

Loud & Clear!



A Cochlear Implant Rehabilitation Newsletter

Volume 4 Issue 1

Table of Contents

- Infants and Implants
- The IT-MAIS
- IT-MAIS Results from Young Children with Cochlear Implants
- Using IT-MAIS Results to Guide Communication Therapy
- References

Infants and Implants: Listening Skills in Very Young Children

By Sue Zimmerman-Phillips, M.S., Amy McConkey Robbins, M.S., and Mary Joe Observer, Ph.D.
Edited by Dawn Burton Koch, Ph.D.

Cochlear implants are increasingly being used in children as young as 12 months of age. Because of this trend, it becomes a challenging task to determine implant candidacy and implant benefit in infants and toddlers. Even though the *identification* of a severe-to-profound sensorineural hearing loss can be made reliably in newborns, quantifying the amount of *functional* sensory aid benefit in this population is difficult.

In this issue of *Loud and Clear*, we present information about a measure designed specifically to assess the auditory skills of very young children (the Infant-Toddler Meaningful Auditory Integration Scale



(IT-MAIS) (Zimmerman-Phillips et al. 1997). This tool can be used both to evaluate auditory skill development in very young children before and after implantation and to guide the design of communication therapy. We describe the test briefly, then summarize results from children who have received a CLARION® cochlear implant. Finally, we provide suggestions for therapy that are based on results obtained using the IT-MAIS.

The IT-MAIS

The IT-MAIS is a criteria-referenced measure that employs a structured interview technique to obtain information from parent(s) about the frequency with which a child demonstrates a set of ten auditory or speech behaviors in everyday situations.



An Advanced Bionics® Corporation Publication
www.bionicear.com

The IT-MAIS is a modification of the MAIS (Meaningful Auditory Integration Scale), a measure originally designed to assess the use of everyday listening skills in school-age children (Robbins et al. 1991). Items and criteria-response behaviors were modified on the IT-MAIS to be more appropriate for infants and toddlers.

The IT-MAIS consists of ten probes or questions that are used to query parents about the frequency with which a child demonstrates target behaviors in everyday situations. The IT-MAIS should be administered only in an interview format (having parents complete the form themselves invalidates the results). Based on the dialogue between parent and clinician, the

clinician assigns a rating consistent with the frequency of occurrence of each behavior. Strict scoring criteria have been developed to ensure uniformity among examiners in scoring parents' responses.

The ten probes assess three main areas: vocalization behaviors (Questions 1-2), alerting to sounds (Questions 3-6), and

deriving meaning from sounds (Questions 7-10). Performance is scored in terms of the total number of points accrued out of 40 possible points. A scale of 0 (lowest) to 4 (highest) is used to rate the frequency of occurrence of the target behavior for each question.

IT-MAIS

Results from Young Children with Cochlear Implants

The IT-MAIS has been part of the test battery for assessing benefit from the CLARION cochlear implant since 1997. The IT-MAIS results below are from 90 children (59 children were implanted between 7 and 23 months of age, 31 children were implanted between 24 and 36 months of age). The ten test scores were collapsed into three categories.

- **Vocalization Behavior** (Questions 1-2): These two questions are designed to assess changes in the child's vocal behavior associated with device use. Changes in vocalization associated with auditory stimulation often precede overt behavioral responses to sound in very young children.
- **Spontaneous Alerting to Sound** (Questions 3-6): This group of questions examines the child's ability to alert spontaneously to speech and environmental sounds in everyday situations.
- **Deriving Meaning from Sound** (Questions 7-10): The third group of questions evaluates the child's ability to interpret sound in a meaningful way in everyday situations.

Mean Scores Over Time

The average score was calculated for each child for each category. Then the mean scores were computed for all children.

