Statistics minus anxiety

Statistics anxiety and maths anxiety, key messages, comparing the evidence and examining the literatures

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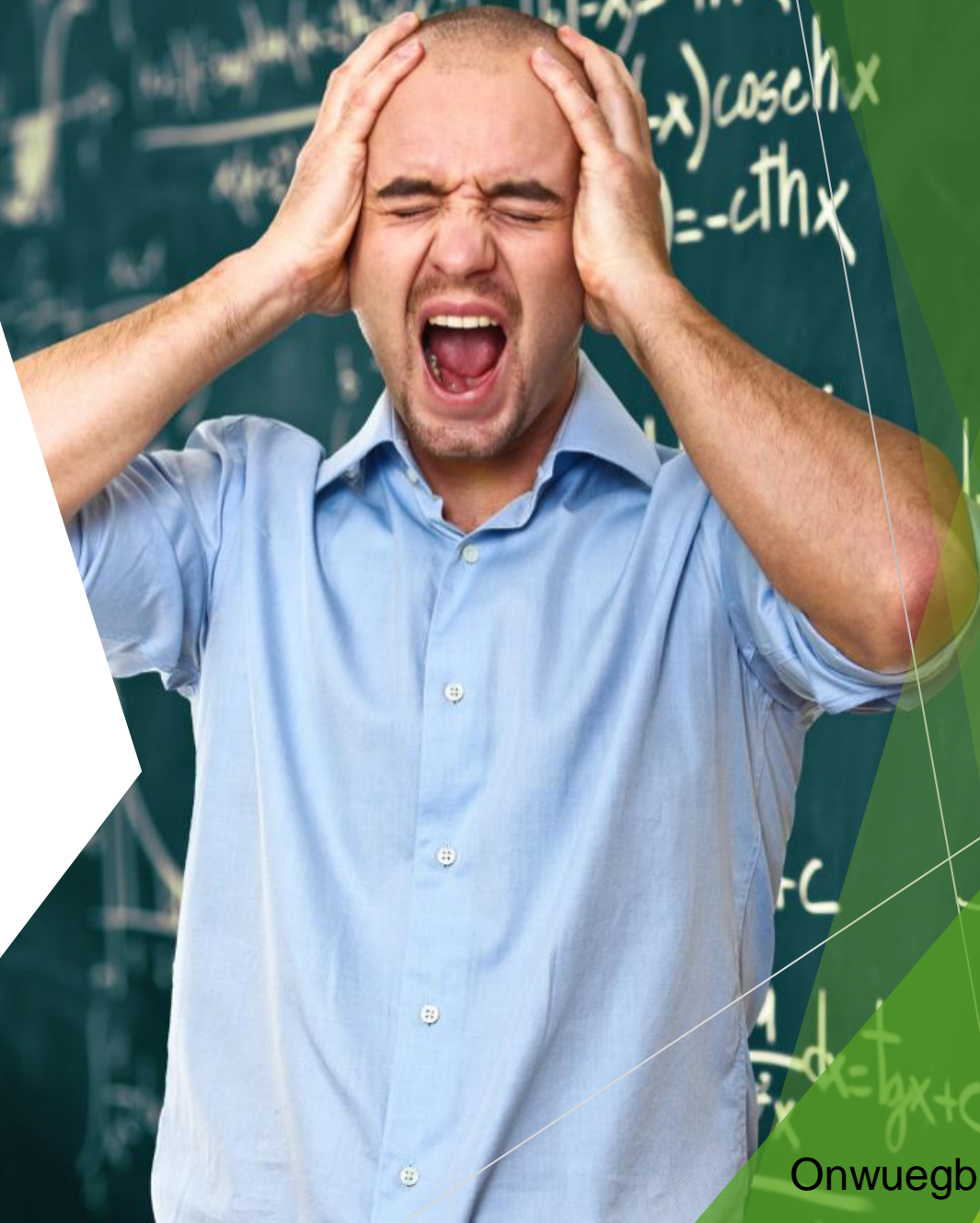York St John University

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Background

What is statistics anxiety?

'an anxiety that comes to the fore when a student encounters statistics in any form and at any level'.

Onwuegbuzie *et al.* (1997)

'*this emotional state is preceded by negative attitudes toward statistics and is related to but distinct from mathematics anxiety.*'

Chew and Dillon (2014)

'statistics anxiety describes an enduring, habitual type of anxiety'

Photo by Simon Wijers on Unsplash

Macher *et al.* (2015)

Measuring Statistics Anxiety

Measures of SA have been developed

Anxiety

- Statistics Anxiety Rating Scale - STARS (Cruise et al., 1985)
- Statistics Anxiety Inventory - STAI (Zeidner, 1991)
- 10 item, Statistics Anxiety Scale - SAS (Pretorius and Norman, 1992)
- An unnamed instrument measuring statistics anxiety and attitudes developed by (Zanakis and Valenzi, 1997)
- Statistics Anxiety Measure (Earp, 2007)
- 24 item, Statistics Anxiety Scale by (Vigil-Colet et al., 2008)

