



Auditory plasticity

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Auditory plasticity

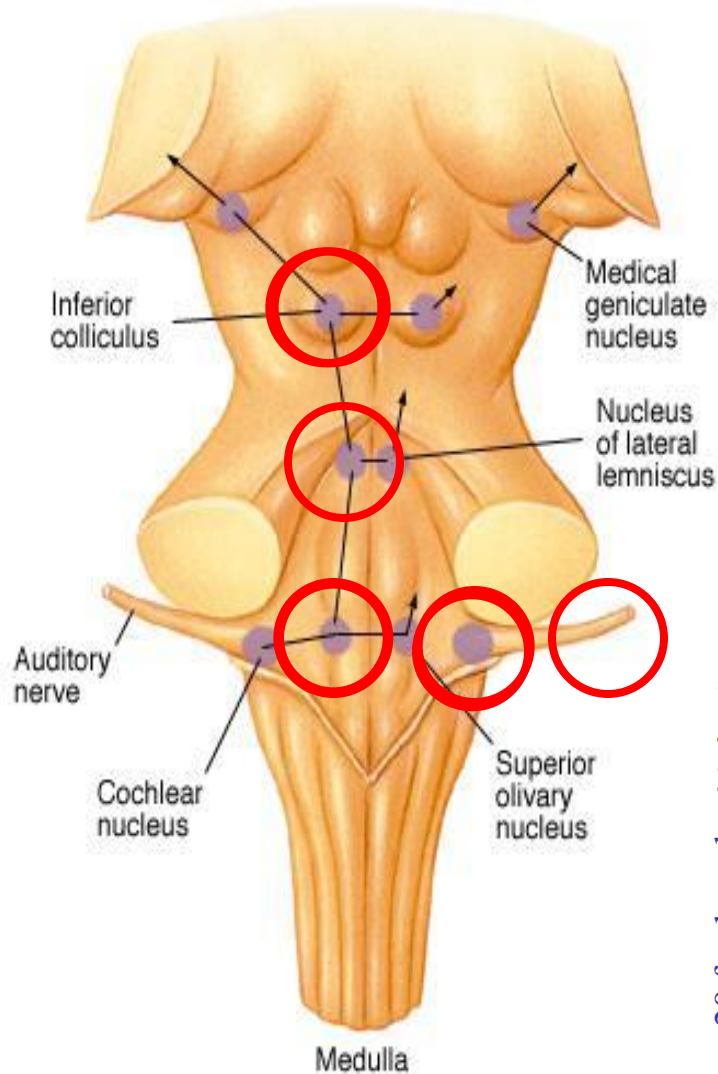
Maturing of the auditory system



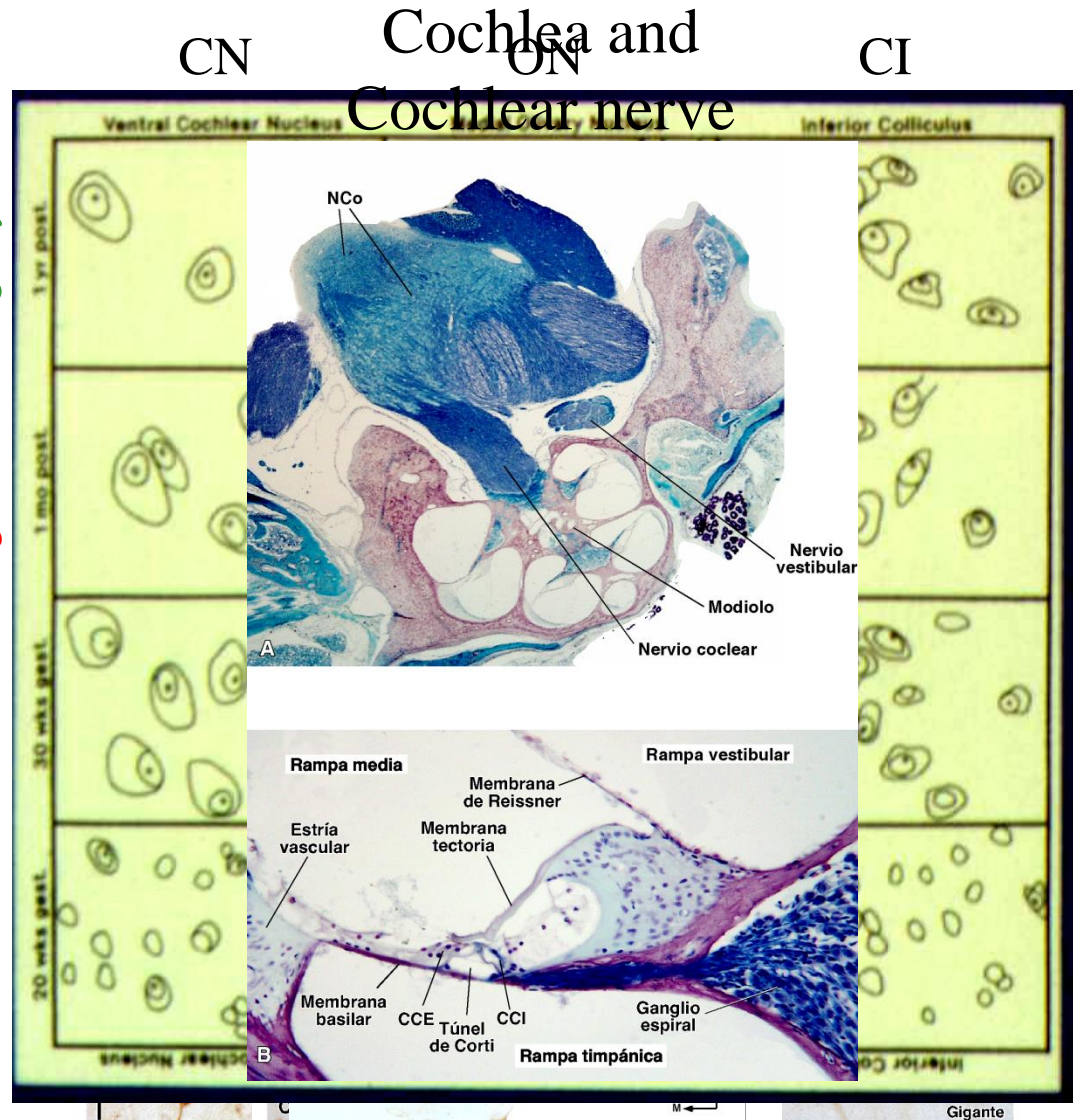
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Brainstem Auditory Pathway