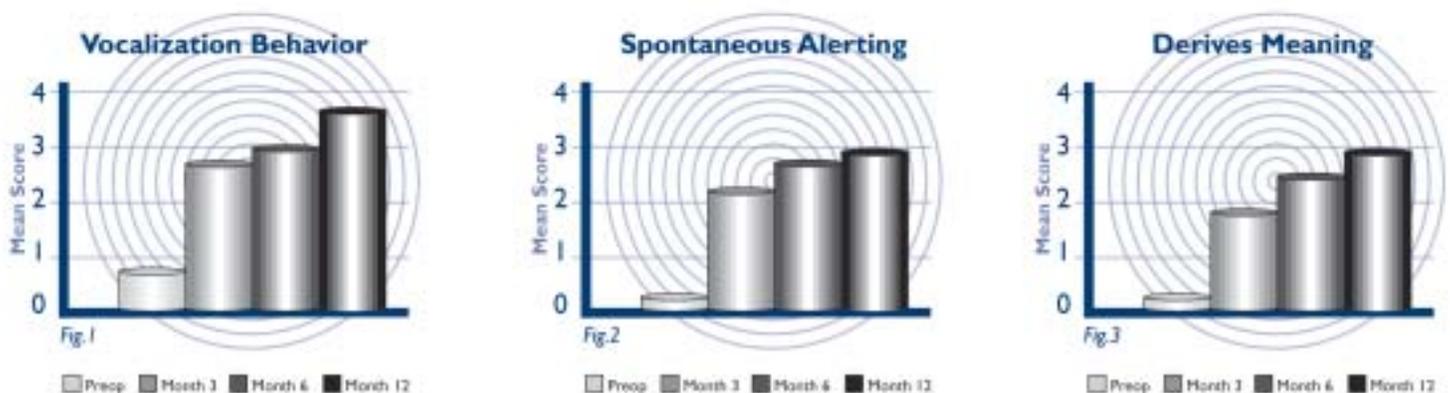


Figure 1 shows mean scores for Vocalization Behavior over time. The preoperative scores indicate that there was little or no change in vocal behavior associated with hearing aid use before implantation. A dramatic increase in vocalization behavior occurred within the first three months of implant use, where the score indicates that, on average, children vocalize occasionally or frequently when using their cochlear implants. The mean score continues to improve at six and 12 months after implantation.

Figure 2 shows mean scores for Spontaneous Alerting over time. Preoperatively, the children did not spontaneously alert to speech or environmental sounds in everyday situations. By three months after implantation, children are beginning to demonstrate this behavior consistently. After six months of device use, the average child responds consistently to speech (e.g., name being called) and environmental sounds in everyday situations. The scores continue to improve at 12 months postoperatively.

Figure 3 shows mean scores for the Derives Meaning category over time. The questions in this category evaluate the most difficult auditory skills that can be assessed using the IT-MAIS. As expected, the children demonstrate slower development of these skills relative to other two categories. By 12 months post-implant, the majority of the children are able to interpret sounds in a meaningful way on an occasional or frequent basis.

In summary, the results suggest that the IT-MAIS, when used in conjunction with other medical and audiological findings, can assist in the determination of implant candidacy in very young children. Preoperatively, no consistent response to

sound in everyday situations was demonstrated by these children. Thus, the inability to acquire auditory skills over time with hearing aids, as measured by the IT-MAIS, can assist clinicians in the determination of implant candidacy. After implantation, the greatest improvements were observed after only three months of implant use. The most robust improvement occurred in vocalization behavior, followed by alerting to sound, and finally interpreting sounds in a meaningful way. These results are consistent with the progression of complexity of auditory behaviors assessed with the IT-MAIS. Thus, clinicians can use this information to gauge progress in very young children with implants. Specifically, notable changes in vocalization behavior should be observed within three months of device use. After six months, children should be responding to sounds in their environments on an occasional or frequent basis and, after 12 months, children should be able to interpret sounds meaningfully on an occasional or frequent basis.

Using IT-MAIS Results to Guide Communication Therapy

While the IT-MAIS can be used as an assessment tool, IT-MAIS results also may be used as a rehabilitation guide, steering the clinician toward appropriate goals for early intervention. Following are some suggested therapy activities that have been used successfully in developing the skills addressed by the ten IT-MAIS probes in young children with the CLARION cochlear implant. These activities represent only a small sample of the many possible therapy

activities that would be appropriate. Note that these activities should take place within the home environment or during a parent-child session where the clinician works alongside the parent(s) to demonstrate these games. This therapy environment will make it easy for parents to continue expanding upon these games at home, where true listening development takes place.

