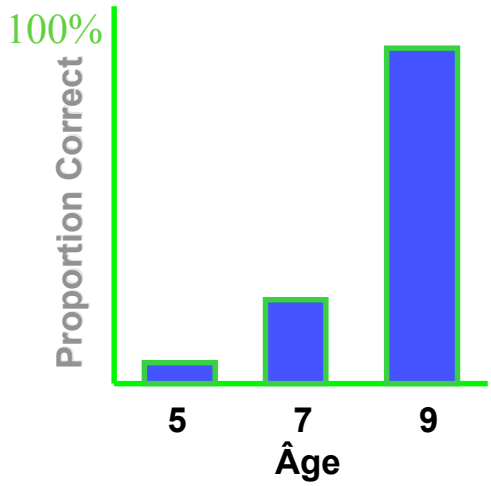
# Entrenamiento fonológico en niños disléxicos

6 años de investigaciones

## Plan del curso

- Recuerdo histórico : relaciones entre metafonologia y lecto-escritura
- Concepciones actuales :
  - fonología y percepción auditiva
  - Las bases de nuestra experiencia : el método “Tallal”
- El proyecto “Lavande” original
- Desarrollos recientes

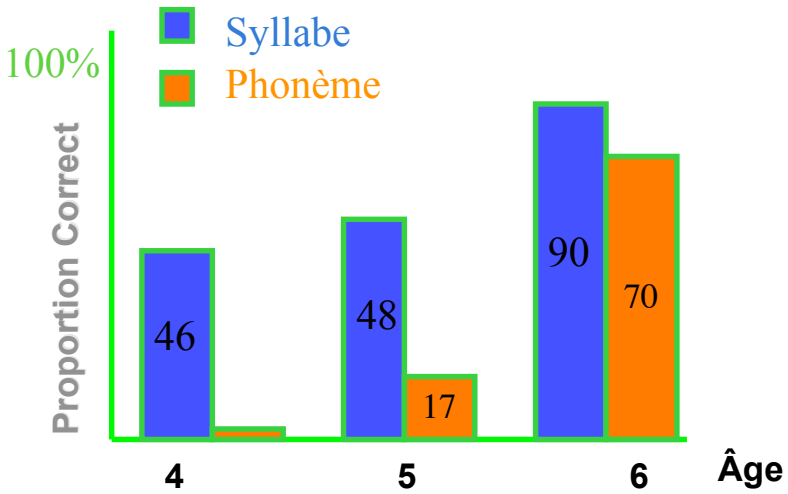
# Bruce (1964) : supresion de fonema



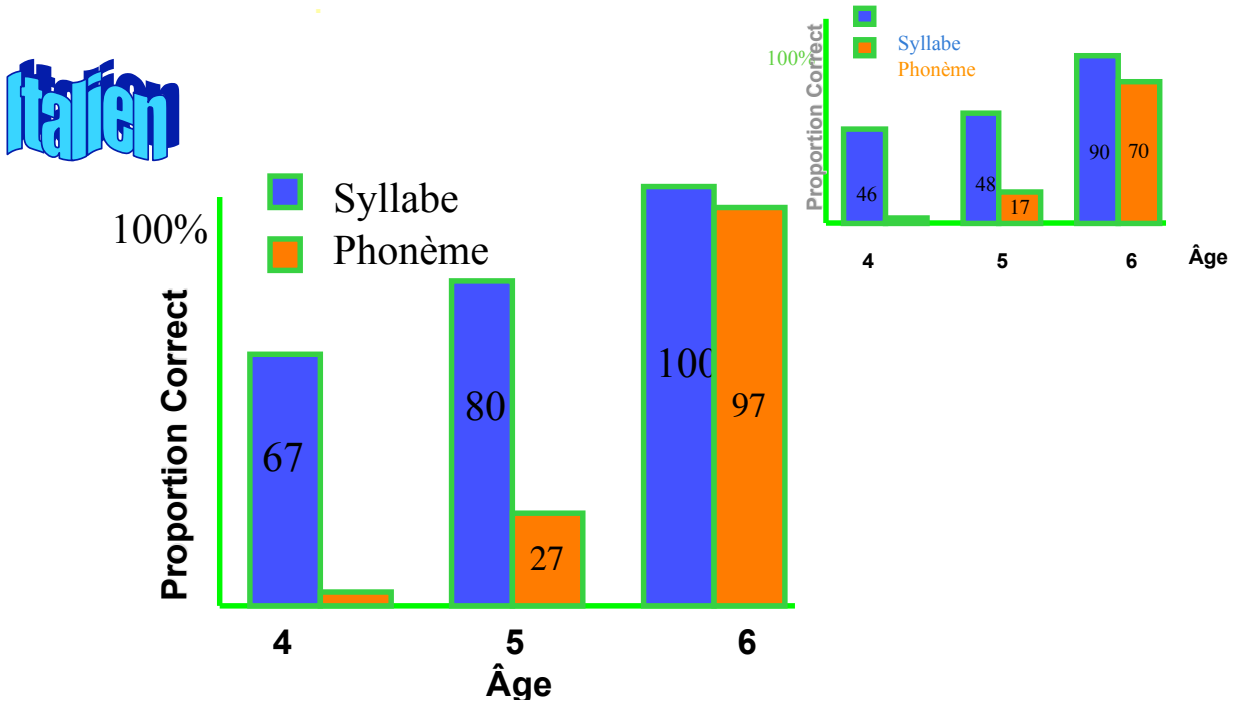

- /troi/ => /roi/ (début)
- /trou/ => tou (milieu)
- /tul/ => /tu/ (fin)

- Niños pre-lectores  estan quasi incapaz realizar la tarea

# Liberman et al (1974)



# Cossu et al



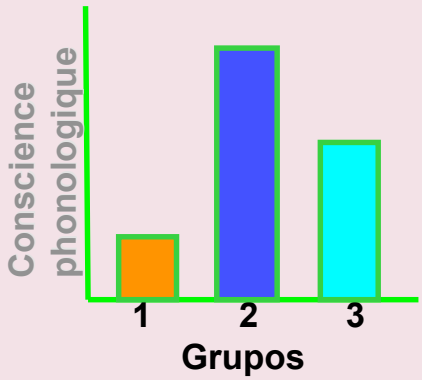

# Pruebas de un vínculo conciencia fonológica – lectura (1)

- Tarea de conciencia fonológica (ataque-rima) a pre-lectores de 4-5 años (escuela de párvulos)
  - Los mismos fueron evaluados otra vez a la edad de 8-9.
  - El nivel de conciencia fonológica de cada niño a 4-5años fue el mejor predictor de su nivel de lectura 3 años despues

Bradley & Bryant (1983). Categorising sounds and learning to read: A causal connection. *Nature*.

# Pruebas de un vínculo conciencia fonológica – lectura (2)

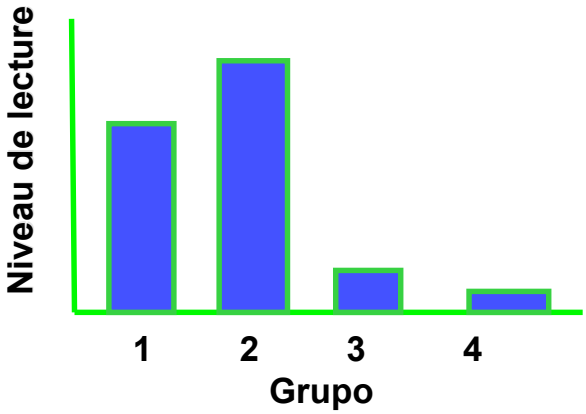
- Niños pobre lectores :
  - Niños de 10 años con dificultades en lectura
  - Niños de 10 años con ninguna dificultad
  - Niños de 7 años sin dificultad y de mismo nivel de lectura que lo de niños con dificultades




Bradley & Bryant (1978), Difficulties in auditory organisation as a possible cause of reading backwardness, *Natur*

# Pruebas de un vínculo / conciencia fonológica – lectura (3) Estudios de entranamientos

- Bradley & Bryant (1983), *Nature*
  - Gr 1 : Categorisación de sonidos
  - Gr 2 : Ligar varios sonidos a la ortografía con letras de plastico
  - Gr 3 : Categorisación semántica
  - Gr 4 : nigún entranamiento




=> relation causale entre la conscience phonologique et la lecture, au moins ce qui concerne les unités sonores plus larges que les phonèmes

# Entranamiento fonológico y dislexia

- Hatcher et al., 1994 : niños de 7;5 a. por termino medio con eded de lectura 5;9 a.
- 3 grupos experimentales :
  - lectura sola
  - Fonología sola
  - Lectura + fono

•Grupo fono mejora significativamente variables fonológicas.

• Solo el grupo fono mejora la lectura respecto al los controles

Wise, Ring & Olson, 2000 : 122 niños 7 - 11 años

Entranamiento fono (40 horas) segun 3 modos

- clasico: manipulación de sonidos

-Foco atencional sobre movimientos artiuclatorios

-combinación 1+2

•Mejoría muy significativa de los 3 grupos

•Niguna ventaja de las condiciones articulatorias

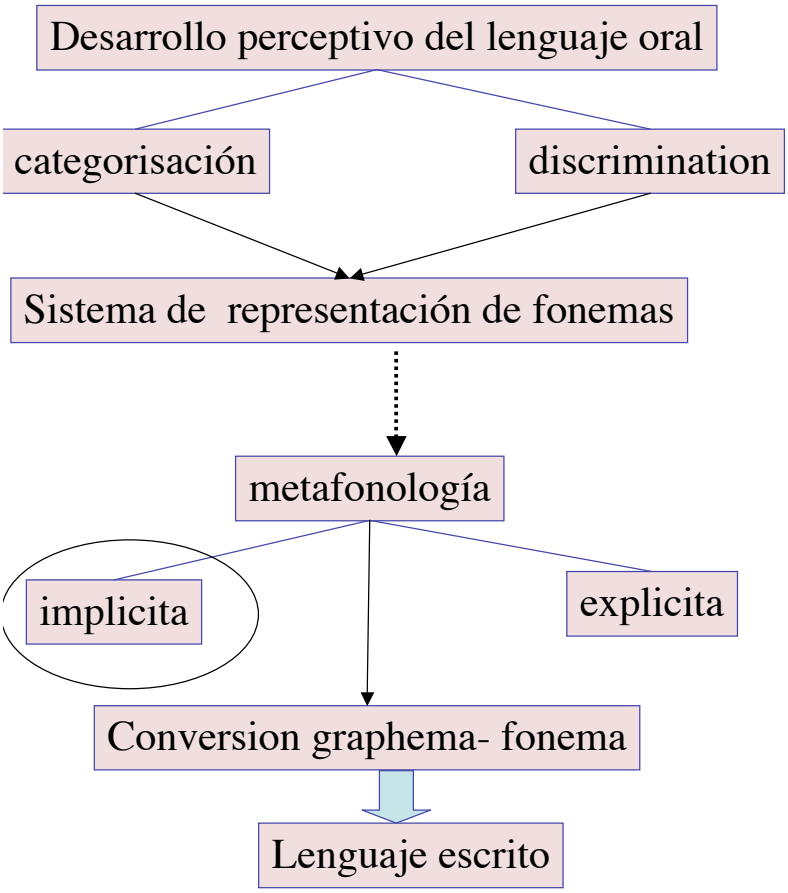
# Incidencia de un entranamiento fonologico en una lengua transparente : español

- Delfior & Tudela (1994): 4 varios programas por 20 semanas con tarea de clasificacion
  - 2 groupos con criterio semantico
  - 2 groupos con criterio fonémico
  - Con o sin soporte escrito

Resultado :

- groupo fonémico con soporte superior a los 3 otros
- groupo fonémico solo no se distingue de 3 otros

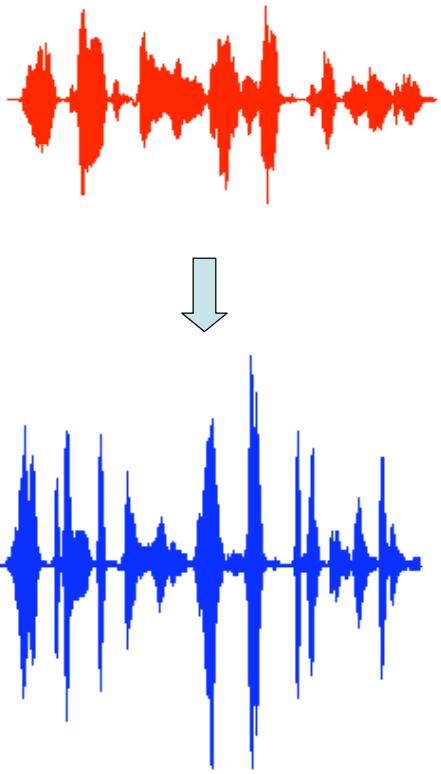
En qualquer sistema ortografico, el desarrollo de la conciencia fonémica Y el aprendizaje de las corespondencias grafo-fonémicas estan imprescindibles

