



*The effect of age at implantation on
performance with a cochlear
implant*

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Cochlear Implants

- It is well documented that cochlear implants are a safe and effective treatment for children with severe to profound hearing loss, and that children implanted at younger ages demonstrate more rapid post-implantation improvement and significantly faster rates of spoken language development than children with later ages of implantation.



Introduction

- Unfortunately, many clinics continue to report that children are referred for cochlear implant evaluation later than they should be.
- This decreases the child's chance for successful development of spoken language skills.



Purpose

- To report on the effect of age at implant on speech/language and speech perception outcomes in children implanted prior to the age of five years.
- To provide guidelines of when to refer children to CI programs in order to promote early success with cochlear implantation.



- "Anytime hearing is used, think auditory brain development."

Carol Flexer



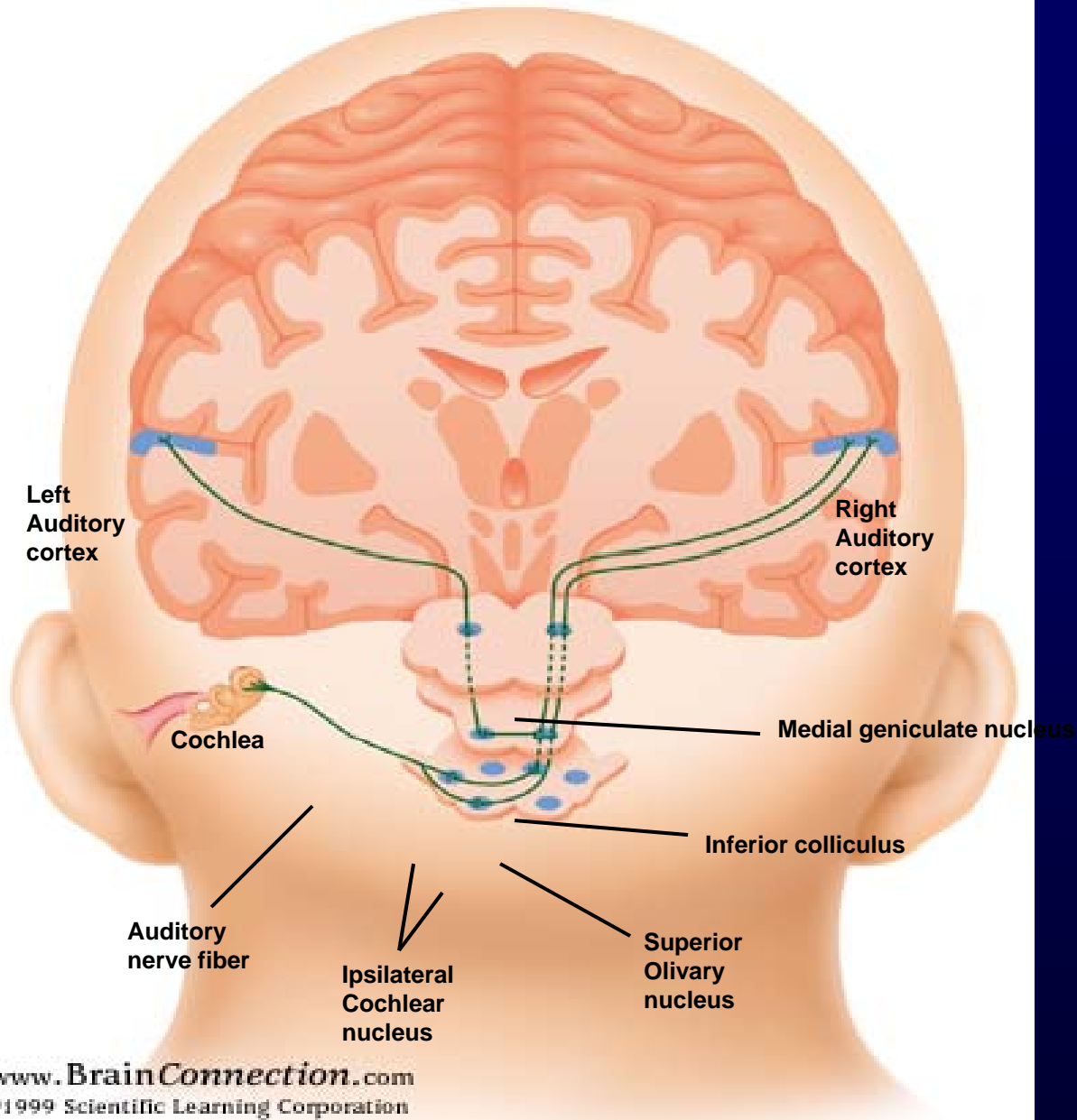
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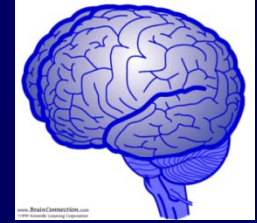


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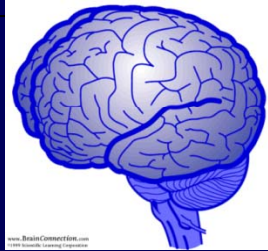
Why Now?



- Plasticity in the brain is greatest at birth and becomes progressively more limited with age. Early listening is crucial to the achievement of a functional auditory system.

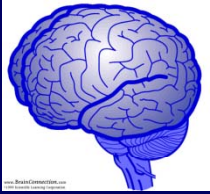


Babies Lose 1/2 their Neurons at Birth



- It is estimated that a baby loses about half their neurons before they are born. This process is sometimes referred to as pruning and may eliminate neurons that do not receive sufficient input from other neurons.



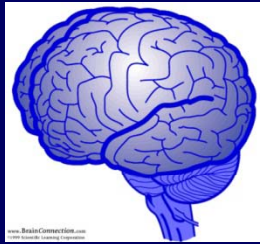


Newborns Distinguish Speech

Children as young as four days old can distinguish the vowel sounds of the language in their natural environment from those of a foreign language.



