligibility. Local (1980) pointed out that sociolinguistic competence must include the "framing" functions of suprasegmental features. The projection and interpretation of communicative intentions for both the speaker and the listener are contingent upon the use of the suprasegmental systems.

If, as some researchers believe, suprasegmental development precedes segmental development, the acquisition of adequate articulation skills may partially depend on prior acquisition of adequate suprasegmental skills. Current articulation therapy approaches appear to hold the assumptions that (1) the acquisition of segmental skills is independent of suprasegmental skills, and (2) deviations or delays in articulatory performance need only correction of phonemes as the target objective. For children with severe intelligibility problems, several target phonemes may be objectives of therapy. However, increases in intelligibility may be slight until the majority of articulatory errors have been corrected. Suprasegmental skill acquisition might serve not only to facilitate phonological development but also to improve intelligibility during the therapeutic process and facilitate more natural sounding speech production at the conclusion of the therapy program (Shadden et al., 1980).

Subjects

Two preschool children with severe intelligibility problems were the subjects for this study. Child A was a male, 5;8 years to 6;11 years during the study; Child B was female, 3;6 years to 3;11 years during the study. Even though a dissimilarity in the ages of the children existed, the phonological processes profiles of both children represented a similar stage in the production of phonological processes. Both subjects demonstrated general delay in acquiring natural phonological processes which put them at Hodson and Paden's Level I of intelligibility in communication (1983). Hodson and Paden (1983; p. 39) indicate four general levels of intelligibility, labeled 0 to III, with Level 0 being the least intelligible. The sounds primarily affected in Level I are all obstruents. The deficient patterns characterizing Level I are omissions, major place substitutions, glottal replacements, voicing alterations, miscellaneous patterns, vowel deviations, and idiosyncratic rules. The composite scores of both children placed them in the severe category of priority for intervention. The phonological processes profile for each child as determined by the Assessment of Phonological Processes Screening Test (Hodson, 1981) is presented in Table 1.

Table 1. Results of the Assessment of Phonological Processes Screening Test

Process assessed	Number of possible occurrences	CHILD A Pre-test	CHILD A Probe test	CHILD A Post test	CHILD B Pre-test	CHILD B Probe test	CHILD B Post test
Prevocalic singletons	17						
Omissions		3	1	1	1	0	0
Other (substitutions)		6	3	4	4	6	8
Prevocalic clusters	6						
Reductions		0	4	6	3	3	6
Other (reduction subs.)		6	2	0	3	3	0
Postvocalic obstruents	10						
Omissions		8	6	1	7	7	10
Other (non-speech sound)		1	3	3	0	2	0
Stridents	13						
Omissions		6	6	5	8	7	7
Non-strident subs.		2	1	1	0	1	1
Total stridency deletion		0	0	0	0	0	0
Other (strident subs.)		1	1	0	0	0	1
Velars	7						
Omissions		4	2	0	5	2	2
Fronting		0	0	2	0	0	1
Other		0	0	0	0	0	0
Liquids	11						
Omissions		6	5	5	5	4	5
Gliding		0	0	2	0	0	1
Vowelization		0	0	0	0	0	0
Other (substitutions)		2	0	0	0	1	1

Procedure

Intervention strategies used for this study were (1) phonological processes training, and 2) intonation training. The phonological processes training followed a hierarchical model for remediating deficient phonological processes as proposed by Hodson and Paden (1983). Establishment of word-final consonants, development of front/back contrasts, facilitation of stridency, use of consonant clusters, and reduction of stopping are basic objectives in remediation of unintelligible speech of children. Therapeutic progress for this intervention strategy is determined by a decrease in the number of omissions of the targeted phonological process patterns. The priority objective for each subject within this study was the establishment of postvocalic obstruents. The specific remediation procedures from the phonological processes model that were used with these children can be found in Hodson and Paden (1983).

