

The Effects of an Intoning Therapy on the Speech
of a Developmentally Apraxic Adult

Jennifer D. Hyland and Malcolm R. McNeil
University of Wisconsin, Madison, Wisconsin

INTRODUCTION

Melodic Intonation Therapy (MIT) has been suggested as an effective procedure for adults with apraxia of speech (Albert, Sparks, and Helm, 1973; Sparks, Helm and Albert, 1974). More recently, using single subject experimental designs, Helfrich-Miller (1984); Doszak, McNeil, and Jancosek (1981); Krauss and Galloway (1982); and Schumacher, McNeil and Yoder (1984) have documented the efficacy of MIT in the treatment of children with developmental apraxia of speech. However, the effects of MIT on developmentally apraxic adults have not been addressed. For this reason, and because we wanted to know if our current treatment was effective, a study was conducted to investigate the effects of a derivative of MIT on the speech of a developmentally apraxic adult. Specifically, we investigated the efficacy of intoning therapy on one subject's consonant and vowel productions from selected meaningful phrases and sentences.

METHOD

The subject was a 33-year-old female with a high school education. She was diagnosed as having developmental apraxia of speech based on a thorough case history and behaviors consistent with those descriptive of adult acquired apraxia of speech. These characteristics are presented in Table 1 and summarized from those of Wertz, LaPointe, and Rosenbek (1984).

Table 1. Common speech and nonspeech characteristics displayed in the subject's speech.

1. Initial consonant phonemes misarticulated more frequently than final consonant phonemes.
 2. Difficulty with volitional speech.
 3. Difficulty with imitative speech.
 4. Disturbed prosody.
 5. Majority of errors are close approximations of target sounds.
 6. Anticipatory articulation errors.
 7. Inconsistent awareness of errors.
 8. Groping behaviors (auditory and visual).
 9. Improved performance with visual cues.
 10. Schwa insertion.
 11. Sound perseverations.
 12. Sound substitutions, distortions and additions predominate. Sound omissions, prolongations and repetitions noted less frequently. Most errors are variable.
 13. Laryngeal and facial tension, struggle behavior.
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Table 2 summarizes the speech and language tests administered prior to the initiation of the study. Her performance on these language usage and auditory processing tests was judged to be within normal limits for persons her age.

The subject had received intermittent treatment for her speech deficit over a 14-year period. Past therapeutic approaches were all judged limited in their success by the patient and by the clinicians. Based on the subject's limited success with previous therapeutic techniques and her initial success with the intoning treatment, the present modified Melodic Intonation Therapy protocol was implemented.

Modification of the MIT protocol. The technique utilized in this experiment was a modified version of the Sparks and Holland (1976) Melodic Intonation Therapy Protocol (MIT). The technique employs an intoning procedure to facilitate verbal production. Intoning involves an alternation between high and low pitches about the fundamental frequency of the intonational contour. The modified version of MIT utilized in this study consisted of three levels of difficulty, each containing a series of steps as summarized in Table 3. The first level moved from the experimenter and subject intoning phrases in unison to imitation, to the subject responding to a request for a repetition. Level II proceeded similarly to level I, however, difficulty was increased by the introduction of delayed responses and intoned responses to intoned questions. Level III progressed toward normal speech prosody by fading the intoning.

Design. A single subject multiple baseline, multiple withdrawal, changing criterion design was chosen to measure the effects of the intoning protocol on this subject's speech. Baseline data on four stimulus levels was obtained for several sessions prior to the initiation of treatment and also during each treatment session. Maintenance probes were taken on all lists preceding the treated list. Generalization probes were taken two lists immediately following the treated list.

In addition to the multiple baseline design used, several naturally occurring withdrawal periods occurred when the subject took breaks from therapy (breaks ranged from 2-1/2 to 4 weeks). A one-week break from therapy was also devoted to retraining of the melodic pattern used during therapy sessions. This occurred because the subject somehow forgot or became confused by the intoning procedure and required some practice with the technique before continuing with the therapeutic process. Advancement to the next step or level within the modified intoning protocol or advancement to a new list was made as criteria were met. In this way, changing criterion across lists was made part of the design.