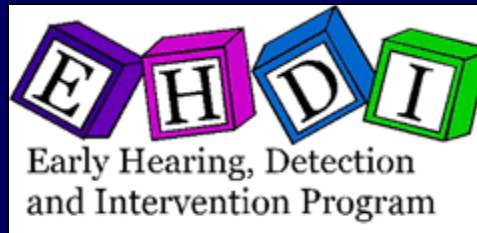
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■ Early Brain Growth

During the first month of life, the number of connections or synapses, dramatically increases from 50 trillion to 1 quadrillion. If an infant's body grew at a comparable rate, his weight would increase from 8.5 pounds at birth to 170 pounds at one month old.





- Ideally, UNHS has the potential to lower the age at which many children are identified with a severe to profound sensorineural hearing loss, decreasing the age at which intervention takes place, and decreasing the long term effects of auditory deprivation.



University of Michigan Cochlear Implant Program

- Established in 1986
- More than 1800 children and adults have received a cochlear implant at the University of Michigan.
- In our clinical practice, we continue to see children who are identified late and who are referred later than they should be for a cochlear implant evaluation.



Design

- Children who receive a cochlear implant at our facility routinely participate in speech perception and speech/language testing as part of their annual follow up. Such testing is important to monitor function and integrity of the device.



Design

- All available speech perception and speech/language scores obtained at these annual appointments by children implanted prior to age five were used in this study.



Subjects

Children divided into 4 age groups based on age at implant:

9-23 months	N= 93
24-35 months	N= 99
36-47 months	N= 82
48-60 months	N= 73



Test scores

- Mean scores obtained 12-60 months post-activation.
- All available data were used to derive mean group data.
- Fewer scores available on younger children at the early test intervals
- Fewer scores available on all children at the longer post-implant intervals.



Speech Perception Test Measures

- CLOSED SET
 - NUCHIPS - Northwestern University Children's Perception of Speech Test
 - WIPI - Word Intelligibility by Picture Identification