Attitudes

- Attitudes Towards Statistics scale - ATS (Wise, S. L, 1985)
- Multifactorial Scale of Attitudes Toward Statistics - MSATS (Auzmendi, 1991)
- Survey of Attitudes Toward Statistics - SATS-36 (Schau et al., 1995)
- Attitudes Towards Research - ATR (Papanastasiou, 2005)

Maths

- Maths Anxiety Ratings Scale (Richardson and Suinn, 1972)

Statistics Anxiety Ratings Scale (STARS)
## *'Statistics teachers are so abstract they seem inhuman'*

- 51 Items!
- 6 dimensions
  - **Test and class anxiety**
  - **Interpretation anxiety (anxiety when interpreting statistical results)**
  - **Ask for help anxiety**
  - **Worth of Statistics**
  - **Teacher anxiety**
  - **Self-concept**

- *How much anxiety would you experience, from no anxiety to strong anxiety (on a scale of 1 to 5 with 1 being no anxiety and 5 being strong anxiety)*

- Chew and Dillon (2014) recommend the Q 1-23:
- Hanna et al. (2008) provides a confirmatory analysis of STARS in a UK context, they reword several questions

Research evidence:
Why does statistics anxiety matter?

Meta-analyses show correlation with performance **r=-0.27**
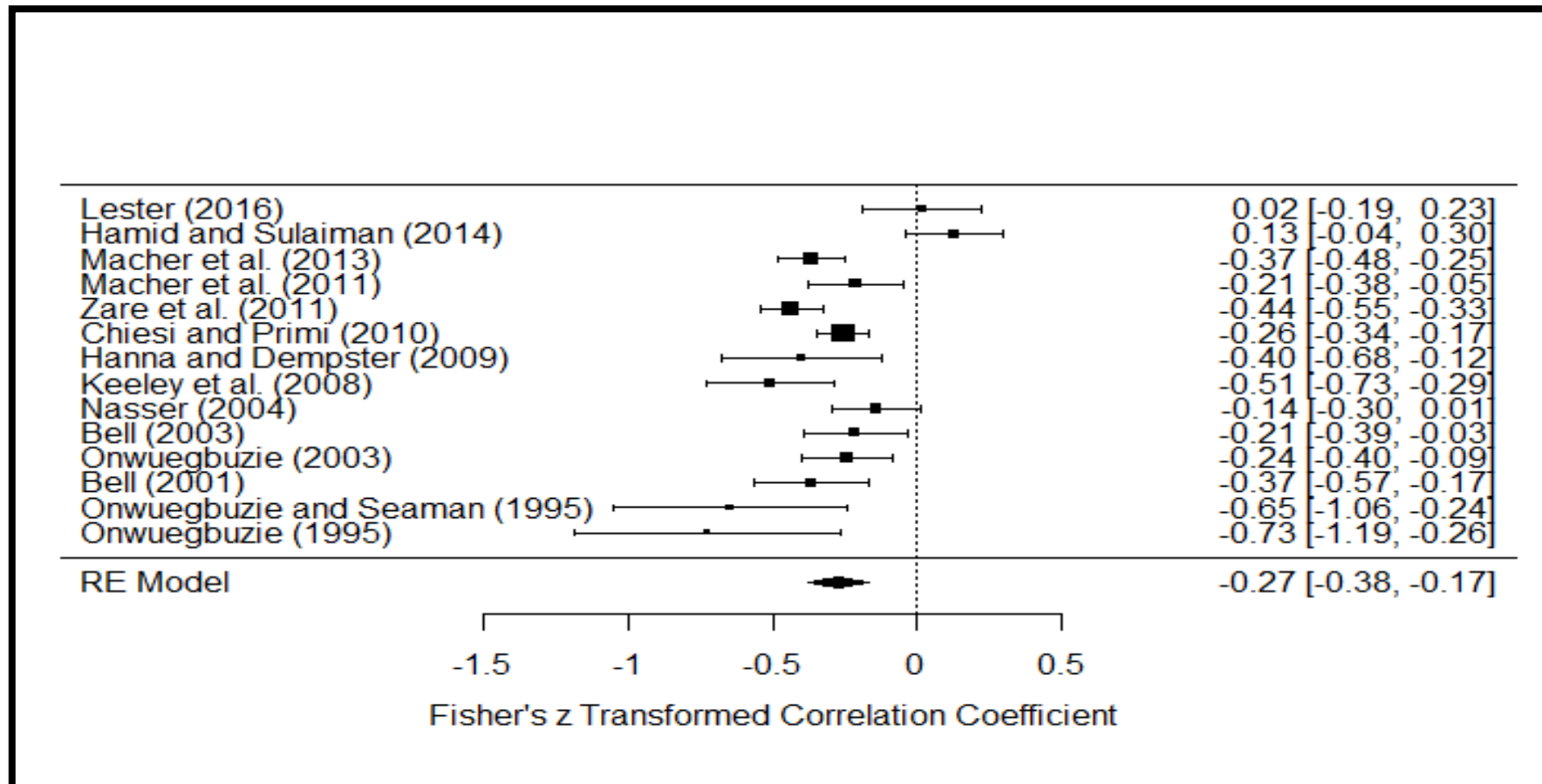
Forest plot of Hunter and Schmidt meta-analysis of the correlation between statistics anxiety and course performance. Fisher's z-standardized correlations and their 95% confidence intervals are reported for each study and the random effects estimate.

