developmental English Lexicon Project (d-ELP)

An Interdisciplinary Research Hub

The Challenge of Reading Difficult Words for Developing Readers – Moving from Experimental Studies to an Online Resource for Teachers, Researchers, and Stakeholders

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THE HEBREW UNIVERSITY OF JERUSALEM

Differences Across Languages: The English Conundrum

- Seymour, Aro, and Erskine (2003) reported that children who were acquiring reading in orthographically consistent languages (Greek, Finnish, German, Italian, Spanish) were close to ceiling in both word and nonword reading by the middle of first grade.

- In contrast, English-speaking children performed extremely poorly (34% correct). Danish (71% correct), Portuguese (73% correct) and French (79% correct) children showed somewhat reduced levels of recoding accuracy, which is in line with the reduced consistency of these languages

Table 1 *Data (% correct) from the large-scale study of reading skills at the end of grade 1 in 14 European languages (adapted from Seymour, Aro & Erskine, 2003)*

Language	Familiar real words	Pseudowords
Greek	98	92
Finnish	98	95
German	98	94
Austrian German	97	92
Italian	95	89
Spanish	95	89
Swedish	95	88
Dutch	95	82
Icelandic	94	86
Norwegian	92	91
French	79	85
Portuguese	73	77
Danish	71	54
Scottish English	34	29

English: The Double Whammy!

Table 16.1 Hypothetical Classification of European Languages Relative to the Dimensions of Syllabic Complexity (Simple, Complex) and Orthographic Depth (Shallow to Deep) (from Seymour et al., 2003)

Syllabic structure	*Orthographic depth*					
	Shallow . . . . . : . . . . . : . . . . . : . . . . . *Deep*					
Simple	Finnish	Greek Italian Spanish		Portuguese	French	
Complex		German Norwegian Icelandic		Dutch Swedish	Danish	English

When Irregularities Occur

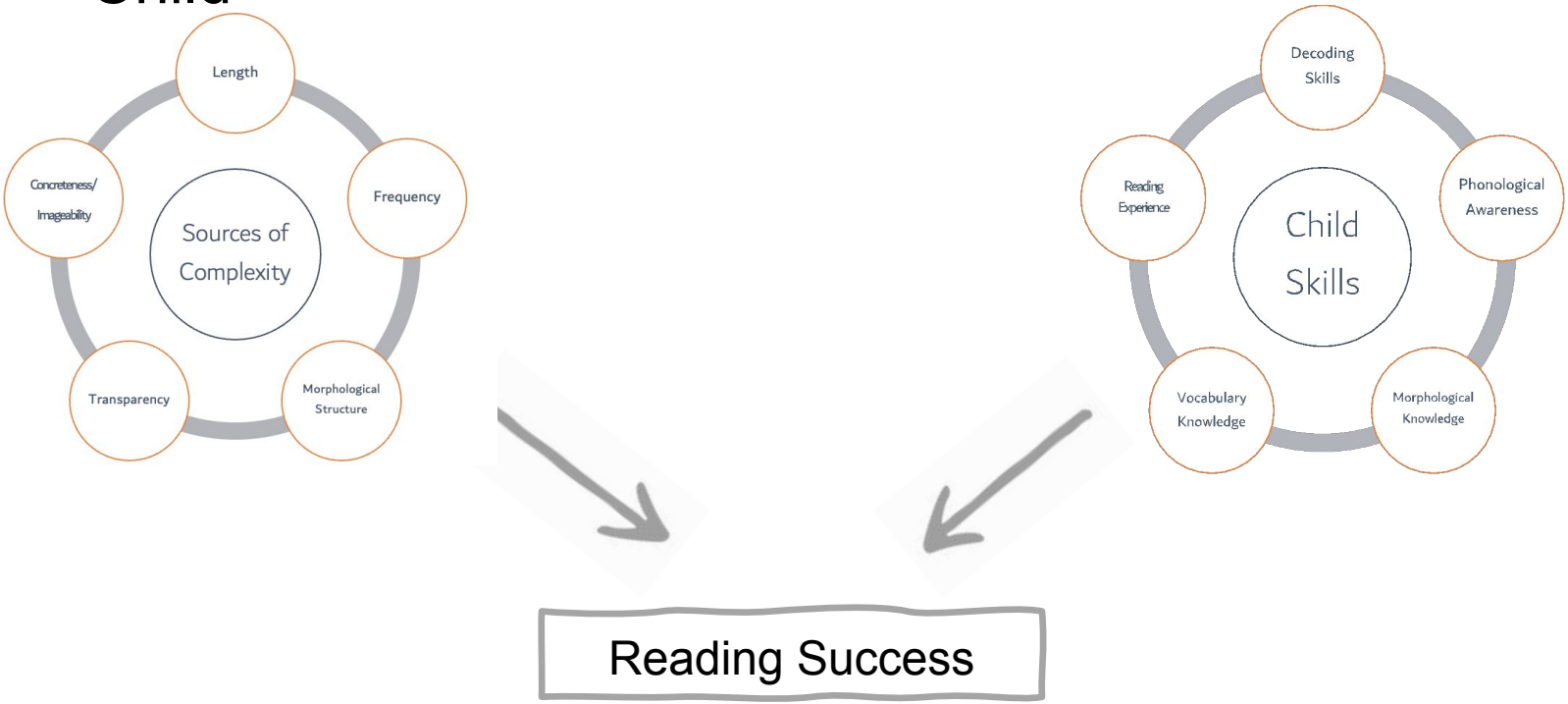
- In a quasiregular orthography like English, children inevitably encounter irregular and complex words during reading.

- Successful reading of an irregular word depends at least partially on
  - a child's ability to flexibly address the mismatch between the decoded form and the correct pronunciation
  - the word's relative transparency

Increasing Complexity through School

Temperature changes make rocks expand and contract. Where there are extreme daily temperature changes, such as in a desert, expansion and contraction can help make rocks break apart. Another important mechanical weathering process is called abrasion. Think about what happens when you use sandpaper to smooth a piece of wood or an emery board to file your fingernails. When gravity, wind, or moving water causes rocks to run against each other, the rocks wear down or break into smaller pieces.

The Interaction of Child Skills and Word Attributes in Predicting Accurate Reading of a Word by a Child



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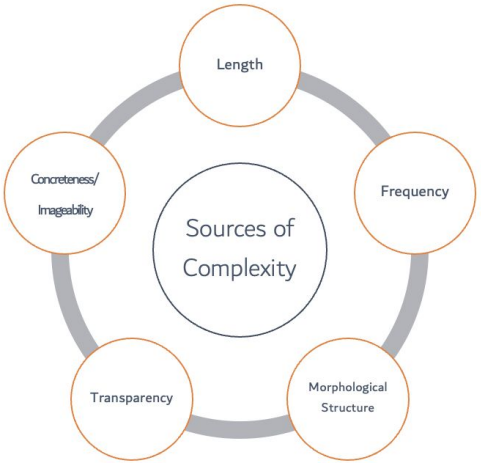

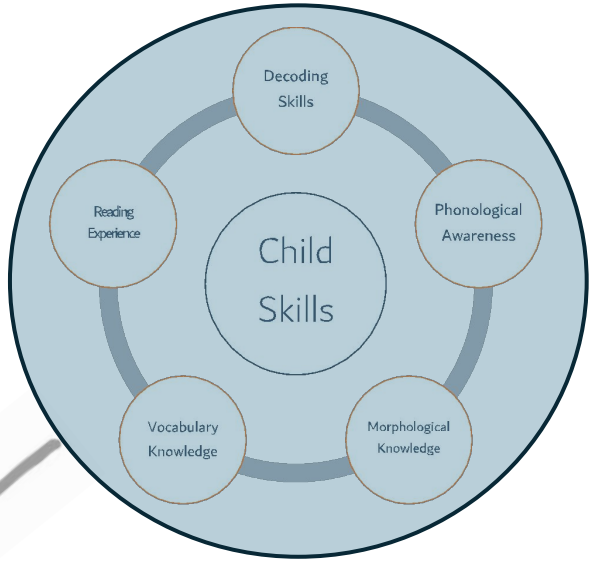

Reading Success

The Challenge for Children with Dyslexia in Learning to Read Words

Phonological system constraints

- Imprecise phonological representations in the language system, not always captured by PA measures, result in difficulty learning and stabilizing grapheme-phoneme mappings during early reading development.
- Slow establishment of context-free decoding skills.
- The adoption of more global approaches to learning words.

