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Aspects of Prosody in the Mentally Retarded Population (Suprasegmentals, Lexical Stress, Deficient Sentence Accent, Contrastive Stress).

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ASPECTS OF PROSODY IN THE MENTALLY RETARDED POPULATION

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ASPECTS OF PROSODY IN THE MENTALLY RETARDED POPULATION

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
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in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

Speech Pathology

by
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Abstract

The purpose of this research was to examine the use of prosody in a group of mentally retarded (MR) subjects who were impressionistically dysprosodic. Seven adult, institutionalized, severe mentally retarded subjects matched with two groups of normal subjects (matched for chronological age and for language age) were compared in two production experiments.

The first experiment was a study of word level stress in which the subjects named pictures of two syllable, morphologically simple, non-derived words. The second experiment was a study of sentence level stress in which the subjects described changing toy locations with three word (subject-preposition-object) utterances, intended to require the use of prosody to distinguish contextually unchanged information from changed information. All subject productions were analyzed perceptually for stress accuracy by three sophisticated judges. Acoustic measurements were made using a Visi-Pitch 6095 interfaced with an Apple IIe computer and an Epson FX 100 printer. This instrument combination enabled extraction of fundamental frequency (FØ) peaks, relative intensity (IØ) peaks, mean FØ, mean IØ, and duration data for each subject's productions

in each experiment. Comparisons were made of the subject groups' use of the acoustic parameters which might have cued stress.

The lexical stress experiment revealed no differences in perceptual judgments of the groups' ability to mark stress on the appropriate syllable. The sentence accent experiment revealed that the MR group performed significantly poorer than the two groups of normal subjects. The MR group was perceived to use utterance final stress in a majority of its productions. They did not appear to use prosody to distinguish contextually unchanged information from contextually changed information. No differences in stress cues were found for the first and third stress positions. However, variations in the use of these parameters occurred in the second stress position. The acoustic analyses did not reveal patterns which characterized the dysprosodic nature of the MR subjects' productions. Possible explanations for acoustic variations in the second stress position were discussed along with future research considerations.

ASPECTS OF PROSODY IN THE MENTALLY RETARDED POPULATION

CHAPTER 1: INTRODUCTION

Mentally retarded individuals exhibit developmental deficits in cognitive, motoric, social, and communicative domains. Their speech and language deficits detrimentally affect cognitive, social, and educational development. Mentally retarded individuals exhibit problems in the comprehension and production of language. Their deficits span the full range of linguistic components: semantic, syntactic, morphologic, phonologic, and pragmatic (McCormick and Schiefelbusch, 1984). Mentally retarded individuals also have difficulty producing suprasegmental phonologic (or prosodic) speech characteristics (Edwards and Shriberg, 1983; Berry, 1980; Freeman, 1982). The present study explored mentally retarded speakers' control of word level production (lexical stress) and sentence or clause level production (sentence accent).

Prosodic features are superimposed over one or more speech segments. These features include stress, tone,

rhythm, intonation, and duration (Atkinson-King, 1980). Prosody functions linguistically by representing prominence in language. The two aspects of prosody considered in this research are lexical stress and sentence accent. Lexical stress and sentence accent differ primarily in the length of utterance to which each applies. Otherwise, these two aspects of prosody share similar effects. Lexical stress and sentence accent function to separate grammatical categories, at the word level (parts of speech) and at the sentence level (sentence types). They also have semantic/pragmatic effects which function to show focus and contrastive meaning. Reviews of the adult usage of lexical stress and sentence accent are presented next, followed by discussion of the normal development of prosody and of dysprosody.

ADULT PROSODY

LEXICAL STRESS

According to Chomsky and Halle (1968), lexical stress is determined by application of word level rules for stress assignment. They proposed a cyclic application of stress rules in English. For example, in their approach the word <u>blackbird</u> would derive its stress in the following manner: the speaker would note

that the first syllable in this compound noun is an adjective and the second, a noun. Application of the lexical stress rule assigns primary stress to both elements and then deletes the internal brackets.

(e.g.) [[black] [bird]] becomes [black bird]
[[adj.] [noun]] becomes [compound]

Next, the compound stress rule gives primary stress to the left most part of the compound and reduces the rest. Thus, the correct stress pattern for BLACKbird is derived (Hyman, 1975).

Akmajian, Demers, and Harnish (1979) suggested that English stresses nouns by assigning stress to the penultimate syllable (second to the last) if that syllable consists of either a long vowel or any vowel which is followed by two consonants (e.g., ariZOna, eLECtric). Otherwise, stress is assigned to the antepenultimate (third to last) syllable when the penultimate syllable is weak (e.g., aMErica).

Cutler and Isard (1980) theorized that lexical stress may be stored in the mental lexicon with the abstract phonological representation of each word rather than be generated by rule. They cited evidence that words may be stored in the mental lexicon in a more

abstract form than the phonetically realized surface form. As evidence, they indicated that lexical stress errors of competent speakers occur only on morphologically complex or derived words (e.g., PHOtography, EDucation) and not on non-derived words (e.g., WINdow, aROUND) which have only one form. Furthermore, these errors are thought to maintain the stress pattern of a morphological relative of the intended word. Cutler and Isard suggested that Chomsky and Halle's assignment of stress via rule was an unsatisfactory explanation for such errors. Simple misapplications of stress rules can not account for the regularities in errors or for the nature of errors. Otherwise, non-derived words should also show stress errors. Cutler and Isard claimed that lexical stress errors are the result of a confusion within the lexical selection process.

> " Thus, the pattern is always that of a related word since the error occurs within the common lexical entry; and stress errors only ever appear in derived words because only derived words share lexical entry with other words---non-derived words have private lexical entries (p. 249)."

For example, the error in tonic accent placement in the

initial syllables of photography and education is only allowed because the tonic accent is there in PHOtograph and EDucate.

On the other hand, Cutler and Isard (1980) reported findings indicating that English speakers can use appropriate lexical stress on invented words. This supports the stress rule assignment theory inasmuch as these would not be expected to be present in the lexicon. Perhaps the adult speaker maintains a form of rule-governed device for adding new lexicon entries. Such a device should be evident in children's errors but not necessary for the adult's usual functioning. Finally, with regard to lexical stress, Cutler and Isard hypothesized that the system may involve both knowledge of stress assignment rules as well as stress marking of individual items in the mental lexicon, i.e., a set of production rules plus a more fully specified lexicon.

Lexical stress of words produced in citation form appears to be governed by the rules of the phonological system of the language being spoken. However, lexical stress can be used to show contrasts in broader contexts. Consider the verb include spoken in citation form with the second syllable stressed. If a speaker wished to contrast this word with exclude, then the stress shifts to the first syllable as in the following

sentence:

(e.g.) You must INclude it, not EXclude it.

Such use is called contrastive stress and overrides any other kind.

Syntactic categories of English nouns and verbs which are phonetically similar are differentiated by lexical stress, e.g., CONtent, noun; conTENT, verb. Nouns tend to be stressed on the first syllable and related verbs tend to be stressed on the second syllable in English (Baltaxe, 1981). Not only is the lexical stress altered for contrastive purposes or for indicating grammatical category differences, but it will also be altered when placed in certain phrasal contexts. To begin with, English disallows contiguously stressed vowels, and this general constraint will trigger stress shifts. For example, the citation form of fourteen is stressed on the second syllable. The second syllable is also stressed in the sentence I see fourteen. However, the stress shifts to the first syllable in a sentence such as, I see fourteen men since men carries primary sentence stress, thus forcing a leftward stress shift to the first syllable of fourteen in accordance with the no contiguously stressed syllables constraint (Ladefoged, 1982).

SENTENCE ACCENT

Another category of prosodic effect involves accent. Sentence accent provides prominence on a word in a tone group. The syllable which receives the sentence accent is the syllable bearing the lexical stress of the accented word. Simple, declarative sentences are spoken with accent on the final tonic syllable (Ladefoged, 1982; Minifie, 1983); with focal stress at or near the end of the sentence (Clark and Haviland, 1977). Chomsky and Halle (1968) claimed that each sentence has a normal form governed by the syntactic structure of the sentence. They claimed that other sentence accent placements are intended to show contrast of the accented word with the other constituents in the sentence. Bolinger (1972) refuted this claim inasmuch as sentence accent is not dependent on syntactic structure and that many sentences do not have a neutral form. Rather, sentence accent may be determined by contextual or semantic/pragmatic factors (Bolinger, 1972; Schmerling, 1976; Cutler and Isard, 1980). The prominent word in a sentence or clause is dependent on the speaker's intended information focus, often indicating the "new" information provided (Bolinger,1981). The focus is

determined by the context. As the context changes, the focus changes, altering sentence accent. Consider for example, the sentence John hit Mary. The sentence accent would be different in different linguistic contexts. In answer to the question Did Alice hit Mary? sentence accent would fall on John, but in answer to Did John kiss Mary?, hit would receive the accent, (also see Clark and Haviland, 1977).

Sentence accent is revealed through use of focus, contrast, and deaccentuation. Cutler and Isard (1980) claimed that sentences can have accent on several words, some of which show focus and some of which show contrast.

(e.g.) London's the capital of Scotland,
isn't it?
No, EDINBURGH'S the captial of
SCOTLAND, LONDON is the
capital of ENGLAND.

Cutler and Isard indicated that the words in upper case represent different kinds of accent. In this example the focused words have a rising-falling intonation pattern (London, Scotland). The contrasted words (Edinburgh, England) have a falling intonation pattern which, in

this case, signals "new information."

Ladd (1980) defines contrastive stress as "accent placement that signals narrow focus, and narrow focus can be used for reasons other than explicit contrast" (p. 78-79). Focus does not always refer to contrastive stress.

(e.g.) Who shot Mary? JOHN shot Mary.

Focus marks the part of the sentence that the speaker thinks the hearer is not presupposing (i.e., the new or changed information). If the focus of that sentence is known, then the presupposition can be determined by replacing the focused material with a variable.

(e.g.) Q = for what X, X shot Mary

Ladd (1980) indicated that the presupposed material is deaccented, therefore the focused material is stressed by default. He also claimed that heavy stress indicates focus (new information) and focus can be used to indicate contrast.

(e.g.) Did Bill shoot Mary? No, JOHN shot Mary.

Contrastive stress can function to alter the principles which usually determine the way a pronoun is interpreted. When a pronoun is placed under contrastive stress its usual antecedent (referent) becomes some unexpected noun phrase. Solan (1983) described the parallel function strategy devised by Sheldon (1972) as the strategy used to match a pronoun in one clause to the appropriate antecedent in another clause.

Contrastively stressing the pronoun in a sentence alters the binding function strategy.

(e.g.) $John_1$ hit Bill and he_1
hit FRED
John hit $Bill_1$ and HE_1
hit Fred

In the first sentence the parallel function strategy makes <u>John</u> the <u>most likely</u> antecedent but when <u>he</u> receives contrastive stress as in the second sentence, the antecedent shifts to <u>Bill</u>. The contrastive stress signals that the expected antecedent of the pronoun is not the one intended by the speaker. The only time a pronoun receives stress is when the speaker wishes to signal that it should be bound to an unlikely antecedent. As Solan (1983) indicated, the hearer is

warned not to apply the parallel function strategy to the sentence. A further example follows demonstrating the same point with the pronoun in the object position.

(e.g.) John hit $Bill_1$
and then Fred hit him_1
$John_1$ hit Bill
and then Fred hit HIM_1

Again the first sentence, following the parallel function strategy, predictably matches the pronoun with the object of the first clause, Bill. After applying contrastive stress to the pronoun the preferred antecedent becomes the unexpected one, the subject of the first clause, John. This function of contrastive stress can only be understood in reference to the parallel function strategy because it explains what the case is when the pronoun is unstressed (Solan, 1983).

