Establishing measurement invariance across time within an accelerated longitudinal design

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Overview

- Introducing the (educational) problem
- Introducing the project

- Introducing the analytical/methodological framework
- Methodological and Analytical Challenges
- A measurement approach to validation
  - With emphasis on measurement invariance

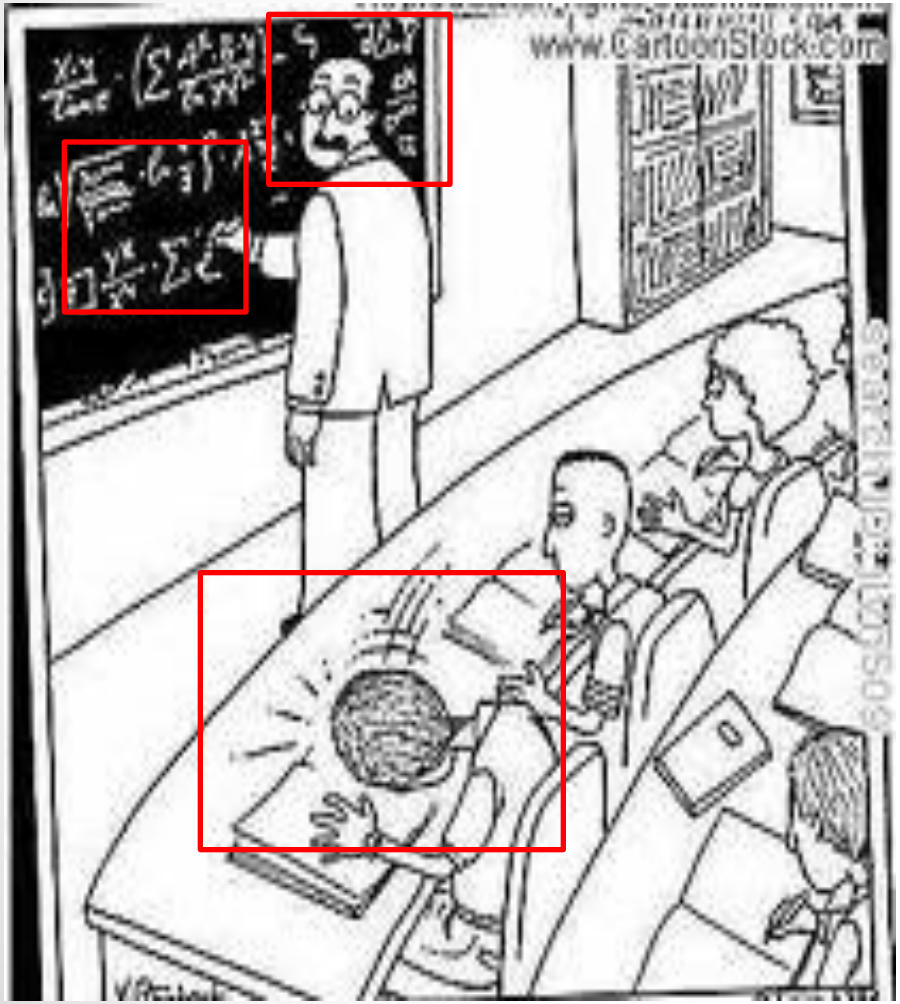
- Statistical modelling of repeated measures (of dispositions)