Ralston et al. unpublished

Theories

The Deficit Theory

Poor performance → Higher anxiety

Debilitating Model

Higher anxiety → Poorer performance

Reciprocal theory

Higher anxiety ⇄ Poor performance

Carey, E., Hill, F., Devine, A., & Szucs, D. (2016). The chicken or the egg? The direction of the relationship between mathematics anxiety and mathematics performance. *Frontiers in Psychology, 6*(1987). doi:10.3389/fpsyg.2015.01987

Research evidence:
Why does statistical anxiety matter?

There is evidence it correlates with debt and poor-financial decisions

Research evidence:
Why does statistical anxiety matter?

Feelings of incompetence, embarrassment, self-doubt, fear of failure

Photo by Melanie Wasser on Unsplash

Literature

antecedents of statistical anxiety

Sociodemographic, experiential and perceptual (Onwuegbuzie and Wilson, 2003)

Epistemological concerns have also been identified (Wilensky, 1997)

Epistemological concern

- This may be of particular relevance in UK sociology, a discipline where there has been a degree of historical animosity towards statistical methods (Daddow, 2010; Williams et al., 2008)

- The philosophical bases of research, and qualitative methods, are often taught and applied more widely than statistical practices (Payne et al., 2004)

Where's the evidence?

- Very little analysis examining sociology
- Very little in the UK
- Very little considering epistemological concern

Research questions

▶ Are epistemological concerns associated with reported statistics anxiety in the context of controlling more established antecedent factors?

▶ Which of the other antecedent factors (environmental/socio-demographic, situational or dispositional) are associated with reported statistics anxiety in sociology students?
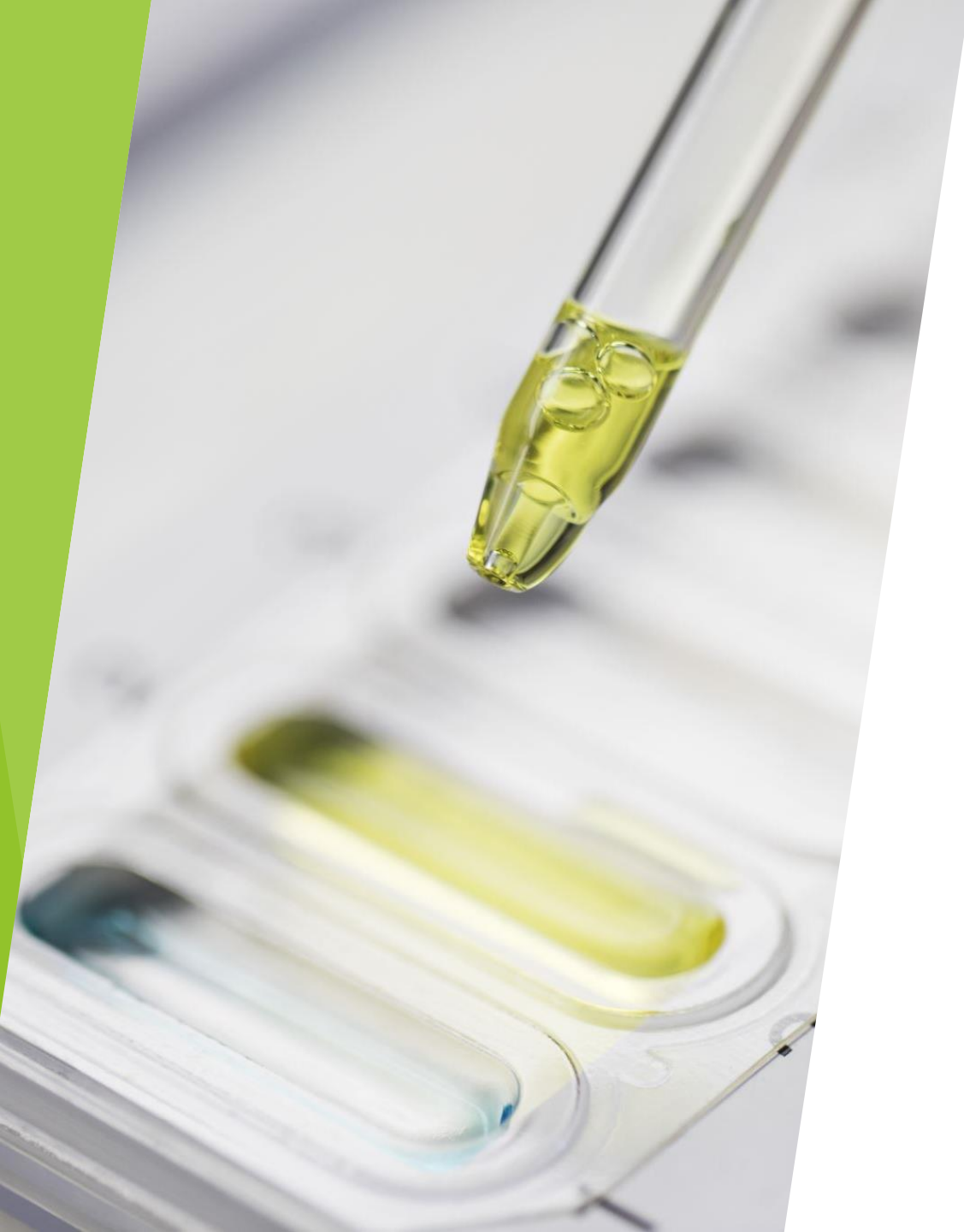
Data and analysis