Stimuli. Table 4 summarizes the criteria used for the construction of each list of the stimuli and an example from each list. Four levels were used, with each level consisting of a pair of 10-item stimulus lists (each pair of lists were phonetically similar). Lists were arranged in order of difficulty. This hierarchy was predicted from an analysis of the subject's speech from the "typical" hierarchy of speech sounds that apraxic persons have difficulty with, as proposed by Rosenbek (1978). The Appendix contains the stimuli used in this investigation.

Table 2. Speech and language tests administered and their results.

Test	Results
1. Speech motor assessment	No oral motor speech and nonspeech tasks revealed pathological signs.
2. Word Fluency Test (test of word retrieval)	A score of 25 on this test placed the subject below the 10th percentile for normal females her age. Aphasic patients with this score are placed between the 80th and 90th percentile. Subject indicated she "drew a blank" and felt "frozen" during the task. She felt she did not employ any type of phonetic or semantic strategies for retrieving words.
3. Peabody Picture Vocabulary Test- Form M (test of receptive vocabulary)	Score of 151 (99+ percentile) placed the subject in the adult range, although below exact CA.
4. Goldman-Fristoe Test of Articulation	On single words, the subject demonstrated several substitution errors including those of place and manner (s/z, b/v, kr/kl) and one omission (-/th).
5. Revised Token Test (RTT) (test of auditory comprehension)	A score of 14.54 placed the subject at the 21st percentile for normal adults.
6. Porch Index of Communicative Ability (PICA)	Subject achieved the following mean scores: verbal - 14.00 gestural - 14.35 graphic - 13.32 overall - 13.92
7. Non-standardized speech protocol evaluating the consistency and variability and type of apraxic errors relative to imitated words, imitated sentences, and elicited words.	Error Consistency and Variability: Results indicated the subject was more consistent on imitated words followed by imitated sentences than on elicited words. Subject was more variable on imitated sentences.
	<p><u>Type of Error</u></p> <p>The majority of error types were substitutions, distortions, and additions, respectively. Substitutions were observed primarily during sentence imitation, whereas distortions were predominant during elicited words with additions seen mainly during word imitation.</p>

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Table 3. Modified melodic intonation therapy protocol.

Stimulus	Response
<u>Level I</u>	
1. Clinician presents intoned item once, then patient joins in.	Patient and clinician intone item in unison.
2. Same as #1, plus clinician fades own participation.	Same as #1, plus patient intones item alone.
3. Clinician presents intoned item once and signals patient to repeat.	Patient repeats intoned item.
4. Clinician intones request, says "What did you say?"	Patient repeats intoned item.
<u>Level II</u>	
1. Same as Level I, step 2.	Same as Level I, step 2.
2. Clinician intones item. Patient repeats intoned item following a 2-3 second delay.	Patient intones repetition of item when signalled.
3. Clinician intones question based on some element of information in item.	Patient intones appropriate stimulus item.
<u>Level III</u>	
1. Clinician intones item. Patient repeats intoned item following a 4-second delay.	Patient intones repetition of item when signalled.
2. Clinician presents item in sprechgesang, inviting patient to participate. Clinician fades own participation.	Patient joins clinician in unison sprechgesang of item. Patient produces item alone.
3. Clinician presents item in sprechgesang. Patient repeats item following a 2-3 second delay.	Patient repeats item in sprechgesang when signalled.
4. Clinician presents item in normal speech. Patient repeats item following 3-second delay.	Patient repeats item in normal speech when signalled.
5. Clinician asks two questions relative to stimulus item.	Patient replies with appropriate stimulus item.

Table 4. Criteria for construction of each list and examples of stimuli used.

