The hierarchy of phonetic features in printed syllables matching, in adult skilled readers, normally developing young readers and dyslexic children

Nathalie Bedoin & Sonia Krifi

Laboratoire EMC / DDL, Université Lyon 2

Syllable matching task :

choice between two phonetic features categories

Experiments designed to investigate the hierarchical organization of cognitive (but implicite) knowledge of 3 categories of phonetic features :

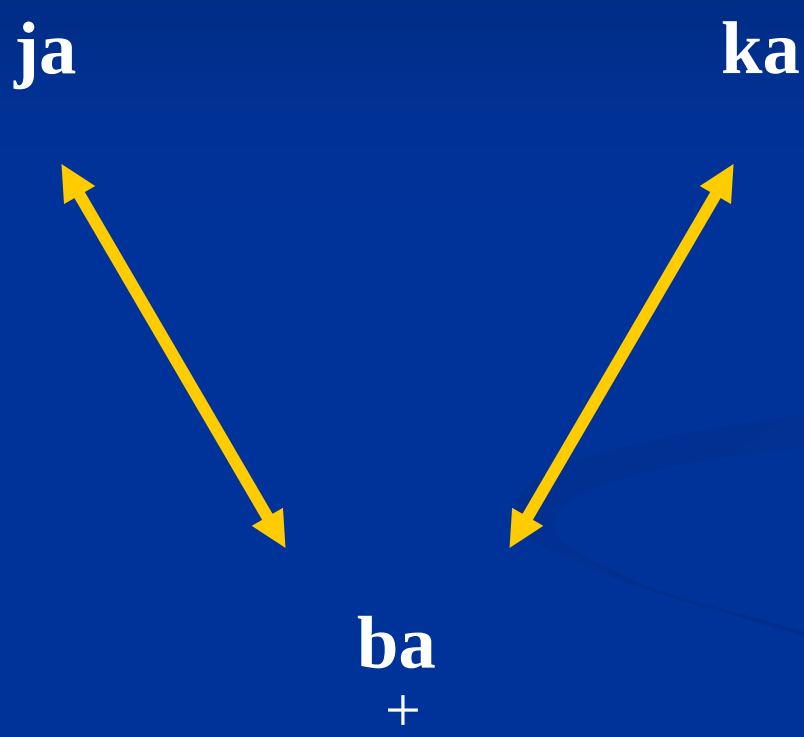
Voicing | Place of articulation | Manner of articulation

- 3 printed CV, the vowel was always /a/

- The target syllable was to be matched with one of two printed CV, according to intuitively estimated acoustic similarity

- Experiment 1 : Manner / Voicing
- Experiment 2 : Manner / Place
- Experiment 3 : Voicing / Place

Example (Voicing-Manner)



Participants

- 24 adults, normal reading level, without academic knowledge in linguistics
- 10 children with normal reading level, 2d graders (CE1)
- 20 dyslexic children (Debrousse Hospital, Lyon)

12 dyslexic children :

- 6 had phonological deficit

  Chronological age = 11 years 10 months
  Lexical level = 7 years 10 mois

  Reading retardation = 4 years

- 6 had no obvious phonological deficit

  Chonological age = 12 years
  Lexical level = 8 years 1 month

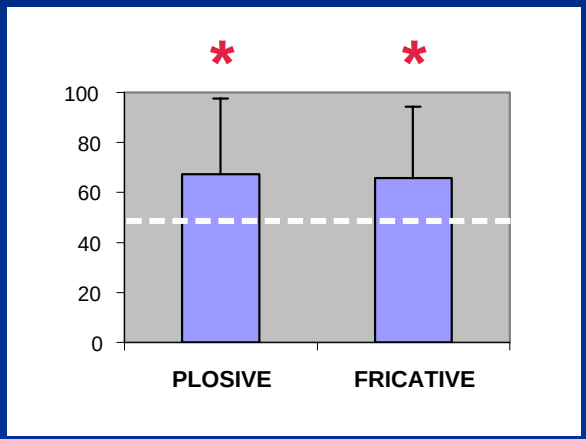
  Reading retardation = 3 years 11 months

Each child is paired with another one for age and lexical level

MANNER or PLACE ?