Intonation patterns of declaration, interrogation, and exclamation were targeted during intonation training. The design of the intonation training included six steps progressing from modeled imitation plus motor movement in step one to spontaneous production without motor prompt or imitation in step six. The vocalizations of the children during training in production of intonation patterns followed a progression from single syllable to multi-syllable non-meaningful consonant-vowel combinations. Singular and multiple combinations of "ba" were used throughout the training. For example, during a three-syllable utterance, "ba-ba-ba" was used. Each subject was at the level of five-syllable patterns at the end of the intonation training. A complete description of each step and the motor movements is presented in Appendix A.

The length of the research project was twenty weeks. Each child received ten weeks of phonological processes training and ten weeks of intonation training. Training sessions were fifty minutes in length, twice a week. When Child A was receiving phonological processes training, Child B was receiving intonation training. At the end of ten weeks, the strategies were reversed for the subjects. For the purposes of this study, the children acted as their own controls.

Measures and Data Analysis

Two tests of intelligibility were administered prior to the initiation and subsequent to each phase of training, resulting in the intelligibility of each subject being assessed three times. The first test was the Assessment of Phonological Processes Screening Test (Hodson, 1981). This test measures the production of six classes of phonological processes using common objects to elicit single-word naming responses from the child. Frequency of occurrence of the phonological processes identified was computed and the subjects were assigned a phonological processes level as described by Hodson and Paden (1983). The results of this test are presented in Table 1. The second test was a clinician-constructed intelligibility test composed of 75 preselected utterances. The test items are presented in Appendix B. This test was constructed to measure two variables: length of utterance and intonation pattern. Length of the preselected utterances ranged from one to five words, with equal representation for each length (15 utterances for each length). The three intonation patterns targeted for intervention were also equally divided among the 75 utterances (25 utterances per intonation pattern). The 75-item test was administered to each child via an elicited imitation procedure. Prior to each administration of the test, the 75 items were randomized, resulting in different orders of presentation for each administration.

The children's responses to the 75 items were audio tape recorded prior to interventions and subsequent to the completion of Phases I and II of the training programs. Following each recording, the same three untrained judges from the Department of Communication, The University of Toledo, were asked to listen to tapes of each test administration and to (1) identify the responses and (2) indicate the intonation pattern. Only the children's responses to each item on the test were presented for the judges' identifications. The recording form (Appendix C) provided for the judges was divided into two sections per item. Blanks were available for identification of the utterances. Identification of the intonation pattern was checked under an appropriate column. For identification of the utterance, the judges were asked to do one of the following: (1) transcribe each word recognized, (2) transcribe those words recognized and place an "X" for those words not recognized within the utterance, (3) place a series of "X"s to indicate the number of words perceived but not recognized, or (4) place a line through the item when neither words nor presence of words were perceived. For identification of intonation pattern, the judges were asked to (1) check the appropriate intonation column or (2) place a line through the item when the intonation pattern could not be identified.

The raw data from the judges' responses were tabulated and a mean for each measure was computed. The data were then graphed for visual inspection to allow observation of trends in response patterns. Comparisons of the judges' accuracy in the perception of intelligibility for each child were made prior to and following each phase of training.

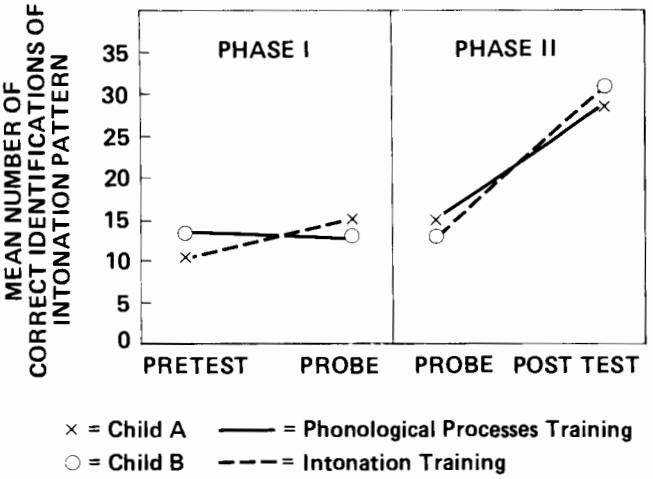
Results

The data comparing the effectiveness of the two intervention strategies are presented in Figures 1 and 2, and Tables 1, 2, and 3. The following report is based on that information. Phase I refers to the first ten weeks of the research project. Phase II refers to the second ten weeks. The type of training each subject had received during each phase is noted in parentheses.

