Learning difficulties in oral and written language in children with SLI

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http://www.psy.ox.ac.uk/oscci/
Specific language impairment (SLI)

- Language does not follow normal developmental course
- Normal development in other areas
- Not due to hearing loss, physical abnormality, acquired brain damage
Aspects of language structure

- Phonology
  - speech sounds
- Syntax
  - word order
  - grammatical morphology

Areas of particular difficulty for many language-impaired children
Grammatical tense/agreement: an area of especial difficulty

• Omission of 3rd person singular
  • e.g. Every day my brother walk to school
  • He like chocolate

• Omission of past tense -ed
  • e.g. Yesterday I walk to school
Specific reading disability (SRD) (developmental dyslexia)

- Unusual difficulty in learning to read
- Not due to hearing loss, physical abnormality, acquired brain damage, or lack of opportunity
- Normal intellectual development
Cognitive neuroscience approach

Specify underlying nature of impairment in terms of model of normal function, using evidence from

- Pattern of difficulties
- Tasks beyond those used to define disorder
Decomposing the task of learning to read

Animal
Lives in desert
Has hump(s)
etc.

lexica\al representation

/ˈkaml/  phonological representation
Decomposing the task of learning to read

- CAMEL
  - Animal
  - Lives in desert
  - Has hump(s)
  - etc.

Lexical representation

phonological representation

/ˈkæml/

CAMEL
orthographic representation
Decomposing the task of learning to read

Animal
Lives in desert
Has hump(s)
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lexical representation

/'kaml/
phonological representation

CAMEL
orthographic representation
"Indirect" route to word reading

Convert letters into sounds to achieve pronunciation

CAMEL

/k/+a/+m/+ɛ/+l/

/kamɛl/
Two routes to word reading

Animal
Lives in desert
Has hump(s)
etc.

lexical representation

Direct route

Indirect route

CAMEL

phonological representation

orthographic representation

Which aspects are impaired in developmental dyslexia?

- Common belief that dyslexia is a visual disorder – problems with reversing b/d

Problems with mappings between orthography and lexicon

Animal
Lives in desert
Has hump(s)
etc.

Surface dyslexia:
Key symptom – difficulties in reading irregular words, e.g. YACHT
Problems with mappings between orthography and phonology

Animal
Lives in desert
Has hump(s)
etc.

Phonological dyslexia:
Key symptom – difficulties in reading nonwords, e.g. ZUG
“Phonological awareness”: ability to identify individual speech sounds in syllables
(Introducing monster): This is ‘Bill’. He likes things that sound like the first sound of his name. Which do you think he will choose? The cake, the jug, the leaf or the boat?
Oral language deficits in dyslexics: Poor phonological processing

- Phonological awareness deficits
- Poor at nonword repetition
- Slow at naming familiar items
Example of rapid naming task
CAMEL

Animal
Lives in desert
Has hump(s)
etc.

lexical representation

/'kaml/
phonological representation

CAMEL
orthographic representation

**Learning new words**

Vindy thinks the best animal is the lork. She likes the lork because it runs around a lot. Vindy goes to the zoo. She goes to see the lork first. The lork gets fed at noon.
Cognitive analysis: insights

- Same behaviour can be caused by different underlying problems

- Developmental dyslexia usually a language problem rather than visual disorder
Traditionally, considered as separate disorders

- **SLI**
  - Studied by speech and language therapists

- **Dyslexia**
  - Studied by educators/psychologists
Association between SLI and poor literacy skills
data from Briscoe et al, 2001

CA and CB: control
HI: hearing impaired
SLI-Y and SLI-O: older and younger SLI
Association between dyslexia and oral language impairment

- Language delay more frequent in dyslexic than controls (e.g. Naidoo, 1972)

- McArthur et al (2000): 61/110 children with specific reading disability scored more than 1 SD below average on CELF-R
High-risk studies
Gallagher et al, 2000; Lyytinen et al, 2001

• Children of dyslexic parents tend to have slower language development than controls
  - though few meet criteria for SLI
Continuum view

- Common core language deficit in SLI and dyslexia
- SLI is (a) more severe form and/or (b) earlier manifestation
Alternative view...

- Similarities between dyslexia and SLI are superficial
- Different underlying cognitive deficits can lead to poor literacy
Cognitive processes

Is the nature of language/reading impairment the same in dyslexia and SLI?
Similar phonological deficits: Kamhi et al, 1988
Literacy assessment

- Single word reading/spelling
- Nonword reading/spelling
- Passage reading:
  - accuracy
  - comprehension
  - (rate)
Neale Analysis

A robin hopped up to my window. She made a nest in my garden. I gave her some bread. Now I look after her little birds.

Sample question:
1. Where was the little boy standing when he saw the robin?
SLI vs dyslexic 15-yr-olds
Goulandris et al, 2000

groups equivalent, except on reading comprehension
Oral language skills in dyslexics
Goulandris et al, 2000

Dyslexics did not differ from age-matched controls
Summary: Differences between SLI and dyslexia

Dyslexia

– Problems with phonological processing and verbal memory
– Vocabulary, syntax, and general listening comprehension relatively intact
– Reading: decoding poor, comprehension OK

SLI

– Poor syntax, vocabulary and phonological short-term memory
– Problems with reading comprehension as well as decoding
Is the difference just in severity?