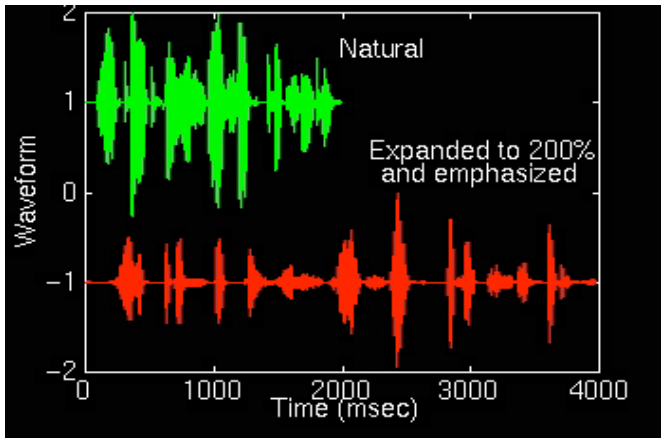



Modelo de base por las investigaciones terapeuticas

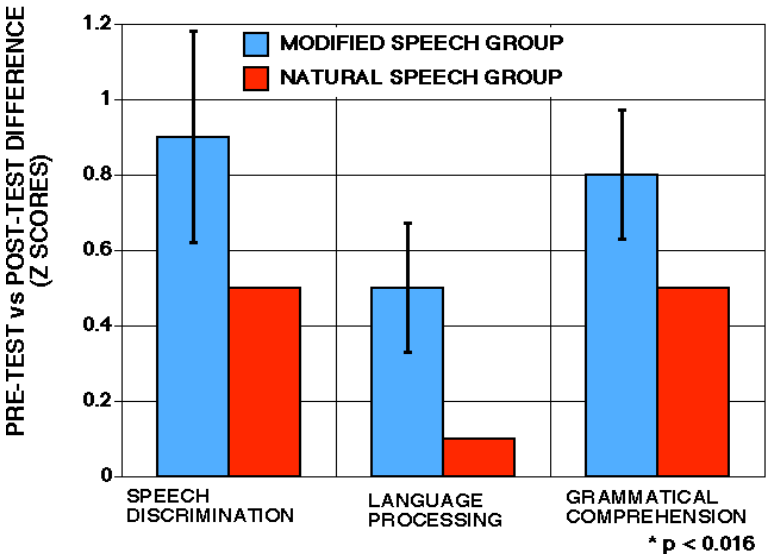
# Bases teóricas

- La teoría del « déficit de procesamiento temporal »
  - Tallal & Piercy (1973) : déficit para percibir estímulos auditivos cortos y de cambio rápido
  - Tallal et al. (1974-76) : déficit en el juicio del orden temporal (J.O.T.) de una sucesión de sílabas
  - Eficacia en el método de tratamiento basada en en esta teoría (Tallal, Merzenich, and coll., 1996)






RESULTS FOR STUDY 2




Merzenich et al., 1996; Tallal et al., *Science*, 1996

## Efficacy of Fast ForWord Training on Facilitating Acquisition of Reading Skills by Children with Reading Difficulties—A Longitudinal Study

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*Sandra Jones*

Independent Educational Consultant
Boston, Massachusetts

*We explored the effects of Fast ForWord (FFW) training on readin and spoken language skills in children with difficulties in phonemi awareness and word identification. Gains were examined both imme diately after treatment and over a period of two years. In the shor term, children who received FFW training were compared to children who received Orton Gillingham (OG) training. The FFW group was also compared to a matched longitudinal control group (LC); all participants in the FFW and LC groups received similar multisensory structured language instruction over two academic years. The FFW and OG groups made similar gains in phonemic awareness. However, the children who received FFW training did not show significant*

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Analysis of outcomes showed that both treatment groups (FFW and OG) made gains in phonemic awareness immediately after treatment, while only the OG group made gains in word attack. Neither group made gains in word identification. The

Over the course of two academic years, the FFW group and the LC group made gains in phonemic awareness and all areas of reading (word attack, word identification, and passage comprehension). The extent of gain in each area was similar for both groups. Although some of the gains in phonemic awareness could be attributed to increased age (given that this test does not have standard scores), the higher standard scores in all areas of reading indicated that the children made more than one year gain per year. It appears that the multisensory structured approaches used with these children resulted in significant advances but that FFW did not result in additional or faster improvement.

In the area of spoken language, results indicated that the FFW group made gains in speaking and syntax immediately after FFW treatment. These findings were consistent with those of Merzenich et al. (1996) and could be interpreted as evidence that FFW improved spoken language function. Another possible explanation for these immediate gains, however, is that they were due to enhanced auditory attention after listening intensively to stimuli for an extended period of time. These gains

*Special Forum on Fast ForWord*

## Looking Back: A Summary of Five Exploratory Studies of Fast ForWord

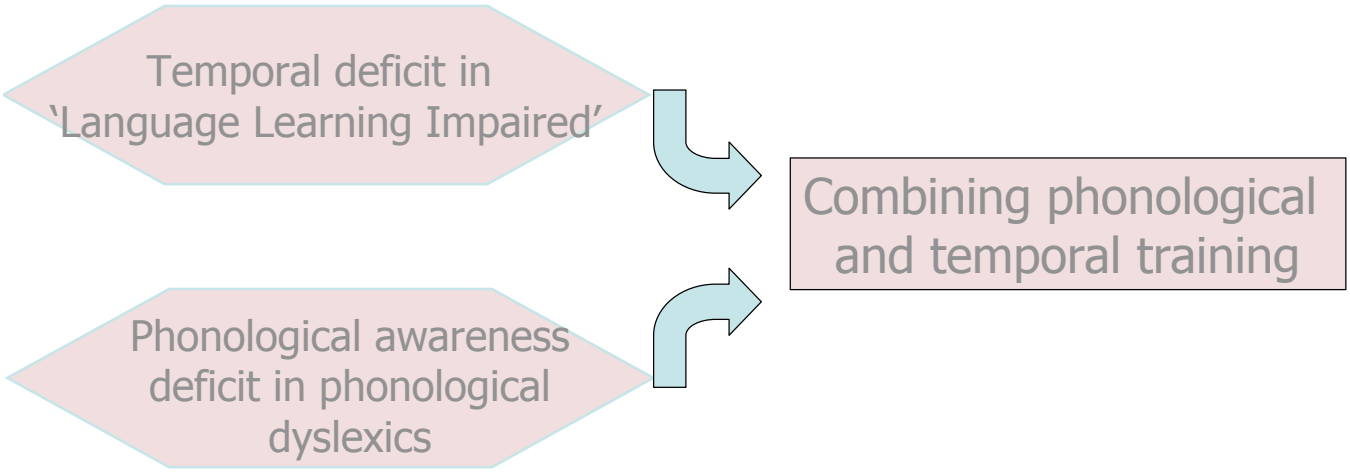
Ronald B. Gillam
*The University of Texas at Austin*

Diane Frome Loeb
*The University of Kansas, Lawrence*

Sandy Friel-Patti
*The University of Texas at Dallas*

> "The collective results of our studies suggest that improvements in language abilities after FFW training did not result from changes in temporal processing. It is possible that similar improvements in language may be obtained from a variety of interventions that are presented on an intensive schedule, that focus the child's auditory and visual attention, that present multiple trials, that vary task complexity as a function of response accuracy, and that reward progress."

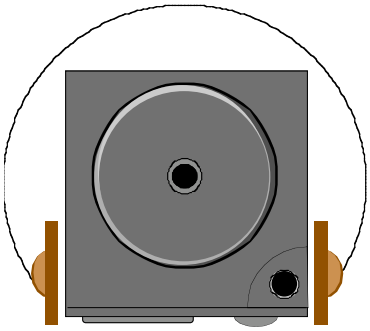
# Temporo-phonological training : the « Lavande » programme

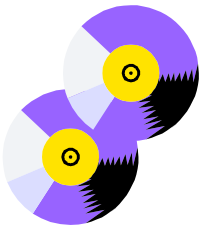


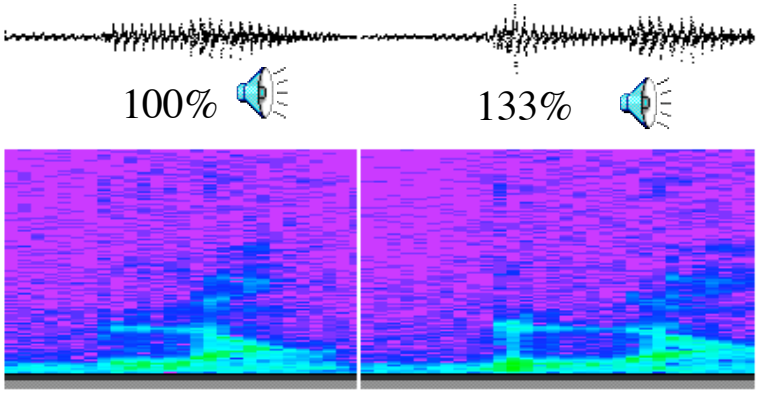

## El programa "Lavande 1"

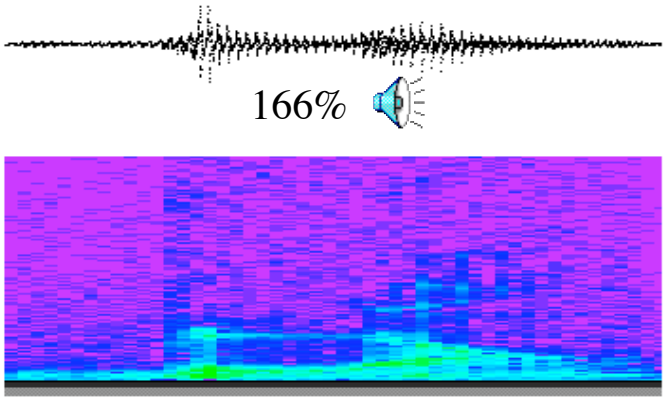
tratamiento fonológico con habla modificada acústicamente

- Población : 12 niños disléxicos (11-12 años)
- 2 grupos:
  - EXP = tratamiento con habla modificada
  - PLAC = los mismos ejercicios con habla natural normal
- Una sesión por día, 5 días a la semana, durante 5 semanas consecutivas
- Modificación del habla:
  - incremento de la intensidad proporcional con la inestabilidad espectral de la señal de habla
  - alargamiento temporal sobre los resultados del estadío previo







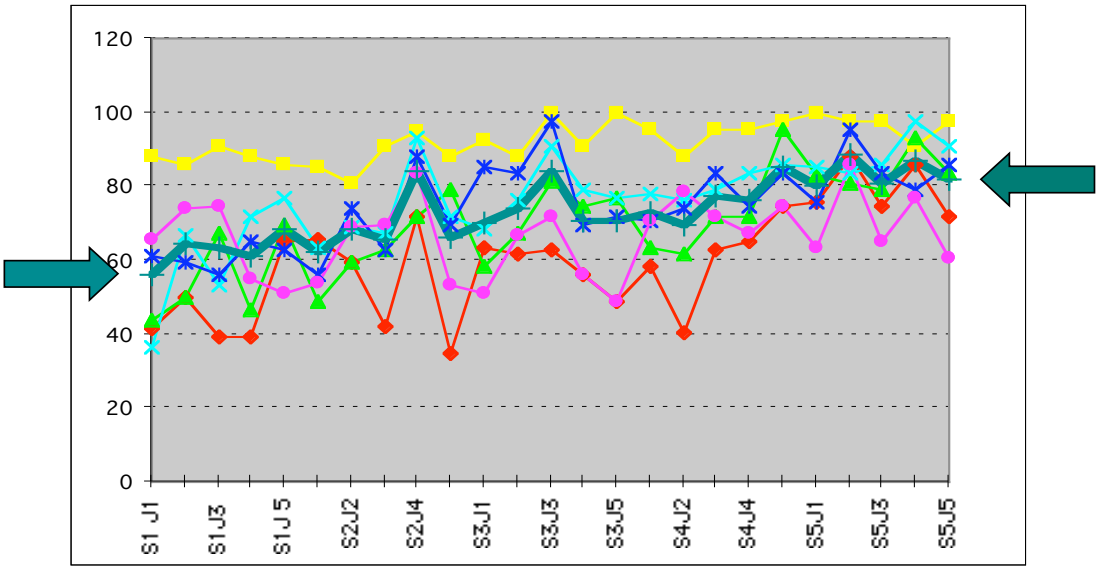

# El programa “Lavande 1”

## Diseño de los ejercicios de tratamiento

| | **Estructura silábica simple** | **Estructura silábica compleja** |
|---|---|---|
| Identificar el distinto (primer fonema) | *e.g.:* dauphin-tonneau-démon | *e.g.:* /palto/-/plati/-/palty/ |
| Identificar el distinto (no incluye una letra blanco) | *e.g.:* /t/ : pitou-body-mité-nintan | *e.g.:* /sp/: aspofil-apsofal-aspoful |
| Deletreo de no palabras (dictado) | *e.g.:* syjachi | *e.g.:* aclipsy |

