Update on Language Arts Course: Using DELPH-IN Resources in Online Education

Dan Flickinger

Stanford University and

Redbird Advanced Learning

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Language Arts and Writing course

- Started in EPGY (Education Program for Gifted Youth) in 2003

- English Language Arts for grades 2–6

- Now used in classrooms in public schools (not only "gifted")

- Goal: to help students improve writing skills

- Automated exercise-based course with immediate feedback

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- NEW! EPGY now Redbird Advanced Learning as of last week

Course design

- Four "strands" in each grade

    Part of Speech

    Sentence Structure

    Paragraphs

    Sentence Composition

- Short lecture for each concept, plus 15-20 exercises

- Over 1,000 exercise sets

- Rate of progress determined by individual student performance

Exercise design for sentence composition

- Present a few sentences of context

- Ask a question

- Provide a set of (fully inflected) words, listed by part-of-speech

- Ask the student to compose an answer as a complete sentence

- Evaluate the answer, and if incorrect, identify error where possible

- Ask the student to try again once

An example from Grade 5

Abigail didn't want to go hiking with her parents because she felt too tired and wanted to rest instead.

Why didn't Abigail want to go hiking?

Sentence Composition

Write a complete sentence that answers the question by clicking on words from the lists.
To remove a word from your answer, click and drag it out of the box. Use RESET to remove all your words.

Abigail didn't want to go hiking with her parents because she felt too tired and wanted to rest instead.

Why didn't Abigail want to go hiking?

Verb	Preposition	Noun	Adjective	Pronoun	Conjunction	Contraction	Adverb
want	to	Abigail	tired	she	because	didn't	too
was		hike	hungry				
were			sick				
go							
hiking							
hike							

No answer

OK

Please select words from the word lists to write your answer.

RESET

Approach

- Use existing DELPH-IN resources (`www.delph-in.net`)

    English Resource Grammar (ERG: Flickinger 2000, 2011)

    Efficient PET parser (Callmeier 2000)

- Adapt 'mal-rule' approach to accept mild ungrammaticality

    Schneider & McCoy (1998), Bender et al. (2004)

- Parse each novel input and return derivation tree

- Check for `root_robust`, and if so, find `..._rbst` node

- Look up robustness symbol in error code table (grade-specific)

- Present appropriate message to student

An ungrammatical student answer

Ricky's toys are in closet
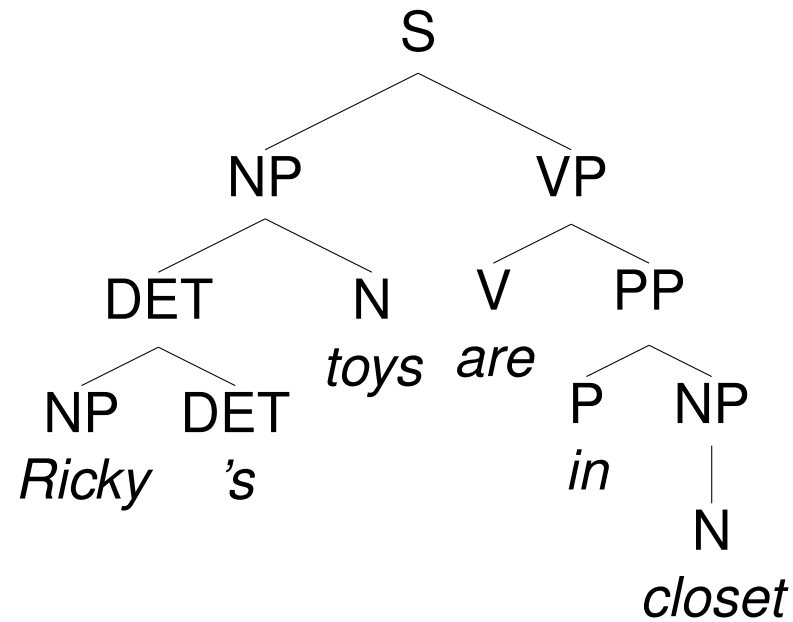
```
                    S
          ┌─────────┴─────────┐
         NP                   VP
      ┌───┴───┐            ┌───┴───┐
     DET       N          V        PP
   ┌──┴──┐    toys       are    ┌───┴───┐
  NP    DET                    P        NP
 Ricky   's                    in        |
                                         N
                                       closet
```

