

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Idiopathic Language
Impairment:
A Neurolinguistic and
Electrophysiological Study

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- Language is a complex symbolic human communicative ability specific to mankind.
- The human child is born with prerequisites for symbolic communication.

Prerequisites of normal language development

- Intact sensation.
- Intact brain functions.
- Intact Psyche.
- Stimulating environment.

Kotby 1980

Structural maturation

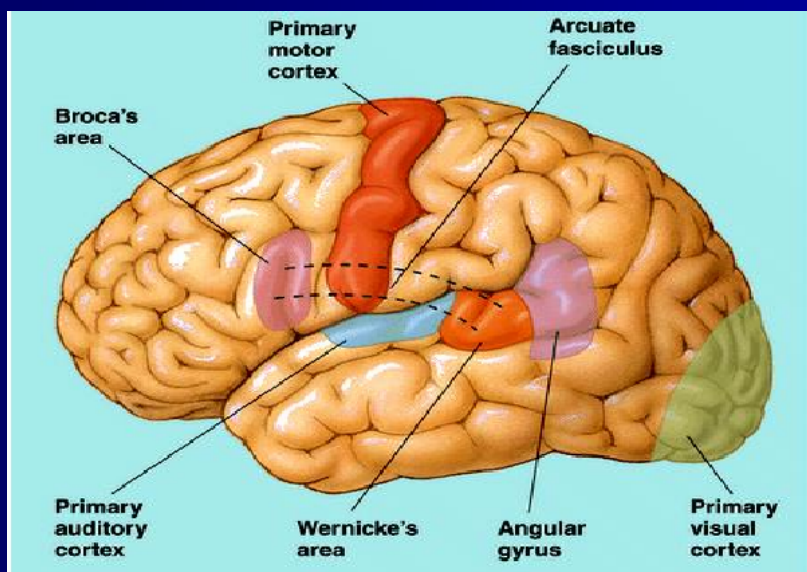
Metabolic maturation

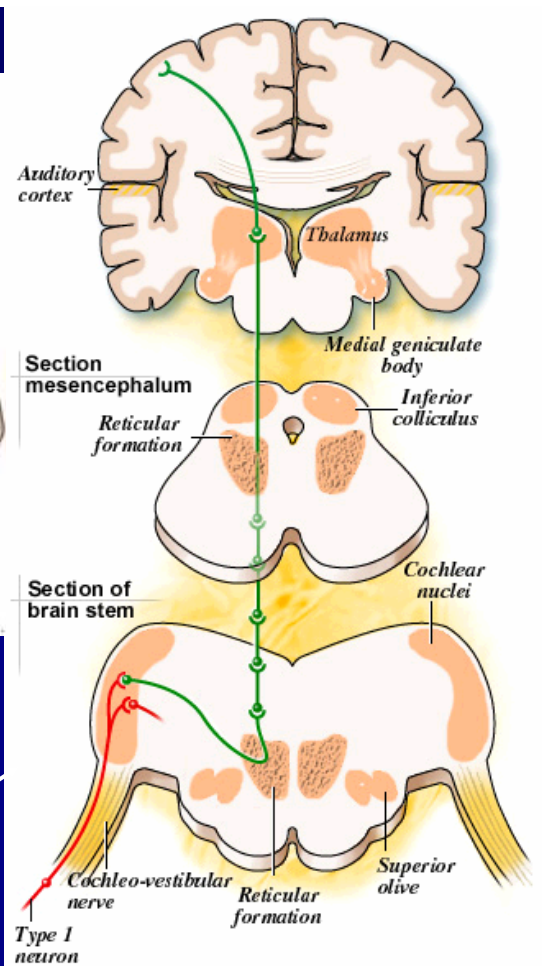
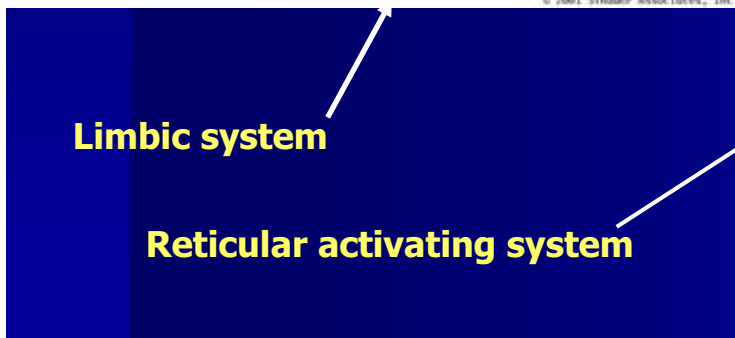
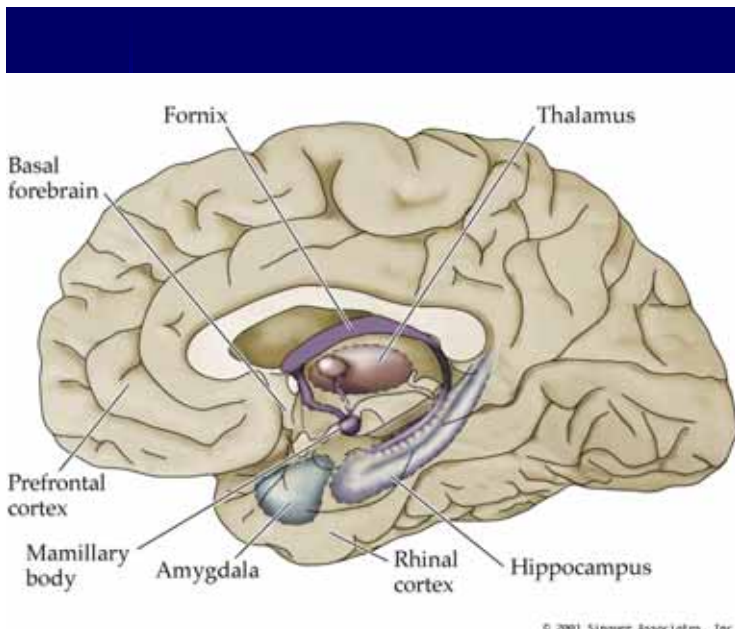
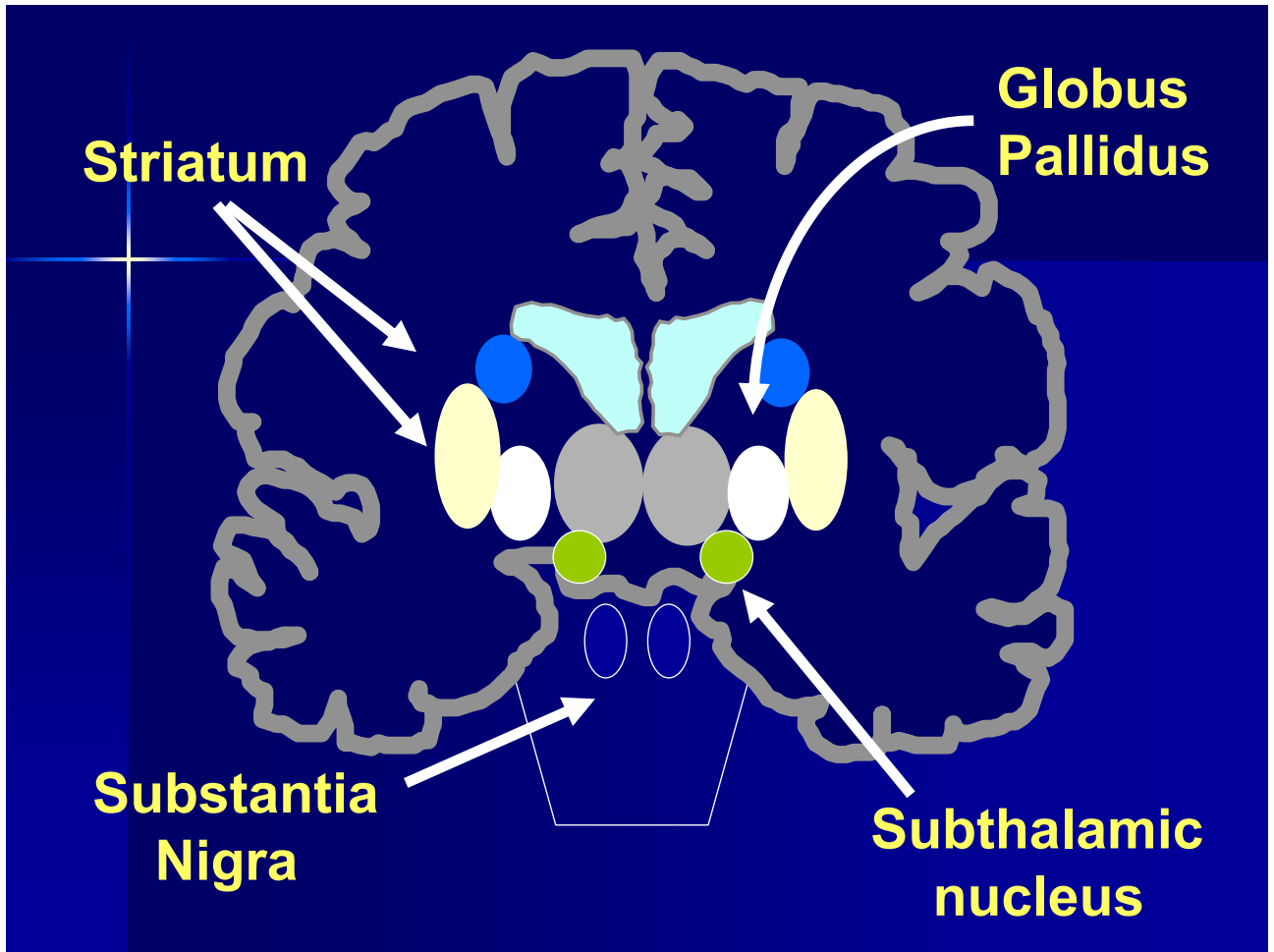
Higher cognitive functions

Neurophysiological maturation

Albert et al. 1999

Anatomical representation of Language





CNS Maturation

- Maturation occurs in an organized, predetermined pattern, correlating the functions the infant performs at various stages of development.