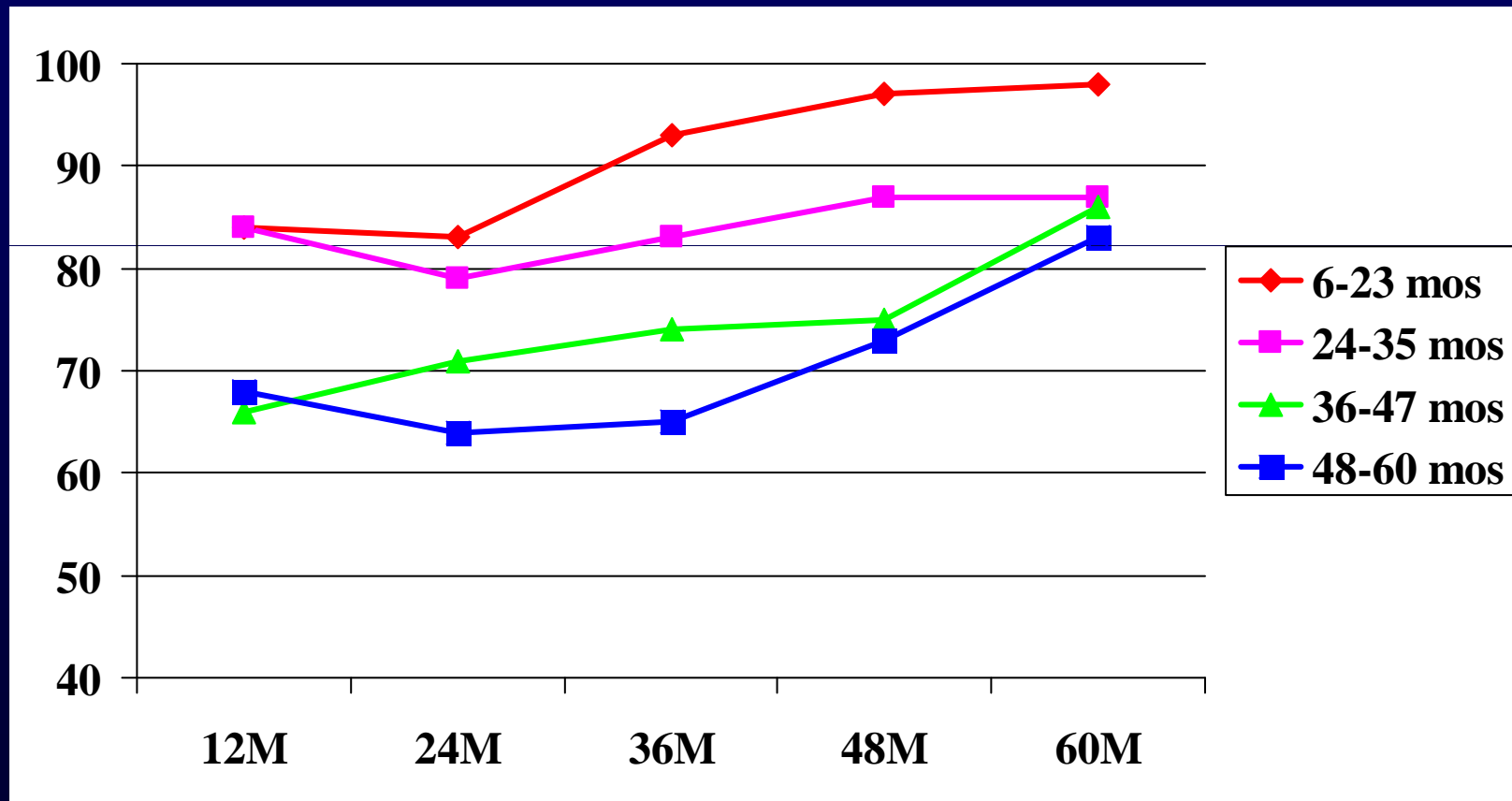


NuCHips



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NUCHIPS



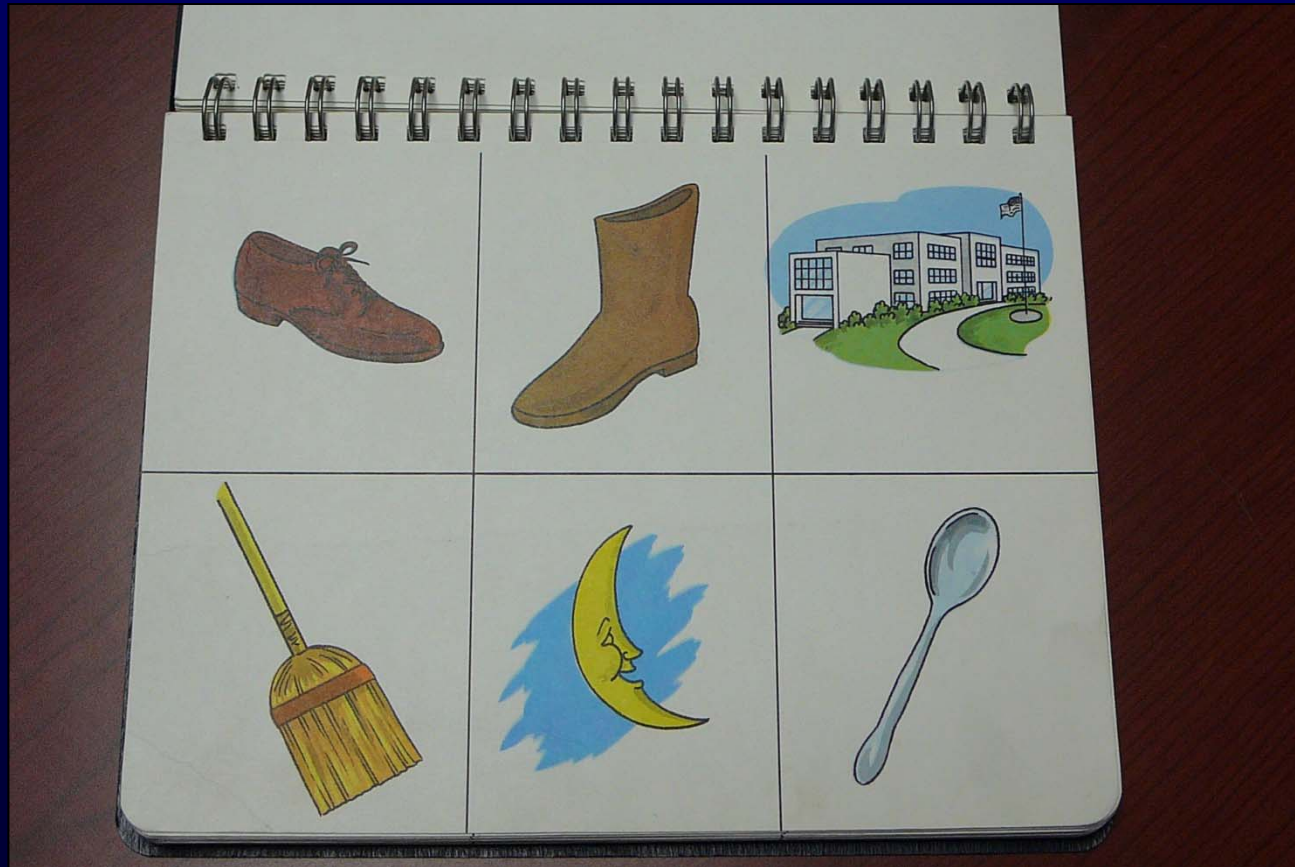
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Group (p=0.1)