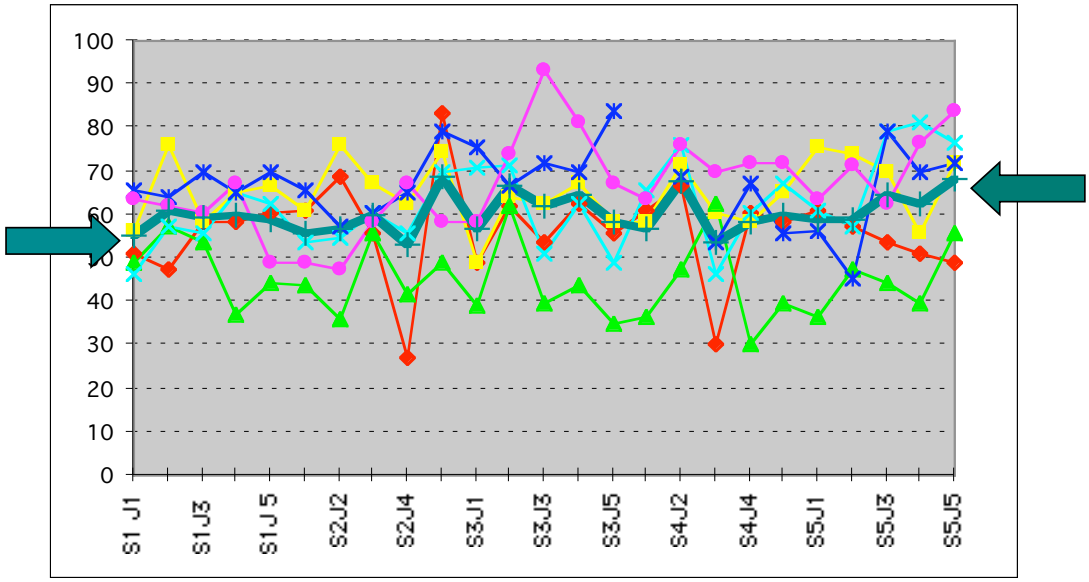
# Desempeño fonológico individual y promedio durante el tratamiento (5 semanas)

grupo experimental (EXP)

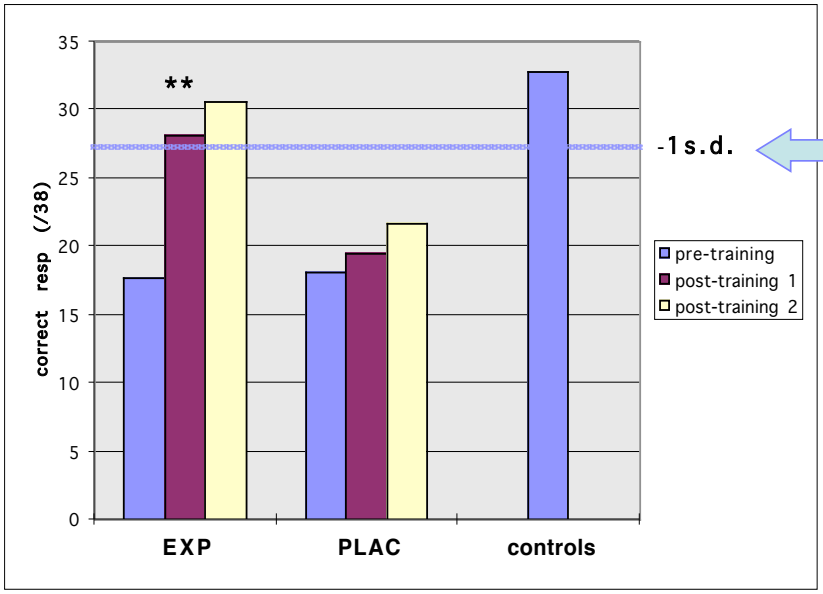



# Desempeño fonológico individual y promedio durante el tratamiento (5 semanas)

grupo de control (PLACEBO)



# Mejoría en las tareas metafonológicas luego del tratamiento




| task | Improvement (P value) | Group effect (P value) |
|---|---|---|
| Rapid automated naming | ns | ns |
| Stroop effect | 0.049 | ns |
| Test de l'Alouette | 0.001 | ns |
| Reading age (months) | 0.006 | ns |
| Syllable counting (/5) | ns | ns |
| Phoneme counting (/10) | 0.0029 | ns |
| Rhyme detection (%) | 0.031 | ns |
| Phonemic segmentation (%) | 0.0007 | ns |
| First phoneme deletion (%) | 0.008 | ns |
| Oral comprehension | 0.024 | ns |
| Simple non-word spelling (% | 0.035 | ns |
| Complex non-word spelling (%) | ns | 0.043 |

Summary of results (repeated-measure ANOVA)
« Lavande » program, Study 1

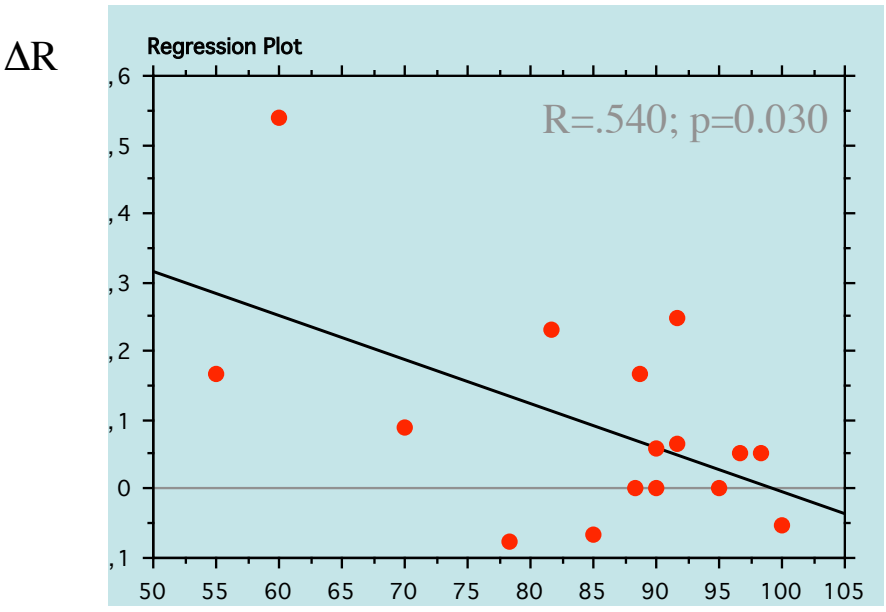
- Marked improvement in a large number of tasks
- Most tasks do not improve better in EXP than PLAC conditions = no effect of temporal modification

# El programa “Lavande ” : estudio 2

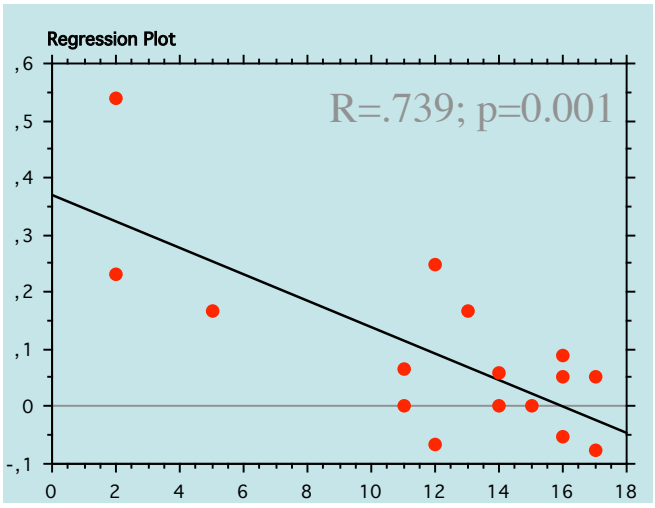
## Buscando marcadores comportamentales de sensibilidad temporal

- 23 nuevos niños disléxicos, edad 9;2 - 12;6
- Programa de entranamiento similar
- Intentando corelar el nivel de mejoria a ciertos marcadores del deficit temporal
- 3 marcadores potenciales:
  - Temporal Order Judgment (TOJ) task
  - Finger - tapping reproduction task
  - Cuestionario comportamiental sobre nociones temporales

ΔR = Index of improvement on rhyme judgment task (E2-E1/E2+E1)



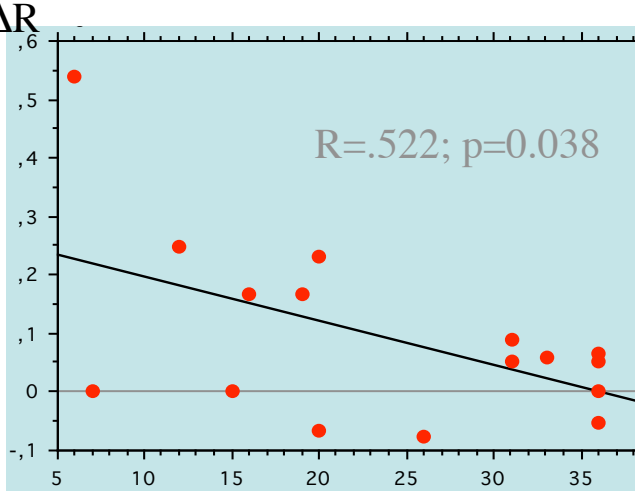
ΔR



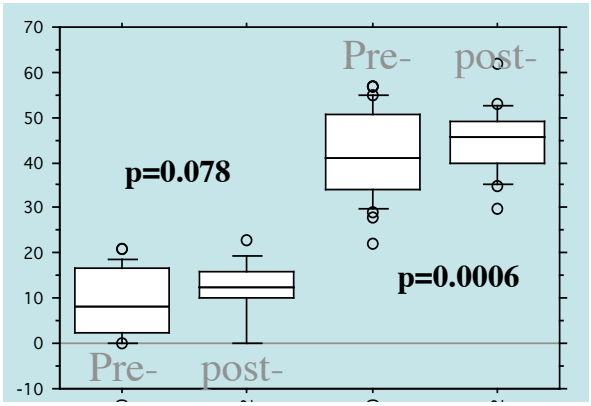

Tapping sequence reproduction score

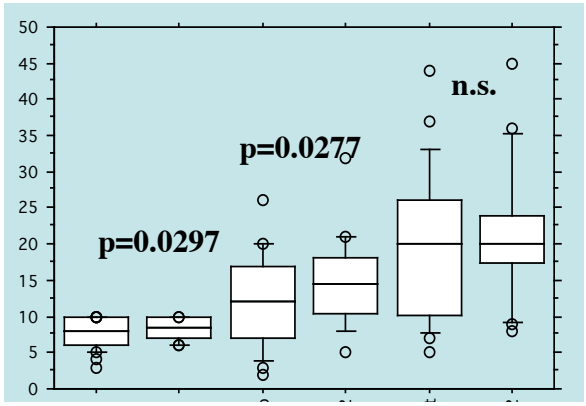
Questionnaire of impaired temporal notions

ΔR




ΔR = Index of improvement on Rhyme judgment task (E2-E1/E2+E1)




Pre- post-

Non-word spelling

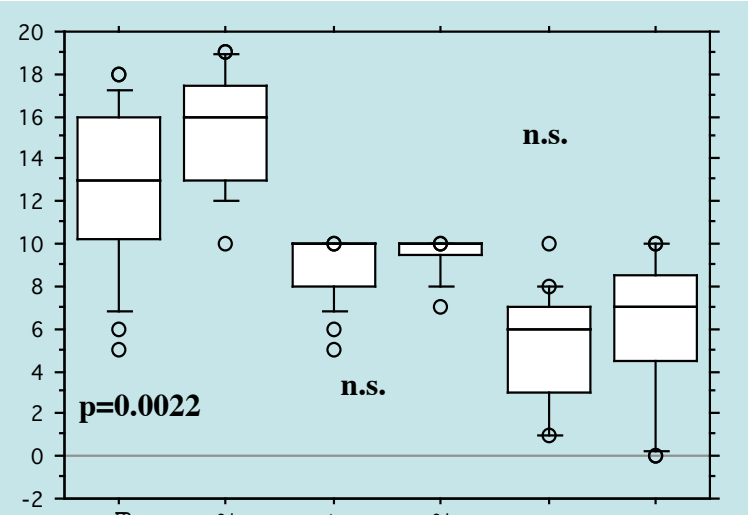
Phonological score

Rhyme jugdement.