(Jernigen et al.1991)

- The gradual evolution allows the infant to gain control of locomotion, language, and thought.

(Albert et al. 1999)

Circuits

The final configuration of circuit occurs by elimination of synapses (genetically programmed) based on cell interaction.

The interactions:

- Reduce the degree of initial programmed redundancy.
- Selectively promote the development of compatible and/or interdependent neuronal innervations patterns.

Lieberman 2002, Kandel 1998

Circuits

Circuits activation are dependent on the probabilities of repeated stimulation profiles.

The increased probability is created by:

- changes in the synaptic connections.
- changes at the level of the cell membrane.

(Martin and Kandel 1996)

Circuits

The linked neural processes carried out in the circuit constitute the basis of a complex, observable aspect of behavior.

(Vargha-Khadem et al. 1998)

Circuits

The specific firing pattern



representation.

The activation of neural patterns

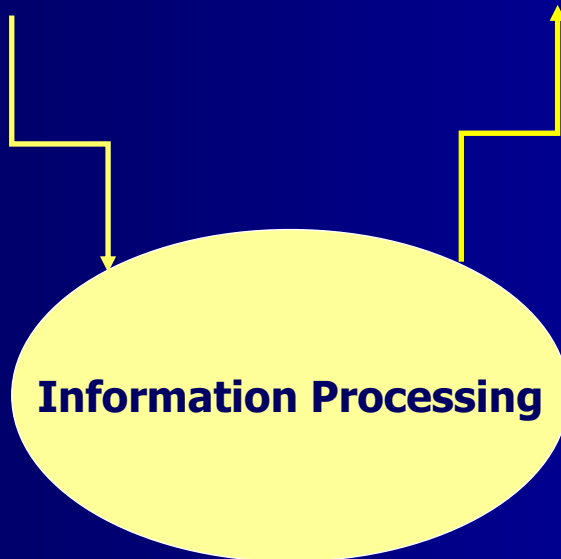


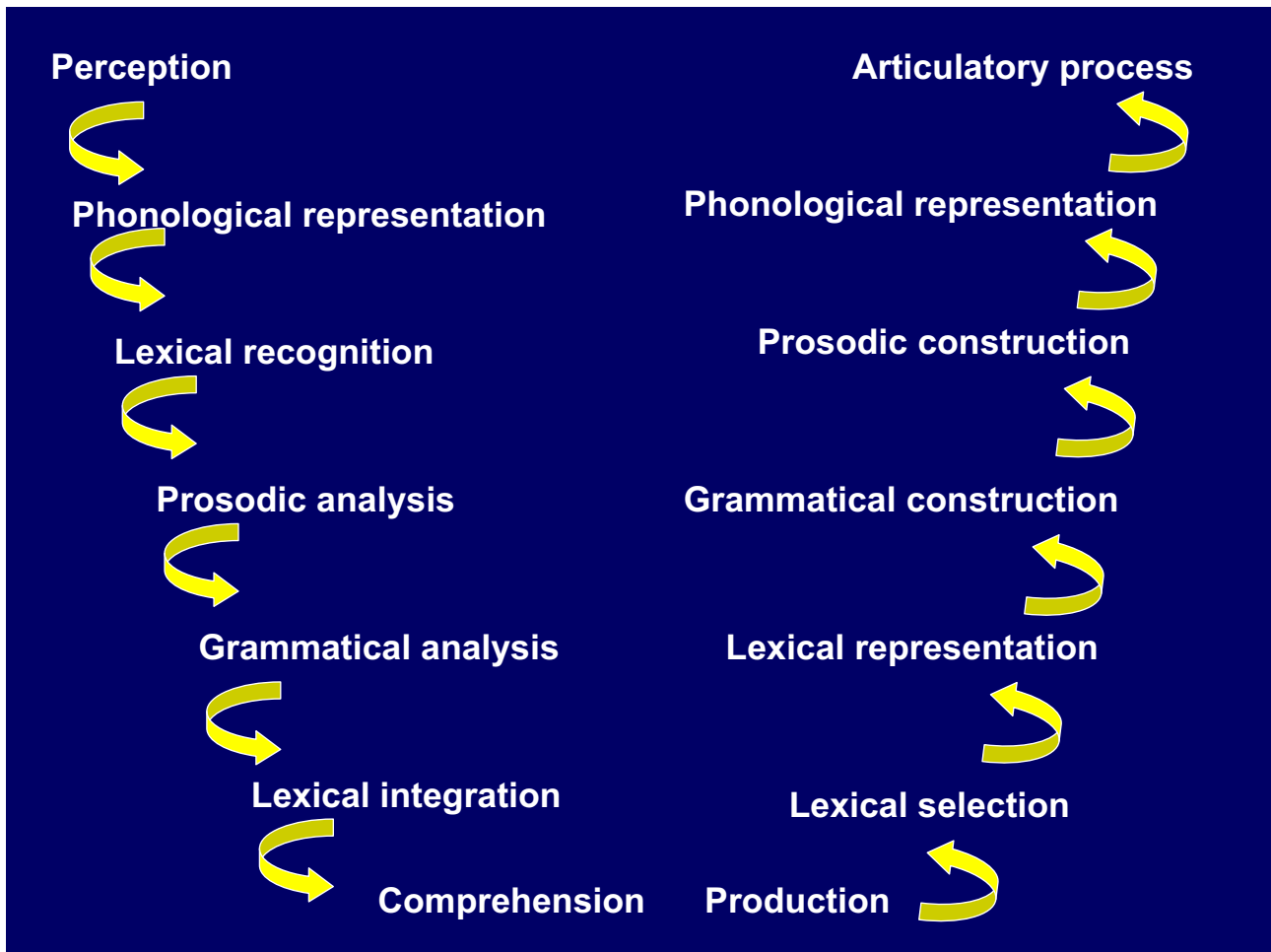
informational processing.

Language Processing

Mental representation

Cognitive operation





How the brain of children differ?

- Brain regions more diffuse.
- Non-motor temporo-parietal areas more active.
- Controlled processing more involved.

Language development

- Language development involves an ***additive, subtractive & reorganization process.***
- Language learning is progression from detailed encoding of complex material.
—————→ simple representation.

Neurolinguistic Development

Vocal Learning



Utterance acquisition



Analysis and computation



Integration and Elaboration *Locke 1997*

Clinical Issues

- Why is my child Not speaking?
- Will my child ever develop language?

Idiopathic

Language impairment

Heterogeneous

Dynamic

Theories

- Auditory processing disorder.
- Limited information processing Capacity.
- Speech production disorder.
- Genetic basis.
- Subtle structural anomalies.
- *Innate versus learning theory.*
- *Higher-level conceptual deficit.*

- Language (complex cognitive skill) controlled by the **mental computations** that process information.
- Mental computations are described in terms of the **neural activity** that implements them.
- The neural activities can be reflected on various **electrophysiological measures**.



Aim of the study

- Assess idiopathic language delay physically and linguistically in order to **present a diagnostic profile** of this category and to **substantiate the inclusion criteria**, and **elucidate an etiological mechanism** for the pathogenesis of this category of delayed language problem.

Aim of the work

1. To assess ILI children from various aspects (audiological, neurological, cognitive and behavioral) and compare to normal children.
2. To correlate the results of the studied aspects to various language components and to find out the possibility to specify this language ailment.
3. To evaluate the value of these aspects in predicting the outcome of language intervention in these children.



Subjects

**Studied
Children
(70)**



**Group I
ILI children
40
5.5±1 year**

**Group II
Control
30
5.7±1.2 year**

Methods



Methods

- Preliminary Evaluation: (two visits)
 - Detailed history taking.
 - Physical and neurological examination.
 - Psychometric evaluation.
 - (Informal Language evaluation).
 - Basic audiological assessment.
 - ✓ Determination of the developmental profile.

Methods

- Formal Language evaluation:
 - Arabic language test.
 - Articulation test.
- ✓ Determination of the language profile.

EEG

P300

MLR

ABR

Methods

- Electroencephalogram:
 - Digital EEG analysis
 - Dominant waves
 - Paroxysmal abnormalities
 - Maturity state



Methods

- Evoked potentials (one–two visits)
 - Auditory Brain Stem Response (ABR).
 - Middle latency response (MLR).
 - Cognitive auditory evoked potential (P300).

Description of the latency, amplitude, IPL and AR of various waveforms.



Methods

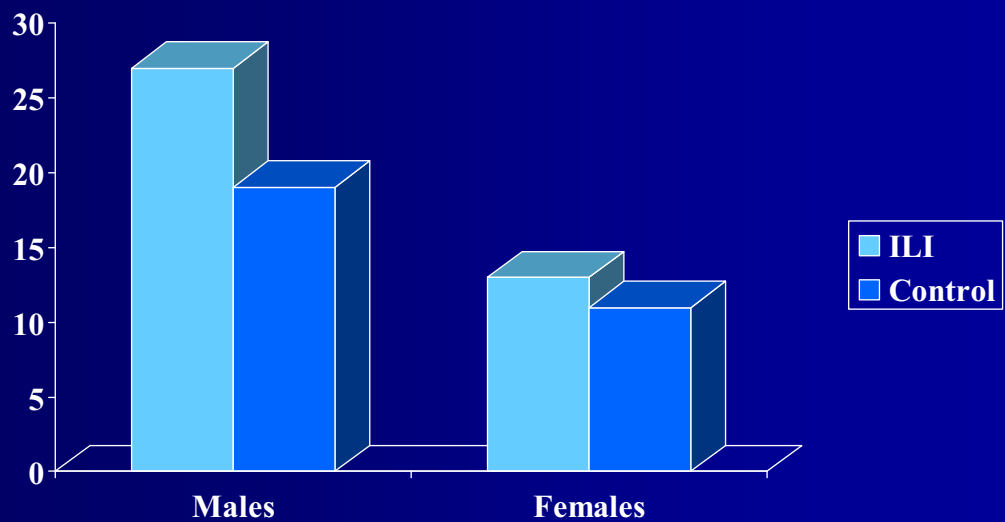
- Planning for language intervention.
 - Counseling and regular follow up.
 - Language intervention program.
- Formal language reevaluation after a period of 6 months of therapy.