THE DEVELOPMENT OF PROSODY

Normal children start their development of prosody in infancy. Study of infant speech perception indicates that 24 hour old infants coordinate their body movements with speech rhythm (Condon and Sanders, 1974). These initial prosodic productions are probably reflexive. The

infant's early cries are associated with hunger or pain, and communicate basic needs (Menyuk, 1971, 1972; Sheppard and Lane, 1968). By four or five months, the infant produces a variety of distinctive non-cry vocalizations (Kaplan and Kaplan,1971). At around eight months, before infants say their first words, their jargon utterances represent imitations of the basic intonation patterns of adult speech in their environment (Crystal, 1975). Infants' vocalizations during the babbling stage have been labeled prosodic "envelopes" or "matrices" (Crystal, 1978, p. 262 in Bruner, 1975, p.10), prosodic "frames" (Dore, 1975), and "primitive prosodic units" (Crystal, 1971). Dore (1975) revealed how the child at the one word stage expresses several communicative intentions using intonation. Children can use the same lexical item to label, call, or request. Dore found that labelling was expressed with a falling intonation contour, calling with a sudden rising-falling intonation contour, and a request with a rising intonation contour. Morse (1972) found that 18 - 24 month olds discriminate between rising and falling intonation patterns.

Weiman (1976) indicated that during the two word stage, children placed heavier stress on one word systematically using stress to distinguish new

information from given information. In fact, the children she studied used prosody to express semantic relations more than syntax at this stage.

Weir (1962) noted the use of contrastive stress by her 2 1/2 year old child. Two year olds have been found to imitate contrastive stress successfully. Berry (1980) indicated that children of this age group fit words into a prosodic envelope. Even when the articulation of words is not precise the message can be interpreted by adults when stress and intonation patterns are appropriate.

Baltaxe (1984), in her study of contrastive stress in normal, aphasic, and autistic children, found that normal children between the ages of 2,9 and 3,11 correctly used stess to mark contrasts in subject-verb-object sentences (S-V-O) 100% of the time in the subject and object positions. Stress misassignments were noted in the verb position.

Hornby and Hass (1970) reported that normal four year old children correctly used stress to mark contrasts in S-V-O sentences in the subject position 80% of the time, in the verb position 56.25% of the time, and in the object position 43.75% of the time.

Amy Weiss, Arlene Carney, and Larry Leonard (1985) reported that their normal subjects (ages 3,7 - 6,7) correctly used contrastive stress in S-V-O sentences in

the subject position 49.95% of the time, in the verb position 44.56% of the time, and in the object position 22.24% of the time.

Klein (1978) suggested that stress position may affect children's recall of auditory stimuli. Stress may be a more important cue for processing and reproducing sequences of segments or syllables in a word than in producing words in a meaningful sentence because the arrangement of syllables in a word has no intrinsic meaningful order. She cited work of Frith (1969) who found evidence for developmental changes in the use of stress for recall and meaning. According to Klein, Frith found an increase in dependence on grammatical structure and a decrease in dependence on stress with cognitive development. Klein reported that Lahey (1974) found evidence that children did not use prosody for sentence processing. She indicated that word order seemed to be the primary cue for processing meaning relationships. Klein also indicated that Lahey suggested that the significance of prosody may differ depending on the degree of demand for interpretation of semantic relationships.

Adults modify their prosody when they speak to infants and young children. Garnica (1979) found that adults exaggerated their intonation patterns and used a

three to four octave range when talking to two-year-olds (normal range is one to two octaves). It is thought that the modifications may be used to maintain the infant's attention during interaction.

Camaioni (1979) reported that four year olds modified their prosody when they spoke to younger children. They exaggerated their stress and intonation patterns in a manner similar to adults. Four year olds did not, however, make these changes when speaking to other four year olds.

DYSPROSODY

Dysprosody refers to impairments in the use of the melody of language, receptively and/or expressively. Kent (1984) described dysprosody in patients with neurological impairments. He stated that Parkinson's patients and patients with right-hemisphere lesions exhibit "a general pattern of reduced acoustic contrast, including limited fundamental frequency variation, continuous voicing, weakly formed consonants, and extensive nasalization." The cerebellar ataxic and the verbal apraxic exhibit a "slower rate with disproportionate lengthening of certain phonetic

segments, and a tendancy toward equal syllable duration" (Kent, 1984, p. 325). Kornhuber (1977) claimed that the basal ganglia and the cerebellum influence speech to a greater extent than is represented in the literature. He stated that subcortical lesions, in the absence of cortical lesions, cause more profound speech defects than do pure cortical lesions. Whitaker (1976) identified chorea-like symptoms in patients with damage to the caudate nucleus, athetoid symptoms in patients with damage to the putamen, and Parkinson-like symptoms in patients with damage to the globus pallidus.

Broca's aphasics experience problems processing content words versus function words when sentence stress is varied (Swinney, Zurif, and Cutler, 1980). Blumstein (1981) indicated that aphasic patients do not exhibit normal prosodic processing but that their performance in that area is far superior to their processing of segmental cues.

Ross (1981) described the disorder of "aprosodia" by site of lesion. He claimed that disorders of prosody stem from lesions in the right hemisphere homologous to the classical left hemisphere sites of lesion. Thus, his proposed system included global, motor, sensory, transcortical motor, transcortical sensory, and mixed transcortical aprosodia. Millar and Whitaker (1983) warn

of the dangers of accepting such a system. They reported that Ross used CT scans which were taken within a day or two of brain insult. CT scans are unreliable as indicators of extent and location of lesions until after two months post brain insult. They also questioned the adoption of an aphasia classification system for prosodic aspects of language, when "(1) the aphasia classification system itself has been questioned and (2) no attempt was made to find out whether these prosodic disturbances appear in patients with lesions in other areas of the brain" (Millar and Whitaker, 1983, p. 98-99). They also reported that Ross did not assess known linguistic phonetic features of prosody, nor did he offer analyses of prosody in aphasics.

Individuals with right hemisphere lesions in the parietal lobe have been found to have problems identifying affective components of language, but not the propositional aspects. These individuals exhibit difficulty comprehending emotion and affect in expressions. Millar and Whitaker claimed that this evidence supports the hypothesis that the right hemisphere (post sylvian area) is dominant for comprehension of affective speech just as the left hemisphere (post sylvian area, i.e., Wernicke's area) is dominant for the comprehension of propositional speech (Millar and Whitaker, 1983).

Kent (1984) reported neural pathways and centers which are important to the affective-prosodic characteristics of speech. They are a follows: (1) the right cerebral hemisphere; (2) contralateral cerebello-cerebral connections; (3) ipsilateral thalamocortical pathways, conducting information from the basal ganglia; (4) the thalamus; and (5) the cerebellum.

Deaf individuals exhibit a lack of control of fundamental frequency (FØ), intensity, and duration. They use a higher FØ with random and wide fluctuations. Deaf speakers use a restricted FØ range, restricted intensity range, extended syllabic duration, and monotonus syllables as compared to hearing speakers (Calvert and Silverman, 1975).

Autistic children also exhibit dysprosodic behaviors. Some of them use monotonous, flat, uninflected speech while others use a "sing-song" stereotypic pattern. Fay (1980) stated that very little is known about autistic children's intonational deficiencies. He indicated that, at present, it is unknown what role perceptual-motor factors may play in prosodic problems, and to what extent idiosyncratic development influences the use of intonation in speech.

He did report that there is evidence for a failure to appreciate word boundaries, phrase boundaries, and tone groups in autistic echolalia. Baltaxe (1981) studied prosody in autism. She found that autistic children seem to overselect intensity in expressing prosodic information. She also found that autistic children have problems using prosody for contrastive stress purposes.

Dysprosody has been studied in neurologically impaired, deaf, and autistic individuals. The research cited above reveals aspects of the prosodic disturbances exhibited in each of these populations.

Mentally retarded individuals also exhibit difficulties in the use of prosody (Edwards and Shriberg, 1983; Berry, 1980; Freeman, 1982). Although it is accepted that mentally retarded individuals exhibit prosodic problems a limited amount of research has focused on the expressive use of prosody in this population. Wheldall and Swann (1976) studied the effect of intonational emphasis on sentence comprehension in severely subnormal preschool children. Their results did not reveal significant evidence that intonational emphasis facilitates sentence comprehension. Ingram (1976) reported that Down's Syndrome children's speech may be characterized by "grunt-type sounds" and unusual intonation patterns. Zisk and Bialer (1967) in their

review of the literature dealing with speech and language problems in Down's Syndrome indicated that these children exhibit rhythmic defects and phonation problems. The research that they cited dealing with rhythmic defects in this population centers on stuttering and cluttering problems, and not dysprosody. Edwards and Shriberg (1983) stated that they were "not aware of studies of the phonological production of mentally retarded children that focus on suprasegmentals" (p. 281).

The use of inappropriate prosody inhibits intelligibility. Some researchers are of the opinion that prosody is more important to intelligibility than precise articulation (Wingfield, Lombardi, and Sokol, 1984; Berry, 1980). Improvements in the prosodic elements might increase intelligibility more than improvements in articulation skills. However, before this issue can be addressed with the mentally retarded population, the nature of their prosodic deficits must be better understood.

CHAPTER 2: PURPOSE AND RESEARCH QUESTIONS

This study involved two experiments designed to reveal the level of prosodic disturbance in a group of mentally retarded individuals who were impressionistically dysprosodic. Their performance was compared to that of normal adults matched for chronological age and normally developing children matched for language age. The first experiment measured subjects' productions of lexical stress. Deficits at this level were thought to be indicative of failures in relatively early processing levels of stress assignment in lexical storage. The second experiment assessed subjects' abilities to change utterance focus in response to changes in nonlinguistic context.

Specific questions included the following:

1. Is there a perceptible difference in lexical stress performance between mentally retarded subjects who exhibit the clinical impression of dysprosody and normal subjects matched for chronological age. If so, what acoustic characteristics are misused?
2. Is there a perceptible difference in lexical stress performance between mentally

retarded subjects who exhibit the clinical impression of dysprosody and normal subjects matched for language age equivalence. If so, what acoustic characteristics are misused?

3. Is there a perceptible difference in sentence accent performance between mentally retarded subjects who exhibit the clinical impression of dysprosody and normal subjects matched for chronological age. If so, what acoustic characteristics are misused?

4. Is there a perceptible difference in sentence accent performance between mentally retarded subjects who exhibit the clinical impression of dysprosody and normal subjects matched for language age equivalence. If so, what acoustic characteristics are misused?

CHAPTER 3: METHOD

Subjects

There were 21 subjects: seven were mentally retarded individuals from a residential institution who exhibited the clinical impression of dysprosody, seven were normal subjects matched for chronological age, and seven were normal subjects matched for language age equivalence. Table 1 presents subject identification information.

The mentally retarded group's chronological age ranged from 23 years to 39 years with a mean age of 27 years. Information regarding the speech, language, hearing, and cognitive levels of the mentally retarded subjects was provided by the staff professionals at the residential institution. The severity of the cognitive deficit in the mentally retarded group was judged by psychologists using standardized I.Q. tests. All of the mentally retarded subjects were classified as severely retarded. The mentally retarded subjects were capable of using three word utterances spontaneously and were intelligible although they exhibited articulation

errors. Mentally retarded subjects with diagnosed hearing impairment, motor speech deficits, or stuttering problems were excluded from the study. Subjects who were on medication were also excluded from the study. The Peabody Picture Vocabulary Test - Revised, Dunn and Dunn (1981) was used to match language ages of the second control group with the experimental group. The language age equivalences for the mentally retarded group ranged from 3,6 to 5,1 with a mean language age equivalence of 4,3.

The mentally retarded subjects were chosen in the following manner. Speech pathologists who were familiar with the students at a residential school for the mentally retarded identified those clients who exhibited the clinical impression of dysprosody in their speech production. This investigator then observed their speech. From the group of individuals, who the school speech pathologists and the investigator agreed exhibited the clinical impression of dysprosody, seven were randomly selected for this research.