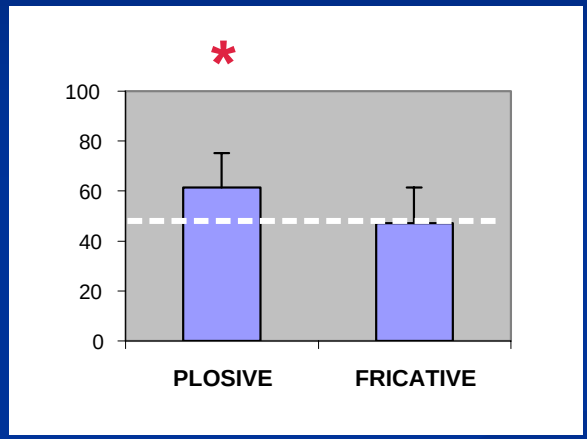
% of Manner matching

Adults



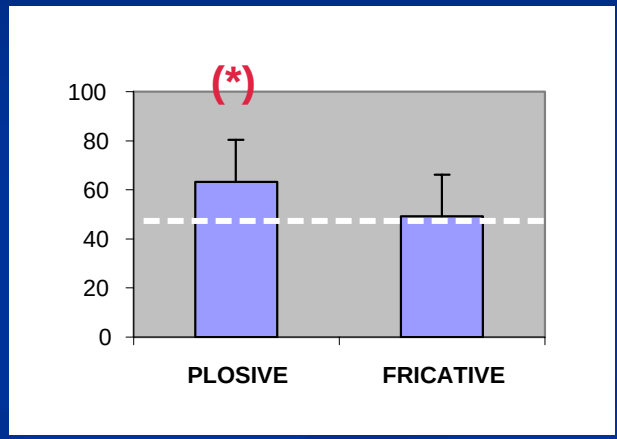
target

2d graders



target

Dyslexic children with phonological deficit



target

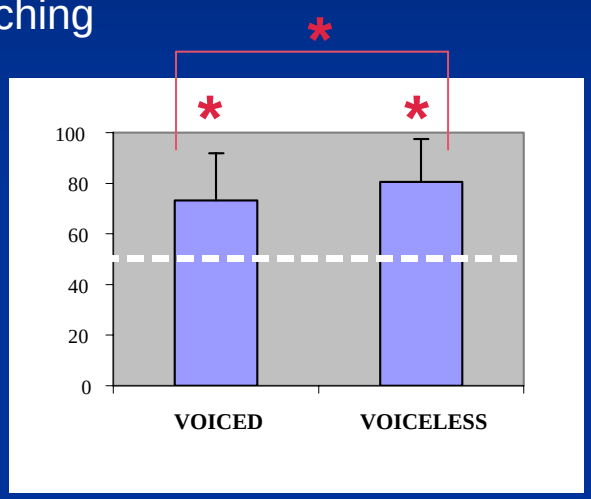
Growing preference for Manner (versus place),

from dyslexic group, to 2d graders, to adults

MANNER or VOICING ?

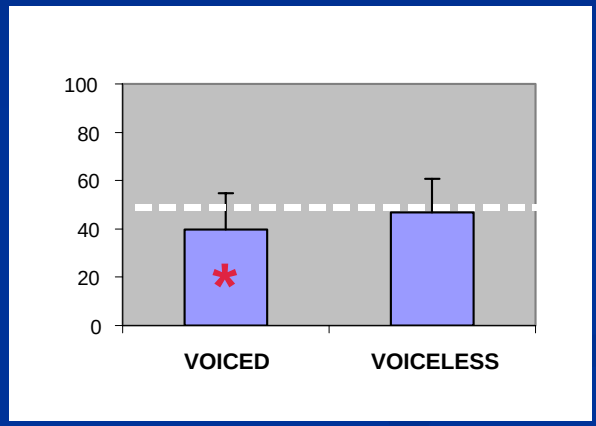
% of Manner matching

Adults



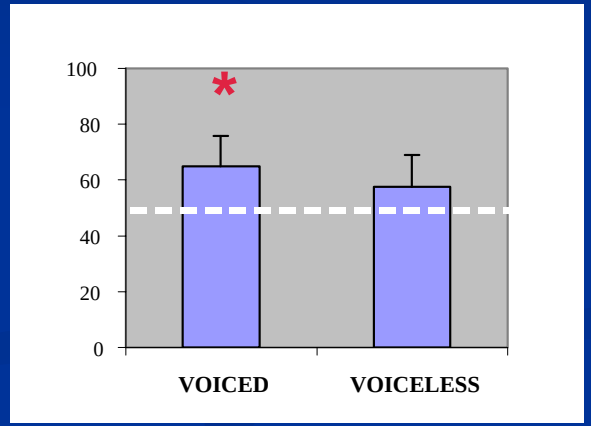
target

2d graders



target

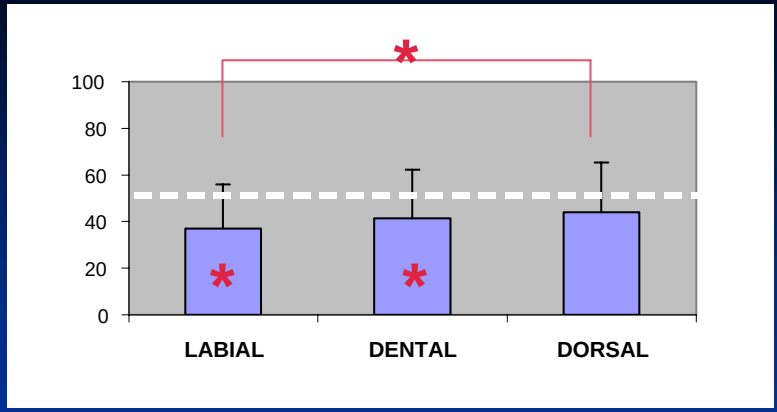
Dyslexic children with phonological deficit



target

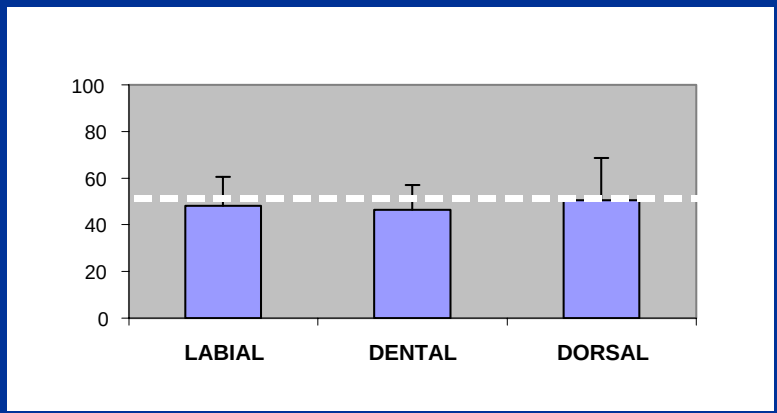
- Young normal readers prefer Voicing to Manner, contrary to adults
- Dyslexic children are not similar to 2d graders (not only a reading retardation, but a qualitative difference)
- Opposite modulating effect of the Voicing of the target upon the choice between Manner and Voicing

% Voicing matching

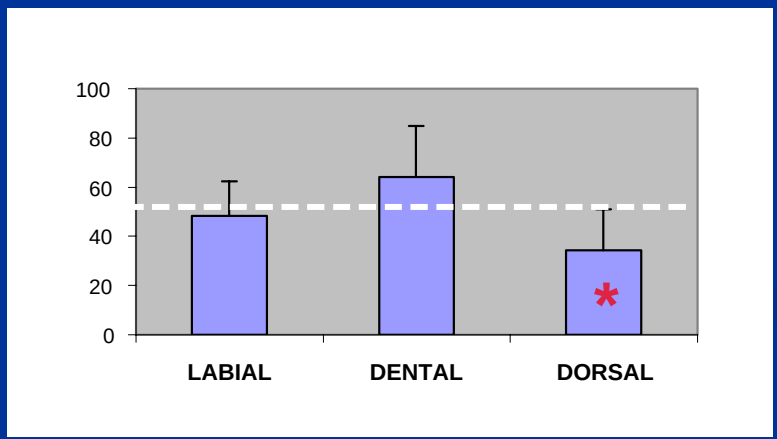


VOICING or PLACE ?