Results

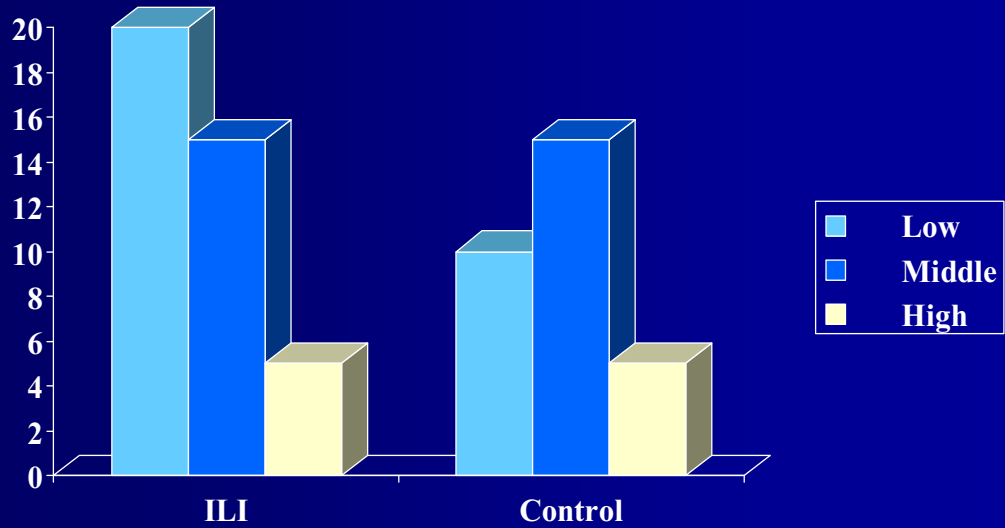


Sociodemographic

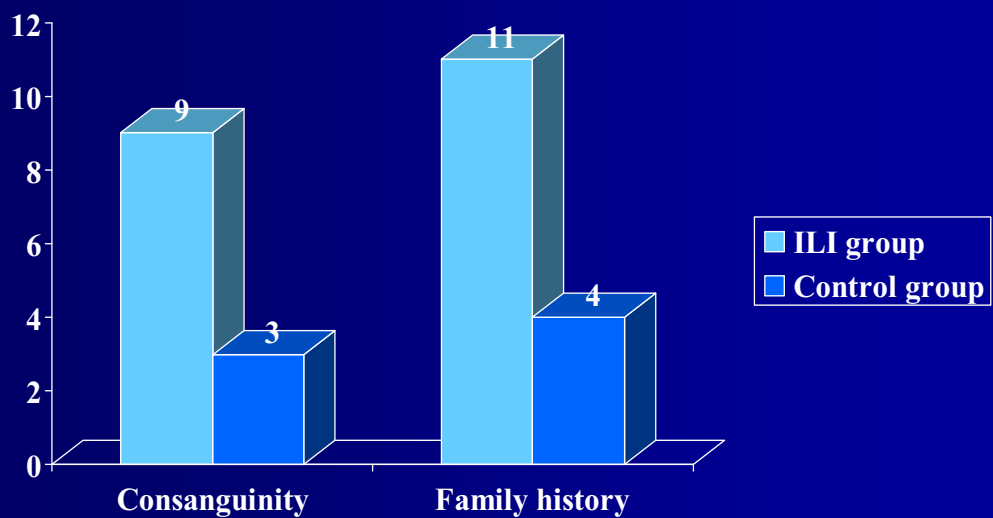
Sex Distribution



Socioeconomic class

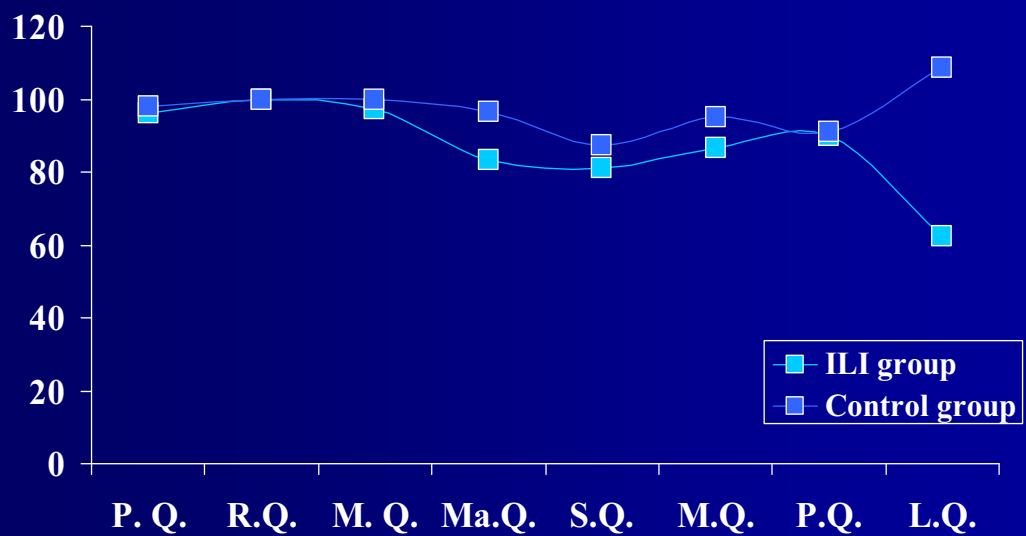


Consanguinity and Family History

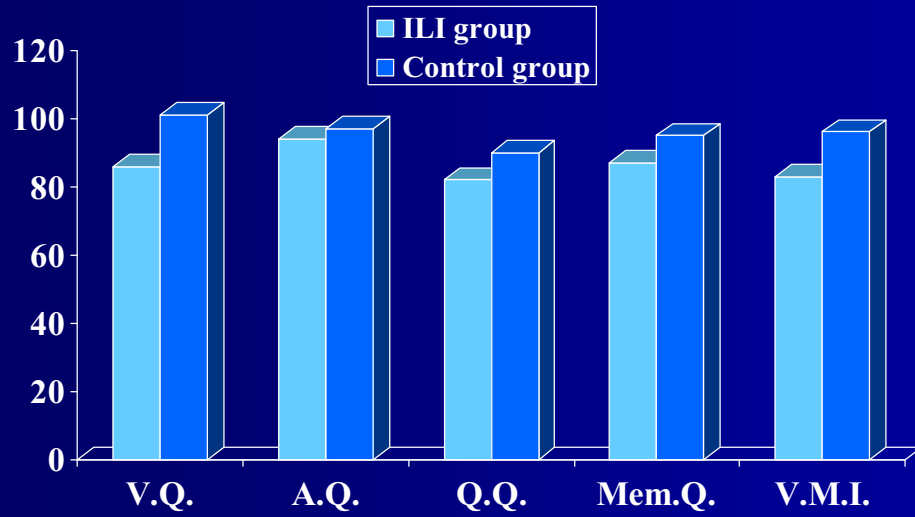


Developmental profiles

Developmental profile

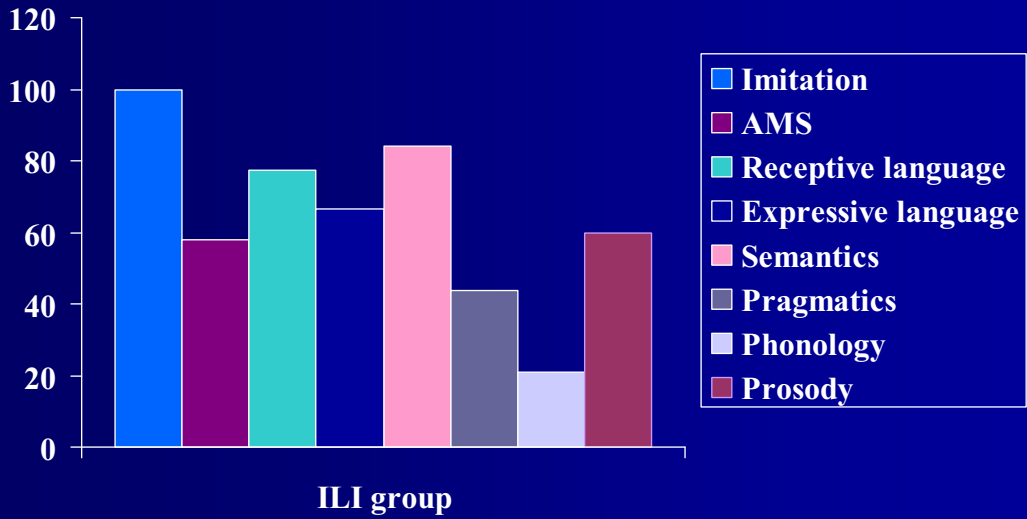


Psychometric results

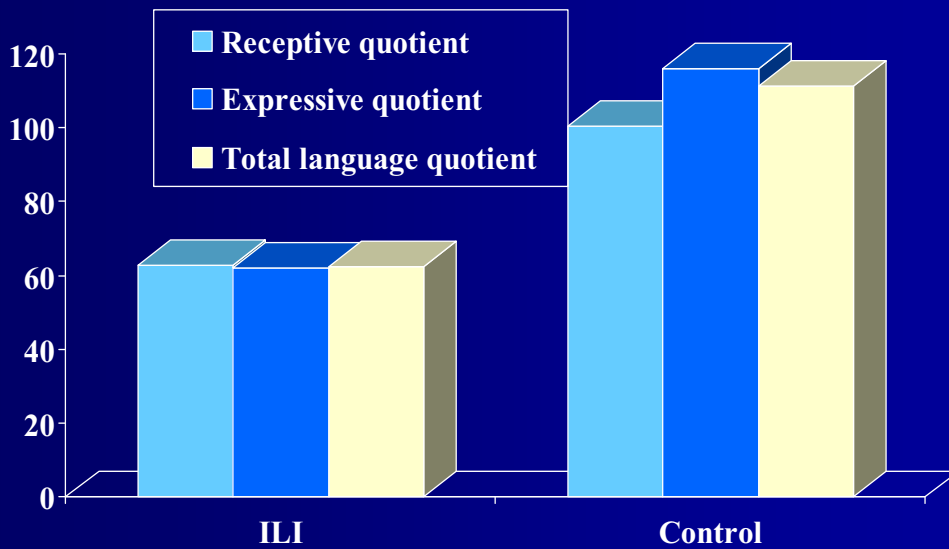


Language performance

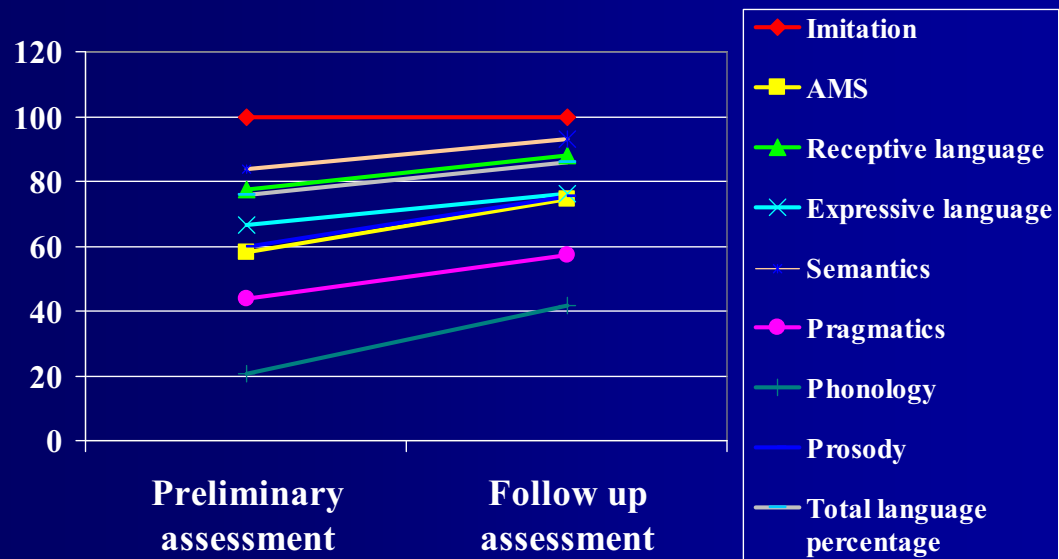
