

# What do alternative measures of learning outcomes tell us about students learning (gain)?

---

**Maria Pampaka (maria.pampaka@manchester.ac.uk)**  
**The University of Manchester**

Session 2: Student participation: how can learning gain data help students from all backgrounds access, succeed and proceed in higher education?

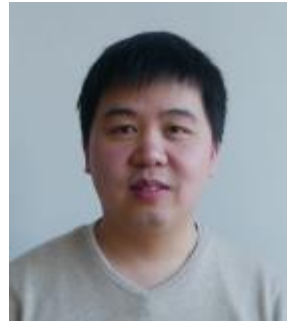
**OfS national conference on learning gain**  
**March 12<sup>th</sup>, 2019**  
**The Studio, Birmingham**

# Outline

- The project and its design
- Analytical framework
- Some measures and measurement results
- Some modelling results
- Some concluding points

# Learning Gain at Manchester

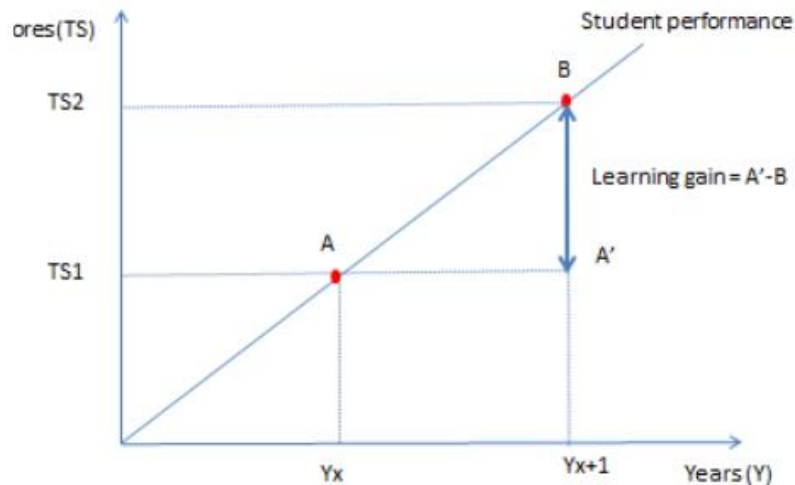
- The team:
  - Dr Maria Pampaka
  - Prof Julian Williams
  - Dr Steve Jones
  - Lawrence Wo
  - Martyn Edwards
  - Daniel Swain
- Learning (gain) – [as in alternative learning outcomes (beyond grades)]
- Measurement and Modelling of LG



# Project Design

- Mixed Methods (Grades, Surveys, 'tests', interviews)
- Longitudinal (& Cross-sectional)
  - Start of Year 2016-17 (DP1)
  - End of 2016-17 (DP2)
  - Start of 2017-18 (DP3)
- Various academic disciplines (e.g. Social Sciences, Engineering, Chemistry, Economics, Nursing)

# Redefining Learning Gain



Learning gain = the 'distance travelled' by students during their studies...

- we consider learning gain as a nexus of various interrelated dimensions (some of which might not always fall into what is normally perceived as 'learning') and influences → to account for with robust statistical modelling

# The sample

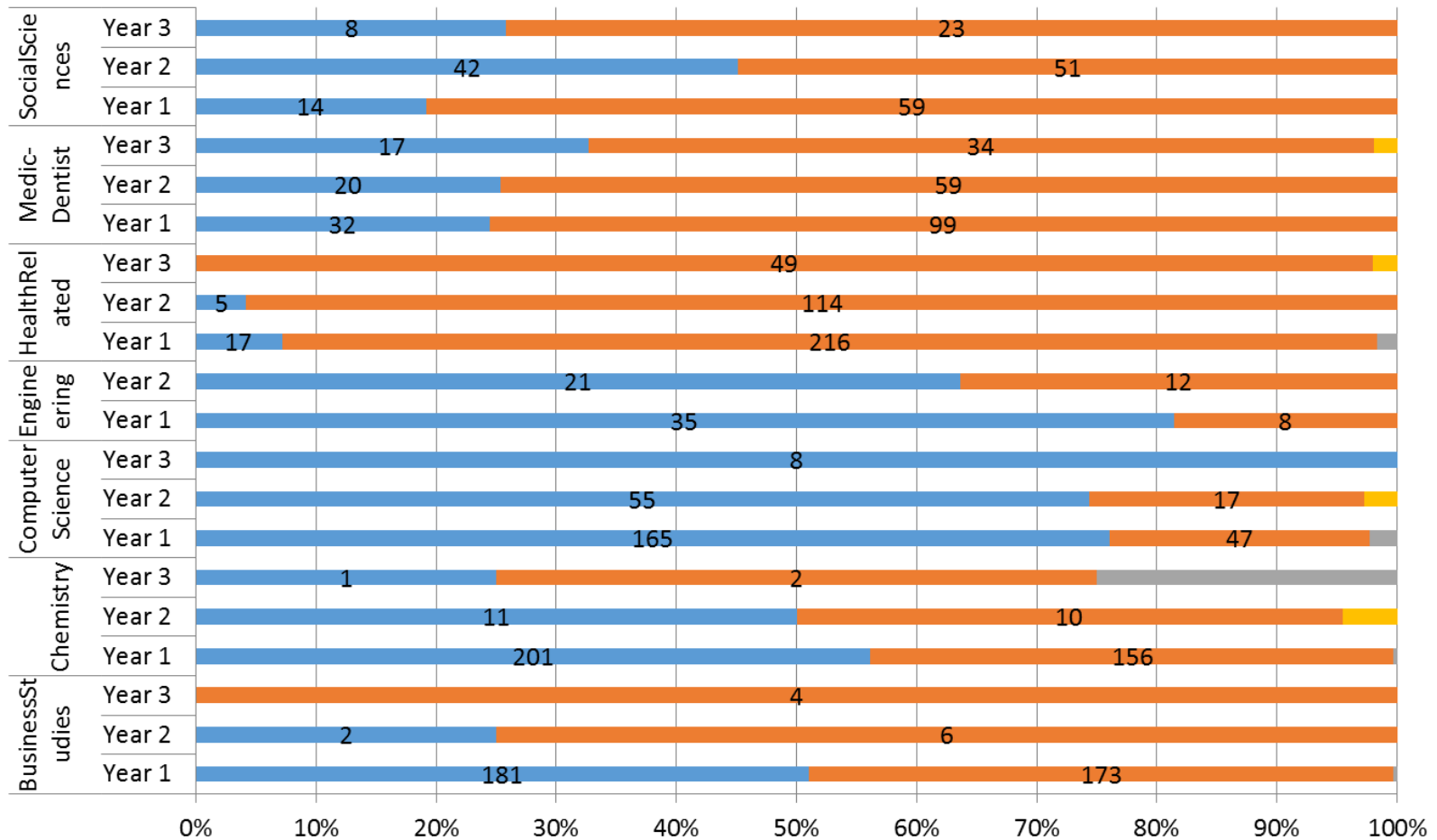
- A small sample with repeated measures (N=125+)
- Mainly cross-sectional here

Subject Area	DP1				DP2				DP3				Total
	Y1	Y2	Y3	Total	Y1	Y2	Y3	Total	Y1	Y2	Y3	Total	
Business Studies	349			349	1			1	7	8	4	19	369
Chemistry	146	3		149	3	6	1	10	210	13	3	226	385
Computer Science	88	4	6	98					130	70	2	202	300
Engineering	42			42		32		32	4	1		5	79
Health Related	50	4	2	56	13	10	6	29	177	105	42	324	409
Medic-Dentist	52	52		104					80	28	52	160	264
Other Humanities	17	20	22	59	2		4	6	18	8		26	91
Social Sciences	61			61	14	19	17	50	1	75	14	90	201
<b>Grand Total</b>	<b>805</b>	<b>83</b>	<b>30</b>	<b>918</b>	<b>33</b>	<b>67</b>	<b>28</b>	<b>128</b>	<b>627</b>	<b>308</b>	<b>117</b>	<b>1052</b>	<b>2098</b>