Compensatory learning pathway in dyslexia

- Reading develops via word-specific orthography → phonology mappings (Harm & Seidenberg, 1999; Harm et al., 2003; Steacy et al., 2021).
- Increased reliance on memorized word-specific mappings.
- Reduced generalization across orthographic patterns that allow the accurate reading of new words.

Let’s Watch this in Real Time in a Large Set of Developing Readers

CHILD DEVELOPMENT

Child Development, May/June 2021, Volume 92, Number 3, Pages e252–e269

Modeling and Visualizing the Codevelopment of Word and Nonword Reading in Children From First Through Fourth Grade: Informing Developmental Trajectories of Children With Dyslexia

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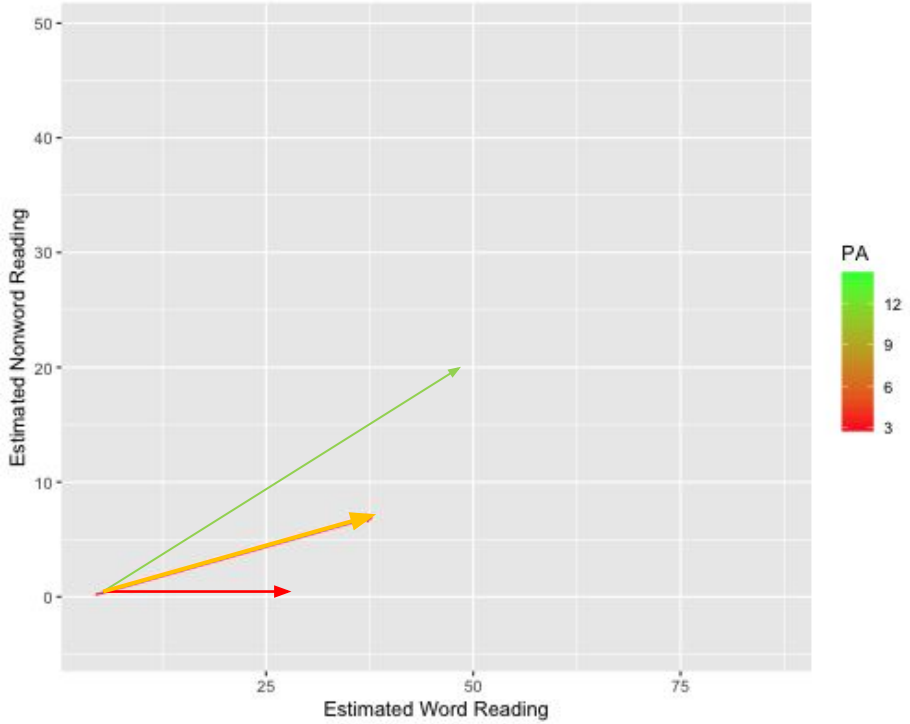
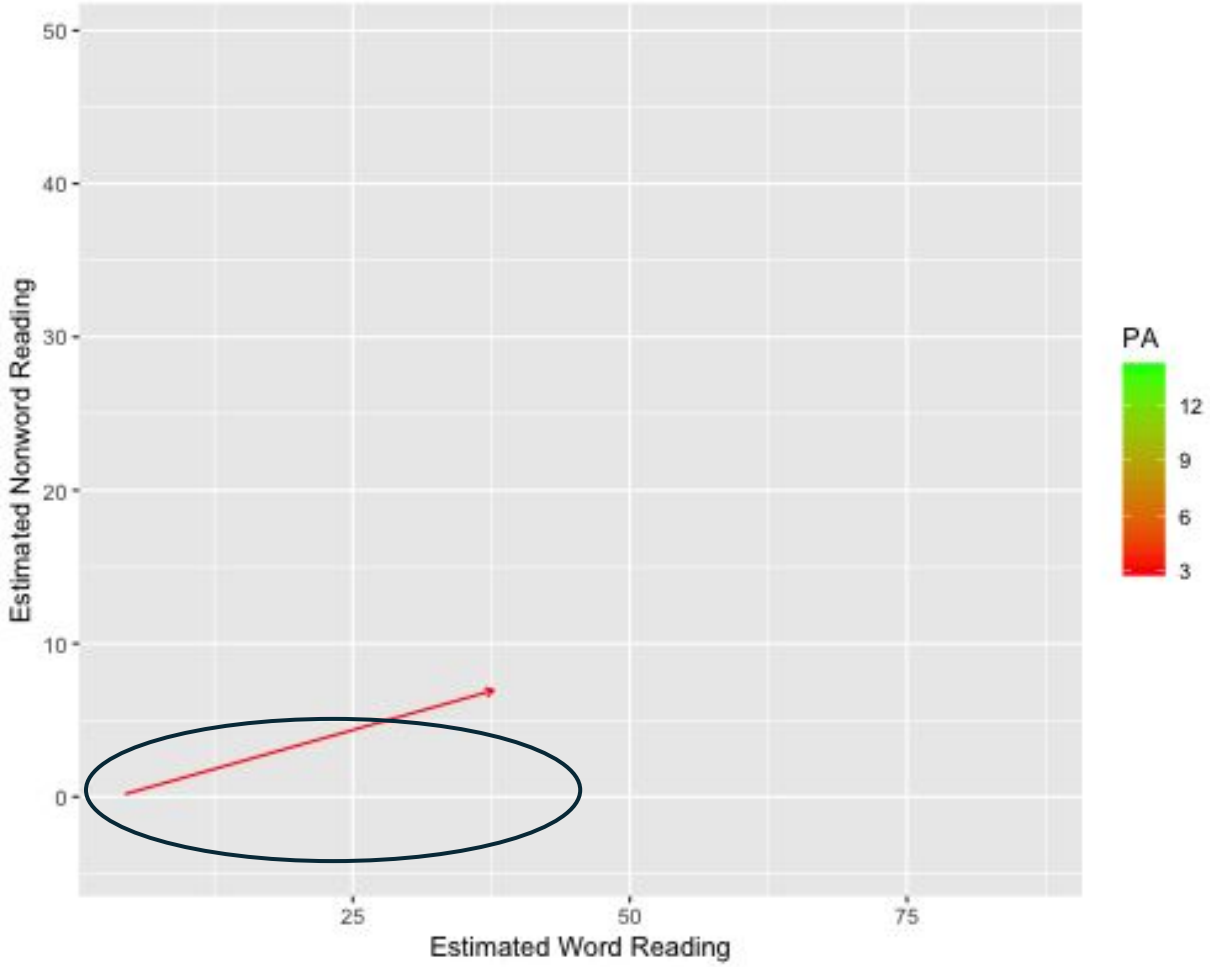
Jay G. Rueckl
University of Connecticut

Yaacov Petscher and Donald L. Compton
Florida Center for Reading Research, Florida State University

Developmental studies examining relations between word reading (WR) and decoding in typical and dyslexic populations routinely cut the reading distribution to form distinct groups. However, dichotomizing continuous variables to study development is problematic for multiple reasons. Instead, we modeled and visualized the parallel growth of WR and nonword reading (NWR) factor scores longitudinally in a Grade 1–4 developmental sample ($N = 588$). The results indicate that while WR and NWR growth factors are highly related ($r = .71$), the relation between WR and NWR trajectories change as a function of initial WR. Results are interpreted within computational models of dyslexia in which children with dyslexia overfit orthography → phonology relations at the level of the word, limiting the development of sublexical representations needed to read nonwords.