Neuronal Somas

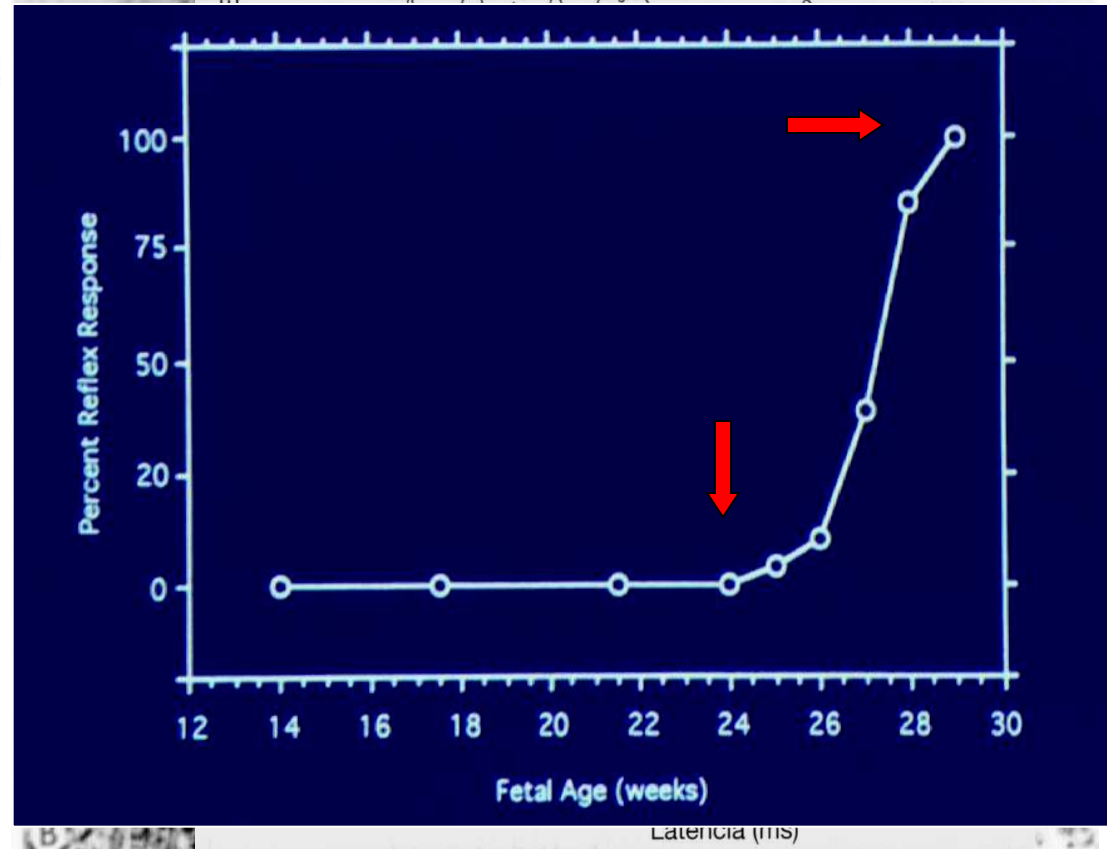
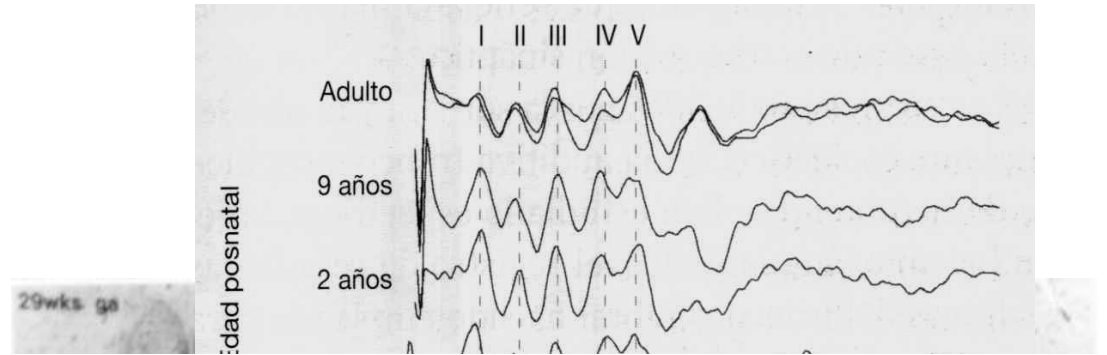
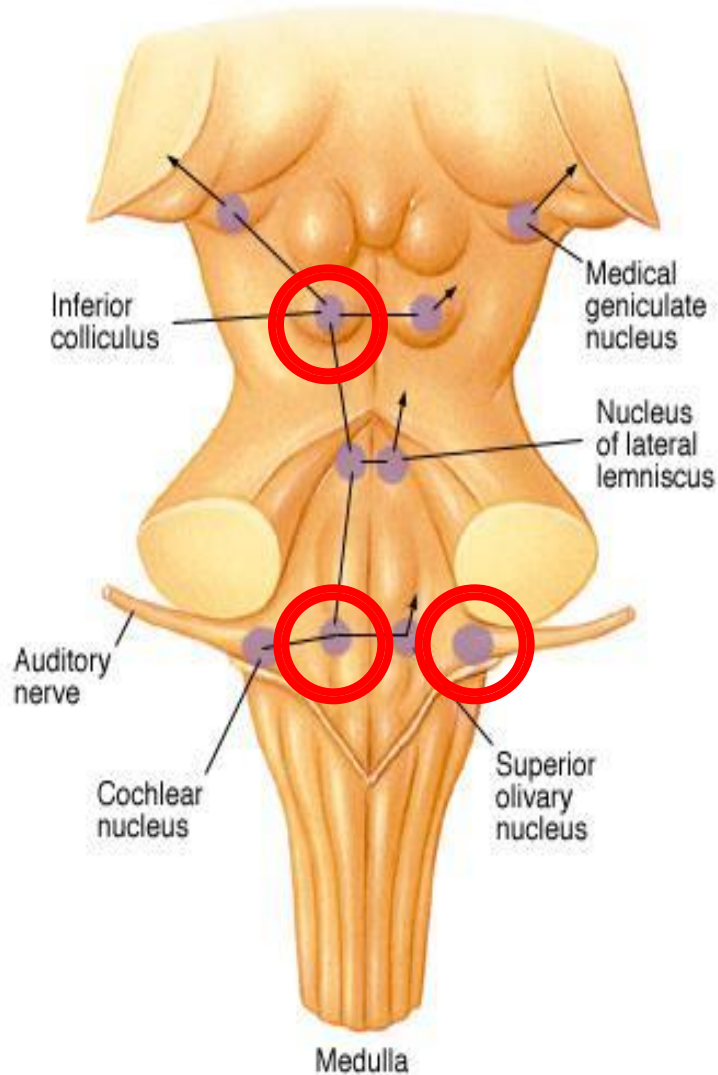