- Concluding/Discussion Points

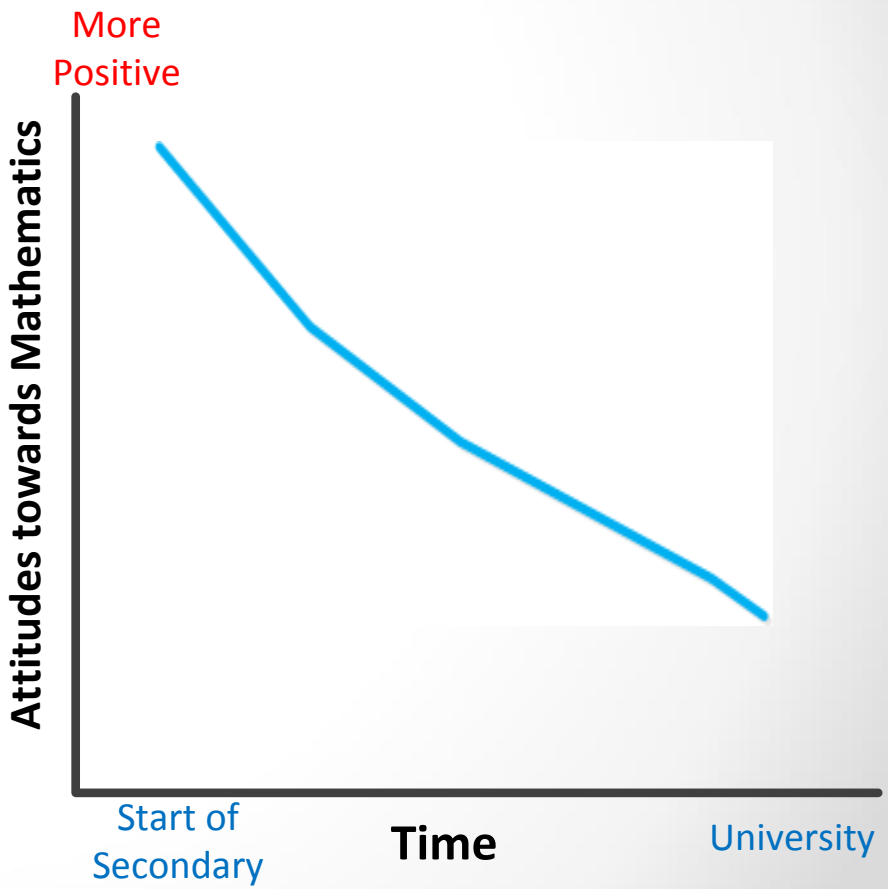
The problem…

Declining students' mathematics dispositions/attitudes

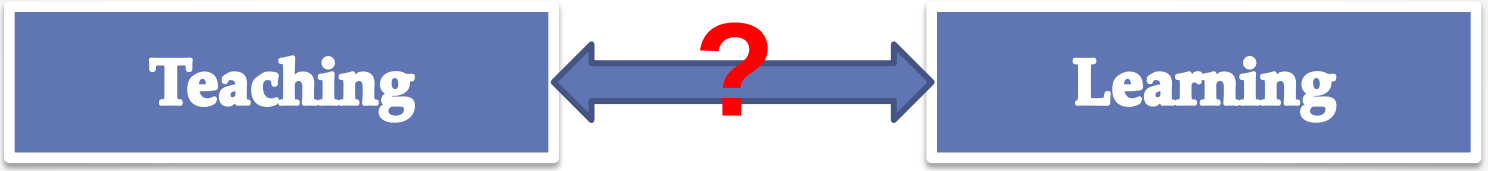
The main actors

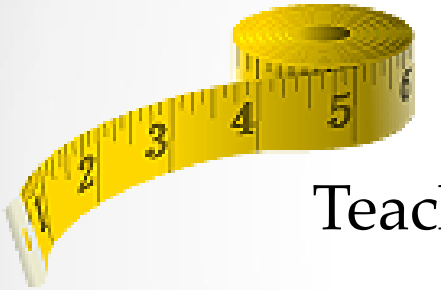


Recent evidence …



A research problem / question…





Teaching practices

Learning Outcomes and Attitudes

What is the association between teaching styles/practices in mathematics with variables relevant to students' mathematical dispositions /attitudes?

The project: TeLePriSM

Teaching and Learning Practices in Secondary Mathematics

ESRC funded study in UK (2011-2014) (www.teleprism.com)

Aim: To map secondary students' learning outcomes and choices, including dispositions and attitudes, together with the teaching they are exposed to.