What Happens When Children Fail to Grasp the "Alphabetic Principle"

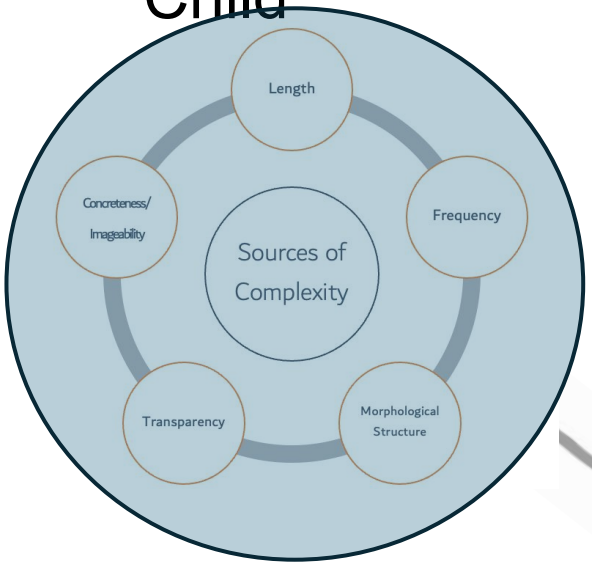


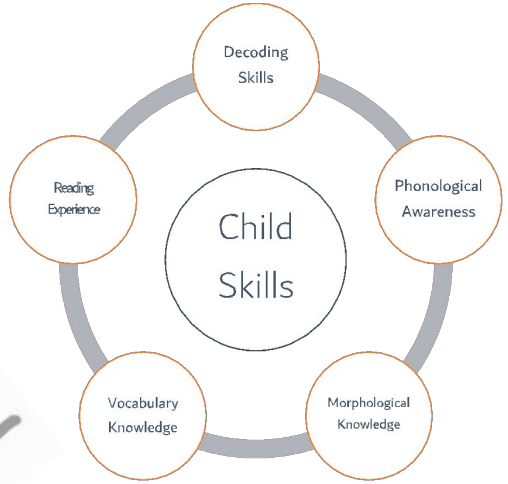

50
40
30
20
10
0
Estimated Nonword Reading
25
50
75
Estimated Word Reading
PA
12
9
6
3

The Consequences of Poor Phonological Representations in Children with Dyslexia

- Poor phonological representations result in the adoption of more global processing of orthographic structure, with little attention to the sublexical structures in words.
- This dependence on global orthographic structure is not a strategy but a consequence of how the mappings between orthography and phonology are learned when the capacity to represent phonological structure is limited (Harm & Seidenberg, 1999).
- Further development of the reading system (including advanced O→P and O→S connections) are compromised leading to a negative cascade of effects of phonological deficits across the entire reading system in children with dyslexia (Joanisse & McClelland, 2015).
- And thus, weak understanding of how the language maps onto the writing system, particularly at the sublexical level, results in the need to teach children with dyslexia to fully analyze word spellings across multiple grain sizes (see Ehri, 2020).

The Interaction of Child Skills and Word Attributes in Predicting Accurate Reading of a Word by a Child

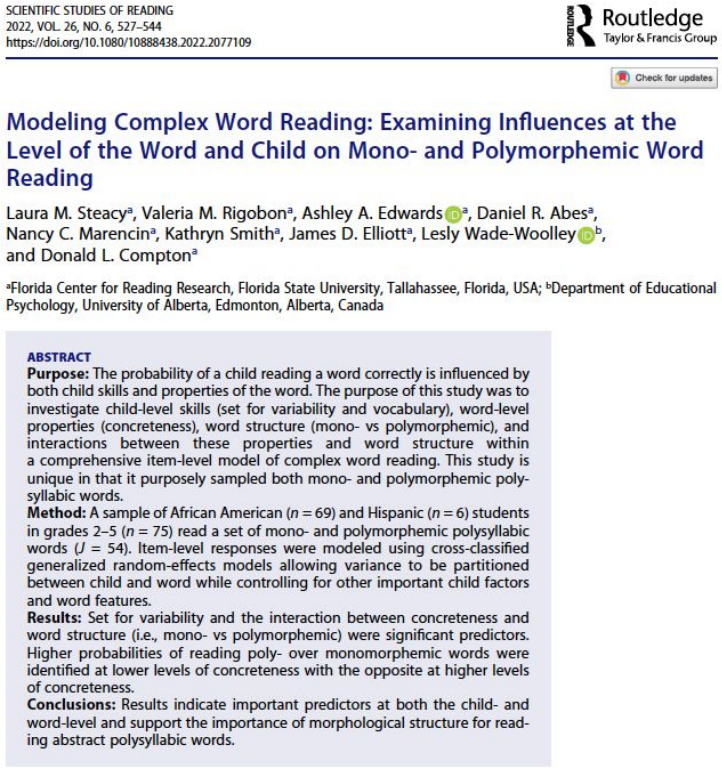




Reading Success

Moving Past Simple Monosyllabic Words

- Despite the fact that most words in English have more than one syllable (Baayen et al., 1993), the vast majority of the literature on word reading development has focused on the study of monosyllabic word recognition with relatively little attention paid to polysyllabic and polymorphemic word recognition skill (e.g., *mischievous, palatial, physician;* Perry et al., 2010).
- Studies suggest that complex words place unique demands on developing readers related to word features such as syllable boundaries (Perry et al., 2010), word stress and vowel reduction (Ševa et al., 2009), vowel pronunciation ambiguities (Venezky, 1999), larger and more complex grapheme–phoneme units (Berninger, 1994), and morphological transparency (Kearns et al., 2016) and complexity (Carlisle & Stone, 2005; Nagy et al.,



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2022, VOL. 26, NO. 6, 527–544
https://doi.org/10.1080/10888438.2022.2077109

Routledge
Taylor & Francis Group

Check for updates

Modeling Complex Word Reading: Examining Influences at the Level of the Word and Child on Mono- and Polymorphemic Word Reading

Laura M. Steacy[a], Valeria M. Rigobon[a], Ashley A. Edwards[a], Daniel R. Abes[a], Nancy C. Marencin[a], Kathryn Smith[a], James D. Elliott[a], Lesly Wade-Woolley[b], and Donald L. Compton[a]

[a]Florida Center for Reading Research, Florida State University, Tallahassee, Florida, USA; [b]Department of Educational Psychology, University of Alberta, Edmonton, Alberta, Canada

ABSTRACT

Purpose: The probability of a child reading a word correctly is influenced by both child skills and properties of the word. The purpose of this study was to investigate child-level skills (set for variability and vocabulary), word-level properties (concreteness), word structure (mono- vs polymorphemic), and interactions between these properties and word structure within a comprehensive item-level model of complex word reading. This study is unique in that it purposely sampled both mono- and polymorphemic polysyllabic words.

Method: A sample of African American ($n = 69$) and Hispanic ($n = 6$) students in grades 2–5 ($n = 75$) read a set of mono- and polymorphemic polysyllabic words ($J = 54$). Item-level responses were modeled using cross-classified generalized random-effects models allowing variance to be partitioned between child and word while controlling for other important child factors and word features.

Results: Set for variability and the interaction between concreteness and word structure (i.e., mono- vs polymorphemic) were significant predictors. Higher probabilities of reading poly- over monomorphemic words were identified at lower levels of concreteness with the opposite at higher levels of concreteness.

Conclusions: Results indicate important predictors at both the child- and word-level and support the importance of morphological structure for reading abstract polysyllabic words.

Examining the relations between concreteness and complex word structure in predicting word reading

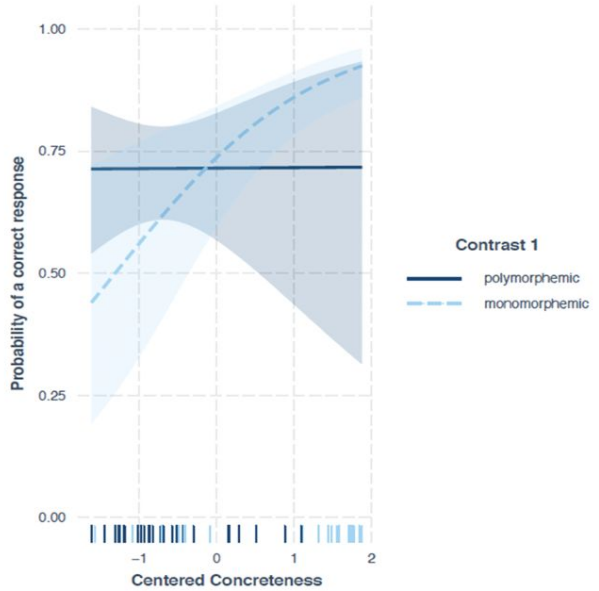
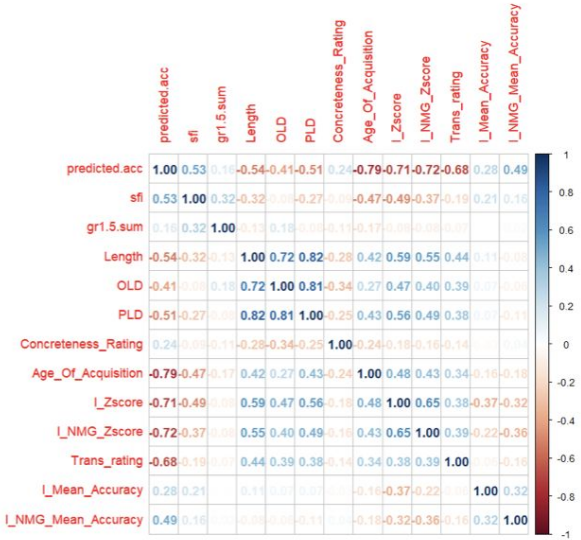