# The sample

## (Gender, Subject and Year group)

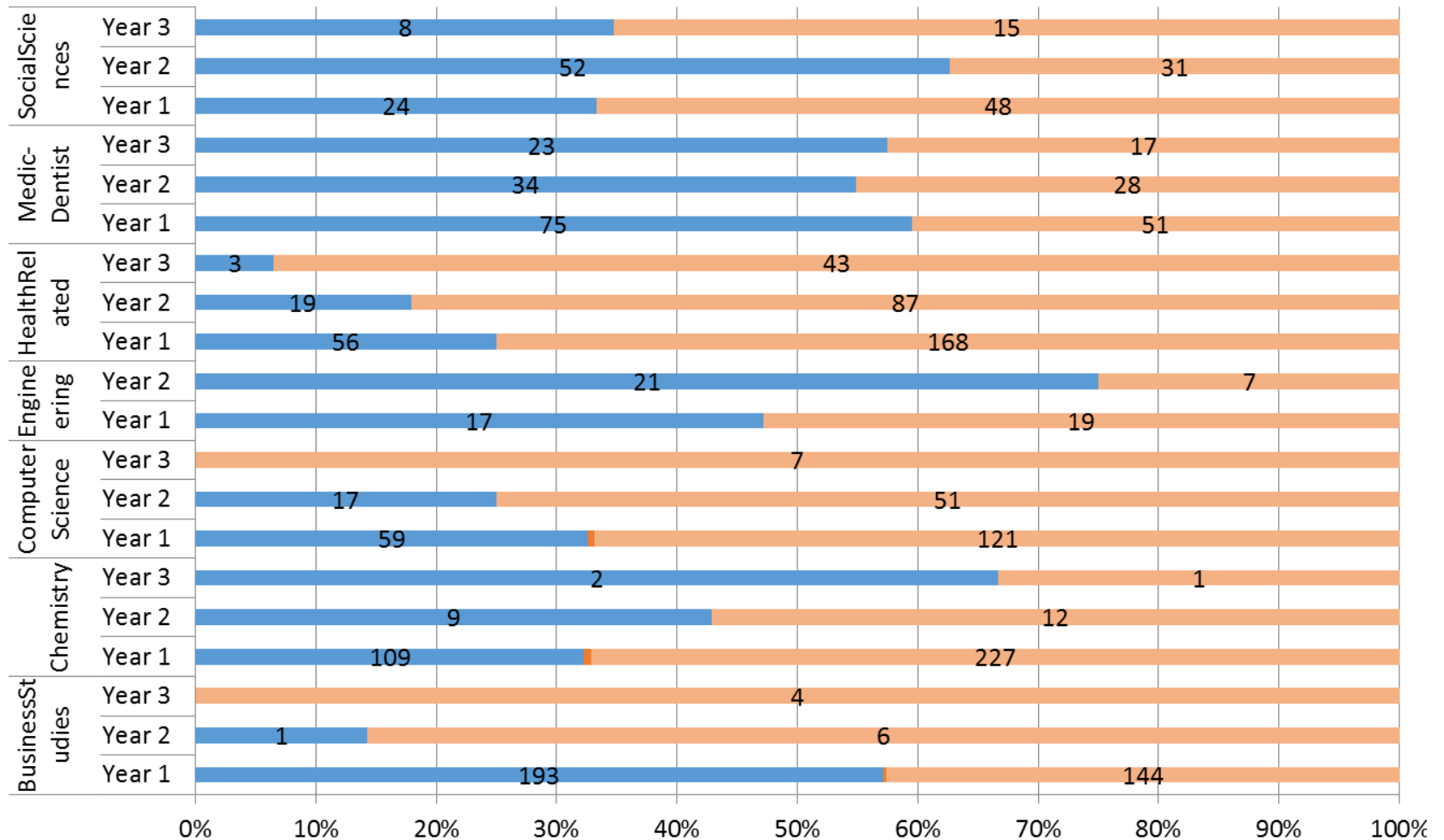
■ Male ■ Female ■ Other ■ Prefer not to say



# The sample

(Ethnic group, subject and year group)

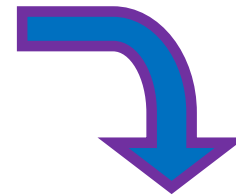
■ BME ■ NOT KNOWN ■ WHITE





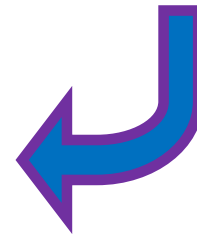
# Comprehensive Analytical Framework

**Instrument/Questionnaire  
Development**



**Constructing and Validating  
Learning Outcomes Measures  
(Rasch Model)**

**Analysis  
(Descriptive and Modelling)**



# Alternative Measures: Disposition to Complete Course

C4

We also want to know how you feel about completing your chosen degree subject.  
Please rate your agreement with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree	Don't know
I am happy with the grades I have received so far.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am certain I will complete my degree course.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am considering dropping out of my degree course.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial reasons may make me stop my course.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am working towards a first-class honours degree.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I might change my course/subject or degree Programme.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would take a job rather than complete my course if a good job was on offer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I might consider taking time off or interrupting my degree course for a while.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



# Alternative measure of process/transition: Transitional gap and positivity towards transition

**C3** Please tick the appropriate box for each statement in the table below to indicate the way in which your experience at university is different from your experience at school/college. Then choose your feelings about each change.

## Transitional Gap

How do you feel about it?  
(circle appropriate face)

What is different between university and school/college?	Negative	Mixed	Positive
I have to do <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> about the same amount of independent study at university.			
I am treated <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> equally like an adult at university.			
I have <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> about the same amount of responsibility for my own learning at university.			
The work is <input type="checkbox"/> harder / <input type="checkbox"/> easier / <input type="checkbox"/> about the same at university.			
I have access to <input type="checkbox"/> better / <input type="checkbox"/> worse / <input type="checkbox"/> about the same quality of resources/equipment at university.			
The pace of the course is <input type="checkbox"/> faster / <input type="checkbox"/> slower / <input type="checkbox"/> about the same at university.			
Learning is <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> about equally 'in depth' at university.			
Teachers have <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> about the same control over my work at university.			
I have <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> about the same opportunity to ask questions at university.			
I have <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> about the same opportunity to discuss ideas and problems at university.			
The language used is <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> about equally formal at university.			
Teaching is <input type="checkbox"/> more / <input type="checkbox"/> less / <input type="checkbox"/> about equally personal at university.			
I have a <input type="checkbox"/> more active / <input type="checkbox"/> less active / <input type="checkbox"/> about the same social life at university.			
I find it <input type="checkbox"/> easier / <input type="checkbox"/> harder / <input type="checkbox"/> about the same making friends at university.			

Positivity towards transition

# Alternative measure of Learning Process: Learning activities and positivity

C5

Please tell us how much of your study time do you expect to be spending on the following activities during this academic semester? How do you feel about this?

					How do you feel about it? (circle appropriate face)		
	Never	Rarely (monthly)	Often (weekly)	Almost always	Negative	Mixed	Positive
Study on your own	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Being taught on a one-to-one basis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Being taught in a small group (up to 10 students)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Being taught in a classroom/seminar (11-50)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Being taught in a large lecture group (>50 students)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Do laboratory work (e.g. experiments)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Do computer-based projects (e.g. analysis, simulations)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Engage with online material and resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Work with fellow students during organised sessions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Work with fellow students outside lectures or tutorials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Work-related placement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Other activities, please tell us:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			

# Measurement Approach

- ‘Theoretically’: Rasch Analysis
- ‘In practice’ – the tools:
  - Winsteps software
- Interpreting Results:
  - Fit Statistics (to ensure unidimensional measures)
  - Differential Item Functioning for ‘subject’ groups
  - Person-Item maps for hierarchy
  - Qualitative checks (Interview data)

# Fit Statistics – good measurement (construct validity) properties overall

PERSON: REAL SEP.: 2.34 REL.: .85 ... ITEM: REAL SEP.: 11.20 REL.: .99

ITEM STATISTICS: ENTRY ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD	PT-MEASURE CORR.	EXP.	OBS%	EXP%	ITEM
1	6011	2119	-.27	.03	.96	-1.4	.98	-.7	.55	.55	55.3	53.8	general_skills1
2	5981	2118	-.24	.03	1.00	.0	1.01	.4	.52	.55	57.7	53.8	general_skills2
3	5611	2100	.09	.03	1.13	4.3	1.15	5.0	.51	.56	50.6	52.7	general_skills3
4	5856	2091	-.19	.03	.90	-3.4	.91	-3.2	.58	.55	57.3	53.7	general_skills4
5	4521	1793	.42	.03	1.37	9.9	1.36	9.9	.53	.57	45.9	51.7	general_skills5
6	5493	2090	.19	.03	.83	-6.2	.83	-6.1	.62	.57	57.7	52.4	general_skills6
7	5606	2050	-.04	.03	1.10	3.3	1.10	3.3	.55	.56	53.1	53.2	general_skills7
8	5456	2070	.17	.03	.86	-4.8	.87	-4.5	.59	.57	56.5	52.5	general_skills8
9	6361	2110	-.68	.03	.90	-3.3	.90	-3.4	.57	.53	59.3	55.1	general_skills9
10	6077	2098	-.40	.03	.68	-9.9	.69	-9.9	.64	.54	63.4	54.3	general_skills10
11	5912	2084	-.26	.03	.82	-6.5	.82	-6.1	.62	.55	60.3	53.8	general_skills11
12	5040	2105	.68	.03	1.29	9.2	1.30	9.5	.55	.58	44.8	51.3	general_skills12
13	5012	2090	.67	.03	.99	-.2	1.00	-.1	.58	.58	52.1	51.3	general_skills13
14	5467	2089	.21	.03	.78	-8.0	.80	-7.3	.61	.57	58.5	52.4	general_skills14
15	5600	2116	.14	.03	1.25	8.1	1.25	8.0	.49	.56	49.1	52.5	general_skills15
16	6001	2046	-.48	.03	1.11	3.4	1.15	4.6	.47	.54	54.9	54.4	general_skills16
MEAN	5625.3	2073.1	.00	.03	1.00	-.4	1.01	.0			54.8	53.1	
S.D.	454.7	75.3	.38	.00	.19	6.0	.19	6.0			5.0	1.1	