Question 1: *Is the child's vocal behavior affected while wearing his/her sensory aid?*

Evidence of benefit from a cochlear implant is sometimes seen first in the child's vocal output, rather than in auditory perception behaviors. In the early weeks after initial implant stimulation, parents sometimes report that they see a consistent pattern of vocalization changes in their child even though they do not see dramatic changes in listening behavior. The vocalization behaviors are notably different when the device is on compared to when it is off or when it is not working. Therapy can focus on reinforcing a child's use of voice and vocalization on demand to help the child learn that sound can make things happen. Learning this concept is pivotal if children are to progress along the auditory and speech continuum following cochlear implantation. Tannenbaum (1998) describes a game called "The Cat" in which an

association is repeatedly built between an object (the kitten) and the sound it makes (“meow”). A language routine is established that includes putting the kitty to sleep with a very soft voice and waking it up with a loud voice. Notably, the child must vocalize in order to get the kitty.

Sindrey's (1997) suggestions for encouraging spontaneous vocalization include “Come Back” and “Bye Bye and Wanting Up.” In these games, the adult builds a movement pattern over and over with associated words where the child is primarily a spectator. Eventually, the adult breaks the pattern by not using the accompanying vocalization, thereby setting up an expectation that the child will vocalize. Sindrey's “The Equal Time Pie”, Listening Tip #4, provides other helpful pointers. Simmons-Martin and Rossi (1990) also provide many appropriate suggestions for encouraging vocalization in children with hearing loss. Their book is laid out in an outstanding way for parent-child therapy because each page states the learning objective, then gives one column of information describing “How the Teacher Helps” with how-to suggestions, and a second column describing “What the Parent Does at Home” with further suggestions.

Question 2: *Does the child produce well-formed syllables and syllable sequences that are recognized as “speech”?*

Research has shown that babies who are profoundly deaf and receive little or no auditory feedback about their own voice do not develop the same sound-making behaviors as children who can hear. Babbling (consonant-vowel alternations such as “ba ba ba ba ba ba”) almost never

emerge until after a child has learned to coo and vocalize with a range of vowel sounds. Thus, an earlier step to babbling is to encourage vocalizing with vowel sounds that carry prosodic and suprasegmental variations. Walker's (1998) “Ride a Horsie” game is an appropriate activity to address these skills. In this game, the clinician teaches a routine to the child where speech is linked to a movement. Specifically, the “Ride a Horsie” rhyme is spoken by the clinician while the child sits



on the clinician's lap and they bounce and move together. The clinician establishes an *expectation* for repeated activity, she smiles and looks expectantly at the end of the rhyme, signaling that the child must initiate another round of the rhyme with his own vocalization.

To encourage consonant-vowel babbling, repeated use of the “Learning to Listen Sounds” (Estabrooks 1994) or other sets of

onomatopoeic targets is appropriate. Onomatopoeic sounds have multiple segments with highly characteristic suprasegmental patterns, such as large fluctuations in pitch contour or repeated syllables. These sounds are more acoustically salient than single words. They also teach the child a representative sample of early-developing consonants and vowels including ah, ee, and oo (recommended as a first step by Ling 1976), which are produced with maximum excursion of the tongue in three directions. Once these vocalizations are mastered, the child can be taught the other vowels that “fill in” the vowel circle. In addition, onomatopoeic utterances function as “protowords” that help the child understand the consistent link between an object (e.g., a shoe) and a series of spoken sounds (walk, walk, walk). These protowords become a stepping stone towards the use of more symbolic real words.

Question 3: *Does the child spontaneously respond to his/her name in quiet with auditory cues only (no visual cues)?*

Normal-hearing babies reliably recognize their name through listening before they are one year of age. Name recognition is an important milestone for implanted children. Consequently, parents should be advised to call their child's name immediately after initial stimulation and to establish an expectation that the child will hear it. In the “Mirror-Mirror” game (Robbins 1998), the parent helps the child wait quietly and then look into a mirror after she hears her name. In early stages of the game, a detection task is used where the clinician instructs the child to listen, then calls the child's name on every trial. As the child lifts the mirror and looks into it, the clinician or parent models, “That's you! I said, “Susie. That's your name!” At

more advanced levels, the game can be changed to a discrimination task where the clinician sometimes calls the child's name and sometimes says other stimuli, such as the names of other children in the child's family or class. The child's task is to look in the mirror and say, "That's me!" only when her own name has been called, ignoring all other stimuli. Other helpful name recognition activities include "Shoebox" by Zara (1998) and "Where's Mother?" and its variations (Lowell and Stoner 1963).

