

Documenting Functional Benefit from FM Technology

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Functional Auditory Skill Development

While the audiologist is responsible for fitting amplification and FM technology, the early interventionist, therapist, or teacher, along with the child's parents, join the audiologist to develop an auditory skills program for a child. The development of functional auditory skills, historically known as auditory training, is the therapeutic program that teaches a child to listen. It requires optimal fitting of amplification. It also requires ongoing monitoring of the effectiveness of the technology the child is using. If the technology is not effective, the team needs to determine what needs to be done to alter the fitting to enhance the child's ability to learn to listen.

What do we know about auditory skill development? We know that auditory skills correlate directly with speech development for children who are deaf or hard of hearing. We know that the development of auditory skills is systematic (Laughton and Hasenstab, 2000, Pollock, 1970) following an inherent hierarchy of skills. And, we know that the development of auditory skills does not happen in isolation. In order to achieve optimal outcomes, specific strategies must be incorporated into that child's routines.

Monitoring Effectiveness

It is important for a child's functional auditory skills treatment program to have an embedded measure of accountability. In order to be accountable, there needs to be a prescribed procedure to measure a child's skills and a way to calculate the improvements

that occur over time. The documentation is used to design a treatment plan and to measure the effectiveness of that treatment plan. In addition, the documentation becomes a tool, used by professionals and parents, to identify skills and effective strategies to be used with the child. This protocol is shared among the audiologist, the (re)habilitation expert, and the parents, all of whom have a vested interest in developing a child's auditory skills and monitoring the child's progress.

The Functional Auditory Performance Indicators (FAPI)

The FAPI (Stredler-Brown A., and Johnson, C., 2002) provides a procedure to establish a profile of a child's auditory skill development, to quantify the level of competency a child acquires with each skill, and to provide accountability.

The FAPI identifies seven categories from the well-known hierarchies of auditory skill development (Caleffe-Schenck and Stredler-Brown, 1992; Erber, 1982; Estabrooks, 1998; Flexer, 1999; Johnson, et al, 1997; Stout and Windle, 1992; Tye-Murray, 1992; Watson, 1993). The categories on the FAPI are defined as:

1. **Sound Awareness:** The child is aware that an auditory stimulus is present. The child may demonstrate awareness of loud environmental sounds, noisemakers, music, and/or speech.
2. **Sound is Meaningful:** The child attends to sounds and associates a variety of auditory stimuli with their sound source. The stimuli include loud environmental sounds or noisemakers,

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music, vocalizations (non-true words) and speech stimuli. A child may simply attend to a sound, which is relatively easy. Or, the child may match the sound with its sound source – a more difficult skill.

3. **Auditory Feedback:** The child monitors the sounds s/he hears. A child may demonstrate this skill by responding to sound when amplification is turned on, by vocalizing in order to monitor when amplification is working, and/or by noticing his/her own vocalizations.
4. **Localizing Sound Source:** The child searches for and/or finds the auditory stimulus. Searching is a prerequisite skill for localizing. Children with hearing in only one ear may not be able to localize to the sound source.
5. **Auditory Discrimination:** The child distinguishes the characteristics of different sounds including environmental sounds, suprasegmental characteristics of speech (e.g., intensity, duration, pitch), non-true words, and true words.
6. **Short-term Auditory Memory:** The child can hear, remember, repeat, and recall a sequence of numbers. This skill is developmentally appropriate for children who are two years of age and older.
7. **Linguistic Auditory Processing:** The child utilizes auditory information to process language. This category measures the ways in which audition is used to sequence elements of language, to learn and use morphemes, to learn and use syntactic information, and to understand spoken language.

There are 31 skills in the entire protocol, with one to eight skills in each category. The skills in each category are listed in hierarchical order.

The FAPI also recognizes that listening occurs in a variety of conditions. A unique feature of the protocol is an in-depth examination of a child's skill in a variety of listening conditions. Testing in various conditions supplies a qualitative report of the child's ability. Some of these conditions are:

- responses to auditory stimuli that are presented in *close proximity* to the child versus responses to stimuli that are *presented far away*
- responses to auditory stimuli that are paired with *visual cues* contrasted to responses to an *auditory stimulus alone*
- responses to auditory stimuli that are presented

in a *noisy situation* versus responses to stimuli that are presented in a *quiet room*

- responses to auditory stimuli that are observed when the child is *prompted* to listen versus *spontaneous* responses to auditory stimuli.