20 fetal weeks 30 fetal weeks Age 1 month Age 1 year

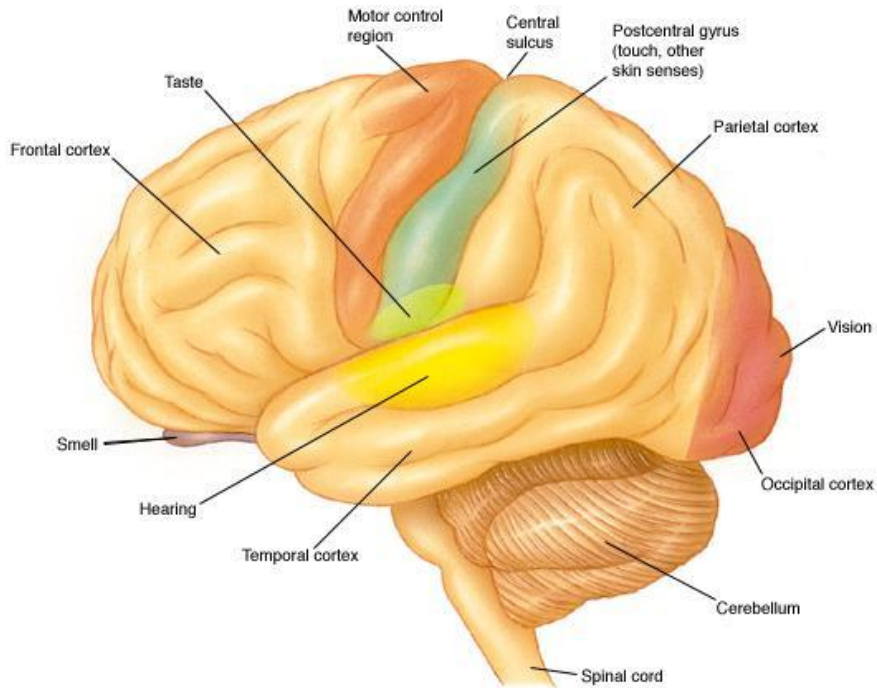


Brainstem Auditory Pathway

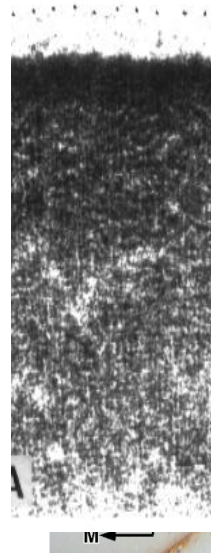
Myelination



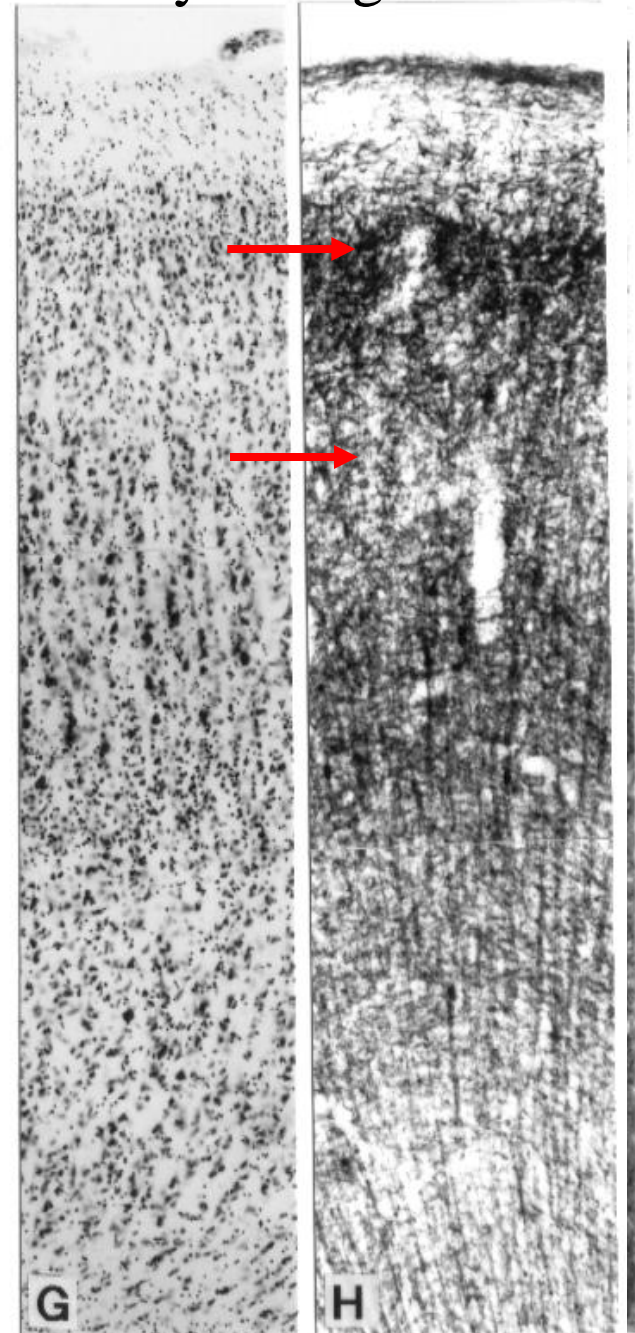
Auditory Cortex



24 fetal







12 years age



Development of speech and language (I)

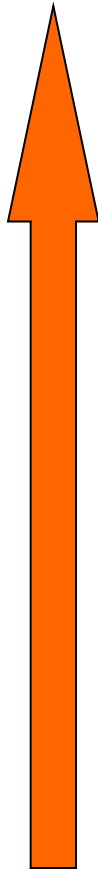
American Speech-Language Hearing Association






<p>Does your child recognize words for common items like "cup," "shoe," "juice"?</p> <p>Has your child begun to respond to requests ("Come here." "Want more?")?</p>	<p>7 MONTHS-1 YEAR</p> 	<p>Does your child have 1 or 2 words (bye-bye, dada, mama, no) although they may not be clear?</p>
<p>Does your child enjoy games like peek-a-boo and pat-a-cake?</p> <p>Does your child turn or look up when you call his or her name?</p> <p>Does your child listen when spoken to?</p>		<p>Does your child's babbling have both long and short groups of sounds such as "tata upup bibibibi"?</p> <p>Does your child imitate different speech sounds?</p> <p>Does your child use speech or non-crying sounds to get and keep your attention?</p>
<p>Does your child respond to "no"? Changes in your tone of voice?</p> <p>Does your child look around for the source of new sounds, e.g., the doorbell, vacuum, dog barking?</p> <p>Does your child notice toys that make sound?</p>	<p>4-6 MONTHS</p> 	<p>Does your child's babbling sound more speech-like with lots of different sounds, including <i>p</i>, <i>b</i>, and <i>m</i>?</p> <p>Does your child tell you (by sound or gesture) when he/she wants you to do something again?</p> <p>Does your child make gurgling sounds when left alone? When playing with you?</p>
<p>Does your child turn to you when you speak?</p> <p>Does your child smile when spoken to?</p> <p>Does your child seem to recognize your voice and quiet down if crying?</p>	<p>0-3 MONTHS</p> 	<p>Does your child repeat the same sounds a lot (cooing, gooing)?</p> <p>Does your child cry differently for different needs?</p> <p>Does your child smile when he/she sees you?</p>
<p>Does your child listen to speech?</p> <p>Does your child startle or cry at noises?</p> <p>Does your child awaken at loud sounds?</p>	<p>BIRTH</p> 	<p>Does your child make pleasure sounds?</p> <p>When you play with your child, does he/she look at you, look away, & then look again?</p>
<p>Total</p>		<p>Total</p>

Development of speech and language (II)

American Speech-Language Hearing Association



Hearing and Understanding	Child's Age	Talking
<p>Does your child hear and understand most of what is said at home and in school?</p> <p>Does everyone who knows your child think he/she hears well (teacher, baby sitter, grandparent, etc.)?</p> <p>Does your child pay attention to a story and answer simple questions about it?</p>	<p>4½-5 YEARS</p> 	<p>Does your child communicate easily with other children and adults?</p> <p>Does your child say all sounds correctly except maybe one or two?</p> <p>Does your child use the same grammar as the rest of the family?</p>
	<p>4-4½ YEARS</p>	<p>Does your child's voice sound clear like other children's?</p> <p>Does your child use sentences that give lots of details (e.g., "I have two red balls at home")?</p> <p>Can your child tell you a story and stick pretty much to the topic?</p>
<p>Does your child hear you when you call from another room?</p> <p>Does your child hear television or radio at the same loudness level as other members of the family?</p> <p>Does your child answer simple "who," "what," "where," "why" questions?</p>	<p>3-4 YEARS</p> 	<p>Does your child talk about what he/she does at school or at friends' homes?</p> <p>Does your child say most sounds correctly except a few, like r, l, th and s?</p> <p>Does your child usually talk easily without repeating syllables or words?</p> <p>Do people outside your family usually understand your child's speech?</p> <p>Does your child use a lot of sentences that have 4 or more words?</p>
<p>Does your child understand differences in meaning ("go-stop"; "in-on"; "big-little"; "up-down")?</p> <p>Does your child continue to notice sounds (telephone ringing, television sound, knocking at the door)?</p> <p>Can your child follow two requests ("get the ball and put it on the table")?</p>	<p>2-3 YEARS</p>	<p>Does your child have a word for almost everything?</p> <p>Does your child use 2-3 word "sentences" to talk about and ask for things?</p> <p>Do you understand your child's speech most of the time?</p> <p>Does your child often ask for or direct your attention to objects by naming them?</p>
<p>Can your child point to pictures in a book when they are named?</p> <p>Does your child point to a few body parts when asked?</p> <p>Can your child follow simple commands and understand simple questions ("Roll the ball," "Kiss the baby," "Where's your shoe?")?</p> <p>Does your child listen to simple stories, songs, and rhymes?</p>	<p>1-2 YEARS</p> 	<p>Is your child saying more and more words every month?</p> <p>Does your child use some 1-2 word questions ("where kitty?" "go bye-bye?" "what's that"?)?</p> <p>Does your child put 2 words together ("more cookie," "no juice," "mommy block")?</p> <p>Does your child use many different consonant sounds at the beginning of words?</p>

Auditory plasticity

Concepts of auditory plasticity



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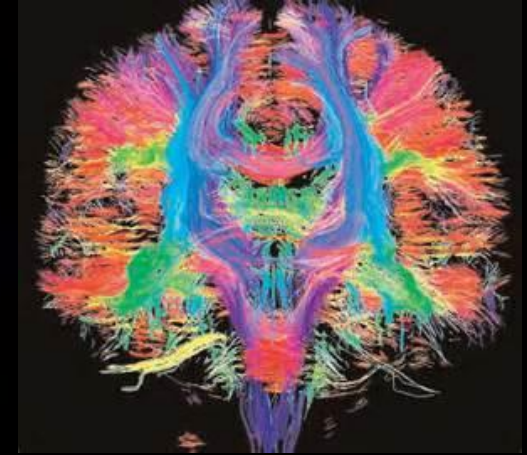
What is brain plasticity??