Language test results of the ILI children



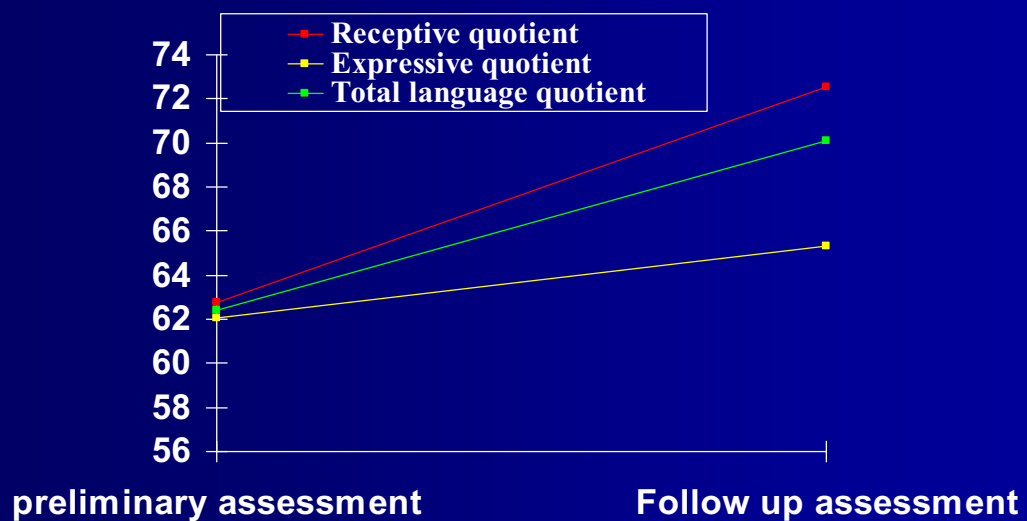
Language test results of the ILI children



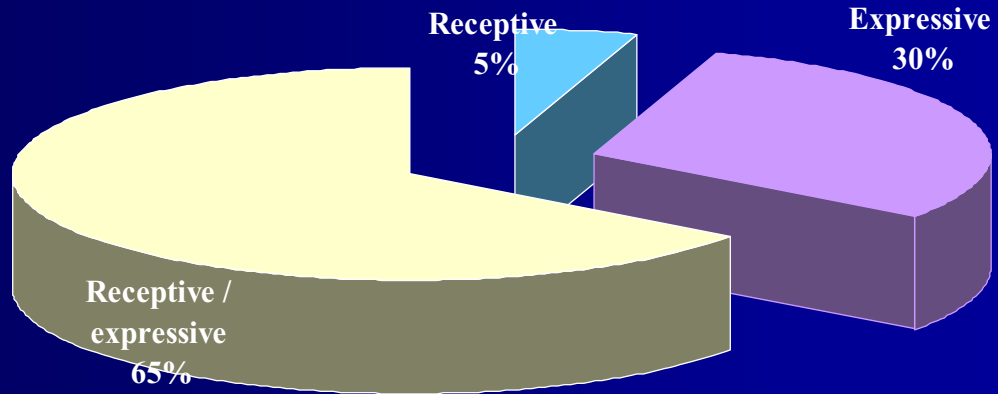
Language performance after a period of 6 months of language intervention



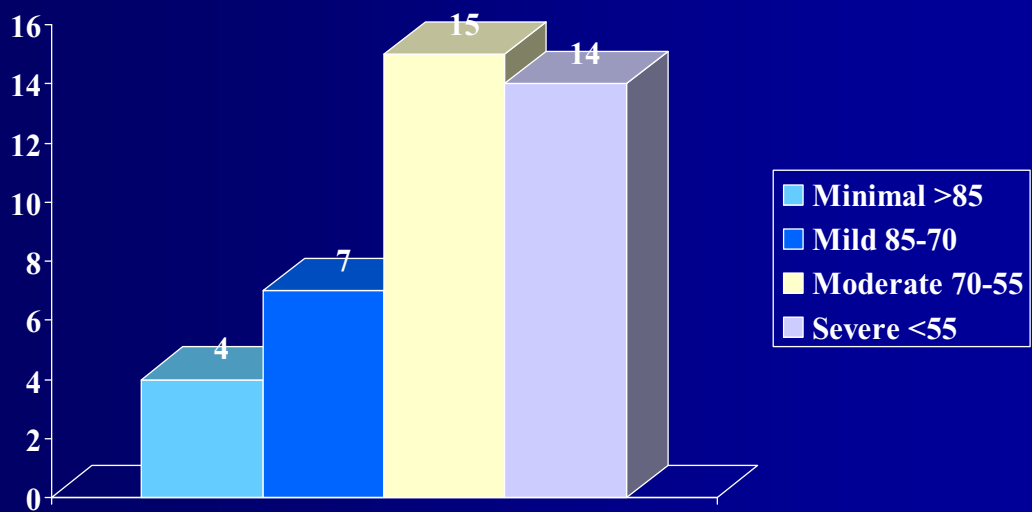
Language performance after a period of 6 months of language intervention.



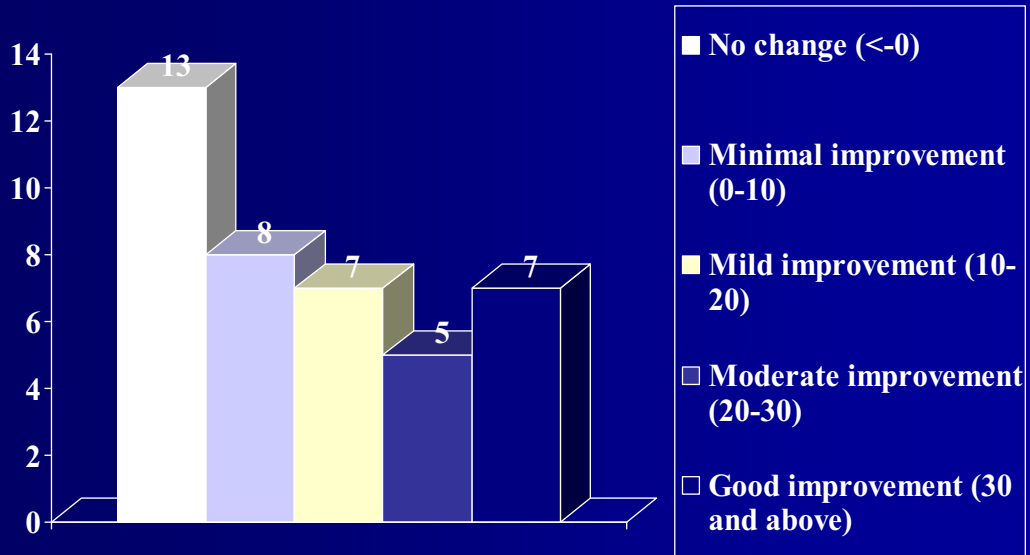
Different language profiles of the ILI children



