Using the ERG and DELPH-IN Tools for Online Education

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DELPH-IN Summit, Sofia

July 4, 2012

Language Arts and Writing in EPGY curriculum

- EPGY (Education Program for Gifted Youth) at Stanford

- LA&W 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

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 3

Colin and Miguel enjoy eating spaghetti with meat sauce.
What do Colin and Miguel like to eat?

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.

Colin and Miguel enjoy eating spaghetti with meat sauce.

What do Colin and Miguel like to eat?

Noun	Preposition	Pronoun	Verb
fork	to	he	eat
sandwich		them	like
spaghetti		they	sings

reset   ok

Approach

- Use existing DELPH-IN resources
    - ERG adapted for grammar checking
    - PET parser

- Adapt 'mal-rule' approach to accept mild ungrammaticality
    - Schneider & McCoy (1998), Bender et al. (2004)
    - Addition of *masking* for some lexical entries and rules

- 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

Changes to ERG for grammar-checking

Extensions

- **Mal-rules** for inflection, syntax

  e.g. bare singular NP, or bare 3sg-present verb

- **Mal-types** for lexicon

  e.g. subj-equi with base VP: *Ricky likes go to the park*

Reductions to avoid some ambiguity

- Rules

  For example, block noun-noun compound rules

  *Ricky's **closet toys** are in the closet*

- Lexicon

  For example, block the verb *flower*

  *Art and science **flowered** during the 17th century.*

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>)))))))))
```

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

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

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?

She was tired.

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?

She was tired.
She was too tired.

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?

She was tired.
She was too tired.
She was too tired to.

An example from Grade 5

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She was too tired to.
She was too tired to go.
She was too tired to hike.
She was too tired to go hike.
She was too tired to go hiking.
She didn't because she was too tired.

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She was too tired to go hiking.
She didn't because she was too tired.
She didn't want to because she was too tired.
She didn't want to go because she was too tired.
She didn't want to hike because she was too tired.
She didn't want to go hike because she was too tired..

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She didn't because she was too tired.
She didn't want to because she was too tired.
She didn't want to go because she was too tired.
She didn't want to hike because she was too tired.