Oral presentations

# Differential Item Functioning –

## To ensure measurement invariance across groups

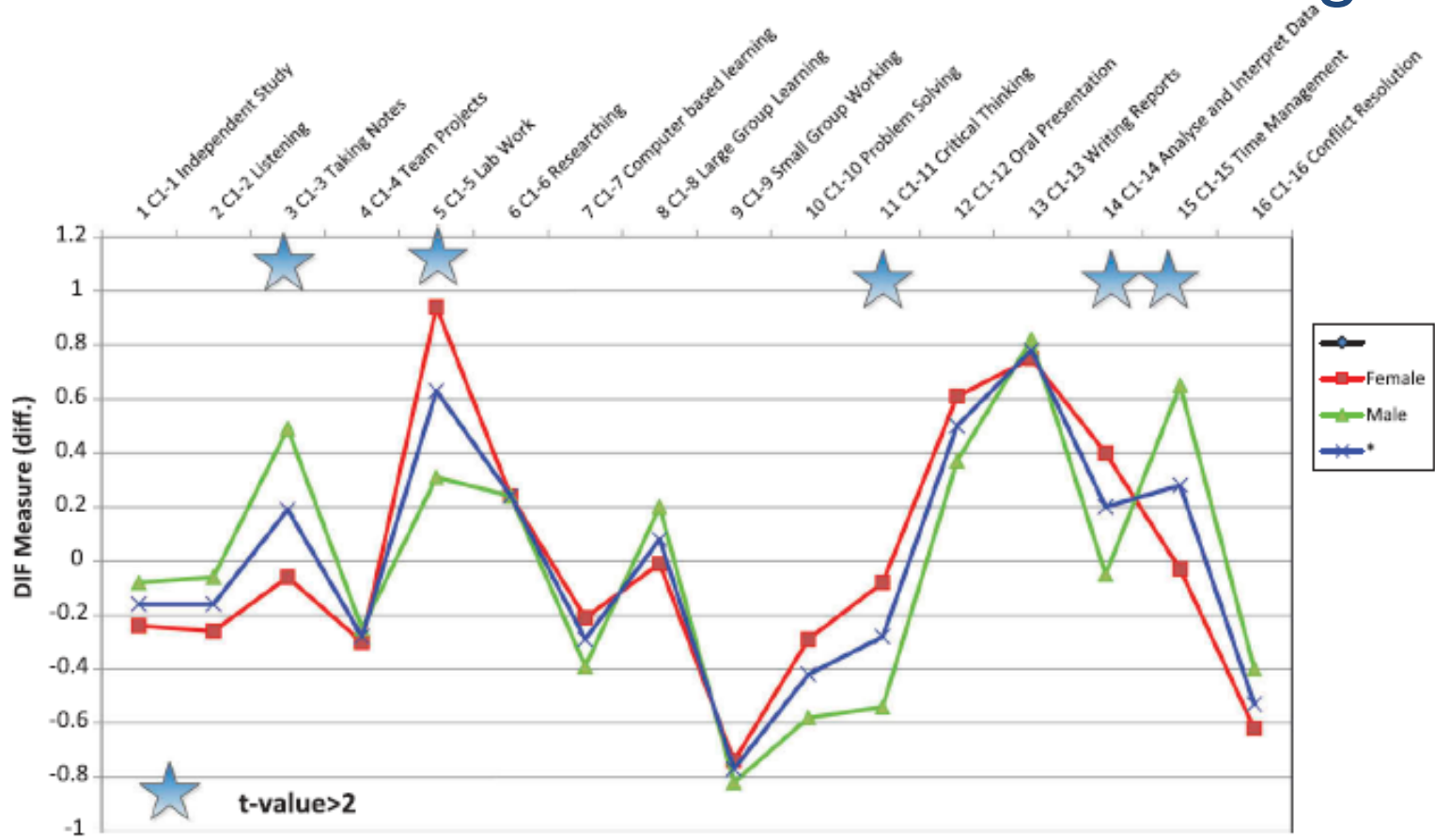
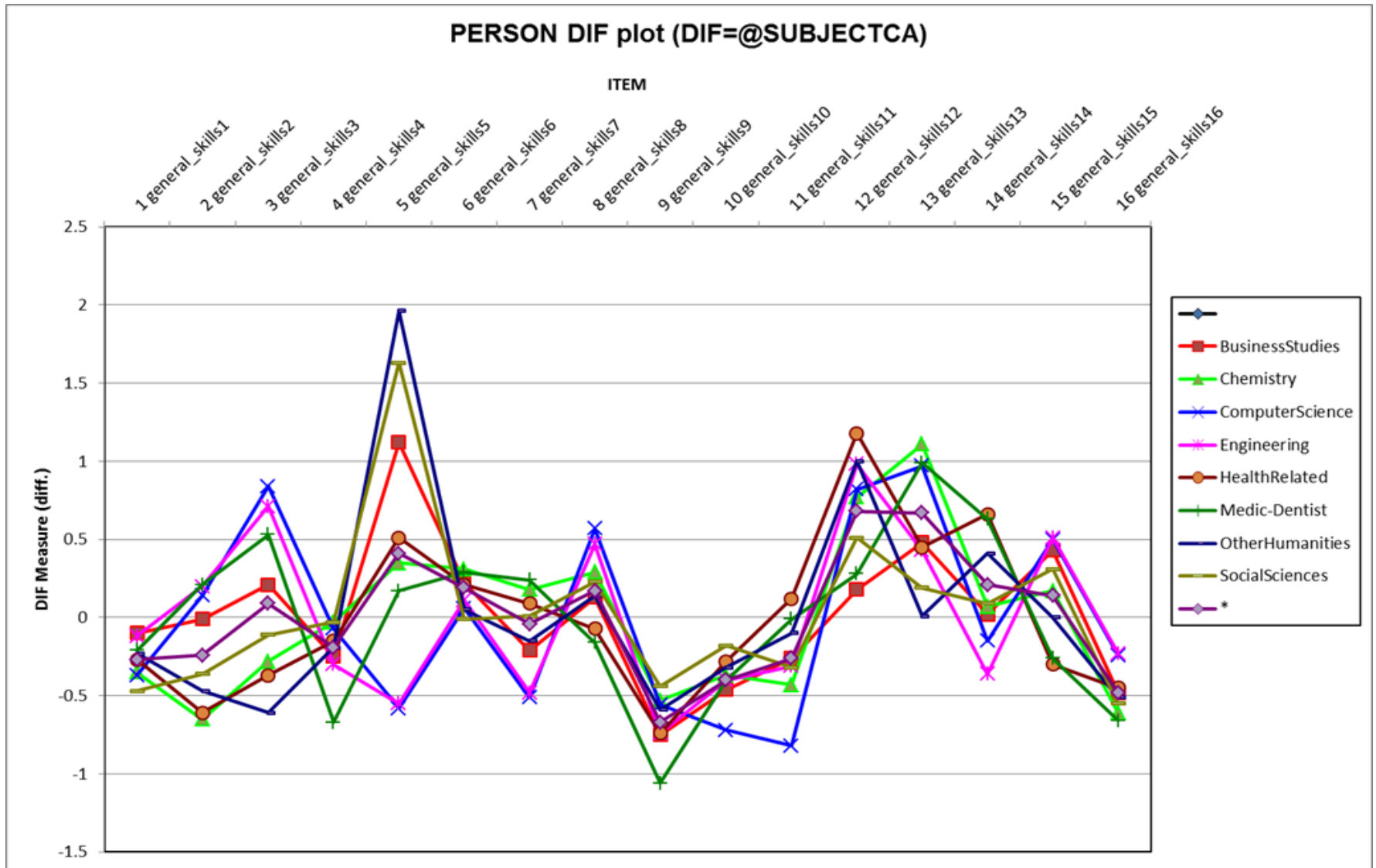


Figure 3. Item measures by gender groups and indicators of significant DIF.



# Differential Item Functioning – Some further challenges



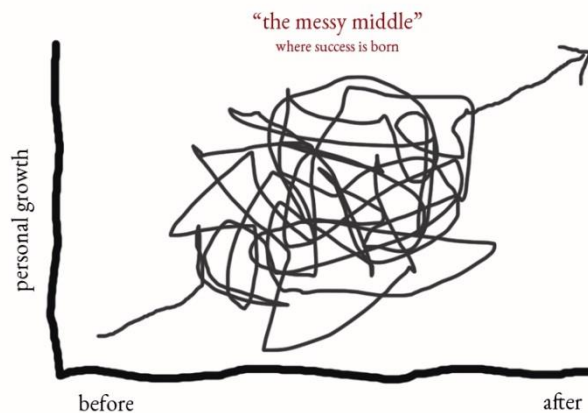
# (Some) Measures

Perceptions of process	Attitudinal/Emotional
Perception of Transitional Gap (Year 1)	Positivity towards transition
	Learner Academic Self-Efficacy (LASE)
Perception of Maths Necessity	Maths Confidence
Expectations for learning activities	Learning process positivity
	Disposition to complete course
Perception of critical reasoning	

Perception of Learning Gain	
Overall	Degree at which of varied academic experience is perceived to be helpful...(overall) or for (academic, employment, life, critical thinking)
Academic LG	
Employment LG	
Life LG	
Critical Thinking LG	

# Further statistical analysis

- With these measures
- And other background and outcome variables (e.g. degree outcome)
- How different students experience the university experience?
- Some example results...