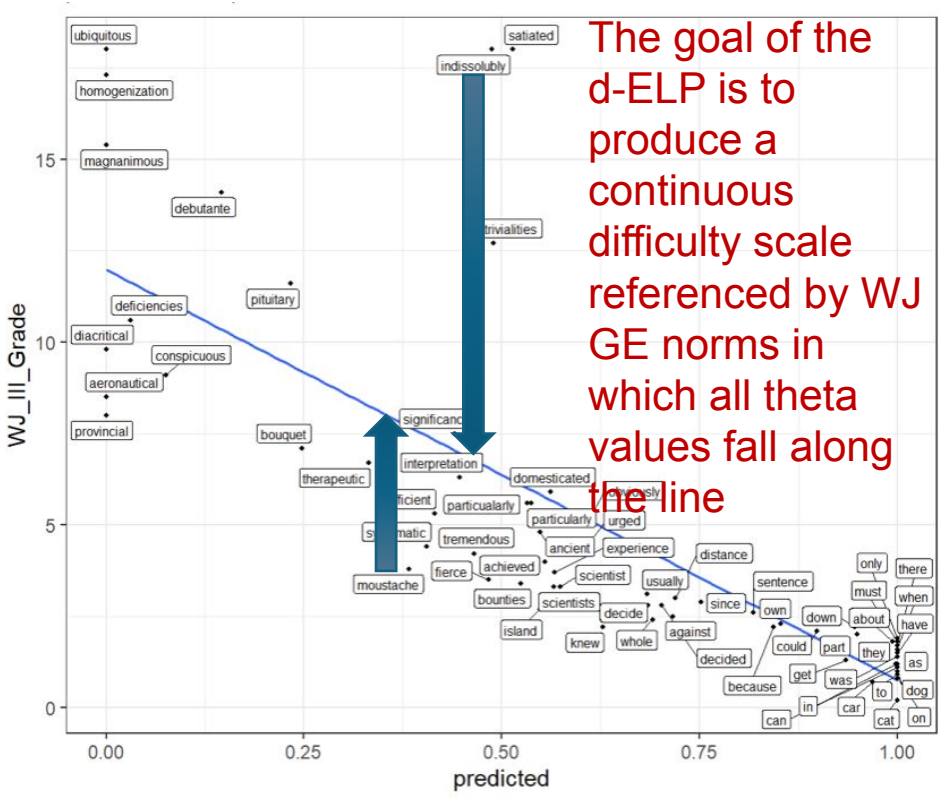
Figure 1. Interaction between contrast 1 and concreteness rating in the prediction of word reading. The colors along the x-axis denote the observed values of concreteness for polymorphemic (dark blue) and monomorphemic words (light blue). Concreteness on the x-axis is grand mean centered (0 corresponds to the mean concreteness rating of 3.12, −1 corresponds to a concreteness rating of 2.12, 1 corresponds to a concreteness rating of 4.12, and 2 corresponding to a concreteness rating of 5.12. The maximum concreteness rating was 5. Note that polymorphemic words have a smaller range of observed values than monomorphemic words. The shaded areas represent the 95% confidence interval surrounding each line with the darker blue shaded area representing the confidence interval for polymorphemic and light blue representing that of monomorphemic words. Significant differences are represented by areas in which the line for one is outside of the shaded area for the other.

- More concrete words had a higher probability of a correct response for only monomorphemic words, whereas polymorphemic words showed no difference in difficulty based on the level of concreteness.
- Results support the importance of morphological structure for reading abstract polysyllabic words.
- We suggest results support the idea that polymorphemic words contain orthographic structure anchored by morphemes that support decoding of these complex words.

Demonstrating Our (In)Ability to Predict Word Difficulty

We worked to predict word reading difficulties across child word reading data from our labs using various word features.



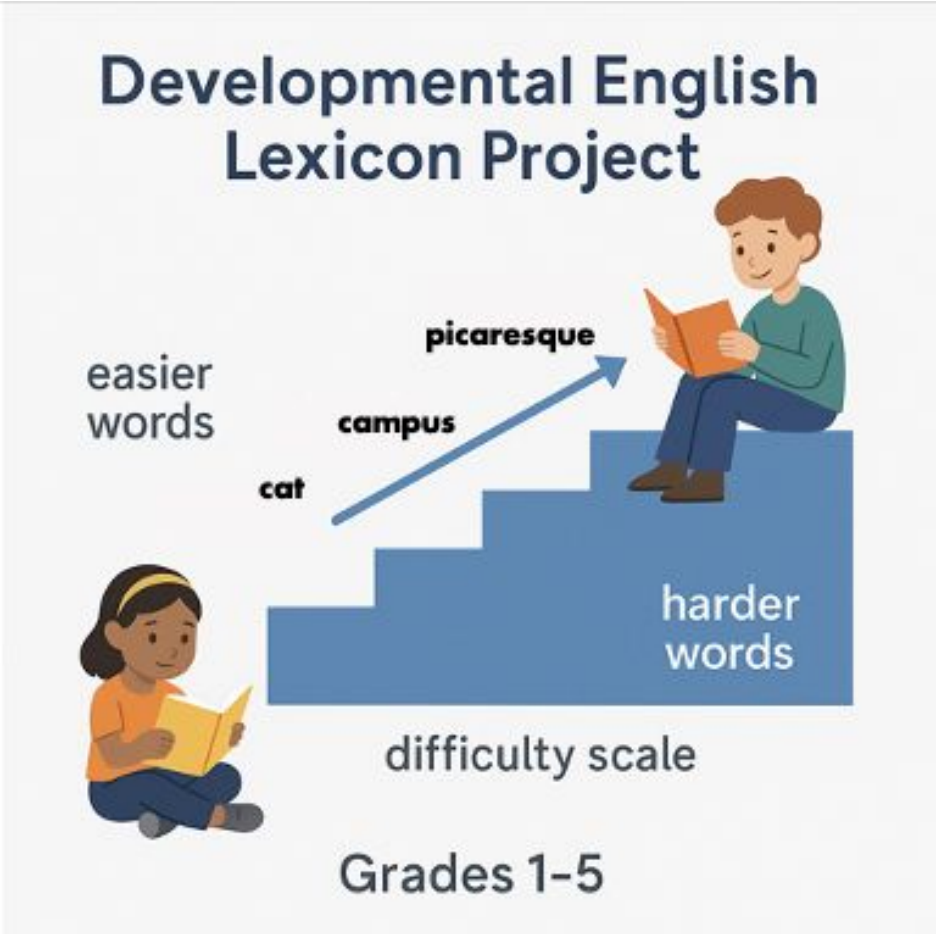


Working to Better Understand Word Complexity as it Relates to Early Word Reading Development