She didn't want to go hike because she was too tired..
She didn't want to go hiking because she was too tired.

More variants

She **didn't** because she was tired.
She didn't because she was too tired to.
She didn't because she was too tired to go.
She didn't because she was too tired to go hike.
She didn't because she was too tired to go hiking.
She didn't because she was too tired to hike.
She didn't **want to** because she was tired.
She didn't want to because she was too tired to.
She didn't want to because she was too tired to go.
She didn't want to because she was too tired to go hike.
She didn't want to because she was too tired to go hiking.
She didn't want to because she was too tired to hike.
She didn't **want to go** because she was tired.
She didn't want to go because she was too tired to.
She didn't want to go because she was too tired to hike.
She didn't want to go because she was too tired to go hike.
She didn't want to go because she was too tired to go hiking.
She didn't want to go because she was too tired to hike.
She didn't want **to go hike** because she was tired.
She didn't want to go hike because she was too tired to.
She didn't want to go hike because she was too tired to go.
She didn't want to go hike because she was too tired to go hike.
She didn't want to go hike because she was too tired to go hiking.
She didn't want to go hike because she was too tired to hike.
She didn't want **to go hiking** because she was tired.
She didn't want to go hiking because she was too tired to.
She didn't want to go hiking because she was too tired to go.
She didn't want to go hiking because she was too tired to go hike.
She didn't want to go hiking because she was too tired to go hiking.
She didn't want to go hiking because she was too tired to hike.
She didn't want **to hike** because she was tired.
She didn't want to hike because she was too tired to.
She didn't want to hike because she was too tired to go.
She didn't want to hike because she was too tired to go hike.
She didn't want to hike because she was too tired to go hiking.
She didn't want to hike because she was too tired to hike.

And more variants

She didn't because she was tired.
She didn't because she was too tired to.
She didn't because she was too tired to go.
She didn't because she was too tired to go hike.
She didn't because she was too tired to go hiking.
She didn't because she was too tired to hike.
She didn't want to because she was tired.
She didn't want to because she was too tired to.
She didn't want to because she was too tired to go.
She didn't want to because she was too tired to go hike.
She didn't want to because she was too tired to go hiking.
She didn't want to because she was too tired to hike.
She didn't want to go because she was tired.
She didn't want to go because she was too tired to.