Adult skilled readers prefered Place for front consonants



2d graders have no preference for place



Dyslexic children prefer Place… but only for back consonants

Conclusion

- **Adult skilled readers** : a hierarchical organization for phonetic features categories in this implicit task

→ Prominent status for **Manner**
(compared with Place and with Voicing)

→ A slight role of Voicing similarity, as a modulator effect on Manner categorization

→ Preference for Place, rather than Voicing similarity, only for front consonants :

- visual influence (lip reading) (?)
- influence of articulatory properties (front-back) (?)
- influence of acoustical properties (?)

Conclusion (2)

- **Dyslexic children without obvious phonological deficit :**

  → No preference for any category of phonetic features

- **Dyslexic children with phonological deficit :**

  → ➢ Do not respond at random

  ➢ They may use phonetical rules as a basis for phonemic knowledge organization

  ➢ But these rules seem different from those of adult skilled readers and normal reading children paired in reading level

Voicing similarity decreases performances on the 2d stimulus in lexical decision

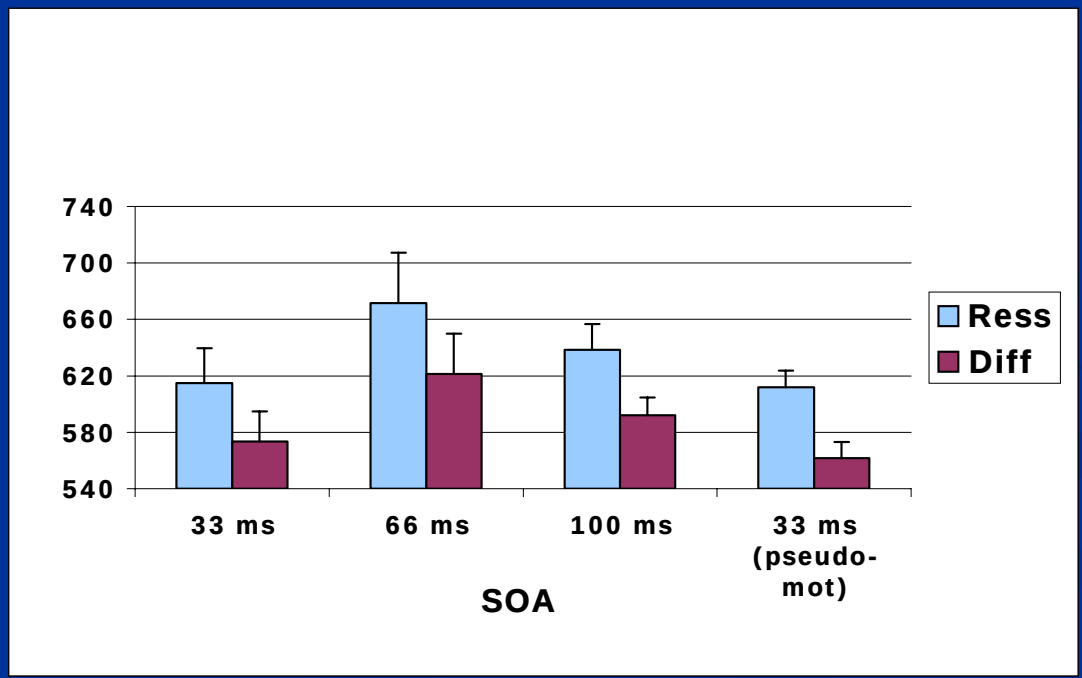
Priming

voiceless → **passe**

voiced → **basse**

passe / **basse** → **TASSE**

voiceless



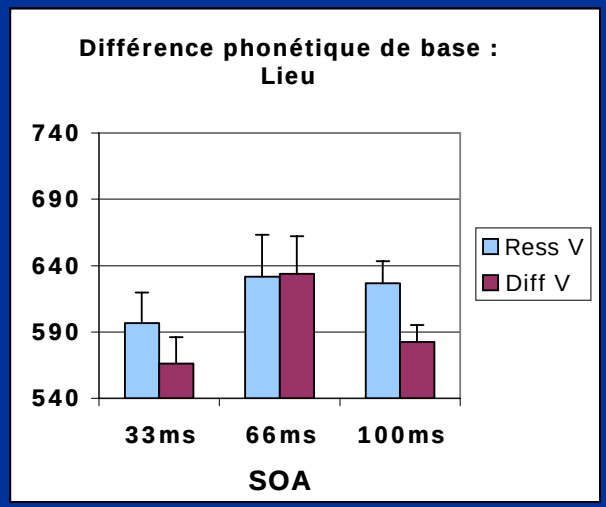
Bedoin (1998)

CONSTANT EFFECT :

