Driving Data Dialogue

Engaging staff with visualisation of school analytics

Ben Hicks Oxley College

1. Why?
2. Cognition and Design
3. Measuring Impact
4. Enabling Dialogue
5. Pitfalls

What was observed by us…with the aid of the spyglass, may be observed so well that all the disputes that for so many generations have vexed philosophers are destroyed by visible certainty, and we are liberated from wordy arguments.

Galileo Galilei – from *Starry Messenger*

I hope you will get out of today:

- strategies for engaging staff in talking about data
- theories and principles of effective data visualisation
- an idea of some of the pitfalls of preparing data to be seen

1. Why?

Why collect, visualise and share data?

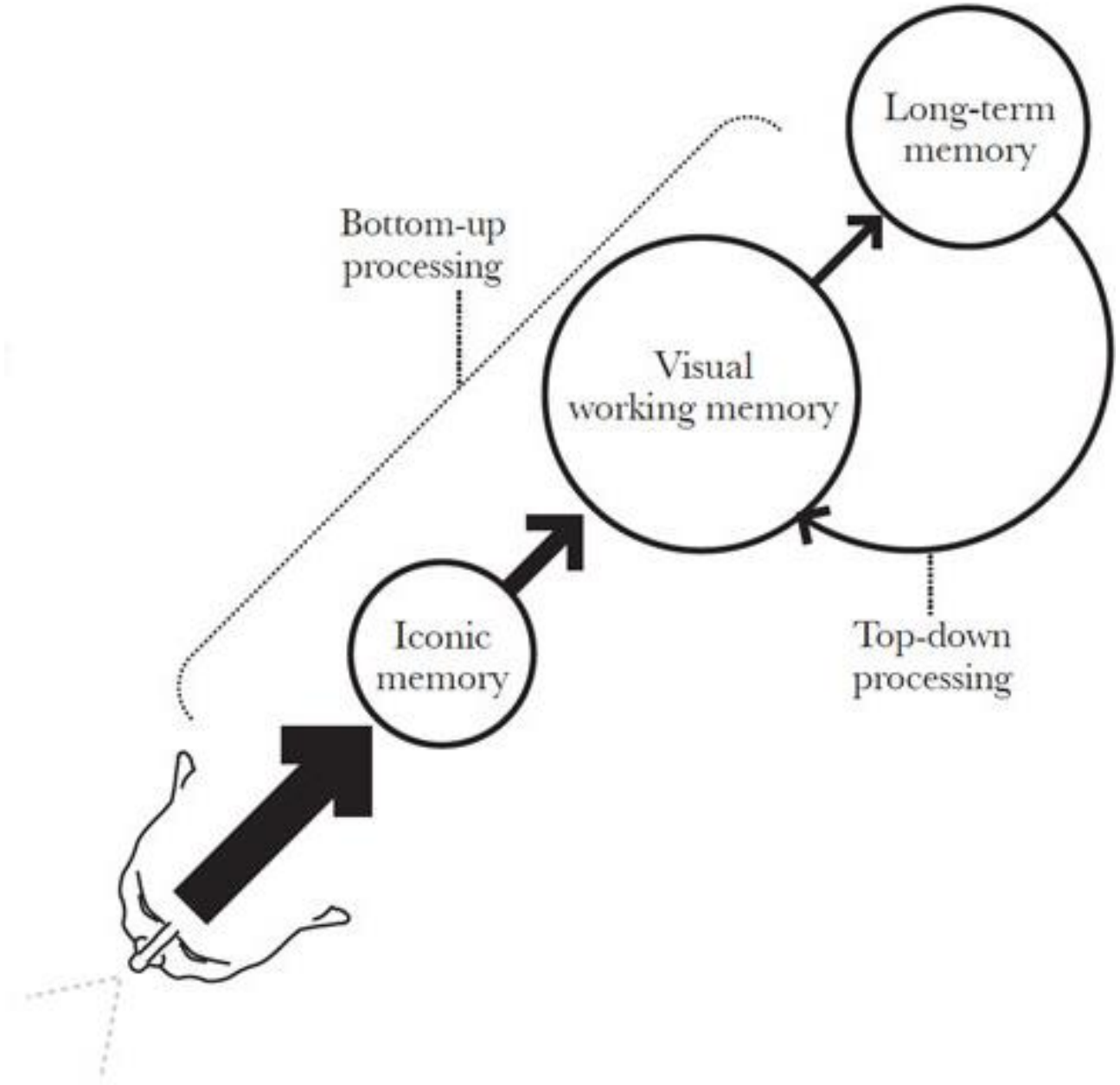
- To find truth, and then learn from it.
- Schools are already data rich, and we often don’t use it well.
- Helping people engage with data helps broaden the conversation.


SCHOOL REFLECTS ON PROGRESS & MAKEs MOST EFFECTIVE CHANGES
STIMULATE EFFECTIVE DISCUSSION
STAFF MEANINGFULLY ENGAGE WITH DATA
SHOW DON'T TELL – ALLOW STAFF TO DRAW LOGICAL CONCLUSIONS
VALIDATE STAFF KNOWLEDGE & CAPACITY
ANALYSE & VISUALISE
GATHERING DATA

2. Cognition and Design

Everything I have learned so far (thanks to Edward Tufte, Alberto Cairo, Andy Kirk, many R-bloggers and my own mistakes)

1. Vision is fast, reason is slow
2. Visualisation happens in the mind



Pictures from
The Functional Art,
pages 120 and 138

A. Cairo (2013)

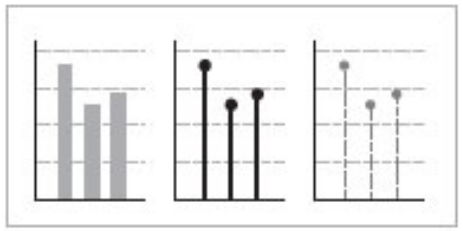
2. Cognition and Design

Everything I have learned so far (thanks to Edward Tufte, Alberto Cairo, Andy Kirk, many R-bloggers and my own mistakes)

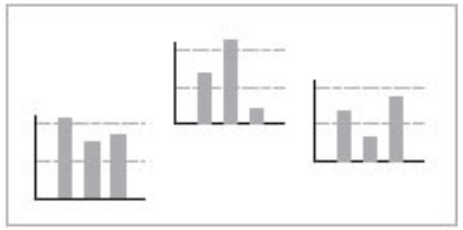
1. Vision is fast, reason is slow
2. Visualisation happens in the mind
3. The first thought should be ‘what does that mean?’ not ‘how did they do that?’
4. Assist the viewers cognitive task in viewing evidence

Allows more accurate comparisons

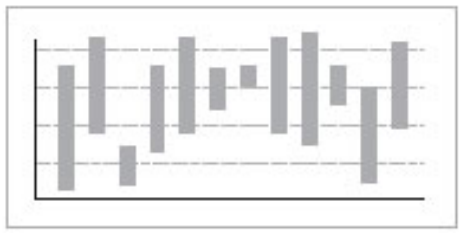
Allows more generic judgements



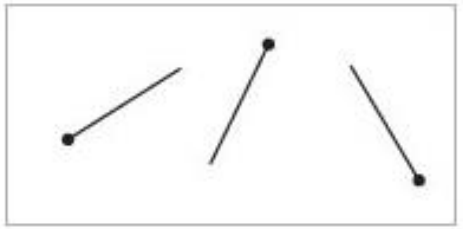
Position along a common scale



Position along nonaligned scales

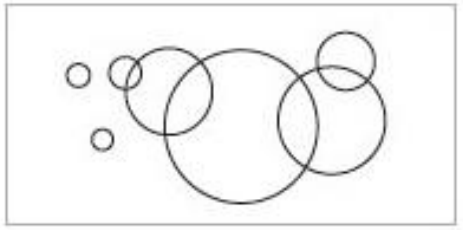


Length

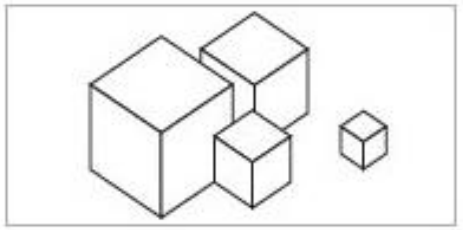


Direction

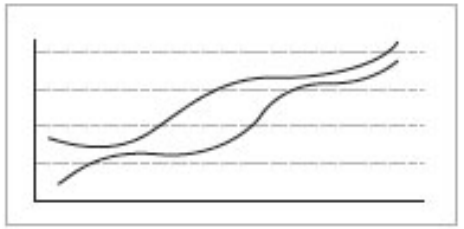
Angle



Area



Volume



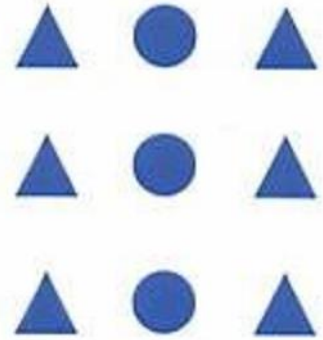
Curvature

Shading

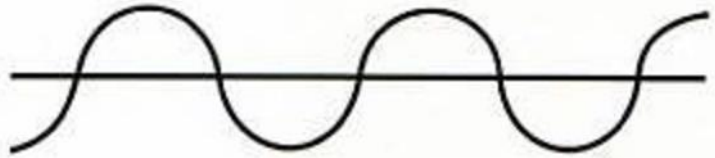
Color saturation

A. Cairo (2013)

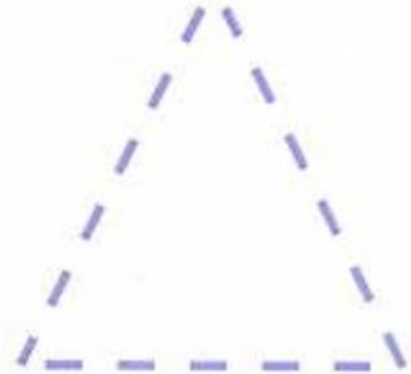
Proximity



Similarity



Continuity



Closure

Connectedness

Lessons - Cognition and Design

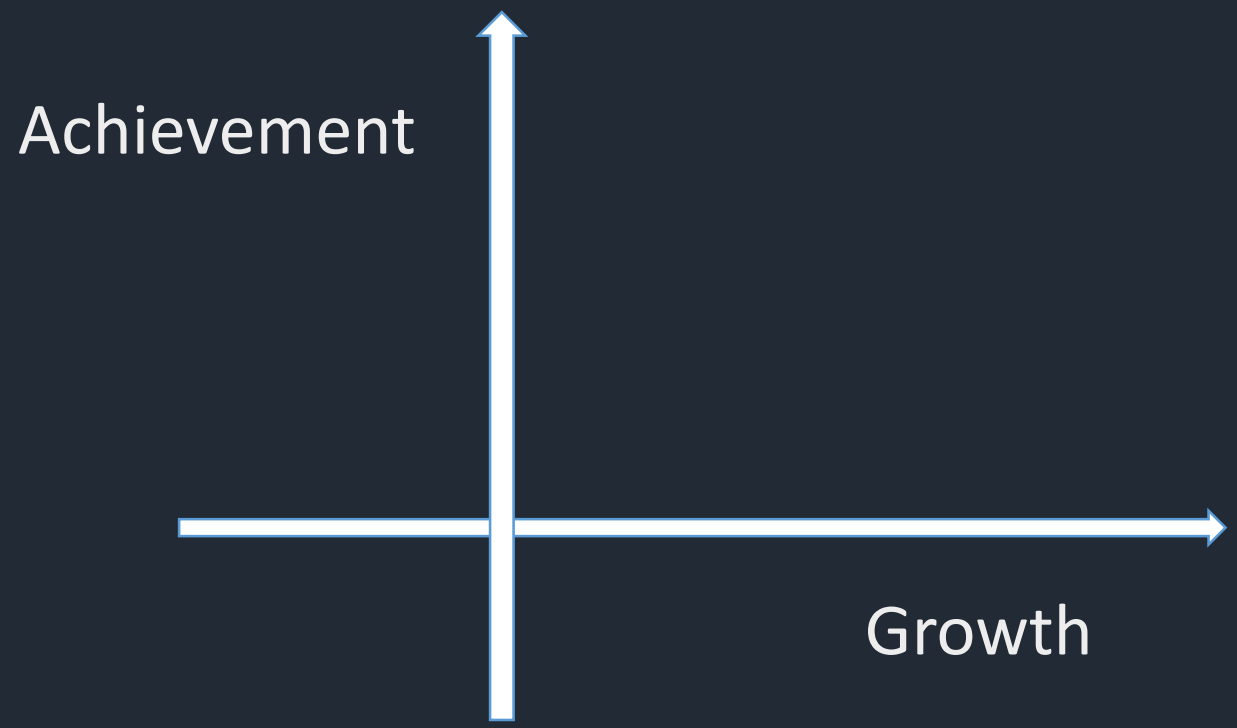
The visual brain has evolved to quickly do two main things:

- detect patterns
- categorise and distinguish

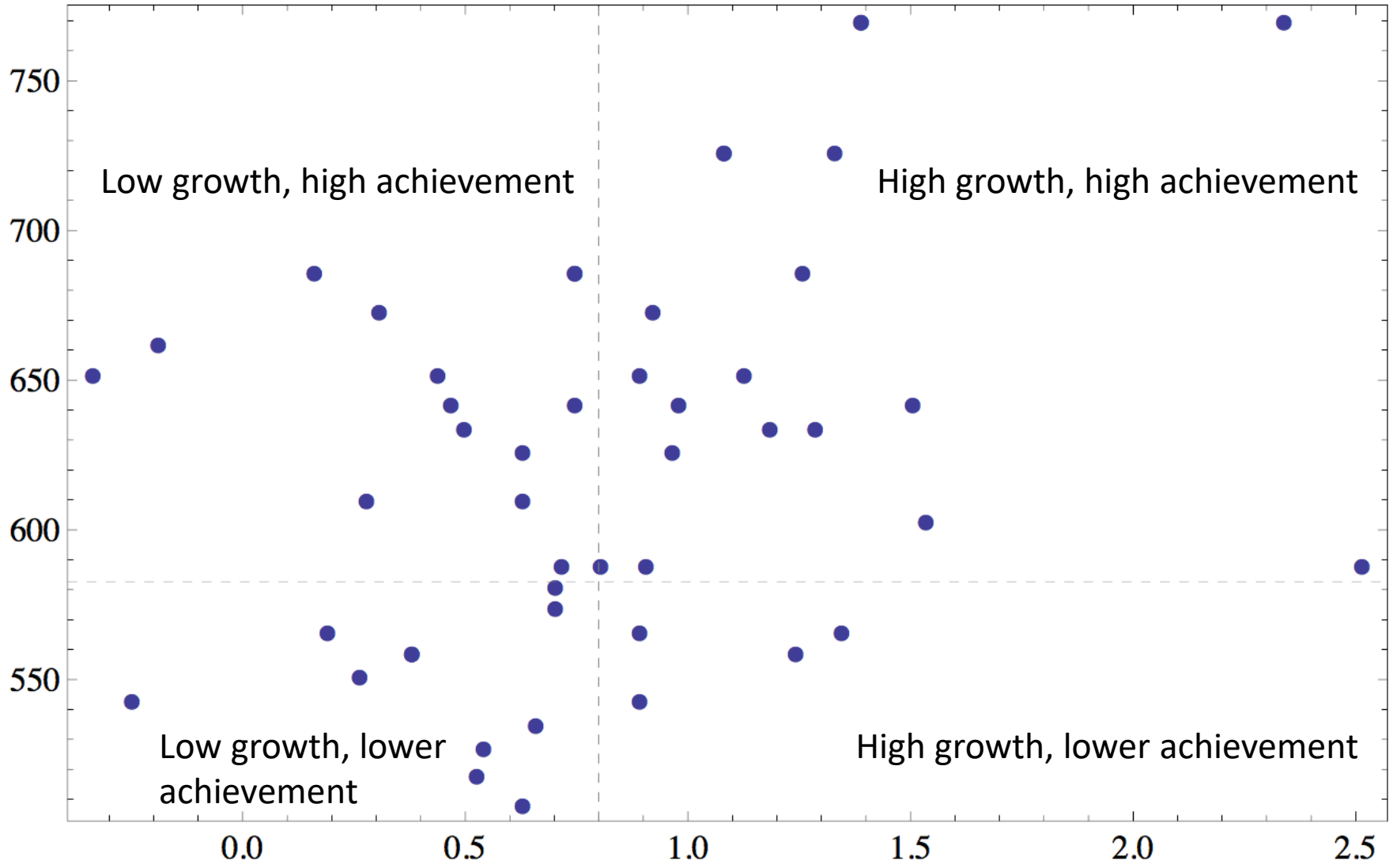
As much as possible, design with this in mind.

The brain *loves* difference – but difference is a finite resource

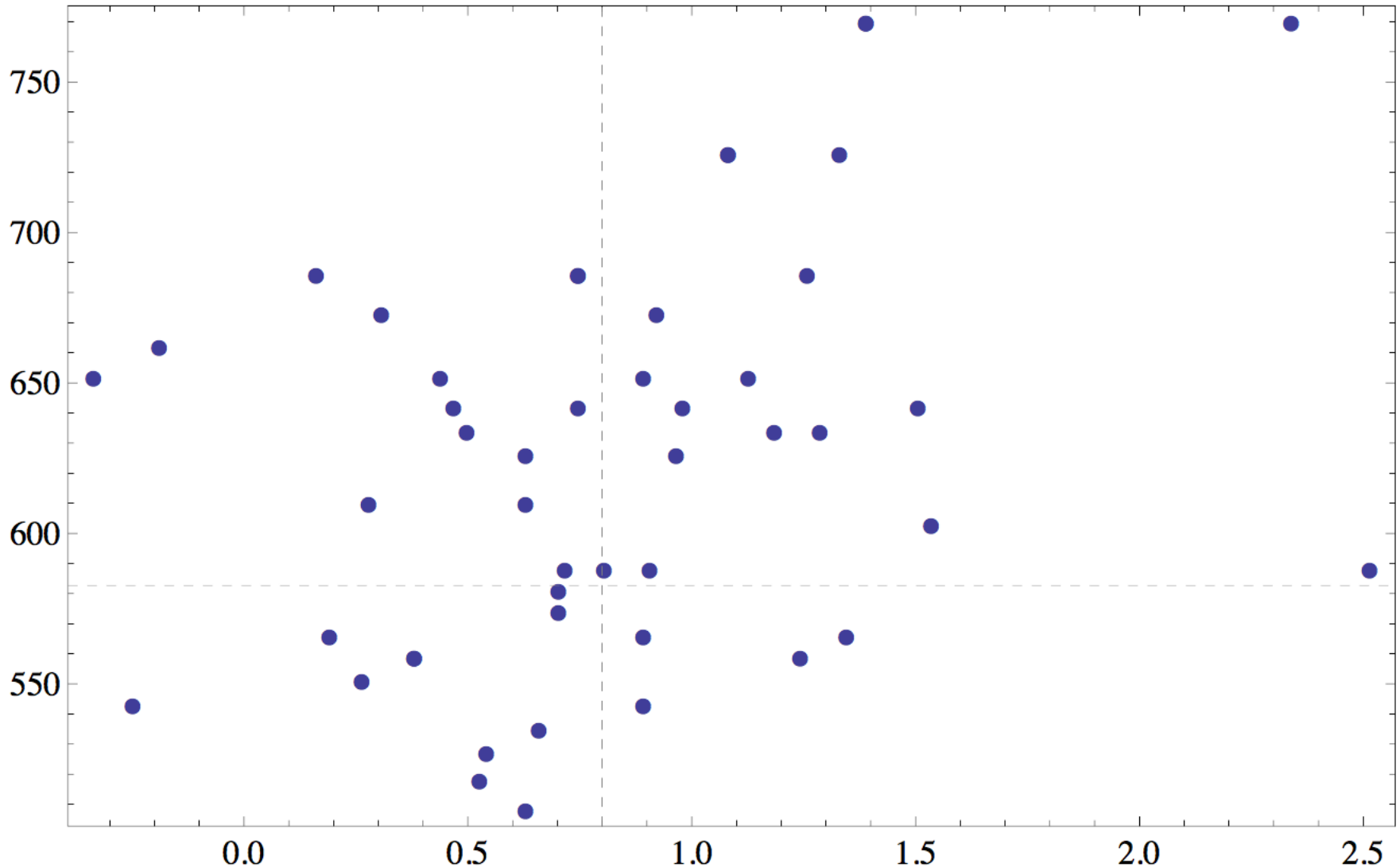
3. Measuring Impact

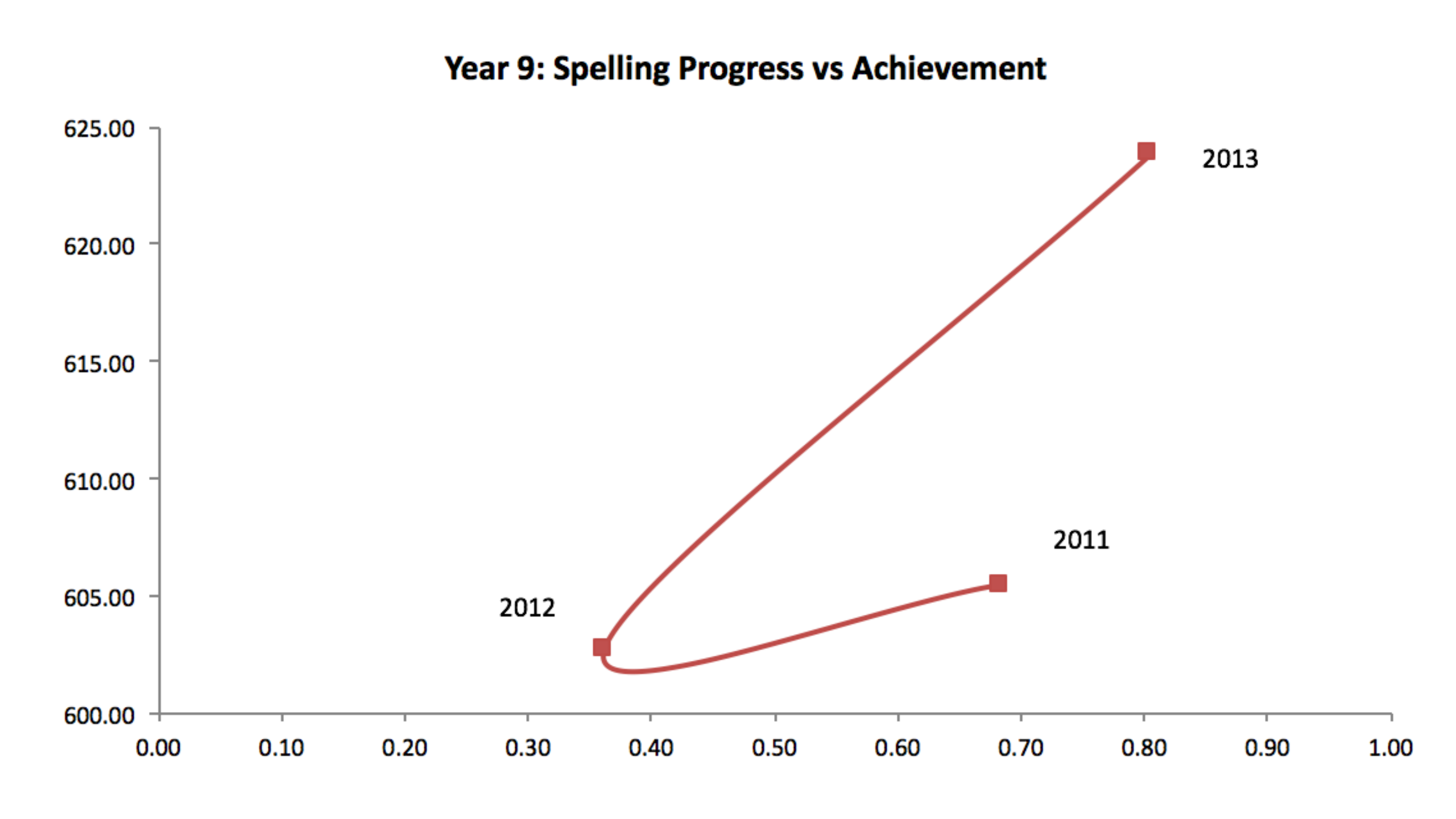


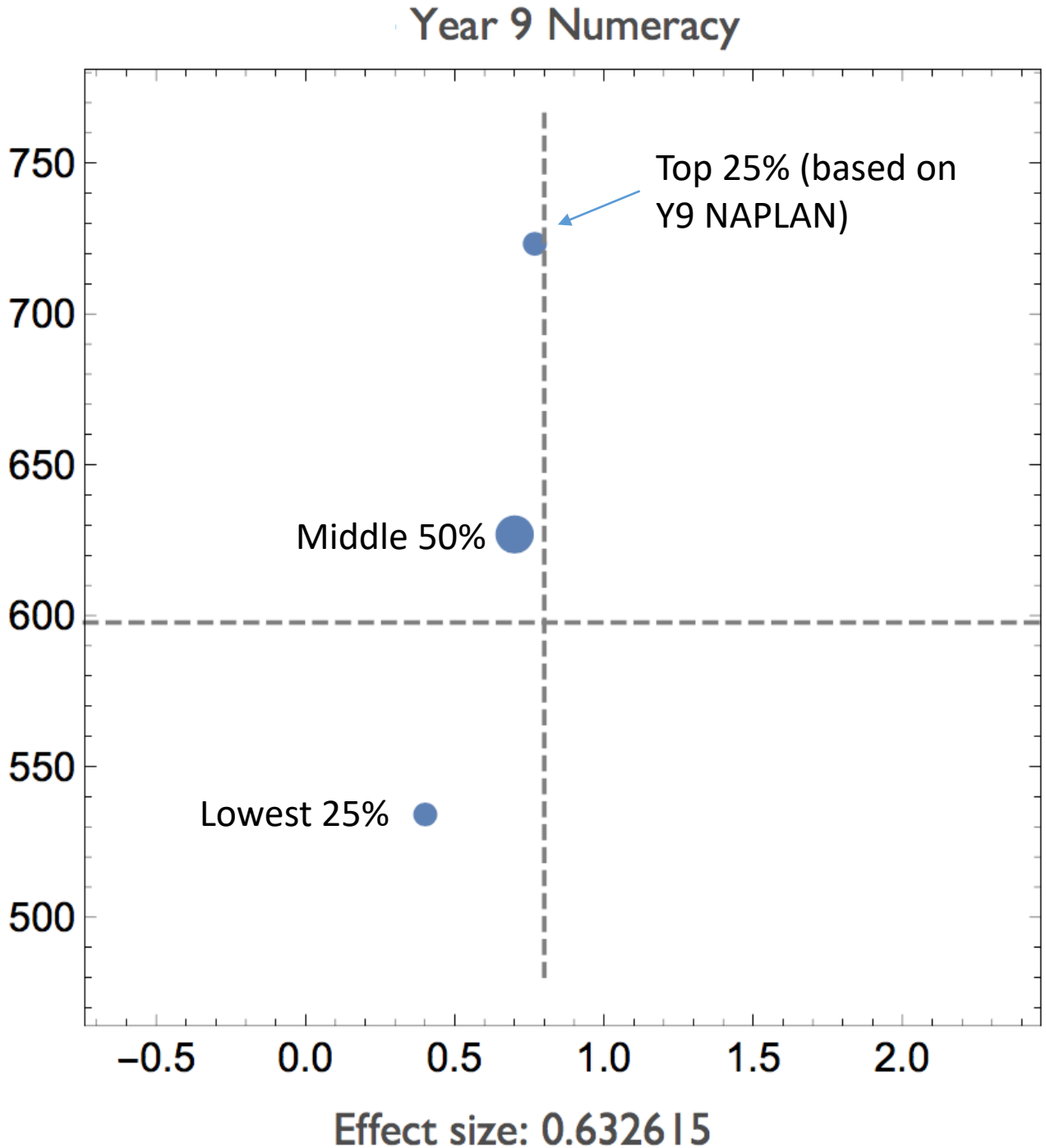
Y9 NAPLAN Spelling: Progress vs Achievement