Another novel element of the FAPI is the scoring rubric. This feature provides quantitative documentation of a child's skills. The FAPI is scored by assigning a value to each of the 31 skills that are distributed in each of the seven categories. There are four values that are used to define each skill: "acquired", "in process", "emerging", and "not present". An acquired skill receives a weighted value of three points, in process receives a weighted value of 2 points, emerging is assigned one point, and no points are assigned to a skill that is not present. The profile is generated by calculating the scores on each item of the profile. The weighted scores are added together. Then, the child's score is divided by the total possible points. A percentage score is calculated for each of the seven categories. The profile identifies a child's unique strengths and needs and is used to create goals for the child's individualized program.

A Case Study

The profile of this 2½ year old girl explains the practical application of the results obtained on the FAPI. The girl in this case study had her hearing loss identified shortly after referral on her newborn hearing screen. She was diagnosed with a moderately-severe sensorineural hearing loss and was enrolled in an early intervention program, the Colorado Home Intervention Program (CHIP), at four months of age.

The FAMILY Assessment (Hafer, J.C. and Stredler-Brown, A., 2003; Stredler-Brown, A. and Yoshinaga-Itano, C. 1994) was administered every six months. This assessment includes a comprehensive battery of tests and is used extensively by the early intervention program. Test results indicated that the child's cognitive development was within normal limits for her chronological age. She demonstrated a delay in expressive vocabulary and syntax. An analysis of spoken words indicated she used vowels accurately 52% of the time and produced consonants accurately 38% of the time. This made her speech intelligible 25%–50% of the time.

A summary of this child's functional auditory skills in each of the seven categories of the FAPI

Table 1.

Sound Awareness	Sound is Meaningful	Auditory Feedback	Localizing Sound Source	Auditory Discrimination	Short-term Auditory Memory	Linguistic Auditory Processing
92%	84%	75%	63%	40%	0%	0%

shows a predictable hierarchy of skills with higher mastery of skills in the easier categories (table 1).

Further analysis compares her listening performance in two conditions (table 2). Auditory skills are significantly better when easy listening conditions are present. Performance on the same skills is significantly lower when listening occurs in challenging listening conditions.

Clearly, the use of FM technology will enhance this child’s listening ability in challenging listening conditions such as distance hearing, when stimuli are presented in noise, when stimuli are presented in the auditory-only mode, when an open-set condition is used, when unfamiliar words are used, and when competing activities occur.

Analysis of the specific skills in each of the seven listening conditions provides indicator for treatment. Work on auditory awareness would focus on awareness of speech when speech is presented in the presence of noise, when the child is listening at a distance, and when an auditory stimulus is provided without visual cues.

For the second category, sound is meaningful, the child should work on attending to environmental sounds. While the skills in this category are relatively easy the child needs practice working on this skill in difficult listening conditions such as noisy situations and when the stimulus is presented at a distance.

Goals for searching and localizing to the sound source focus on challenging listening conditions. In addition, some work needs to be done in easy listening conditions because the child finds it difficult to search for and localize a speech stimulus in these easy listening conditions.

The analysis indicates that treatment needs to focus on enhancing auditory discrimination skills in easy listening situations. This child still needs to learn to discriminate true words when the stimulus is close, in quiet, and when presented with a closed set of options. Use of FM technology will certainly enhance this child’s success.

By working on multiple skills in different categories, the child will learn through an *integrated* approach to develop her auditory skills. Of importance, this approach also provides the data needed for program accountability.

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Table 2.

Listening Condition	Score for Easier Listening Conditions	Score for Challenging Listening Conditions
Sound Awareness	100%	83%
Sound is Meaningful	100%	71%
Auditory Feedback	100%	50%
Localization	88%	42%
Discrimination	67%	11%
Short-term Auditory Memory	DNT	DNT
Linguistic Processing	DNT	DNT

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Participant Survey

When implementing a hierarchical approach to develop auditory skills, several techniques from only one category should be selected and implemented at any point in time.

- 1. True
- 2. False