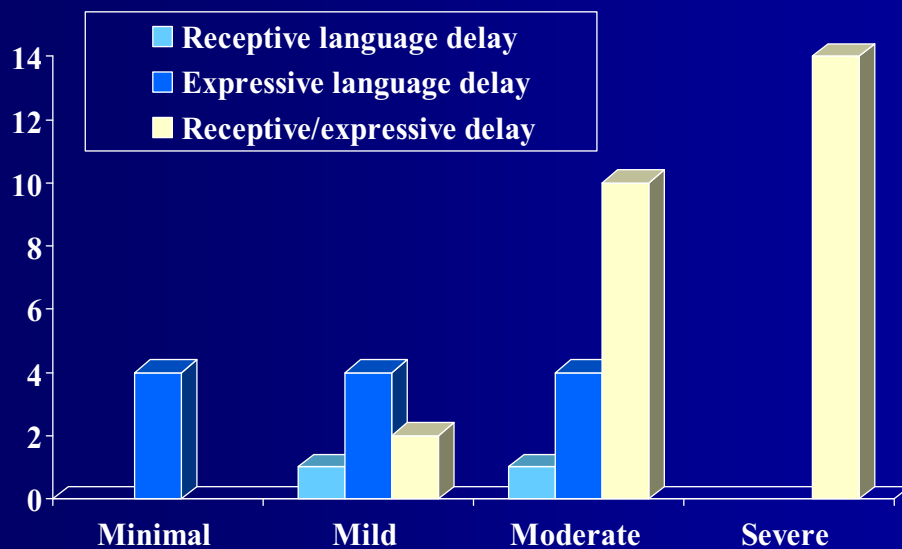
Severity of language impairment



Degree of Improvement

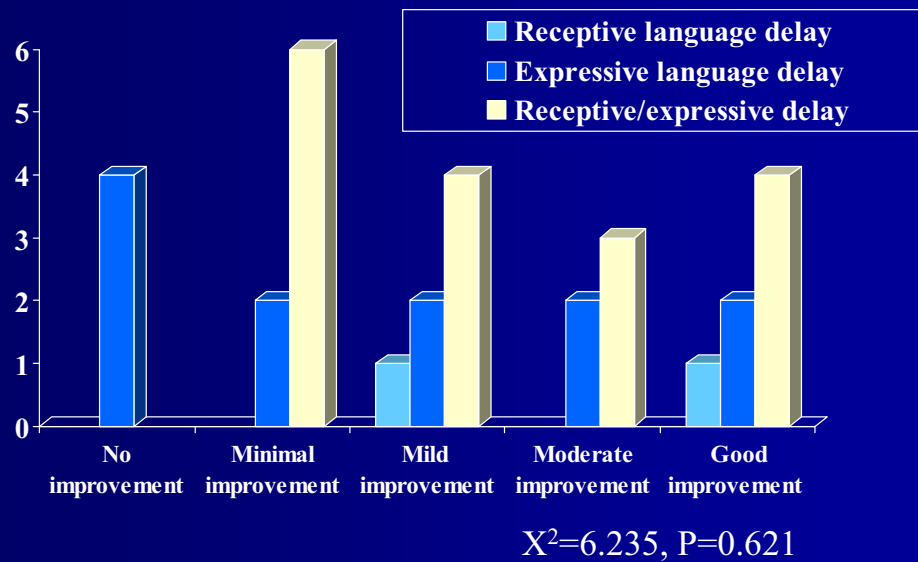


Distribution of ILI group by language delay severity and profiles



$X^2=22.895, P=0.001$

Distribution of ILI group by degree of improvement and language profiles



Electrophysiological studies

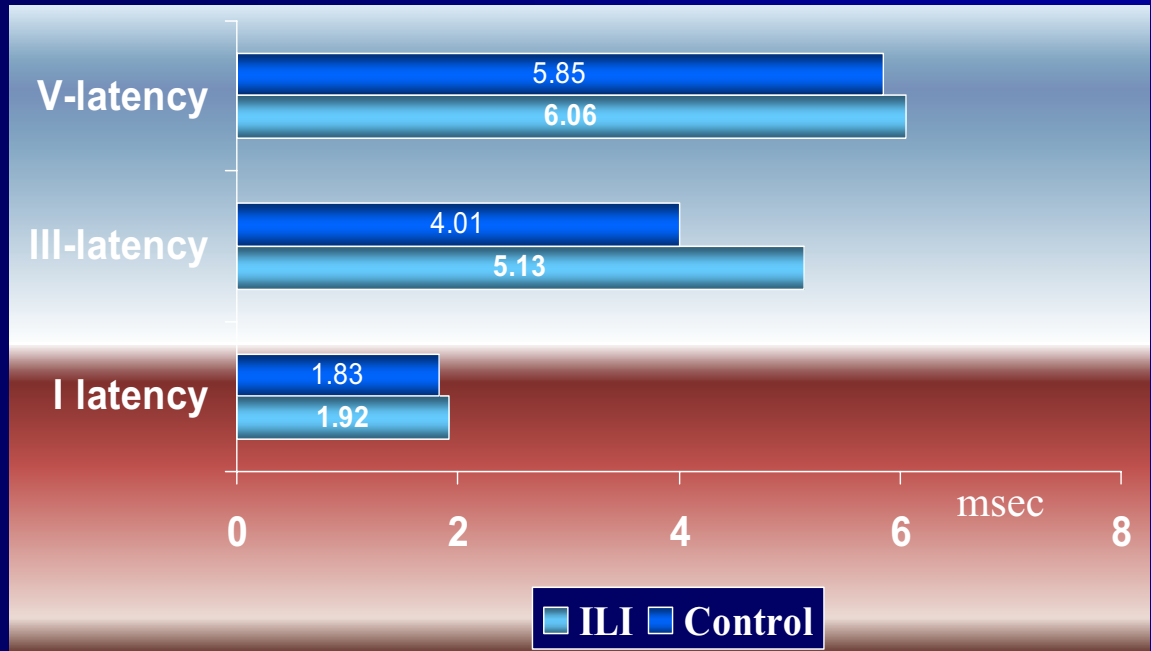
- A) Evoked potentials
- B) Electroencephalogram

A) Evoked potentials

ABR latencies (Right)



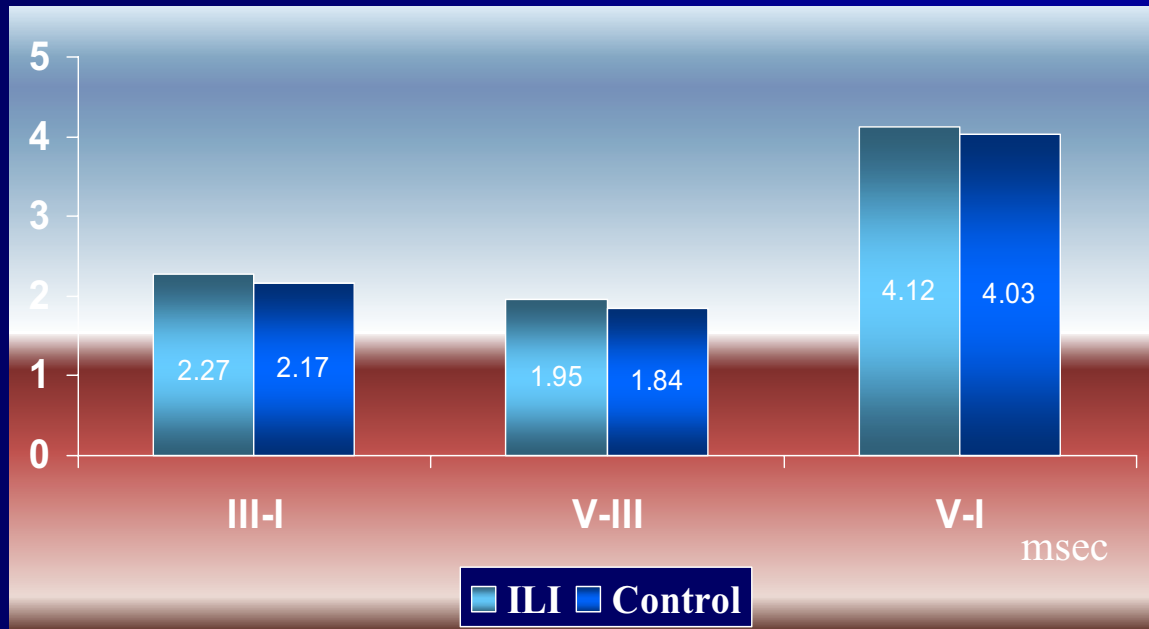
ABR latencies (Left)



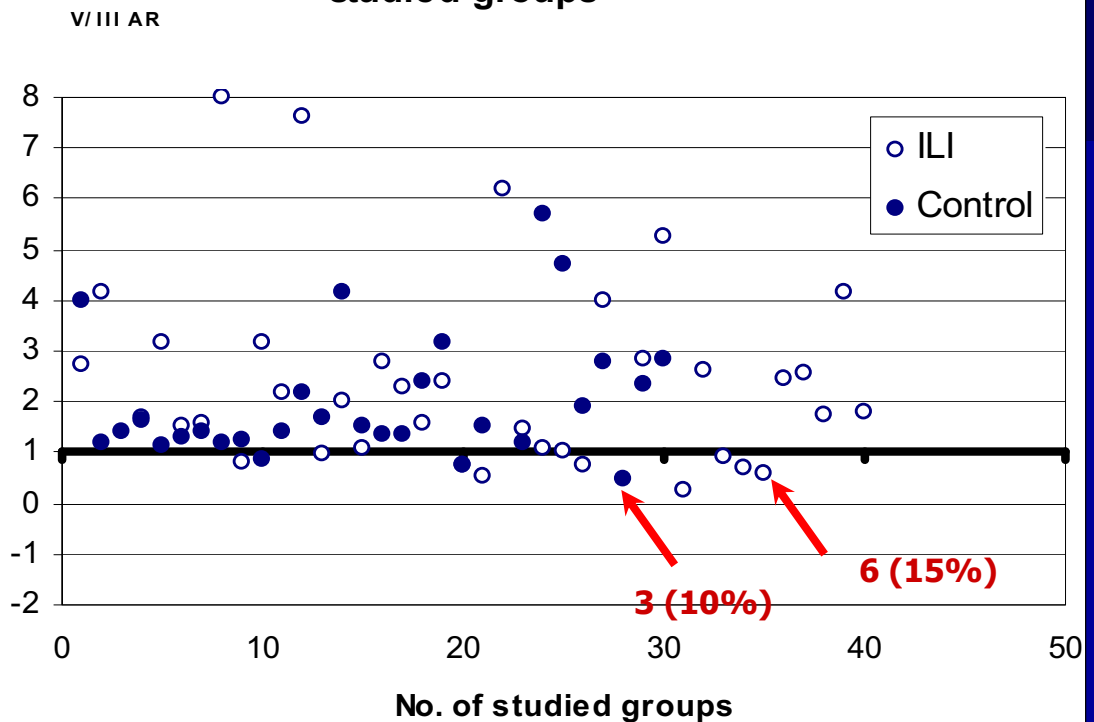
ABR interpeak latencies (right)