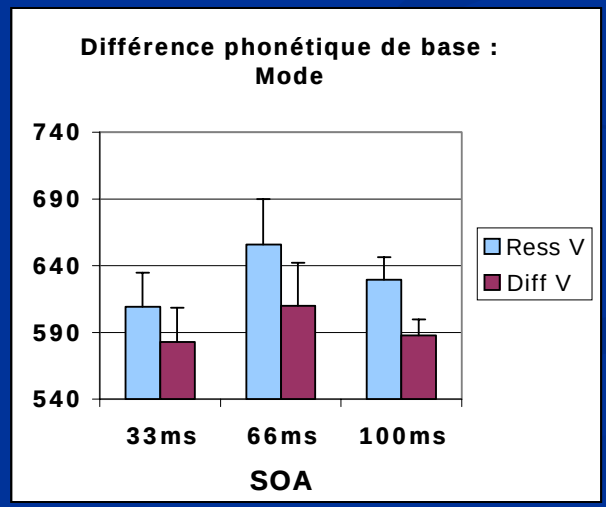
- **whatever the SOA :**
  - **SOA 33 ms** *F*1(1,46)=13.15 7; *p*=.0007, *F*2(1,10)=5.99; *p*=.028
  - **SOA 66 ms** *F*1(1,22)=7.505; *p*=.012, *F*2(1,10)=5.98; *p*=.0283
  - **SOA 100 ms** *F*1(1,22)=13.715; *p*=.0012, *F*2(1,10)=2.501; *p*=.136
- **whatever the prime lexicality** : pseudoword as the prime

  effect with pseudo-words, ***F*1(1,26)=5.094; *p*=.03, *F*2(1,13)=3.917; *p*=.06**
- **whatever frequency** difference between prime and target
- **whatever the other phonetic difference** between prime and target

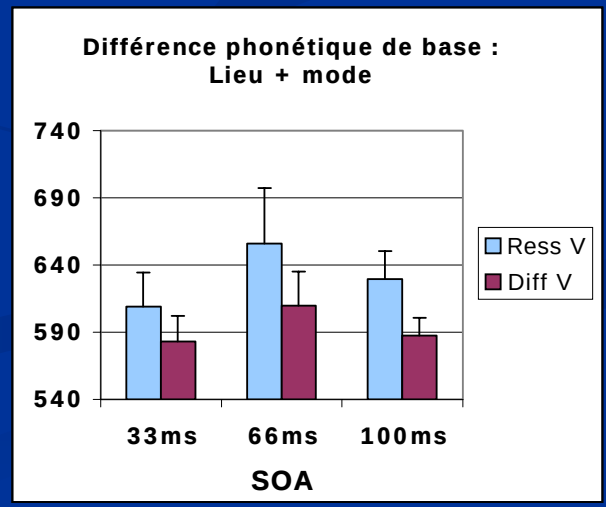
Place



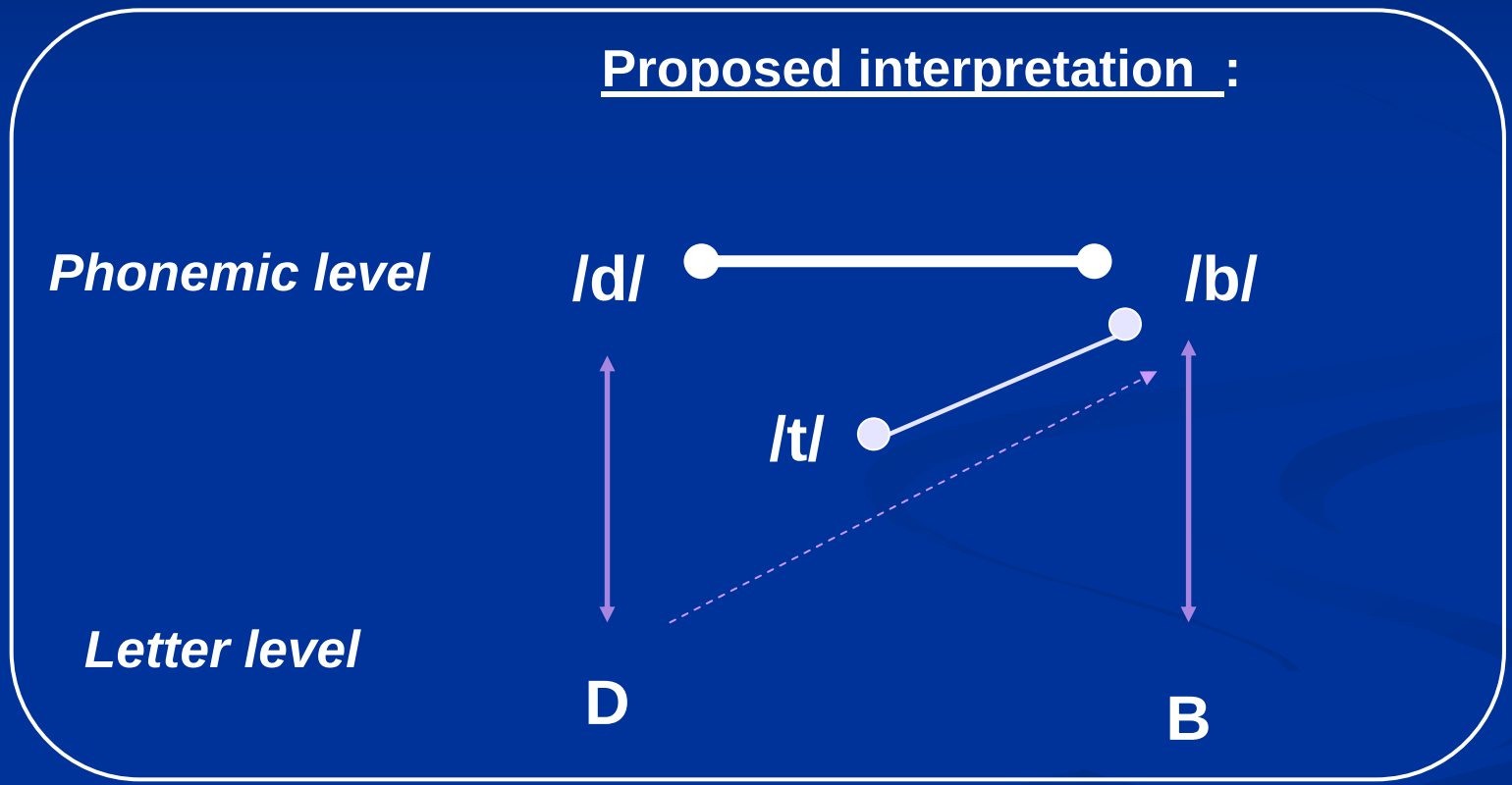
Manner



Place and Manner



- **The effect may be due to the organization of phonemic knowledge.**
- **Inhibitory relations are supposed between phonemic detectors, according to the number of shared phonetic features**