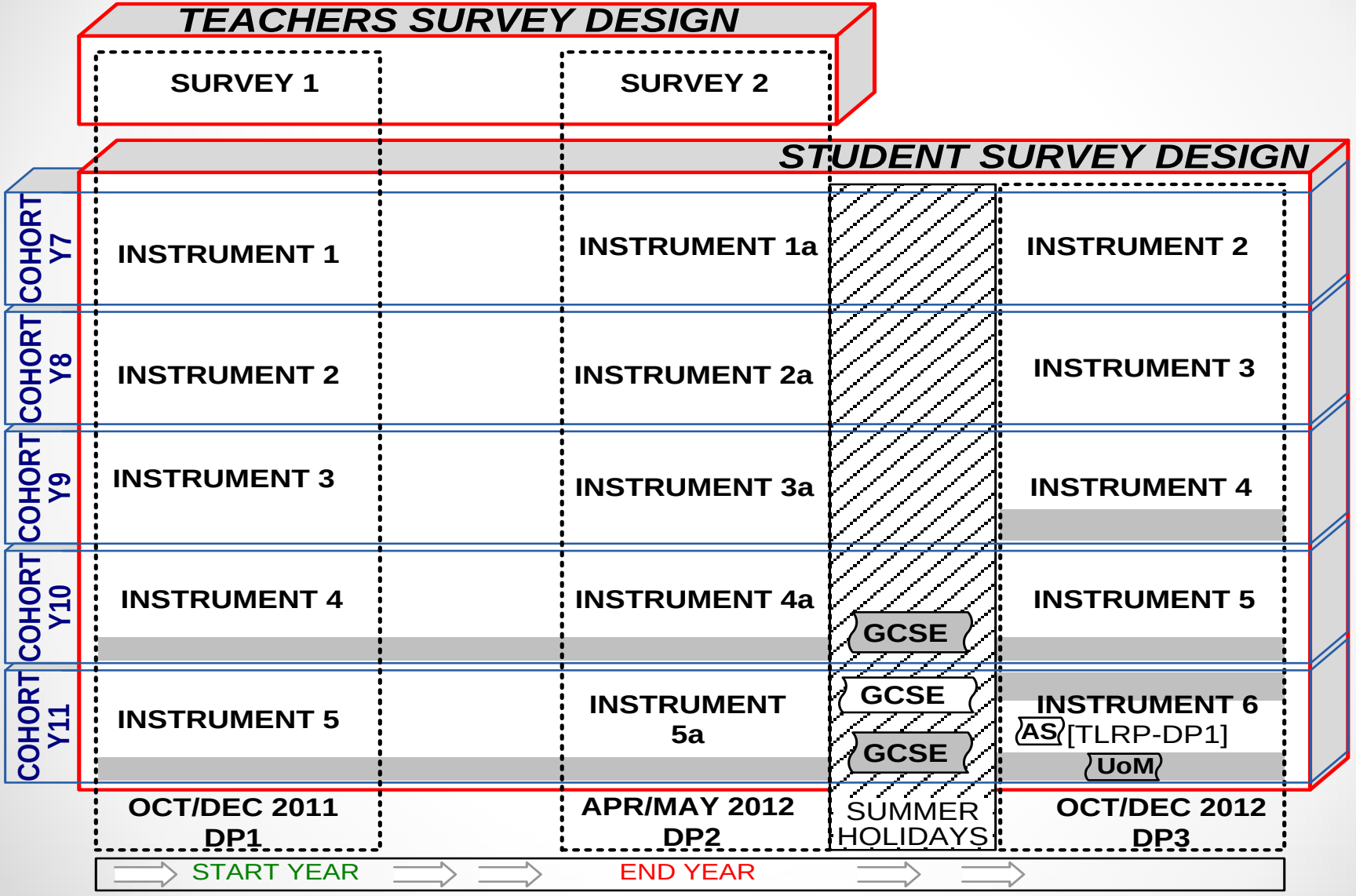
- Surveys for students from Years 7 to 11 (3 times) and also for their mathematics teacher (twice).

- Case studies in a small number of schools with lesson observations and interviews with students and teachers.