<p><u>LEVEL I</u> (List A and B)</p> <ol style="list-style-type: none"> 1. voiceless sounds 2. plosives /p,b/, nasals /m,n/, lateral /l/ 3. front vowels /i,I,e,E,æ/ 4. singletons 5. frequently occurring sounds 6. concrete words 7. mono- and bisyllabic words 8. phrase length = 3 words 9. Examples: list A - "Hit the baseball." list B - "Number your paper." 	<p><u>LEVEL II</u> (List A and B)</p> <ol style="list-style-type: none"> 1. voiceless and voiced sounds 2. plosives /k,g,t,d/, fricatives /f,v/ 3. dental sounds /θ,ð,ʃ/ 4. concrete words 5. bi- and trisyllabic words 6. phrase length = 3-4 words 7. Examples: list A - "He developed confidence." list B - "Cook his favorite dinner."
<p><u>LEVEL III</u> (List A and B)</p> <ol style="list-style-type: none"> 1. primarily fricatives /s,z,θ,ð/ 2. palatal sounds /ʃ,ʒ/ 3. back vowels /u,v,o,ɔ,a/ 4. consonant clusters 5. concrete and abstract words 6. bi- and trisyllabic words 7. phrase length = 5-6 words 8. Examples: list A - "The manager was being facetious." list B - "The journalist wrote a paragraph." 	<p><u>LEVEL IV</u> (List A and B)</p> <ol style="list-style-type: none"> 1. primarily affricates /tʃ, dʒ/, some fricatives /s,z,θ,ð,ʃ,v/ 2. voiced sounds 3. consonant clusters 4. abstract words 5. 3-5 syllables/word 6. phrase length = 5-6 words 7. Examples: list A - "There was insufficient compounding evidence." list B - "Fraternalizing with the customers wasn't permitted."

Training, Probes, Scoring criteria, and Presentation of Stimuli. The melodic pattern used consisted of a High-Low-High-Low melody matched to each syllable. Therapy was conducted over an eight-month period yielding a total of 28 therapy sessions. Sessions lasted one hour with 15 minutes devoted to obtaining a baseline and 45 minutes to treatment. As stated above, several naturally occurring breaks ranging from 2-1/2 to 4 weeks were interspersed throughout the course of treatment.

Treatment began with stimulus list 2A at level I, step 1. List 2A was chosen as the first stimulus list for treatment because baseline performance on list 1A and 1B was above criterion. During treatment, consonants and vowels were scored for accuracy. Responses were judged as incorrect if they were perceived as sound substitutions, additions, omissions, repetitions, audible groping, and self-corrections. Correct productions permitted prolongations, pauses, distortions, and silent groping if these did not distract from identification of the target sound.

Each stimulus item from a list was run through the same step in the intoning protocol until criteria were met. One production was requested; if incorrect, a second production was required. A +/- scoring system was used. Only the first production was scored. All stimuli within a list were randomized for each block of 10 trials to avoid an order effect.

In this procedure, the subject was given an auditory model as well as a visual display of the stimulus item. Stimuli were printed on cards with each syllable raised or lowered to represent the High-low-high-low melodic pattern. As stated above, the criterion for advancement to the next step or level was 80% correct per block. When performance fell below 60% for a block, treatment on the following block resumed at a lower level. Criterion for advancement to a new list was 90% accuracy in three consecutive sets of 10 trials (i.e., three consecutive blocks). When advancing to a new list or following a withdrawal period, treatment resumed at a lower level or at an easier step within a level. When the accuracy of a previously treated list dropped below 60% on any of the maintenance list probes that preceded the treatment list, treatment was reestablished on that list.

Reliability. Both intrajudge and interjudge reliability were assessed on two separate occasions to measure the consistency of judgments of the subject's productions. Measures were taken on audio tape during the initial baseline and a second time two-thirds of the way through the treatment phase. Point-to-point intrajudge reliability, determined by a second scoring of the tapes, was 95% for both baseline and treatment phases. Point-to-point agreement scores for interjudge reliability were 93% and 97% for baseline and treatment phases respectively. The second judge used for the interjudge reliability was a certified speech-language pathologist.