Question 4: *Does the child spontaneously respond to his/her name in the presence of background noise with auditory cues only (no visual cues)?*

Background or competing noise increases the difficulty of auditory tasks for any listener, including individuals with cochlear implants. The clinician will want to develop name recognition first in quiet (see Question 3) and then use the same activities in competing noise. Typically, a clinician should start with noise that is much softer and less interesting than the signal to which the child should attend. If the child is successful, the task can be made more difficult by presenting louder noise or noise that is more confusing, such as speech or music.

Question 5: *Does the child spontaneously alert to environmental sounds in the home without being told or prompted to do so?*

Within the first weeks or months of implant use, children typically show detection of common sounds in the home, such as the doorbell, knocking, dog barking, telephone, dishwasher, toilet flushing, microwave buzzer, etc. If a child does not detect environmental sounds spontaneously, structured detection tasks can be used. For example, a first step to building consistent detection skills in implanted youngsters is for adults to utilize the "Hands to Ear" response. Anytime a sound occurs in the environment, the adult points to his/her ear with a surprised expression and says, "I hear that!" The adult shows curiosity and searches visually to show the child that he/she is interested in the source of the sound. More structured activities to develop sound detection include the "Will Someone Answer the Telephone?" game (Lowell & Stoner 1963). This detection game involves associating a person with the ringing of a telephone (e.g., "Grandma's going to call"), then waiting quietly until the phone rings loudly. It is a structured detection task because the child is told what to listen for and always hears the same sound.

Question 6: *Does the child spontaneously alert to environmental sounds in new environments?*

This question probes whether a child with a cochlear implant is becoming aware of sounds that occur around him/her, even if the sounds are not familiar or part of the daily routine. Parents can encourage a young child's curiosity and interest in new sounds using Sindrey's (1997) "In the kitchen" activity. The parent and the child explore the kitchen together



and discover all the sounds present there. Sindrey emphasizes not only listening, but associating an onomatopoeic utterance to each action. For example, the adult turns the faucet on and listens to the rushing sound with the child, then imitates the sound by saying "shhhhhhhhhh" when the water is running. Parents also might pair an environmental sound with a repeated word, such as "Round and round and round" as they wipe the kitchen counter clean, or "cut cut cut" as they pretend to use a knife.

Question 7: *Does the child RECOGNIZE auditory signals that are part of his/her everyday routines?*

This behavior indicates that a child not only detects a sound but starts to associate the sound with its meaning. For example, the child might hear the garage door open and know that Daddy is home, or start to clap when he hears someone say, "Patty-cake" from behind his back. Sindrey (1997) provides many excellent suggestions for games that will develop auditory association, such as "Doors", where the child learns to associate and understand knocking, and "The Phone", which teaches the association between ringing and the telephone. Koch (1999) also gives many helpful training suggestions in her curriculum for associating sounds with meaning. For example, the "Auditory Sandwich" technique involves presenting stimuli first through listening, then providing visual cues, then re-presenting the stimuli through listening alone.

Question 8: *Does the child demonstrate the ability to discriminate spontaneously between two speakers with auditory cues only (no visual cues)?*

Identifying a speaker through the characteristics of his/her voice (called an “indexical” cue) relies upon the listener having adequate access to auditory cues. This skill is beyond the capability of many children wearing hearing aids, but often develops nicely in children with cochlear implants. Lowell and Stoner’s (1963) “Hi” game gets family members involved in a speaker identification activity and is an excellent game to play with grandparents or other relatives. The goal is for the child to identify who is speaking based upon voice characteristics. The authors suggest that the child initially have auditory and visual cues as he listens to various speakers’ voices. As he becomes able to recognize people through the quality peculiar to their voice, auditory cues alone are given. This activity is played as a game, so that other family members also take turns identifying voices. Another group activity for voice recognition is “I Know your Voice” (Graham 1992). Children sit in a circle and close their eyes. An adult walks behind the children, tapping on one child’s shoulder. That child then says a designated phrase such as “Hello, how are you?” The children open their eyes and try to guess who spoke based upon listening alone. If unsuccessful, the children can practice recognizing voices with both visual and auditory cues.