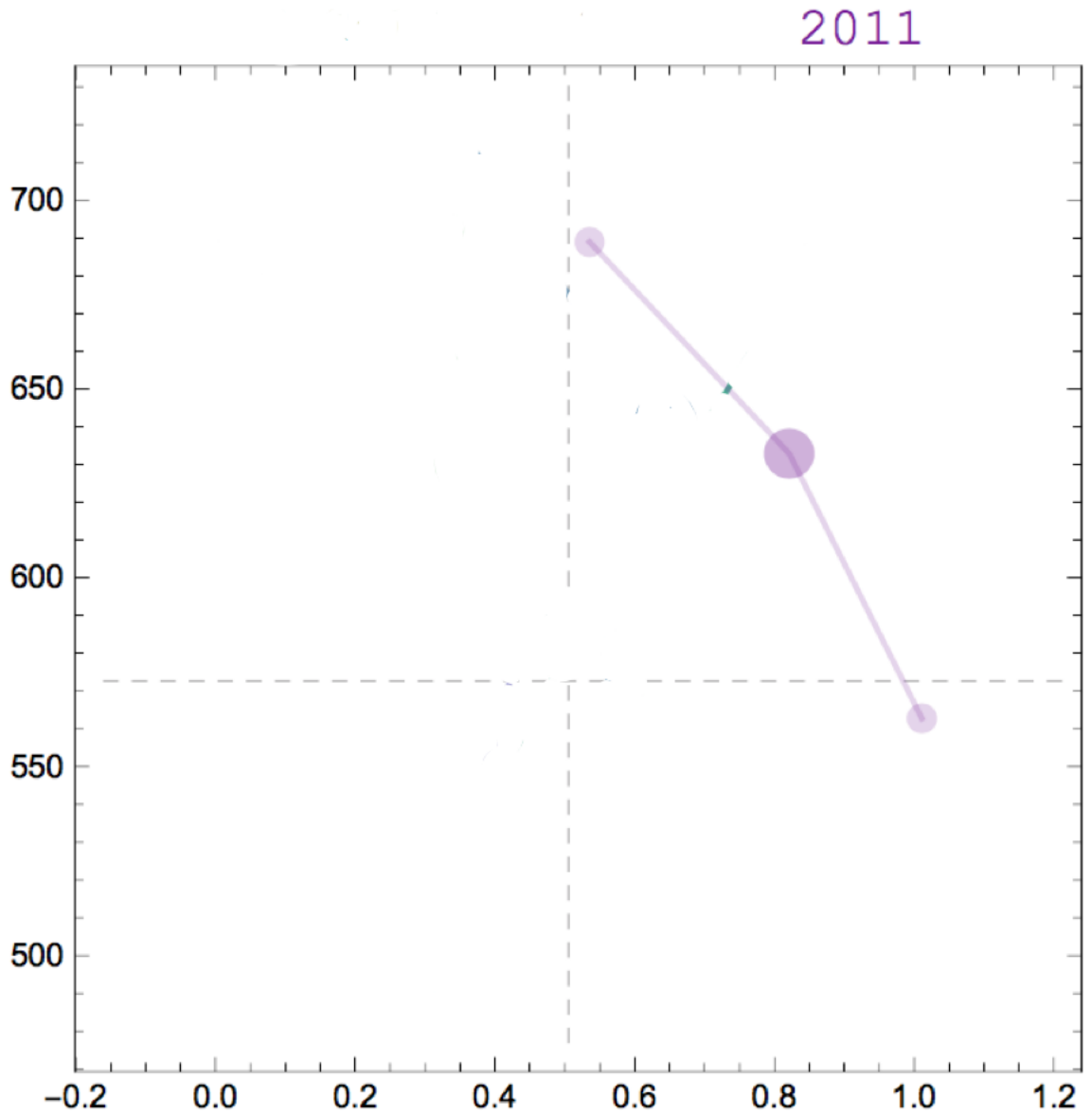
Y9 NAPLAN Spelling: Progress vs Achievement



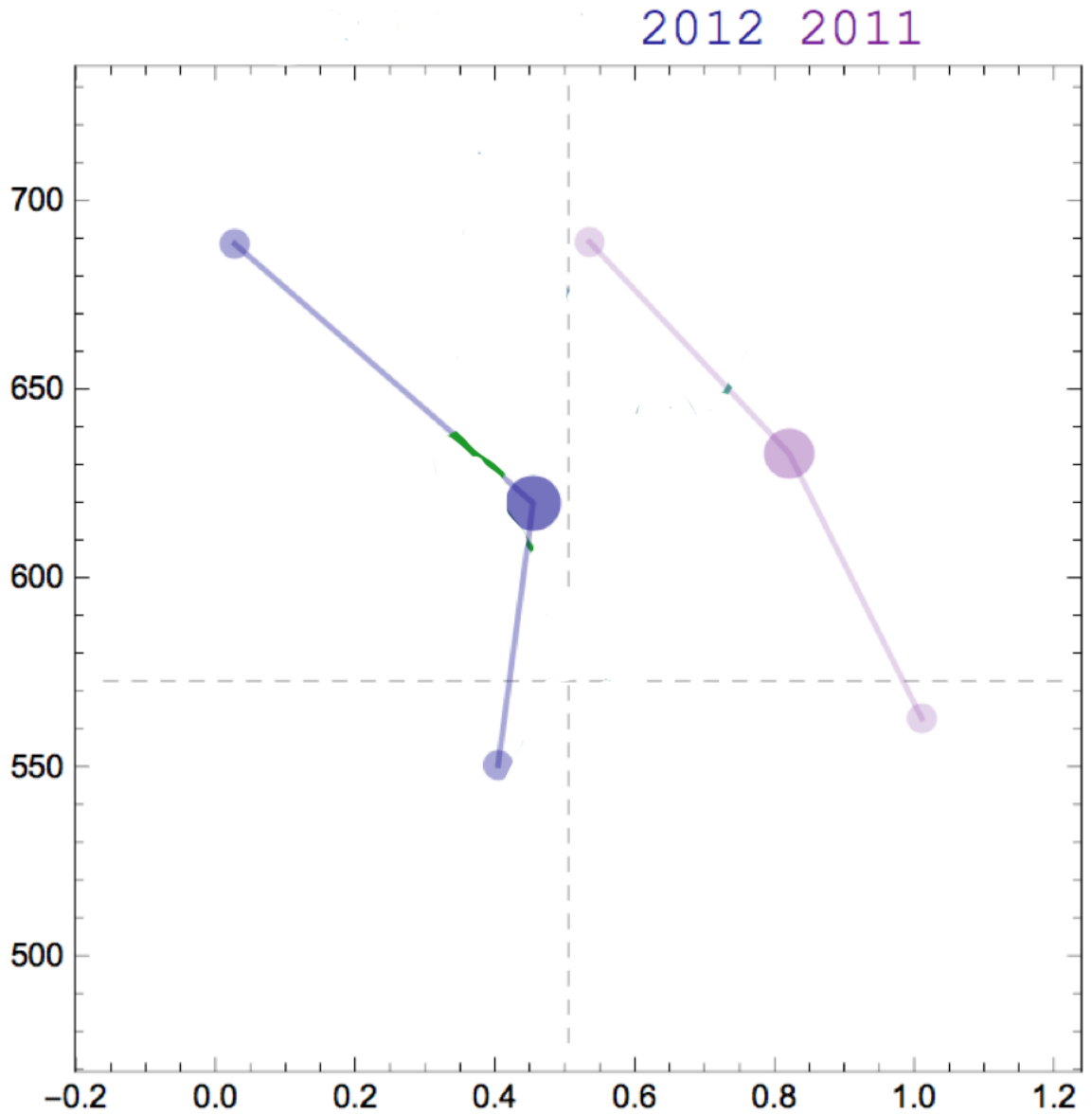

Year 9: Spelling Progress vs Achievement
625.00
620.00
615.00
610.00
605.00
600.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
2013
2011
2012


Year 9 Numeracy
750
700
650
600
550
500
Top 25% (based on Y9 NAPLAN)
Middle 50%
Lowest 25%
−0.5
0.0
0.5
1.0
1.5
2.0
Effect size: 0.632615

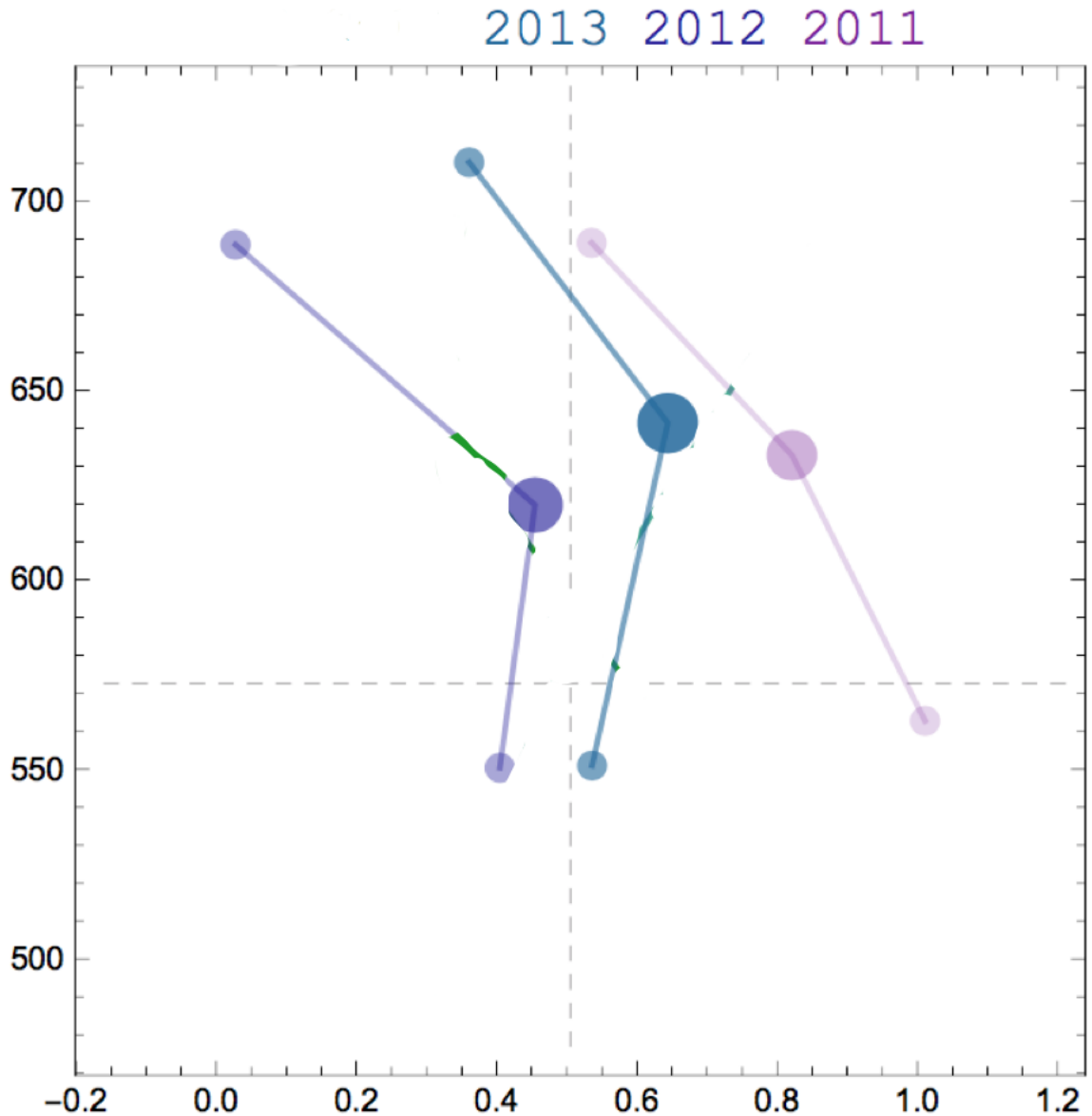
Year 9 NAPLAN Reading from 2011 to 2015 – Quartiles