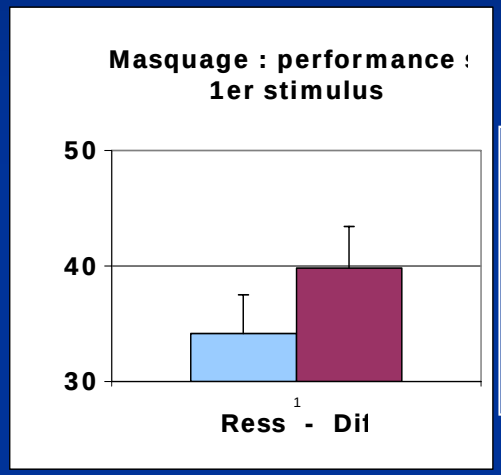


Bedoin, N. (2003). Journal of Phonetics

To test this hypothesis : priming and backward masking experiments

SOA = 33 ms

Backward masking : recall of the 1st stimulus



target *mask*

(Ress) **ZÉVUT**

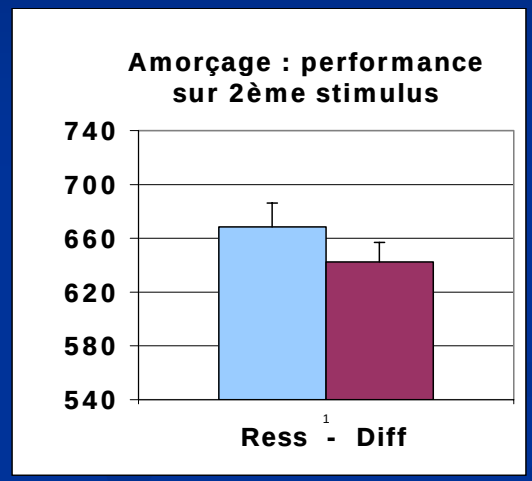
début

(Diff) **SÉFUT**

***F*1(1,34)=8.865; *p*=.013**

***F*2(1,22)=5.823; *p*=.0246**

Priming : lexical decision on the 2d stimulus



prime *target*

(Ress) **zévut**

DÉBUT

(Diff) **séfut**

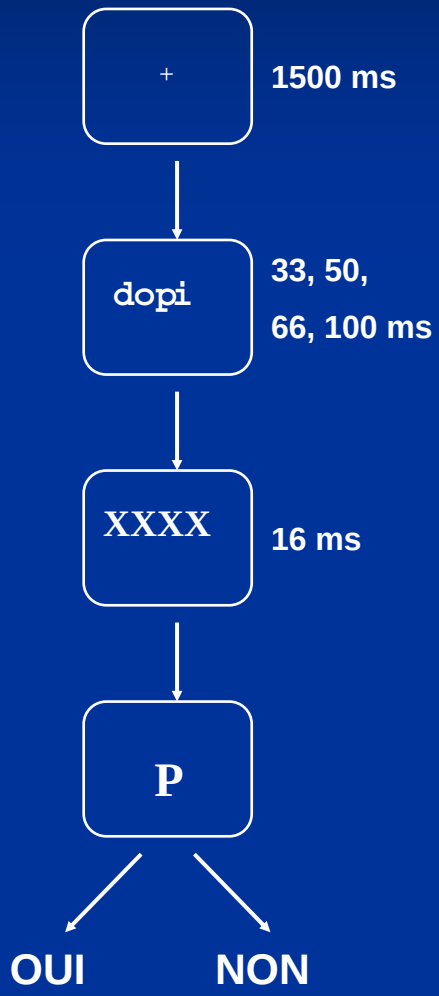
***F*1(1,34)=8.025; *p*=.007**

***F*2(1,22)=8.269; *p*=.009**

VOICING SIMILARITY :

- **decreased performances for the 2d stimulus,**
- **increased performances for the 1st stimulus**

Both effects are replicated with voicing similarity manipulated within one single CVCV stimulus