Our Goal

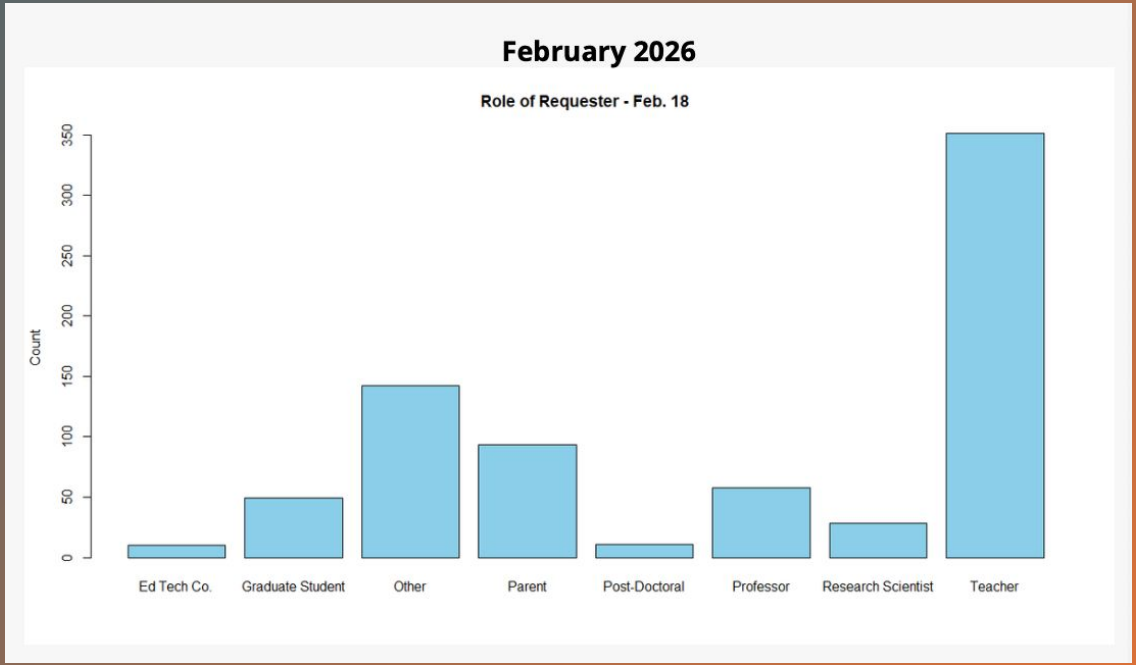
- To obtain estimates of word reading difficulty for the 10,000 most frequent English words with a diverse sample of approximately 2,000 children in grades 1-5 including over-sampling of children with reading difficulties (the developmental English Lexicon Project, d-ELP).
- Pair word difficulty estimates with an extensive set of word attributes (length; frequency; imageability; orthographic, phonological, morphologic characteristics; lexical diversity; bigram frequency; part of speech; grade equivalence; etc.)
- Make the database available publicly with advanced search capabilities.

We Accomplished our Goal, Introducing the d-ELP (funding from NICHD)

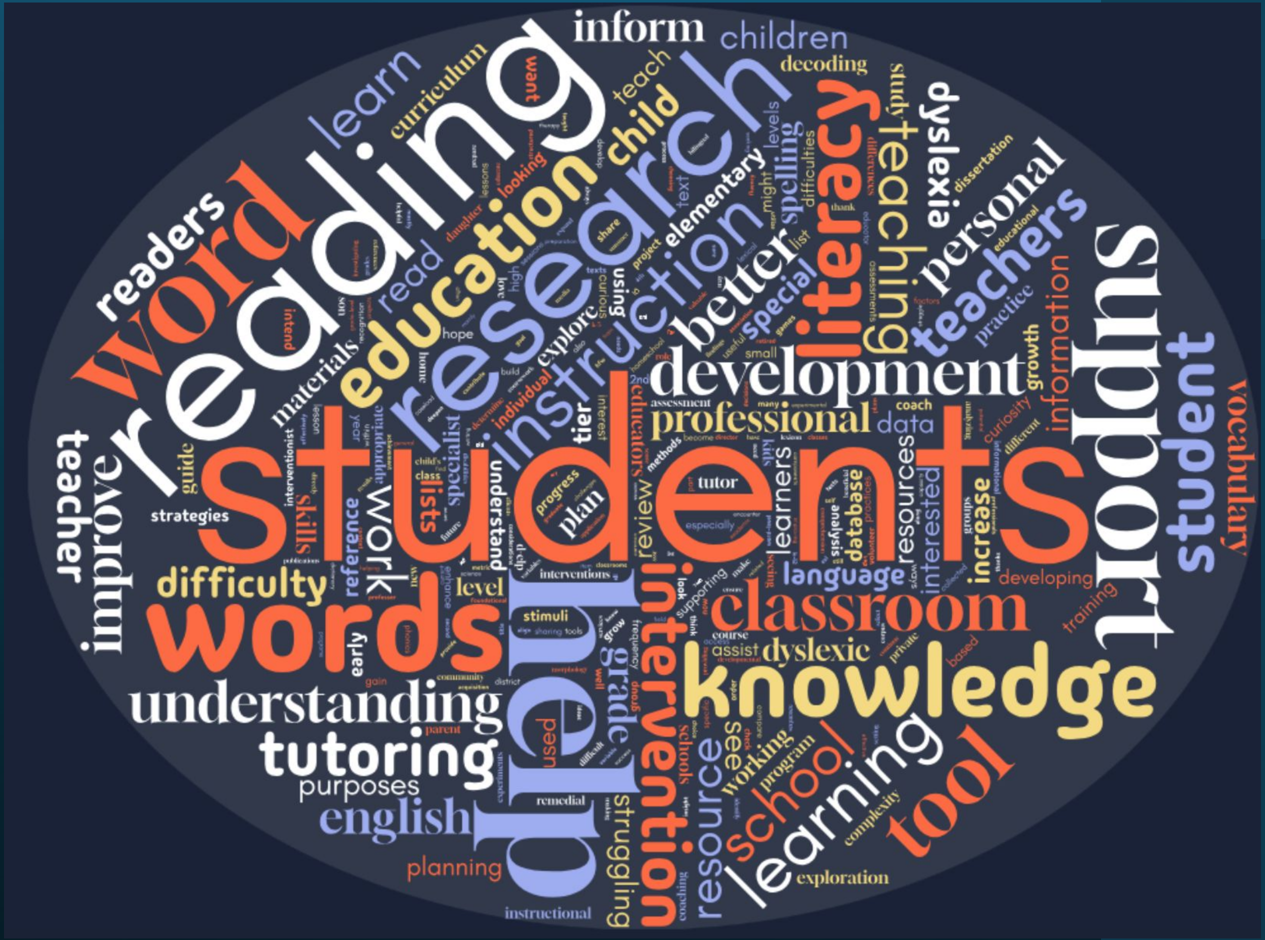


Register for the d-ELP at http://d-elp.org

Breakdown of Registrants



Location of Requestors (Sort of)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help
support
word
words
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development
instruction
intervention
literacy
education
teaching
classroom
learning
tool
school
understanding
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student
teachers
teacher
improve
difficulty
professional
personal
better
dyslexia
english
child
inform
children
learn
curriculum
readers
materials
vocabulary
resource
struggling
grade
planning
purposes
language
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spelling
elementary
special
explore
information
increase
interested
resources
data
practice
growth
learners
review
specialist
lists
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plan
progress
tutor
strategies
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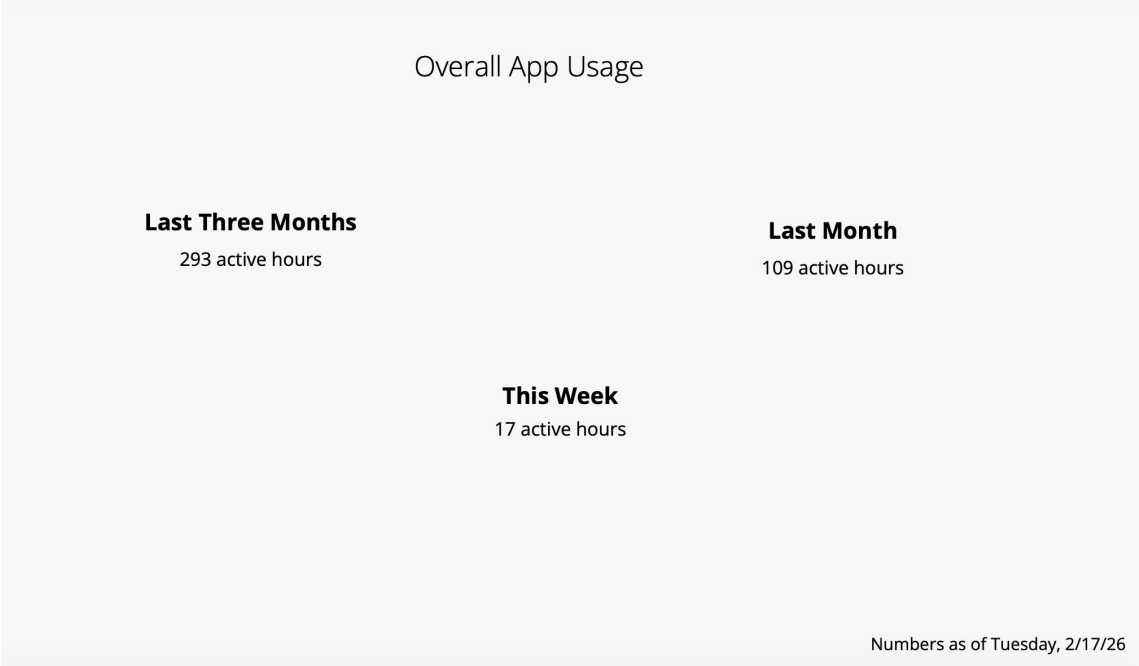
D-ELP Server Usage Data



developmental English Lexicon Project (d-ELP)

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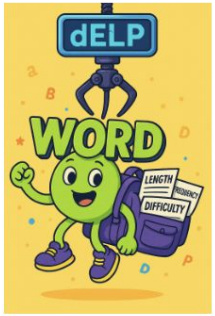
Description:

The developmental English Lexicon Project (d-ELP) is a searchable database comprising continuous IRT-based word reading difficulty estimates of 9,961 of the most frequently printed English words for US children, along with accompanying word-level properties. Data on isolated word reading accuracy were collected from children in grades 1-5 across multiple sites in the US. Across 1,907 children a total of 631,322 total responses were collected with the average child providing 336 responses. In addition to various word reading difficulty attributes, the d-ELP contains a wide range of word properties derived from various open-source databases.