Judges' Identification of Intonation Pattern

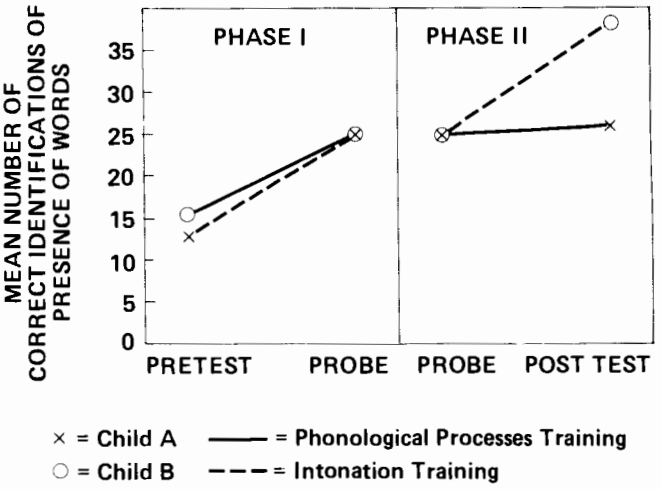
Figure 1 represents the judges' accuracy of identification of intonation pattern. At the end of Phase I, the

judges' identification of the intonation patterns of Child A (intonation training) increased from a mean of 10.6 patterns to a mean of 15.6 patterns. The judges' identification of the intonation patterns of Child B (phonological processes training) decreased from a mean of 13.6 patterns to a mean of 13.3 patterns. At the end of Phase II, the judges' identification of intonation patterns of Child A (phonological processes training) increased from a mean of 15.6 patterns to a mean of 28.6 patterns. The judges' identification of intonation patterns of Child B (intonation training increased from a mean of 13.3 patterns to a mean of 31.3 patterns).



Judges' Identification of Presence of Words

Figure 2 represents the judges' perception or identification of presence of words. At the end of Phase I, the judges' identification of presence of words for Child A (intonation training) increased from a mean of 13 words to a mean of 25 words. The judges' identification of presence of words for Child B (phonological processes training) increased from a mean of 15.6 to a mean of 25 words. At the end of Phase II, the judges' identification of



presence of words for Child A (phonological processes training) increased from a mean of 25 words to a mean of 26 words. The judges' identification of presence of words for Child B (intonation training) increased from a mean of 25 words to a mean of 38 words.

Judges' Identification of Each Length of Utterance

Tables 2 and 3 represent the judges' perception or identification of each length of utterance for Child A and B respectively. At the end of Phase I, the judges' identification of length of utterance for child A increased in one-, two- and three-word utterances, decreased in four-word utterances, and showed no change in five-word utterances. The judges' identification of each length of utterance for Child B increased in one-, two-, three- and four-word utterances, and showed no change in five-word utterances. At the end of Phase II, the judges' identification of each length of utterance for Child A increased in one-word utterances, decreased in two- and three-word utterances, and increased in four- and five-word utterances. The judges' identification of each length of utterance for Child B increased in each length of utterance.