- Brain ability to reorganize and modify functions being able to adapt to external or internal changes.

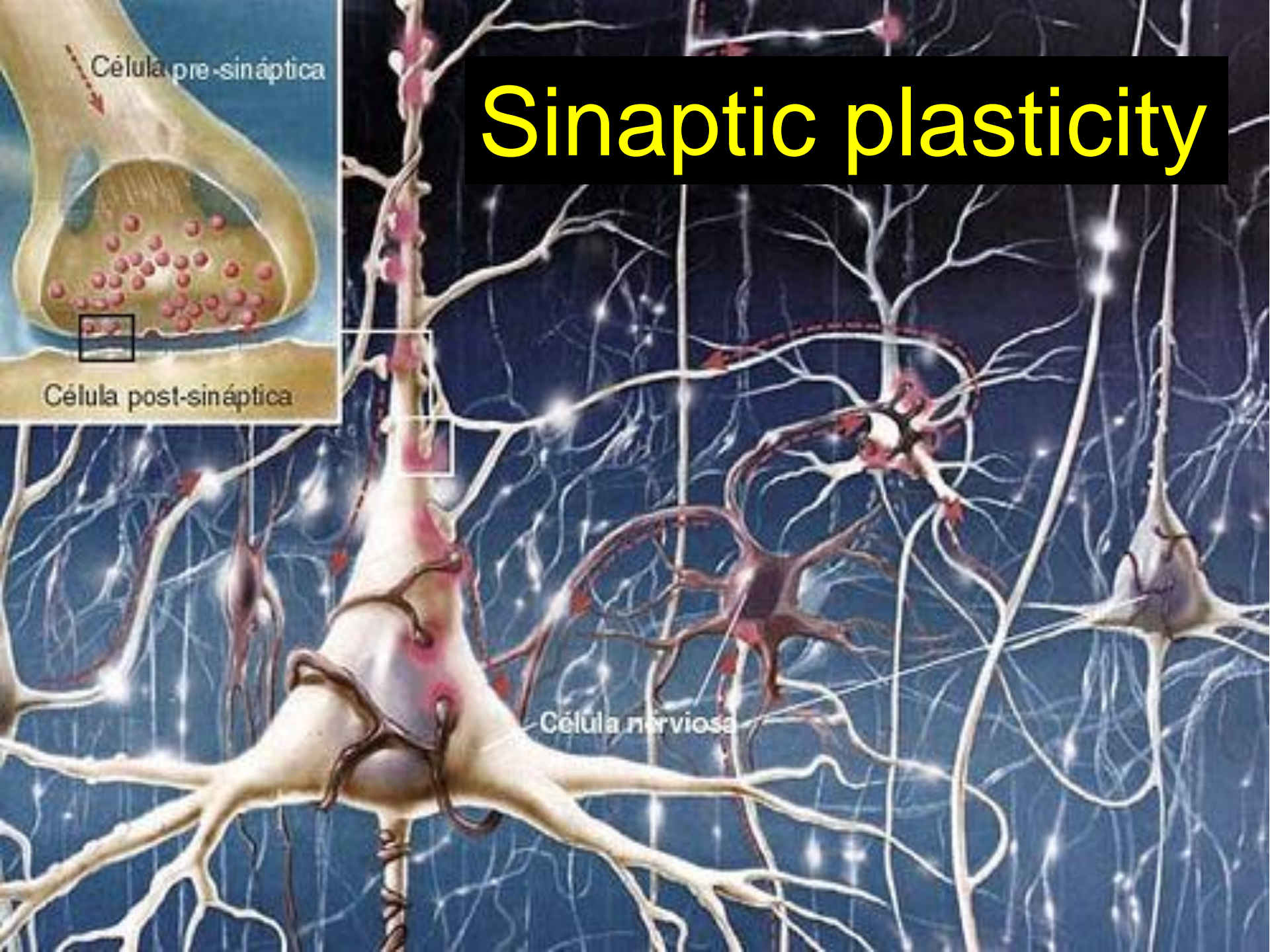


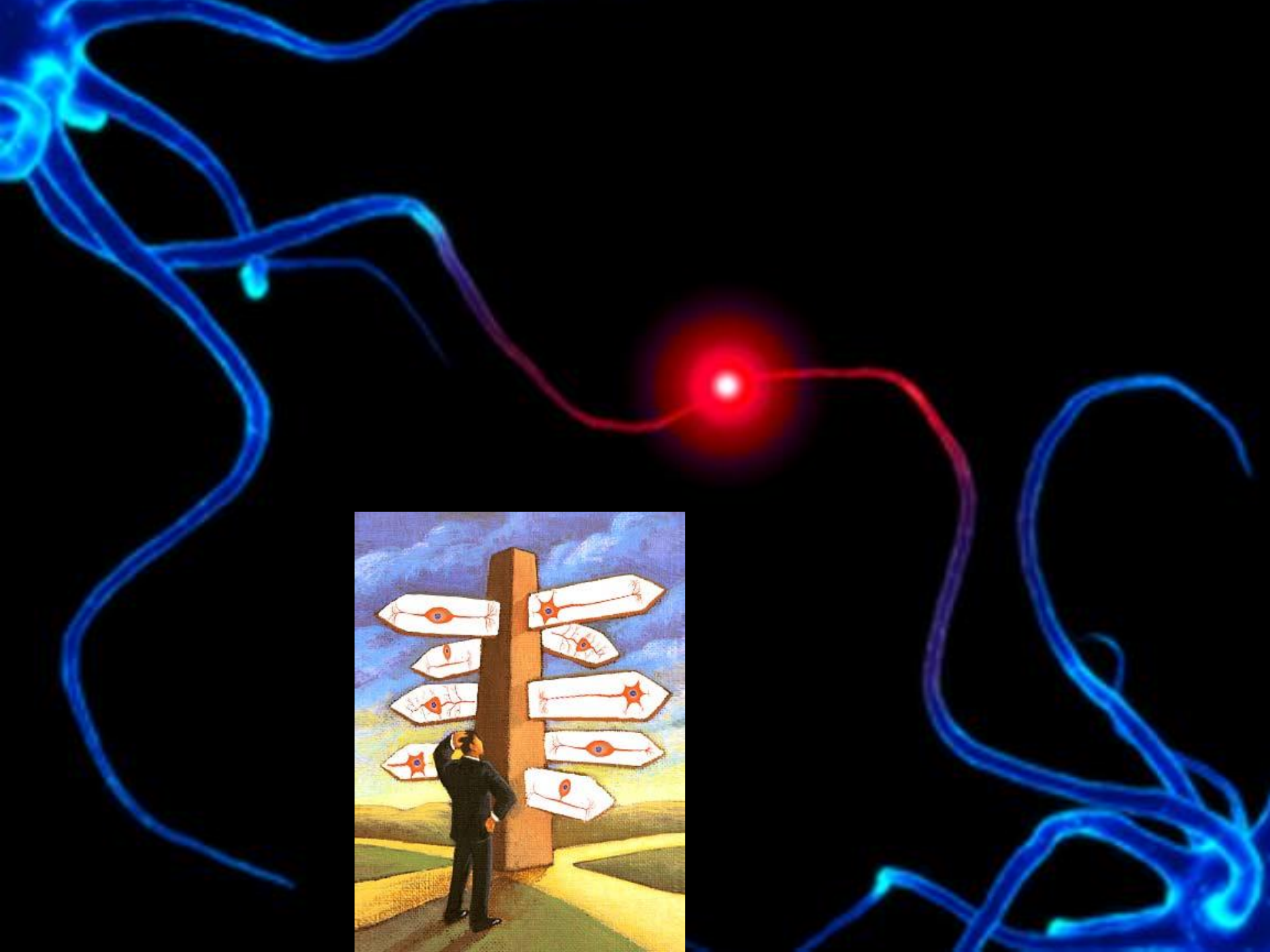
What mechanisms are related to neuroplasticity in the CNS?