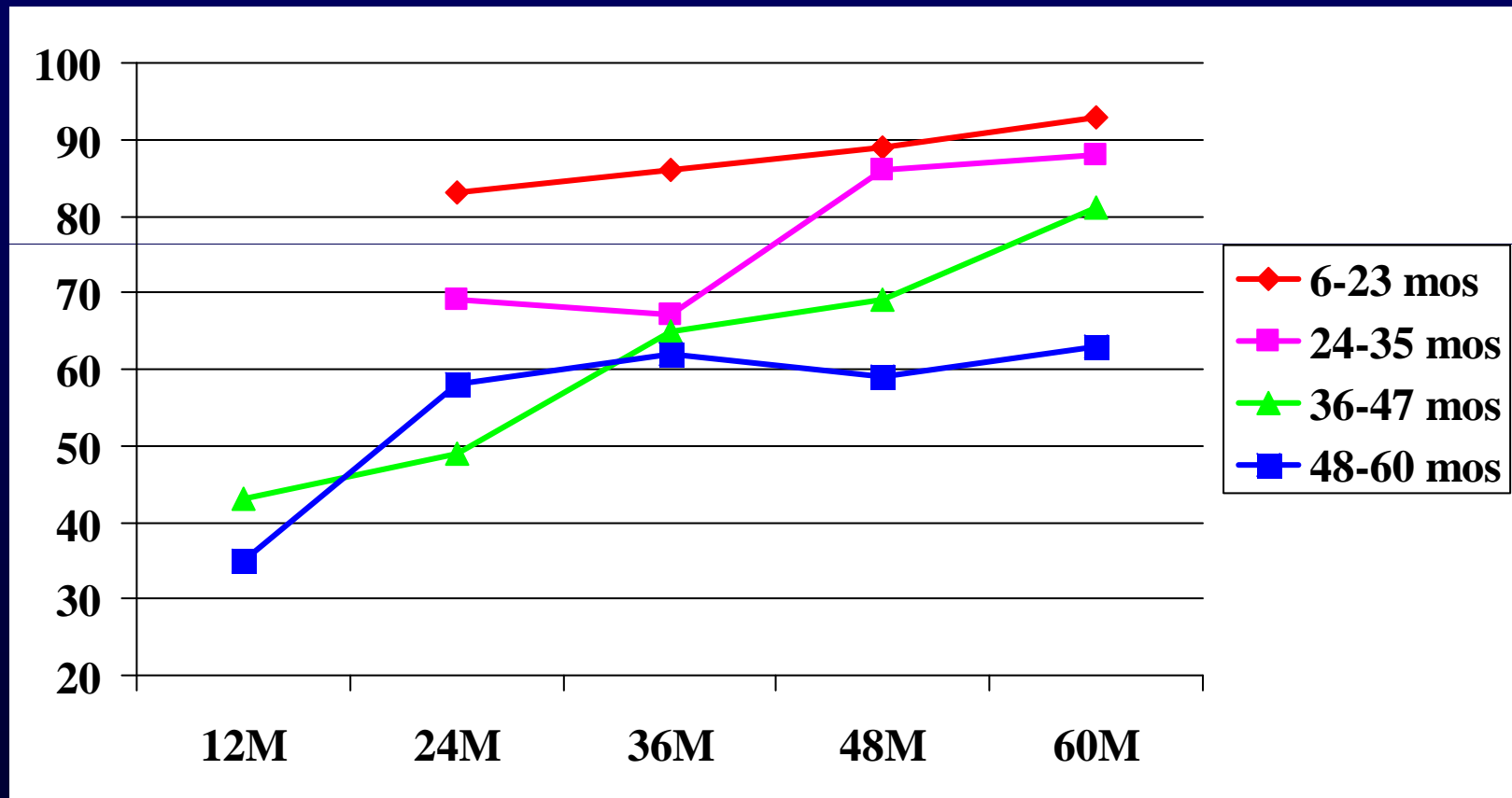


WIPI



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WIPI



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Group (p=0.1)

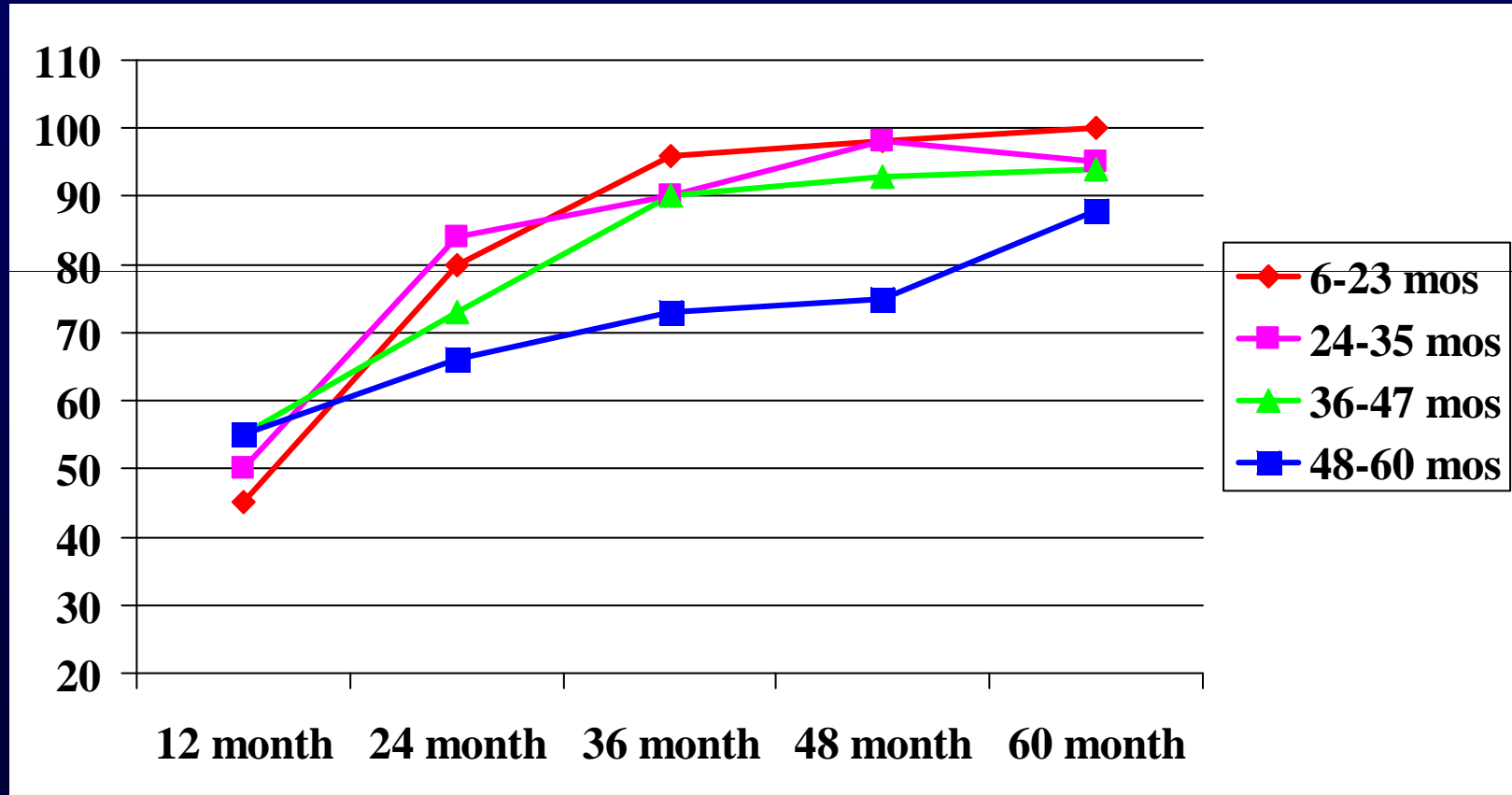


Speech Perception Test Measures

- OPEN SET
 - GASP - Glendonald Auditory Screening Procedure
 - Words and Sentences
 - MLNT - The Multisyllabic Lexical Neighborhood Test
 - LNT – Lexical Neighborhood Test