The normal subjects matched for chronological age ranged in age from 22 years to 40 years with a mean age of 27 years. The language matched group was composed of children attending a day care facility. The language age equivalences for the language matched group ranged from

3,7 to 5,5 with a mean language age equivalence of 4,3. The chronological ages of the language matched group ranged from 3,5 to 5,0 with a mean chronological age of 4,0.

Table 1. Description of Subjects. (MR1-7 = mentally retarded subjects, CA1-7 = normal subjects matched for chronological age, LA1-7 = normal subjects matched for language age equivalence; CA = chronological age, LA = language age equivalence on the PPVT-R IQ = intelligence quotient for MR group, MR Level = classification of mental retardation for MR group)

Subject	Sex	CA	LA	IQ	MR LEVEL
MR1	F	27	3,11	31	Severe
MR2	M	39	4,8	28	Severe
MR3	M	23	4,0	33	Severe
MR4	M	25	4,5	34	Severe
MR5	M	25	5,1	29	Severe
MR6	M	28	4,0	32	Severe
MR7	M	26	3,6	30	Severe
CA1	F	28	--	--	--
CA2	F	40	--	--	--
CA3	F	23	--	--	--
CA4	M	24	--	--	--
CA5	M	22	--	--	--
CA6	F	31	--	--	--
CA7	F	26	--	--	--
LA1	F	3,9	3,10	--	--
LA2	F	4,8	5,1	--	--
LA3	M	3,9	4,1	--	--
LA4	F	4,3	4,3	--	--
LA5	M	5,0	5,5	--	--
LA6	M	3,6	3,11	--	--
LA7	M	3,5	3,6	--	--

Experiment I: Lexical Stress Production

Sampling Procedure

Subjects were asked to produce the two-syllable words in a picture naming task. Each subject was tape recorded in a sound treated room using a Sony WM D-6 Professional cassette recorder with a Sony ECM-150 microphone stabilized four to six inches from each subject's mouth.

The targets included fifteen two-syllable words: (1) five words with stress on the first syllable and an unstressed, full vowel in the second syllable (S + FV, eg., turkey, /tə́rki/); (2) five words with stress on the first syllable and an unstressed, reduced vowel in the second syllable (S + RV, eg., wagon, /wǽgə n/); (3) two words with stress on the second syllable and an unstressed, full vowel in the first syllable (FV + S, eg., racoon, /rǽkun/); and (4) three words with stress on the second syllable and an unstressed, reduced vowel in the first syllable (RV + S, eg., giraffe, /ǰə rǽf/) See Ladefoged (1982, Chapter 5) for his analysis of stress, full and reduced vowels. The target words are presented in Table 2.

Table 2. Words in the lexical stress experiment by word type.

Word Type 1. (Stress + Full Vowel)

(1) Turkey

(2) Monkey

(3) Pillow

(4) Chimney

(5) Window

Word Type 2. (Stress + Reduced Vowel)

(1) Rabbit

(2) Pencil

(3) Wagon

(4) Table

(5) Apple

Word Type 3. (Full Vowel + Stress)

(1) Hello

(2) Racoon

Word Type 4. (Reduced Vowel + Stress)

(1) Giraffe

(2) Canoe

(3) Balloon

Perceptual Measure.

Three judges listened to the tape recordings of the subjects' productions of the two-syllable words. Two judges had advanced degrees in speech pathology and one judge had an advanced degree in linguistics. They were each given a list of the words which were produced by the subjects and were asked to mark the syllable which was stressed for each word. If neither syllable was perceived as stressed, i.e., equal stress, the judges were to designate equal stress (see Appendix A for the judges' perceptual score sheet for the lexical stress experiment). The syllable which at least two out of the three judges agreed was stressed was designated as stressed. This criterion was met for 100% of the judgments.

Acoustic Analysis.

Acoustic data were obtained using a Visi-Pitch 6095, Kay Elemetrics, interfaced with an Apple IIe computer, and an Epson FX 100 printer. This instrument combination was recommended by Horii (1984) since it

accurately displays speech parameters in near real time. The Visi-Pitch 6095 provides the following features: captures each glottal pulse up to a fundamental frequency of 1000 Hz and stores this information in a two byte word (14 bit accuracy) in Apple memory. The internal clock which measures the extracted pitch period operates at 100k Hz. This high internal clock frequency and the two byte representation of the pitch period insures a high accuracy in pitch extraction and storage. The frequency ranges available are: Band A = 50 - 300 Hz, Band B = 135 - 535 Hz, Band C = 200 - 760 Hz, and Band D = 450 - 1600 Hz. Intensity Accuracy is plus or minus 1.4 dB with the microphone to speaker distance fixed. The dynamic range of relative intensity is 30-70 dB or a 40 dB range. Seven time displays are available (1/4, 1/2, 1, 2, 4, 6, or 8 seconds). Two cursors can be positioned on the monitor to define the "window of calculations" so that mean fundamental frequency, mean relative intensity, and time between the cursors can be calculated over the window selected.

Mean fundamental frequency (FØ), mean relative intensity (IØ), and duration measurements were obtained for each syllable of each subject's correctly stressed words. The syllables with FØ and IØ peaks were designated by viewing printed contours. Those words

which were judged to be correctly stressed were analyzed to determine the acoustic features that cued stress in each instance and to provide descriptive information for further comparisons of the experimental group with the two control groups.

A second evaluator used the same analysis procedures to measure acoustic data for 36 of the CA matched group's utterances. Interjudge reliability was determined for each acoustic parameter by comparing the overall mean values for each judge using t-tests. These showed no significant differences ($p>.01$). The reliability coefficients were: for FØ .99, for IØ .93, and for duration .92. See Table 3 for reliability of the acoustic measurement scheme for lexical stress.

Table 3. Reliability of the acoustic measurement scheme for the lexical stress experiment (n = 36). Measurements were made by two judges of mean fundamental frequency (FØ), mean relative intensity (IØ), and duration of 36 randomly selected syllables produced by normal adults.

	FØ (Hz) X	FØ (Hz) SD	IØ (dB) X	IØ (dB) SD	Dur (ms) X	Dur (ms) SD
Judge (1)	195.98	46.27	47.23	4.66	309	113
Judge (2)	195.47	45.29	47.92	4.57	292	111
r =	.99		.93		.92	
t =	.56		-2.34		2.26	
p =	ns @ .05		ns @ .01		ns @ .01	

Experiment II: Sentence Accent

Procedure

The subjects were asked to describe the location of toys, using three word (subject-preposition-object) utterances. True sentence forms were not used in order to simplify the toy manipulation task. Toy locations were systematically changed, thus changing the conversational context. The toys included a Fisher-Price camphouse, a box, a male doll, and a ball. The male doll and the ball were alternately placed in and on the house and the box. The following utterances were target productions: "man in house", "man on house", "ball in house", and "man in box". The utterance analyzed was man in house. By changing the toy locations, the focus of the utterance changed, thus requiring the speaker to show contrast between the given information in the utterance and the new information. For example, if an initial target is man on house and the examiner then placed the man IN the house, the next target was man IN house.

Each subject was tape recorded using the same equipment and procedures as were used in Experiment I.

The examiner instructed each subject to describe the toy locations with three words. The examiner also gave examples of the correct productions including the target stress patterns.

Perceptual Measure.

Perceptual judgments of sentence accent were determined by agreement of two out of three judges. The judges were asked to listen to twelve recordings of man in house, four productions where man should have been stressed (MAN in house), four productions where in should have been stressed (man IN house), and four productions where house should have been stressed (man in HOUSE). The judges were then asked to identify the prominent word in each production (see Appendix A for the judges' score sheet for the sentence accent experiment). Productions of the stimulus utterances were not included and the target productions were randomly presented on the judges' recording. An utterance was determined to be correctly stressed if two of the three judges indicated that the appropriate syllable was stressed. Thus, the correct accents were not available to the judges. 96% of the judgments met the two thirds agreement criterion. 4% of the utterances could not be

agreed upon by the judges. A PC score for sentence accent was obtained for each subject.

Acoustic Analysis.

Acoustic data were obtained using the same equipment as in Experiment I. Mean fundamental frequency (FØ) values, mean relative intensity (IØ) values, and duration values for the twelve target utterances were obtained. The words with FØ peaks and IØ peaks were determined by observing printed contours. Those sentences which were correctly stressed were analyzed to determine the acoustic features which cued stress in each instance and to provide descriptive information for further comparisons of the experimental group with the two control groups.

A second evaluator used the same analysis procedures to measure 38 of the CA matched normal group's utterances. Interjudge reliability was determined for each acoustic parameter by comparing the overall mean values for each judge using t-tests. These showed no significant differences. The reliability coefficients were: for FØ, .99; for IØ, .97; and for duration, .89. See Table 4 for reliability information for the acoustic measurement scheme for sentence accent.

Table 4. Reliability of acoustic measurement scheme for the sentence accent experiment (n = 38). Measurements were made by two judges of mean fundamental frequency (FØ), mean relative intensity (IØ), and duration of 38 randomly selected words produced by normal adults.

	FØ (Hz)		IØ (dB)		Dur (ms)	
	X	SD	X	SD	X	SD
Judge (1)	197.9	33.16	47.96	4.34	34.69	13.83
Judge (2)	197.43	32.47	47.68	4.38	34.46	13.44
r =	.99		.97		.89	
t =	.55		1.77		.227	
p =	ns @ .05		ns @ .05		ns @ .05	

CHAPTER 4: RESULTS

Experiment I: Lexical Stress

Perceptual Measure

The number of productions perceived (by at least two of the three judges) to be stressed was tallied and a PC score was obtained for each subject and for each group by word type. These results are presented in Table 5. Five words were included in word types 1 and 2. Due to the infrequency of simple, picturable words for types 3 and 4, word type 3 included two words and word type 4 included three words.

Total Lexical Stress Scores.

The mentally retarded (MR) group, obtained a total PC score of 77.13% (SD = 27.6%) on the lexical stress task. The normal subjects matched for chronological age (CA), obtained a total PC score of 95.27% (SD = 5.87%) on the lexical stress task. The normal subjects matched for language age equivalence (LA), obtained a total PC score of 89.53% (SD = 15.46%) on the lexical stress task. The MR group showed more variation in performance than the two groups of normal subjects. The coefficients

of variation (CV) were calculated by dividing the group standard deviations by the group means and then multiplying the result by 100 to derive a percentage. CV results for the three groups were as follows: 35.8% for the MR group, 6.2% for the CA group, and 17.3% for the LA group. This indicates that the PC scores for the MR group were twice as variable as the LA group and that the PC scores for the LA group were twice as variable as the CA group. The great variability within the MR group was due to subject MR 7. When MR 7 was removed from the group, the CV for the MR group was 12.3%, which more closely matched the variability of the LA group.

Due to the widely different group variabilities, nonparametric statistics were used for group comparisons. A Kruskal-Wallis one way analysis of variance was calculated for total PC scores. The mean ranks (1 - 21) for the groups were: MR (8.43), LA (11.50), and CA (13.07). A chi square test of the significance of differences in these mean ranks ($X^2 = 2.31$) proved to be nonsignificant ($p < .328$). Therefore, there were no differences in total lexical stress performances for the three groups.

Lexical Stress Scores by Word Type.

The MR group was perceived to place stress on the correct syllable 82.85% (SD = 34%) of the words in word type 1, where stress configuration = S + FV, as in the word turkey. The coefficient of variation (CV) for word type 1 = 41.8%. They were perceived to correctly stress 79.41% (SD = 34%) of the words in word type 2, where stress configuration = S + RV, as in the word wagon. The CV for word type 2 = 44.8%. They were perceived to correctly stress 71.42% (SD = 36.5%) of the words in word type 3, where the stress configuration = FV + S, as in the word racoon. The CV for word type 3 = 51%. They were perceived to correctly stress 71.42% (SD = 36.67%) of the words in word type 4, where the stress configuration = RV + S, as in the word giraffe. The CV for word type 4 = 52.3%. These data are represented in Table 5.