RESULTS

Figure 1 displays the multiple lists (crossing the vertical axis of the figure) that were either treated or probed, the baseline and maintenance data for each list (connected by the X's in the unshaded areas) the percentage correct for each list during the treatment or retraining phases (shaded areas connected from session to session with 0's) and the withdrawal periods (shaded with the diagonal lines through them). The horizontal axis displays each session and each small vertical marking at the top of list 1A represents a one-week time period. Unshaded areas of x/s represent baseline, maintenance, and generalization performance. Each data point represents the average of 10 trials within each session.

Figure 1 illustrates the results of training over an eight-month period on all lists. Treatment began on list 2A and proceeded to lists 2B and 3A, respectively as criteria were met. In general, performance improved following the introduction of treatment. As treatment was introduced to a new list, advancement within the intoning protocol followed. Level III of the intoning program was reached in both lists 2A and 2B. However, the subject went no further than level I in list 3A before treatment was terminated.

Observation of performance on the untreated lists revealed a generalization or practice effect for list 1A, as a slight rise following baseline. Performance on untreated lists 1B, 3B, 4A and 4B was relatively stable suggesting no influence of the treatment on the other lists and no general maturation or other source of internal invalidity.

In reviewing the effects of the withdrawal periods on the subject's behavior, performance was maintained or improved for the treated lists only. However, an exception was seen following the four week withdrawal period where performance declined. In general, performance on untreated lists following withdrawal periods was maintained or reduced (with the exception of list 1A).