GASP Words

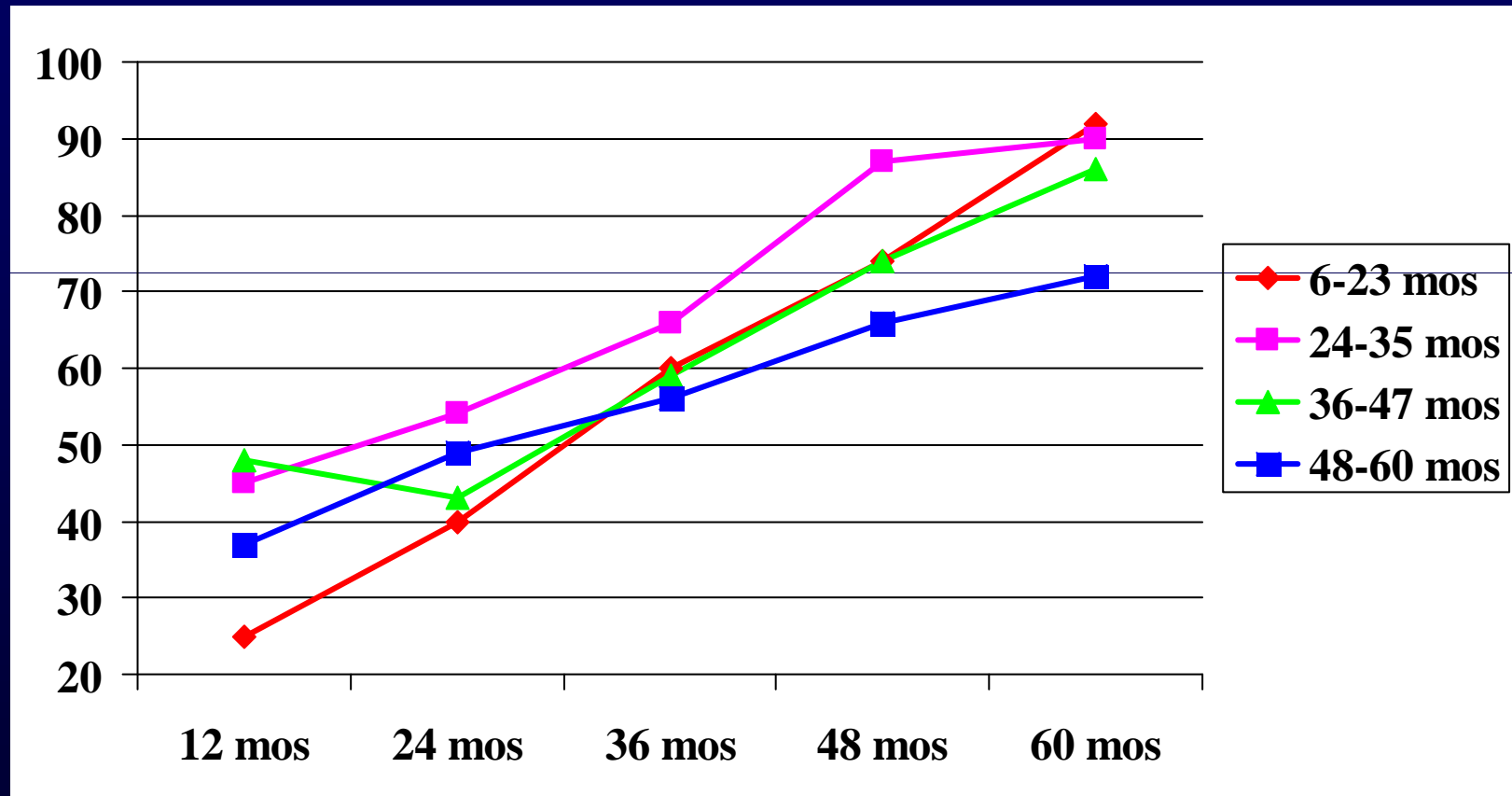


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Time
Group X Time



GASP Sentences

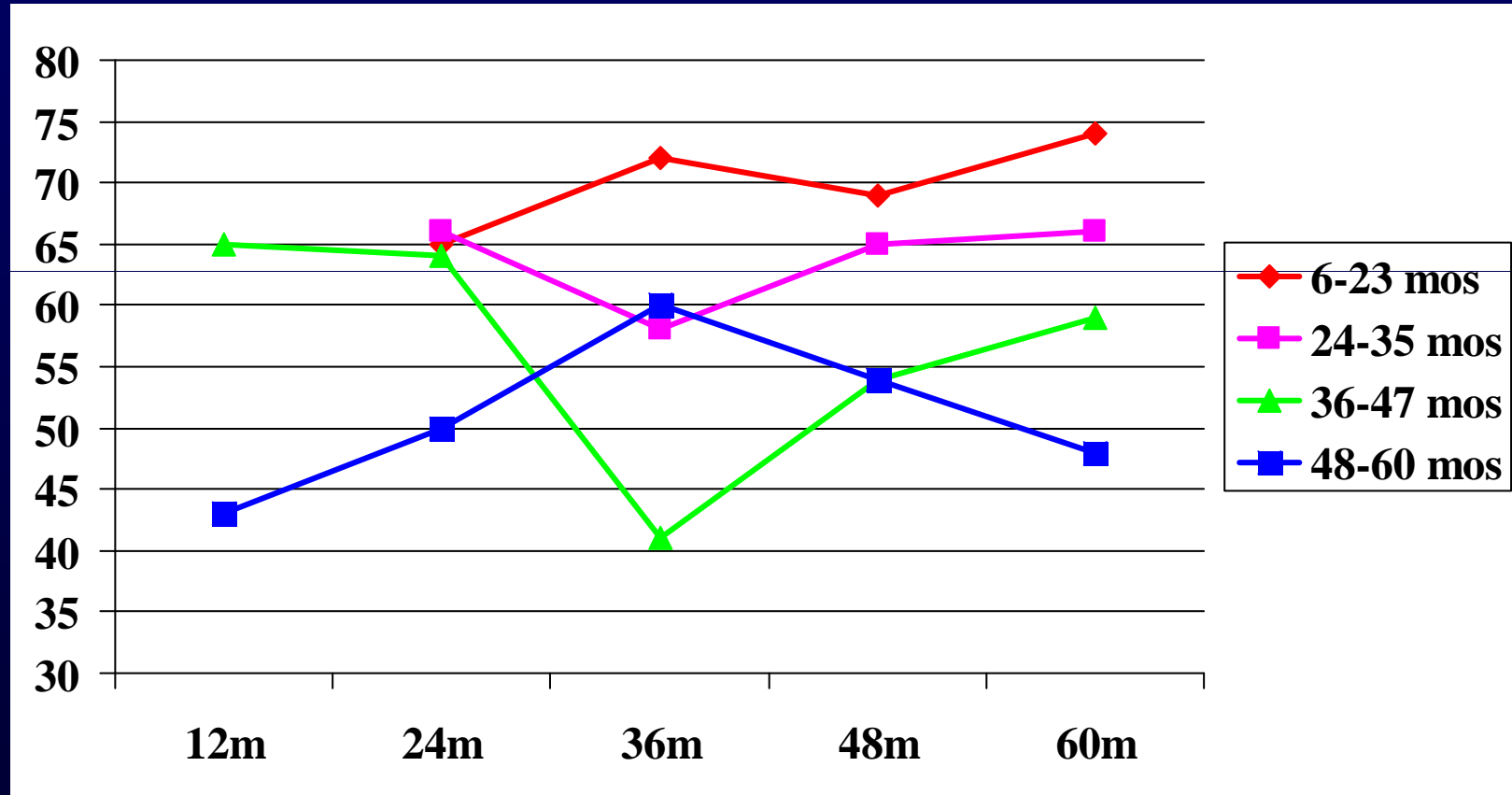


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Time