Predicts a child who has impairment lower down the list will also have impairments higher on the list.

- spelling
- reading
- phonological awareness
- verbal short-term memory
- expressive phonology
- vocabulary
- expressive syntax
- language comprehension
“Poor comprehenders”


- Defined as those who do badly on tests of reading comprehension despite good reading accuracy.
- Typically not identified as having problems by teachers/parents.
- On most tests of oral language/working memory, look like children with SLI.
- But good phonological skills.

Do not fit ‘severity’ model: master reading accuracy despite weak oral language skills.
Bishop & Snowling, 2004

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<table>
<thead>
<tr>
<th>Poor oral language</th>
<th>Good phonological processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic dyslexia</td>
<td>Typical development</td>
</tr>
<tr>
<td>Classic SLI (+poor reading)</td>
<td>“Poor comprehenders”</td>
</tr>
</tbody>
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Typical development and “Poor comprehenders” are associated with good phonological processing. Classic dyslexia and Classic SLI with poor oral language.
Etiology

Are same genes/environmental risk factors implicated in dyslexia and SLI?
What causes SLI?

- Family aggregation
- Twin studies

  - Both point to important effect of genes
  - Nonword repetition (measure of phonological short-term memory) is good marker of heritable phenotype

see Bishop 2002 for review
What causes reading disability?

“Since the first documented cases at the beginning of the last century, it has become increasingly apparent that the reading problems of people with dyslexia form part of a heritable neurobiological syndrome”

What causes reading disability?

“.. school effectiveness findings indicate that pupil achievements and behavior can be influenced (for the better or worse) by the overall characteristics of the school environment”

Twins as a tool for uncovering genetic and environmental influences

• Monozygotic (MZ) twins: genetically identical

• Dizygotic (DZ) twins: share 50% of polymorphic genes

• Twin-cotwin similarity could be due to shared genes or shared environments
  • However, if genes are implicated expect more similarity for MZ than for DZ twins
2001 twin study

- Sample A: 86 pairs selected because one or both twins met criteria for Specific Language Impairment (SLI); aged 7 to 16 yr
- Sample B: general population sample of 100 twin pairs aged 7 to 13 yr
- All pairs same-sex

Results: sample A

SLI is highly heritable

- Children with SLI also tend to have literacy problems:
  specific reading disability in
  - 47% of children with SLI
  - 14% of unaffected

- Oral language and reading problems appear to have same genetic influences
Results: sample B

- General population sample
- High twin-twin correlations ($r > .7$) for reading ability in both MZ and DZ
- Suggests environmental rather than genetic influence is most important in determining reading ability
Results disagree with Colorado Twin Study

Sample selection

– wide range of social/educational backgrounds included; cf Colorado middle class sample
– Colorado sample used more extreme definition of reading impairment
– Maybe few true “dyslexics” in sample B
Can we distinguish genetic and environmental cases phenotypically?

- **genetic risk**
- **environmental risk**
- **more like SLI?**

**reading disability**
Children’s Nonword Repetition Test (CNRep)

child listens to spoken nonwords and repeats, e.g.
  2 syllables: hampent
  3 syllables: dopelate
  4 syllables: confrantually
  5 syllables: pristoractional

Genetic analysis of sample B showed significant genetic effect on reading disability only for those with poor nonword repetition
Study of 6 yr old twins

Twin testers:

Caroline Adams

Courtenay Norbury

Thanks to:

• Robert Plomin and staff at the Twins Early Development Study
Subset of TEDS sample, biased to include those with language difficulties

- 65 MZ and 67 DZ pairs with ‘low language’ on basis of parental report at 4 yr
- 37 MZ and 29 DZ control pairs (neither ‘low language’)

Individual assessment included:

- Children’s Nonword Repetition Test (CNRep)
- Basic Reading (Wechsler Objective Reading Dimensions)
Classification of twin pair by CNRep

NN: both twins with CNRep above 84
LX: one or both twins with CNRep < 85

NB twins with poor CNRep were more likely to have characteristics of SLI:

- Have had speech-language therapy
- Been identified as ‘low language’ by parents at 4 yr
- Have poor language test scores at 6 yr
Twin 1 vs. Twin 2: reading scores adjusted for age/PIQ

heritability: 0 (CI: 0 to .43)
sh.envmmt: .60 (CI: 21 to .71)

heritability: .79 (CI: .49 to .87)
sh.envmmt: 0 (CI: 0 to .43)
Conclusions from twin studies

2001 study suggested reading disability only heritable in children with low nonword repetition

2004 study: similar results in 6-year-olds across whole range of reading ability

Current classification

- Dyslexia – poor literacy
- SLI – poor oral language
A better classification?

- Categorise children according to underlying skills, i.e. whether they have:
  - Language comprehension problems
  - Phonological processing problems

- Reveals that many “dyslexic” do have oral language problems

- Many “SLI” have poor phonology
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