How to use:

1. Searching for **Properties** associated with a **List of Words:**

    1. Select the **Query Tab**
    2. Type or paste the set of **Words** separated by a space in the text box.
    3. Select the **Word Properties** of interest from the various dropdown **Accordion Lists** (e.g., Word Difficulty).
    4. Click on the **Submit** button

The words with associated properties will populate on the right-hand side of the app. To download a copy as a CSV file select the **Download as CSV** button.

2. Searching for **Words** with **Associated Properties:**

    1. Select the **Filter Tab**
    2. Select the **Word Properties** of interest from the dropdown **Accordion Lists** (e.g., Word Difficulty)
    3. Select the **Filters** Accordion to refine the range of values of interest for each of the selected **Word Properties** by sliding the range bubbles for numeric values or typing in the text box for character variables.

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Looking at potential –ea words for a spelling assignment

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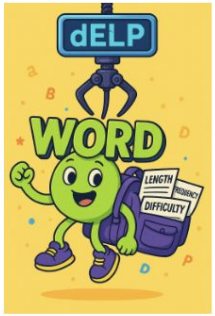

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2. Searching for **Words** with **Associated Properties:**

    1. Select the **Filter Tab**
    2. Select the **Word Properties** of interest from the dropdown **Accordion Lists** (e.g., Word Difficulty)
    3. Select the **Filters** Accordion to refine the range of values of interest for each of the selected **Word Properties** by sliding the range bubbles for numeric values or typing in the text box for character variables.

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Searching for **Words** wi th **Associate d Properties**

- 1. Select the **Filter Tab**
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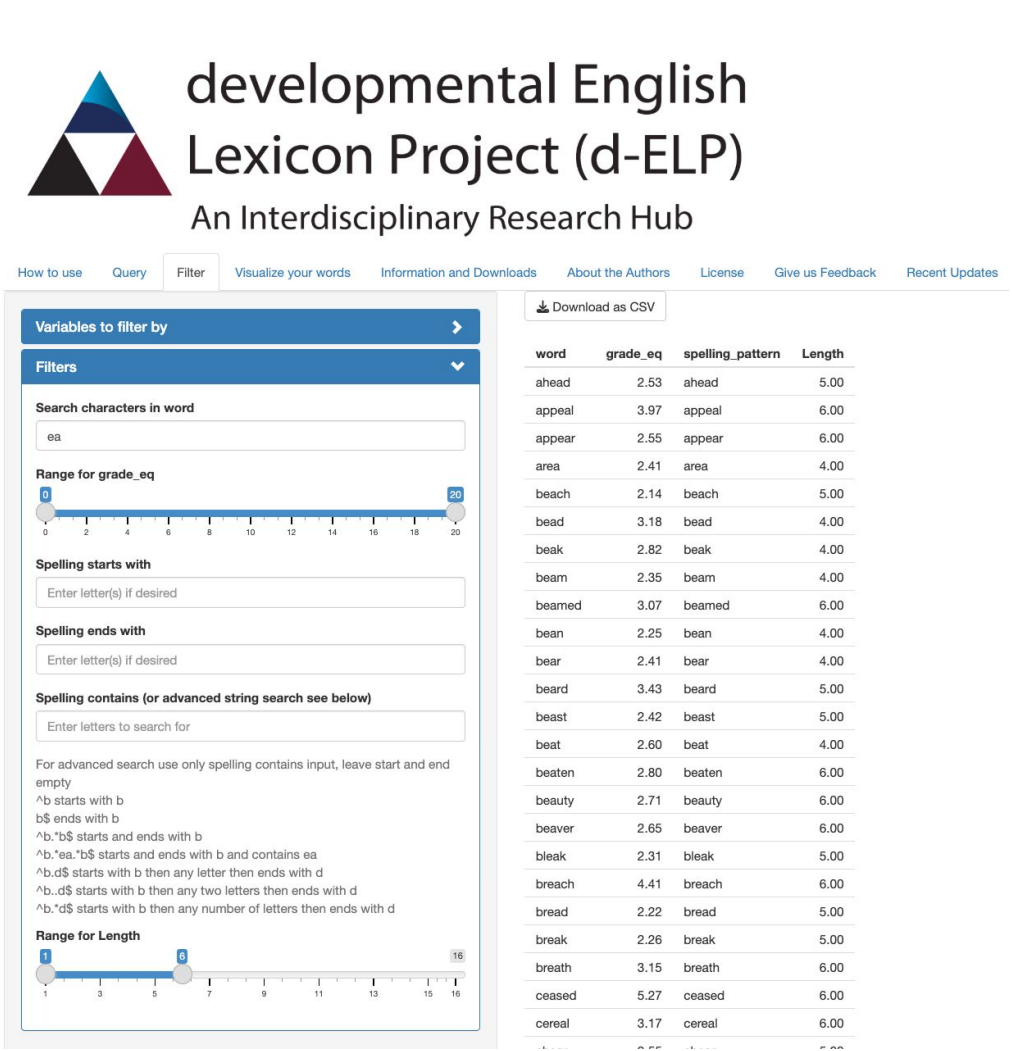
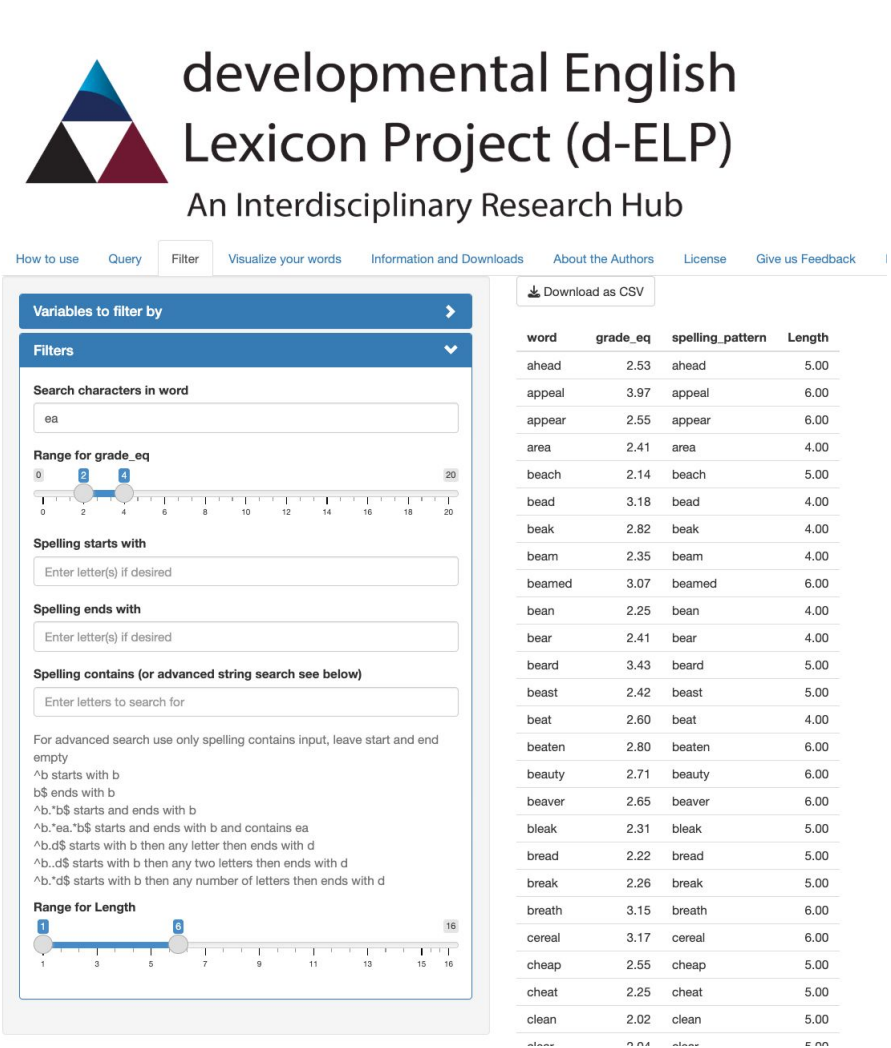
The words with associated properties will populate on the right-hand side of the app. To download a copy as a CSV file select the Download as CSV button.