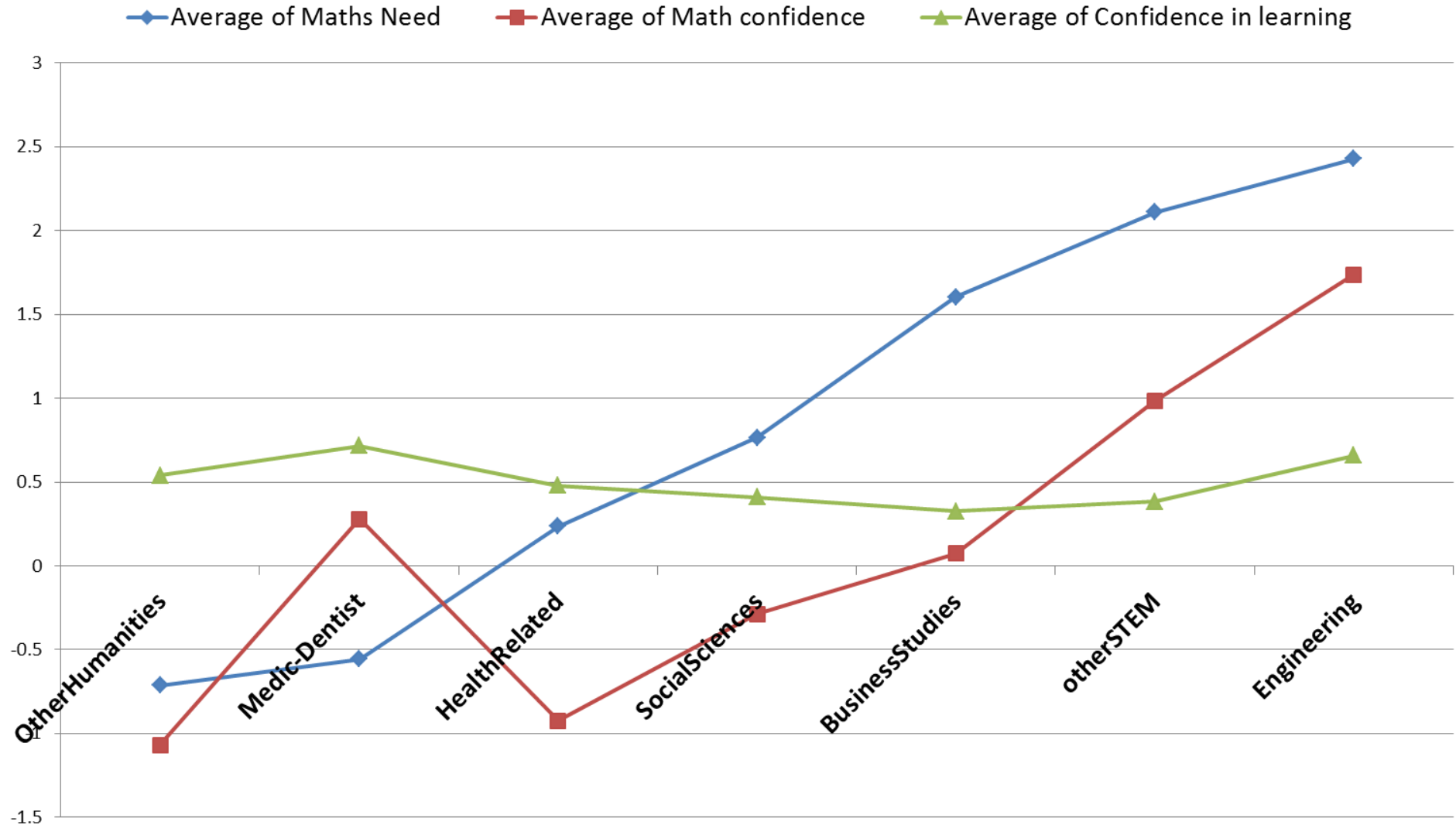
...aiming to understand some of the complexity of the process

uocoronibequindas

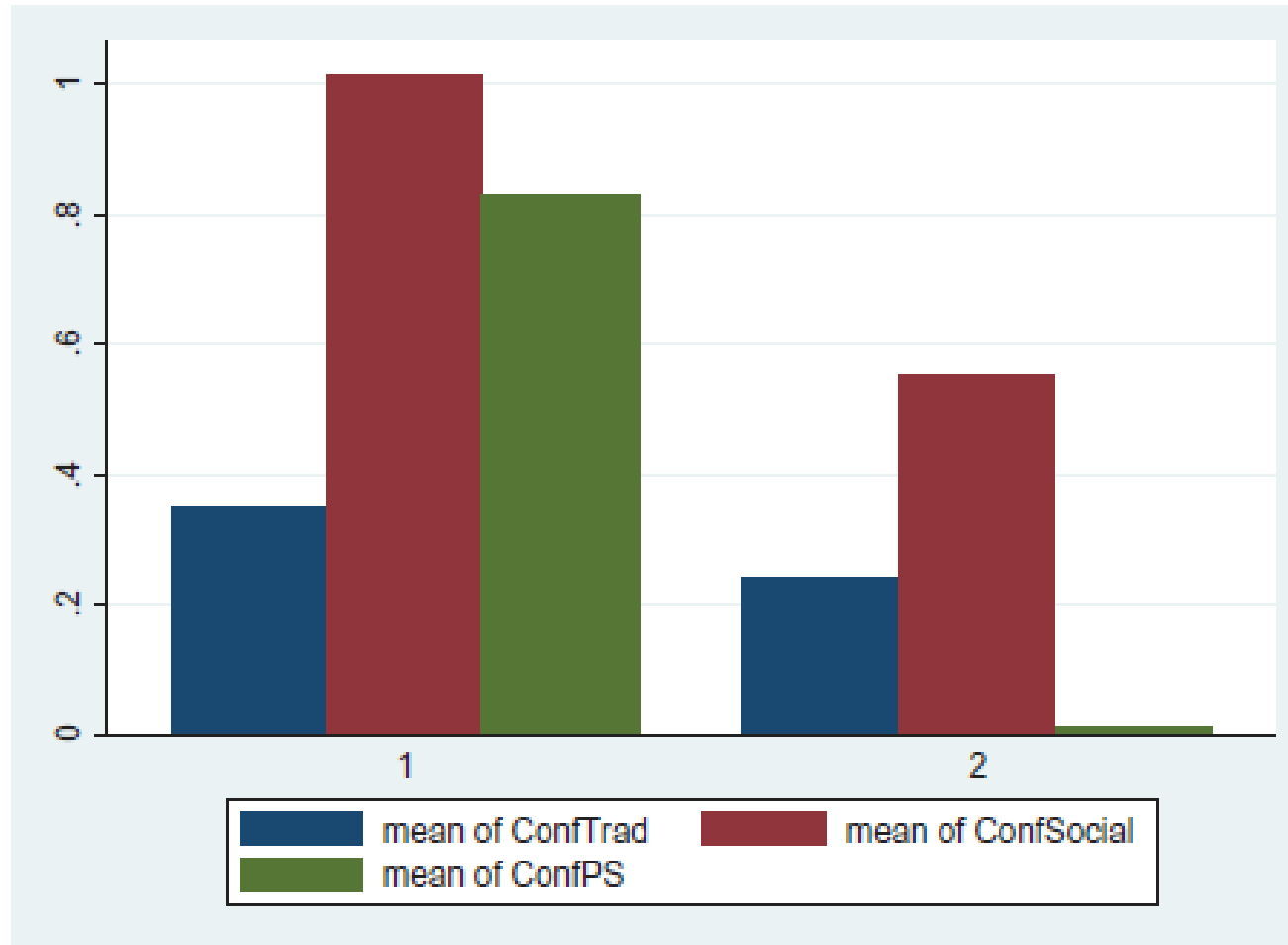
Image credits:

<http://www.soniagartside.com/blog/2016/6/21/how-to-deal-with-the-messy-middle>

# Learners' Academic Self-efficacy and Maths Confidence

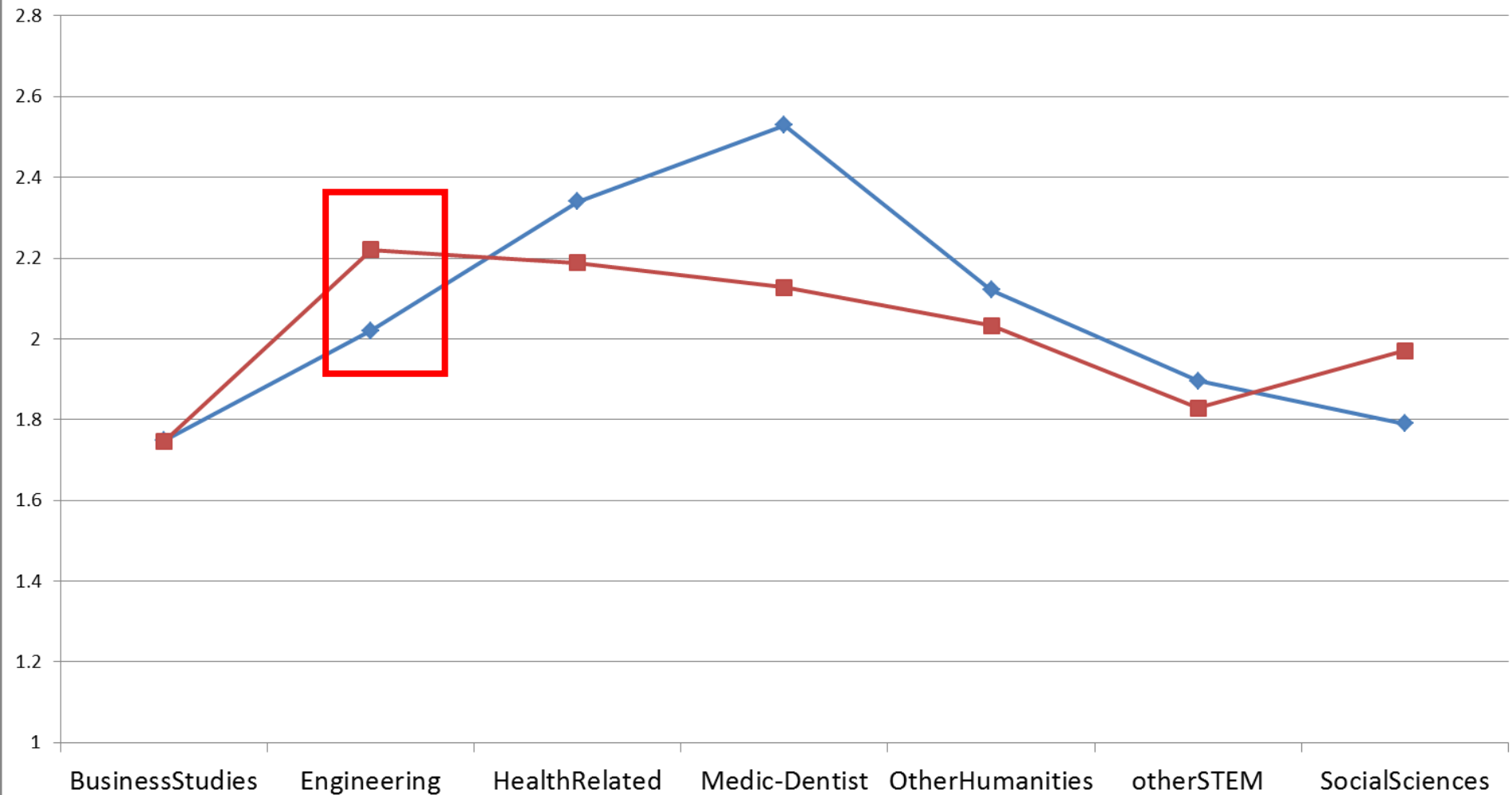


# Learners' Academic Self-efficacy (By gender, Male=1, Female=2)

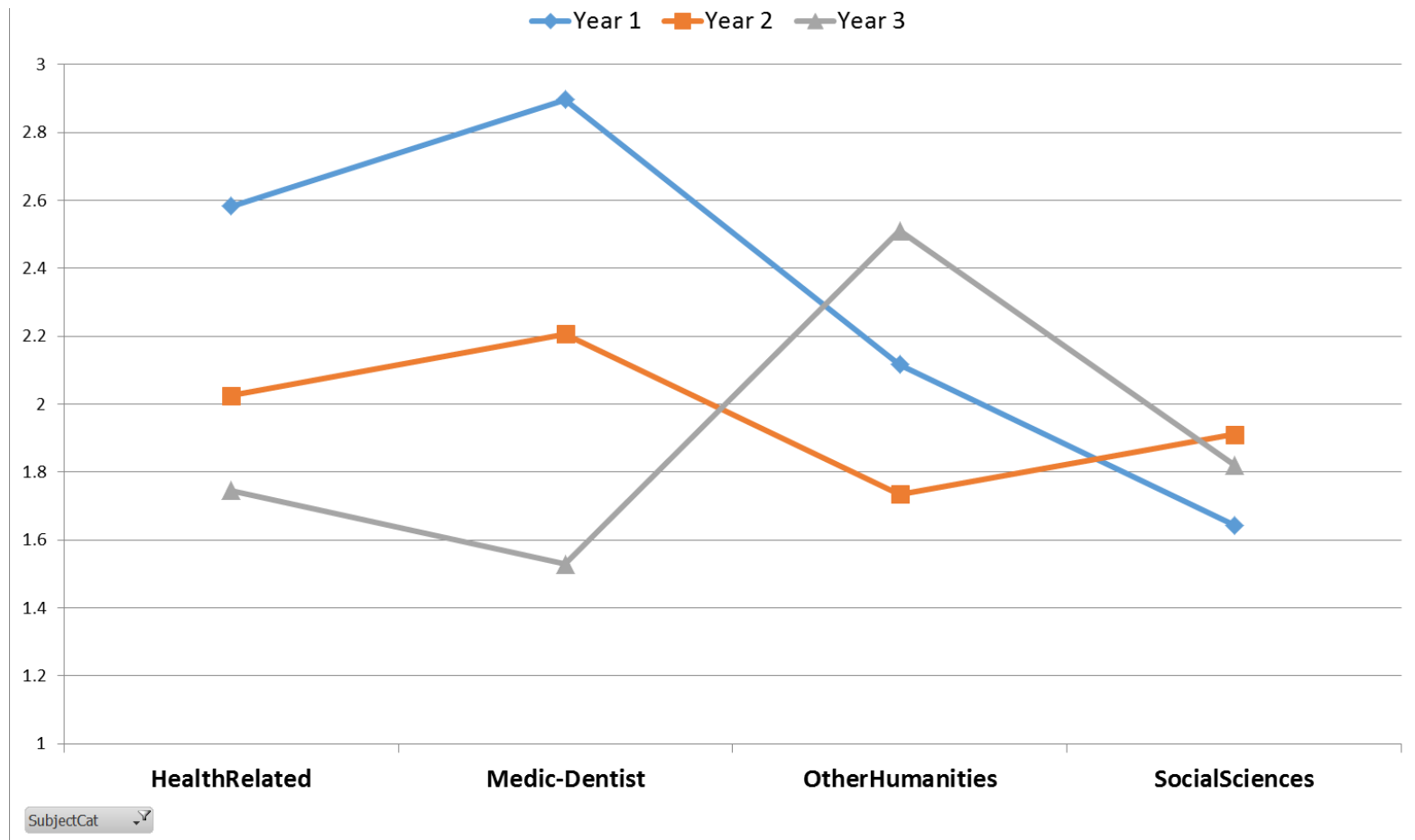


# Disposition to complete chosen course (by gender and topic, DP1)

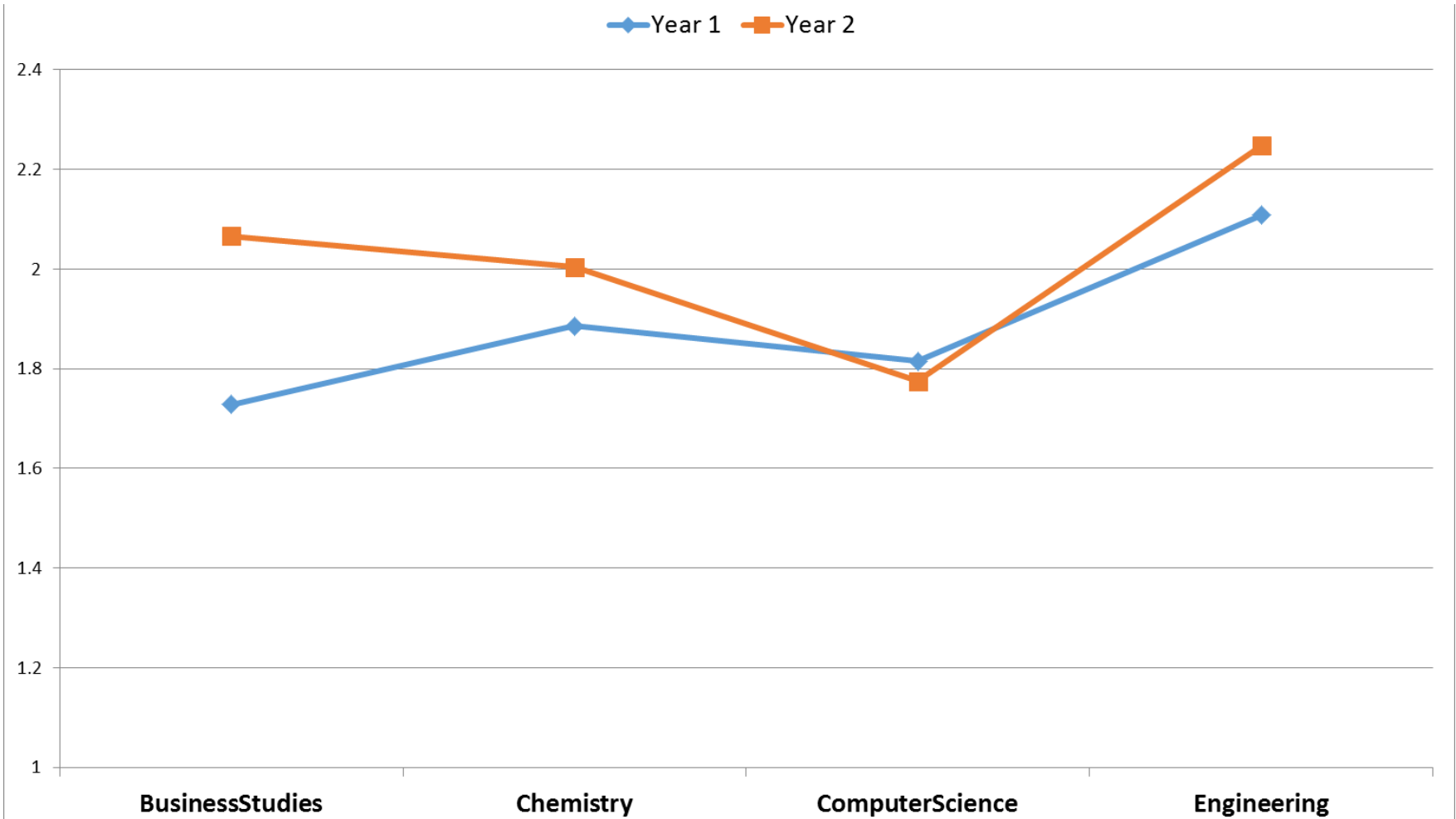
—◆— Female —■— Male



# Disposition to complete chosen course (by Year group, all DPs)

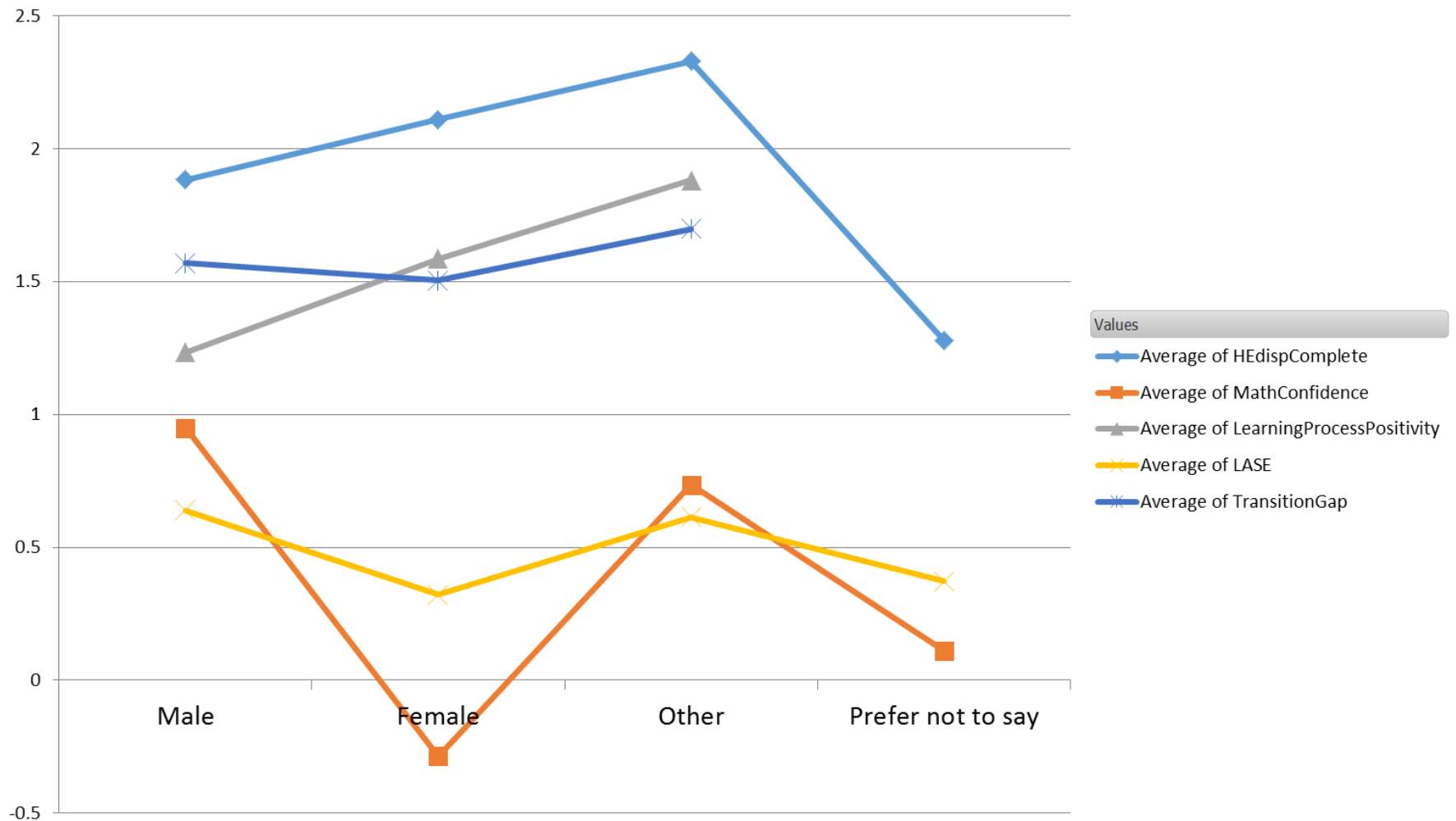