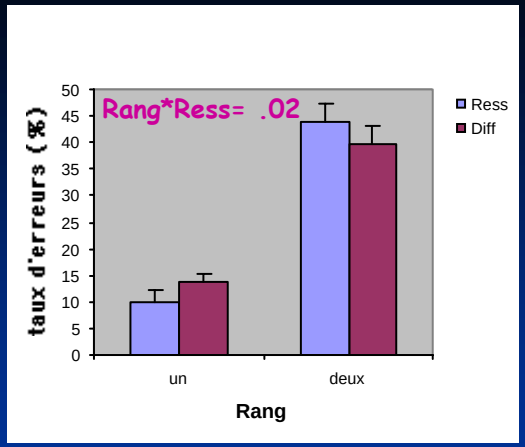
Letter detection task

Voicing similarity

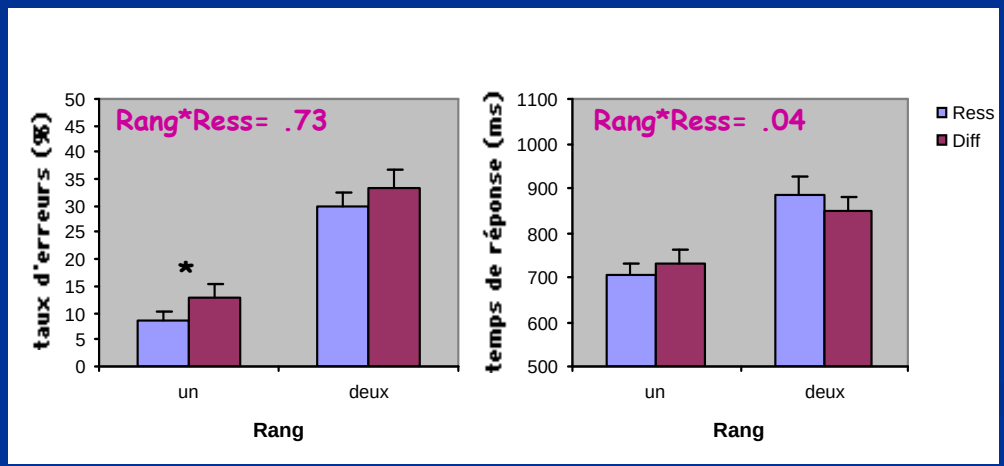
➔ decreased performances for C2

➔ increased performances for C1

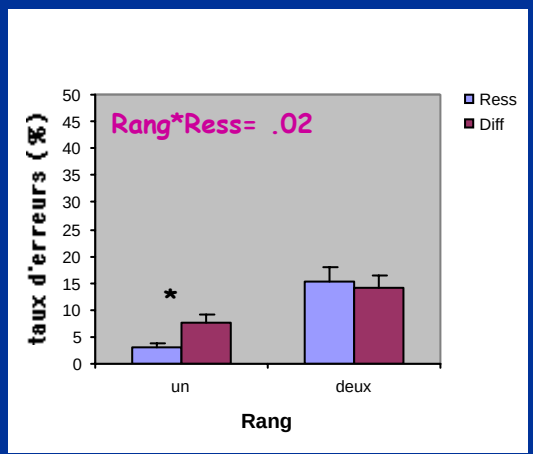
Results in adults



Presentation = 33 ms



Presentation = 50 ms

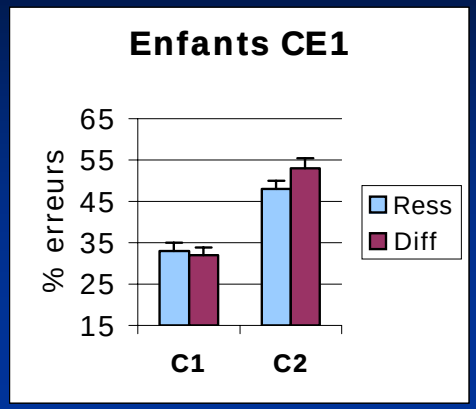


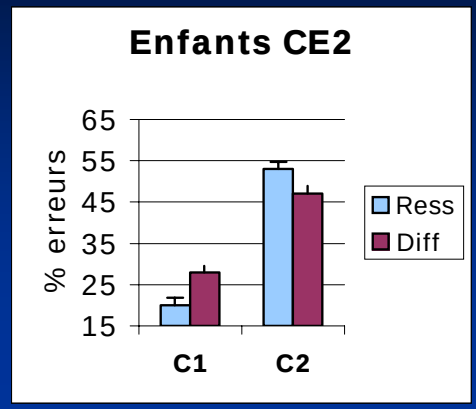
Presentation = 66 ms

Presentation = 100 ms

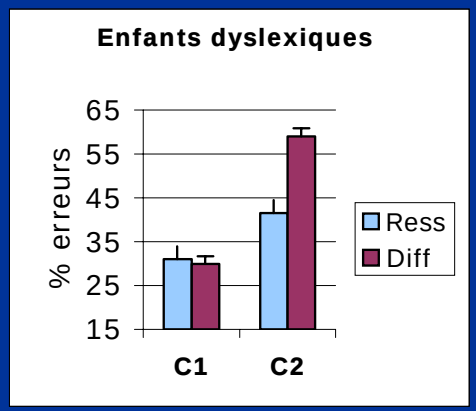
➔ *no effect*

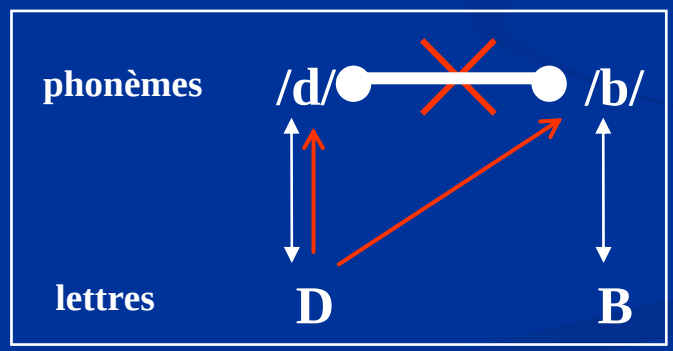
Results in normal reading children (presentation = 85 ms)



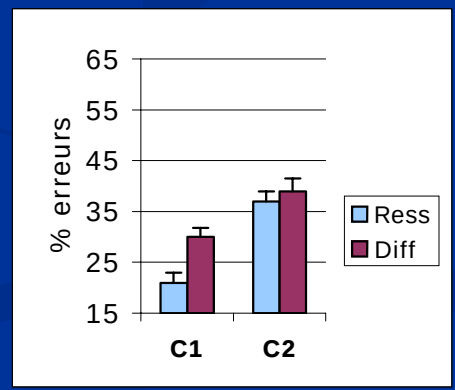


Results in dyslexic children





After an intensive audio-visual training about voicing :



(Krifi, Bedoin & Mérigot, 2003)

Voicing similarity effects (benefit for C1, cost for C2) in a syllable recalling test