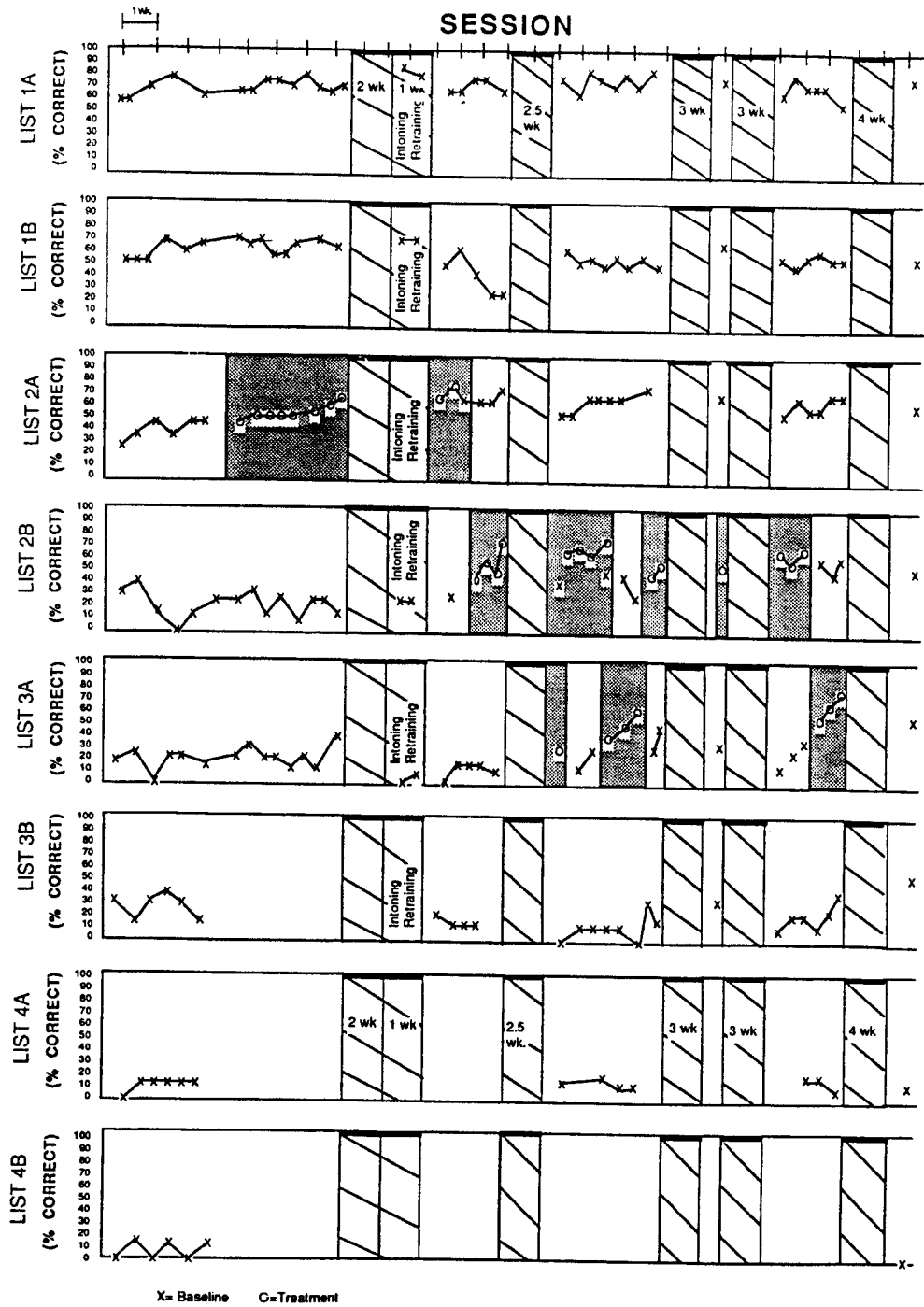


Figure 1. Treated and untreated stimulus lists: Percentage of correct productions by session.

DISCUSSION

In reviewing the results of this study, it can be seen that all treated lists (2A, 2B, 3A) improved, and this improvement can be attributed to the effects of the treatment procedures. There was also evidence to support generalization or a practice effect for list 1A. There was also a maintenance effect demonstrated for list 2A. Generally, following withdrawal periods, maintenance or improvement in the subject's performance occurred for the list being treated. This was not observed for the untreated lists.

The subject progressed through all three levels of the intoning protocol when lists containing less complex stimuli were targeted for training (2A, 2B). When a more difficult list (3A) was trained, the subject remained at level I over all treatment sessions. It cannot be determined whether this subject would have progressed through other levels on this list with extended treatment. Our belief is that she would have.

We have only incompletely addressed the issue of external validity or generalization for this treatment procedure and this subject. The fact that untreated lists of equal or harder difficulty did not change while the treated lists did is evidence against generalization. We did not look beyond those measures within the treatment for any changes in behavior that this technique might have influenced in addition to those used as dependent variables. These social validation studies would need to be performed before the technique described here can be offered as a technique recommended for other developmentally apraxic adults.

During the implementation of this study, several problems arose. 1) On some occasions, intoning alone was not enough to improve the subject's performance on more difficult stimuli. In these instances, the subject was provided with phonetic placement cues. 2) The subject sometimes became confused about the intoning pattern. Difficulty matching the High-Low-High-Low melodic pattern was exhibited. At this point, treatment of the lists was dropped and concentration was placed on stabilizing the melodic pattern for 2 sessions. 3) Several times during the study the subject experienced high levels of stress. Prior to the study, a relaxation technique was selected and utilized by the subject during these times to reduce stress.

The results of this study are interpreted as evidence that the intoning treatment used in this investigation and in previous studies with developmentally apraxic children was efficacious for this developmentally apraxic adult to improve her consonant and vowel production in the context of selected meaningful phrases and sentences. Training within the context of the intoning protocol facilitated correct productions of carefully controlled phrases and sentences and in the maintenance of earlier treated stimuli. Although the intoning technique appeared efficacious for this subject, generalization of these findings to the larger population of adults with developmental apraxia of speech is not warranted until the technique has proven efficacious with other developmentally apraxic adult speakers. In addition, the utility of the technique must be judged with some caution until a training procedure for generalization has been established.