# Disposition to complete chosen course (by Year group, all DPs)

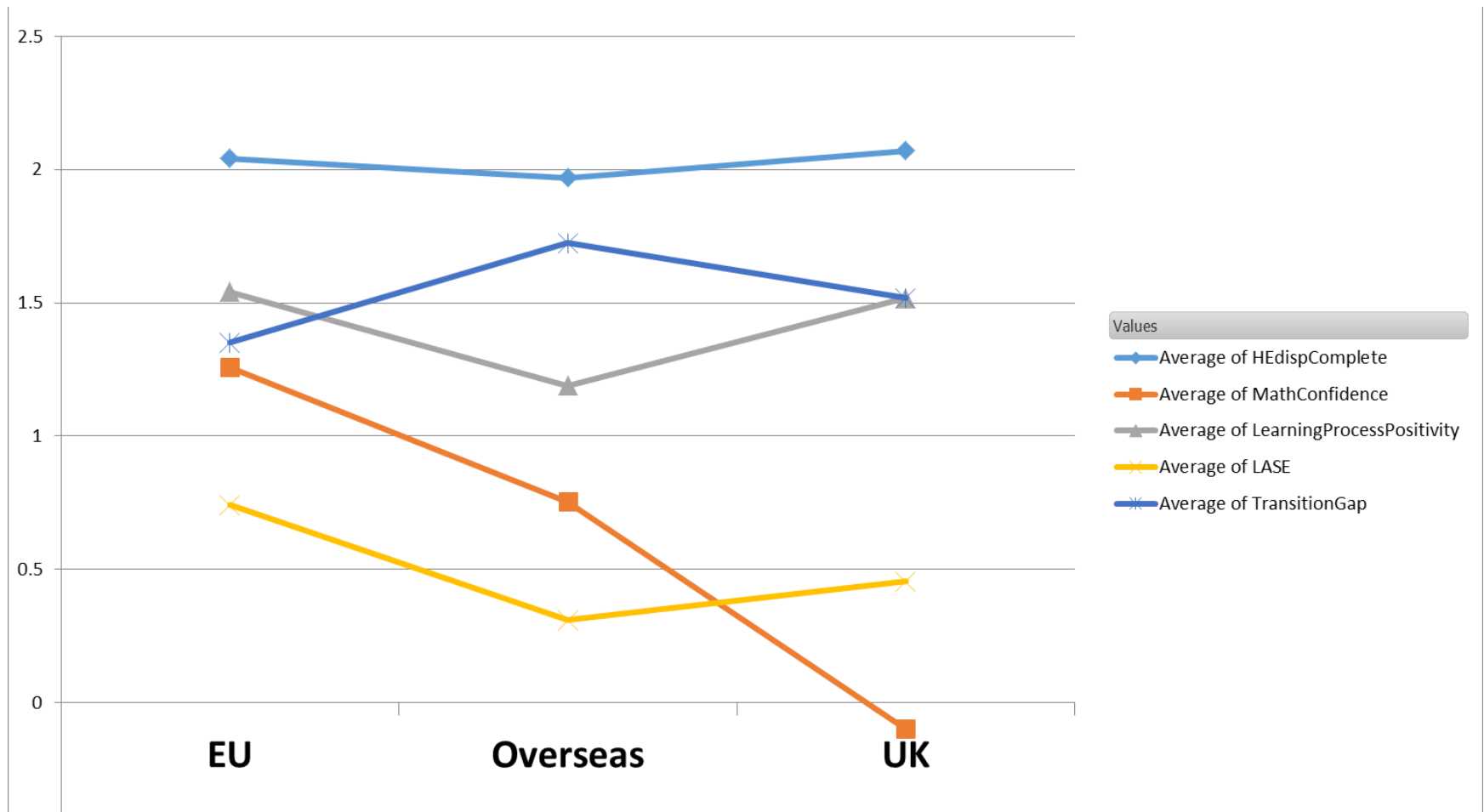




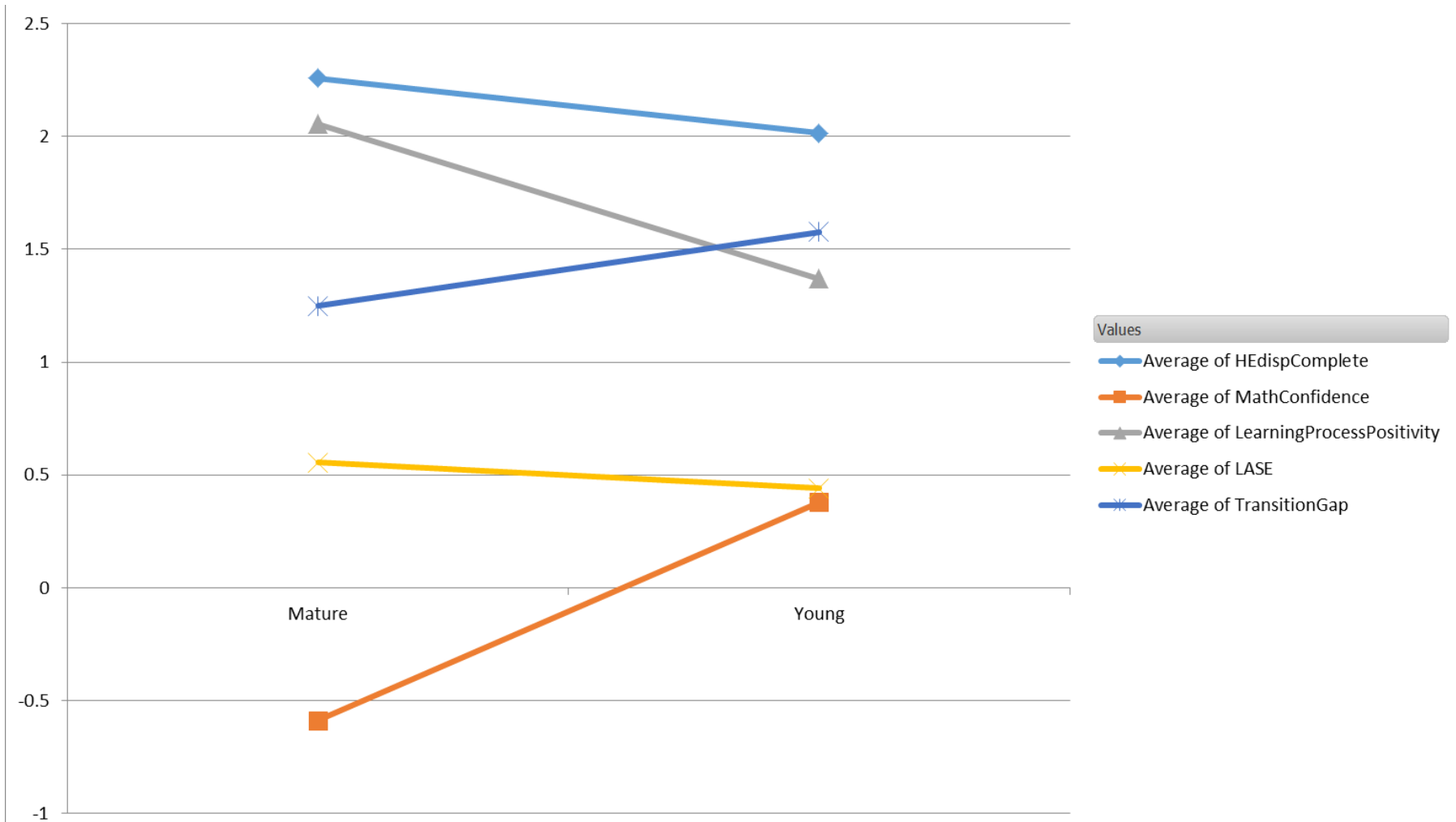
# Various measures by gender



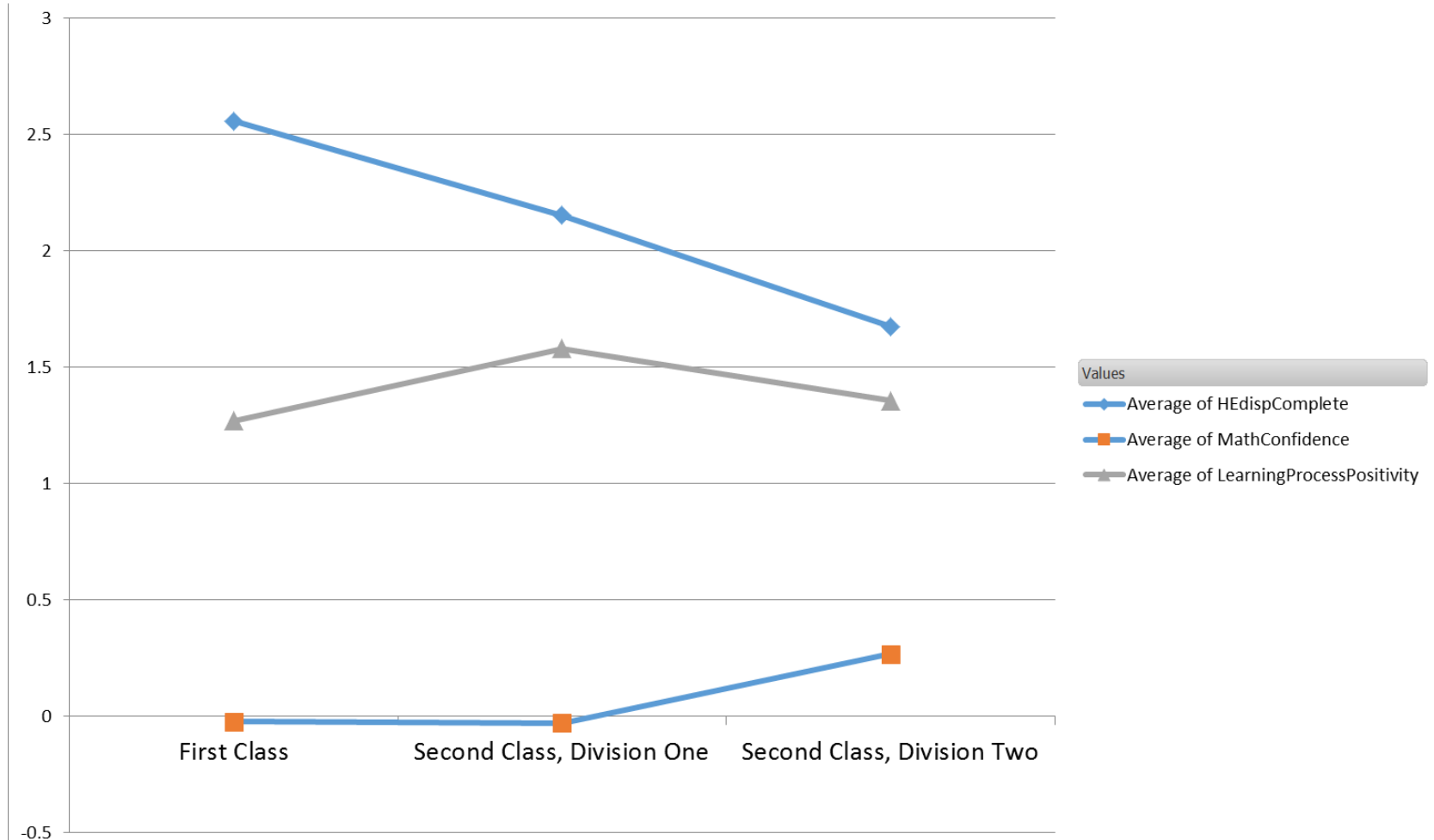
# Various measures by ethnic group



# Various measures by 'age' group



# Various measures by outcome result



# Further Analysis with such Measures

- Correlations with measures of attainment

	Entry qualification	Year 1 results
Traditional confidence	.04 (415)	.21***(394)
Social confidence	-.04 (415)	-.1* (394)
Problem-solving confidence	-.01 (415)	-.06 (394)
Maths confidence	.16**(374)	.196*** (391)
Disposition complete	.05 (412)	.18*** (393)
Transitional gap	.01 (400)	-.02 (393)
Transition positivity	-.03 (387)	.15** (387)

Note: The cells present the Pearson  $r$  correlation coefficient, significance (\*\* $p < .001$  \*\* $p < .01$ ; \* $p < .05$ ) and sample size ( $N$ ).