Group X Time



LNT

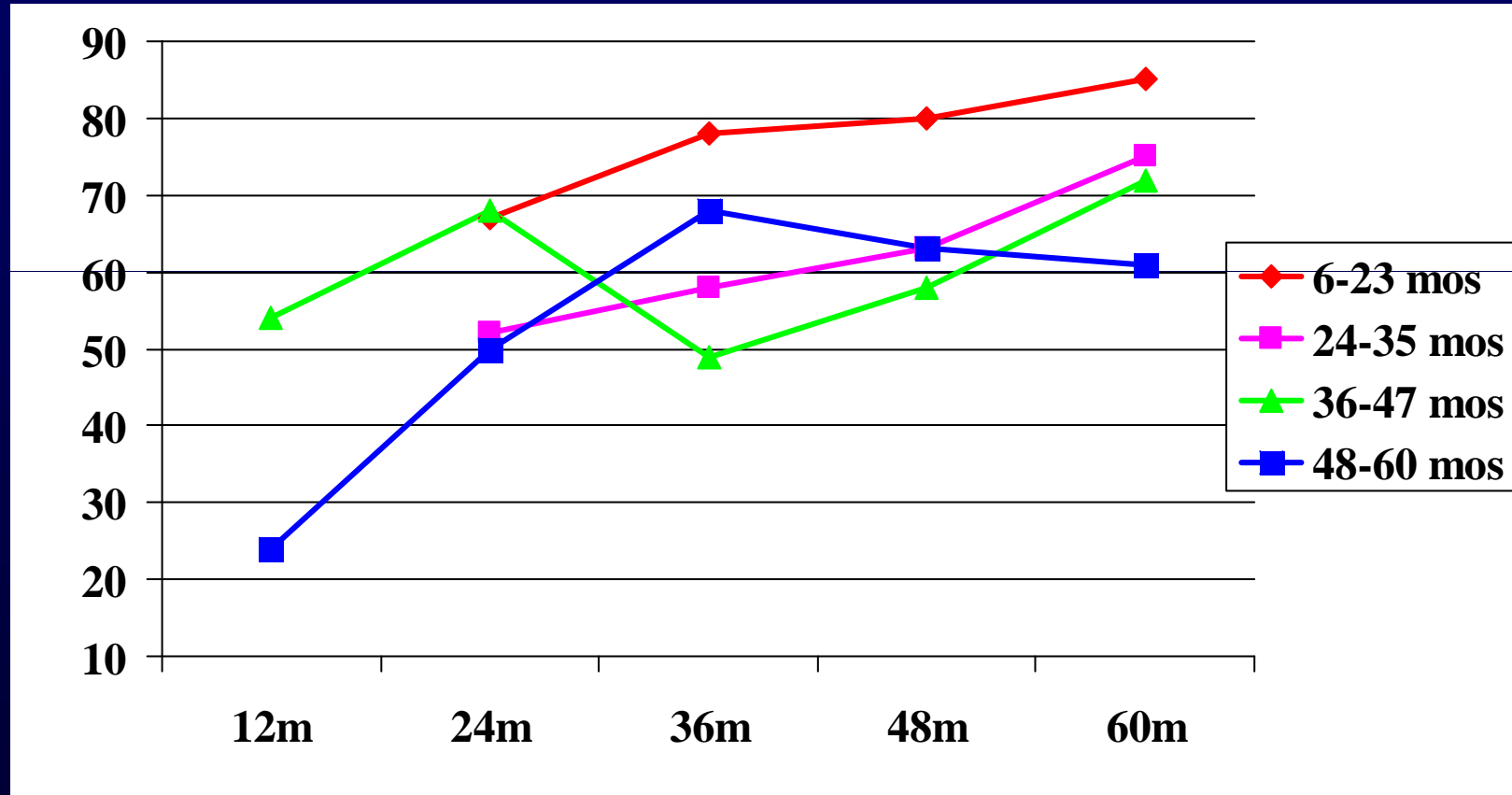


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Time
Group X Time



MLNT



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Time