Looking for all words with the –ea spelling pattern with 6 or fewer letters

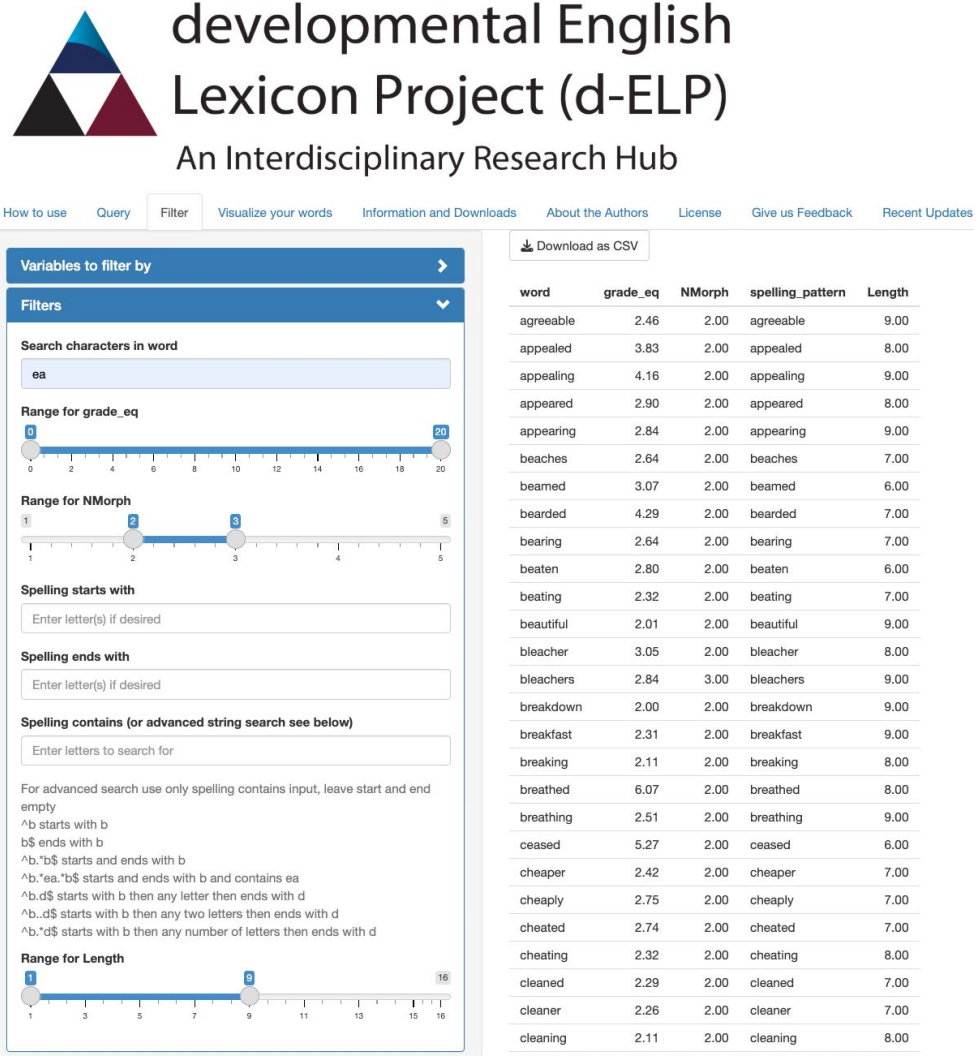


word	grade_eq	spelling_pattern	Length
ahead	2.53	ahead	5.00
appeal	3.97	appeal	6.00
appear	2.55	appear	6.00
area	2.41	area	4.00
beach	2.14	beach	5.00
bead	3.18	bead	4.00
beak	2.82	beak	4.00
beam	2.35	beam	4.00
beamed	3.07	beamed	6.00
bean	2.25	bean	4.00
bear	2.41	bear	4.00
beard	3.43	beard	5.00
beast	2.42	beast	5.00
beat	2.60	beat	4.00
beaten	2.80	beaten	6.00
beauty	2.71	beauty	6.00
beaver	2.65	beaver	6.00
bleak	2.31	bleak	5.00
breach	4.41	breach	6.00
bread	2.22	bread	5.00
break	2.26	break	5.00
breath	3.15	breath	6.00
ceased	5.27	ceased	6.00
cereal	3.17	cereal	6.00

Looking for all words with the –ea spelling pattern with 6 or fewer letters that have a Grade_EQ between 2 & 3

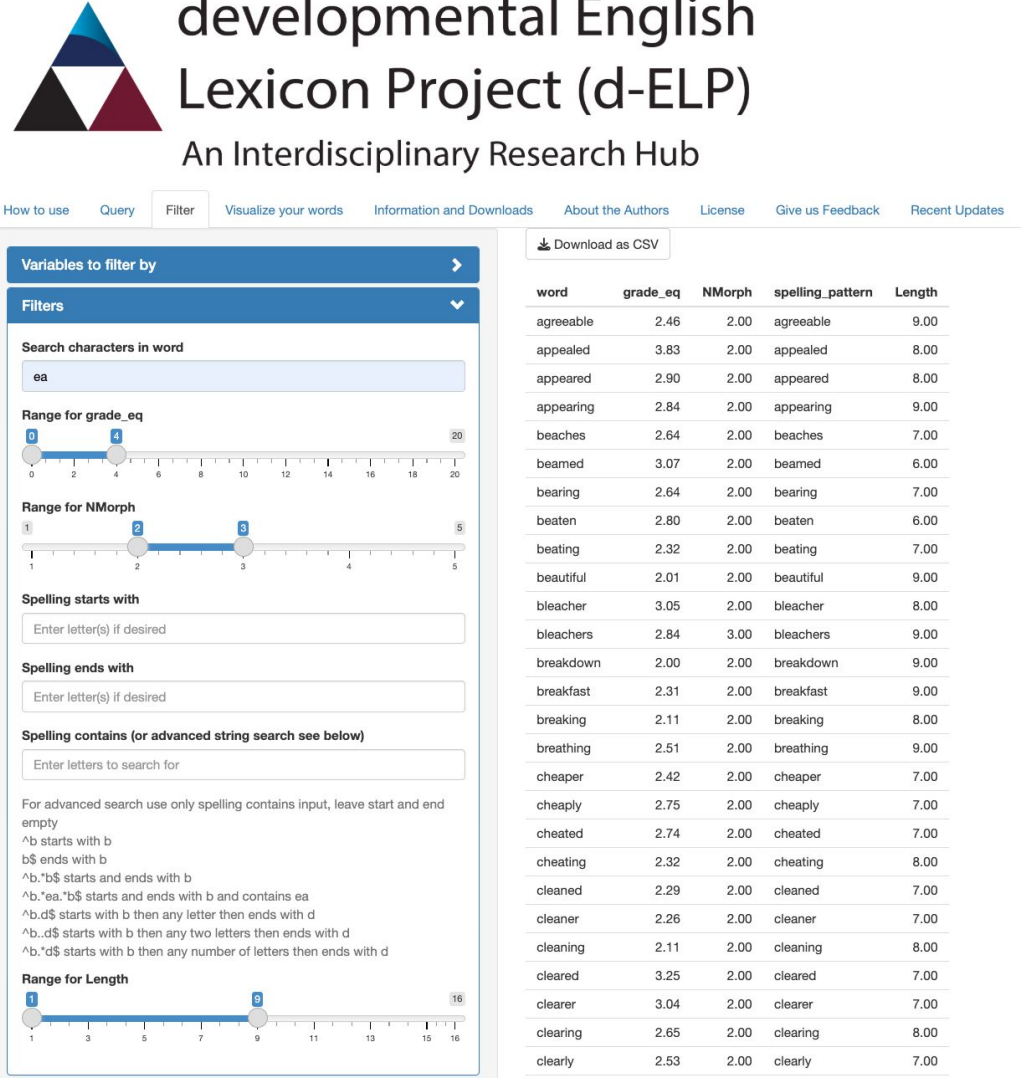


Looking for all words with the –ea spelling pattern with 9 or fewer letters that have 2-3 mporphemes