Example derivation

```
(sb-hd_mc_c [root_robust_s]
  (sp-hd_n_c
    (sp-hd_hc_c
      (hdn_bnp-pn_c
        (n_sg_ilr (ricky_n1/n_-_pn_le ("ricky" <0:1>))))
      (apostrophe_s_2_lex/n_-_cl-poss_le ("'s" <1:2>)))
    (n_pl_olr (toy_n1/n_-_c_le ("toys" <2:3>))))
  (hd-cmp_u_c
    (be_c_are/v_prd_are_le ("are" <3:4>))
    (hd-cmp_u_c
      (in/p_np_i-reg_le ("in" <4:5>))
      (bare_np_sg_rbst
        (n_sg_ilr (closet_n1/n_-_c_le ("closet" <5:6>)))))))))
```

Example derivation

```
(sb-hd_mc_c [ root_robust_s]
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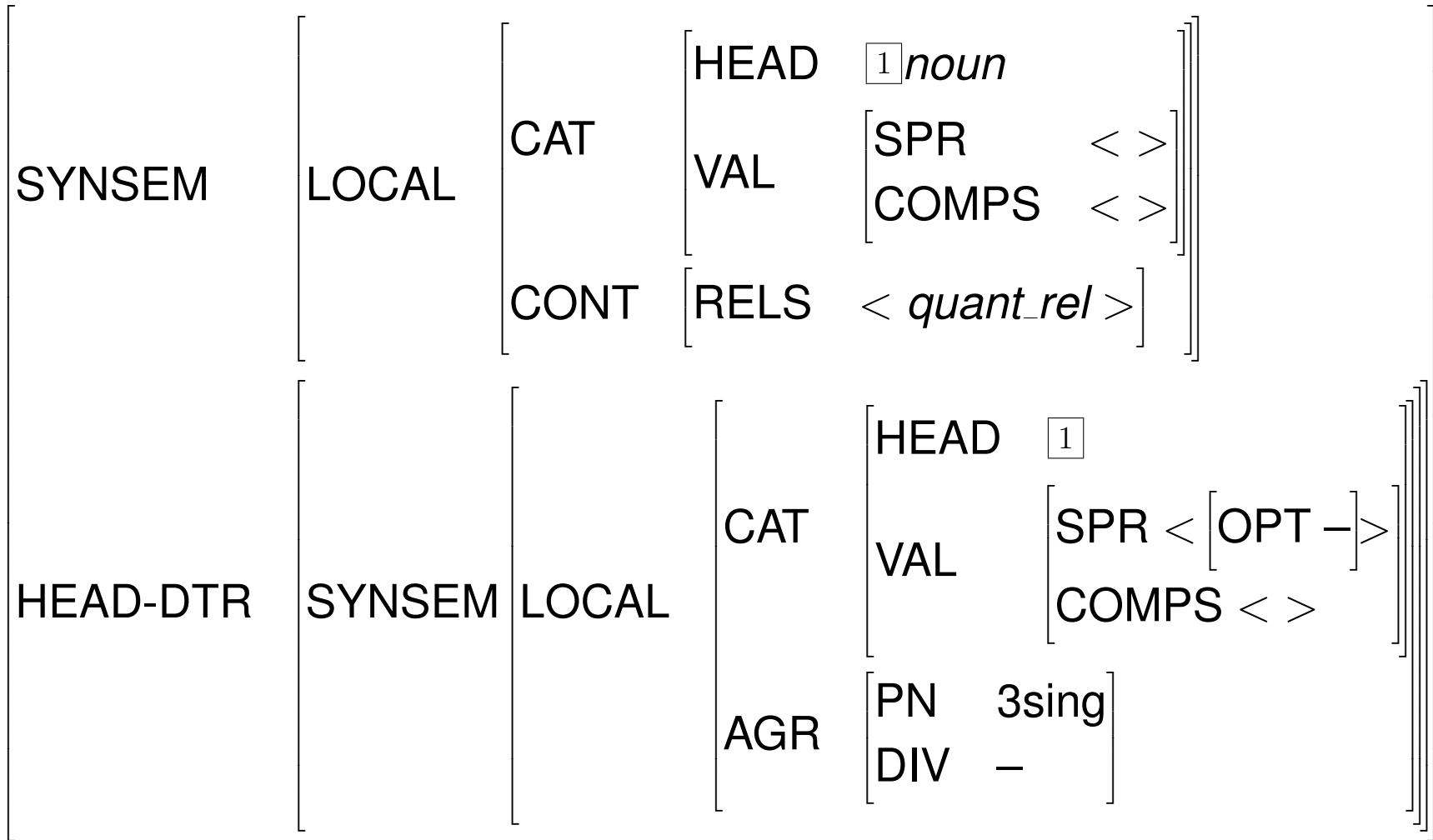
Mal-rule example: bare_np_sg_rbst

$$
\begin{bmatrix}
\text{SYNSEM} & \begin{bmatrix} \text{LOCAL} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1}\,noun \\ \text{VAL} & \begin{bmatrix} \text{SPR} & <\ > \\ \text{COMPS} & <\ > \end{bmatrix} \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{RELS} & <\ quant\_rel\ > \end{bmatrix} \end{bmatrix} \end{bmatrix} \\[4em]
\text{HEAD-DTR} & \begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{LOCAL} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{VAL} & \begin{bmatrix} \text{SPR} < \begin{bmatrix} \text{OPT} - \end{bmatrix} > \\ \text{COMPS} < \ > \end{bmatrix} \end{bmatrix} \\ \text{AGR} & \begin{bmatrix} \text{PN} & 3sing \\ \text{DIV} & - \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}
\end{bmatrix}
$$

Sample error messages

Your answer is not grammatical.	*He are be was dog*
Your answer is not a complete sentence.	*In the park*
Your answer is grammatical but awkward.	*They saw in the lake a duck*
Your answer cannot be a question.	*Did she go to the beach*
You are missing an article before the word $X.	*She went to house*
Remember to use "an" only before a vowel.	*He ate an sandwich*
Don't use "a" before a vowel.	*She saw a owl*
Don't put "the" before a name.	*The Katherine eats breakfast*