Students who question the legitimacy of maths

Random sample of universities Payne et al. (2009) – on UK data service 6173

n=734 Sociology and social policy students from 32 UK universities.

- ▶ Learning statistics makes me feel anxious?
 - ▶ 53% yes
  - ▶ 47% no

Logit model on this outcome.

Payne, G., Hodgkinson, L., Williams, M. (2009). *Student Perceptions and Experiences of Quantitative Methods, 2006.* [data collection]. UK Data Service. SN: 6173. http://doi.org/10.5255/UKDA-SN-6173-1

Students who question the legitimacy of maths

- Survey questions on the legitimacy of maths – epistemological concern
  - 'Using statistics detaches you from your research topic'
  - 'I don't think sociology students should have to study statistics'

| Antecedent variables controlled in the model			
Sociodemographic	**Experiential (situational)**	**Perceptual (dispositional)**	**General variables**
Sex	Has a maths qualification	On the whole I'm good at maths	Type of course
Age	Has previously studies Quantitative Methods	My degree will help me get a good job	Current year of study
Parent who undertook higher education	Self reported average grade		

Marginal probability of reporting statistical anxiety
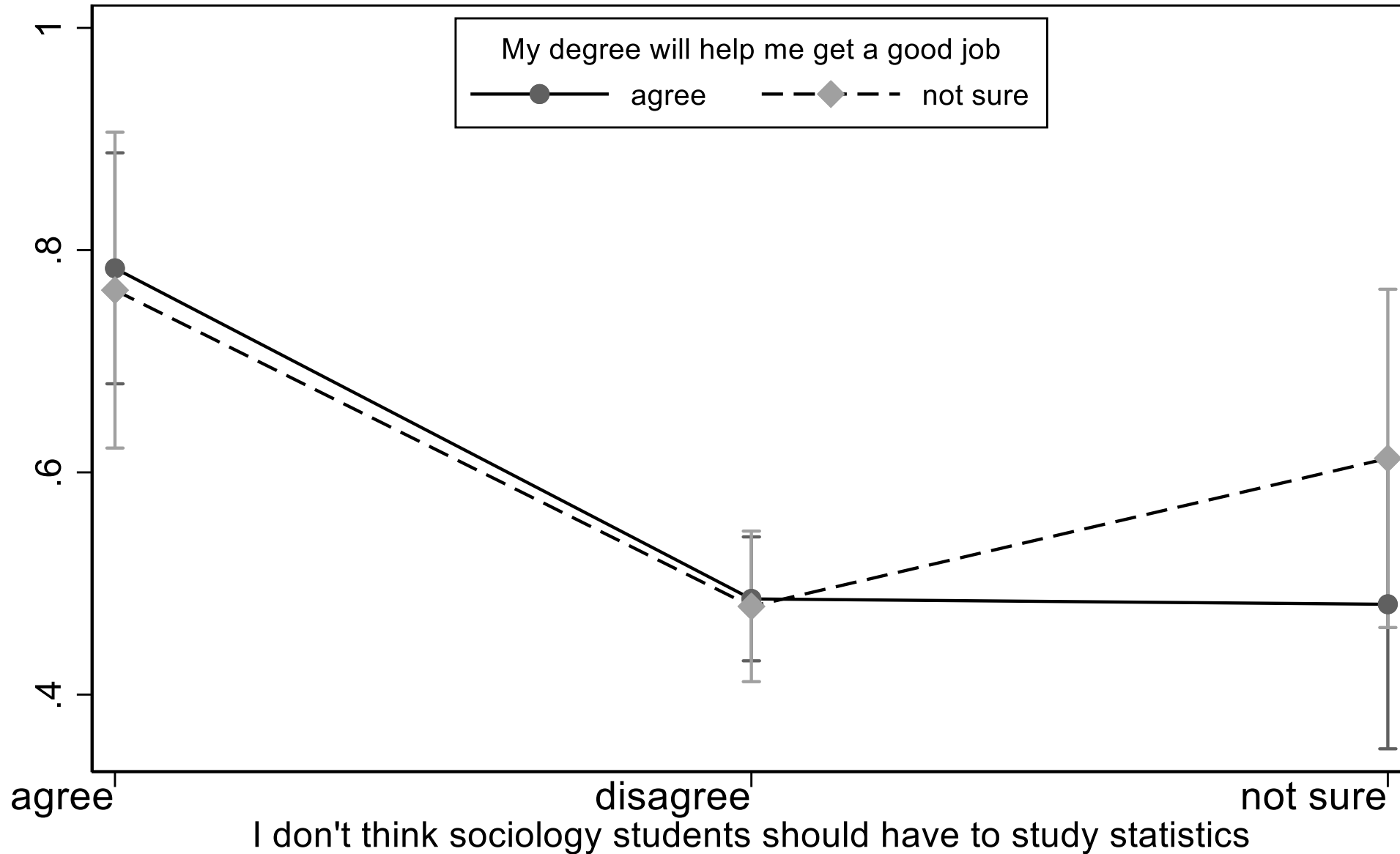
My degree will help me get a good job
— ● — agree   – – ◆ – – not sure