ABR Interpeak latencies (Left)

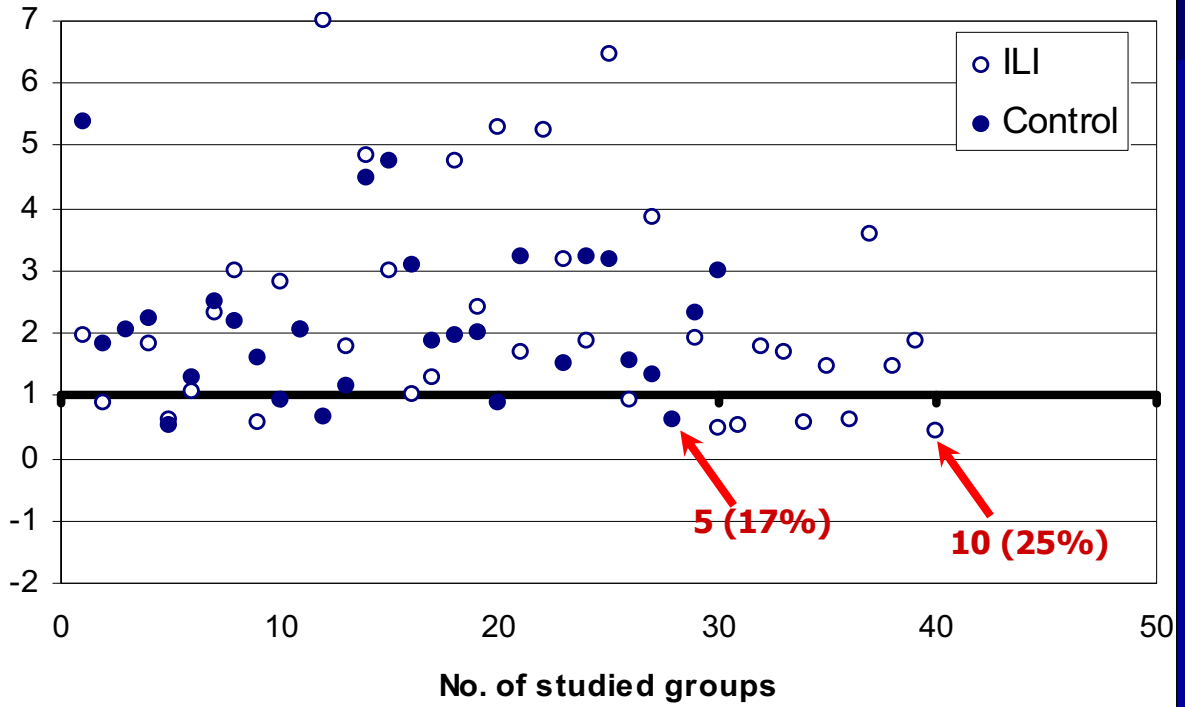


Scatterdiagram: displays the V/III AR right for the studied groups

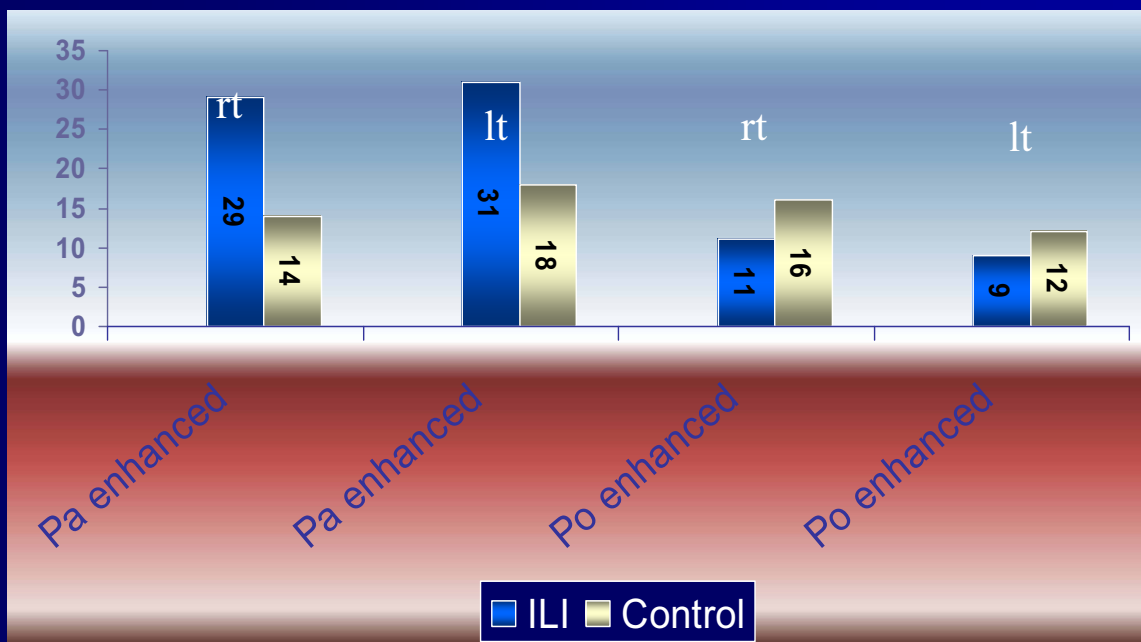


scatterdiagram: displays V/III AR left for the studied groups

V/III AR left



Morphological characteristics of MLR waveform



MLR latencies (right)

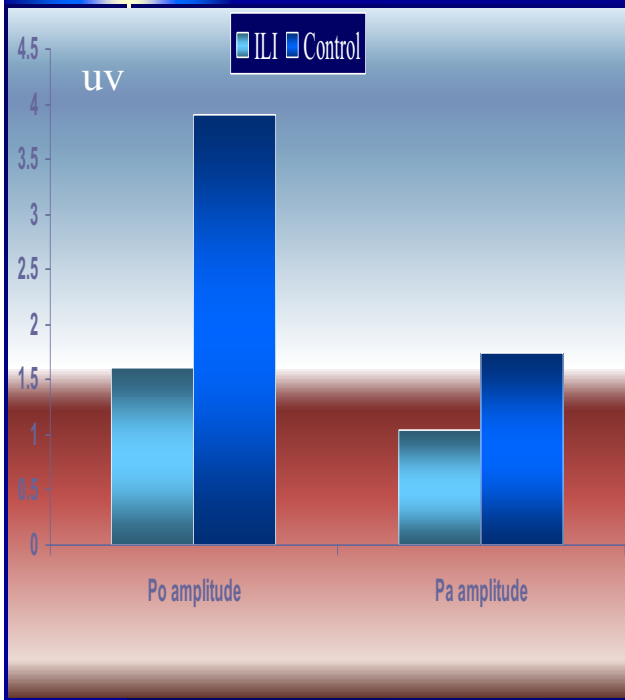


MLR Latencies (left)