You are missing the preposition "on" before $X.	*They watched movies Tuesday*
You are missing "to" before $X.	*She told her brother borrow her book*
Don't put "to" before $X.	*She let her brother to borrow her book*
The verb $X needs an object.	*She let borrow her book*
You are missing a noun.	*His chased the cat*
You have an extra noun in your answer.	*The children ate a lunch pizza*
Use an adverb like "well" or "poorly" instead of "bad".	*He did bad on his test*
Use "its" instead of "it's" to show ownership.	*The dog is in it's house*
Remember to use "this" only before a singular noun.	*He said he like this mittens*
Don't use "did/does/do" in your answer.	*The dog did go for a walk*
You have the wrong form of the verb.	*The boy be late for school*
Your subject doesn't agree with the verb $X.	*Alex write a letter*

Composing Your Narrative Paragraph

You have two tries to write your sentence. Click "Period" to end the sentence. When you are finished writing, click "Next Exercise".

Imagine that you went to the park last Saturday. Write a narrative paragraph to describe how you spent your day and whether you had a good time.

Reset		Period		Next Exercise

Basic Words			Modifiers		Nouns		Verb	
,	I	we	boring	warm	book	rain	eat	were
a	it	when	cold		brother	Saturday	enjoyed	
all	my	with	fun		day	slides	felt	
an	next		good		friends	snacks	had	
and	of		great		game	time	played	
at	on		last		grass		raced	
down	other		rainy		hide-and-seek		read	
each	the		really		mom		sat	
finally	there		sunny		monkey bars		slid	
first	to		tired		park		was	

Some sample student paragraphs

20120312211040	I went to beach with my family yesterday.
20120312211101	I went to the beach with my family yesterday.
20120312211224	At the beach we made sandcastles.
20120312211339	We went swimming in the ocean.
20120312211429	We read books at the beach.
20120312211546	I had a fun time at the beach.