Group X Time

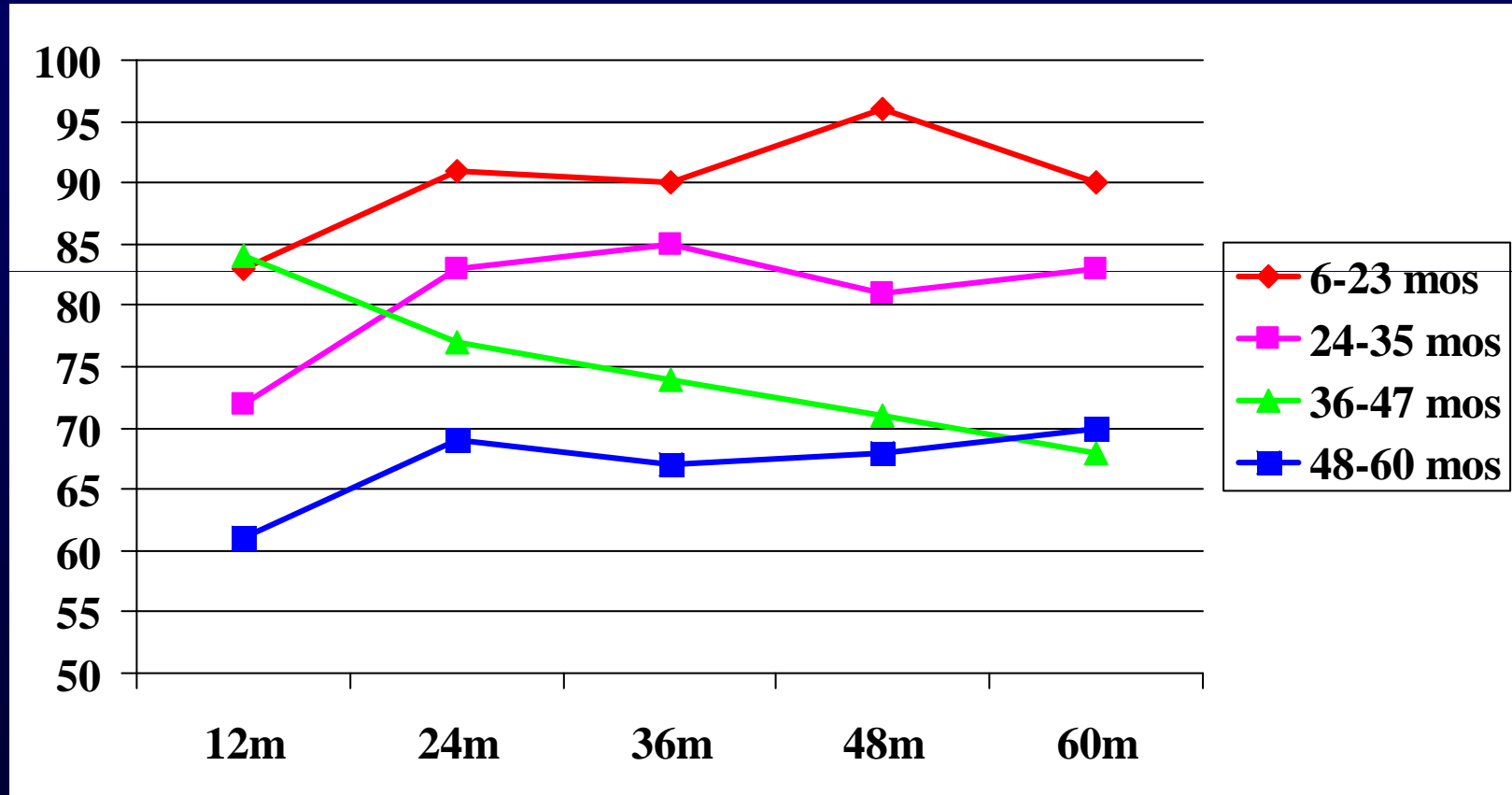


Speech/Language Test Measures

- EVT - Expressive Vocabulary Test
- PPVT - Peabody Picture Vocabulary Test
- PCC - Percent of Consonants produced Correctly (CProph Marc Fey)