I don't think sociology students should have to study statistics

Source: Payne et al. 2009
Model Controls: age, sex, has a maths qualification, has studied QM, reported grade, good at maths

Marginal probability of reporting statistical anxiety
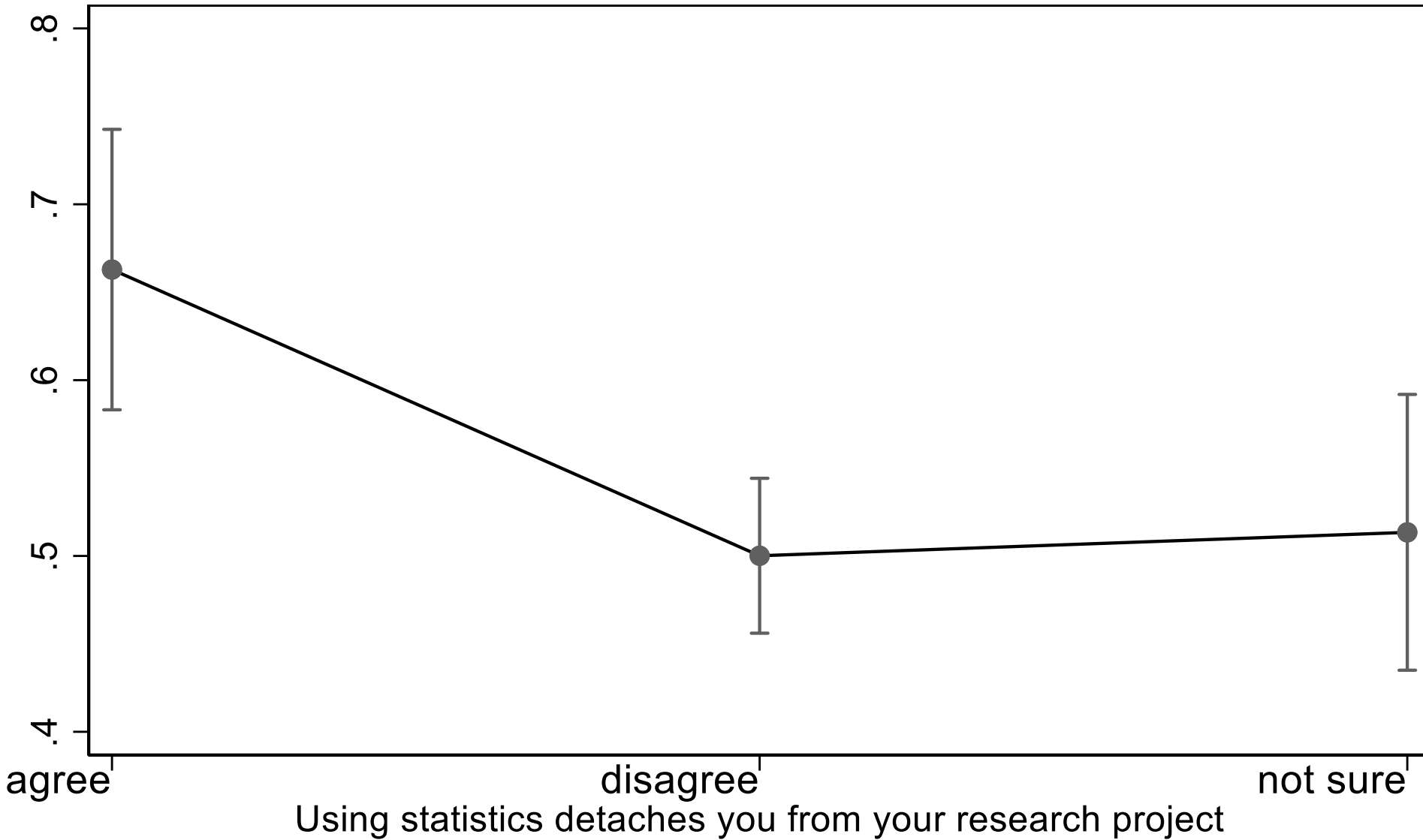
Using statistics detaches you from your research project