Alphabetic fluency

Semantic fluency

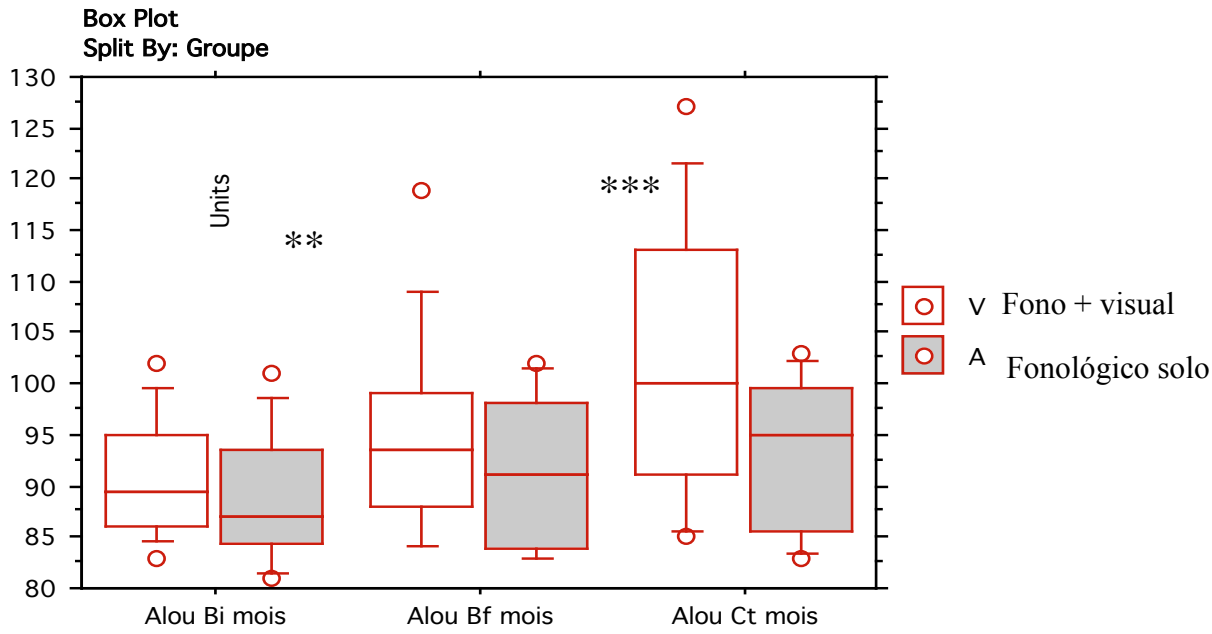
Improvement in phonological tasks



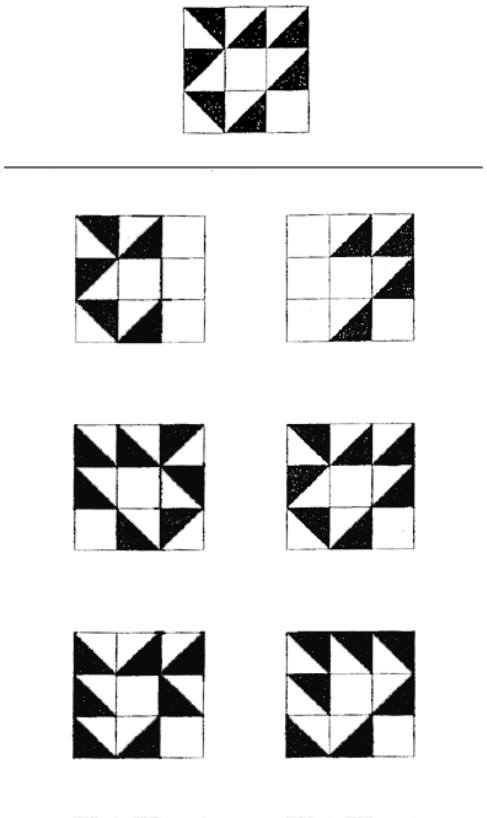

Word reading : improvement for non-word only

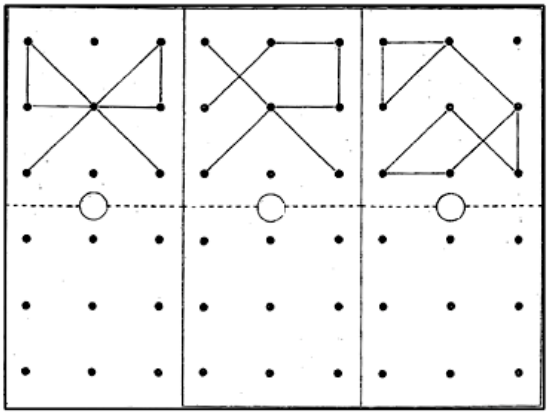
Entrenamiento con modificación acústica (Fastforword) : conclusiones (1)

- Efecto modesto sobre las variables fonológicas
- No efecto sobre la lecto-escritura
- Entrenamiento intensivo temporo-fonológico :
  - mejoría más significativa de las variables fonológicas
  - Efecto sensible sobre procesos sublexicales en lectura (pseudo-palabras)
  - Amplificado y permanesce con entrenamiento visuo-atencional asociado (potenciación?)




Lectura : mejoría en ambos grupos a 6 semanas
7 meses despues : ventaja sensible del grupo visual



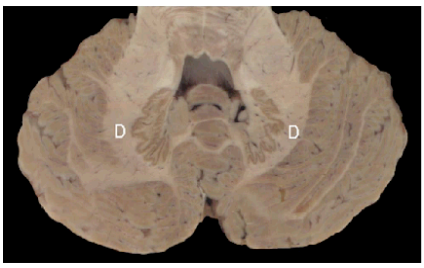


Examples of exercises in the « visual training » group

# Desarrollos recientes del método

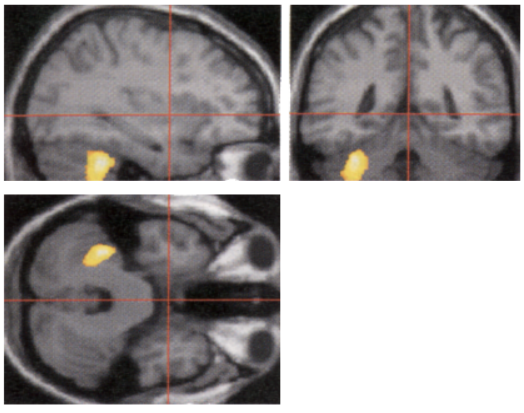
- Derivados de la hipótesis cerebelosa o motora de dislexia
- Derivados de la hipótesis de un deficit de transcodificación
- Buscando las bases neurológicas de la mejoría con potenciales evocados

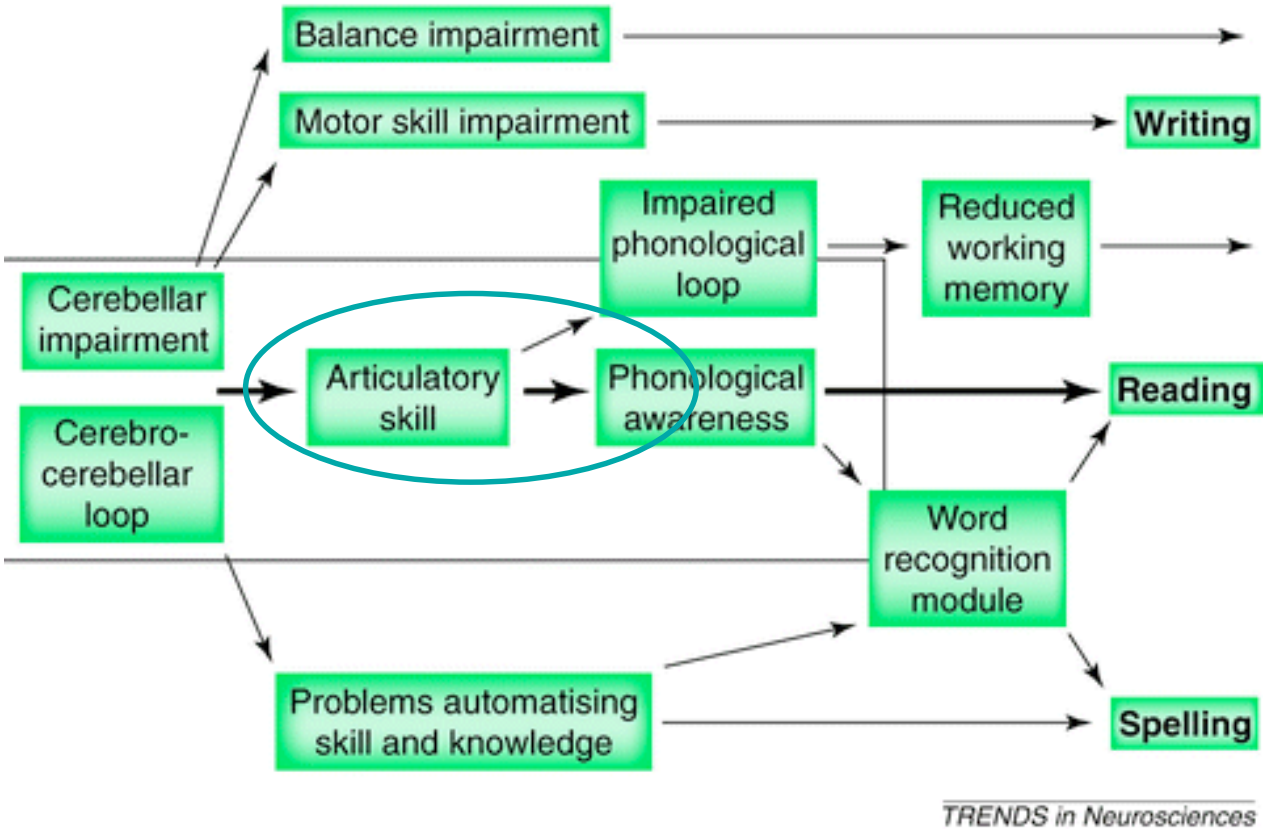
# Dislexia : la teoria cerebelosa




**Developmental dyslexia: the cerebellar deficit hypothesis**

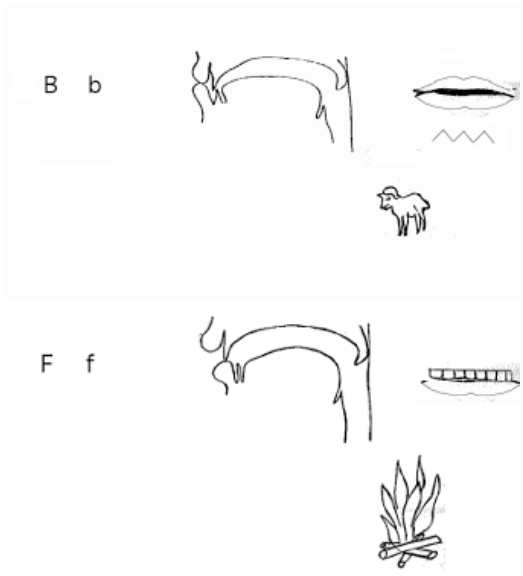
Roderick I. Nicolson, Angela J. Fawcett and Paul Dean






# Estudio 1 : Entranamiento de la bucle audio-articulatoria para reducir el deficit fonológico

19 Niños : 7 - 11 a. Dislexia fonológica seria clasica




- Ejemple de dibujo utilisado en el entranamiento intensivo articulatorio
- En asociación con IBM « Speech-viewer™ » software

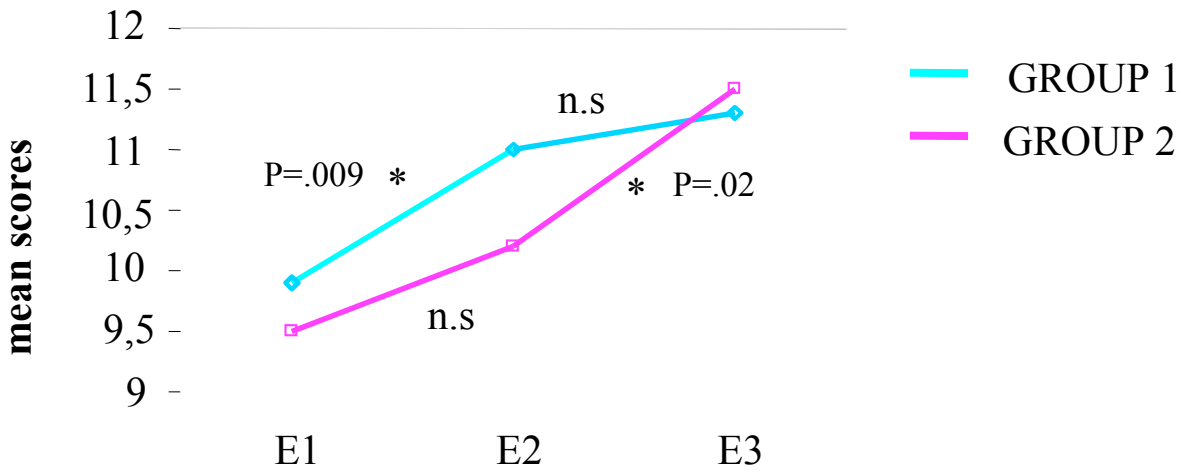
Software IBM speech-viewer™

# diseño experimental

| | GRUPO 1<br>10 niños | GRUPO 2<br>9 niños | |
|---|---|---|---|
| sesión 1<br>(sem. 1-3) | Fonologia +<br>Articulation | Fonologia | EVAL. 1<br><br>EVAL. 2 |
| sesión 2<br>(sem. 4-6) | Fonologia | Fonologia +<br>Articulation | <br><br>EVAL 3 |