Table 2. Judges' Perception of Length of Utterance for Child A (male)

		Phase I		Phase II	
Length of utterance	Pretest	Amount of change	Probe	Amount of change	Post test
1 word	14	+17	31	+5	36
2 word	18	+13	31	-5	26
3 word	3	+6	9	-2	7
4 word	4	-3	1	+10	11
5 word	0	0	0	+1	1

Table 3. Judges' Perception of Length of Utterance for Child B (female)

		Phase I		Phase II	
Length of utterance	Pretest	Amount of change	Probe	Amount of change	Post test
1 word	22	+5	27	+8	35
2 word	16	+10	26	+11	37
3 word	7	+6	13	+17	30
4 word	1	+5	6	+3	9
5 word	0	0	0	+3	3

Changes in the Use of Phonological Processes

Table 1 represents the subjects' use of phonological processes. The priority objective for each subject was the modification of postvocalic obstruents, a decrease in the number of omissions. At the end of Phase I, Child A (intonation training) showed a decrease in the number of omissions. Child B (phonological processes training) showed no change in the number of omissions. At the end of Phase II, Child A (phonological processes training) showed a decrease in the number of omissions. Child B (intonation training) showed an increase in the number of omissions. Changes in other phonological processes represented in the data will be discussed in the following section.

Discussion

The results of this study indicate intonation training tends to influence listener perception of intelligibility of words and intonation patterns. For the purpose of discussion, the word "intelligibility" is defined as including the combined factors of (1) identification of presence of words or recognition of specific words, (2) identification of length of utterance, and (3) identification of intonation pattern. The focus of discussion is the effects and the possible relationship of the two intervention strategies on the perception of intelligibility by untrained listeners. Traditionally, clinicians have approached the problem of intelligibility by targeting the motoric production of individual speech sounds. It is emphasized that the phonological processes training method of increasing intelligibility does not address the motoric production of individual speech sounds. Instead, the focus is the modification of phonological patterns. It is further emphasized that during the intonation training no attempt was made at articulatory proficiency. The only segmental feature used during the intonation training was the syllable "ba". The structure of the following discussion is: (1) performance and the perception of intelligibility by the judges for child A; (2) performance and the perception of intelligibility by the judges for Child B; (3) comparison of the effects of the two intervention strategies; (4) summary of generalizations and trends that appear to be emerging from the study; and (5) implications for further research.

Performance and Perceived Intelligibility of Child A

At the end of Phase I (intonation training), the accuracy of the judges' perception of intelligibility for Child A increased in the areas of identification of intonation patterns, presence of words, and length of utterance up to three-word utterances. Child A showed limited change in his production of phonological processes; however, the phonological processes training had not been implemented during this phase. Phonological processes modified were: a decrease in the number of omissions of postvocalic obstruents, prevocalic singletons, velars, and liquids; and a decrease in the number of substitutions of prevocalic singletons and prevocalic clusters. These changes were measured by the probe test of the Assessment of Phonological Processes Screening Test (Hodson, 1981).

At the end of Phase II (phonological processes training), the accuracy of the judges' perception of intelligibility continued to increase. During this phase of training, the child's performance showed a marked decrease in the number of omissions of postvocalic obstruents as well as continued improvement in modifications of other phonological processes as measured by the post test of the Assessment of Phonological Processes (Hodson, 1981). The decrease in the number of omissions of postvocalic obstruents is believed to be a direct effect of the phonological processes training. The continued improvement in other phonological processes can be attributed to either generalizations of the method or to maturation.

In summary, the accuracy of the judges' perception of intelligibility showed the greater increase in the areas of identification of presence of words and identification of length of utterance up to three-word utterances after the intonation training. Even though Child A was no longer working on intonation patterns, the accuracy of the judges' identification of intonation pattern and length of utterance for four- and five-word utterances was greater after the phonological processes training. This may indicate a relationship between the phonological processes training and the intonation training. It may be possible for a child to generalize the behaviours learned with the intonation training as the child learns the phono-

logical processes training. The greater improvement in modification of phonological processes followed the phonological processes training.