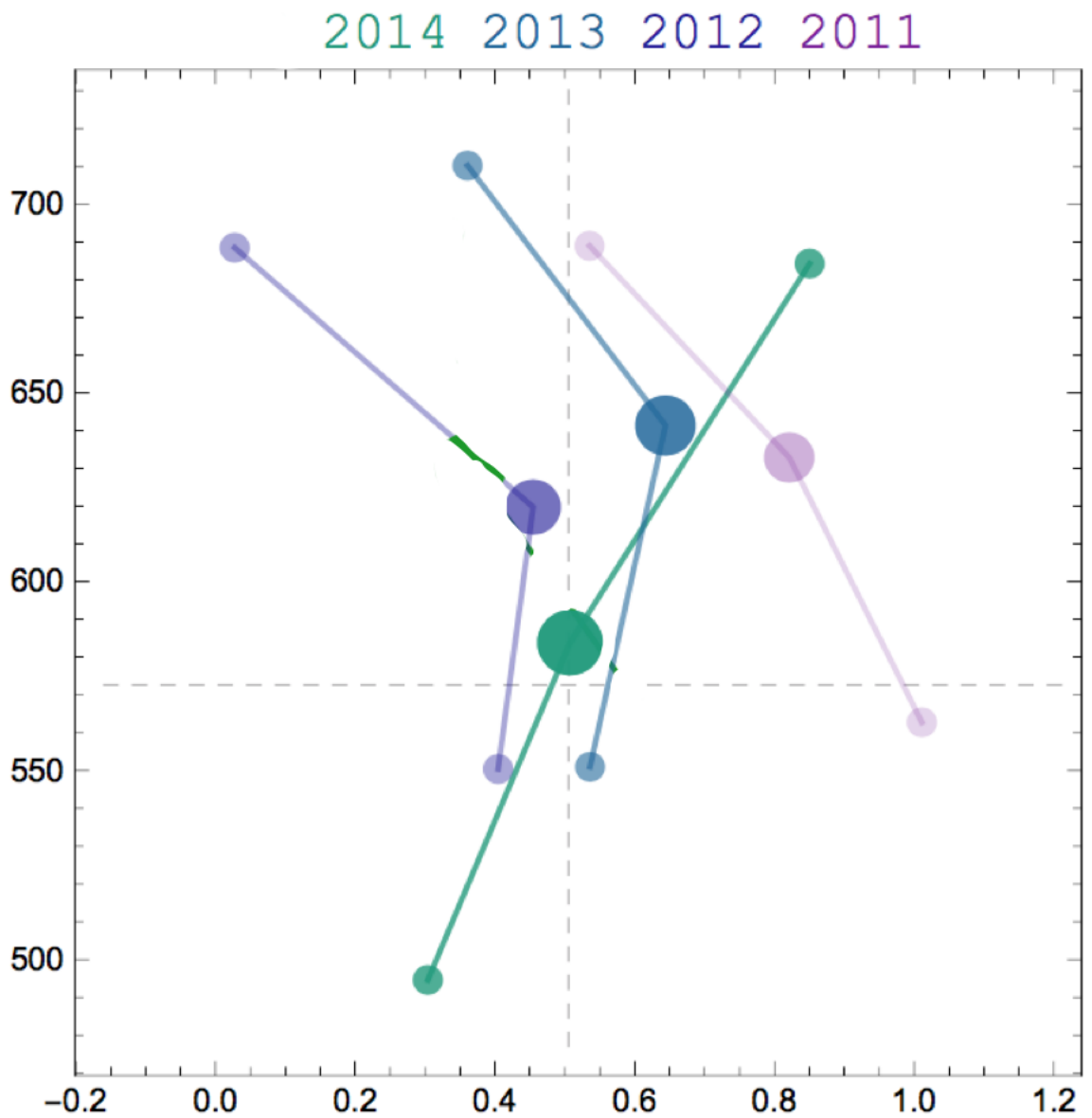
Year 9 NAPLAN Reading from 2011 to 2015 – Quartiles



Year 9 NAPLAN Reading from 2011 to 2015 – Quartiles

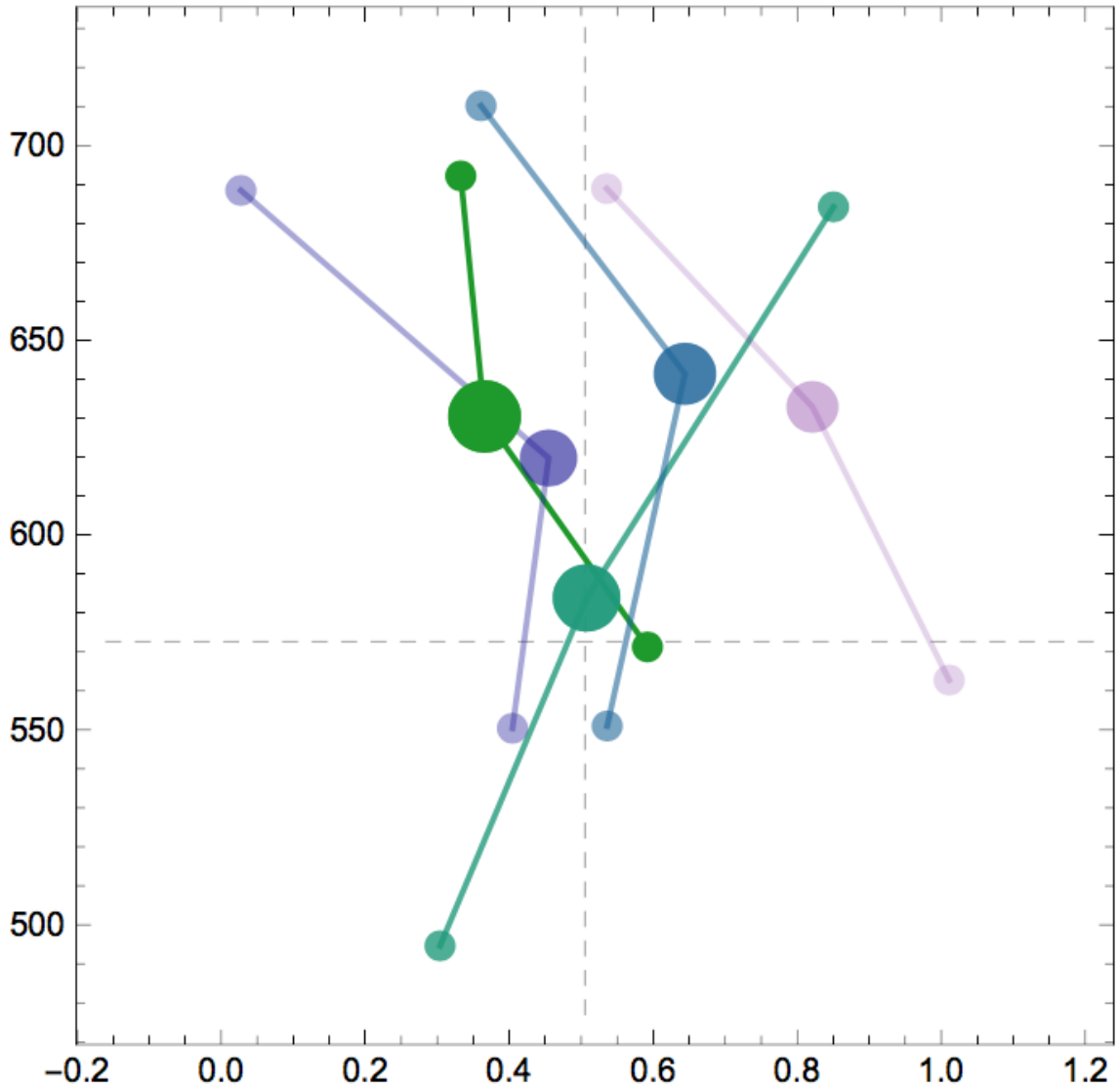


Year 9 NAPLAN Reading from 2011 to 2015 – Quartiles

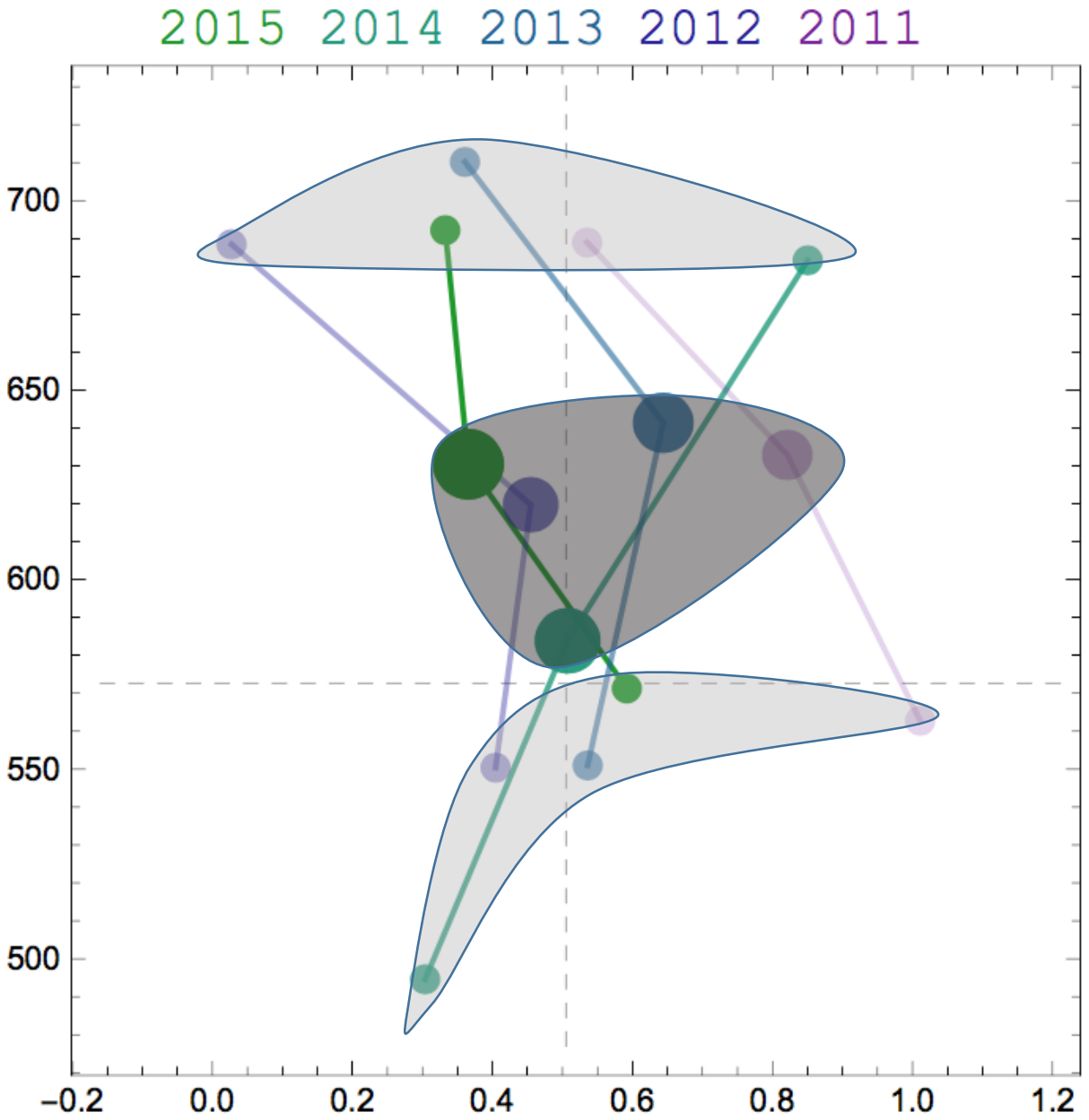


Year 9 NAPLAN Reading from 2011 to 2015 – Quartiles

2015 2014 2013 2012 2011



Year 9 NAPLAN Reading from 2011 to 2015 – Quartiles



Lessons from Measuring Impact

- Aggregate intelligently because outliers will drive dialogue.
- Design to get the viewer to the story first
- Don’t expect the story to be simple.
- Always ask – how do I know that?

4. Enabling Dialogue

- Validate staff experience
- Do not underestimate your staff’s desire to engage with the data
- Enable staff to draw their own conclusions. Show – don’t tell.
- Presentation mode.

- Build trust.

Numbers on the screen are representations of the real world.

Look at the real world, not just representations. Walk around what you want to learn about.

Edward Tufte

Walkthroughs

Visit about 30 classes over four periods

Record what students are doing in the class

Ask 3-4 students two questions:
- What is your learning aim
- How do you know if you have succeeded

Methodology

Walkthough Analysis 2016/02/10

Ben Hicks
10 February 2016
Ben Hicks - 10 Feb 2016

Methodology

Walkthrough conducted on 10 February 2016 by Kate Cunich and Ben Hicks. The following questions were data was collected from each class:

Context of Lesson

Question	Description / Method
period	The period of the lesson visited (1 - 6)
room	Room visited
year level	The year level visited. An answer of "3.5" indicates a mixed class of year 3 and year 4 students
number of students	how many students in the class
lesson time	The time of the lesson, designated as beginning (B), middle (M) or end (E). Beginning was deemed to be anytime in the first 15 minutes (allowing for movement to class) and end was anytime during the last 10 minutes

What the students were doing

These categories are *not* exclusive. Students could be doing a number of these at once. For instance class discussion with heavy scaffolding from the teacher might be classed as *direct instruction* as well as *discussion*.

Question	Description / Method
direct instruction	Students were recieving direct instruction from the teacher, or the teacher was modelling work, or similar.
discussing	Students were talking *about what they were learning* or working on.
reading / viewing	Students were reading a text, viewing media, or similar. This also includes listening to a recording.
groupwork	Students were working on a task in groups of two or more.
independent work	Students were working on a task by themselves.

Learning Intentions and Success Criteria

Question	Description / Method
LI visible	The learning intentions are visible, either on the board, on a document, or online. If online students needed to be able to access / have accessed it.
SC visible	The success criteria are visible, either on the board, on a document, or online. If online students needed to be able to access / have accessed it.