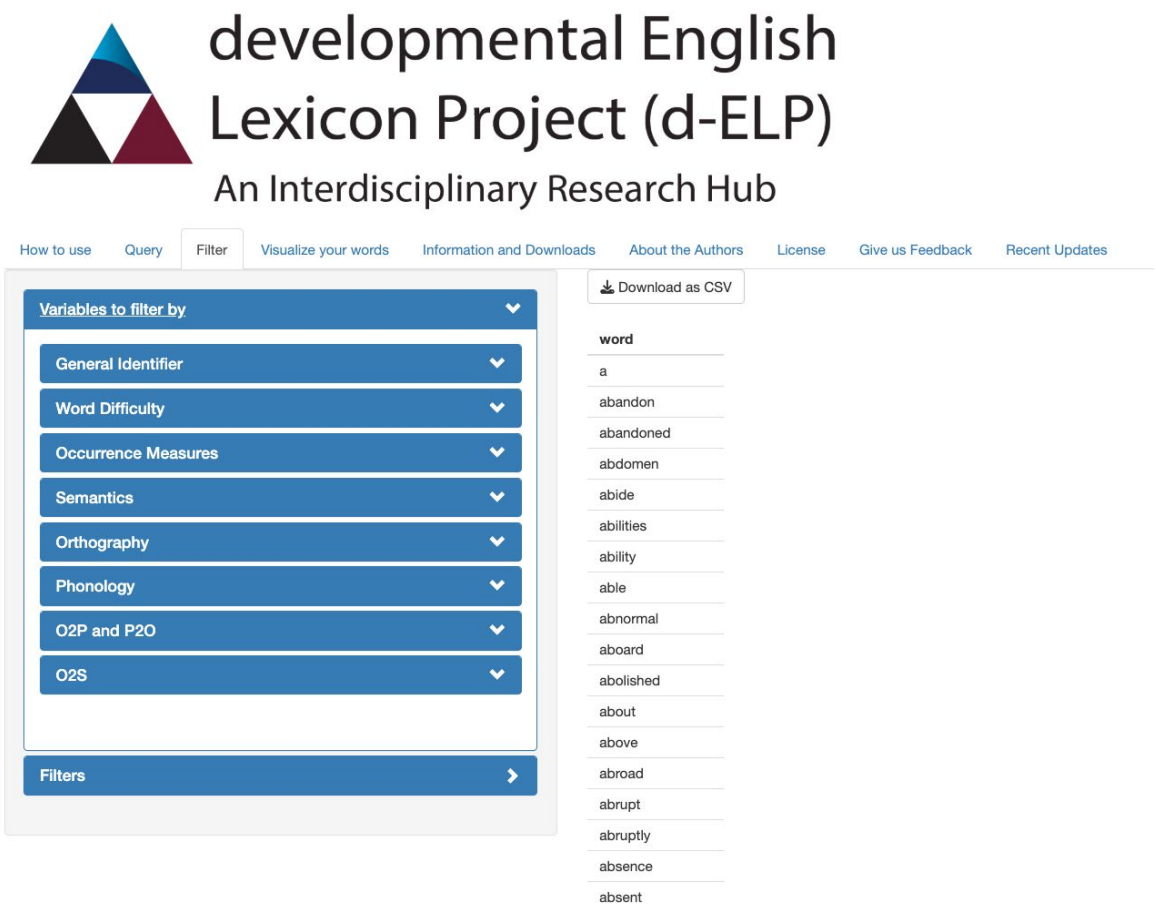
word	grade_eq	NMorph	spelling_pattern	Length
agreeable	2.46	2.00	agreeable	9.00
appealed	3.83	2.00	appealed	8.00
appealing	4.16	2.00	appealing	9.00
appeared	2.90	2.00	appeared	8.00
appearing	2.84	2.00	appearing	9.00
beaches	2.64	2.00	beaches	7.00
beamed	3.07	2.00	beamed	6.00
bearded	4.29	2.00	bearded	7.00
bearing	2.64	2.00	bearing	7.00
beaten	2.80	2.00	beaten	6.00
beating	2.32	2.00	beating	7.00
beautiful	2.01	2.00	beautiful	9.00
bleacher	3.05	2.00	bleacher	8.00
bleachers	2.84	3.00	bleachers	9.00
breakdown	2.00	2.00	breakdown	9.00
breakfast	2.31	2.00	breakfast	9.00
breaking	2.11	2.00	breaking	8.00
breathed	6.07	2.00	breathed	8.00
breathing	2.51	2.00	breathing	9.00
ceased	5.27	2.00	ceased	6.00
cheaper	2.42	2.00	cheaper	7.00
cheaply	2.75	2.00	cheaply	7.00
cheated	2.74	2.00	cheated	7.00
cheating	2.32	2.00	cheating	8.00
cleaned	2.29	2.00	cleaned	7.00
cleaner	2.26	2.00	cleaner	7.00
cleaning	2.11	2.00	cleaning	8.00

Looking for all words with the –ea spelling pattern with 9 or fewer letters that have 2-3 morphemes that have a Grade_EQ less than 4



word	grade_eq	NMorph	spelling_pattern	Length
agreeable	2.46	2.00	agreeable	9.00
appealed	3.83	2.00	appealed	8.00
appeared	2.90	2.00	appeared	8.00
appearing	2.84	2.00	appearing	9.00
beaches	2.64	2.00	beaches	7.00
beamed	3.07	2.00	beamed	6.00
bearing	2.64	2.00	bearing	7.00
beaten	2.80	2.00	beaten	6.00
beating	2.32	2.00	beating	7.00
beautiful	2.01	2.00	beautiful	9.00
bleacher	3.05	2.00	bleacher	8.00
bleachers	2.84	3.00	bleachers	9.00
breakdown	2.00	2.00	breakdown	9.00
breakfast	2.31	2.00	breakfast	9.00
breaking	2.11	2.00	breaking	8.00
breathing	2.51	2.00	breathing	9.00
cheaper	2.42	2.00	cheaper	7.00
cheaply	2.75	2.00	cheaply	7.00
cheated	2.74	2.00	cheated	7.00
cheating	2.32	2.00	cheating	8.00
cleaned	2.29	2.00	cleaned	7.00
cleaner	2.26	2.00	cleaner	7.00
cleaning	2.11	2.00	cleaning	8.00
cleared	3.25	2.00	cleared	7.00
clearer	3.04	2.00	clearer	7.00
clearing	2.65	2.00	clearing	8.00
clearly	2.53	2.00	clearly	7.00

The d-ELP is flexible in terms of searching for word properties



With each category having multiple dropdown **Accordion Lists**

Potential uses for the d-ELP

Teachers

- Develop lists of various difficulty levels containing words with instructionally relevant patterns to help place children in the right level of instruction (i.e., assess to inform instruction)
- Generate parallel word lists of equal difficulty for use as progress monitoring probes (e.g., CBM probes)
- Create words lists of a certain difficulty that stress important psycholinguistic properties of words that can be used for reading and spelling instruction.
- Isolate words of a particular reading grade level as raw materials for AI generated sentences and passages.
- Construct nonwords of various properties that can be used to test generalization of decoding skill learning.

Researchers

- Validation of newly developed and age-appropriate psycholinguistic variables,
- Sub-sampling of specific items to conduct “virtual experiments”
- Item selection for developmental, experimental, and individual differences studies.

Conclusions

- Children vary in their ability to learn to read words, with dyslexia children having substantial problems in learning to decode the writing system due to imprecise phoneme representations in the language system.
- Adding to the problem, English is a complicated orthography for beginning readers to learn, with opaque spelling-sound relations and complex syllable patterns.
- As word increase in length features such as syllable boundaries, word stress and vowel reduction, vowel pronunciation ambiguities, larger and more complex grapheme–phoneme units, and morphological complexity make words more difficult.
- We have created the d-ELP to help teachers and researcher to better select words on overall developmental difficulty and other word characteristics to better facilitate the word learning of children.

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developmental English Lexicon Project (d-ELP)

An Interdisciplinary Research Hub

Register for the d-ELP at http://d-elp.org

Thank You!

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Take the d-ELP Survey

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