The normal subjects matched for chronological age (CA), were perceived to correctly stress 97.14% (SD = 9%) of the words in word type 1. The CV for word type 1 = 9.5%. They were perceived to correctly stress 100% of the words in word type 2. The CV for word type 2 = 0%. They were perceived to correctly stress 85.71% (SD = 22.5%) of the words in word type 3. The CV for word type

Table 5. Sums, means, and standard deviations for lexical stress performance in each of four types of words judged to be correctly stressed by individual subjects in the mentally retarded (MR), chronological age matched (CA), and Language Age matched (LA) subject groups.

Group	S	Word Type 1 S + FV n = 5	Word Type 2 S + RV n = 5	Word Type 3 FV + S n = 2	Word Type 4 RV + S n = 3	Totals n = 15
MR	1	5	5	2	3	15
	2	5	4	1	1	12
	3	4	3	2	2	11
	4	5	5	0	3	13
	5	5	5	1	3	14
	6	5	5	2	3	15
	7	0	0	2	0	2
	Sum	29.00	27.00	10.00	15.00	82.00
	Mean	4.14	3.86	1.43	2.14	11.57
	SD	1.73	1.73	.73	1.12	4.14
CA	1	5	5	2	3	15
	2	5	5	1	2	13
	3	4	5	2	2	13
	4	5	5	1	3	14
	5	5	5	2	3	15
	6	5	5	2	3	15
	7	5	5	2	3	15
	Sum	34.00	35	12.00	19.00	110.00
	Mean	4.71	5.00	1.71	2.71	14.29
	SD	.45	0.00	.45	.45	.88
LA	1	5	5	2	3	15
	2	4	5	2	3	14
	3	5	4	2	3	15
	4	1	2	2	3	8
	5	5	5	2	3	15
	6	3	5	2	3	13
	7	4	5	2	3	14
	Sum	27.00	31.00	14.00	21.00	94.00
	Mean	4.00	4.43	2.00	3.00	13.43
	SD	1.41	1.05	0.00	0.00	2.32

3 = 26.3%. They were perceived to correctly stress 90.47% (SD = 15%) of the words in word type 4. The CV for word type 4 = 16.6%. These data are represented in Table 5.

The normal subjects matched for language age equivalence (LA), were perceived to correctly stress 77.17% (SD = 28%) of the words in word type 1. The CV for word type 1 = 35.3%. They were perceived to stress 91.17% (SD = 21%) of the words in word type 2. The CV for word type 2 = 23.7% They were perceived to correctly stress 100% of the words in word types 3 and 4. The CVs for word types 3 and 4 = 0%. These data are represented in Table 5.

Due to the widely different group variabilities for each word type, nonparametric statistics were again used for group comparisons. A Kruskal-Wallis one way analysis of variance was calculated for each word type in the lexical stress task.

The mean ranks for the group PC scores for word type 1 are as follows: MR (11.29); CA (13.21); LA (8.50). A chi square test of the significance of differences in these mean ranks ($X^2 = 2.926$) proved to be nonsignificant ($p < .232$). Therefore there were no differences in the group PC scores for word type 1.

The mean ranks for the group PC scores for word type

2 are as follows: MR (8.93); CA (13.50); LA (10.57). A chi square test of the significance of differences in these mean ranks ($X^2 = 3.496$) proved to be nonsignificant ($p < .174$). Therefore, there were no differences in the group PC scores for word type 2.

The mean ranks for the group PC scores for word type 3 are as follows: MR (8.86); CA (10.64); LA (13.50). A chi square test of the significance of differences in these mean ranks ($X^2 = 3.613$) proved to be nonsignificant ($p < .164$). Therefore, there were no differences in the group PC scores for word type 3.

The mean ranks for the group PC scores for word type 4 are as follows: MR (8.71); CA (10.79); LA (13.50). A chi square test of the significance of differences in these mean ranks ($X^2 = 3.786$) proved to be nonsignificant ($p < .152$). Therefore, there were no differences in the group PC scores for word type 4.

In summary, the scores for the MR group were two times as variable as the LA group and almost six times as variable as the CA group. Group perceptual PC scores for all four word types showed no significant differences.

Acoustic Analysis

Lehiste (1970) reported results of psychoacoustic studies of stress. Perceptual judgments of stress depend on the listener's ability to perceive changes in frequency, intensity, and duration. Fry (1955) revealed that listeners perceived syllables with higher fundamental frequency (FØ) as stressed in the selection of words from word pairs, such as CONtent, conTENT. The amount of change that is needed for a listener to perceive a difference 50% of the time is called the difference limen (DL). Flanagan (1957) reported that the DL for FØ was between plus or minus .5 to plus or minus 1.0% for a vowel with a 120Hz FØ. Flanagan and Saslow (1958) found that the DL in FØ was between .3 to .5HZ in synthetic vowels with FØ's of 80-120Hz. Flanagan (1957) found that the DL in amplitude of the second formant of a synthetic vowel was approximately 3dB and for overall amplitude of a synthetic vowel, DL is plus or minus 1dB. The DL for duration ranges between 10 - 40ms. It requires greater DL's to perceive differences in longer durations than in shorter durations.

Considering the above DL's for FØ, IØ, and duration, the following perceptual criteria were used in designating an acoustic parameter as a stress cue: FØ

= at least 1Hz higher, IØ = at least 1dB greater, duration = at least 20ms longer (20ms is an adequate DL for these data, i.e., durations under 900ms). Syllables with FØ and IØ peaks were designated from observations of the printed acoustic contours.

Analysis of the acoustic parameters which may have been used to cue stress on the appropriate syllable in the lexical stress task are presented in Table 6. This table represents a breakdown of the cues which met the perceptual criteria and were thus considered as stress cues in the words which were perceived to be correctly stressed. The cues which were included in this analysis were: FØ peak, IØ peak, mean FØ, mean IØ, and duration. Further analyses were conducted to reveal possible patterns used by the three groups for cueing stress.

The MR group appeared to use IØ peak and mean IØ more than the other acoustic parameters in cueing stress on the appropriate syllable in words which were perceived to be correctly stressed. They used higher IØ peaks on the stressed syllable in 79% of the correctly stressed words. They used greater mean IØ (by at least 1dB) in 76% of the correctly stressed words. FØ peaks were higher in 58%, mean FØ's were higher (by at least 1Hz) in 58%, and durations were

Table 6. Percentages of correctly stressed words cued by FØ peak, IØ peak, mean FØ, mean IØ, and duration by individual subjects in the Mentally Retarded (MR), Chronological Age matched (CA), and Language Age matched (LA) subject groups. n = the number of correctly stressed words for which acoustic data could be isolated.

Group	S	FØ peak		IØ peak		mean FØ		mean IØ		duration	
		%	n	%	n	%	n	%	n	%	n
MR	1	50	10	80	10	57	7	27	7	14	7
	2	40	15	67	15	27	15	80	15	13	15
	3	29	7	57	7	33	6	17	6	67	4
	4	82	11	91	11	64	11	100	11	55	11
	5	79	14	100	14	77	13	100	13	69	13
	6	60	15	73	15	79	14	79	14	50	14
	Totals	58	72	79	72	58	66	76	66	44	66
CA	1	40	15	73	15	25	12	67	12	50	12
	2	92	13	77	13	83	12	83	12	67	12
	3	36	14	36	14	33	12	33	12	67	12
	4	62	13	86	14	67	12	75	12	67	12
	5	36	14	75	14	25	12	75	12	42	12
	6	57	14	71	14	58	12	75	12	83	12
	7	29	14	86	14	15	13	62	13	54	13
	Totals	49	97	70	98	44	85	88	85	61	85
LA	1	80	15	87	15	79	14	79	14	57	14
	2	79	14	79	14	69	13	100	13	62	13
	3	79	14	79	14	82	11	10	12	50	12
	4	63	8	75	8	33	6	83	6	83	6
	5	100	15	93	15	93	14	86	12	50	14
	6	69	13	85	13	73	11	100	11	64	11
	7	31	13	29	14	17	12	42	12	58	12
	Totals	73	92	78	93	67	81	82	82	63	76

longer (by at least 20ms) in 44% of the correctly stressed words.

The CA group also appeared to use IØ peak and mean IØ more than the other acoustic parameters. IØ peaks were higher in 70% of the correctly stressed words. They used mean IØ in 88% of the correctly stressed words. They used higher FØ peaks in 49%, mean FØ's in 44%, and longer duration in 61% of the correctly stressed words. Further explanation of the CA group's treatment of lexical stress is warrented because three of the seven subjects used listing intonation (characteristic rise in FØ at the end of each word). In word types 1 and 2 where syllable one was stressed, two of the three subjects who used listing intonation never used higher FØ peaks and the other one used a higher FØ peak once. This is equivalent to a use of higher FØ peak on syllable one in 3% of the words. This can be compared to a 100% occurrence of higher FØ peaks in word types 3 and 4 where syllable 2 was stressed (effect of listing intonation). Similar results were found for mean FØ. The three subjects who used listing intonation used a higher mean FØ on syllable one in word types 1 and 2 in 7% of the words and in word types 3 and 4 they used higher mean FØ on syllable two in 88% of the words.

The LA group appeared to use mean IØ more than the other acoustic parameters in cueing stress on the appropriate syllable. Mean IØ was greater in 82% of the correctly stressed words. They used higher FØ peaks in 73%, higher IØ peaks in 78%, higher mean FØ's in 67% and longer duration in 63% of the correctly stressed words.

In summary, all three groups appeared to use IØ peak and mean IØ more than the other acoustic parameters in cueing stress on the appropriate syllable in correctly stressed words.

Experiment II: Sentence Accent

Perceptual Measure

Percentage correct stress production was determined for each subject by agreement of two of the three judges. Table 7 presents the results of the number of sentences perceived as correctly stressed for each subject and for each group.

The MR group obtained a total PC score of 36.67% (SD = 15%) on the sentence accent task. The CA group obtained a total PC score of 74.17% (SD = 14.17%) on the sentence accent task. The LA group obtained a total PC score of 78.33% (SD = 23.33%) on the sentence accent task. The coefficients of variation for the PC scores are as follows: MR group = 41.5%; CA group = 19.5%; LA group = 30.4%.

Due to the widely different group variabilities, nonparametric statistics were used for all group comparisons. A Kruskal-Wallis one way analysis of variance was calculated for total scores. The mean ranks for the groups were MR (5.14), CA (13.07), LA (14.79). A chi square test of significance of differences in these mean ranks (X^2 = 9.873) proved to be significant

Table 7. Sums, means, and standard deviations for correct sentence accent by individuals in the mentally retarded (MR), chronological age matched (CA), and language age matched (LA) subject groups.

GROUP	SUBJECT	SCORE (n = 12)
MR	1	5
	2	4
	3	3
	4	7
	5	3
	6	7
	7	2
	Sum	31.00
	Mean	4.43
	SD	1.84
CA	1	7
	2	11
	3	10
	4	7
	5	7
	6	11
	7	9
	Sum	62.00
	Mean	8.86
	SD	1.73
LA	1	9
	2	10
	3	11
	4	12
	5	11
	6	3
	7	10
	Sum	66.00
	Mean	9.43
	SD	2.87

($p < .007$). Therefore, the MR group performed significantly poorer than the two groups of normal subjects on the sentence accent task.

Table 8 presents a breakdown of the number of utterances which were perceived to be correctly stressed by stress position for each subject group. In the first stress position (stress on man) the MR group was perceived to correctly stress six utterances whereas the CA group and the LA group each were perceived to correctly stress 19 utterances. A Kruskal-Wallis one way analysis of variance was calculated for the number correct in this stress position. The mean ranks for the groups were: MR (5.93); CA (13.29); and LA (13.79). A chi square test of significance of differences in these mean ranks ($X^2 = 7.367$) proved to be significant ($p < .025$). The MR group was perceived to use significantly fewer correct stresses on man when compared to the two groups of normal subjects.

