The role of letter identity and letter position in Spanish developing readers: Evidence with skilled and dyslexic children

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What does skilled reading mean

• Skilled reading implies identifying words **accurately** and **fast**

• This ability is grounded on the progressive construction of orthographic representations

How are these constructions built?

When do correct reading and automatic recognition converge?
Construction of orthographic representations

- Grapheme-phoneme linkage
- Internalization of regularities (Wimmer & Aro, 2003)
  - Reading = feedback (Frith, 1998)
- Internalization of significant units
  - Whole-word well specified representations
- Paralell automatic access

- Spelling to sound translation
- Coarse grained coding
Letter identity and letter position

Spelling to sound translation ➔ children identify letters one by one

At this stage
letter identity is crucial for efficient reading

Co-occurring letter combinations internalized ➔ component letters of orthographic chunks need to be well specified

At this stage
letter position becomes relevant
Efficient and automatic reading

• Construction of orthographic representations bias progressive and exhaustive letter identity and letter position coding

• Regularly encountered representations are better stored and retrieved faster

• These promote identification of new representations sharing letter combinations -> and more exhaustive representational system
Orthographic representations become more exhaustive

**Form priming experiments**

- **dall**  
  ball  
  lift  
  2nd  4th  6th grades

  Castles, Davis & Lechter, 1999

- **rlay**  
  lpay  
  meat  
  3rd grade  
  5th grade

  Castles, Davis, Cavalot & Forster, 2007

- **terme**  
  efrme  
  gosnh  
  3rd grade  
  5th grade and dyslexics  
  skilled readers

  Lété & Fayol, 2013

**Lexical tuning hypothesis**
Experiments examining influence of N size = SN

**LEXICAL DECISION**
- N size facilitates decision in beginning readers ~ 1st to 3rd
  - Duñabeitia et al., 2008
  - Laxon et al., 1988
- N size does not influence performance->grade 1 to 5
  - Dufau et al., 2010

**NAMING**
- Greater accuracy ~ Grade 1-3
  *in pseudowords and low F. words
  - Laxon et al., 1994, 2002
- Lexicalization errors
- Null effects in words
- Detrimental effect of HFN in 2nd grade and dyslexics
  - Marinus & de Jong, 2010
Receive influence of frequently seen whole-word representations

During the process of word construction, children should be sensitive to frequently encountered whole-word forms = HFNs

Finely tuned system

HFN speeds up naming
* of Low Freq
* and high N size words

Grainger, 1990
Sears, Hino, & Lupker, 1995
Carreiras, Perea, & Grainger, 1997

Coarsely tuned system

HFN

 delays naming response?

 leads to more reading errors?
Predictions

Poorly tuned lexicon

- Sublexical reading: sequential spelling to sound mapping and activation of small shared representations -> negligible HFN effect
- Beginning readers and dyslexics

Parallel processing:
- Activation of whole-word representation during phonological assembly -> hesitations and corrections - misreading

Finely tuned lexicon

- Parallel processing: high general activation and correct selection before phonological output starts -> facilitative effect - accuracy
- Skilled readers
### Method

<table>
<thead>
<tr>
<th>Chronological age years</th>
<th>Developing readers</th>
<th>Dyslexic readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2 (2nd grade)</td>
<td>22</td>
<td>4</td>
</tr>
<tr>
<td>8.9 (4th grade)</td>
<td>22</td>
<td>4</td>
</tr>
<tr>
<td>11.1 (6th grade)</td>
<td>22</td>
<td>4</td>
</tr>
</tbody>
</table>

### Word Stimuli

<table>
<thead>
<tr>
<th>SN</th>
<th>32 words</th>
<th>TN</th>
<th>32 words</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>litro (libro)</td>
<td></td>
<td>labio</td>
</tr>
<tr>
<td></td>
<td>cedro (cerdo)</td>
<td></td>
<td>cenar</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experimental word</th>
<th>Control word</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FREQ.</strong></td>
<td><strong>LEXIN</strong></td>
</tr>
<tr>
<td>SN</td>
<td>8.3</td>
</tr>
<tr>
<td>TN</td>
<td>6.4</td>
</tr>
</tbody>
</table>
Task and procedure

Wrong utterances

jugar
ju ...rar

cerdo
ced...

litro

labio
Results developing readers

Reading times (in ms) % errors

[Graph showing reading times and errors for different groups (SN EXPE, SN CONT, TL EXP, TL CONT) across 2nd, 4th, and 6th stages.]

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[Image of a fabric texture background]
Results dyslexic readers

Reading times (in ms) % errors
Summary results

Sublexical reading: negligible HFN effect

Parallell processing: hesitations – misreading

Parallell processing: facilitative effect - accuracy

poorly tuned lexicon

finely tuned lexicon

SN

2nd grade

4th and 6th grade

TL

6th grade
Evolution of effects: developing

Z scores
Evolution of effects: dyslexic

Z scores
Conclusions

• HFN hallmark of impact of whole-word representations on finely or coarsely tuned developing lexicon

• As previous work suggested, under certain conditions, HFNs can exert detrimental effects on reading

   Depending on the developmental reading stage

   Depending on whether the conflict affects letter identity or letter position coding mechanisms
Conclusions

• Beginning readers -> low vocabulary size, spelling to sound mapping reading strategy = negligible effects from substitution or transposed letter HFN

• Increasing age -> greater vocabulary size, coarse grained processing

finely tuned orthographic representations = facilitative effects of HFNs ✓ Invariant letter location SN

poorly tuned orthographic representations = detrimental effects of HFN × TLN
Conclusions: normal developing

• In early stages of learning to read letter identity is relevant -> children become efficient resolving letter identity mismatches

• Further stages devoted to position coding mechanisms, which take longer to develop

• Both stages essential for correct and automatic reading to converge at some point
These data are in line with previous experiments using other manipulations (Castles et al., 2007; Perea & Estevez, 2008)

Can be accounted by recent models of reading

Conclusions: normal developing
Conclusions: dyslexic children

• This progression might be difficult for dyslexics

• Due to their phonological impairment at the perceptual level they do not create bottom up letter-based exhaustive representations

• Coarse orthographic coding imposed from beginning of reading experience

• Creation of location invariant representations difficult
Conclusions: dyslexic children

This idea is supported by patients with letter position dyslexia (Kohnen et al., 2012; Friedmann & Rahamim, 2014)

Accounted by SOLAR model of reading (Whitney & Cornelissen, 2005)

1. Spatial gradient: serial letter coding - bottom up activation

2. Attentional gradient: Top down activation
Thank you