EVT

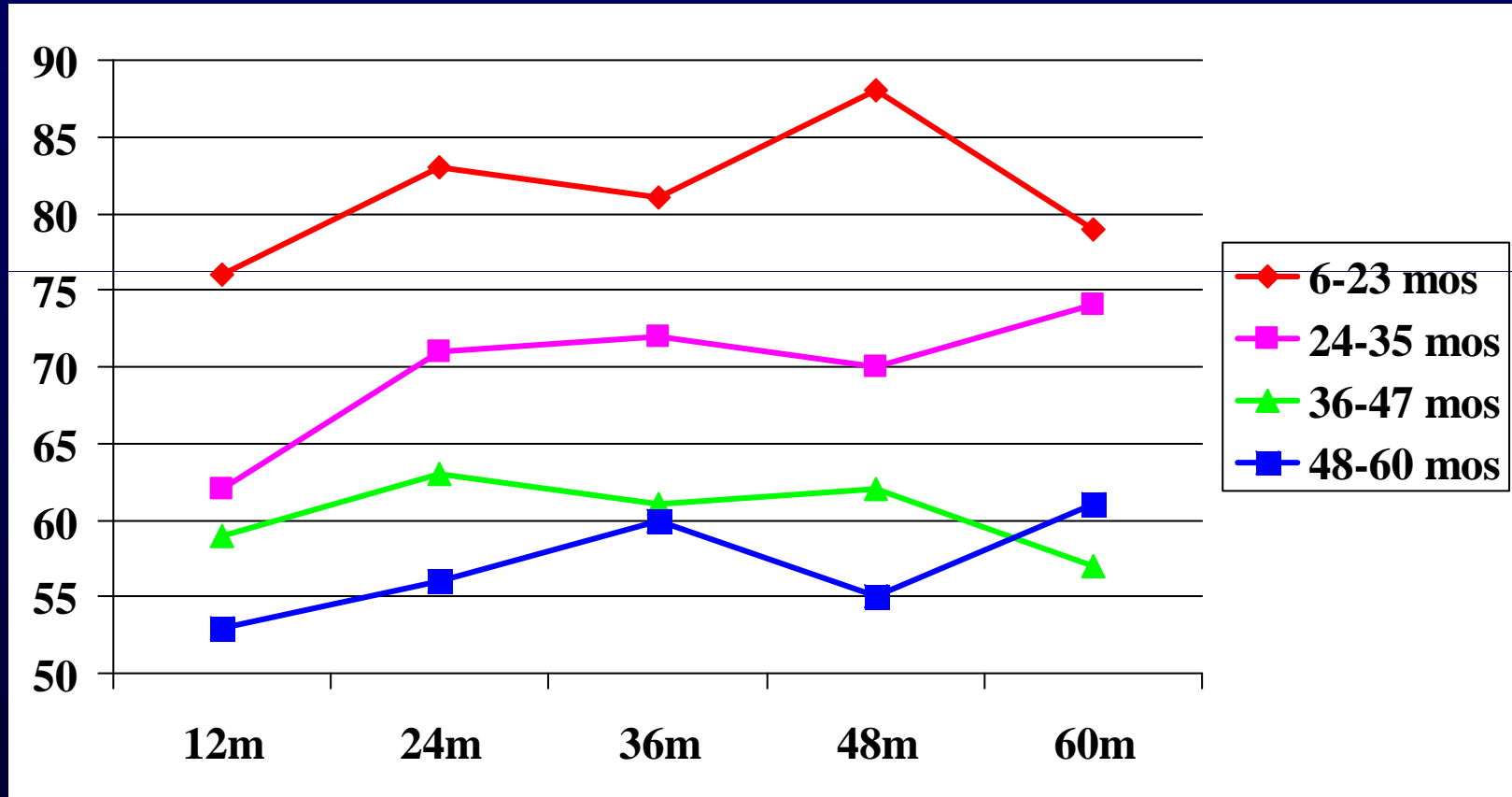


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Time
Group X Time

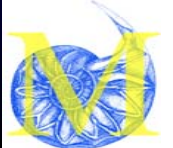


PPVT



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Time
Group X Time



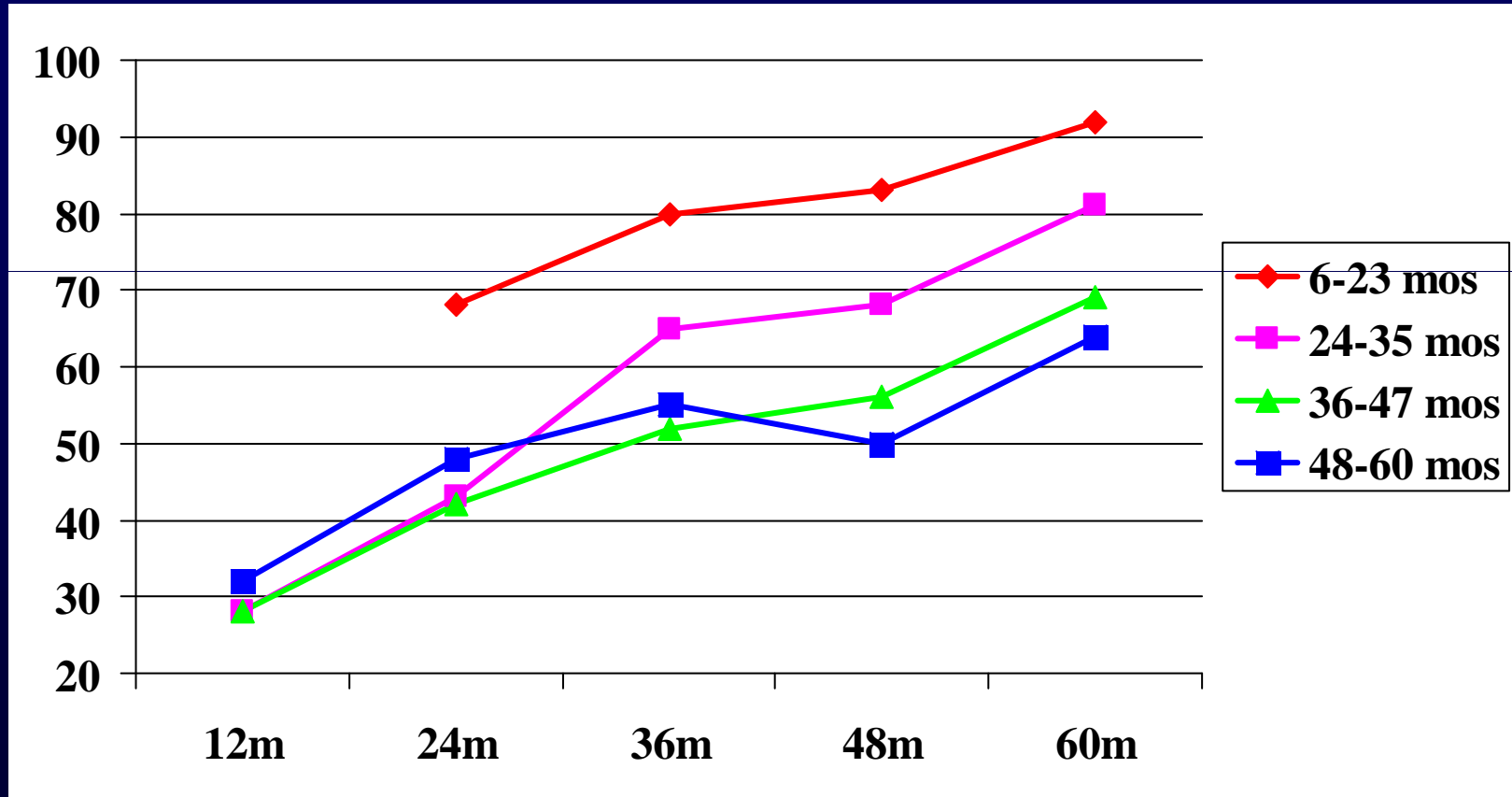
Typical Vocabulary: Words Understood

Age	# of Words
2	300
2.5	500
3	900
4	1,500
5	2,500
6	13,000
7	20,000

Adapted from Gard,
Gilman, & Gorman
(1980) *Speech and
Language
Development Chart*

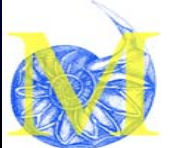


PCC



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Time
Group X Time



Summary

- All 4 groups of children demonstrated improvements in speech/language and speech perception skills over time. Children implanted at younger ages tended to demonstrate better skills more quickly, and tended to reach levels similar to children with normal hearing at much faster rates.



Summary

- Mean speech/language scores for the older children failed to reach a level “within normal limits”, even after 5 years of device use. Children in the younger groups reached this level as early as 12 months post-activation on vocabulary measures.



Referrals

- Even though the FDA indicates it is appropriate to implant children as young as 12 months of age, children continue to be referred to CI programs later than they should...



Recommendations for referrals

- Any child with a bilateral severe to profound sensorineural hearing loss should receive information about a cochlear implant.
- If identified at birth, it is best for the CI clinic to see the child once hearing aids have been fit.
- The CI clinic can partner with the hearing aid audiologist to evaluate and monitor the child's performance with hearing aids.



- If child has auditory neuropathy (or AN is suspected), hearing may be better than severe to profound and consider referring.
- Children with additional needs will always be considered – don't assume it will be too difficult for the child's implant to be programmed.
- If the child is able to participate in speech recognition testing, refer if they score less than 50% on traditional word tests (i.e. PBKs)



From the work of Noam Chomsky:

- We know that at birth our brains have the potential to learn any of the world's languages during the critical period (before age 5) when rapid neural growth occurs.