In the second stress position (stress on in) the MR group was perceived to correctly stress seven utterances, whereas the CA group was perceived to correctly stress 21 and the LA group was perceived to correctly stress 26. A Kruskal-Wallis one way analysis of variance was calculated for the number correct in this stress position. The mean ranks for the groups

Table 8. Percentages correct (PC) and numbers of utterances perceived to be correctly stressed (NC) by stress position for the mentally retarded (MR), chronological age matched (CA) and language age matched (LA) subject groups.

Group	Stress Positions					
	MAN		IN		HOUSE	
	PC	NC	PC	NC	PC	NC
MR	21	6	25	7	64	18
CA	68	19	75	21	79	22
LA	68	19	93	26	71	20

were: MR (5.71); CA (12.14); and LA (15.14). A chi square test of significance of differences in the mean ranks ($X^2 = 9.295$) proved to be significant ($p < .010$). The MR group was perceived to use significantly fewer correct stresses on <u>in</u> when compared to the two groups of normal subjects.

In the third stress position (stress on <u>house</u>) the MR group was perceived to correctly stress 18 utterances, whereas the CA group was perceived to correctly stress 22, and the LA group was perceived to correctly stress 20 utterances. A Kruskal-Wallis one way analysis of variance was calculated for the number correct in this stress position. The mean ranks for the groups were: MR (9.50); CA (12.21); and LA (11.29). A chi square test of significant differences in these mean ranks ($X^2 = .764$) proved to be nonsignificant ($p < .683$). There was no significant group difference in the number of utterances perceived to be correct for the third stress position. Therefore, in analyzing the utterances which were perceived to be correctly stressed, the MR group performed the same as the normal subjects in the third stress position. However, the MR group performed significantly poorer than the two groups of normal subjects in the first and second stress positions.

The MR group's errors were analyzed according to stress position. When the target stress position was on man, the MR group was perceived to stress in once and house 19 times (stress on house 95% of the productions). When the target stress position was on in the MR group was perceived to stress man four times and house 14 times (stress on house 78% of the productions). When the target stress position was on house the MR group was perceived to stress man three times and in two times. 33 of the 43 stress errors (77%) were perceived to be stressed on house.

When correct productions and errors were combined, the MR group was perceived to stress man in 17% of the productions, in in 14%, and house in 70%. Neutral sentence accent is usually located on the final tonic syllable in a tone group. Stress location shifts to other positions in utterances to emphasize other words (Ladefoged, 1982; Minifie, 1983). The MR group in this research did not appear to shift stress location to the first or second positions with the same frequency as the two normal subject groups. The MR group, therefore, did not appear to shift stress to distinguish contextually unchanged information from contextually changed information.

Acoustic Analysis.

Acoustic analyses were performed to determine possible stress cueing patterns. Analysis of acoustic parameters (FØ peak, IØ peak, mean FØ, mean IØ, and duration) which may have been used to cue stress in the utterances which were perceived to be correctly stressed are presented in Tables 9 - 11. These tables present the percentages of occurrence of each acoustic parameter for each subject and for each subject group in utterances for which the acoustic data could be isolated. Missing data in these tables does not necessarily mean that none of the utterances for that subject were correct. It may have been the result of an inability to extract the acoustic data for individual words. Table 9 presents these data for utterances which were perceived to be correctly stressed on man. Table 10 presents these data for utterances which were perceived to be correctly stressed on in. Table 11 presents these data for utterances which were perceived to be correctly stressed on house.

FØ Peak

When man was perceived to be correctly stressed a higher FØ peak was used on man by the MR group in 17% of the utterances, by the CA group in 61% of the

Table 9. Percentages of acoustic parameters which met criterion as stress cues (higher FØ peak, higher IØ peak, higher mean FØ, greater mean IØ, and longer duration) for each subject and each subject group when man was stressed in the utterance man in house. Subject groups are: mentally retarded (MR); chronological age matched (CA); and language age matched (LA).

Grp	S	FØ peak		IØ peak		mean FØ		mean IØ		Duration	
		%	n	%	n	%	n	%	n	%	n
MR											
	1	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-
	4	0	2	100	2	50	2	50	2	100	2
	5	0	2	100	2	100	2	100	2	0	2
	6	0	1	100	1	100	1	100	1	0	1
	7	100	1	100	1	100	1	100	1	100	1
	Total %	17		100		83		83		50	
CA											
	1	100	1	100	1	100	1	0	1	0	1
	2	100	4	100	4	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-
	4	50	4	50	4	100	1	100	1	100	1
	5	66	3	100	3	-	-	-	-	-	-
	6	0	2	100	2	-	-	-	-	-	-
	7	50	4	100	4	100	4	75	4	0	4
	Total %	61		89		60		66		17	
LA											
	1	50	4	100	4	100	4	75	4	0	4
	2	100	1	100	1	0	1	100	1	0	1
	3	66	3	33	3	100	3	66	3	33	3
	4	100	3	100	3	100	3	100	3	0	3
	5	100	3	66	3	33	3	66	3	0	3
	6	-	-	-	-	-	-	-	-	-	-
	7	75	4	100	4	100	4	100	4	0	4
	Total %	78		83		83		83		6	

Table 10. Percentages of acoustic parameters which met perceptual criterion as stress cues (higher FØ peak, higher IØ peak, higher mean FØ, greater mean IØ, and longer duration) for each subject and each subject group when <u>in</u> was stressed in the utterance <u>man in house</u>. Subject groups are: mentally retarded (MR); chronological age matched (CA); and language age metched (LA).

Grp	S	FØ peak		IØ peak		mean FØ		mean IØ		Duration	
		%	n	%	n	%	n	%	n	%	n
MR											
	1	100	1	100	1	100	1	0	1	0	1
	2	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-
	4	100	2	100	2	0	2	100	1	0	2
	5	-	-	-	-	-	-	-	-	-	-
	6	75	4	75	4	50	4	25	4	0	4
	7	-	-	-	-	-	-	-	-	-	-
	Total %	86		86		43		43		0	
CA											
	1	50	2	50	2	50	2	0	2	0	2
	2	100	3	100	3	100	3	100	3	0	3
	3	75	4	100	4	100	4	50	4	0	4
	4	33	3	66	3	50	2	50	2	100	2
	5	0	1	0	1	-	-	-	-	-	-
	6	50	4	50	4	100	4	25	4	0	4
	7	50	2	50	2	100	2	100	2	0	2
	Total %	58		76		88		53		12	
LA											
	1	50	2	50	2	100	2	100	2	0	2
	2	100	4	75	4	100	4	100	4	50	4
	3	100	3	33	3	100	3	33	3	0	3
	4	100	4	75	4	75	4	50	4	0	4
	5	100	4	100	4	100	4	100	4	0	4
	6	100	3	100	3	66	3	33	3	0	4
	7	100	4	100	4	75	4	75	4	0	4
	Total %	92		79		88		71		8	

Table 11. Percentages of acoustic parameters which met perceptual criterion as stress cues (higher FØ peak, higher IØ peak, higher mean FØ, greater mean IØ, and longer duration) for each subject and each subject group when house was stressed in the utterance man in house. Subject groups are: mentally retarded (MR); chronological age matched (CA); and language age matched (LA).

Grp	S	FØ peak		IØ peak		mean FØ		mean IØ		Duration	
		%	n	%	n	%	n	%	n	%	n
MR											
	1	100	4	25	4	0	4	0	4	75	4
	2	100	4	100	4	100	4	50	4	75	4
	3	33	3	0	3	33	3	0	3	0	3
	4	0	3	0	3	0	3	0	3	0	3
	5	0	1	0	1	0	1	0	1	100	1
	6	50	2	0	2	0	2	0	2	100	2
	7	100	1	0	1	100	1	0	1	0	1
	Total %	61		28		33		11		50	
CA											
	1	100	4	0	4	100	4	0	4	100	4
	2	0	4	75	4	100	1	0	1	100	1
	3	100	4	0	4	100	4	0	4	100	4
	4	66	3	0	3	100	1	0	1	0	1
	5	100	3	0	3	-	-	-	-	-	-
	6	100	1	0	1	-	-	-	-	-	-
	7	0	1	0	1	-	-	-	-	-	-
	Total %	80		15		100		0		90	
LA											
	1	0	1	0	1	0	1	0	1	0	1
	2	100	2	100	2	-	-	-	-	-	-
	3	25	4	100	4	0	4	25	4	0	4
	4	100	4	100	4	100	4	0	4	100	4
	5	100	4	75	4	100	4	0	4	100	4
	6	-	-	-	-	-	-	-	-	-	-
	7	100	2	50	2	0	2	0	2	50	2
	Total %	76		82		53		7		60	

utterances, and by the LA group in 78% of the utterances. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were MR (6.98); CA (11.79); LA (14.29). A chi square test of significance of differences in these mean ranks ($X^2 = 5.679$) proved to be nonsignificant ($p < .058$). Therefore, although there were large differences in percentages of the use of FØ peak, these differences in the mean ranks for the occurrence of FØ peak as an acoustic cue when <u>man</u> was perceived as the correct stress position were not statistically significant.

When <u>in</u> was perceived to be correctly stressed a higher FØ peak was used on <u>in</u> by the MR group in 86% of the utterances, by the CA group in 58%, and by the LA group in 92%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (8.21); CA (9.00); LA (15.79). A chi square test of significance of differences in these mean ranks ($X^2 = 6.988$) proved to be significant ($p < .030$). Therefore, the LA group used FØ peak more than the MR group or the CA group. The MR group did tend to use FØ peak on <u>in</u> but a statistically significant difference was shown between mean ranks for the MR group and the LA group.

When house was perceived to be correctly stressed a higher FØ peak was used on house by the MR group in 61% of the utterances, by the CA group in 80%, and by the LA group in 76%. A Kruskal-Wallis one way analysis of variance was calculated for these data. The mean ranks for the groups were: MR (9.93); CA (12.21); LA (10.86). A chi square test of significance of differences in these mean ranks (X^2 = .570) proved to be nonsignificant ($p < .752$). Therefore, there were no significant group differences in mean ranks for the occurrence of FØ peak as an acoustic cue when house was perceived as the correct stress position. All three groups appeared to use FØ peak in this position.

IØ peak

When man was perceived to be correctly stressed a higher IØ peak was used on man by the MR group in 100% of the utterances, by the CA group in 100%, and by the LA group in 83%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (9.86); CA (12.14); and LA (11.0). A chi square test of significance of differences in these mean ranks (X^2 = .633) proved to be nonsignificant ($p < .729$). Therefore, there were no significant group differences in mean ranks for the

occurrence of IØ peak as an acoustic cue when man was perceived as the correct stress position. All three groups appeared to use IØ peak in this position.

When in was perceived to be correctly stressed a higher IØ peak was used on in by the MR group in 86% of the utterances, by the CA group in 76%, and by the LA group in 79%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (8.71); CA (10.79); and LA (13.50). A chi square test of significance of differences in these mean ranks ($X^2 = 2.225$) proved to be nonsignificant ($p < .329$). Therefore, there were no significant group differences in mean ranks for the occurrence of IØ peak as an acoustic cue when in was perceived as the correct stress position. All three groups appeared to use IØ peak in this position.

When house was perceived to be correctly stressed a higher IØ peak was used on house by the MR group in 28% of the utterances, by the CA group in 15%, and by the LA group in 82%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the the groups were: MR (9.79); CA (8.36); and LA (14.86). A chi square test of significance of difference in these mean ranks ($X^2 = 5.609$) proved to be nonsignificant ($p < .061$). Therefore,

although there were differences in these percentages, there were no statistically significant group differences in mean ranks for the occurrence of IØ peak as an acoustic cue when house was perceived as the correct stress position. The MR and the CA groups did not appear to use IØ peak in this position.