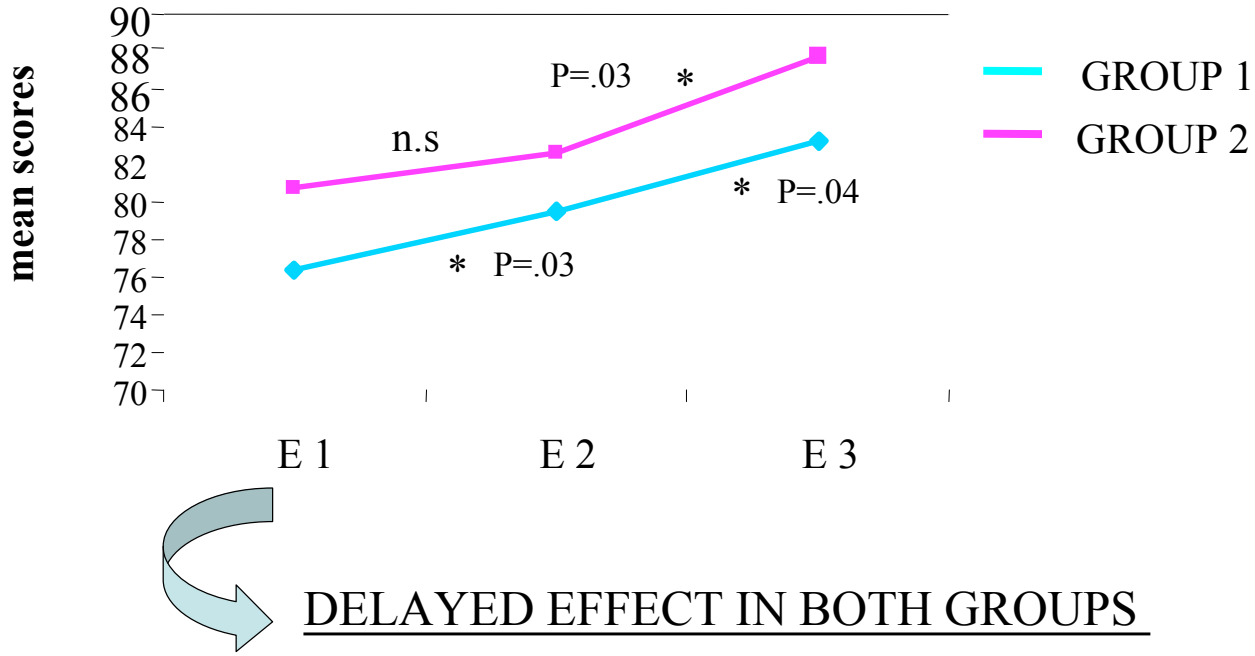
G2 * C2 * E3

## PHONOLOGICAL AWARENESS SCORE




More improvement with both (phonological + articulatory)

READING SCORE




DELAYED EFFECT IN BOTH GROUPS

# Plastic neural changes and reading improvement caused by audiovisual training in reading-impaired children

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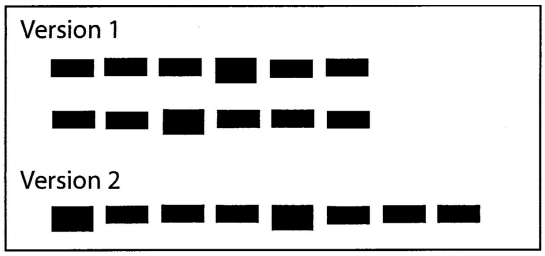
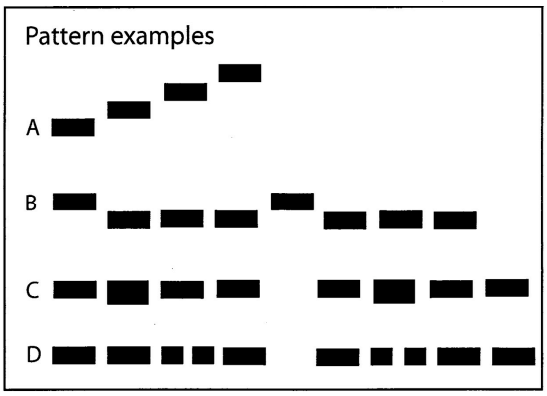
Game patterns

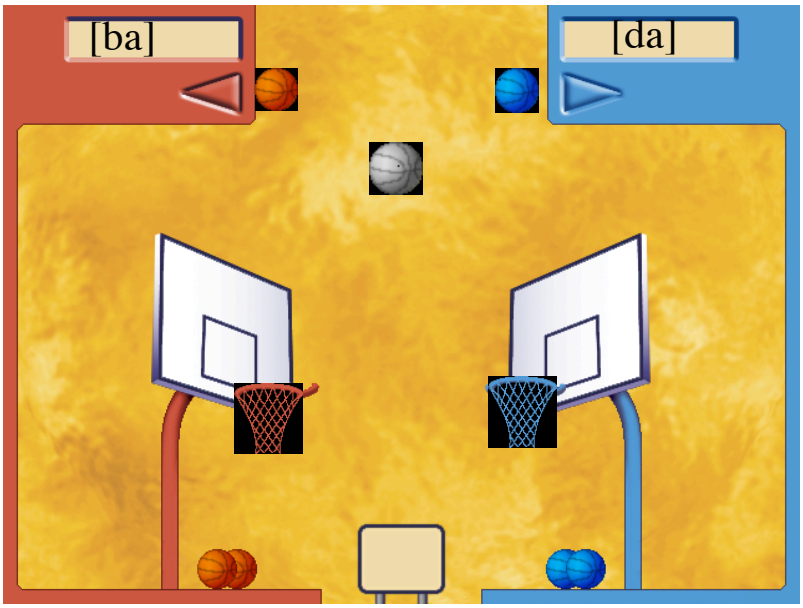



# Estudio 2 : potenciales auditivos tardios antes y despues entranamiento especifico

- 26 dyslexic children (8-11 y-old)
- Two groups :
  - 12 children receiving daily phonological training according to a previously tested technique (Habib et al., 1999; 2002)
  - the remaining 14 : the same + a new intermodal training software (Play-on®, Danon-Boileau & Barbier, 2000)
- Auditory evoked potentials recorded before and after training

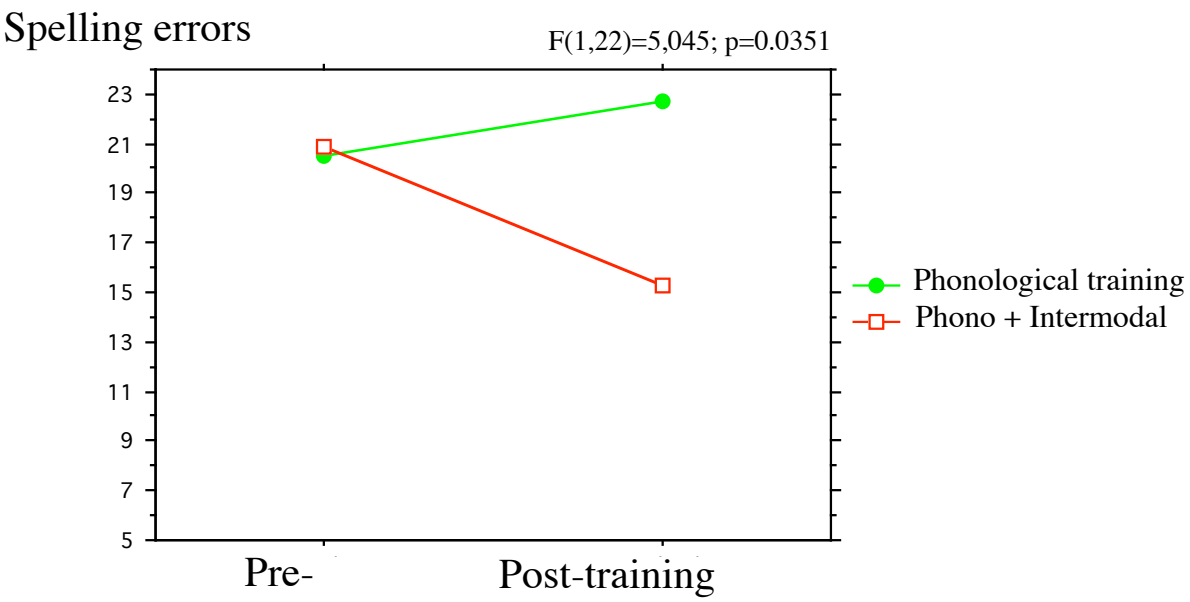
Danon-Boileau, L., & Barbier, D. (2000). Play-On: Un logiciel d'entraînement à la lecture. Paris: Audivi-Media.




Intermodal training with « Play-on® » (Danon-Boileau & Barbier, 2000)


Overall effect of training

More improvement with intermodal training




Improvement in spelling abilities (short text dictation): superiority of intermodal training

## ERP protocol : « proso »

Incongruity resulting from F0 manipulation of the last word of sentences

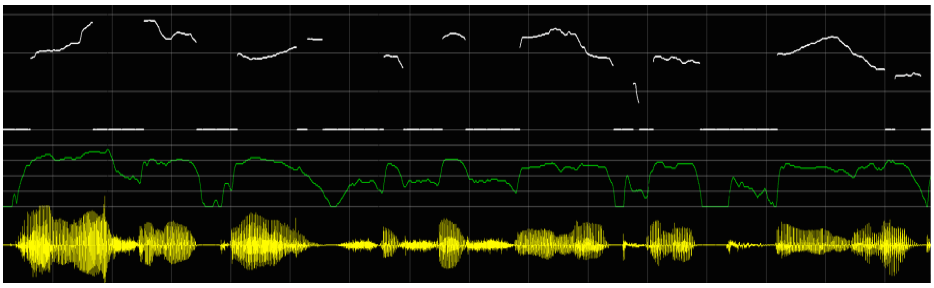
Unmodified ending

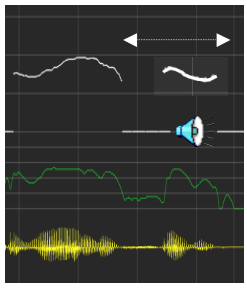
low incongruity

high incongruity

Possible effect on semantic/prosodic integration of phonemic information

Un loup solitaire se faufile entre les troncs de la grande **forêt**



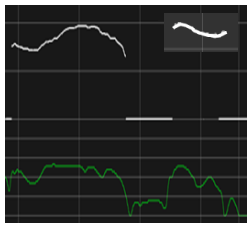


120 sentences from a children's book :

40 with F0 unchanged

40 with F0 increased by 135 % + 35%

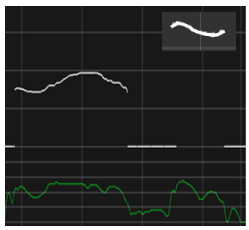
40 with F0 increased by 220 %



•*Un loup solitaire se faufile entre les troncs de la grande forêt*

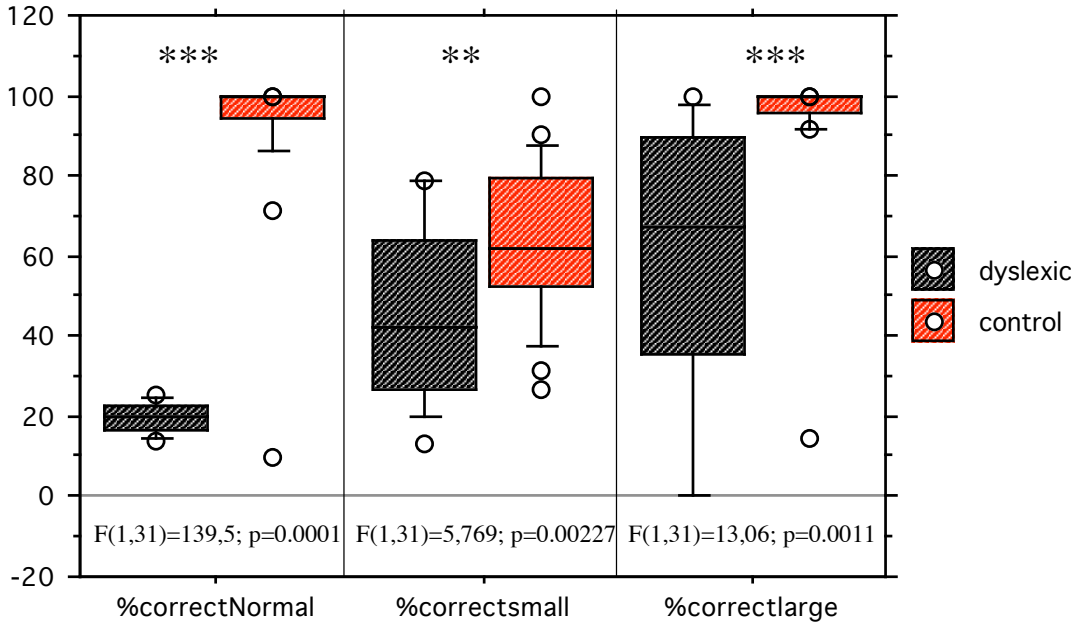
• *Je voudrais un animal à moi pour lui dire tous mes secrets* + 120%