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20120322082558	Dinosaurs dinosaurs dinosaurs.
20120322082628	Pictures pictures pictures books bus.
20120322082644	Books books books.

Evaluation of Student Writing in LA&W

Sentences composed by 29,000 students in 2010-2012:

	Correct (stored)	Incorrect (stored)	New	All
Total	3,390.850	691,021	1,977,932	6,059,803
	56.0%	11.4%	32.6%	
Analyzed with ERG			Correct: 574,312 Incorrect: 1,358,411	

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Paragraphs composed by students since 2012:

40,000 in Grade 3

15,000 in Grade 6

5,000 in Grades 4 and 5

Language Arts 2-Year Analysis

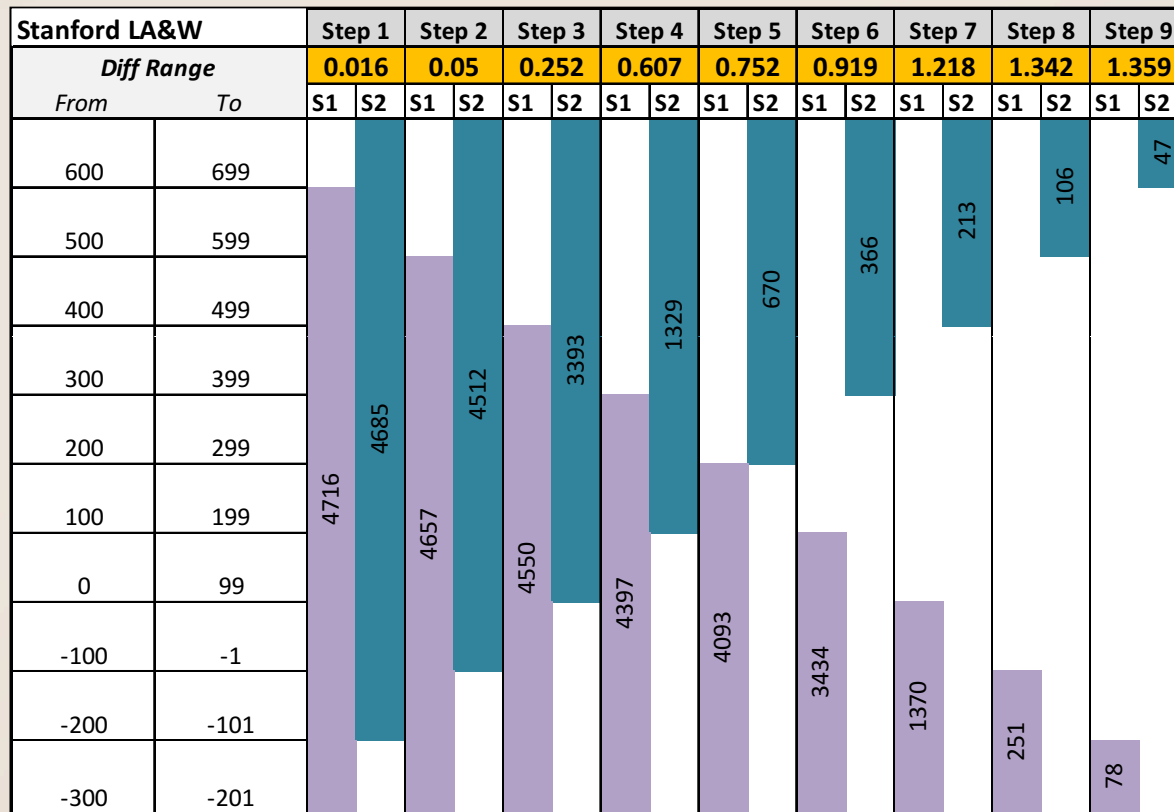| Diff Range		Changes in scaled scores TCAP ELA 2009 to 2011					
From	To	600-650	650-699	700-749	750-799	800-849	Total N
600	699			22 21.6	25 20.0		47
500	599			36 20.7	23 16.0		59
400	499			64 14.7	43 16.1		107
300	399			93 14.5	60 21.8		153
200	299			215 13.2	89 13.8		304
100	199		49 12.5	403 8.6	207 12.4		659
0	99		269 -0.1	1231 -0.9	525 -0.8	39 -3.2	2064
-100	-1	22 21.0	290 -12.9	686 -16.2	121 -17.0		1119
-200	-101			74 -12.0	99 -21.9		173
-300	-201			34 -6.8	44 -17.2		78

- Total 4,763 students used the course in both years
- Categorized by 2009 TCAP ELA score
- Mean change in score between 2009 and 2011 TCAP
- Gains are green, losses are red
- Students with Diff over 100 averaged gains on TCAP
- Difference of over 38 points between top and bottom of Diff range

Language Arts 2-Year A...

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- To
  us
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- Ca
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- M
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  an
- Ga
  los
- St

Effects of More or Less Student Work in the Stanford Language Arts (LA&W) Course

Stanford LA&W		Step 1		Step 2		Step 3		Step 4		Step 5		Step 6		Step 7		Step 8		Step 9	