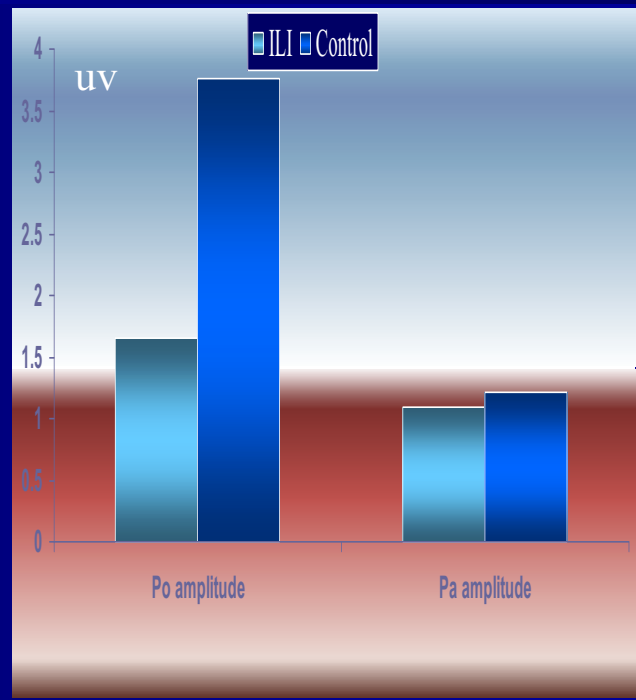


MLR amplitude

Right



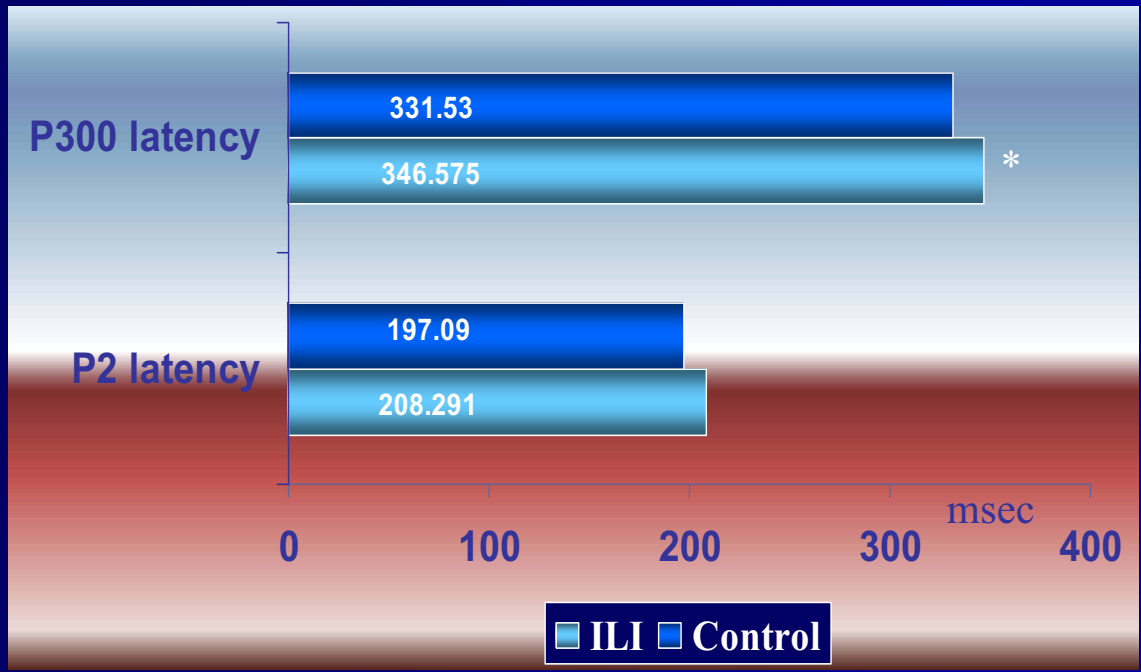
Left



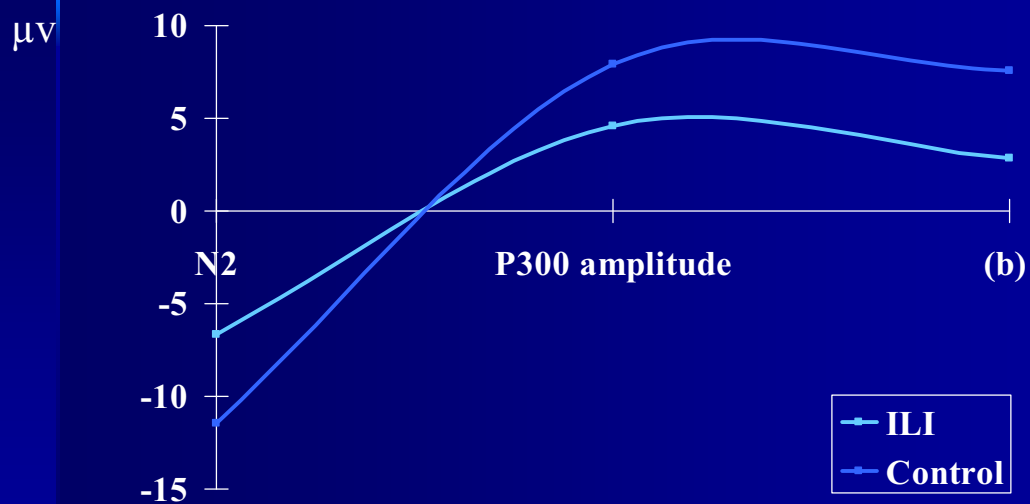
Pa/Po AR



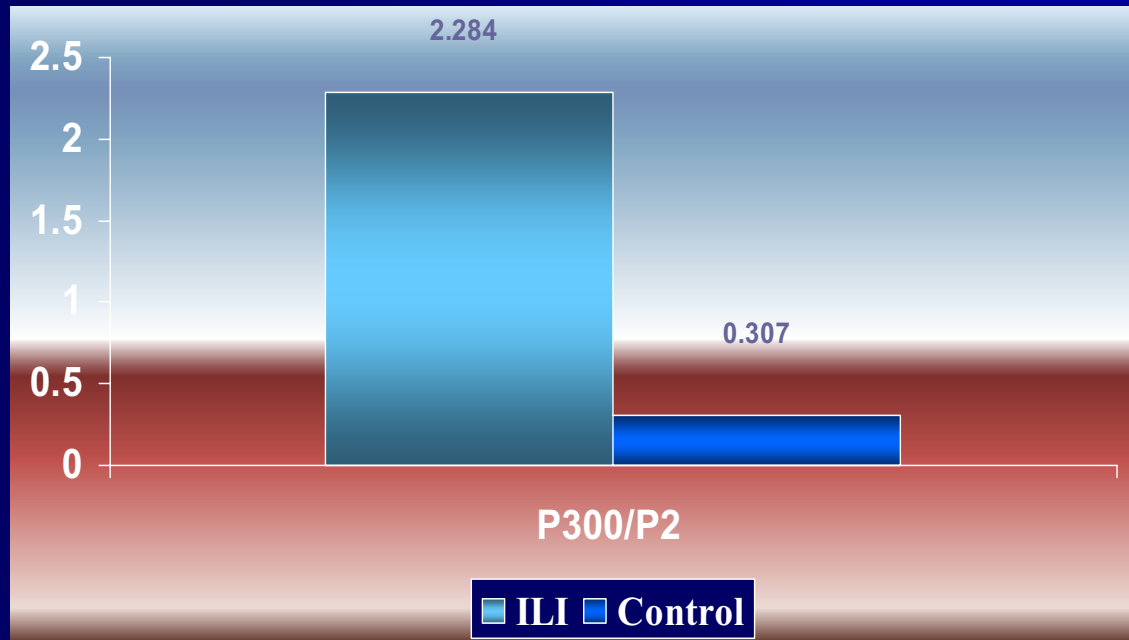
P300 & P200 latencies



P300 wave form amplitude

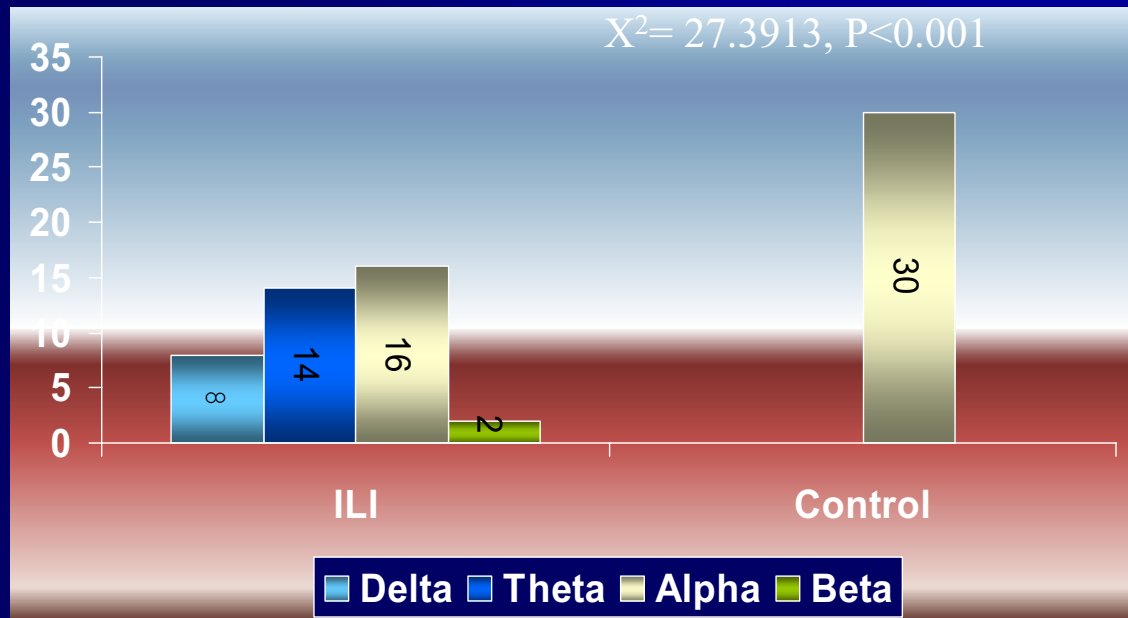


P300/P2 AR

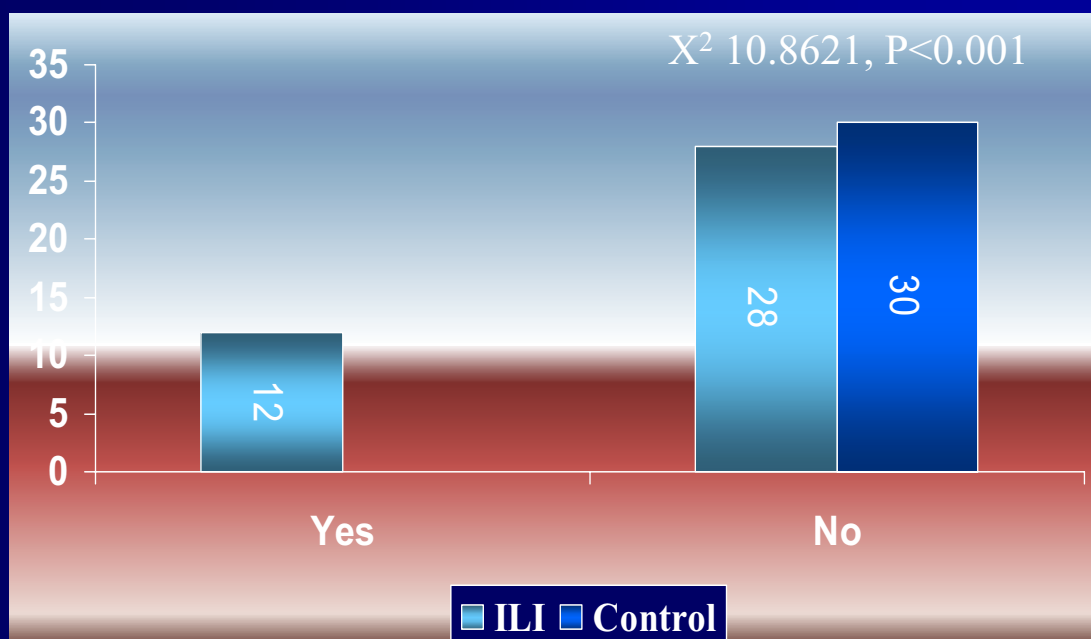


B) Electroencephalogram results

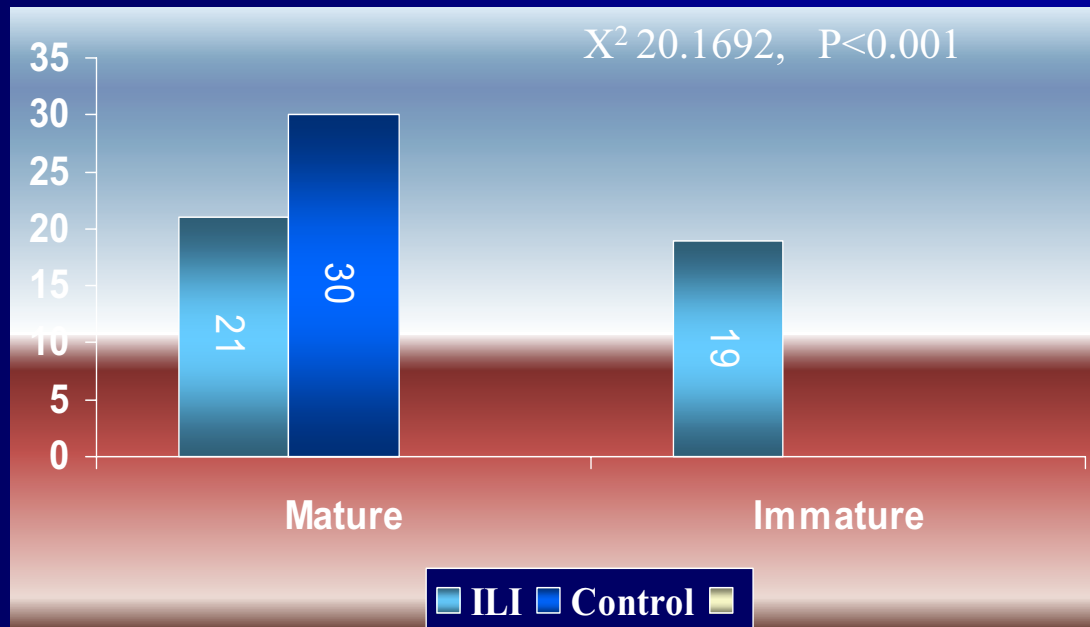
Dominant wave



Paroxysmal abnormalities



Maturity of EEG pattern



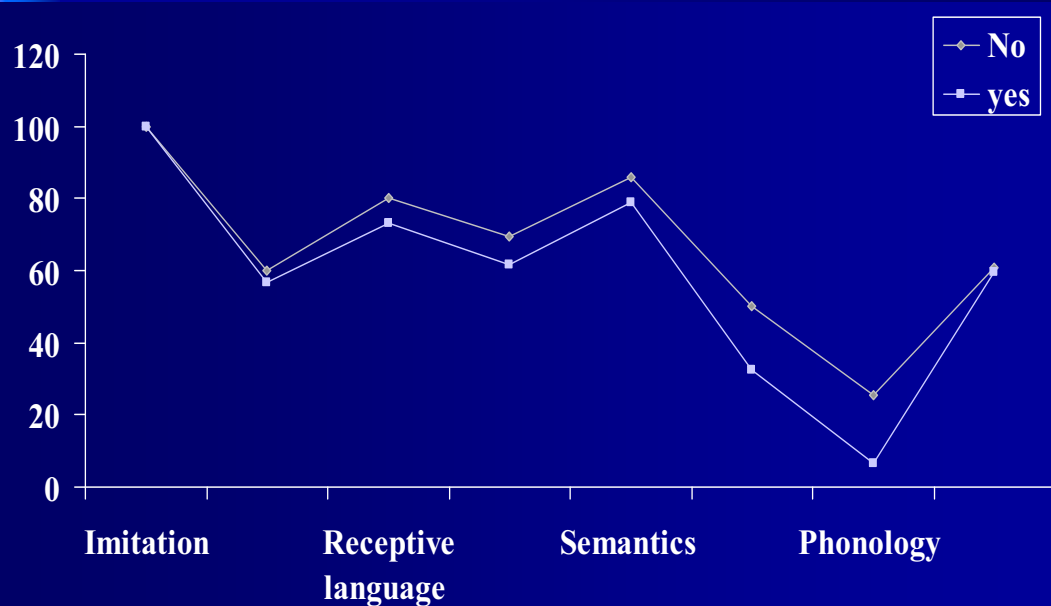
Electrophysiological findings and severity of language impairment.

- No association for ABR parameters.
- No association for MLR parameters.
- Significant association for P2-P300 IPL.
- Significant association for EEG maturity.

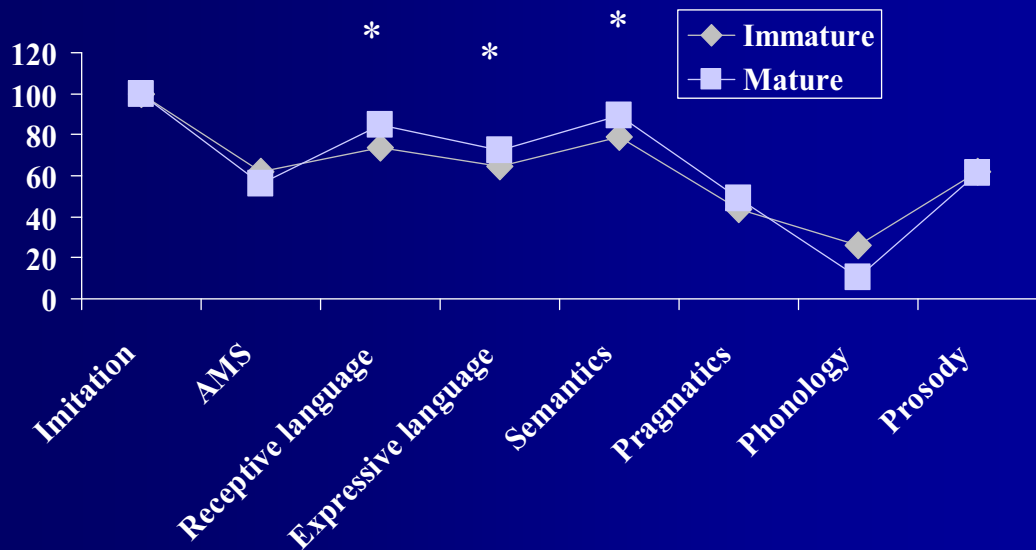
Electrophysiological findings and profiles of language impairment.

- Significant association of No latency (right).
- Significant association of Po latency (left).
- Significant association of EEG maturity.

Language performance of the children with and without paroxysmal abnormalities.



Language performance of the children with and without mature EEG pattern.



Correlation between language performance and EPs parameters

- **Mild and Moderate correlations**
- **ABR**
 - The latencies correlated to the language performance of the ILI on the preliminary assessment.
 - V/III AR correlated to the degree of change.

Correlation between language performance and EPs parameters

■ MLR

- Pa & Po latencies correlated to the AMS.
- MLR latencies and Pa/Po AR correlated to the degree of change in pragmatics and semantics.

■ P300

- N2 amplitude correlated negatively.
- P300 amplitude correlated positively.
- P300 latency correlated negatively.

Correlation between language performance and QEEG

■ QEEG

- Alpha wave at O2 correlated positively to all language test items except AMS.
- Delta wave at C3 and Beta wave at C4 correlated to the AMS negatively.
- Delta wave at C3, C4, P4 and T4 correlated to the degree of change in AMS positively.
- All correlation to the degree of change were positive.
- Alpha wave at occipital region showed no correlation to the degree of change.

Variables affecting the degree of improvement.

- Variables
 - P300/P2 AR
 - Pa/Po AR (lt)
 - Pa/Po AR (rt)
 - Severity
 - V-III IPL(rt)

Idiopathic Language Impairment

**Specific
auditory
disorder
(LAEP, ABR)**

**Non-specific
general cerebral
disturbance
(EEG)**

Tonnquist-Uhlen 1996

Conclusions



Conclusions

The ILI children are characterized by receptive and/or expressive language deviance, not attributed to hearing impairment, mental retardation, neurological deficit, or socioemotional and environmental deprivation.