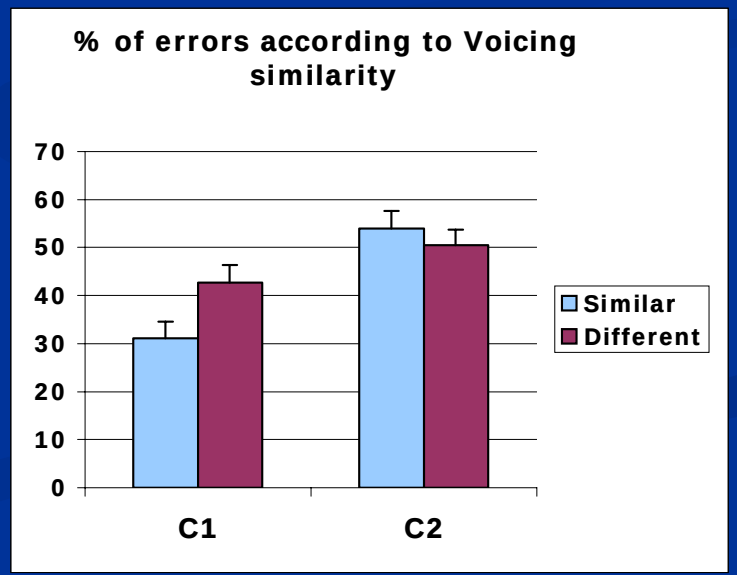
Procedure :

Results :

Syllable rank X Voicing similarity,
F(1, 23) = 41.78, *p* <.0001

➢ **Voicing similarity improves C1 processing**
F(1, 23) = 49.56, *p* < .0001

➢ **Voicing similarity impaired C2 processing**
F(1, 23) = 4.42, *p* < .047



The role of other phonetic categories in priming

➔ **6 experiments tested the role of Manner and Place similarity between two stimuli (lexical decision was made on the second stimulus)**

Prime and target differed in voicing

- Experiment 7 (SOA = 100 ms)
- Experiment 8 (SOA = 66 ms)
- Experiment 9 (SOA = 33 ms)

Prime and target did not differ in voicing

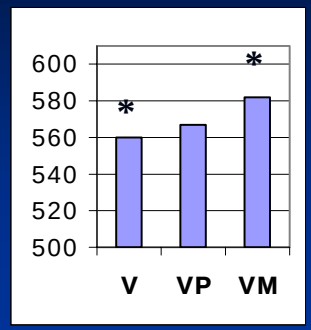
- Experiment 10 (SOA = 100 ms)
- Experiment 11 (SOA = 66 ms)
- Experiment 12 (SOA = 33 ms)

Additional difference in Voicing

33 ms

Expé. 9

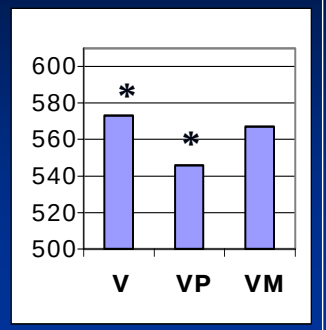
Manner similarity increases performances



66 ms

Expé. 8

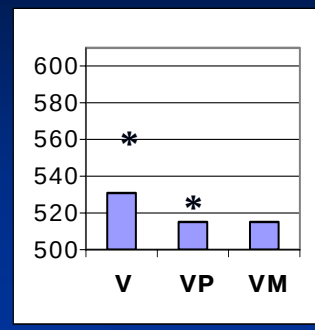
Place similarity decreases performances



100 ms

Expé. 7

Place similarity decreases performances



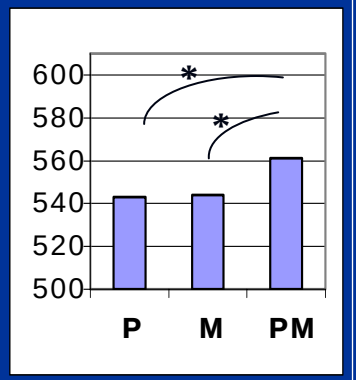
No difference in voicing

Expé. 12

Manner similarity

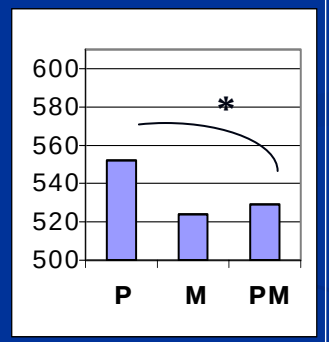
And

Place similarity increases performances

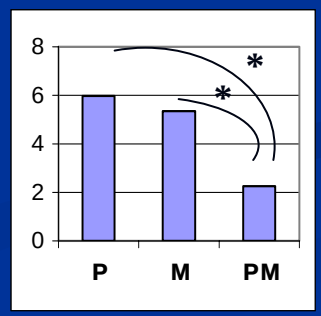


Expé. 11

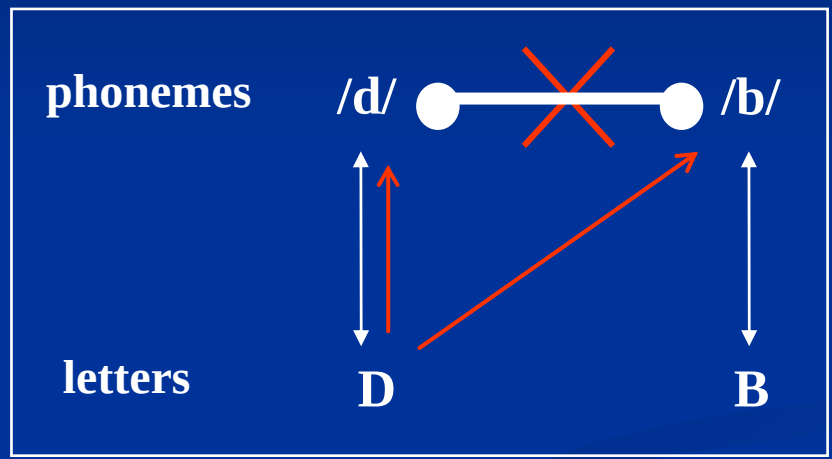
Manner similarity decreased performances



Place similarity and Manner similarity de creased response accuracy



Expé. 10


phonemes
/d/
/b/
letters
D
B

Expérience avec un essai de condition « neutre »

Chaque mot cible (e.g., PEINE) est précédé de :