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Abigail didn't because she was tired.
Abigail didn't because she was too tired to.
Abigail didn't because she was too tired to go.
Abigail didn't because she was too tired to go hike.
Abigail didn't because she was too tired to go hiking.
Abigail didn't because she was too tired to hike.
Abigail didn't want to because she was tired.
Abigail didn't want to because she was too tired to.
Abigail didn't want to because she was too tired to go.
Abigail didn't want to because she was too tired to go hike.
Abigail didn't want to because she was too tired to go hiking.
Abigail didn't want to because she was too tired to hike.
Abigail didn't want to go because she was tired.
Abigail didn't want to go because she was too tired to.
Abigail didn't want to go because she was too tired to hike.
Abigail didn't want to go because she was too tired to go hike.
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Abigail didn't want to hike because she was too tired to.
Abigail didn't want to hike because she was too tired to go.
Abigail didn't want to hike because she was too tired to go hike.
Abigail didn't want to hike because she was too tired to go hiking.
Abigail didn't want to hike because she was too tired to hike.

And still more variants

Because she was tired, she didn't.
Because she was too tired to, she didn't.
Because she was too tired to go, she didn't.
Because she was too tired to go hike, she didn't.
Because she was too tired to go hiking, she didn't.
Because she was too tired to hike, she didn't.
Because she was tired, she didn't want to.
Because she was too tired to, she didn't want to.
Because she was too tired to go, she didn't want to.
Because she was too tired to go hike, she didn't want to.
Because she was too tired to go hiking, she didn't want to.
Because she was too tired to hike, she didn't want to.
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Because Abigail was too tired to hike, she didn't want to hike.

And even more variants

Because she was tired, **Abigail** didn't.
Because she was too tired to, Abigail didn't.
Because she was too tired to go, Abigail didn't.
Because she was too tired to go hike, Abigail didn't.
Because she was too tired to go hiking, Abigail didn't.
Because she was too tired to hike, Abigail didn't.
Because she was tired, Abigail didn't want to.
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Because Abigail was too tired to hike, Abigail didn't want to hike.

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 Paragraphs

- Accept and evaluate input sentence by sentence

- Initially ignore any supra-sentential attributes

- For Grade 3, provide full word list per exercise; click only

- For Grade 6, provide open-class word list; allow typed input

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	