The neurolinguistic and electrophysiological measures has shown delay in ILI children.

Conclusions

The linguistic delay encompasses a delay in all language components with variable degrees.

Subtle developmental lag of manual, mental and social aptitudes and marked intragroup variability was noticed.

Conclusions

The electrophysiological delay is evident in:

- Prolonged latencies of ABR and P300 waveforms of ILI children than the controls.
- Larger proportion of children of ILI group than the control group having a V/III AR less than one.
- Immature EEG pattern recorded in the ILI children.

Conclusions

Deviant electrophysiological findings in the ILI children were noticed, it encompass:

- Deviant MLR waveform morphology in ILI children than the controls.
- Deviant P300 waveform morphology in ILI children than the controls.
- Presence of paroxysmal abnormalities in the EEG profile.

Conclusions

Some electrophysiologic measures as ABR, EEG pattern could be related to the severity of language delay.

Other measures as MLR and P300 amplitude ratios were statistically good predictors of the outcome of language intervention.

Conclusions

The heterogeneity of the ILI group and the intragroup variability stands against the use of these measures in specification of this language disorder.

Recommendations



Recommendations

The presence of language impairment may be established by linguistic, behavioral methods, but for a deeper understanding of the pathophysiology and the etiology of the disturbance, there is a need for further development of objective physiological methods.

Recommendations

Functional studies for brain mapping may rectify electrophysiological findings and provide further tools for objective, sensitive and effective method of assessment.

Recommendations

The electrophysiologic maturation measurements may be beneficial as tools for assessment and monitoring of maturing system in the ILI children. Whatever this maturation is **spontaneous** or **induced** by language stimulation programs.

Recommendations

Extending the **number** of the studied samples and the use **linguistic** signals during various functional studies, may be helpful in clarifying the nature of this disorder to solve the debate about the specification of this language ailment.

قُلْ هُوَ الَّذِي أَنْشَأَكُمْ وَجَعَلَ لَكُمُ
السَّمْعَ وَالْأَبْصَارَ وَالْأَفْئِدَةَ قَلِيلًا
مَّا تَشْكُرُونَ

سورة لملك

ثُمَّ سَوَّاهُ وَنَفَخَ فِيهِ مِن رُّوحِهِ
وَجَعَلَ لَكُمُ السَّمْعَ وَالْأَبْصَارَ
وَالْأَفْئِدَةَ قَلِيلًا مَّا تَشْكُرُونَ

سورة الحشر

Thank You



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