- Synaptic plasticity
- Anatomic and functional CNS organization:
 - Interconnectivity
 - Centralization
 - Neuroaxial hierarchy
 - Structural and functional specialisation
 - Topographic distribution



Synaptic plasticity







- Quality of auditory stimulation
- Moment of stimulation

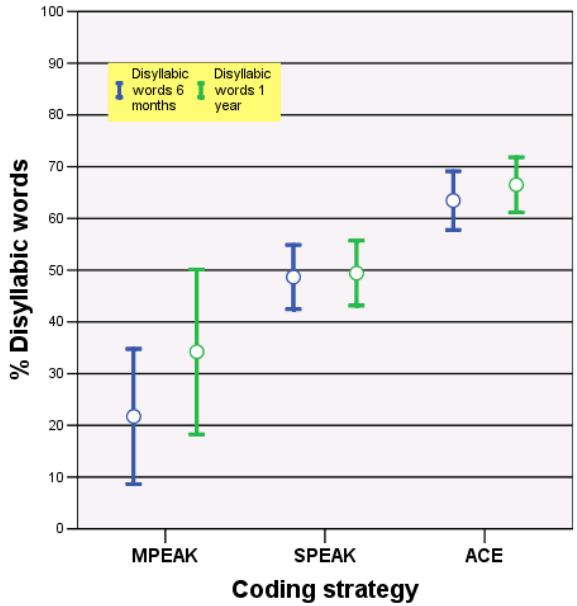




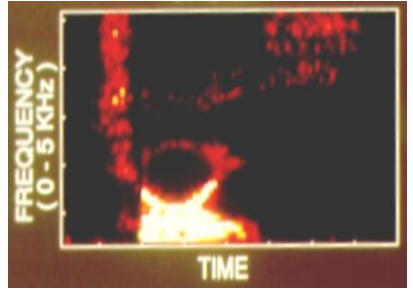
AUDITORY INPUT QUALITY: Hearing aids and bilateral PHL



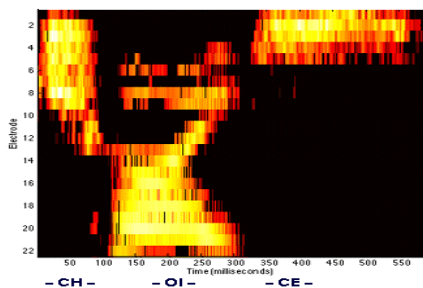
Nucleus CI: Postlinguals, Normal cochlea (0307)



Espectrograma basal

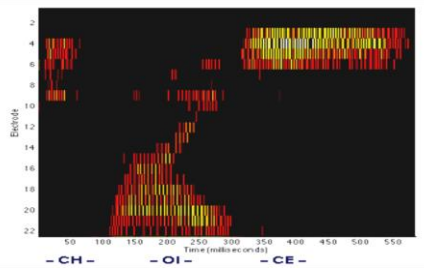


-CH- -OI- -CE-



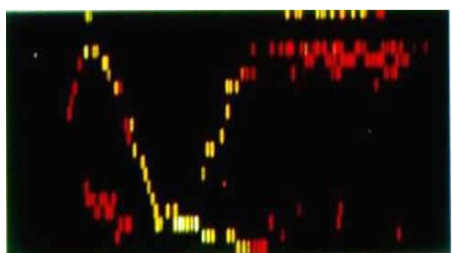
-CH- -OI- -CE-

ACE



-CH- -OI- -CE-

SPEAK



-CH- -OI- -CE-

F0 F2

AUDITORY INPUT QUALITY:
Stimulation strategy



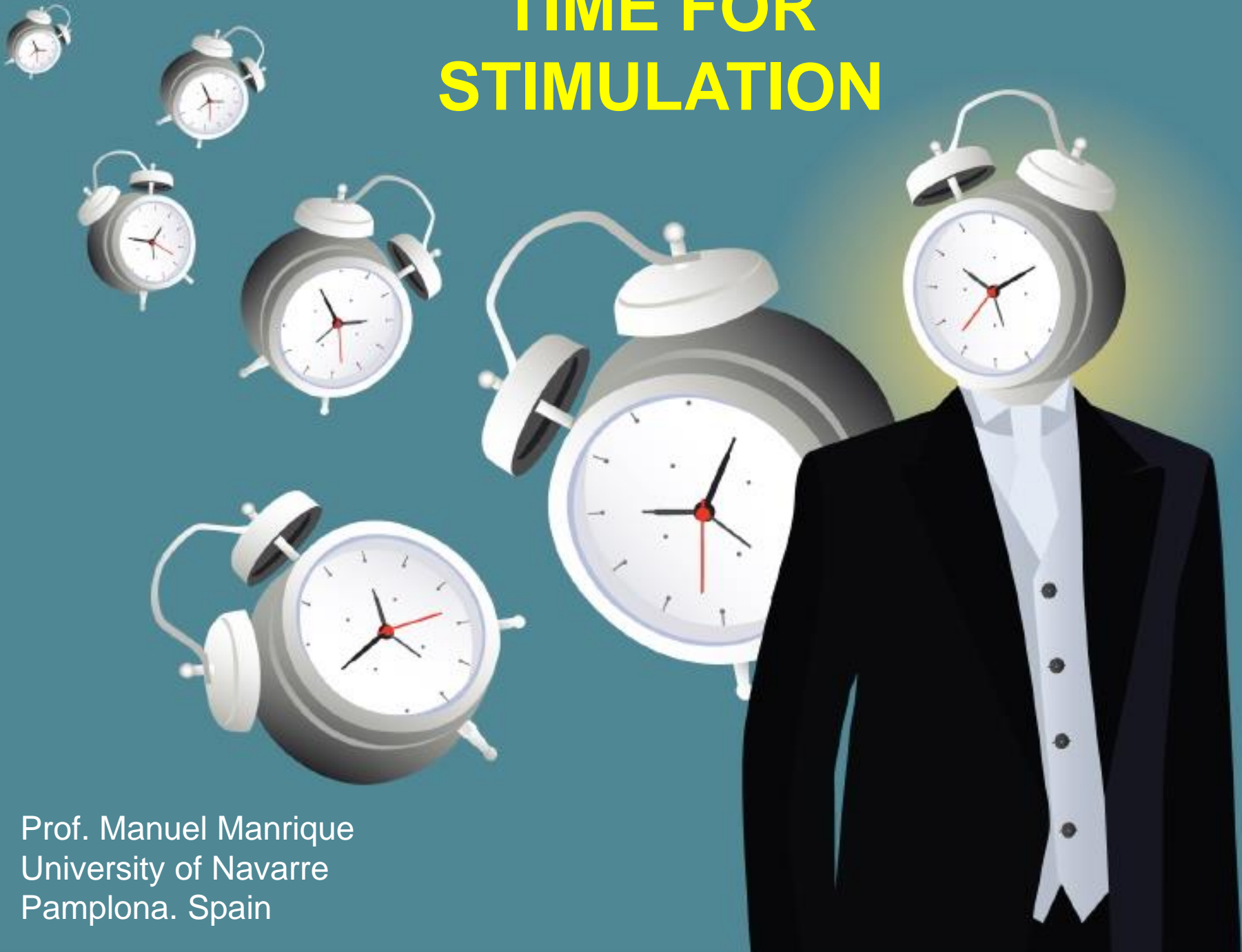
AUDITORY INPUT QUALITY: Uni or bilateral

- **Background that favors language development:**

- Family
- School
- Social
- **Rehabilitation programs**



TIME FOR STIMULATION



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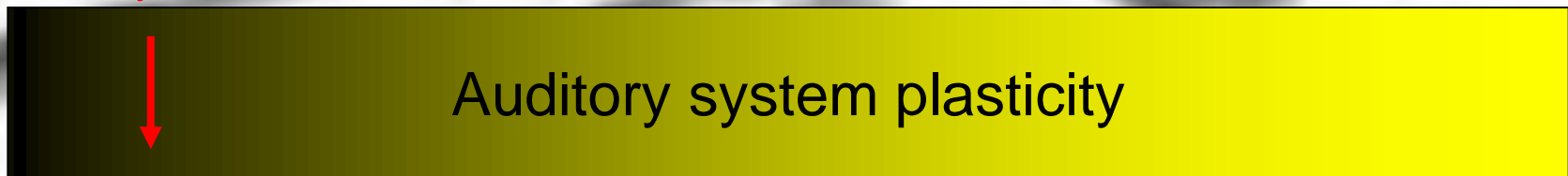
Critical period in children