Evaluation of Student Writing in Memphis

Sentences composed by 29,000 students in 2010 and 2011:

	Correct (stored)	Incorrect (stored)	New	All
Total	2,295,013	510,476	1,386,864	4,192,353
	54.7%	12.2%	33.1%	
Analyzed			Correct: 287,198 Incorrect: 732,856	

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	54.7%	12.2%	33.1%	
Analyzed			Correct: 287,198 Incorrect: 732,856	

Paragraphs composed by 1,900 students in spring of 2012:

19,678

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.

Some sample student paragraphs

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

20120501052750	Me and my friends went ice-skating.
20120501052907	I went ice-skating.
20120501052932	At first I fell.
20120501053318	Then I held on to my friend.
20120501053512	To the middle of the ice.
20120501053638	Then I let go then was ice-skating.

Some sample student paragraphs

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

Some sample student paragraphs

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

20120318111847 Suddenly I learned how to ride my bike.
20120318112127 I first pedaled and pedaled.
20120318112240 Then I proudly pedaled.
20120318112343 Finally I pedaled around happy.

Some sample student paragraphs

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

20120318111847   Suddenly I learned how to ride my bike.
20120318112127   I first pedaled and pedaled.
20120318112240   Then I proudly pedaled.
20120318112343   Finally I pedaled around happy.

20120322192141   I enjoyed the petting zoo.
20120322192255   There were piglets, lambs, and a rabbit.
20120322192531   I tickled the cute, fuzzy, and friendly rabbit as my
little sister petted some piglets.
20120322192957   I petted some piglets and ate some pellets.
20120322193101   I had a really fun trip to the petting zoo.

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.

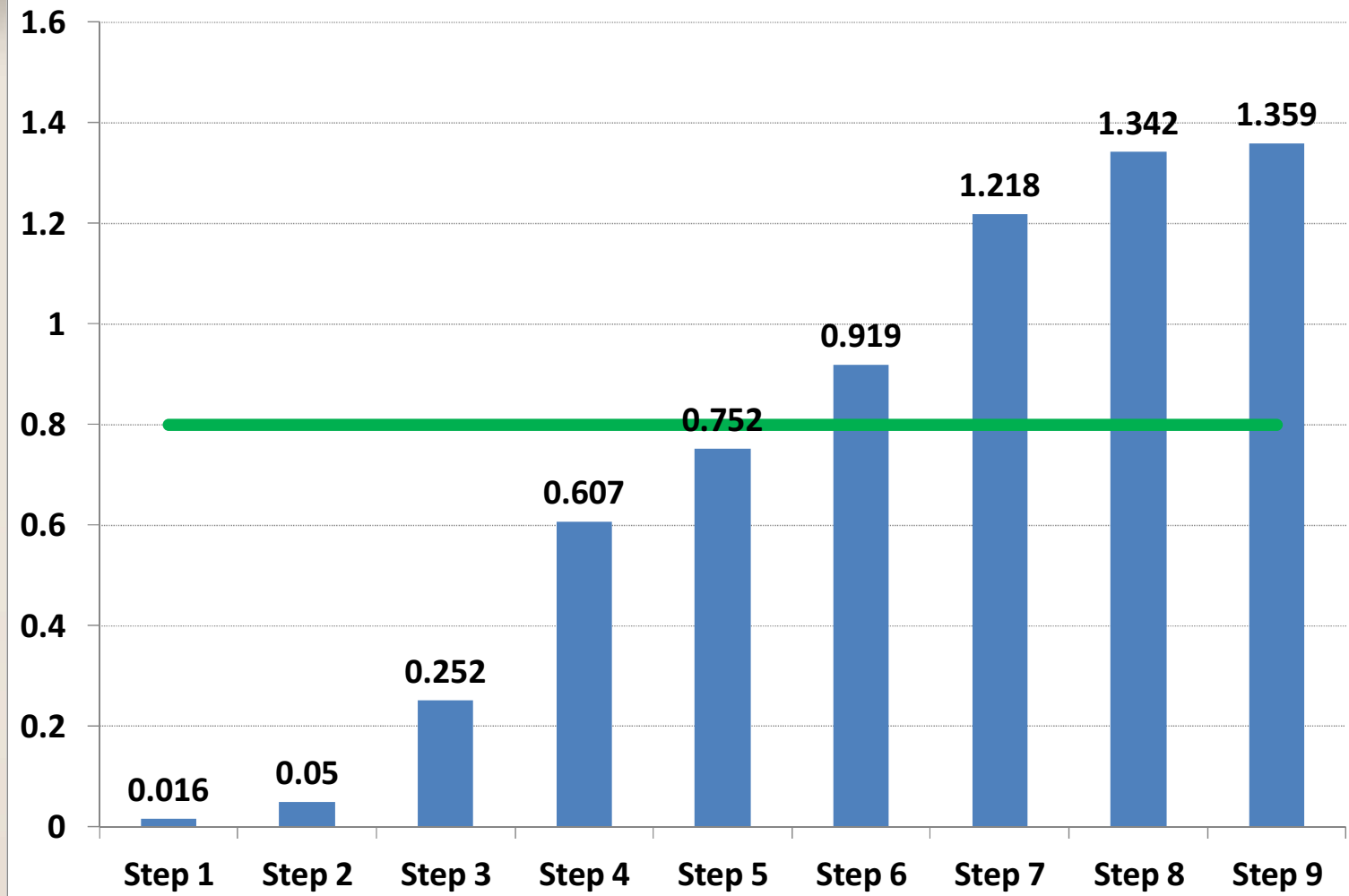- An effect size of 0.8 or greater is viewed as *strong*.

Language Arts 2-Year Analysis

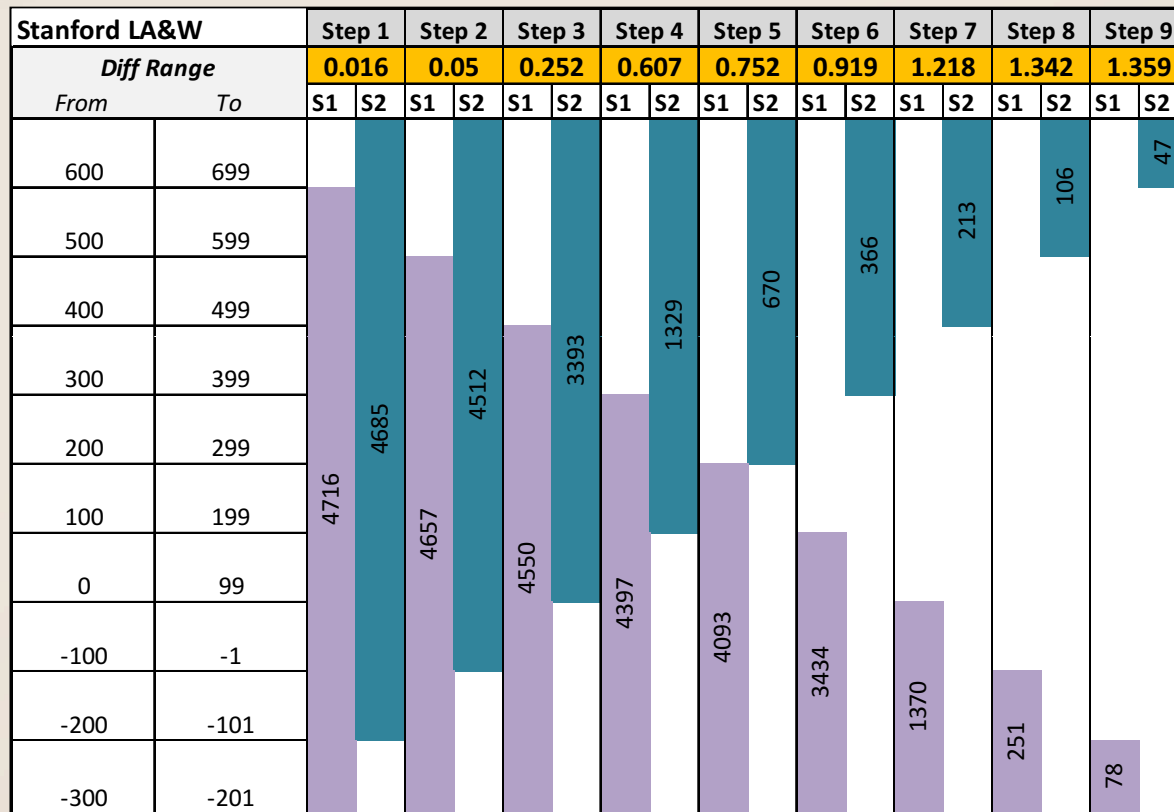| Diff Range From	Diff Range To	Changes in scaled scores TCAP ELA 2009 to 2011					
		600-650	650-699	700-749	750-799	800-849	Total N
600	699			22 / 21.6	25 / 20.0		47
500	599			36 / 20.7	23 / 16.0		59
400	499			64 / 14.7	43 / 16.1		107
300	399			93 / 14.5	60 / 21.8		153
200	299			215 / 13.2	89 / 13.8		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

Stanford LA&W Effect Size by Step (Step = 100 Diff)

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																106		47
500	599												366		213				
400	499										670								
300	399		4685		4512		3393		1329										
200	299	4716																	
100	199			4657															
0	99					4550		4397		4093				1370					
-100	-1											3434				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