Diff Range		**0.016**		**0.05**		**0.252**		**0.607**		**0.752**		**0.919**		**1.218**		**1.342**		**1.359**	
From	*To*	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
600	699		4685															106		47
500	599	4716		4512			3393		1329		670		366		213				
400	499					4550													
300	399			4657				4397											
200	299									4093									
100	199											3434							
0	99													1370					
-100	-1															251			
-200	-101																	78	
-300	-201																		

LEGEND

Less work
Number of students

More Work
Number of students

- The effect size was calculated between the ranges of quality work measured by *Diff*

- All students with TCAP scores who used Stanford LA&W in 2009-10 and 2010-11

- Effect size is strong for students who had more than 300 *Diff* in the 2-year period

Stanford LA&W Effect Size by Step (Step = 100 Diff)
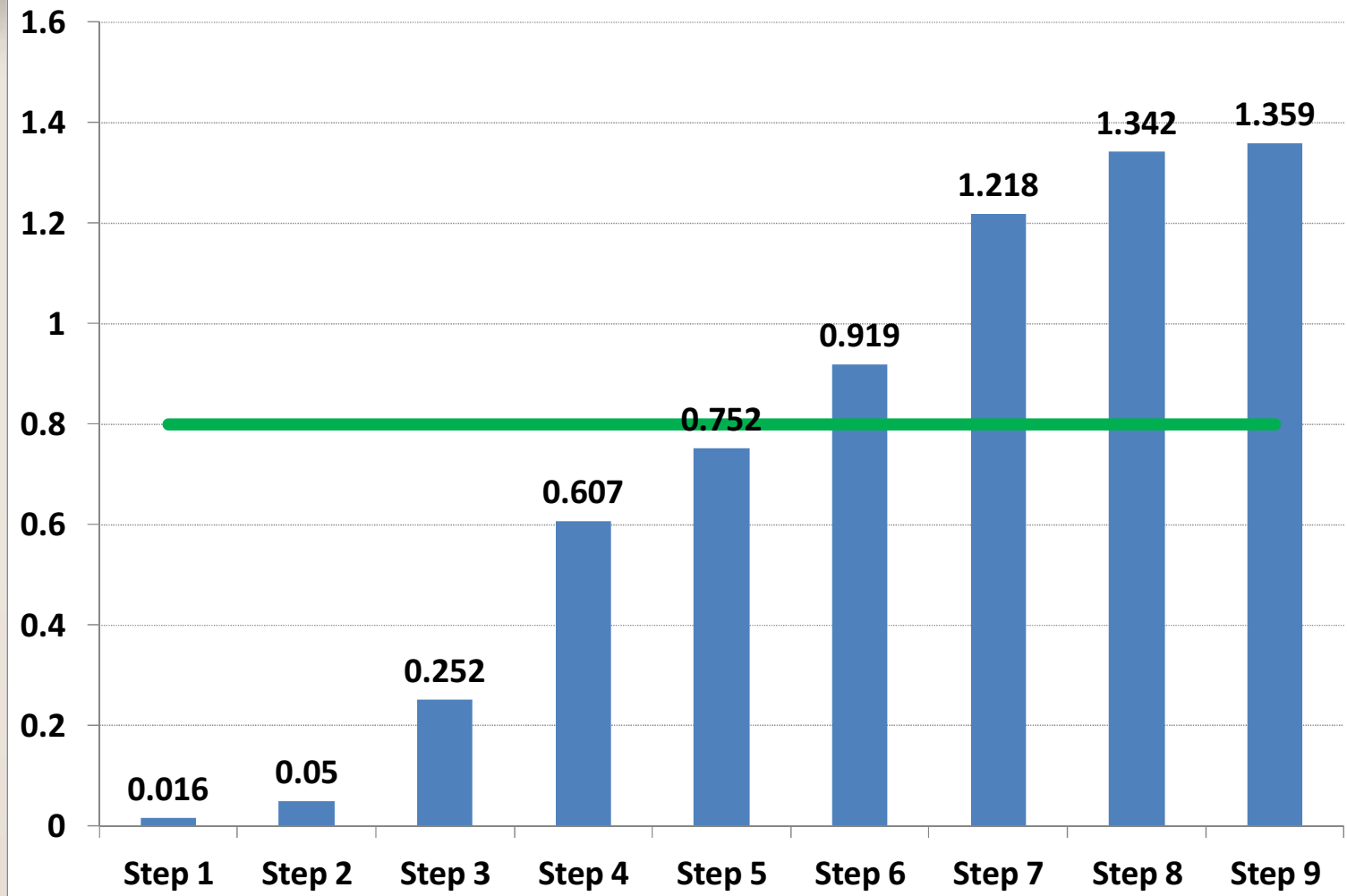
Challenges and next steps

- Disambiguation – Need to add robust sentences to treebank

- Semantic error detection – Add paraphrase and anaphora rules

- Short essay composition – Allow open vocabulary

- Errors of style – Formalize Gricean rules

Effect size

The *effect size* is the standardized mean difference between two groups A and B:

$$\text{effect size} = \frac{\text{[mean of group A]} - \text{[mean of group B]}}{\text{standard deviation}}$$

- It quantifies the size of the difference between the two groups.

- For example, an effect size of 1.2 means that the score of the average person in group A is 1.2 standard deviations above the average person in group B.

- An effect size of 0.8 or greater is viewed as *strong*.

Effects of More or Less Student W... Stanford Language Arts (LA&W...

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600	699																106		47
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0	99							4397		93									

- T... c... t... q... n...
- A... T... u... L... a...