RN 2y

100 a



Auditory system plasticity

730 Days

35.770 Days



Detection, diagnosis and early hearing loss
treatment

Plastic changes are constantly taking place

- Reserve of neuronal connections
- New connections are formed
- These changes may be slow and require extensive time and training, or they may be extremely rapid and spontaneous.
- Even the mature brain is capable of undergoing fundamental reorganization at the cortical level

Auditory plasticity

Clinical applications



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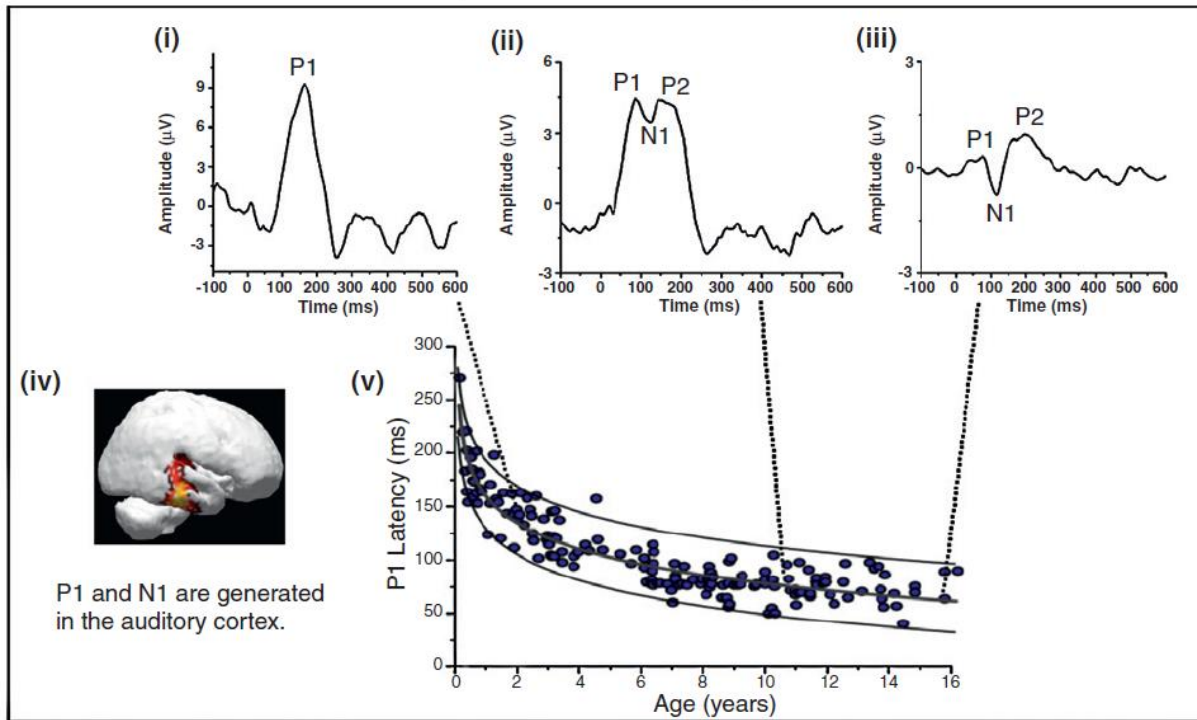
Auditory plasticity

Clinical applications: CAEP

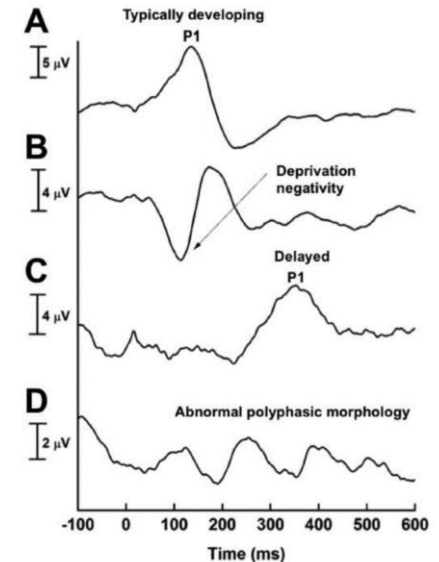


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1. CAEP as a biomarker of auditory cortex maturation



Ejemplos



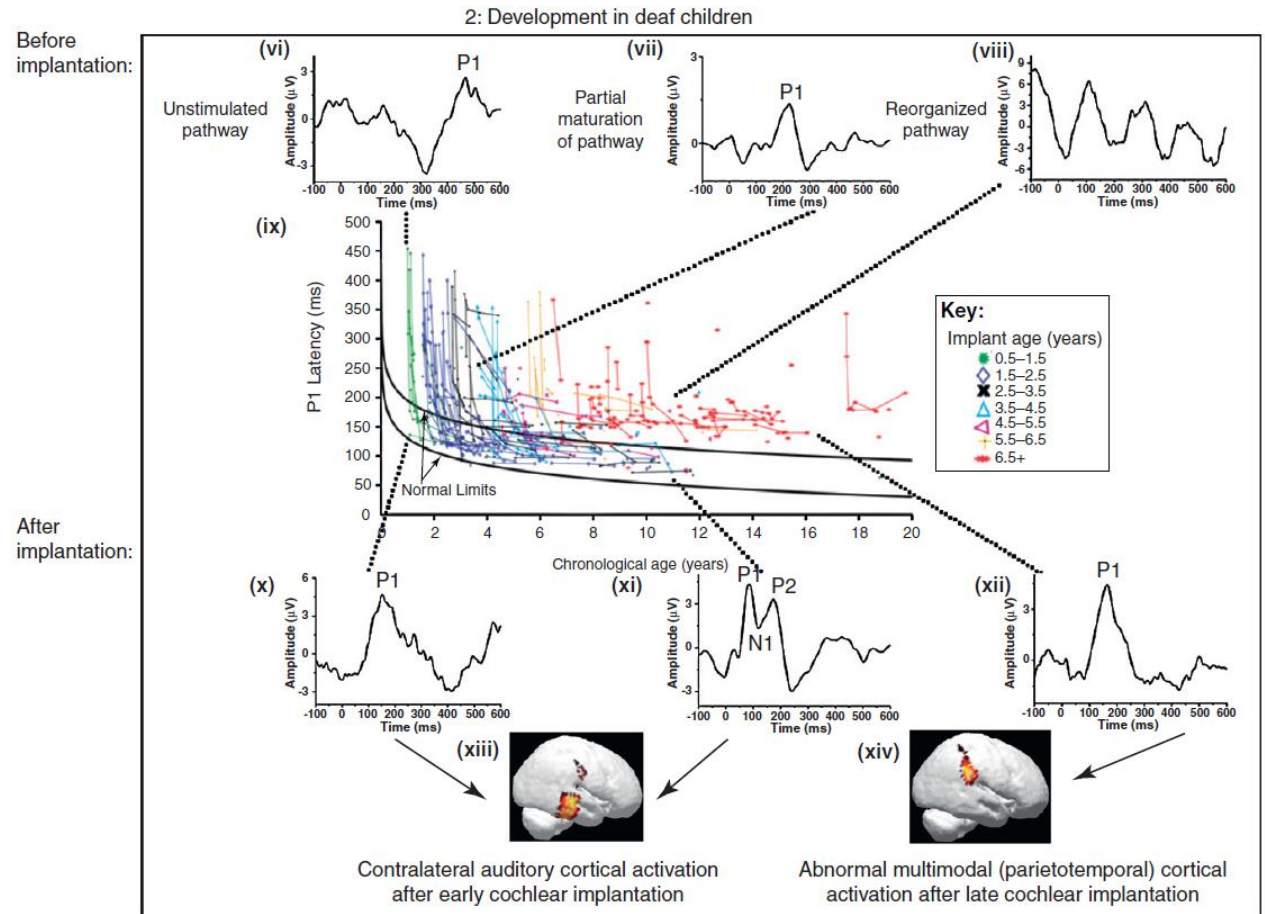
Trends in Neurosciences February 2012, Vol. 35, No. 2

Otorinolaringología. 2015 December ; 65(4): 103-114.