Performance and Perceived Intelligibility of Child B

At the end of Phase I (phonological processes training), the accuracy of the judges' perception of intelligibility for Child B increased for presence of words and length of utterance, but not for identification of intonation pattern. The decrease in the accuracy of the judges' perception of intonation pattern is not surprising since training in this area of intelligibility was not implemented during this phase of the study. Even though phonological processes training for the omission of postvocalic obstruents had been implemented during this phase, there was no change in the production of this process for this child. Modifications of other processes were: a decrease in the number of omissions of prevocalic singletons, stridents, velars, and liquids; and an increase in the number of substitutions of prevocalic singletons, postvocalic obstruents, and fronting. These changes were measured by the probe test of the Assessment of Phonological Processes Screening Test (Hodson, 1981). Accuracy increases shown in the judges' perception of presence of words and length of utterance are attributed to the phonological processes training or to maturation.

At the end of Phase II (intonation training), the accuracy of the judges' perception of intelligibility increased significantly in all areas for Child B even though there was not an improvement in modification of phonological processes as measured by the post test of the Assessment of Phonological Processes (Hodson, 1981). This may indicate that listener perception of intelligibility is more facilitated by intonation training than by phonological processes training.

In summary, the greater increases in the accuracy of the judges' perception of all areas of our definition of intelligibility were after the intonation training. The improvements shown in the modification of phonological processes were greater, although insignificant, after the phonological processes training.

Comparison of the Effects of the Two Intervention Strategies

The greater increases in the judges' accuracy of the perception of intelligibility for each child came after the phase in which the child had received the intonation training. The judges' accuracy of perception of intelligibility for Child A, who received intonation training first, continued to increase after the phonological processes training. The continued increase may indicate that intontion training carried over to the phonological processes training and influenced this phase of the training even though this child was no longer working on intonation training. Child B, who received the phonological processes training first, did not continue to improve in modification of phonological processes after the intonation training was introduced (Phase II). Carry-over of the effects of training were evident only after the intonation training. The results seem to indicate that the child who receives intonation training first may proceed better in phonological processes training.

The judges' ability to perceive the presence of words for both subjects increased more after the phase in which the subjects had received the intonation training. For Child A, an increase of 12 words was perceived by the judges after the intonation training, compared to an increase of only one word after the phonological processes training. For child B, an increase of 10 words was perceived by the judges after the phonological processes training, with an additional increase of 12 words after the intonation training. It would appear that intonation training was the greater facilitator for the accuracy of perception of words for both children.

The judges' perception of length of utterance also appeared to be facilitated by the intonation training in that the judges' accuracy of perception was greater after the intonation training. The increases for child A were with the one-, two- and three-word utterances, while the increases for Child B were with the one-, two-, three- and five-word utterances. This result also gives some indication that intonation training facilitates perception of the number of words as well as perception of words.

There were differences in the judges' perceptions of intonation patterns which seemed to be determined by the order in which the children received the two intervention strategies. The judges' perception of intonation pattern for Child B decreased slightly after the phonological processes training (Phase I). Increase in the accuracy of the judges' perception of intonation pattern for this child occurred after intonation training (Phase II). It would appear that the increase of accuracy was facilitated by the intonation training alone. The accuracy of perception for Child A increased after Phase I (intonation training), and continued to increase after Phase II (phonological processes training). This increase would indicate one of two things: (1) the phonological processes training was a greater facilitator of intelligibility than the intonation training, or (2) the intonation training facilitated growth in intelligibility when it preceded the phonological processes training.

At this point, it is interesting to note that the increase in the mean in perception of intonation pattern for the female child was 18 as compared to an increase in the mean of 5 for the male child after the intonation training. Since the female subject was two years younger than the male subject, the differences in increase, although highly speculative, raise questions of possible sex differences. Implications of this observation would be addressed in further research on intonation. It may be that females would gain the greater benefit from intonation training.

Summary

The results of this study indicate that intonation training influences listener perception of intelligibility of presence of words, identification of words, length of

utterance, and intonation patterns. The judges' perception of intelligibility increased in all areas after the intonation training. This increase may indicate that listener perception of intelligibility is more facilitated by intonation training than by phonological processes training. There is an indication that intonation training may facilitate phonological processes training, while the phonological processes training, does not appear to facilitate the intonation training. Significant changes in phonological processes did not continue when the intonation training followed the phonological processes training. The child who received the intonation training first continued to improve when the phonological processes training was introduced. This continuity would indicate retention and use of the intonation training. Since carry-over of the effects of training are evident only after the intonation training, it may indicate that the child who receives intonation training first may proceed better in the phonological processes training.