Source: Payne et al. 2009
Model Controls: age, sex, has a maths qualification, has studied QM, reported grade, good at maths
My degree will help me get a good job*I don't think students should have to study statistics

Results

- **Concerns of legitimacy** and **self-efficacy** are the key factors associated with likelihood a sociology student reports anxiety of statistics.

  - Along with age and sex

Antecedent variables controlled in the model			
Sociodemographic	**Experiential (situational)**	**Perceptual (dispositional)**	**General variables**
Sex p=0.01	Has a maths qualification	On the whole I'm good at maths p=0.00	Type of course
Age p=0.01	Has previously studies Quantitative Methods	My degree will help me get a good job*Should study statistics p=0.00	Current year of study
	Self reported average grade		Parent who undertook higher education

A conclusion

▶ Sociology students often do not like maths

▶ Many question the legitimacy of statistical methods

▶ The wider discipline tend not to use statistics (at least in the UK)

▶ Sociology could do a better job at engaging more widely with methods

  ▶ de-emphasise any philosophical distinction

  ▶ methods could be treated as equally appropriate tools (Gorard, 2015)
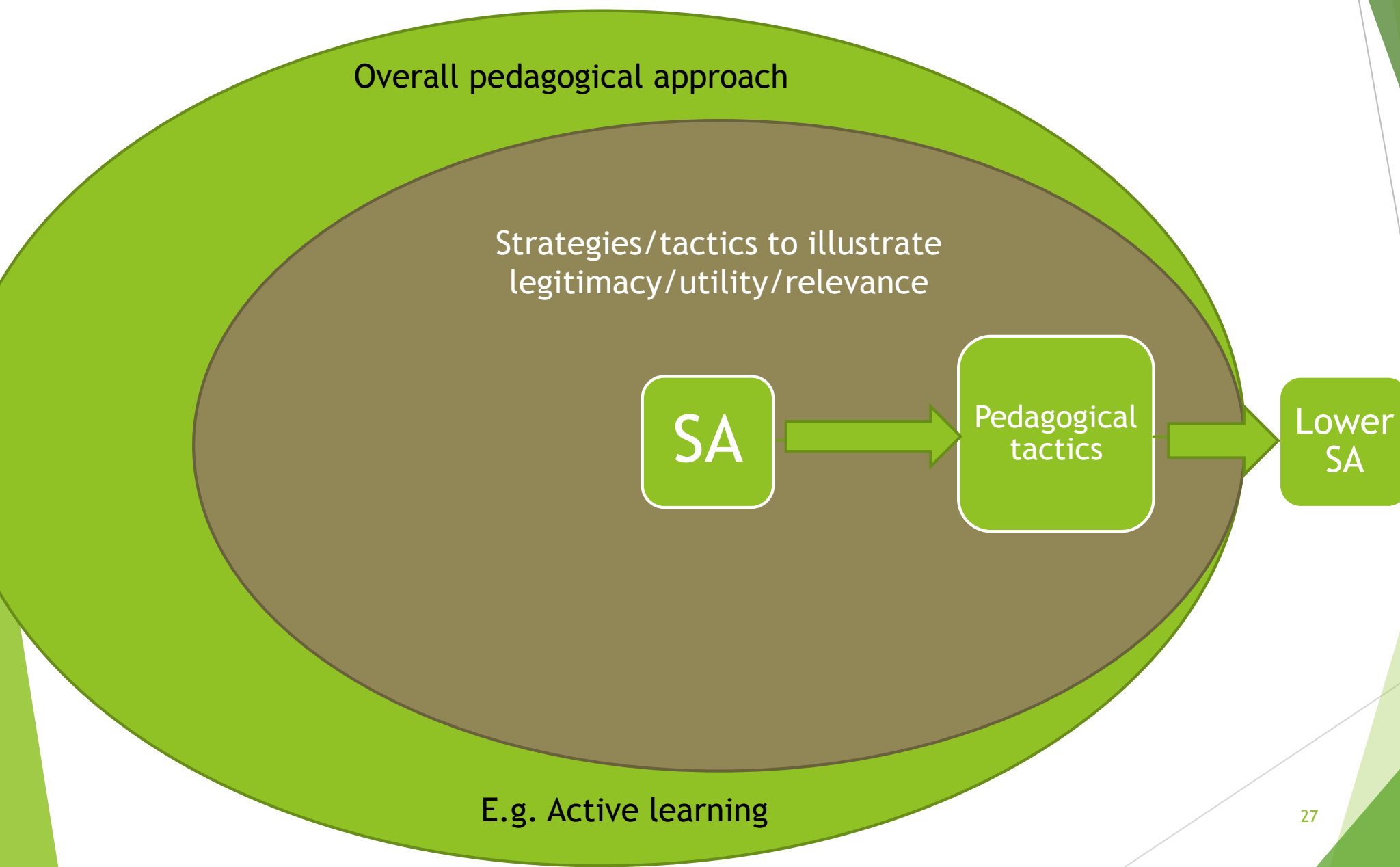
Implications for teaching?