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2. CAEP as a biomarker of auditory cortex maturation with CI in bilateral hearing loss



Trends in Neurosciences February 2012, Vol. 35, No. 2



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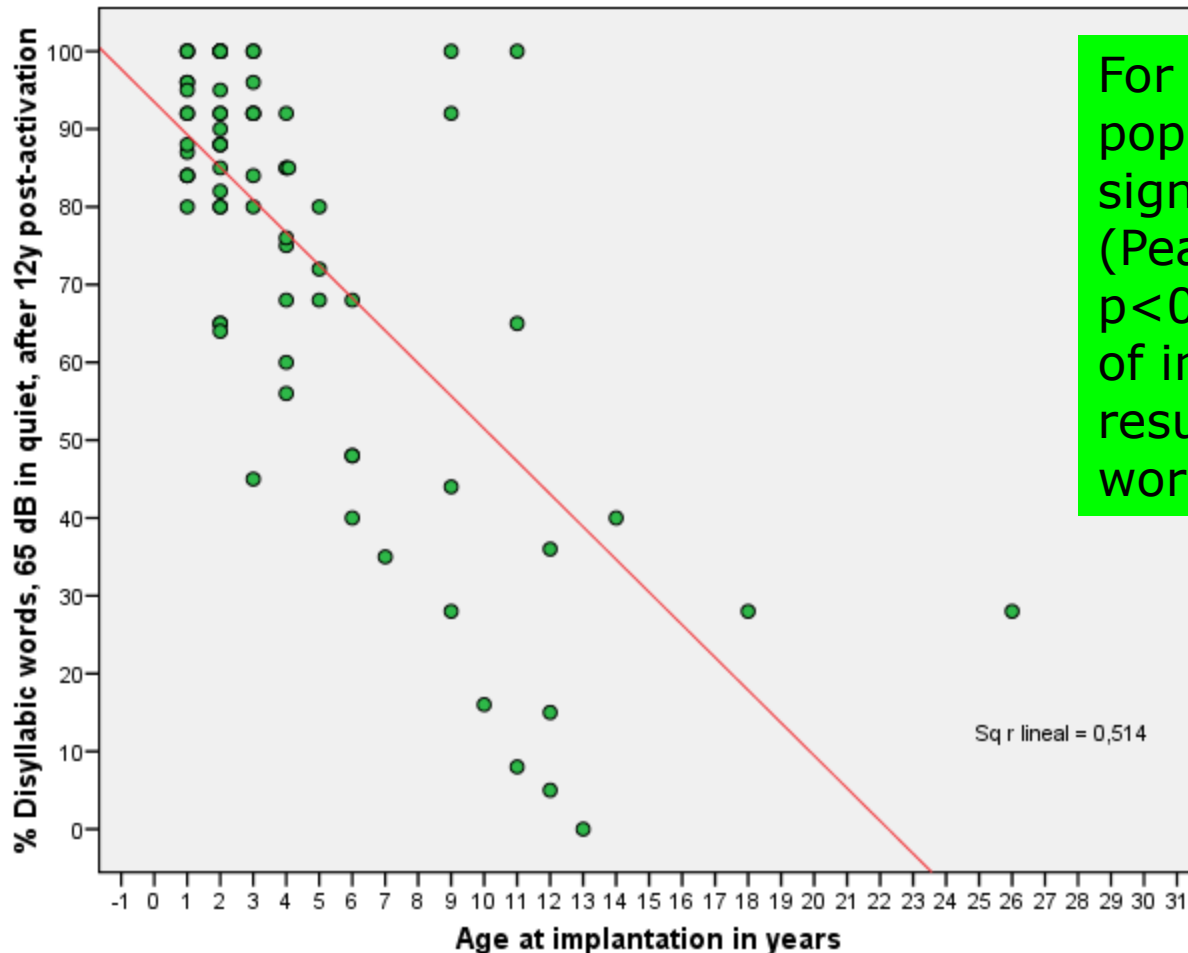
Clinical applications: Critical periods in children treated with CI



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Prelinguals

Correlation between Age at UNILATERAL CI and Speech perception



For prelingual deaf population, there is a significant correlation (Pearson CC= -0.717, $p < 0,001$) between age of implantation and the results of disyllabic words

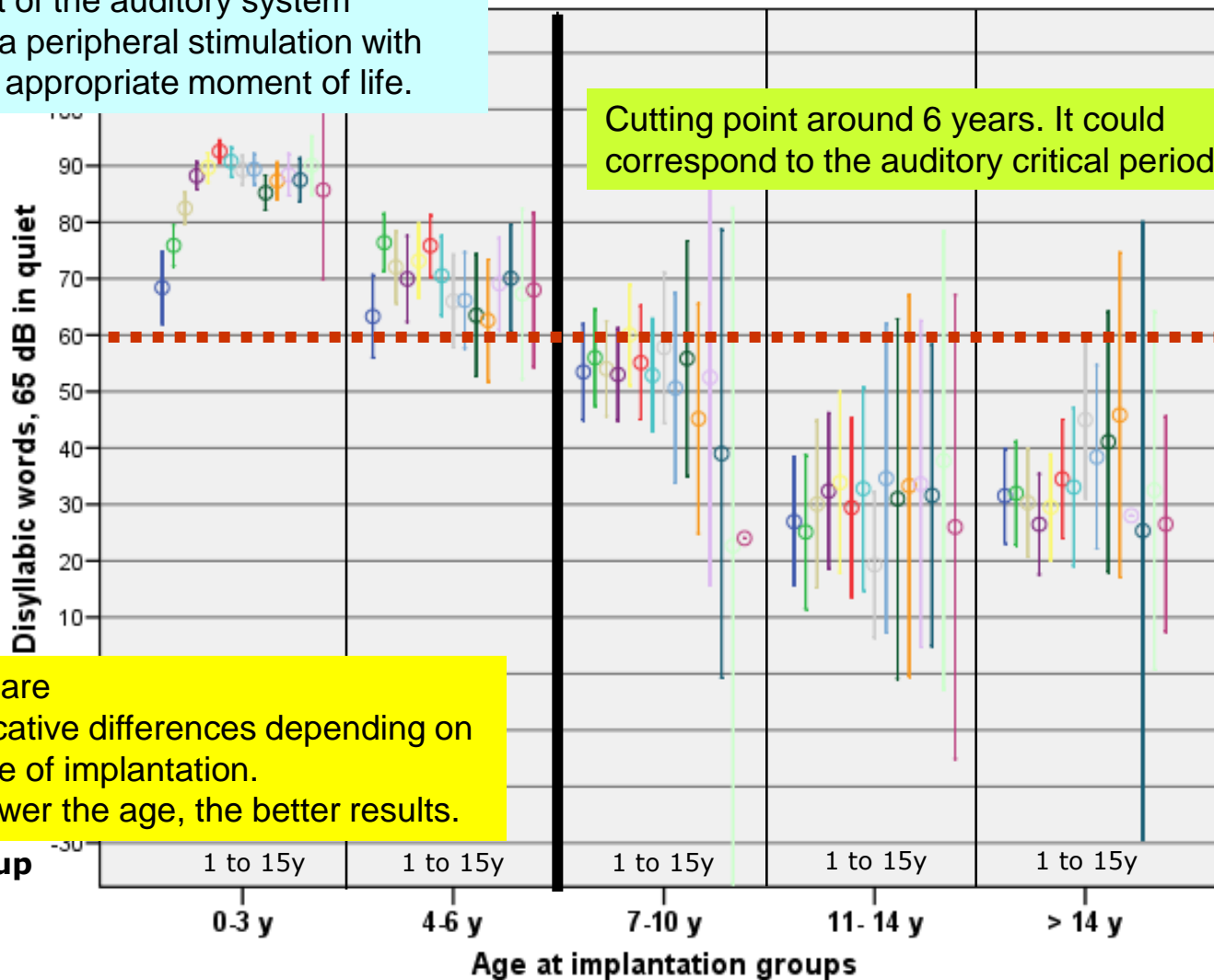
PRELINGUALS N: 219

	Group of age	Number	Mean age CI
1	0-3 years	94	1,79 years
2	4-6 years	36	4,95 years
3	7-10 years	30	8,60 years
4	11-14 years	22	12,32 years
5	> 14 years	37	21,49 years