Student understanding of learning process

This is both the most subjective and important measure of the walkthrough. As such each question was asked to at least 4 students, 2 each for the staff performing the walkthrough. After exiting the class, a short discussion would rate the responses on a scale of 0 - 2, 2 being a *good understanding*, 1 being *some idea*, and 0 being *struggling to understand*. The exact questions would change depending on the student, year level, content, but the goal was to get students to explain what they are learning, and what success in this process would look like. Being a small school it is helpful knowing the students and this was taken into account when evaluating the student responses.

Question	Description / Method
learning understanding	Questions such as *what are you learning today?* were asked, and students prompted to explain what they were learning about. Scored on a scale of 0 - 2.
success understanding	Questions such as *how do you know when you understand it?* or *what do you hope to get out of the lesson?* were asked. The aim was to prompt students into explaining how successful understanding would be achieved. Scored on a scale of 0 - 2.

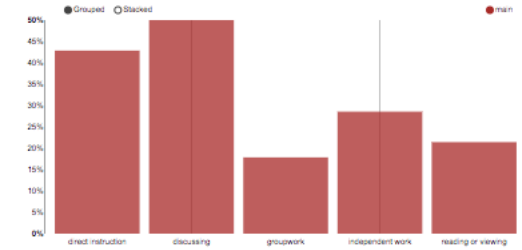
Results

Results

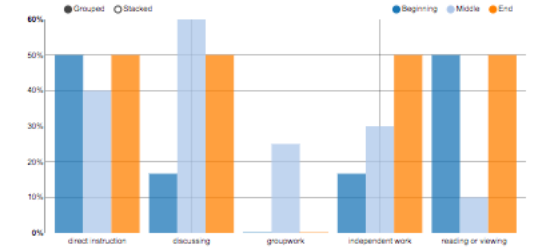
Anecdotal observations of Kate and myself were that there was a pleasing variety of activities happening in classrooms across the school. Students were, in the vast majority, engaged and focused in class.

Summary data	Total
Classes visited:	28
- - beginning of lesson	6
- - middle of lesson	20
- - end of lesson	2
Students observed:	569
- - Primary	124
- - Secondary	445