Solution?

SA → Maths not legitimate → Pedagogical tactics → Lower SA
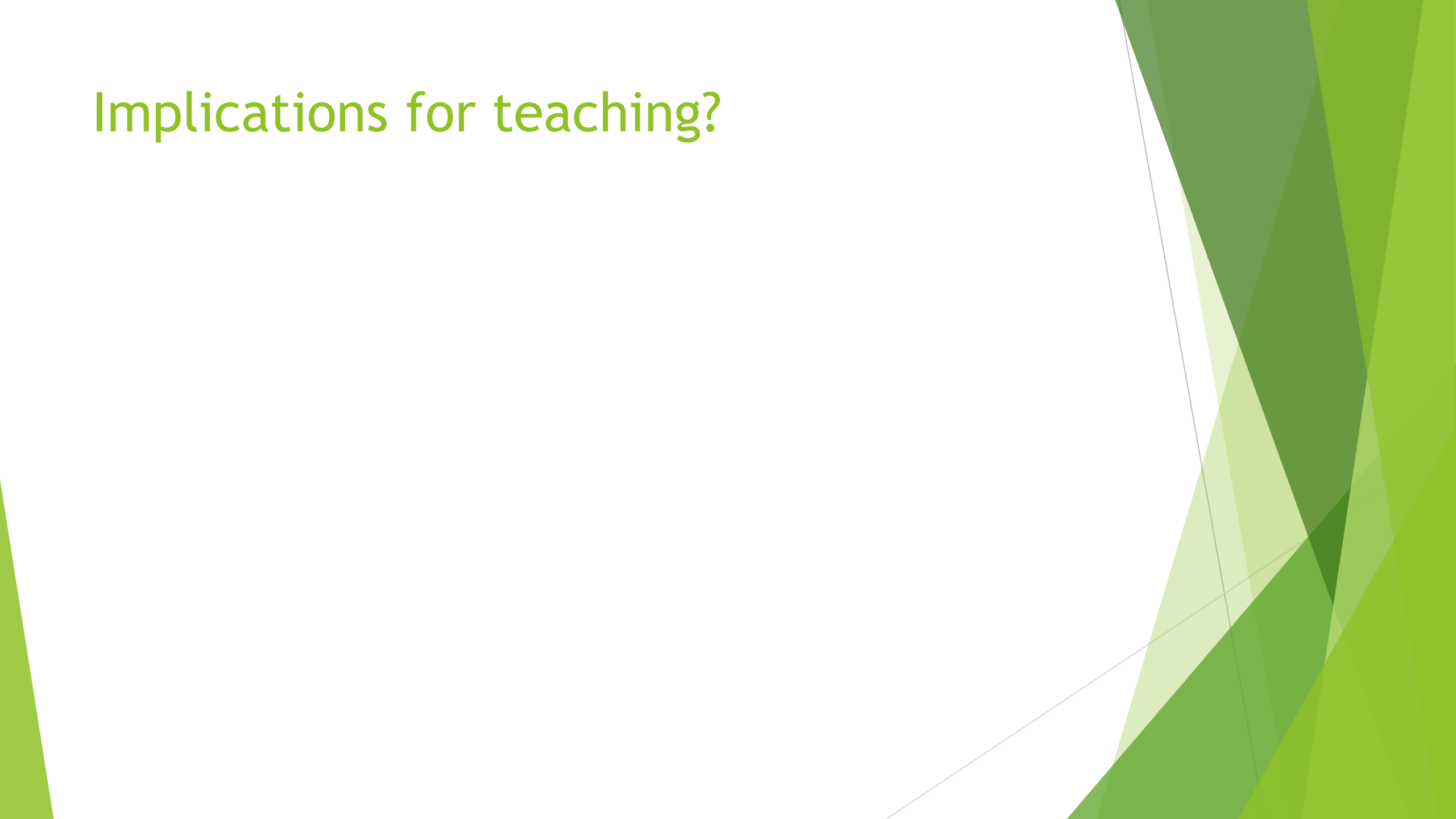
Layered pedagogical approach

Overall pedagogical approach

Strategies/tactics to illustrate legitimacy/utility/relevance

SA → Pedagogical tactics → Lower SA

E.g. Active learning

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At least three types of strategy available

- **Changing perceptions**
- **Classroom activities**
- **Physical action**

Strategies to help with anxiety:
Changing perceptions

- **Reappraisal**
  - Jamiseon et al. (2016). Those who reappraised anxiety as beneficial performed better than a control who were not told anxiety beneficial.
    - Had lower anxiety.
    - Shifting mindset from threat to challenge.