Prelinguals

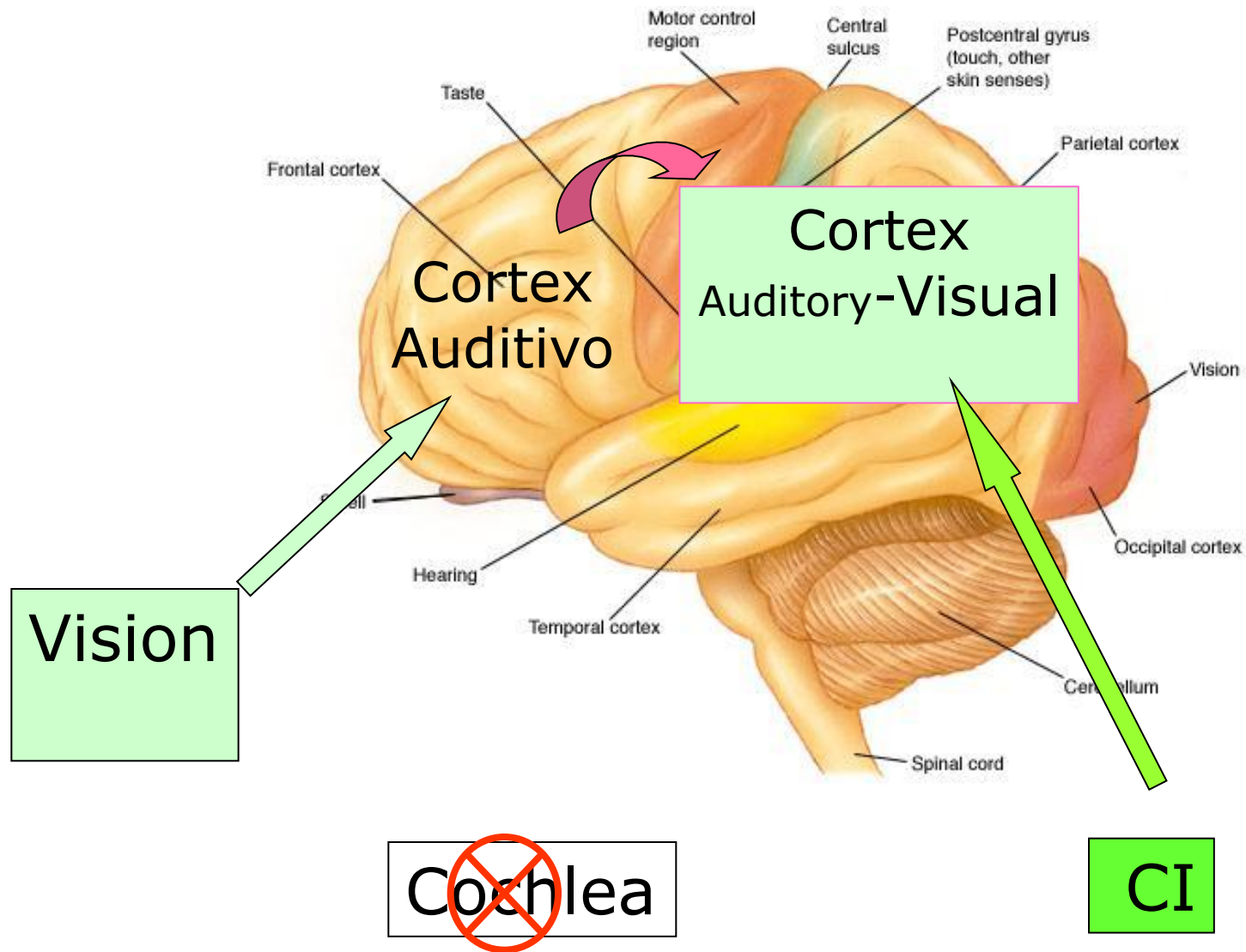
Children implanted between 0-3 years old improve progressively. Therefore, the development of the auditory system depends on a peripheral stimulation with the CI at the appropriate moment of life.

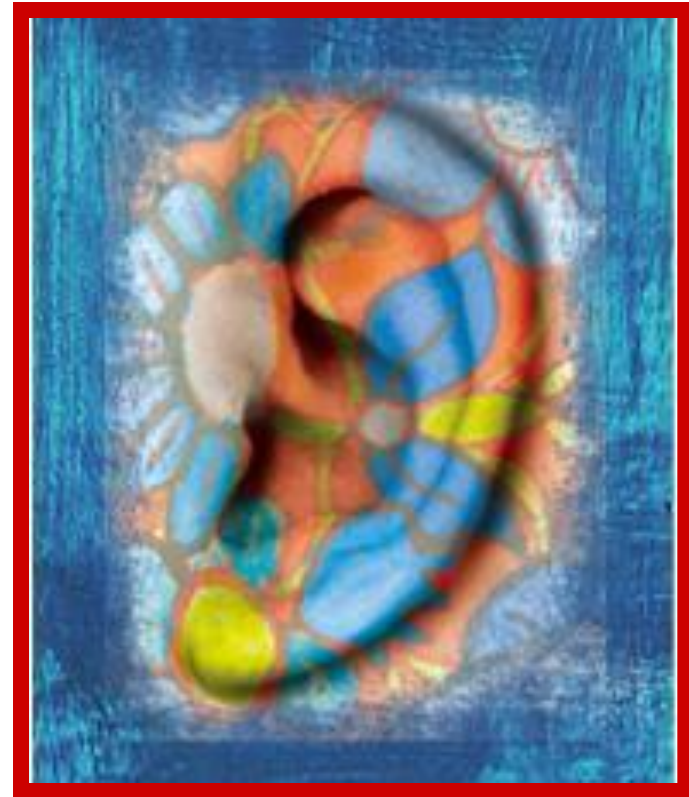
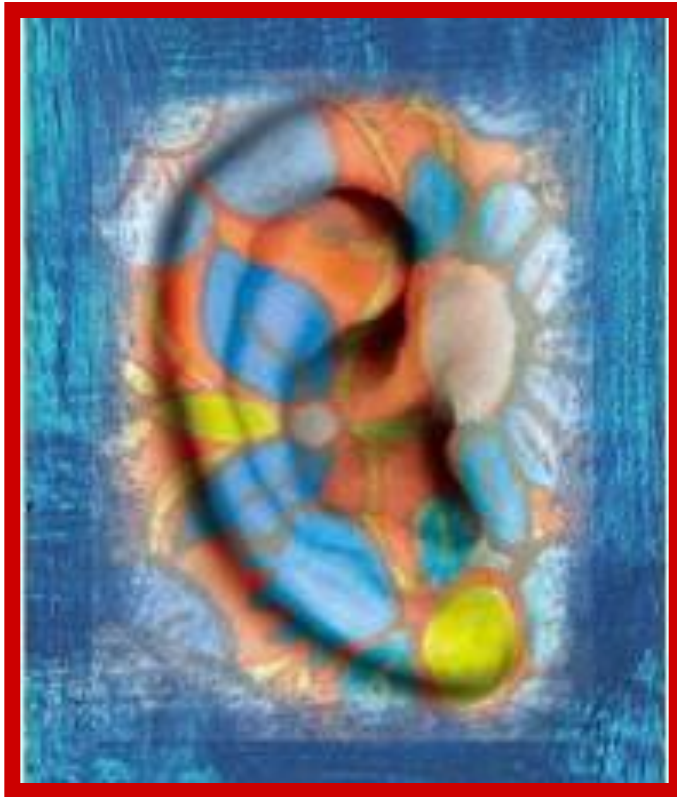
65 dB SPL, open-set context



There are significant differences depending on the age of implantation. The lower the age, the better results.

"Cross modal Plasticity"





Thank you very much!