•*Dans la mare, il y a des canards qui jouent à cache-cache*



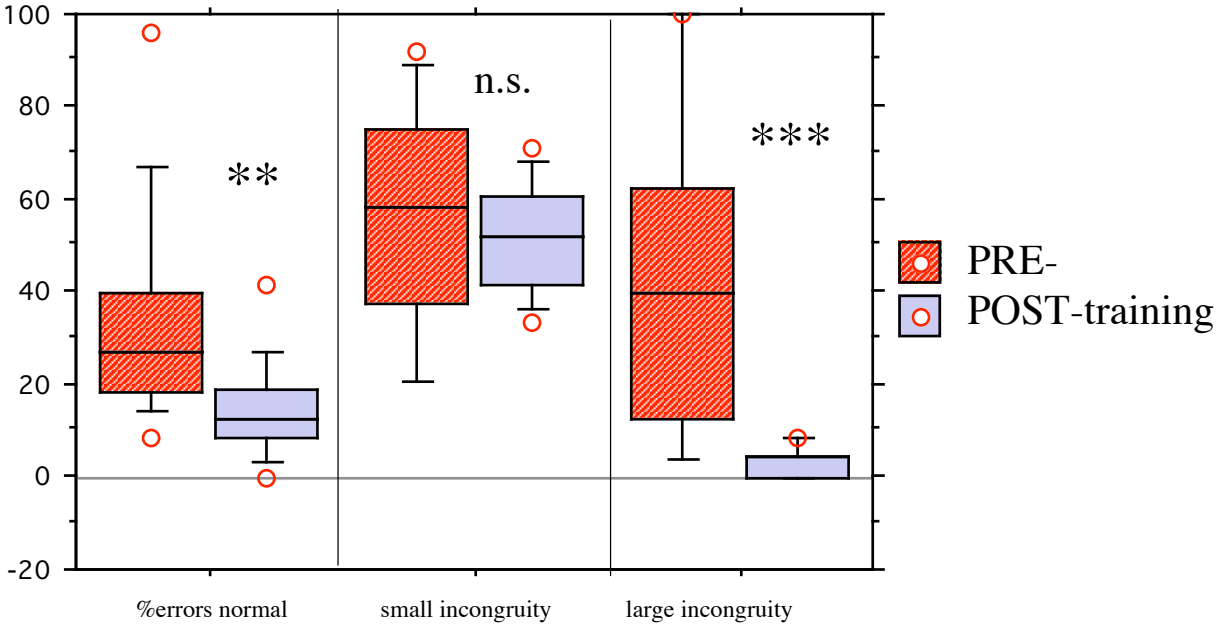
## Why a "prosodic integration" protocol?

- Some evidence of frequency discrimination problems in dyslexia (**McAnnaly & Stein, 1996; Hari et al., 1999; Ahissar et al., 2000**), although with contradictory reports **(Griffith et al., 2003; Schulte-Körne et al., 1998; 2001)**
- Kujala et al. (2003) : diminished MMN to frequency change in tone pairs only when embedded in a longer sequence.
- Preliminary evidence of dyslexics' deficit in a « prosody decision » task

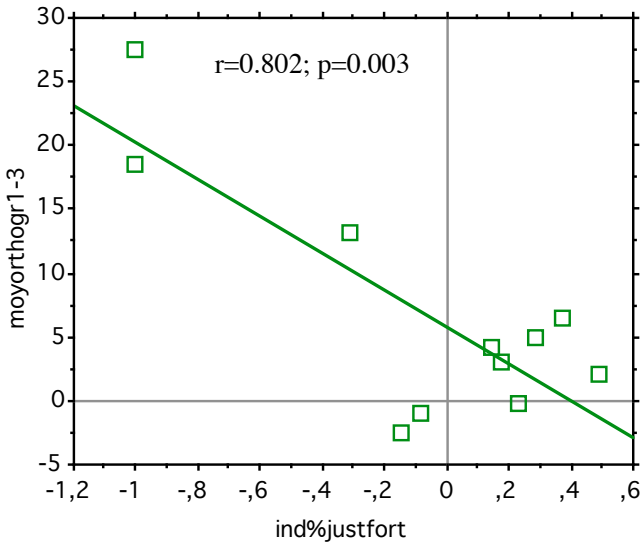



Prosodic integration : significant impairment in dyslexics

%errors

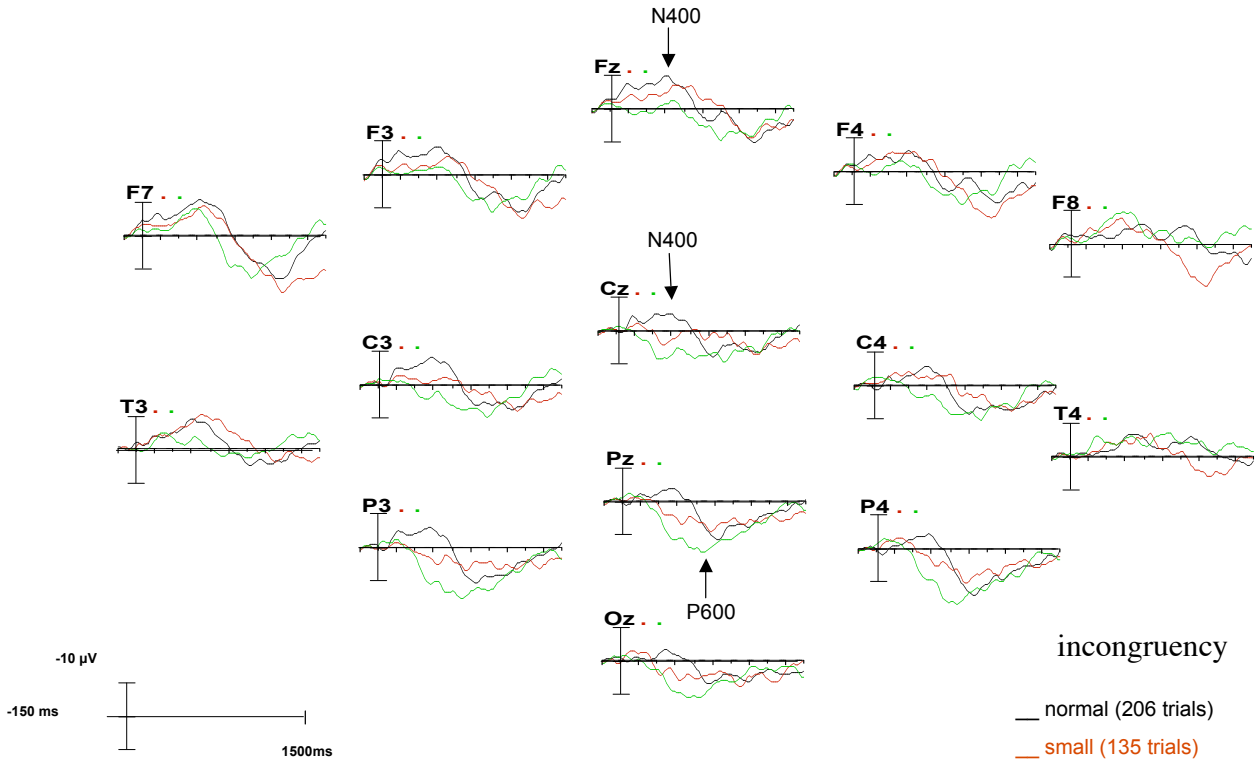



Significant improvement of prosodic integration after phonological auditory training