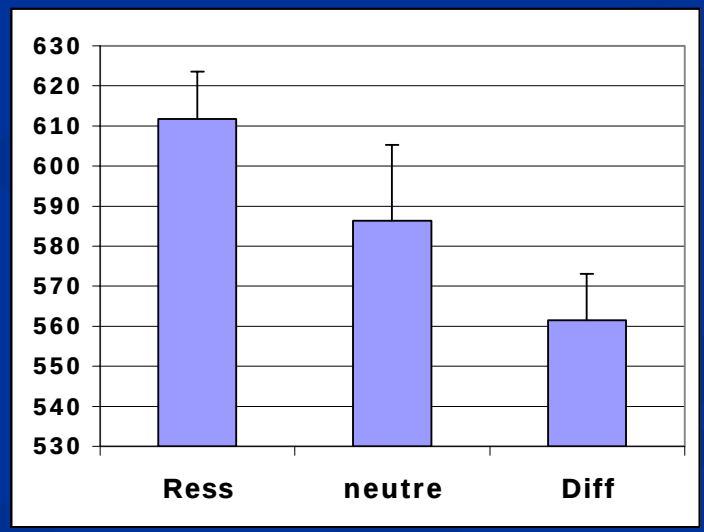
- amorce qui diffère sur un trait (Lieu ou Mode) (teine)
- amorce qui diffère sur un trait (Lieu ou Mode) + sur le Voisement (deine)
- amorce sans phonème en commun et commençant par une voyelle ou une consonne liquide (aurul)

Résultats :

- effet du facteur condition,

$F(2, 66) = 3.72$, $p < .03$

- différence entre les 2 conditions avec ressemblance ou différence de voisement, $F(1, 66) = 7.40$, $p < .01$



Effet négatif de ressemblance infra-phonémique sur le traitement du 2ème stimulus, dans d'autres travaux :

- Production de parole, (Rogers & Storkel, 1998)

- Perception de parole, (Goldinger, Luce, Pisoni and Marcario,1992)

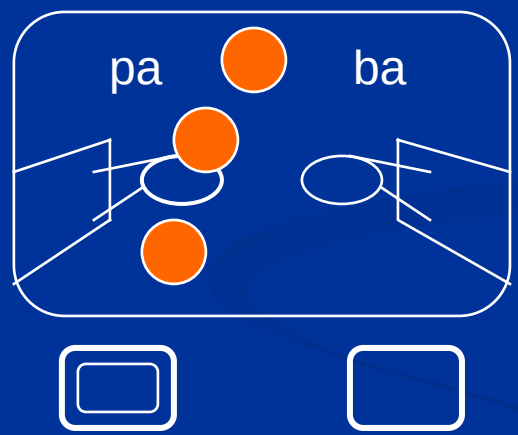
Deux propositions d'interprétation :

• **Effet de compétition** : la ressemblance faciliterait le traitement du 2ème stimulus qui, par effet de backward masking, restaurerait les traitements auparavant effectués sur le 1er stimulus (parce qu'il lui ressemble) --> renforcement de l'identification du 1er stimulus --> compétition entre les 2 stimuli

➔ Prédiction : le 1er et le 2ème stimulus devraient être moins bien identifiés

Entraînement audio-visuel intensif, portant sur les six oppositions de Voisement

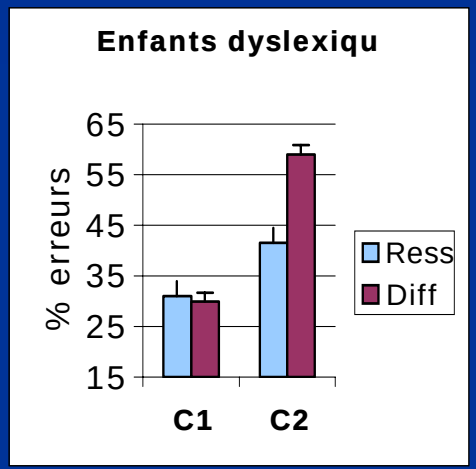
3 sessions de 15 minutes par jour, 4 jours par semaine, pendant 3 semaines



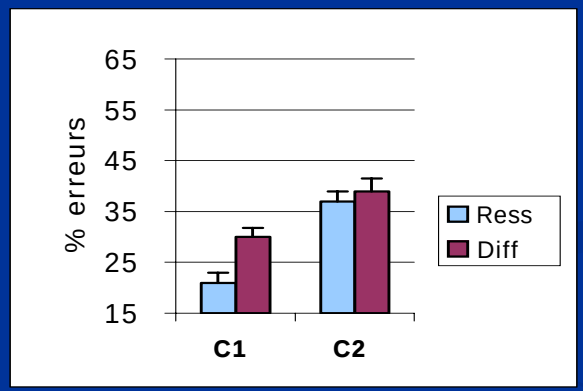
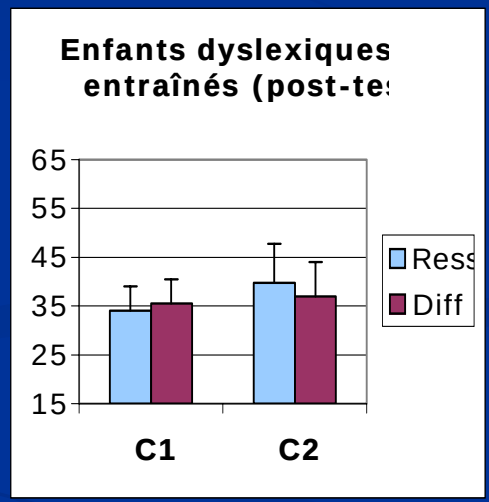
Danon-Boileau & Barbier, 2000

- 18 enfants répartis en deux groupes:
  - groupe A: bénéficiant de l'entraînement
  - groupe B: sans entraînement

Enfants dyslexiques avant entraînement



Enfants dyslexiques après entraînement sur voisement



Enfants dyslexiques après entraînement sur vocabulaire