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DISCUSSION

- Q: In your criteria you didn't include whether the phrases or sentences used were functional for the patient. I'm wondering, especially given the lack of generalization, how important that might be.
- A: In constructing our stimuli, we used information proposed by Rosenbek (1978) for looking at place, manner, voicing, syllable and phrase length, etc. These stimuli were arranged hierarchically based on our best guess of an easy-to-difficult continuum. In addition, these were all phrases that could be functional (e.g. Hit the baseball, Move your marble). As far as generalization is concerned, our results indicate that treatment was efficacious for these particular stimuli. However, there was no generalization to the more difficult untreated stimuli. As far as generalization to spontaneous speech goes, that was not addressed directly. My impression was, however, that her self-corrections approximated the target sounds as we progressed through the protocol. She was more capable of "zeroing in" on the target. She and her friends had noted an improvement in her speech as well. Of course these are all subjective impressions and more objective data are needed.

- Q: Did you mention why you didn't have her finger tap the stimuli?
- A: No, we did not mention that in our paper. However, the rationale for excluding tapping was that it was tried during some initial diagnostic therapy and it was not effective for her. She had difficulty tapping and intoning simultaneously so we modified the melodic intonation therapy protocol. We used a derivative of the Sparks and Holland program.
- Q: In order to be scored correct, did she only have to get targeted sounds correct or did the whole utterance have to be correct?
- A: We looked at the complete utterance. If there was even one occurrence of a sound substitution, omission, addition, etc., it was scored incorrect. That included nontarget sounds.
- Q: When did you conduct the probe in relation to your treatment?
- A: All maintenance and generalization probes were conducted following the treatment (first 45 minutes). The last 15 minutes were devoted to probing.
- Q: In your therapy protocol, you used an easy-to-hard approach. That is, you gave the patient the most information in the first part of treatment and then you gradually asked the patient to continue with a response but with less cuing. That seems to be the case across all three levels. Is that correct?
- A: Yes, that's correct. There was movement toward normal prosody.
- Q: When you conduct the probe at the end of the treatment session, it's probably more legitimate to do so when you have an order of task difficulty such as you used -- easy-to-hard. A lot of treatments start with the least information and then go to giving the patient more. In those circumstances the probe is probably best conducted at the beginning of the treatment session. Because you conducted your probe at the end of treatment, does your probe data look like your treatment data? Was the way the patient performed on the probe the way they performed on the last step of treatment?
- A: No necessarily, because the probes that were used required the subject to produce stimuli with normal speech prosody. It was a different task.
- Q: So the probe items were never the same ones actually presented in treatment?
- A: No, they were. But she was asked to do something differently. She did not have to produce these with normal prosody as in baseline. Also, the maintenance probes were previously treated stimuli, whereas generalization probes continued as untreated stimuli.
- C: I think that if you're going to look at the functional power of your treatment, you should make the probe somewhat distant from your treatment. I would suggest, especially when you go from hard-to-easy that you always conduct the probe when the patient is coming into the beginning of a treatment session. Then your probes are a conservative, but more legitimate measure of the carryover of the treatment.