- Note: UK secondary compulsory education

  Year 7 (age 11) to Year 11 (age ~16, GCSE exams)

The Teleprism Survey Design



Participating Schools

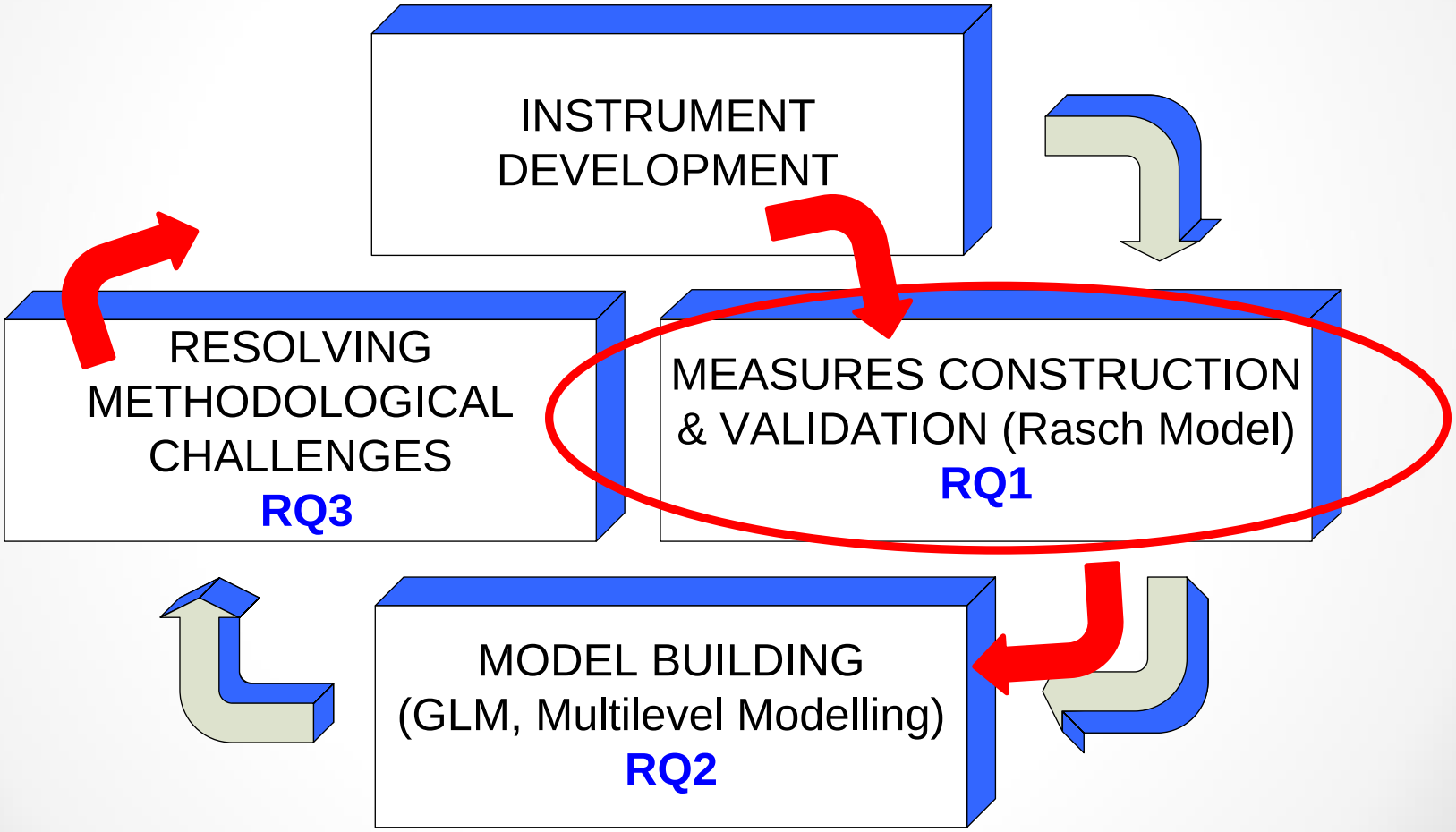
Age range	Boys only	Girls only	Mixed	Total
11-16	0	2	13	15
11-18	1	5	19	25
Total	1	7	32	40