Question 9: *Does the child spontaneously know the difference between speech and non-speech stimuli with listening alone?*

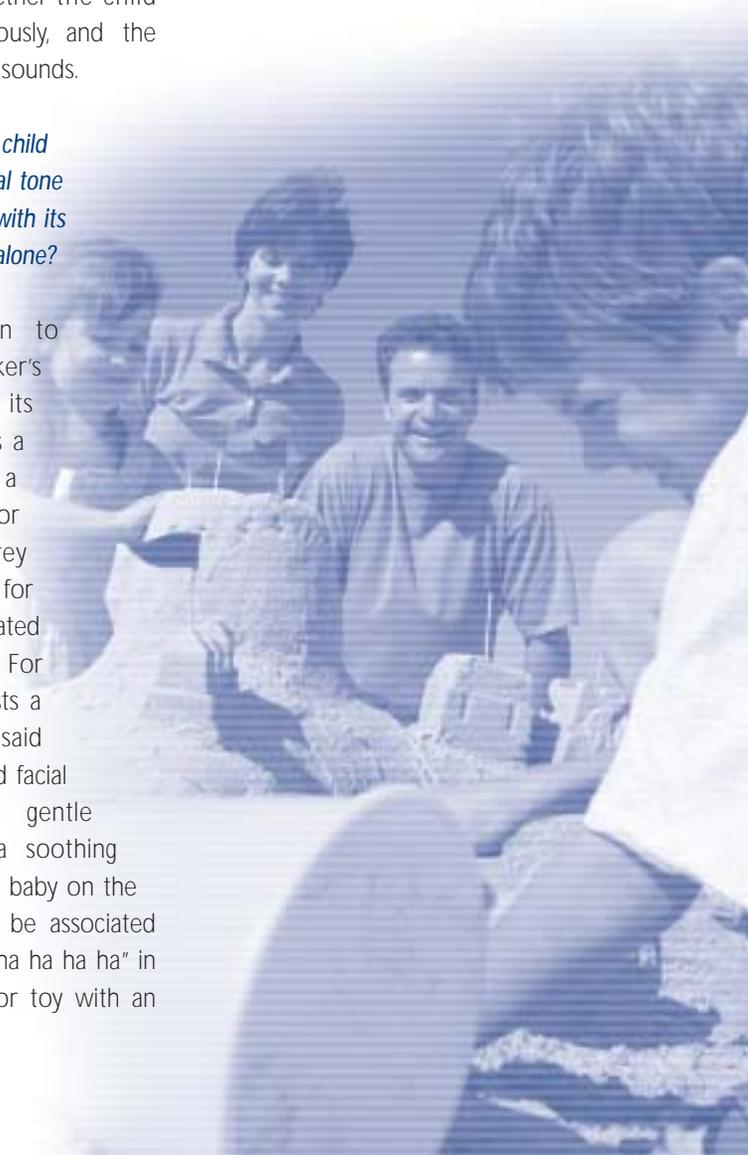
Normal-hearing babies learn quite early that some sounds they hear are made by the human voice and others by

non-human objects. This early categorical perception is an important skill and can be developed in implanted children with training and repeated exposure to meaningful, naturally-occurring sounds in the environment. This skill develops after a child knows that there is a link between sounds and the things that make them (Questions 5 & 6). Taking young children on Listening Walks (Robbins 1998) allow the adult to provide a semi-structured listening activity, even for an infant who is not yet walking. The adult and child together “discover” all the sounds that occur as they walk. The adult points out both human vocal sounds and non-speech sounds. A Listening Walk Log (reprinted in Robbins 1998) is used to record the sounds the child hears, whether the child detects them spontaneously, and the child’s reaction to different sounds.

Question 10: *Does the child spontaneously associate vocal tone (anger, excitement, anxiety) with its meaning, based on hearing alone?*

Young children learn to associate the speaker’s tone of voice with its emotional content, such as a happy soothing voice or a loud angry voice. “The Bee or the Ghost” game (Sindrey 1997) provides a paradigm for distinguishing words associated with a particular emotion. For example, the adult contrasts a ghostly “OOOOOOO” said with a frightened voice and facial expression with a gentle “ahhhhhhhh” said with a soothing voice as he/she comforts a baby on the shoulder. A clown might be associated with a happy laughing “ha ha ha ha ha” in contrast to a biting alligator toy with an

unhappy “OUCH!” The adult can present objects that the child learns to associate with each of these different vocal tones. Vocal emotion also figures highly in reading stories aloud, such as “Goldilocks and the Three Bears,” where Papa Bear is given a gruff low-pitched voice, Mama Bear uses a pleasant soft voice, and Baby Bear uses a high-pitched sad voice. After several repetitions of such stories, young implanted children will anticipate the voice that comes next and may begin to imitate these voices with accompanying vocal emotions and facial expressions.