Activity breakdown

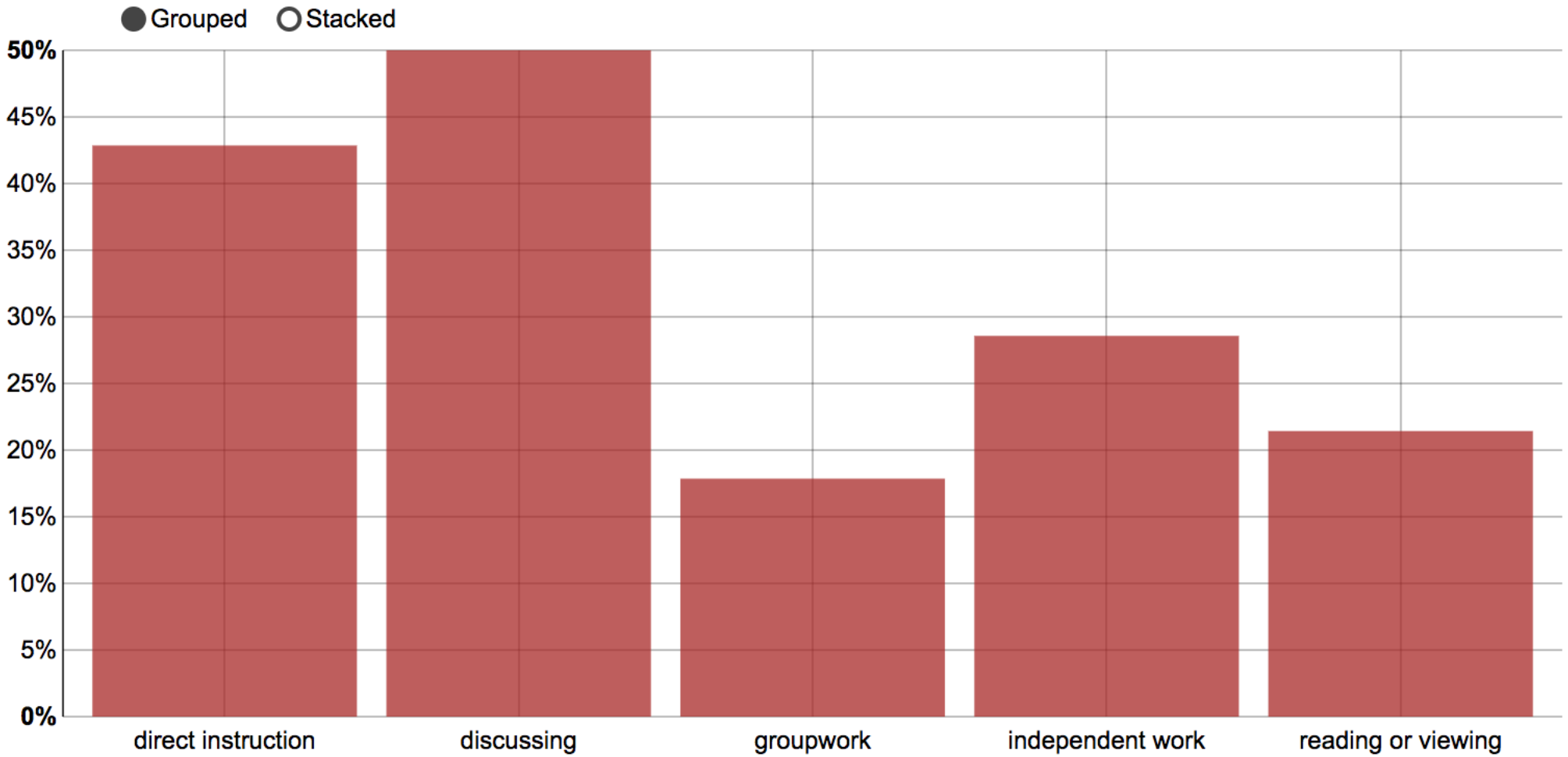


Activity breakdown based on time of lesson

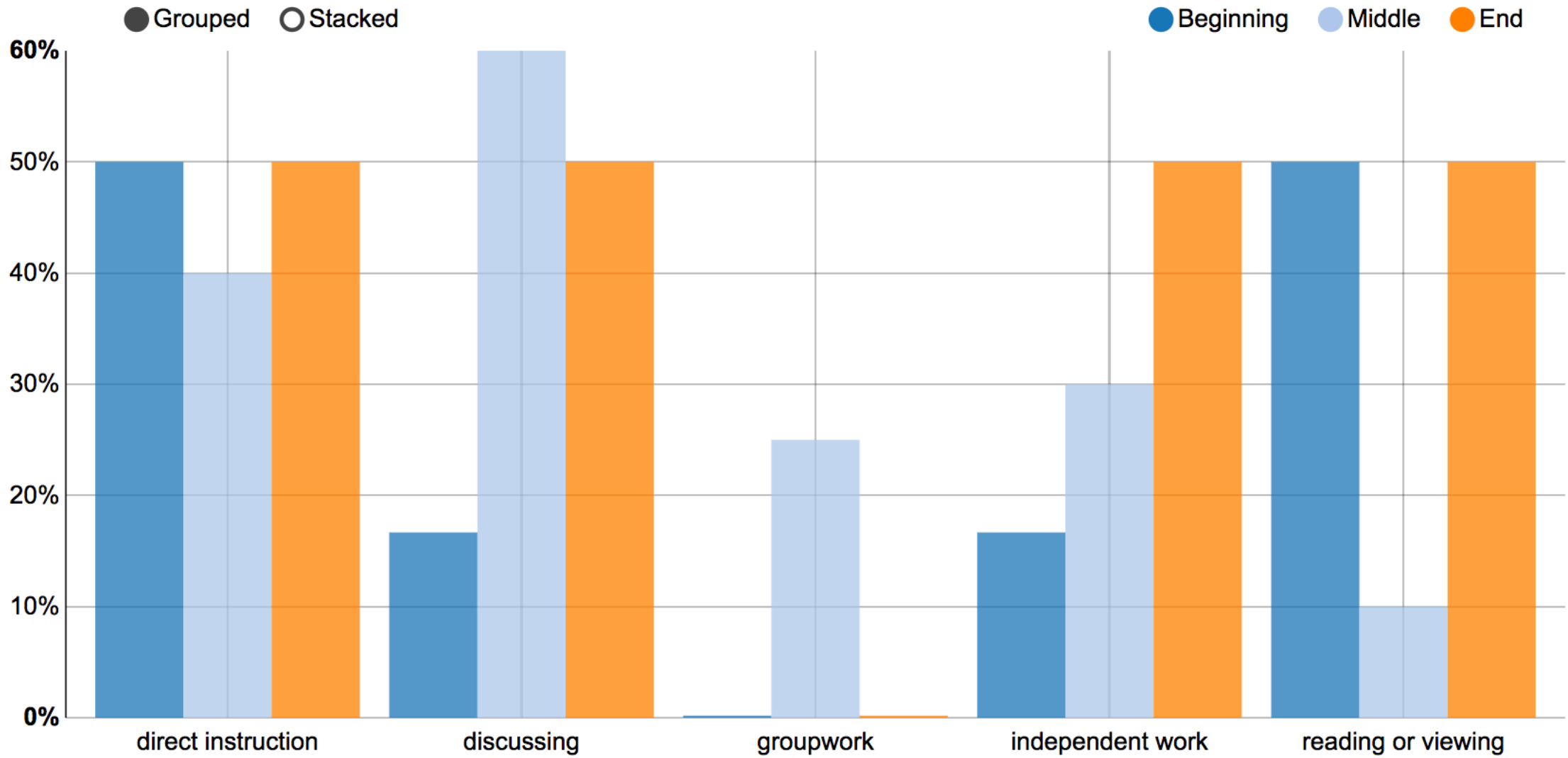


Results

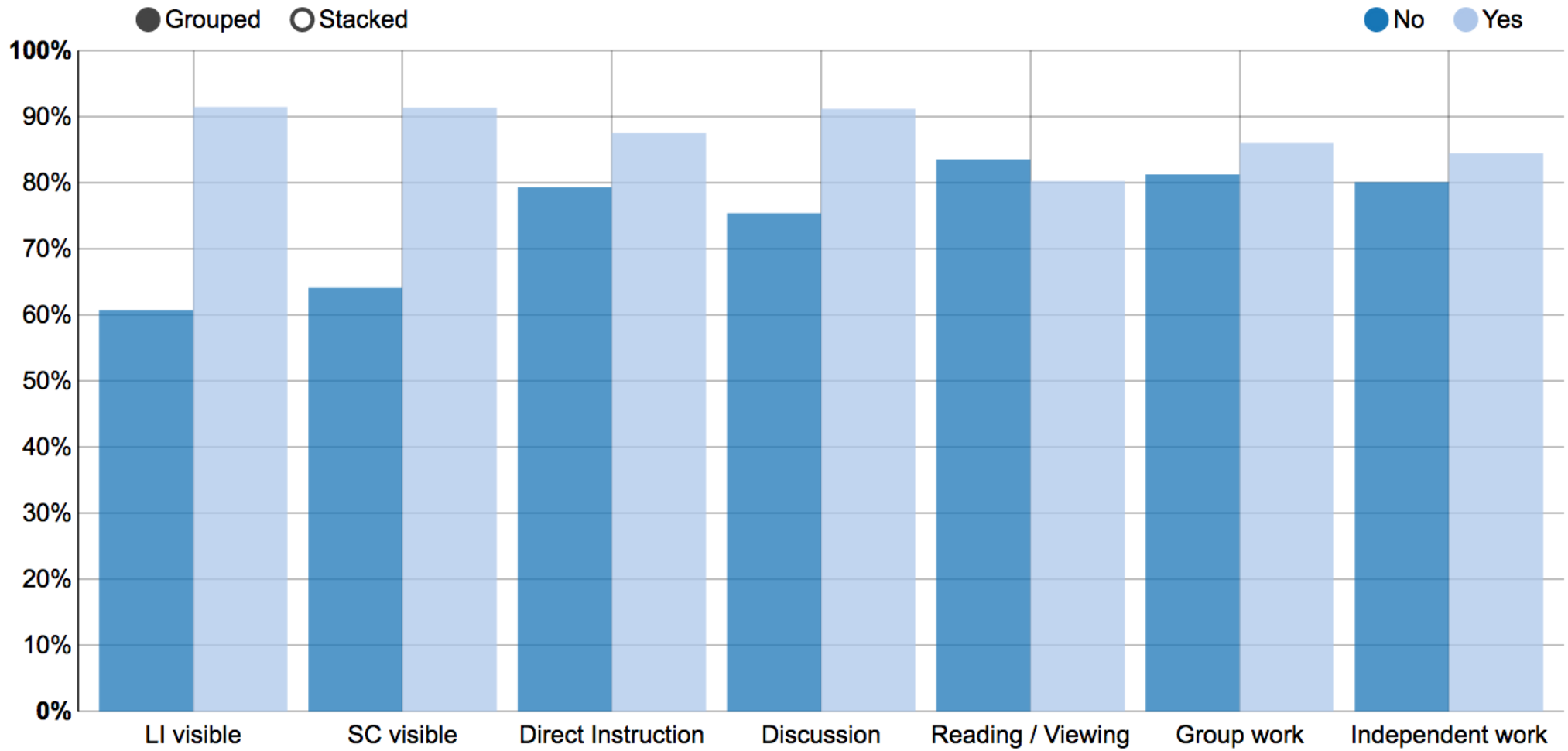
Activity breakdown



Activity breakdown based on time of lesson



Learning understanding based on lesson conditions

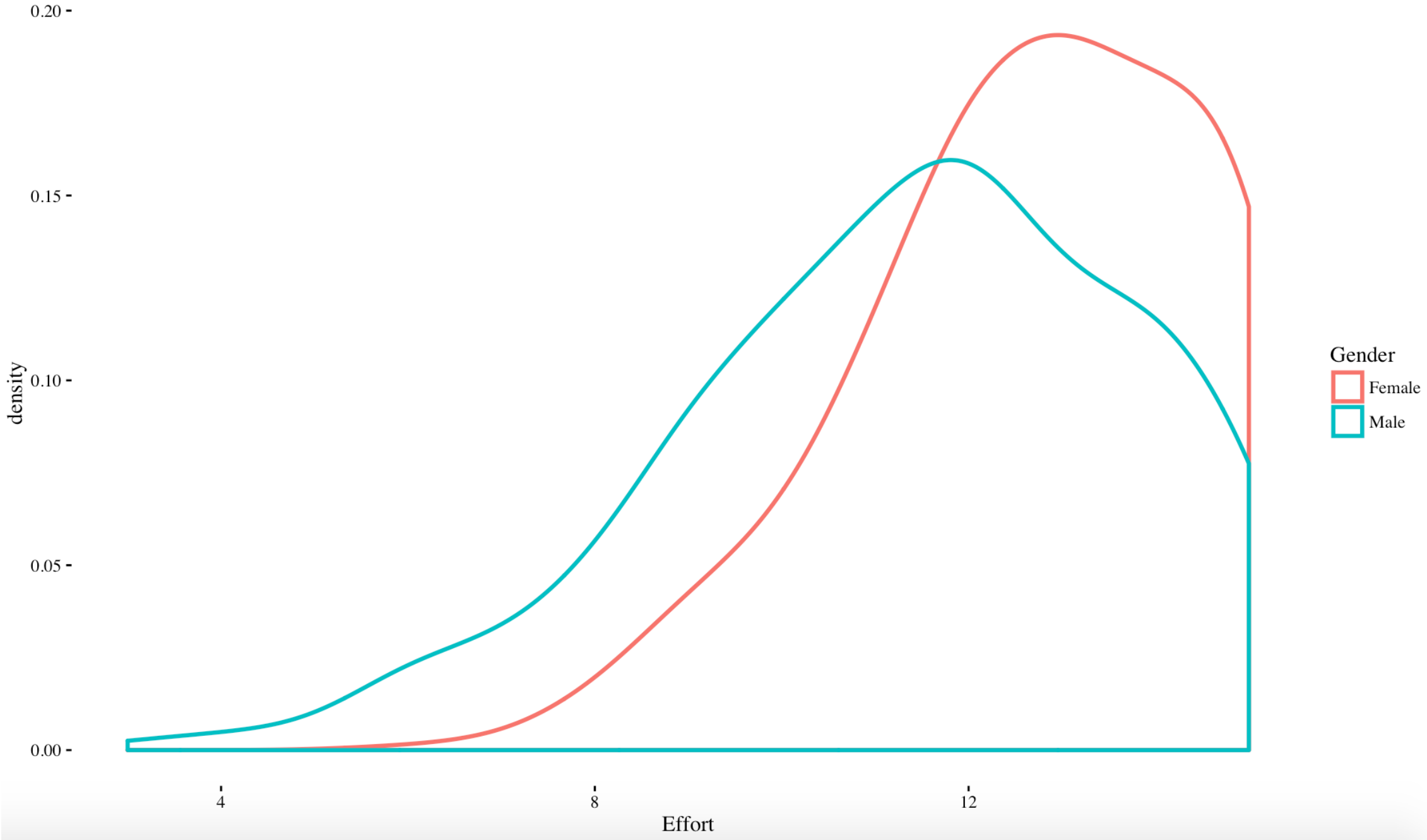


Effort reporting

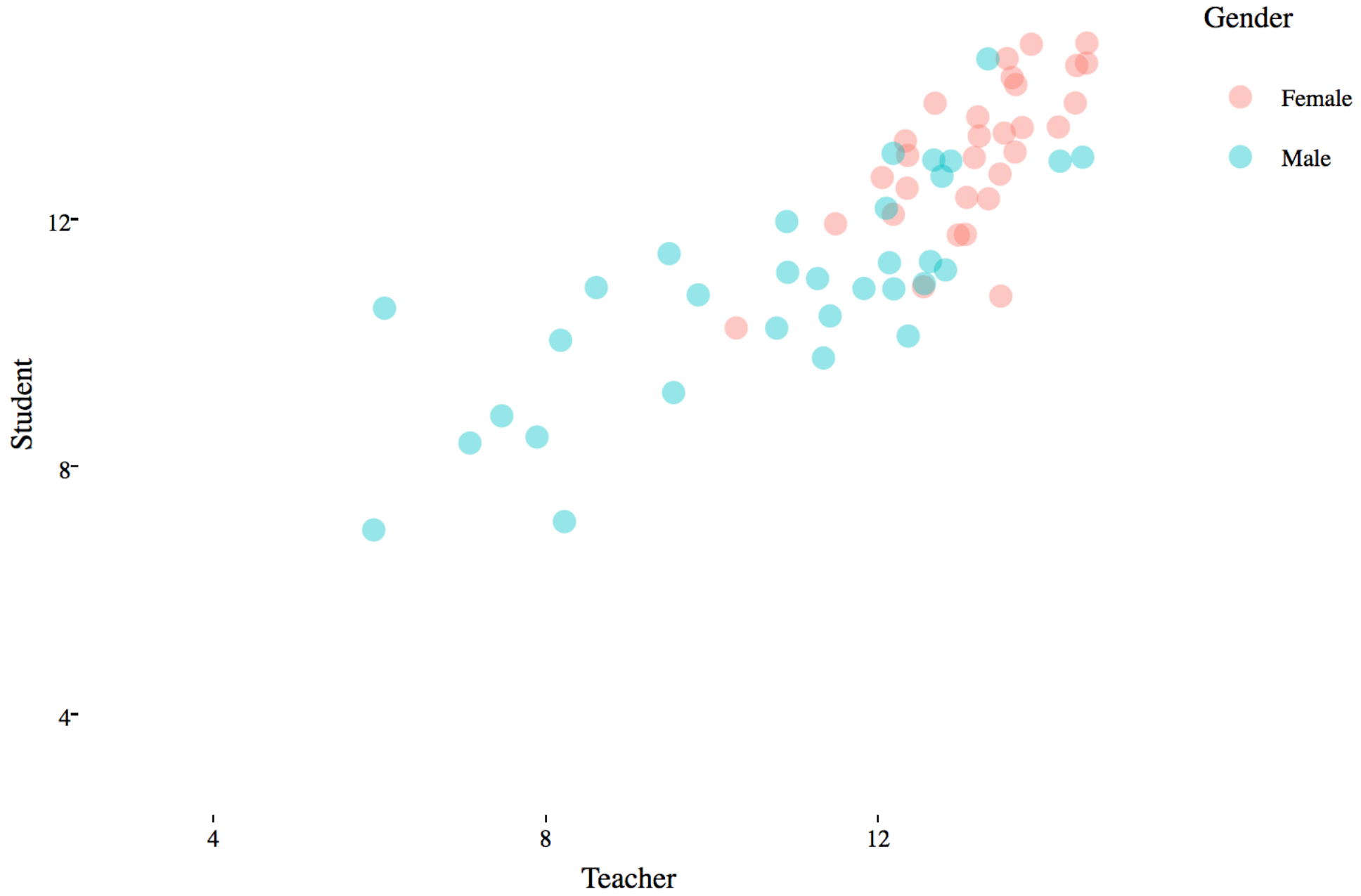
Frame work taken from Nagy (2016):

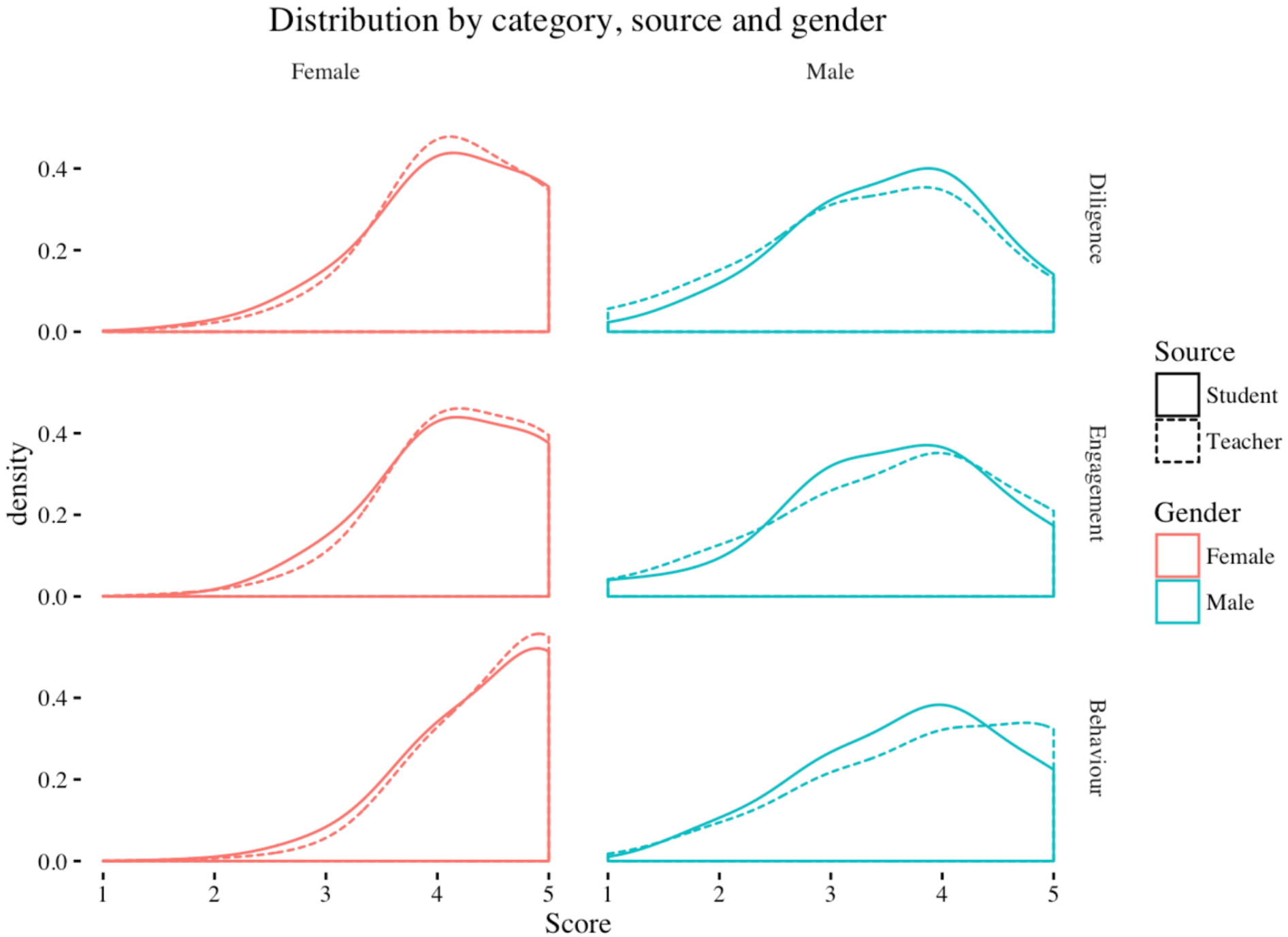
- Students and Teachers report on the student's effort
- 3 Categories on a 1 – 5 scale: Diligence, Engagement and Behaviour