# Modelling Dispositions as outcomes

	Model 1 PS	Model 2 traditional	Model 3 social
Constant	1.06 (1.03)	-.22 (.89)	1.36 (1.15)
Course (ref: humanities focal)			
Health 1	.09 (.49)	-.11 (.43)	.20 (.55)
STEM focal	-.99 bn(2)***	-.04 (.18)	-.65 (.23)**
STEM other	.03 (.29)	-.37 (.26)	-.55 (.33)
Medical & health 2	-.39 (.29)	-.15 (.26)	.5 (.33)
Humanities other 1	.17 (.47)	.42 (.41)	.87 (.53)
Humanities other 2	-.92 (.57)	-.29 (.5)	-.14 (.64)
Humanities other 3	-1.2 (.29)***	-.58 (.25)*	-1.07 (.33)**
Gender (ref: female)	.7 (.18)***	.05 (.15)	.61 (.19)**
Entry qualification	-.002 (.002)	.003 (.002)	-.001 (.003)
Transitional gap	.08 (.07)	-.001 (.06)	.14 (.08)
Positivity for transition	.59 (.07)***	.5 (.06)***	.28 (.08)***
Nationality (Ref: EU)			
Overseas	-1.42 (.56)*	-1.10 (.49)*	-.98 (.62)
UK	-.85 (.5)	-.69 (.46)	.08 (.59)
Model fit statistics	Model 1	Model 2	Model 3
Number of obs	384	384	384
F (degrees of freedom)	10.61 (14, 369)	6.84 (14, 369)	4.9 (14, 369)
Prob > F	<.001	<.001	<.001
R <sup>2</sup>	.287	.206	.157
Adj R <sup>2</sup>	.26	.176	.125
Root Mse	1.523	1.329	1.704

Note: Model parameters on the top part of the table are presented as: coefficients (standard error) significance (\*\*\* $p < .001$ ; \*\* $p < .01$ ; \* $p < .05$ ).

# Regression Models of Learning Gain

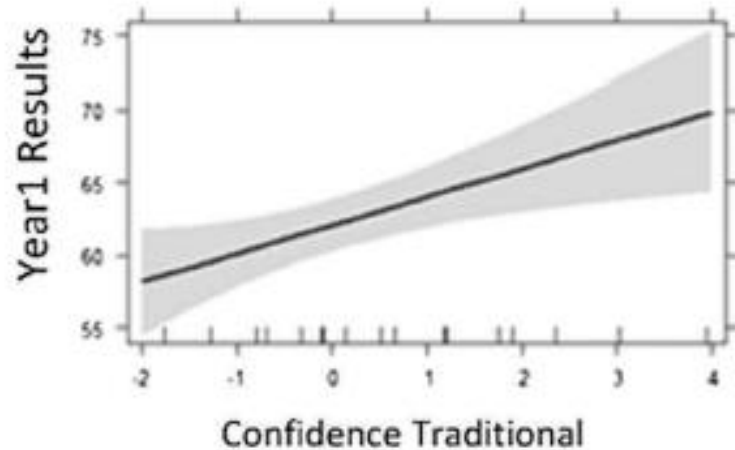
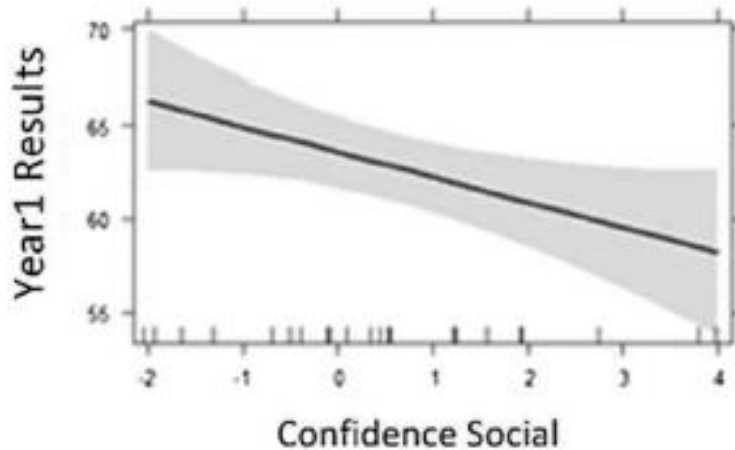
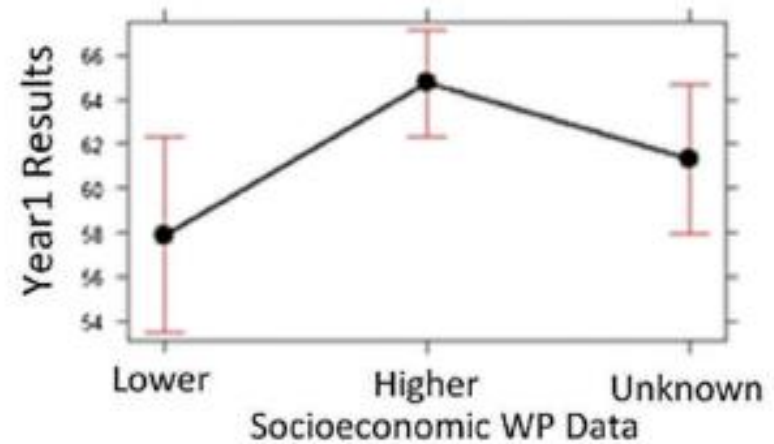
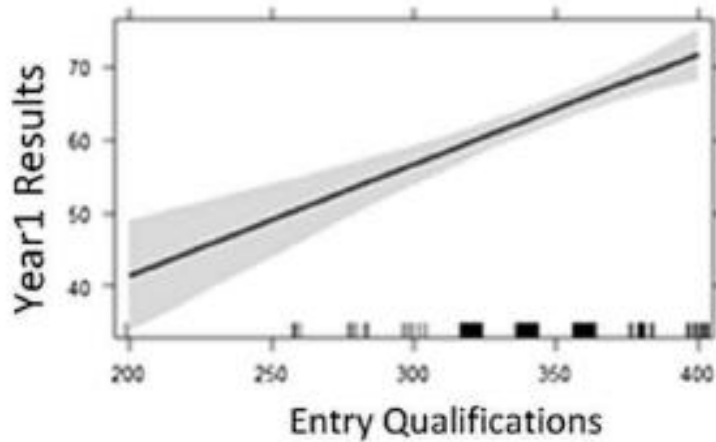
Outcome of Uni (or Year 1) ~ Starting Qualifications + Background Variables + Attitudinal variables + Transition + Teaching Practice + ...

**Table 8.** Regression models for the learning gain (year 1 results as outcome).

	Model LG1	Model LG2	Model LG3
Constant	-.41 (9.39)	4.39 (9.45)	16.12 (9.96)
Entry qualification	0.17 (0.03)***	.17 (.03)***	.15 (.03)***
Gender (Ref: Male)	-1.22 (1.82)	-1.86 (1.92)	-2.82 (1.92)
Subject (Ref: Humanities Course)	-1.179 (1.87)	-2.51 (2.02)	-3.42 (2.07)
Transitional gap	-.37 (0.8)	-.23 (.79)	-.13 (.78)
Positivity about transition	.66 (.88)	.31 (.96)	.16 (.95)
Disposition to complete course	1.82 (0 .71)*	1.52 (.72)	1.35 (.71)
Confidence' Problem solving'		-.47 (.7)	-.14 (.7)
Confidence' social'		-.97 (.61)	-1.34 (.62)*
Confidence' traditional'		1.75 (.73)*	1.95 (.73)**
Maths confidence		.5 (.51)	.64 (.51)
Socio-economic (Ref: Lower)			
Higher			6.87 (2.62)**
Unknown			3.41 (2.81)
Model Fit Statistics	Model LG1	Model LG2	Model LG3
Number of observations	209	208	208
F (degrees of freedom)	8.36 (6, 202)	6.13 (10, 197)	5.96 (12, 195)
Prob > F	<.001	<.001	<.001
R <sup>2</sup>	.199	.237	.268
Adj R <sup>2</sup>	.175	.198	.223
Root MSE	12.95	12.79	12.59

Note: Model parameters on the top part of the table are presented as: coefficients (standard error) significance (\*\*\* $p < .001$ ; \*\* $p < .01$ ; \* $p < .05$ ).

# Effect Plots for a LG Model





# Concluding Points

- To reduce Learning Gain to 'distance travelled' (on a straight line) in terms of attainment alone is to overlook the multiple and complex other ways in which students develop while at university → Complex modelling of LG and reconceptualisation as a multi-dimensional vector.
- We have been able to measure various aspects of this experience/trajectory with multiple, multi-item scales [With occasional challenges with comparability across groups].
- Beyond these challenges, there is still consequential validity and use value of such measures → our research has shown that students with different background characteristics bring with them different academic dispositions. These dispositions can sometimes be a key predictor of LG and must therefore be taken into account alongside attainment indicators.
- Our research ultimately raises questions about the use of LG → LG for who?

# Modelling LG ...for who?

- Teaching and Learning Teams to understand their students and their needs
- Students – to monitor their learning
- Universities to monitor their staff
- TEF
- Government



# References

- [Pampaka, M](#), Swain, D, [Jones, S](#), [Williams, J](#), Edwards, M & Wo, L 2018, '[Validating constructs of learners' academic self-efficacy for measuring learning gain](#)', *Higher Education Pedagogies*, vol. 3, no. 1, pp. 118-144. <https://doi.org/10.1080/23752696.2018.1454264>
- [Jones, S](#), [Pampaka, M](#), Swain, D & Skyrme, J 2017, '[Contextualising Degree-Level Achievement: an exploration of interactions between gender, ethnicity, socio-economic status and school type at one large UK University](#)', *Research in Post-Compulsory Education*, vol. 22, no. 4, pp. 455-476. <https://doi.org/10.1080/13596748.2017.1381287>