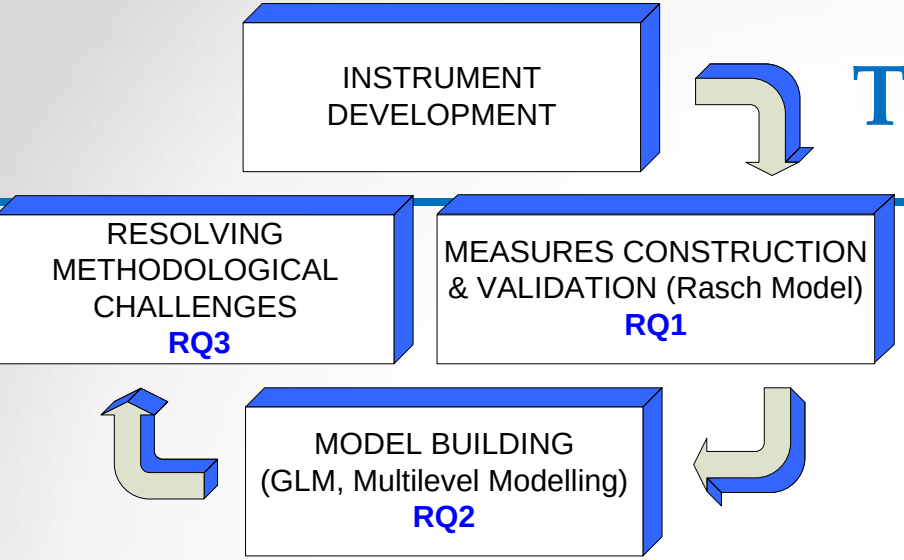
Students @ start

Year 7	3884
Year 8	3025
Year 9	2668
Year 10	2145
Year 11	1794
Total	**13516**

TeLePriSM

The methodological/Analytical Framework





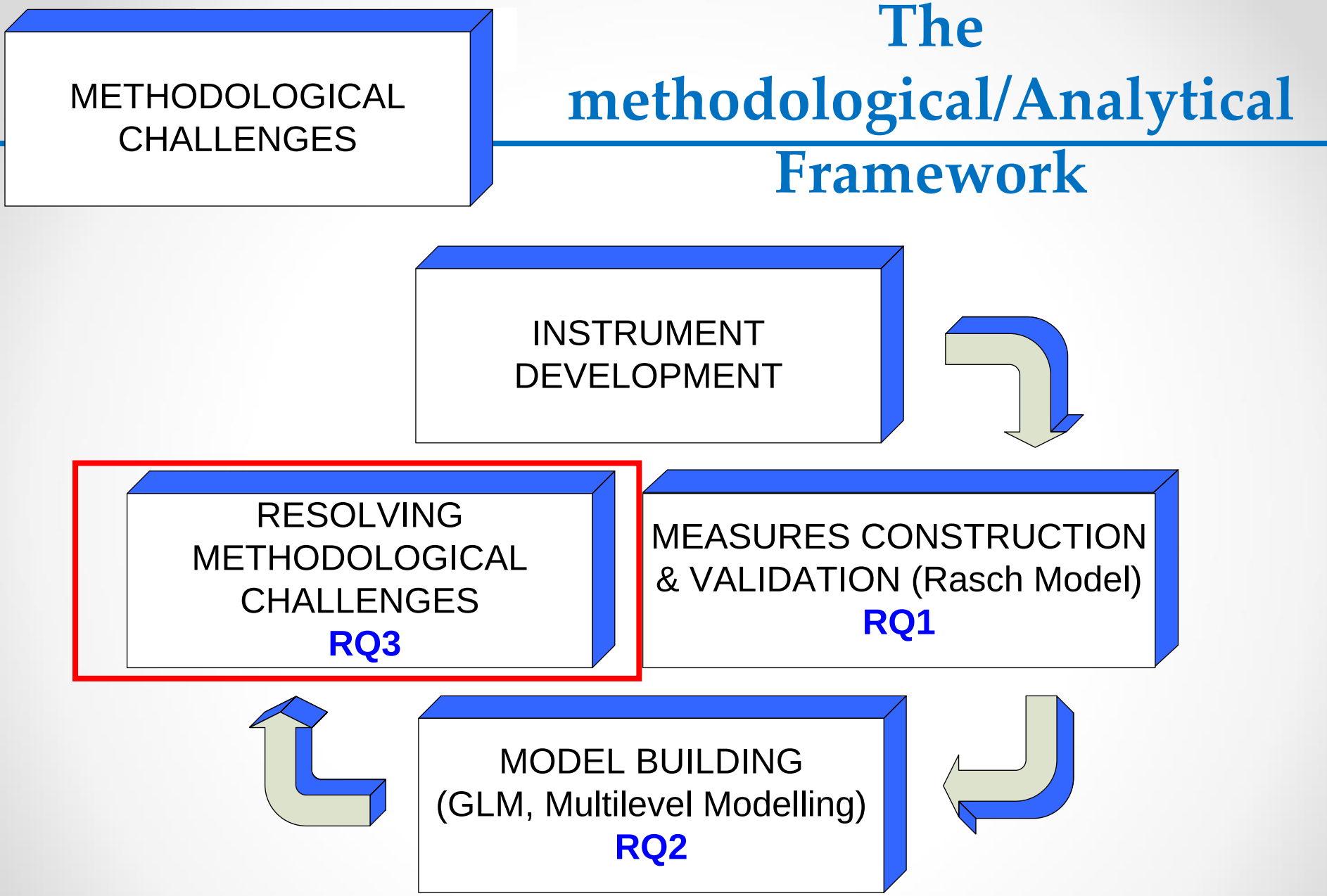
The Research Questions

RQ1: How can we measure (i) teachers' (self-reported) pedagogic practices and (ii) students' dispositions (and other learning outcomes) to study and use mathematics?

How do these measures vary across key subgroups (e.g. year groups), background variables (e.g. class, ethnicity, gender) and institutional types (schools)?

- **RQ2:** How do background and process variables (e.g. programme type) and pedagogy predict students' learning dispositions, outcomes and decisions from Y7 to Y11?
- **RQ3:** How can cross-sectional and longitudinal models be combined in the context of hierarchical data structures and missing data?

The methodological/Analytical Framework



METHODOLOGICAL CHALLENGES

Subjects and patterns of completion

- Unique cases of students who took part in the study: 18 157