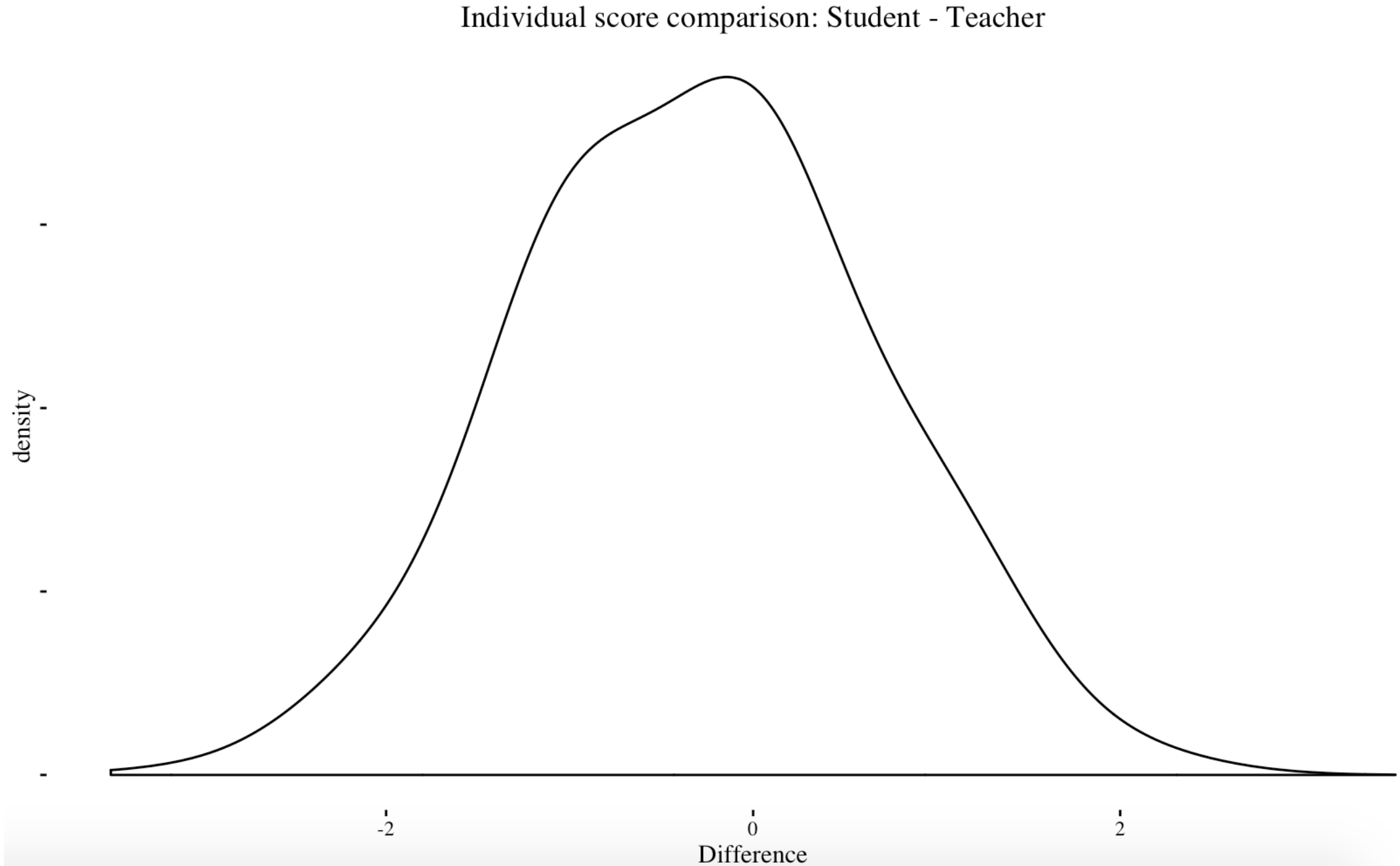
Effort Distribution by Gender

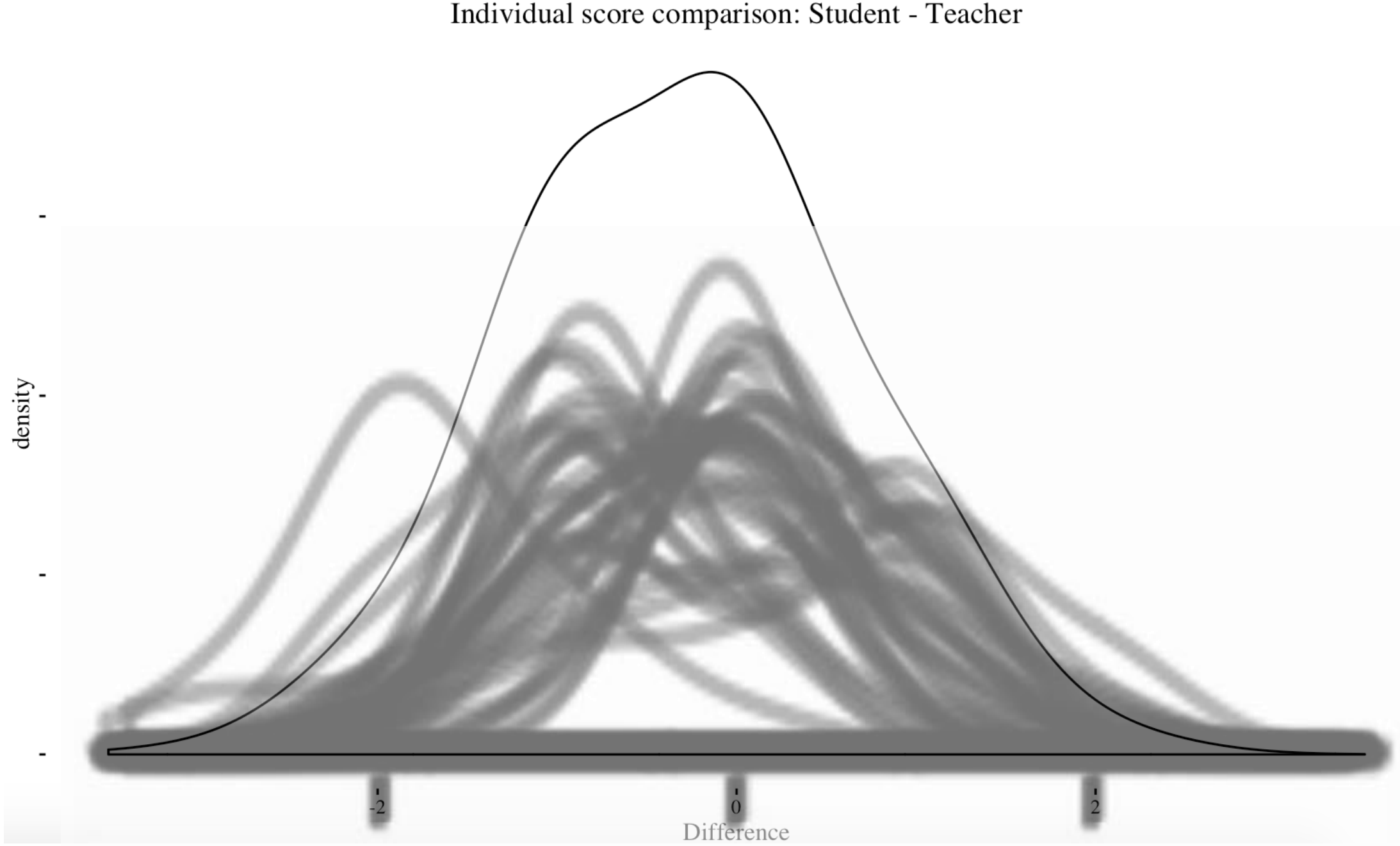


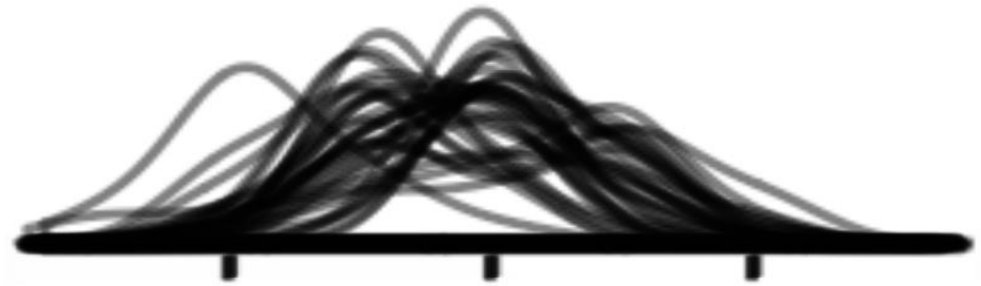
Teacher vs Student Effort Score

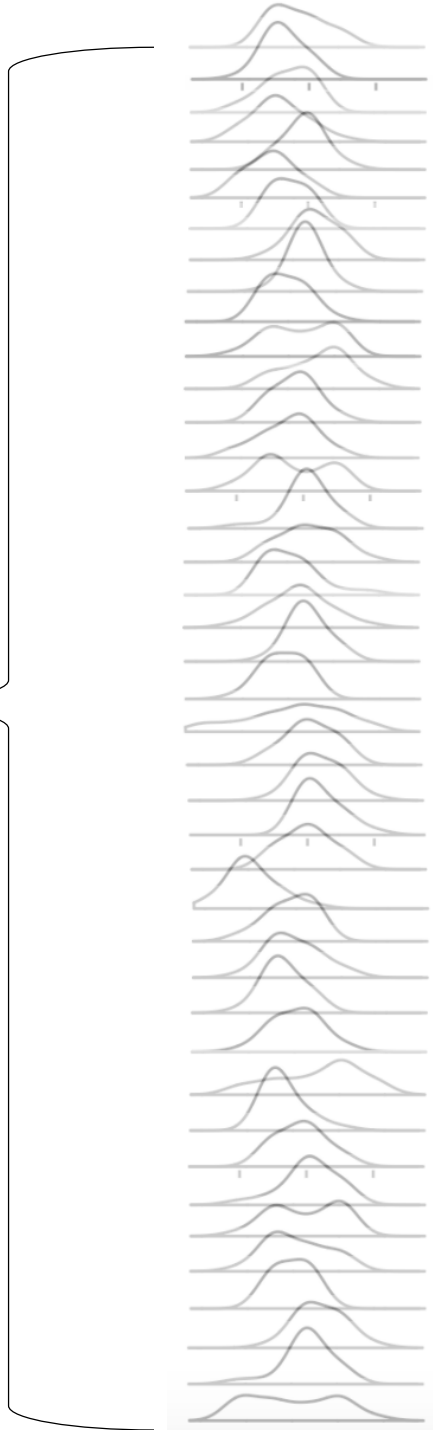



Distribution by category, source and gender
Female
Male
Diligence
Engagement
Behaviour
density
0.4
0.2
0.0
1
2
3
4
5
Score
Source
Student
Teacher
Gender
Female
Male


Individual score comparison: Student - Teacher
density
-2
0
2
Difference


Individual score comparison: Student - Teacher
density
-2
0
2
Difference





Higher achievement

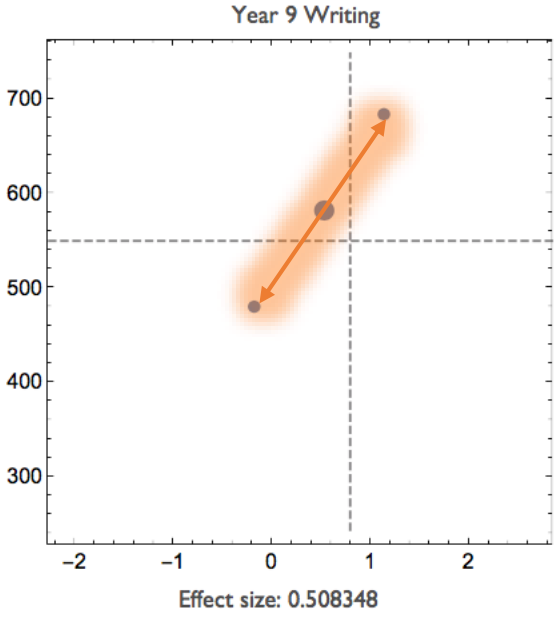
Lessons – Enabling Dialogue

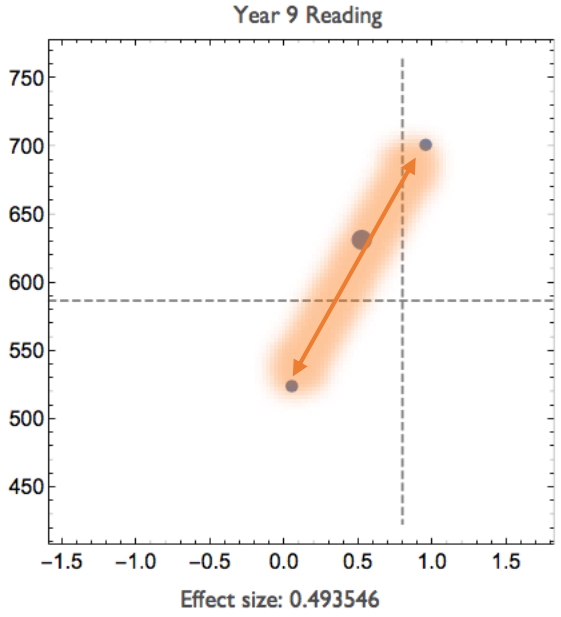
- Build trust. Be transparent. Overshare your methodology.
- Choose your delivery method wisely. For discussion, a graph in the hand is worth 10 on the screen.
- Allow room for staff to come to their own conclusions. Show don’t tell.

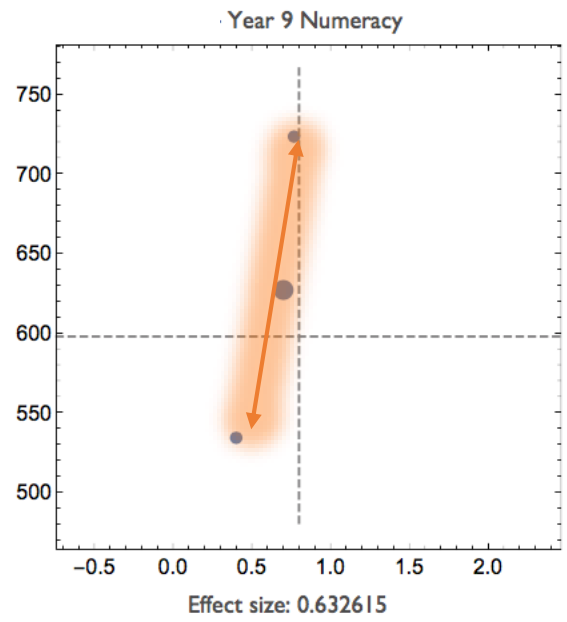
Pitfalls

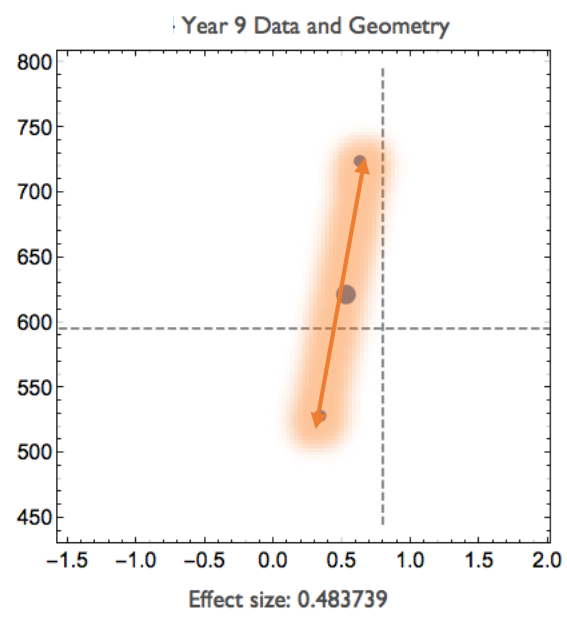
If you torture the data long enough, it will confess to anything