- Q: I would like a little bit more information about your label "developmental apraxia of speech." What, in the history or otherwise, led you to label this patient as developmentally apraxic?
- A: She was given her diagnosis based on a thorough case history and behaviors consistent with adult acquired apraxia. This history has accumulated over a 14-year period of treatment. I had seen her at her 13th year of treatment. I consider developmentally apraxic individuals as possessing similar speech characteristics as those of adult acquired apraxics, with the difference being related to etiology.
- Q: Could you speculate on why you didn't get generalization and what you might have done to promote it?
- A: As far as generalization to other stimuli (equal or more difficult) I think when you're conducting research you'd like to see a treatment effect that doesn't generalize so you can demonstrate the efficacy of your treatment technique with these particular stimuli. We did see generalization to list 1A which was an easier list that had never been treated. As far as generalization to the equal or more difficult stimuli, that was not seen and maybe it's a case where you have to just treat those stimuli. It's unfortunate since you'd like a technique that you'd see generalization occurring in.
- Q: Kids with DAS often have learning disabilities, verbal-nonverbal split on IQ scores, and reduced comprehension. Can you characterize this patient with respect to that?
- A: Again if you refer to Table 2, we did language testing with her and she performed within normal limits. She did not have any kind of aphasia, learning disability, or other coexisting language or motor speech disorder.
- Q: I haven't heard of this technique being used with children. Is this something you would use with children with apraxia?
- A: I feel the only children that would be good candidates are those who are fairly intact with the exception of motor programming difficulties. Children that have other difficulties, including those with auditory comprehension difficulties, and what looked like learning problems, really show little progress and generalization usually is nil.

APPENDIX

TREATMENT STIMULI BY DIFFICULTY LEVEL AND LIST WITHIN LEVEL

LEVEL I (List A and B):

LIST A

1. Hit the baseball
2. Obey the police.
3. Pen and pencil.
4. Paddle the boat.
5. White notebook paper.
6. Peanut butter cookie.
7. Today is Monday
8. Mail the letter
9. Make the bacon
10. The naughty boy.

LIST B:

1. Maybe he'll come.
2. Move your marble.
3. Cook the dinner.
4. Number your paper.
5. He likes popcorn.
6. Knitting a bootie.
7. Pull the wagon.
8. Pamper the baby.
9. Buckle your belt.
10. Peddle the bike.

LEVEL II (List A and B):

LIST A:

1. Vacuum the carpeting.
2. Coffee has caffeine.
3. Use the telephone.
4. Pancakes and syrup.
5. I like mashed potatoes.
6. I vacation yearly.
7. Farmers have gardens
8. He developed confidence.
9. She has bitten fingernails.
10. The hurricane became worse.

LIST B:

1. Take your vitamin.
2. Cook his favorite dinner.
3. The doctor is knocking.
4. Hawaii has volcanos.
5. Sharpen Katie's pencil.
6. Yesterday was my birthday.
7. Begin a new paragraph.
8. Campbell's alphabet soup.
9. Football team captain.
10. Handcuff the burglar.

LEVEL III (List A and B):

LIST A:

1. She received a cabbage patch doll.
2. He was given his preference.
3. The performance inspired him.
4. Suddenly he was awoken.
5. Permission for leaving was granted.
6. He benefits from instruction.
7. The flower began to germinate.
8. He maneuvered the vehicle.
9. The manager was being facetious.
10. The theater was destroyed.

LIST B:

1. She listened to the stereo.
2. Typing the letter was tedious.
3. He embellished the apartment.
4. He won the tennis tournament.
5. The astronauts monitored the television.
6. The tablecloth was checkerboard.
7. The journalist wrote a paragraph.
8. He swallowed the medicine.
9. It was a national holiday.
10. I purchased a feathery mattress.

LEVEL IV (List A and B):

LIST A:

1. Refrigeration preserved the vegetables.
2. The belligerent nation wouldn't cooperate.
3. The military vessel was obliterated.
4. There was insufficient compounding evidence.
5. Charlie had an overproductive imagination.
6. He came from a prestigious institution.
7. A statistical analysis was performed.
8. The child's disease is infectious.
9. Several companies invested in stock.
10. The cashier overcharged the customer.

LIST B:

1. Fraternizing with the customers was permitted.
2. There were insufficient funds available.
3. The chinchilla was very ravenous.
4. His request was ostensibly clear.
5. Supervision of the children was required.
6. The agency was amazingly supportive.
7. The criminal relinquished his weapon.
8. A hemoglobin transfusion was scheduled.
9. The examination question was ambiguous.
10. The employee worked diligently.