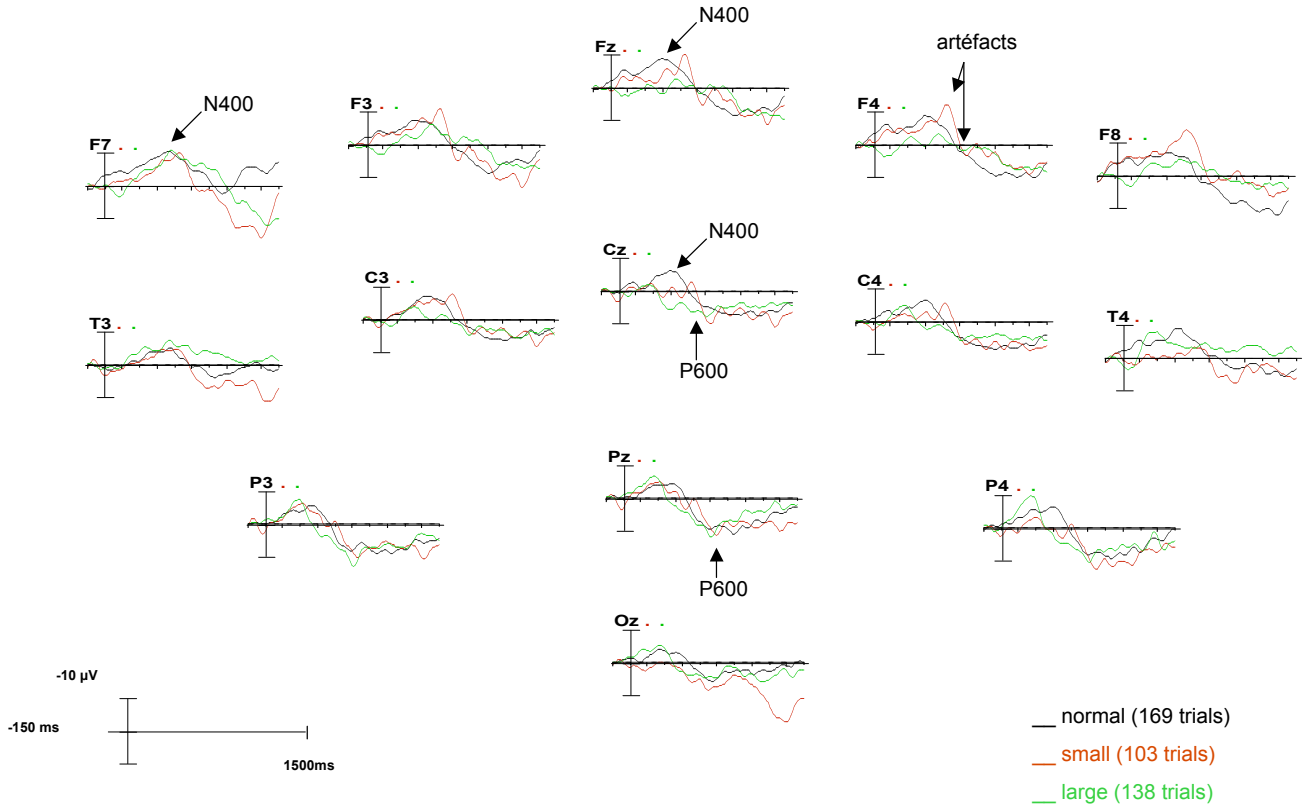



Correlation between pre-post improvement on proso and spelling tasks

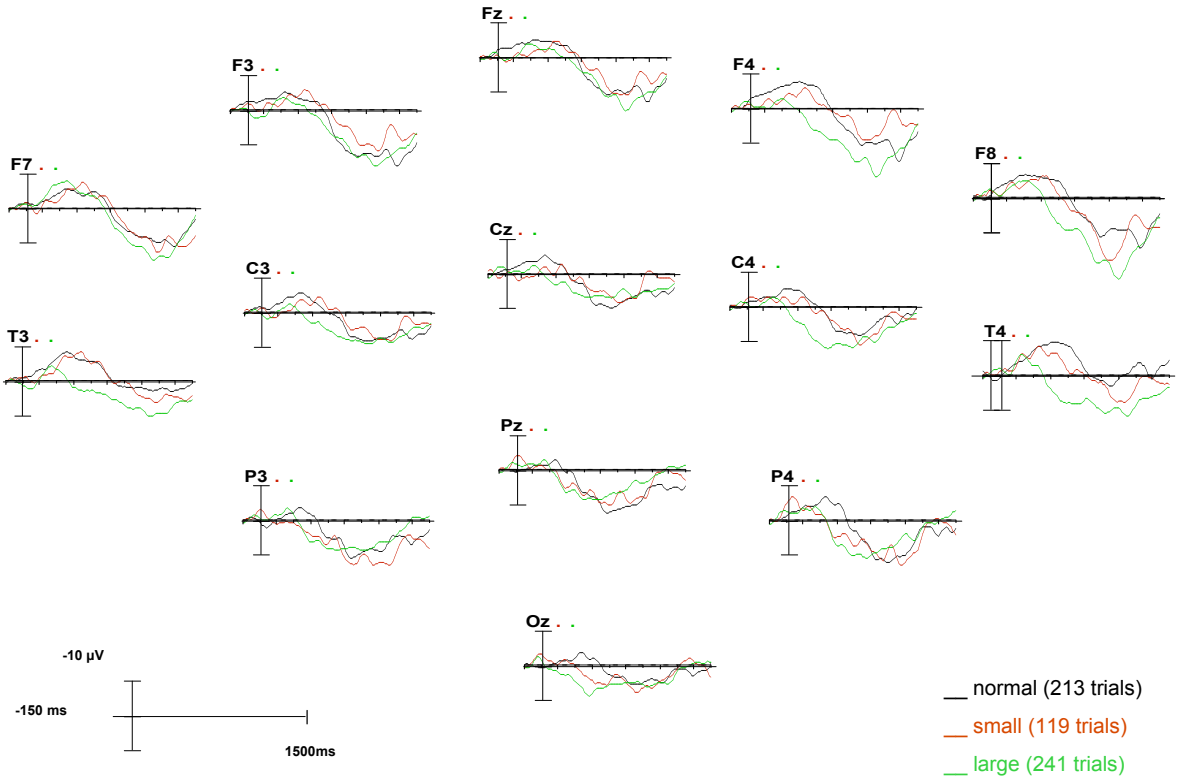
## CONTROLS (N=11)




## PRE-TRAINING (N=11)

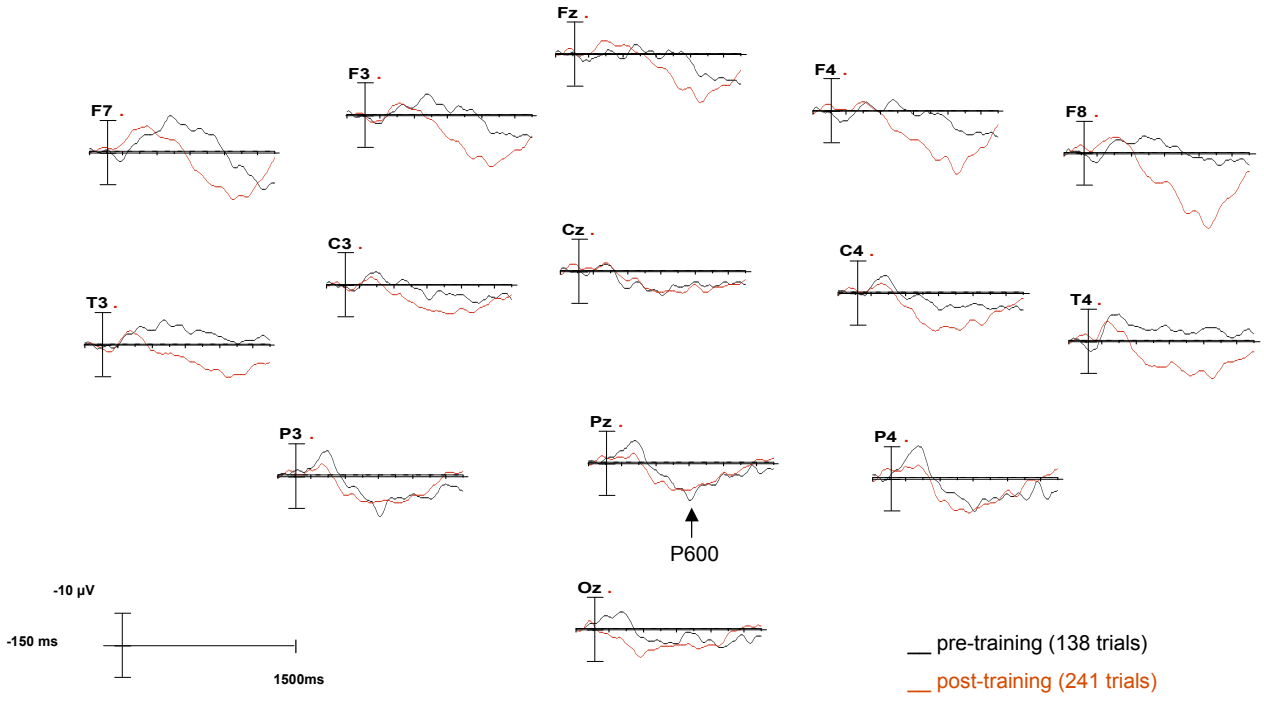


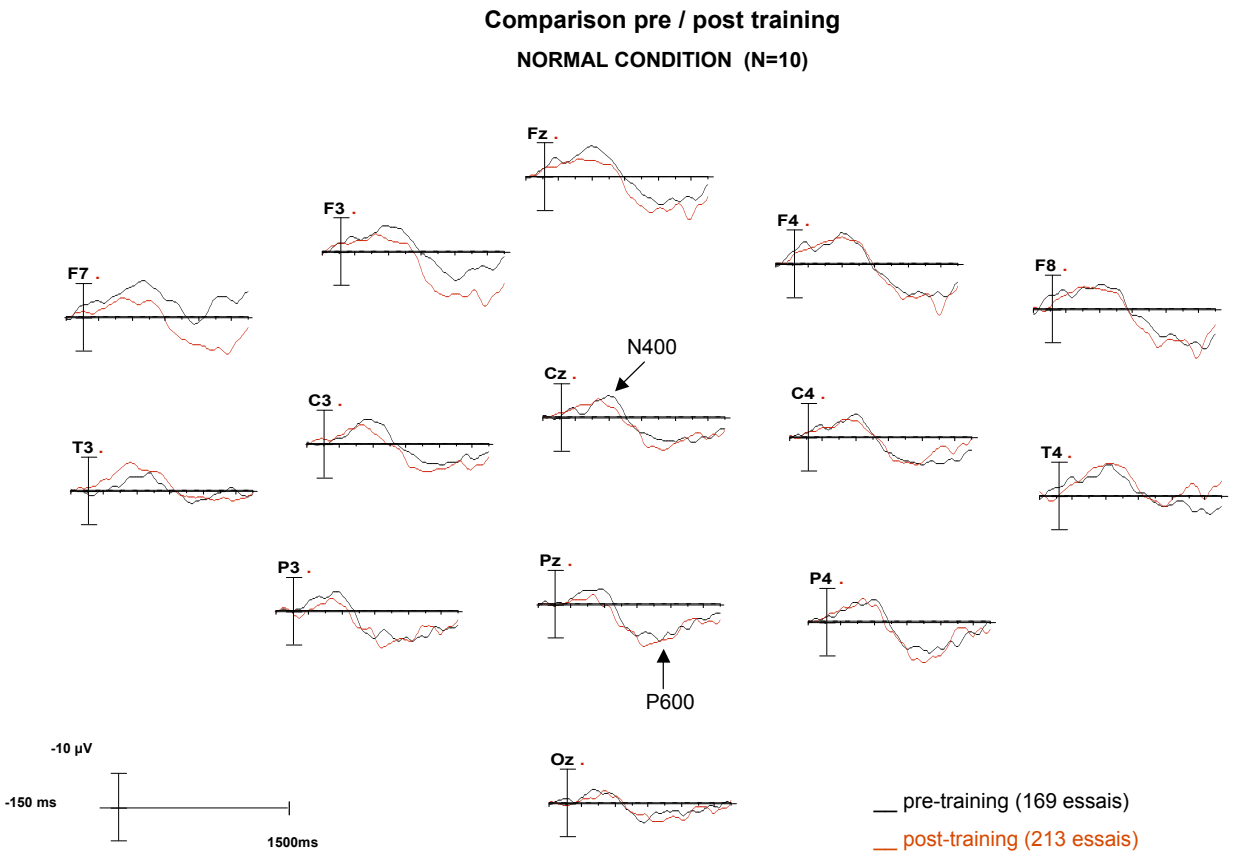
## POST-TRAINING (N=11)




## Comparison pre / post training

### LARGE INCONGRUENCY (N=10)






# Study 2 : conclusions

- Children with phonological dyslexia are poor at a simple prosody decision task, suggesting deficit in integration of otherwise normally perceived information
- Short, intensive training combining phonological and intermodal exercises improves both dyslexic symptoms and prosodic integration scores
- Intermodal training seems to affect mainly spelling error rates and spelling and prosodic integration tasks are strongly inter-correlated

# Entrenamiento intensivo fonológico : conclusiones generales

- Entrenar la fonologia sobre un modo cotidiano y repetido parece el mejor medio actual de tratar el trastorno fonológico del niño disléxico
- Modificar las cualitades acusticas de la habla tiene un efecto modesto pero puede ser util en ciertas formas
- Añadir ejercicios articulatorios tiene un effecto observable pero minimo
- Añadir ejercicios trabajando especificamente la trans-codificación audi-visual constituye un aporte significativo, con pruebas de su acción sobre el substrato cerebral si-mismo.
- Varias direcciones pueden resultar para investigaciones futuras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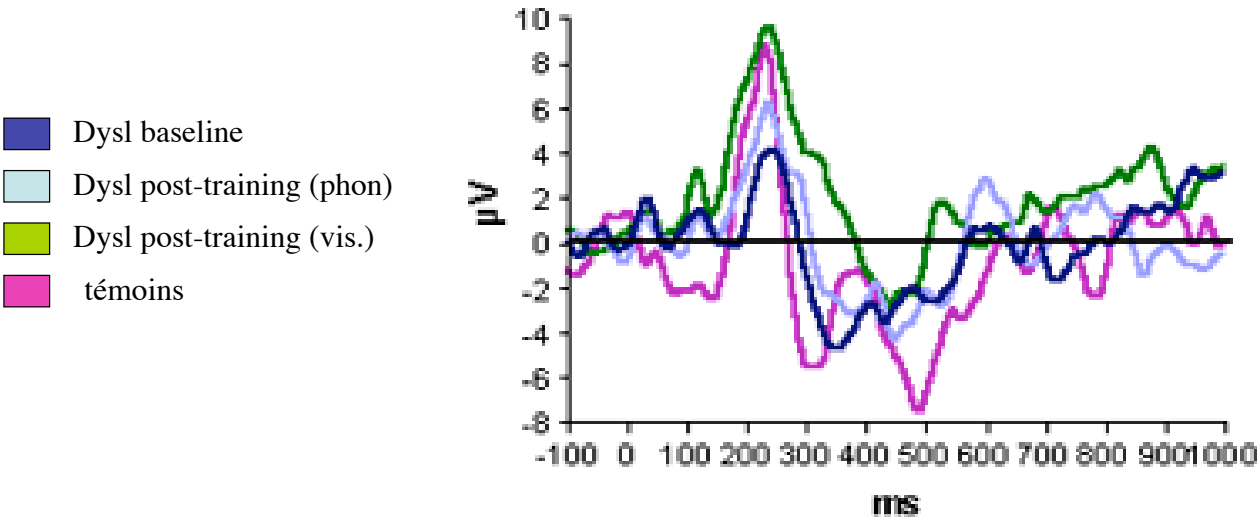
# Study 2 : conclusions (2)

- In normal children, auditory evoked potentials elicited during the prosodic decision task are characterized by a negativity at about 400 msec (N400) followed by a positivity at about 600 msec (P600), probably representing contextual integration of prosodic information
- Highly incongruous words elicit smaller N400 and shallower P600, suggesting easier processing on these stimuli
- Dyslexics display a clearly different pattern with smaller N400 and earlier P600 on highly incongruous words, suggesting that these stimuli are processed less efficiently