Mean FØ

When man was perceived to be correctly stressed higher mean FØ was used on man by the MR group in 83% of the utterances, by the CA group in 60%, and by the LA group in 83%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (10.79); CA (9.93); and LA (12.29). A chi square test of significance of difference in these mean ranks ($X^2 = 6.35$) proved to be nonsignificant ($p < .728$). Therefore, there were no significant group differences in mean ranks for the occurrence of higher mean FØ as an acoustic cue when man was perceived as the correct stress position. All three groups appeared to use mean FØ as a stress cue in this position.

When in was perceived to be correctly stressed higher mean FØ was used on in by the MR group in 43% of the utterances, by the CA group in 88%, and by the LA

group in 88%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (6.07); CA (11.36); and LA (14.93). A chi square test of significance of difference in these mean ranks ($X^2 = 7.770$) proved to be significant ($p < .021$). Therefore, the MR group used higher mean FØ less than the two groups of normal subjects when in was perceived to be the correct stress position.

When house was perceived to be correctly stressed higher mean FØ was used on house by the MR group in 33% of the utterances, by the CA group in 100%, and by the LA group in 53%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (10.57); CA (12.79); and LA (9.64). A chi square test of significance of difference in these mean ranks ($X^2 = 1.248$) proved to be nonsignificant ($p < .536$). Therefore, there was no significant group difference in mean ranks for the occurrence of higher mean FØ as an acoustic cue when house was perceived to be the correct stress position. Although there were no differences in mean ranks, the MR group and the LA group did not appear to use mean FØ as a stress cue in this position as frequently as the CA group.

Mean IØ

When <u>man</u> was perceived to be correctly stressed greater mean IØ was used on <u>man</u> by the MR group in 83% of the utterances, by the CA group in 66%, and by the LA group in 83%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (11.29); CA (8.07); and LA (13.64). A chi square test of significance of difference in these mean ranks ($X^2 = 3.216$) proved to be nonsignficant ($p < .200$). Therefore, there was no significant group difference in mean ranks for the occurrence of greater mean IØ as an acoustic cue when <u>man</u> was perceived to be the correct stress position. All three groups appeared to use mean IØ as a stress cue in this position.

When <u>in</u> was perceived to be correctly stressed greater mean IØ was used on <u>in</u> by the MR group in 43% of the utterances, by the CA group in 53%, in the LA group in 71%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (6.71); CA (11.36); and LA (14.93). A chi square test of significance of difference in these mean ranks ($X^2 = 6.584$) proved to be significant ($p < .037$). Therefore, the MR group used

greater mean IØ less than the two groups of normal subjects when in was perceived to be the correct stress position. The CA group did not use this acoustic parameter as frequently as the LA group in this stress position.

When house was perceived to be correctly stressed greater mean IØ was used on house by the MR group in 11% of the utteracnes, by the CA group in 0%, and by the LA group in 7%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (11.57); CA (10.00); and LA (11.43). A chi square test of significance of difference in these mean ranks ($X^2 = 1.057$) proved to be nonsignificant ($p < .589$). Therefore, there were no significant group differences in mean ranks for the occurrence of greater mean IØ as an acoustic cue when house was percieved to be the correct stress position. None of the groups appeared to use mean IØ as a stress cue in this position.

Duration

When man was perceived to be correctly stressed longer duration was used on man by the MR group in 50% of the utterances, by the CA group in 17%, and by the LA group in 6%. A Kruskal-Wallis one way analysis of

variance was calculated for this parameter. The mean ranks for the groups were: MR (12.14); CA (10.57); and LA (10.29). A chi square test of significance of difference in these mean ranks ($X^2 = .778$) proved to be nonsignificant ($p < .678$). Therefore, there were no significant group differences in mean ranks for the occurrence of longer duration as an acoustic cue when man was perceived to be the correct stress position. None of the groups appeared to use longer duration as a stress cue in this position.

When in was perceived to be correctly stressed longer duration was used on in by the MR group in 0% of the utterances, by the CA group in 12%, and by the LA group in 8%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The mean ranks for the groups were: MR (9.50); CA (11.07); and LA (12.43). A chi square test of significance of difference in these mean ranks ($X^2 = 2.110$) proved to be nonsignificant ($p < .348$). Therefore, there were no significant differences in mean ranks for the occurrence of longer duration as an acoustic cue when in was perceived to be the correct stress position. None of the groups appeared to use longer duration as a stress cue in this position.

When house was perceived to be correctly stressed,

longer duration was used on house by the MR group in 50% of the utterances, by the CA group in 90%, and by the LA group in 60%. A Kruskal-Wallis one way analysis of variance was calculated for this parameter. The ean ranks for the groups were: MR (11.57); CA (11.14); and LA (10.29). A chi square test of significance of difference in these mean ranks ($X^2 = .190$) proved to be nonsignificant ($p < .909$). Therefore, there were no significant differences in mean ranks for the occurrence of longer duration as an acoustic cue when house was perceived to be the correct stress position. The CA group appeared to use longer duration more frequently than the MR group or the LA group although not to a statistically significant degree. According to Minifie (1983) there is final syllable lengthening in all simple, declarative productions. Therefore, a higher percentage of use of this acoustic parameter would have been expected in this position for all groups.

Thus, no acoustic patterns characterizing the dysprosodic nature of the MR subjects' speech were found in these analyses. The MR group did not differ from the two groups of normal subjects in its use of higher FØ peak, higher IØ peak, higher mean FØ, greater mean IØ, or longer duration on words which were perceived to be stressed in the first and last utterance

positions. The MR group did use higher mean FØ and greater mean IØ less frequently on <u>in</u> when it was perceived to be stressed than the two groups of normal subjects. The LA group used higher FØ peak in the second stress position more frequently than the MR group or the CA group. The second stress position appeared to be the most variable in terms of the use of the acoustic parameters which were measured in this research.

CHAPTER 5: CONCLUSIONS AND DISCUSSION

The purpose of this research was to examine control of prosody in a group of mentally retarded subjects who were impressionistically dysprosodic. The research included two experiments. The first experiment sought to reveal differences in the use of prosody at the lexical level between a group of mentally retarded individuals exhibiting the clinical impression of dysprosody and two groups of normal subjects (matched for chronological age and language age). The subjects named pictures of two-syllable, morphologically simple, non-derived words (no use of contrastive stress was required in the production of these words). Percentage correct scores were obtained from judgments of three sophisticated judges. These scores revealed no differences in the ability of any of the three groups in using lexical stress appropriately.

Acoustic analyses suggested that all three subject groups may have used fundamental frequency (FØ) peak, relative intensity (IØ) peak, mean FØ, mean IØ, and duration patterns for cueing stress on the appropriate syllable. The MR group used the same acoustic cues for stressing words which were stressed on

the first syllable as the LA group. Cues for stressing words which were stressed on the second syllable were more variable across subject groups and acoustic cues. Three of the CA subjects used listing intonation (Ladefoged, 1982). This is a characteristic rise in FØ when producing a list of words. These three CA subjects were not found to use mean FØ as an acoustic cue for stressing words which were stressed on the first syllable. The rise in FØ at the end of words prevented use of a higher mean FØ for syllable one in words which were stressed on the first syllable.

The results of the first experiment (lexical stress) were not surprising in view of the fact that word level stress patterns are acquired as early as 18 months of age in normal children (Berry, 1980; Dore, 1975). The MR subjects in this study, whose vocabulary level was between four and five years of age and who exhibited the clinical impression of dysprosody were at least able to correctly mark stress in two-syllable words.

The second experiment studied prosody used to distinguish change in focus (contextually unchanged information from contextually changed information) at the sentence level. Twelve productions of the utterance <u>man in house</u> were examined by the judges. A perceptual

PC score was obtained for each subject. The group scores revealed that the MR group performed significantly poorer than the two groups of normal subjects on the sentence accent task. The MR group was perceived to use utterance final stress in a majority of its productions. These results suggest a breakdown in the use of prosody to distinguish contextually unchanged information from contextually changed information at the sentence level by the mentally retarded subjects who were impressionistically dysprosodic.

Lexical stress and sentence accent differ primarily in the length over which prosodic features apply. Lexical stress for words in citation (a neutral form) separates syntactic categories, such as nouns and verbs (Baltaxe, 1981). This neutral lexical stress may be stored in a mental lexicon along with the other phonological information (Cutler and Isard, 1980). This is not to say, however, that speakers do not have recourse to the Main Stress Rule in English. Neologisms and new borrowings into the language could not receive stress otherwise. The most parsimonious analysis of the phonology of a language would posit a lexicon with items more or less fully specified as well as a rule component when needed (Halle, 1973; 1985). The notion that lexical stress may be stored in a mental lexicon is supported by

data from normal slips of the tongue. Lexical stress errors only occur on derived words and the errors represent morphologically related words. However, lexical stress can be used to show contrastive meaning (e.g., INclude not Exclude). This use of prosody is not syntactically or phonologically determined, but is dependent on the contextual demands. Thus, this use of prosody is governed by the semantic/pragmatic domains of language (Bolinger, 1972; Schmerling, 1976; Cutler and Isard, 1980). Sentence accent also separates syntactic categories, such as declarative and interrogative sentence types. Sentence accent can also be used to show contrastive meaning and focus which produces a distinction between given and new information or a distinction between contextually unchanged and changed information. The semantic/pragmatic domains of language govern this use of prosody and thus stress here is under Message Level control (Garrett, 1984). The focused word in an utterance represents the new or changed information and is contextually determined.

In the acoustic analyses, when the Kruskal-Wallis one way analysis of variance was used to compare group mean ranks, no statistically significant group differences were revealed for the first and third stress positions. The second stress position, however, showed

significant differences in mean ranks for the use of higher FØ peak, higher mean FØ, and greater mean IØ. The MR and the CA groups did not use higher FØ peaks as frequently as the LA group in the second stress position. The MR group did not use higher mean FØ or greater mean IØ in the second stress position as frequently as the two groups of normal subjects. All of the groups used higher IØ peaks in the second stress position. None of the groups used longer duration in the second stress position. The group variability in the use of FØ peak, mean FØ, and mean IØ in the second stress position may have been due to the type of word used in the second stress position. Function words, such as prepositions, do not normally receive stress. Content words, such as nouns, normally do receive stress (Minifie, 1983). Prepositions are unstressed except in contrastive or focused productions. Since the three subject groups were not found to differ significantly in their use of the acoustic parameters as cues for stress in the first and last positions, where content words were used but were found to differ in their use of the acoustic parameters as cues for stress in the second position, where a function word was used, one is led to suspect that the way stressed content words are cued may differ from the way stressed function words are cued.

Future research should examine how dysprosodic MR subjects cue stress in the second position of three word utterances when the second position is a content word.

Information obtained in the acoustic analyses in the sentence accent task did not reveal patterns which characterized the dysprosodic nature of the MR subjects' productions. Future research should examine acoustic patterns which give rise to the impression of dysprosody.

The mentally retarded subjects appeared to use idiosyncratic prosodic patterns. In the perceptual analysis, all of the mentally retarded subjects were judged to use a single pattern at least 50% of the time. Two of the MR subjects were judged to use the same pattern for all twelve productions. One was judged to use the same pattern ten of the twelve times. One was judged to use the same pattern eight of the twelve productions. Three subjects were judged to use the same pattern six of the twelve times. For the entire group this represents sixty out of a total of eighty-four productions (71.5%) to be of a single idiosyncratic pattern.

Caution should be taken in using measures such as the Peabody Picture Vocabulary Test (PPVT-R) as the sole instrument for judgment of language level. Since

the PPVT-R is a measure of receptive vocabulary, it only tests one aspect of language. The PPVT-R has been found to be useful in obtaining comparison language age equivalence scores for many different populations. No significant difference was found between performance on the PPVT-R and the McCarthy Scales of Children's Abilities. The PPVT-R is not a measure of general cognitive ability. Therefore, the language age equivalences should not be interpreted as mental ages. Scores on the PPVT-R were found to be lower than scores obtained on the Stanford-Binet Intelligence Scale in a group of trainable mentally retarded individuals (Bracken, McCallum, & Prasse, 1984). Nevertheless, PPVT-R language age equivalences were used as a comparison measure since these scores do represent language processing at the lexical level, one of the levels of prosody which was studied in this research.