- **Mathematical resilience**: developing resilience Sue Johnston-Wilder. Mindset. Challenge/comfort and what generates an anxiety response? What are the bits that are relevant to the individual.

- **Cognitive restructuring**. Increasing the relevance of maths. Help people understand the importance of maths to life.
  - De-emphasising speed of calculation. Mistakes are part of learning. Emphasise the process. Have an environment where people can understand mistakes – formative feedback. Flexibility in problem solving. Different people approach things differently.

- **Eliminating myths:** girls aren't good at maths, I'm not a maths person, I'm a creative person, some people have a maths mind.

Strategies to help with anxiety:
Classroom activities

- **Feedback.**
  - Informal. Discussion of solutions and errors. Enable students to take control. Formative. Doesn't link anxiety and performance. Builds confidence.

- **Emotional response**
  - write down your worries, write down your fears. Just before you're faced with the fear.

- **Working memory** free up working memory space.
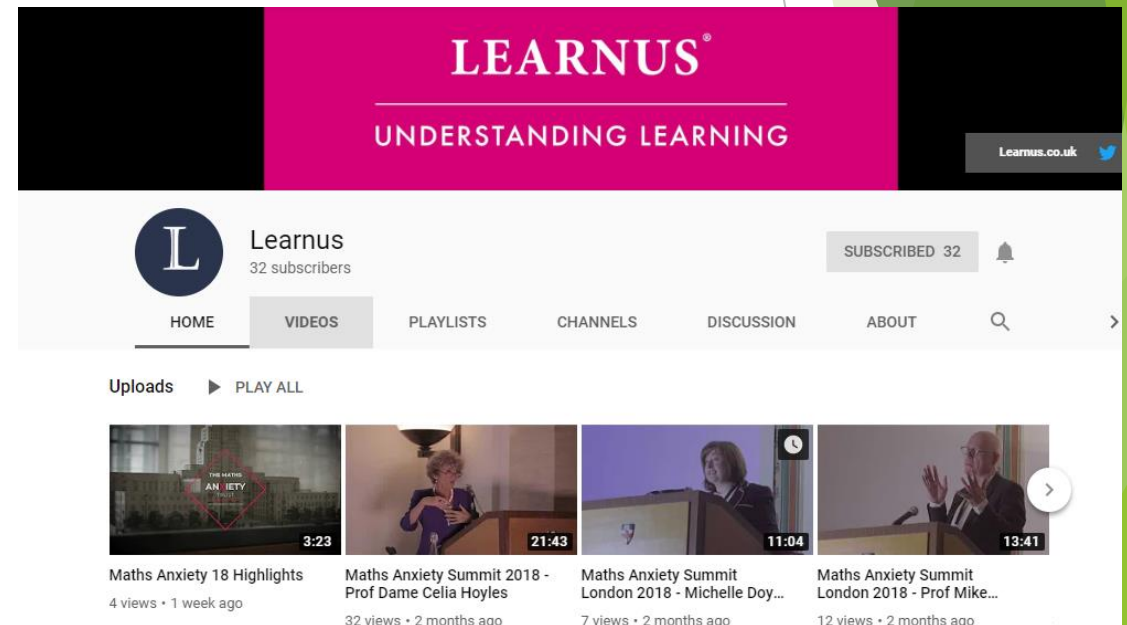 - Ashcraft and Krauis (2007) suggest supportive teachers and encouraging environments to help reduce MA.

Physical action

- **Focussed breathing.** Posture, focus of attention, diaphragmatic breathing. Improved performance.
  - Desensitisation technique. Taught them to breath, then asked them to apply as they were undertaking increasingly difficult maths.
  - Just looking at a number can lead to an anxiety response.

Research evidence:
Strategies to help with anxiety

- **Feedback**

- **Emotional response**

- **Reappraisal**

- **Focussed breathing**

- **Resilience/Cognitive restructuring**

- **Eliminating myths**

- **Working memory**

2018 Maths anxiety summit, Learnus, Tom Hunt and David Sheffield

https://www.youtube.com/channel/UCMlW1aThiDY5TB8uxS3DU0w

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Research evidence:
Strategies to help with anxiety

▶ Action research. Pick and choose strategies.

▶ Would taking a **Student Centred Learning** *'approach'* be a good way to engage with this?

▶ **Problems:**

  ▶ most work tested outside of the UK. What is the long term effect? Maths teaching anxiety and maths anxiety in teachers.

  ▶ Class size and pace/technology don't work.

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