# Entranamiento fonológico intensivo: conclusiones (2)

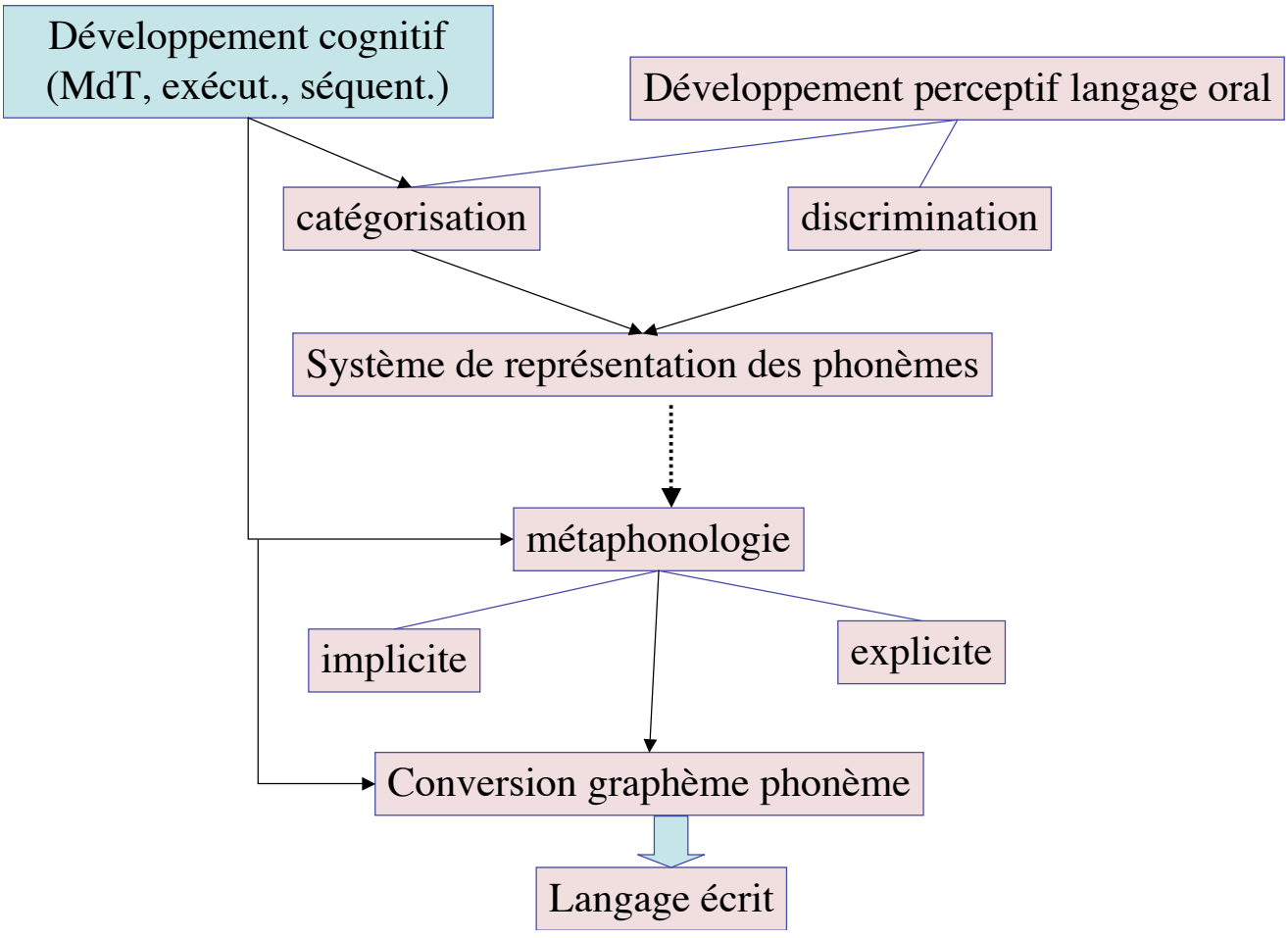
- Using temporally modified speech in phonological training yields moderate advantage in phonological tasks, and no gain whatsoever on reading tasks
- However, this does not preclude a temporal deficit mechanism as a potential cause of dyslexia, since experimental work have generally been more convincing than training studies
- Intensive phonological training, either temporally modified or not, remains most probably the best way to maximize phonological efficiency in dyslexics

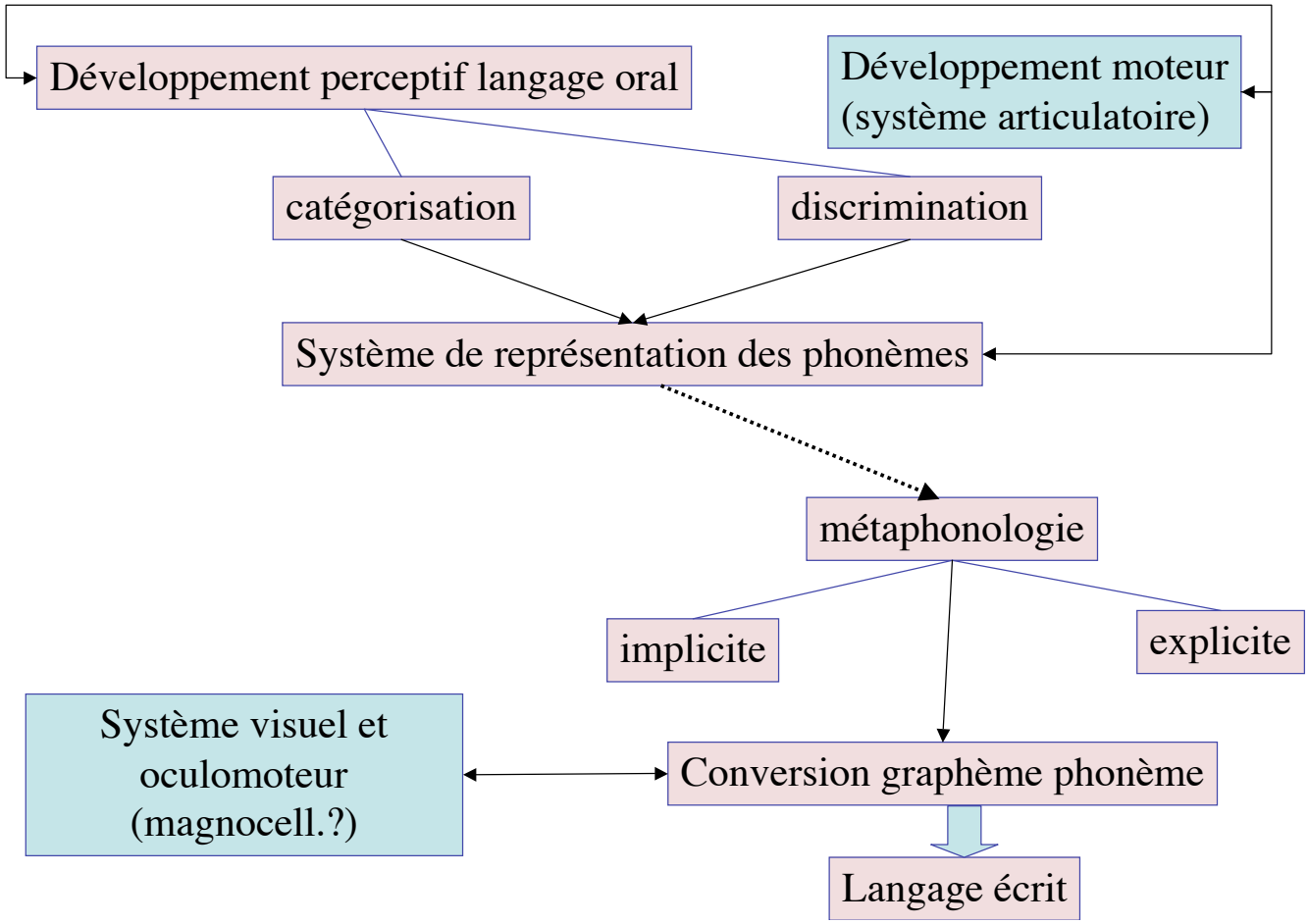
Potentiels Evoqués moyens enregistrés sur l'électrode au vertex au cours de la perception du stimulus /fi/ (de durée moyenne 50-60 ms.)
Batty et al., 2001

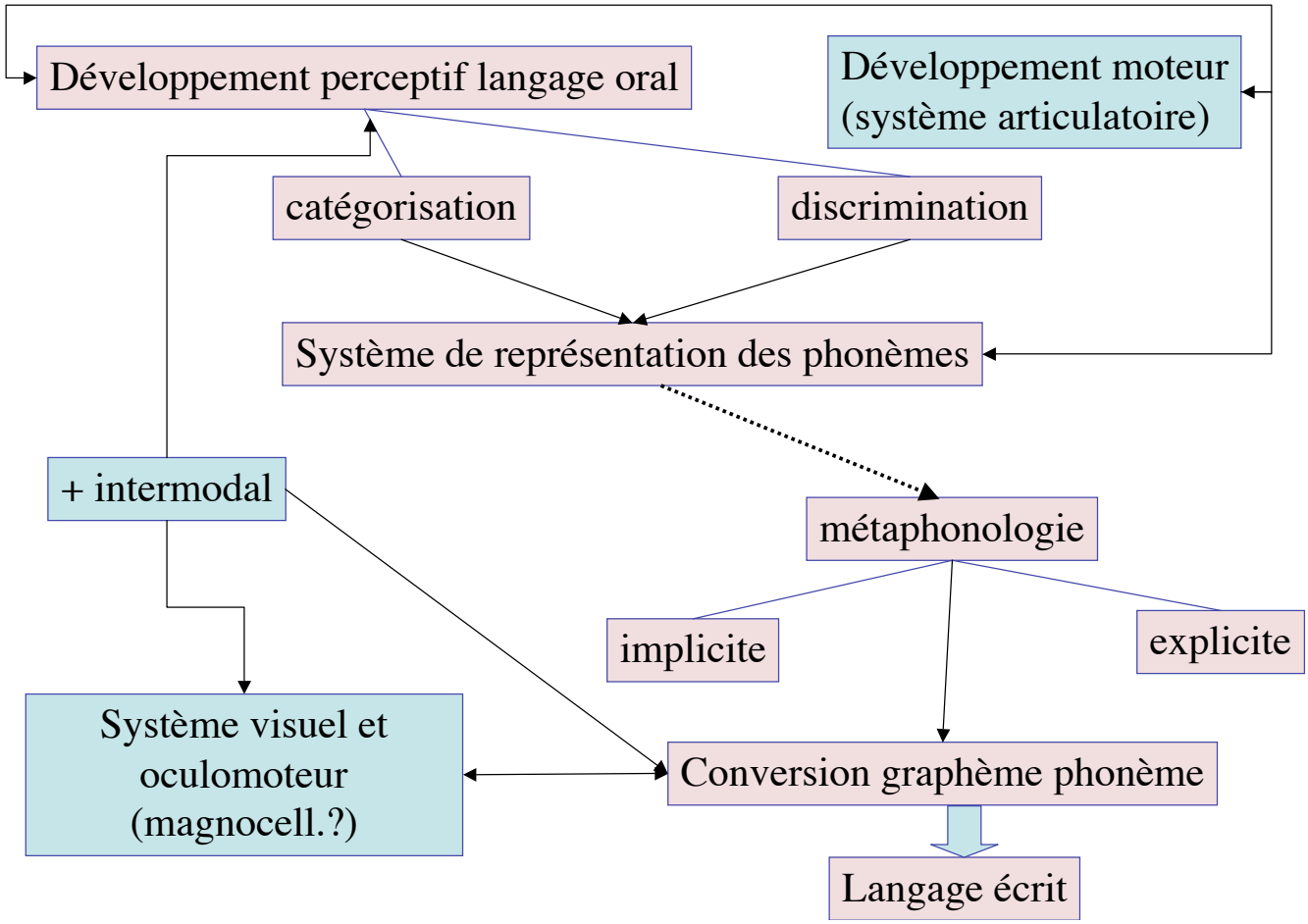



8 semaines entraînement phono, puis 8 semaines visuel

Cz /fi/ 50-60 ms




Développement perceptif langage oral
Développement moteur (système articulatoire)
catégorisation
discrimination
Système de représentation des phonèmes
métaphonologie
implicite
explicite
Système visuel et oculomoteur (magnocell.?)
Conversion graphème phonème
Langage écrit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Système visuel et oculomoteur (magnocell.?)
Conversion graphème phonème
Langage écrit

# Les questions posées

- 1- efficacité du traitement articulatoire?
- 2 - le traitement articulatoire est-il efficace par son caractère intermodal?
- 3 - le traitement intermodal apporte-t-il un plus par rapport au traitement phono- articulatoire?

# Protocole expérimental

| | **Groupe 1 (PA/PV) n=6** | **Groupe 2 (PV/PA) n=6** | **Groupe 3 (PA/PI) n=7** | **Groupe 4 (PI/PA) n=7** |
|---|---|---|---|---|
| **Bilan 1 + potentiels évoqués** | | | | |
| Sem. 1-3 | Phono-articulat. | Phono - visuel | Phono-articulat. | Phono-intermod |
| Sem. 4-5 pause | **Bilan 2** | | | |
| Sem 6-9 | Phono - visuel | Phono-articulat. | Phono-intermod | Phono-articulat. |
| **Bilan 3 + potentiels évoqués** | | | | |

# Les questions posées

- 1- efficacité du traitement articulatoire?

⟹ Comparer sessions phono + articul. aux sessions phono + visuel
PA/PV : amélioration 1/2 > 2/3
PV/PA : amélioration 2/3 > 1/2