The MR subjects in this study were selected from an institution for the mentally retarded. It has been shown that institutionalized mentally retarded individuals do not perform as well as noninstitutionalized mentally retarded individuals on language tests or in personal-social behaviors (Perry, 1974). Therefore, a group of noninstitutionalized, dysprosodic, mentally retarded subjects may not perform comparably to the MR

group in the present research.

Another point regarding subject selection in the present research involves the exclusion of stutterers from the experimental group. It may appear that stuttering and dysprosody are similar inasmuch as they are both impairments of the temporal patterning of speech. Although some of the symptoms are the same (e.g., prolonged vowels; abnormal rate) stuttering is primarily characterized by repetition of segments, whereas dysprosody is primarily characterized by abnormal suprasegmental patterning (Minifie, 1983; Bloodstein, 1979). If this restriction in subject selection would have been lifted, a wider variety of behaviors would have been examined (e.g., segmental repetitions; lengths of blocks). It was this researcher's objective to examine the use of stress on two different linguistic levels in individuals who appeared to exhibit an impairment in the use of prosody. It was not within the scope of this research to examine the influence of stuttering behaviors on the use of prosody.

Comparison of the sentence accent performance of the LA group with performance of normal children in the same age range from previous studies is difficult to make since different elicitation techniques were used

and since previous studies examined stress in S-V-O sentences and this research examined S-Prep-O utterances (Baltaxe, 1984; Hornby and Hass, 1970; and Weiss, et al., 1985). Hornby and Hass (1970), who used two-picture sequences differing in one element, found that the normal children in their study made more stress errors in the object position and the least stress errors in the subject position. Baltaxe (1984), who used yes/no questions, the answers to which were counterfactual to the context (toys were manipulated in the context), found that the normal children in her study made more stress errors in the verb position than in the subject or object positions. She found no errors in the subject or object positions. Weiss, et al. (1985), who used photograph pairs differing in one element, found that the normal children in their study made more stress errors in the object position and the least stress errors in the subject position. The LA group in the present research performed best when stressing the second position (preposition) and made more stress errors in the subject position. None of the other studies found these results.

Normal adults would be expected to use prosody without errors in distinguishing contextually unchanged information from contextually changed information. The

CA group obtained a PC score of 74.17% in the sentence accent task. This score does not represent an inability to use correct stress. It may be a function of normal use of conversational presupposition. Both the subject and the examiner shared knowledge of the contextual changes being made. There was no listener present in the data collection setting who was unaware of the physical context. A greater communicative need might have been established if the subjects had been describing the toy locations to someone who was unaware (someone who did not have shared knowledge) of the contextual changes occurring. A greater communicative need might have motivated the use of prosody to accomplish the task of distinguishing contextually unchanged information from contextually changed information in all three groups. Future experiments should incorporate this important consideration.

Another aspect of the sentence accent task which might have contributed to its artificiality was the use of three word utterances instead of true sentence forms. The unnaturalness of the subject-preposition-object utterances which were used might have interfered with the subjects' use of prosody.

Another important consideration for future investigation is to incorporate questions as stimuli,

the answers to which are counterfactual to the context. If the man is in the house, ask the subject if the man is on the house. It would appear that this task might motivate a need to use prosody to accomplish the communicative task more than spontaneous descriptions of context, especially if the stimulus question included more prominence on the word which would be counterfactual to the context. See Baltaxe (1984) for more specific procedures.

Because of the complexity of the lexical items which use prosody to differentiate syntactic categories (e.g., noun, INsult; verb, inSULT) investigation of the use of prosody at this level may not be warranted with the severe mentally retarded population. However, future research should attempt to investigate this group's ability to use prosody to show contrasts at the word level in different ways. This can be done by asking questions such as, "Is this toothPASTE ?" when showing a picture of a toothbrush. If the subjects use prosody to show this contrast at the lexical level, but do not show it at the sentence level, the breakdown may be related to length and, possibly, to memory for prosodic elements. If these subjects can use prosody to show contrasts in questions, the answers to which are contextually counterfactual at both the lexical level

and at the sentence level, then the breakdown may be related to task complexity, and not to length. Describing context changes (as in the present research) without the benefit of yes/no questions as cues for establishing communicative need for use of prosody, may be beyond the cognitive capacity of severe mentally retarded individuals.

Mentally retarded individuals who are impressionistically dysprosodic appear to possess the capability of accessing prosodic information along with other phonological information for lexical items. They do not, however appear to be able to use prosody to distinguish contextually unchanged information from contextually changed information. This research supports these two claims. The mentally retarded subjects in this research did, however, appear to conceptually distinguish contextually unchanged information from contextually changed information. During practice for the sentence accent task many of the mentally retarded subjects used strategies other than prosody to make these distinctions. Three of the subjects used ellipsis to distinguish unchanged/changed information. They omitted the unchanged information. By omitting the unchanged information, the changed information was brought into "focus". Several of the subjects used

definite articles to distinguish unchanged/changed information. Future research should be conducted to systematically examine how dysprosodic, mentally retarded individuals typically distinguish contextually unchanged information from contextually changed information.

An issue which was not systematically addressed in this research, but which should be considered in future research is this population's ability to imitate prosodic changes. During an informal observation, two of the MR subjects appeared to be able to imitate stress patterns in three word utterances. Systematic observations should be made of imitation ability in future research. If it is found that MR subjects distinguish unchanged/changed information and that they can successfully imitate prosodic patterns, it seems plausible that they could be trained to use prosody to distinguish unchanged from changed information in context.

Before training strategies are addressed much more research is needed to determine the level of prosodic disturbance in this population. At this point we have evidence to support the notion that this population is capable of using lexical stress correctly, but is not capable of using prosody to distinguish contextually

unchanged from contextually changed information at the sentence level.

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APPENDICES

APPENDIX A: JUDGES' FORMS

Subject Number:_________

Lexical Stress: Place a check in the space designating the syllable which you perceive to be stressed. If both syllables are perceived as equally stressed, place a check in the space provided.

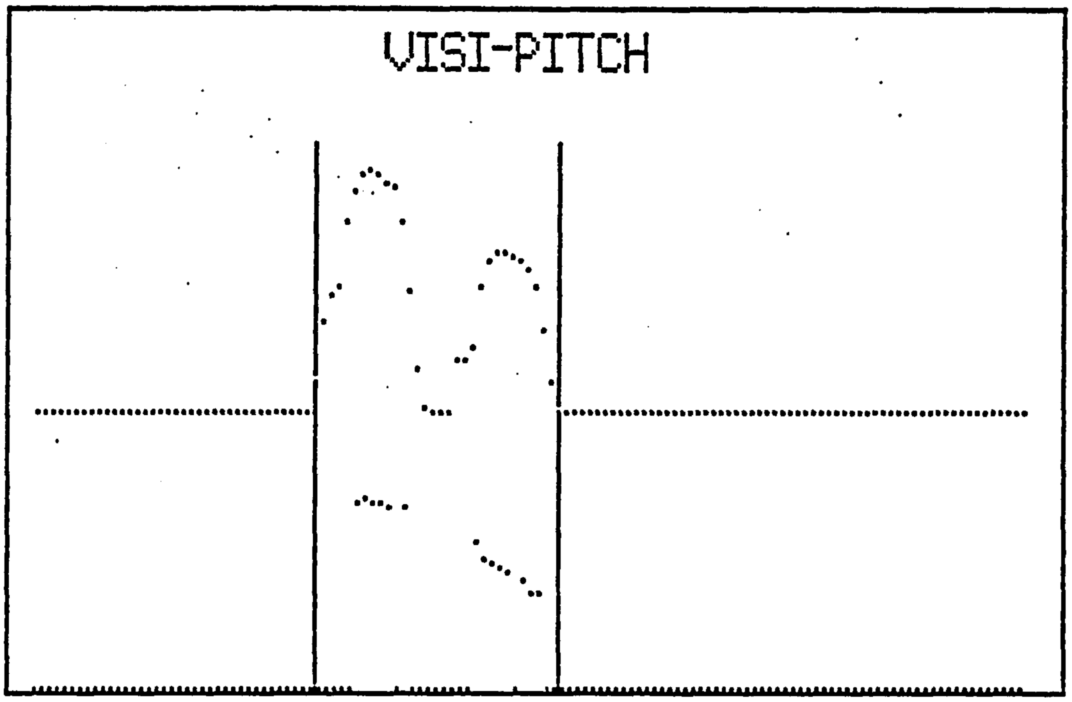
	Syllable 1	Syllable 2	Equal Strs
TURKEY	______	______	______
MONKEY	______	______	______
PILLOW	______	______	______
CHIMNEY	______	______	______
WINDOW	______	______	______
RABBIT	______	______	______
PENCIL	______	______	______
WAGON	______	______	______
TABLE	______	______	______
APPLE	______	______	______
GIRAFFE	______	______	______
GUITAR	______	______	______
CANOE	______	______	______
BALLOON	______	______	______
HELLO	______	______	______
RACOON	______	______	______

Subject Number:________

Sentence Accent: Place a check in the space designating the syllable which you perceive to be stressed in the following twelve productions of "man in house". If a stressed syllable can not be determined place a check in the space provided.

	Syllable 1	Syllable 2	Syllable 3	Undeterminable
1.	________	________	________	________
2.	________	________	________	________
3.	________	________	________	________
4.	________	________	________	________
5.	________	________	________	________
6.	________	________	________	________
7.	________	________	________	________
8.	________	________	________	________
9.	________	________	________	________
10.	________	________	________	________
11.	________	________	________	________
12.	________	________	________	________

APPENDIX B: SAMPLE PRINTED CONTOURS



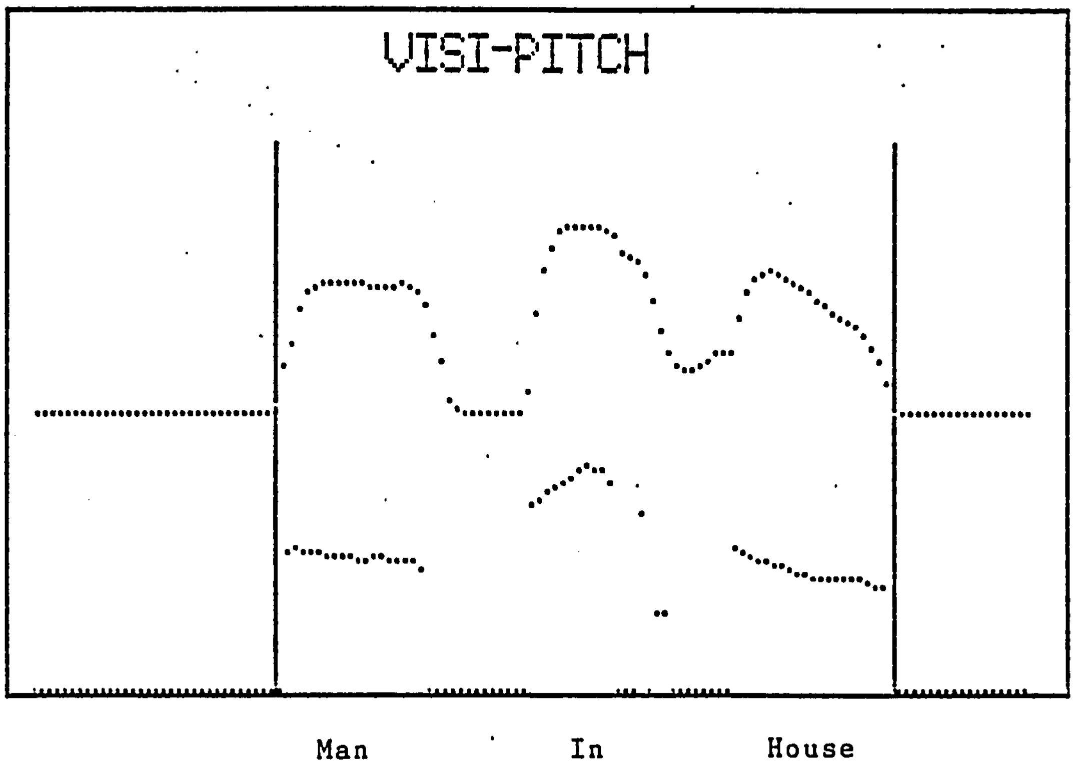
Turkey

TRIGGER NORMAL/CONTINUOUS

ERASE NORMAL/OVERWRITE LIMITER OFF/ON

SCREEN LOWER/UPPER/FULL L 35.4DB ---- HZ

CURSOR LEFT/RIGHT R 31.0DB ---- HZ



TRIGGER NORMAL/CONTINUOUS

ERASE NORMAL/OVERWRITE LIMITER OFF/ON

SCREEN LOWER/UPPER/FULL L 31.5DB ---- HZ

CURSOR LEFT/RIGHT R 30.4DB ---- HZ

APPENDIX C: RAW DATA FROM LEXICAL STRESS EXPERIMENT

COLUMNS:

1. Subject group (1 = CA, 2 = LA, 3 = MR)
2. Subject number
3. Word type
4. Word number within word type group
5. Syllable 1 FØ
6. Syllable 1 IØ
7. Syllable 1 Duration
8. Syllable 2 FØ
9. Syllable 2 IØ
10. Syllable 2 Duration
11. Syllable with peak FØ
12. Syllable with peak IØ

1	1	1	1	198	47	19	286	44	17	2	1
1	1	1	2	215	51	19	282	45	19	2	1
1	1	1	3	237	45	09	203	51	25	1	1
1	1	1	4	213	51	14	232	52	25	2	1
1	1	1	5	203	55	25	225	50	24	2	1
1	1	2	1	190	47	24	262	44	11	2	1
1	1	2	2	222	51	19	252	45	22	2	1
1	1	2	3	204	51	27	241	47	17	2	1
1	1	2	4	209	44	24	254	47	17	2	1
1	1	2	5	212	49	16	230	46	17	2	1
1	2	1	1	214	51	20	152	44	19	1	1
1	2	1	2	201	54	25	154	42	20	1	1
1	2	1	3	186	50	31	145	44	14	1	1
1	2	1	4							1	1
1	2	1	5	207	58	22	156	51	28	1	1
1	2	2	1	181	50	33	088	41	11	1	1
1	2	2	2	209	51	20	165	46	24	1	1
1	2	2	3	191	51	33	172	49	25	1	1
1	2	2	4	201	52	27	163	47	20	1	1
1	2	2	5	193	49	20	181	49	20	1	1
1	3	1	1	240	46	24	307	46	16	2	2
1	3	1	2	215	52	32	278	44	22	2	1
1	3	1	3	229	47	24	257	48	36	2	2
1	3	1	4	236	52	30	251	55	30	2	2
1	3	2	1	227	47	28	292	49	19	2	1
1	3	2	2	207	46	20	270	47	35	2	2
1	3	2	3	228	49	30	271	51	22	2	2
1	3	2	4	239	47	33	195	50	20	2	2
1	3	2	5	224	49	19	273	49	27	2	2
1	4	1	1	171	45	17	141	42	12	1	1
1	4	1	2	154	49	17	150	41	14	1	1
1	4	1	3	159	47	12	147	49	24	1	1
1	4	1	4	161	51	20	144	49	24	1	1
1	4	1	5	159	54	14	144	49	28	1	1
1	4	2	1	152	48	19	182	47	11	2	1
1	4	2	2	152	46	22	167	44	16	2	1
1	4	2	3							2	1
1	4	2	4	204	43	22	151	51	25	2	1
1	4	2	5	136	46	16	138	43	14	1	1
1	5	1	1	120	43	20	151	38	19	2	1
1	5	1	2	117	45	33	135	37	19	1	1
1	5	1	3	122	40	12	110	41	30	2	1
1	5	1	4	125	45	17	127	42	22	2	1
1	5	1	5	128	47	12	130	40	35	2	1
1	5	2	1	120	44	16	110	41	22	1	2
1	5	2	2	120	43	25	162	37	32	2	1
1	5	2	3	116	46	24	119	38	36	2	1
1	5	2	4	118	42	19	112	37	16	1	1
1	5	2	5	121	46	19		32	20	1	1
1	6	1	1	224	44	19	197	39	14	1	1
1	6	1	2	206	51	19	266	42	16	2	1
1	6	1	3	278	54	15	209	54	28	1	1
1	6	1	4								
1	6	1	5	213	52	22	181	51	19	1	1
1	6	2	1	191	53	20	209	45	09	2	1

1	6	2	2	238	46	19	174	41	22	1	1
1	6	2	3	199	53	24	194	45	19	1	1
1	6	2	4	206	47	22	214	43	16	1	1
1	6	2	5	190	47	14	180	40	12	1	1
1	7	1	1	213	51	25	282	48	27	2	1
1	7	1	2	203	54	33	268	47	25	2	1
1	7	1	3	206	52	20	213	55	27	2	1
1	7	1	4	217	52	23	217	56	36	2	2
1	7	1	5	198	56	32	211	55	38	2	1
1	7	2	1	186	55	30	212	53	16	2	1
1	7	2	2	204	52	22	241	48	30	2	1
1	7	2	3	190	56	33	251	53	28	2	1
1	7	2	4	196	53	30	229	51	24	2	1
1	7	2	5	194	54	20	254	51	25	2	1
2	1	1	1	318	43	20	208	42	14	1	1
2	1	1	2	312	51	24	225	44	24	1	1
2	1	1	3	293	50	24	214	42	32	1	1
2	1	1	4	295	51	19	240	48	40	1	1
2	1	1	5	278	53	30	212	45	38	1	1
2	1	2	1	289	50	33	185	44	09	1	1
2	1	2	2	312	49	17	208	43	38	1	1
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2	2	1	3	267	53	46	204	48	43	1	2
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2	2	2	3	284	53	44	227	47	59	1	1
2	2	2	4	244	48	43	196	41	30	1	1
2	2	2	5	304	51	19	231	46	32	1	1
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2	3	1	2	409	47	20	263	36	16	1	1
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2	3	1	4	467	49	16	347	45	35	1	1
2	3	1	5	400	48	38	300	40	41	1	1
2	3	2	2		40	06		44	38	1	1
2	3	2	3	407	53	40	285	40	43	1	1
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2	4	1	4	318	49	35	329	46	20	2	1
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2	4	2	4	301	46	14	308	41	32	1	1
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2	5	1	3	456	51	20	295	49	48	1	1
2	5	1	4	446	54	33	301	50	49	1	1
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2	5	2	3	394	58	35	261	47	44	1	1
2	5	2	4	423	56	32	269	44	22	1	1
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2	6	2	4	245	52	36	217	48	35	1	1
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3	1	2	2	223	54	14	187	57	33	2	2
3	1	2	3							2	1
3	1	2	4							1	1
3	1	2	5	180	51	22	244	51	25	2	1
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3	2	1	5	198	54	27	212	53	30	2	2
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3	3	1	1								
3	3	1	2	115	51	30	119	51	46	1	1
3	3	1	3								
3	3	1	5	123	51	28	122	50	44	2	1
3	3	2	1	121	47	36	134	48	27	2	2
3	3	2	2								
3	3	2	3	116	43	56	132	46	54	2	1
3	4	1	1	253	47	16	174	40	12	1	1
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3	4	1	3	244	51	08	163	45	09	1	1
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3	4	2	2	290	56	17	152	38	17	1	1
3	4	2	3	192	46	28	108	35	11	1	1
3	4	2	4	214	49	19	218	47	12	1	1
3	4	2	5		50	17		36	04	1	1
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3	5	2	4	141	51	27	140	42	12	2	1
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3	6	1	1	165	59	24	144	45	36	2	1
3	6	1	2	153	53	28	145	46	32	1	1
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2	1	4	1	281	47	09	245	46	76	1	1
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2	3	4	2							1	2
2	3	4	3							2	2
2	4	3	1	326	42	19	325	49	72	2	2
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2	4	4	1	268	42	11	270	42	38	1	1
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2	4	4	3							2	2
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2	5	3	2	281	48	12	342	52	64	2	2
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3	2	3	1	168	54	17	167	56	54	2	2
3	2	3	2	170	52	24	199	45	43	2	1
3	2	4	1	151	59	14	175	50	64	2	2
3	2	4	2	163	52	12	163	54	44	2	2
3	2	4	3	160	58	17	190	51	57	2	1
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3	3	4	1	128	49	27	126	48	41	1	1
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3	4	4	2								
3	4	4	3								
3	5	3	1	157	52	08	196	57	32	2	2
3	5	4	1	121	48	14	121	50	25	2	2
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3	6	3	2	151	53	24	145	48	41	1	1
3	6	4	1	189	52	17	137	50	44	2	2
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3	7	3	2	105	48	35	097	42	78	2	2

APPENDIX D: RAW DATA FROM SENTENCE ACCENT EXPERIMENT

COLUMNS:

1. Subject group
2. Subject number
3. Sentence number
4. Word with target stress
5. Word with peak FØ
6. Word with peak IØ
7. Word 1 FØ
8. Word 1 IØ
9. Word 1 Duration
10. Word 2 FØ
11. Word 2 IØ
12. Word 2 Duration
13. Word 3 FØ
14. Word 3 IØ
15. Word 3 Duration

1	1	01	3	3	1	206	52	27	200	52	16	230	47	51
1	1	03	3	3	1	209	54	27	200	52	19	218	45	51
1	1	07	2	2	1	203	54	22	238	54	22	230	45	60
1	1	08	1	1	1	221	54	28	195	54	17	209	46	51
1	1	09	2	3	2	234	51	40	226	51	25	247	45	48
1	1	11	3	3	1	207	54	23	197	52	20	226	45	51
1	1	12	3	3	1	203	53	20	198	52	19	219	44	43
1	2	01	2	2	2	167	49	20	222	55	24	148	41	38
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1	2	03	1	1	1									
1	2	04	1	1	1									
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1	2	07	3	3	3									
1	2	08	1	1	1									
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1	3	02	2	2	2	218	51	27	260	51	22	229	44	67
1	3	03	3	3	1	221	53	27	207	52	17	229	43	68
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1	3	07	2	2	2	234	52	27	269	53	20	249	44	59
1	3	09	2	3	2	218	52	27	243	49	24	233	42	62
1	3	11	3	3	1	233	55	25	211	51	22	234	46	73
1	3	12	3	3	1	234	55	28	226	52	22	249	45	67
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1	4	05	2	3	2									
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1	4	07	3	1	2									
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3	7	07	1	1	1	098	49	112	091	44	76	088	39	54

VITA

KERRI SIMPSON REMMEL

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1976	B.S. in Speech Pathology Louisiana State University

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Speech and Hearing Consultant II
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Thibodaux, Louisiana

Assistant Speech Pathologist
East Baton Rouge Parish School Board
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LICENSE AND CERTIFICATION

Licensed in Louisiana
ASHA Certificate of Clinical Competence - Speech Pathology

PROFESSIONAL ORGANIZATIONS

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Member of the Louisiana Speech and Hearing Association
Program Chairman of the Northeast Louisiana New Voice Club

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Kerri S. Remmel

Major Field: Speech Pathology

Title of Dissertation: Aspects of Prosody in the Mentally Retarded Population.

Approved:

Paul R. Hoffman
Major Professor and Chairman

William Coyle
Dean of the Graduate School

EXAMINING COMMITTEE:

Hugh W. Buckingham

George Yule

R G Daniloff

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Date of Examination: November 1, 1985