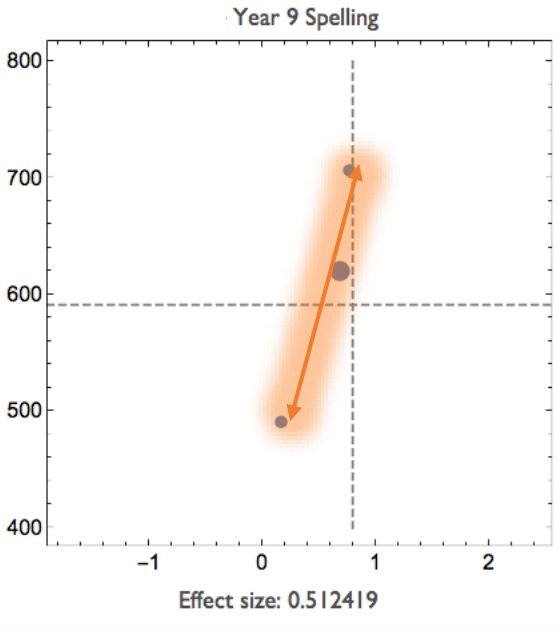
Darrell Huff

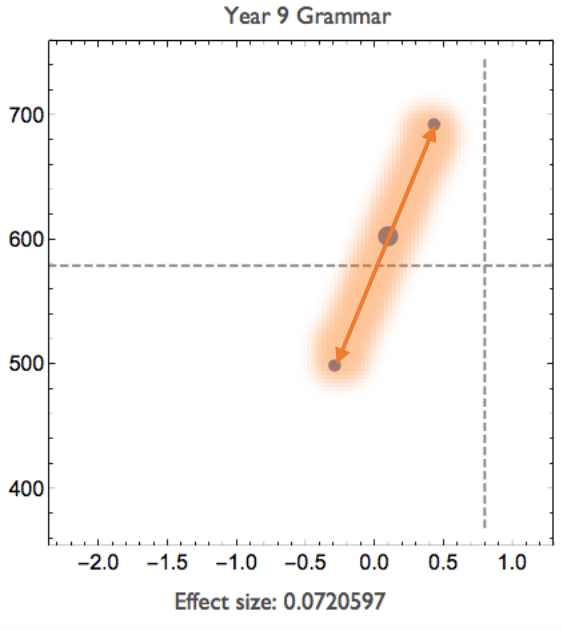

Year 9 Writing
Effect size: 0.508348

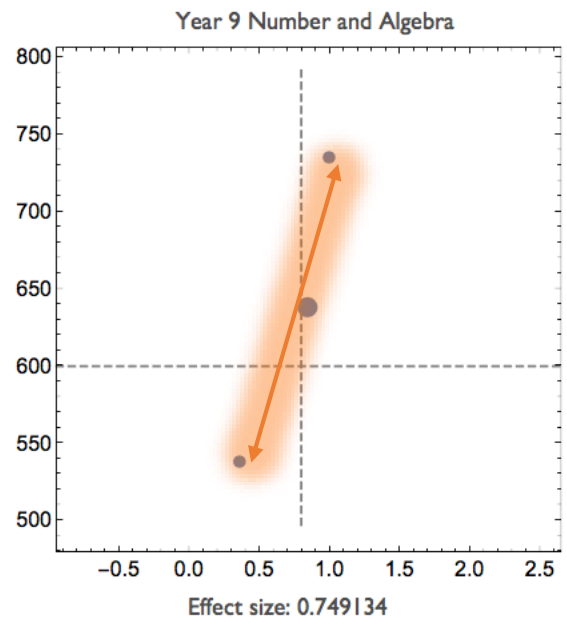

Year 9 Reading
Effect size: 0.493546

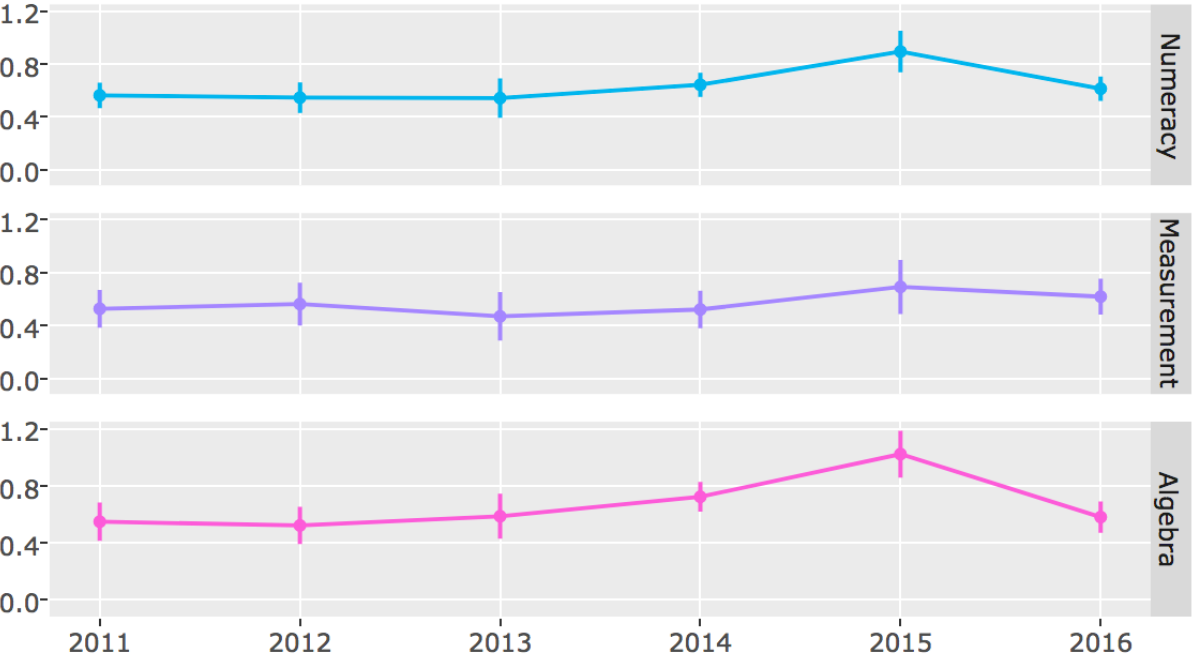

Year 9 Numeracy
Effect size: 0.632615


Year 9 Data and Geometry
Effect size: 0.483739


Year 9 Spelling
Effect size: 0.512419


Year 9 Grammar
Effect size: 0.0720597


Year 9 Number and Algebra
Effect size: 0.749134



Year 9

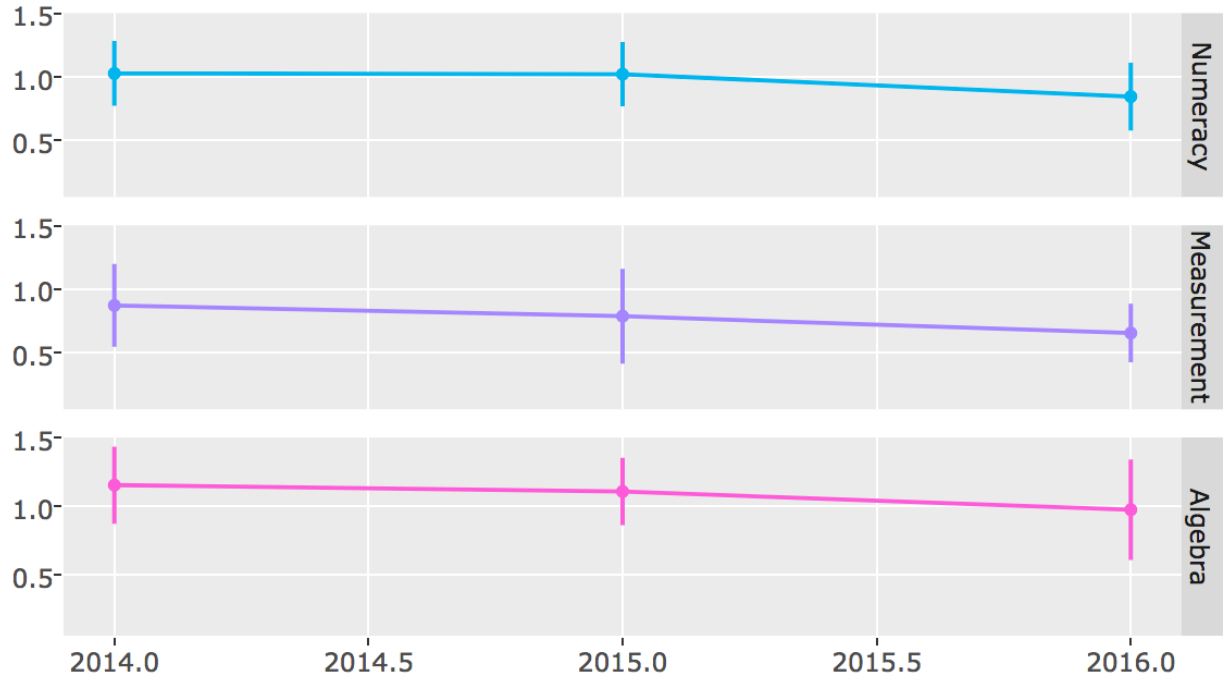
Lower overall effect size measure of growth – due to larger spread of the data.

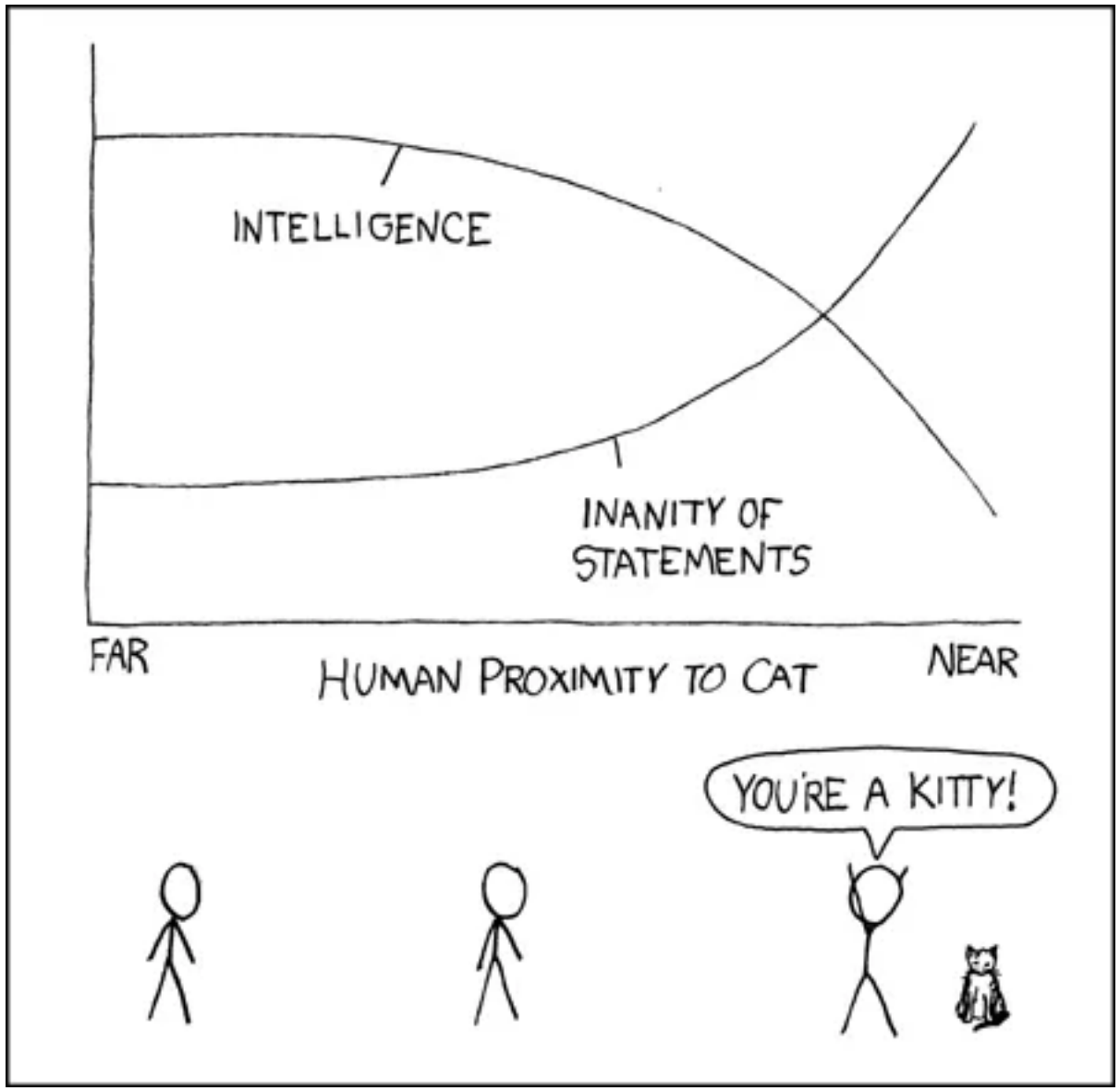
Smaller error due to larger cohort.

Year 5

Higher overall effect size measure of growth.

Larger error due to smaller cohort.





Make sure the data is worth collecting.

Lessons – Pitfalls

- Growth can be slippery to measure
- Beware of introducing artifacts as you aggregate
- Don’t draw precise conclusions from a limited amount data
- Before collecting new data ask yourself – ‘can I answer this question with data that already exists?’

Summary

- Validate teacher experience
- Show don’t tell
- Clarity
- Trust

Thank you

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Code shared at:
https://github.com/benwhicks