Current articulation therapy training approaches appear to hold the assumption that segmental skills are independent of suprasegmental skills. This study indicates that suprasegmental skills contribute to intelligibility. It may be that suprasegmental skill development must precede phonological skill development. Since communication competence is more than language competence, pragmatics of communication may be facilitated by children learning intonation patterns as a part of articulatory training.

Implications for Further Research

This study generates several questions to be answered. Further research is necessary to determine (1) if intonation training should precede phonological processes training; (2) if intonation training should accompany phonological processes training; (3) if intonation training should be integrated into phonological processes training; (4) whether intonation training is a greater facilitator of intelligibility in one sex; and (5) if there is a sex difference, to determine the relationship of the above questions to the sex difference.

Appendix A
Intonation Training Procedure

1. The clinician produced the intonation pattern as a model, performing a motor movement while holding the subject's hands.
2. The clinician and the subject produced the intonation pattern and the motor movement together.
3. The subject produced the intonation pattern without clinician model, performing the motor movement with the clinician.
4. The subject produced the intonation pattern and the motor movement alone while the clinician mirrored the motor movement.
5. The subject produced the intonation pattern and the motor movement alone, without clinician model.
6. The subject produced the intonation pattern without any accompanying motor movement.

Motor movements associated with each intonation pattern:

1. Declaration—the hands and arms went down and to one side.
2. Interrogation—the hands and arms went up and to one side.
3. Exclamation — the hands and arms simulated the motion of hitting two cymbals together.

Appendix B
Clinician-Constructed Intelligibility Test

1. Kick big ball.
2. New bike!
3. Do you want to play?
4. What did you do?
5. You push car.
6. Wow!
7. Block fall.
8. Write on paper.
9. What should I do?
10. Come and play!
11. Big doll!
12. The cup fell?
13. Go sleep?
14. Toy.
15. Go?
16. Dog?
17. The monkey is very funny.
18. I can catch the ball!
19. Hug me.
20. Watch your step!
21. Dog run!
22. Put the book down.
23. How?
24. The heater is hot!
25. My lucky penny!
26. Be careful not to fall!
27. No cry.
28. Up?
29. Is that my ball?
30. What!
31. My daddy!
32. Do you have a bike?
33. Say hello to her.
34. Little John is lost.
35. The dog ate the bone.
36. Eat cookie?
37. You look happy!
38. I hope I can go.
39. Tell me about that.
40. I use my comb.
41. Good?
42. Apple pie!
43. Pick the one you want.
44. Want more drink?
45. Push car?
46. Boy.
47. Butter.
48. He is my best friend!
49. Gate.
50. Where is the birthday party?
51. How does a dog bark?
52. What happened?
53. Wipe the table?
54. My pants.
55. Mommy!
56. Use the knife?
57. Snow!
58. She is lots of fun!
59. More drink?
60. Throw ball.
61. Why are you going?
62. Want more candy.
63. Play with the puppies!
64. The apple is big!
65. When do we eat dinner?
66. Where is the tape?
67. In the bathtub?
68. Happy.
69. Tell me what you did.
70. Me play outside.
71. Candy!
72. I push ball there.
73. This game is fun!
74. There was a puppet show!
75. Bring the bucket!

Appendix C
Judges' Recording Form

INTONATION STUDY

CHILD: MALE FEMALE

ADMINISTRATION: Pretest Probe Post Test

Judge: _____

Date: _____

		(.) Declar.	(?) Question	(!) Exclam
1.	_____	___	___	___
2.	_____	___	___	___
3.	_____	___	___	___
	_____	___	___	___
	_____	___	___	___
	_____	___	___	___
75.	_____	___	___	___

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