Infant Toddler Meaningful Auditory Integration Scale (IT-MAIS)



To request a copy of the IT-MAIS please contact
Advanced Bionics at
(800) 678-2575 • (800) 678-3575 TDD • www.bionicear.com

These activities give examples of listening and learning activities that are appropriate for developing auditory skills in young children during the early stages of implant use. The creative parent or clinician will expand upon and revise them to be appropriate and motivating for each child. Once these skills emerge in a therapy context, they must be transferred to spontaneous use in the real world. The child receives credit only for skills he demonstrates on his own in everyday situations.

Many excellent resources have become available in recent years that approach listening development with imaginative and developmentally appropriate games, a clear departure from the “drill and kill” approach used previously. One resource that is particularly outstanding is the John Tracy Correspondence Course/Distance Learning for Parents. At no cost, parents receive home lessons to use that augment other therapy services the child is receiving. Call (800) 522-4582 for information about this resource. For further information on therapy materials, the clinician is referred to Appendix Q of the Educator’s Guide (1999) published by Advanced Bionics.

In this issue of Loud and Clear, we have tried to convey how the IT-MAIS may be clinically useful as both an assessment tool and are habilitation guide. The authors eagerly await further input from clinicians who use the IT-MAIS with their pediatric cochlear implants patients.

References

- Estabrooks, W. (1994). *Auditory-Verbal Therapy for Parents and Professionals*. Washington, DC: A.G. Bell Association.
- Graham, T.L. (1992). *Listening is a Way of Loving*. Atlanta: Humanics Learning.
- Koch, M. (1999). *Bringing Sound to Life*. Baltimore: York Press (1-800-962-2769).
- Ling, D. (1976). *Speech and the Hearing-Impaired Child: Theory and Practice*. Washington, DC: A.G. Bell Association.
- Lowell, F. & Stoner, M (1963). *Play It By Ear*. Los Angeles: John Tracy Clinic.
- Robbins, AM, Svirsky, M, Observer, MJ, Pisoni DB. (1998). Beyond the audiogram: the role of functional assessments. In Bess F, Gravel, J, eds. *Children with Hearing Impairments: Contemporary Trends*. Nashville: Bill Wilkerson Press, pp. 105-124.
- Robbins, AM (1998). Lesson Plan for Lilly. In Estabrooks W, ed. *Cochlear Implants for Kids*. Washington, DC: A.G. Bell Association, pp. 153-174.
- Robbins, A.M., Rneshaw, J.J., and Berry, S.W. (1991). *Evaluating meaningful auditory integration in profoundly hearing impaired children*. American Journal of Otology, 12 (Suppl.) 144-150.
- Simmons-Martin, A & Rossi, KG (1990). *Parents and Teachers: Partners in Language Development*. Washington, DC: A.G. Bell Association.
- Sindre, D. (1997). *Listening Games for Little Ones*. Ontario, CA: WordPlay Publications.
- Tannenbaum, S. (1998). Lesson Plan for Evan. In Estabrooks W, ed. *Cochlear Implants for Kids*. Washington, DC: A.G. Bell Association, pp. 113-128.
- Walker, B. (1998). Lesson Plan for Jordan. In Estabrooks W, ed. *Cochlear Implants for Kids*. Washington, DC: A.G. Bell Association, pp. 128-143.
- Zara, C. (1998). Listening Plan for Jonathan. In Estabrooks W, ed. *Cochlear Implants for Kids*. Washington, DC: A.G. Bell Association, pp. 90-99.
- Zimmerman-Phillips, S., Osberger, M. J., & Robbins, A.M. (1997). *Infant-Toddler Meaningful Auditory Integration Scale*. Sylmar, CA: Advanced Bionics Corp.

The authors thank all of the centers who participated in the CLARION pediatric clinical trials for providing the data summarized in this publication.

MAY01

© 2001 Advanced Bionics Corporation. All Rights Reserved. Printed in U.S.A.



12740 San Fernando Road • Sylmar, CA 91342

PLACE
POSTAGE
HERE