- Unique student ids managed by schools (ethical constraints)

Challenge 1: Matching students responses across DPs to enable longitudinal analysis

Freq.	Percent	Cum.	Pattern
5830	32.11	32.11	Only DP1
3629	19.99	52.10	**All DPs**
2992	16.48	68.57	DP1 and DP2
2453	13.51	82.08	Only DP3
1298	7.15	89.23	Only DP2
1179	6.49	95.73	DP1 and DP3
776	4.27	100.00	DP2 and DP3
18157	100.00		

Sample per Year group/cohort

Year Group @	DP1	DP2	DP3	Total
Year 7	~~3924~~	~~2628~~	883	**7435**
Year 8	3034	1958	~~2508~~	**7500**
Year 9	2710	1798	1646	**6154**
Year 10	2127	1531	1514	**5172**
Year 11	1835	768	~~1343~~	**3946**
Year 12			143	**143**
Total	**13630**	**8683**	**8037**	**30350**

Cohort @Start	Start Year	End Year	Start New Year	Total
Year 7	3924	2628	2508	**9060**
Year 8	3034	1958	1646	**6638**
Year 9	2710	1798	1514	**6022**
Year 10	2127	1531	1342	**5000**
Year 11	1835	768	144	**2747**
Total	**13630**	**8683**	**7154**	**29467**

Challenge 2: Attrition and dealing with missing data

Challenge 3:

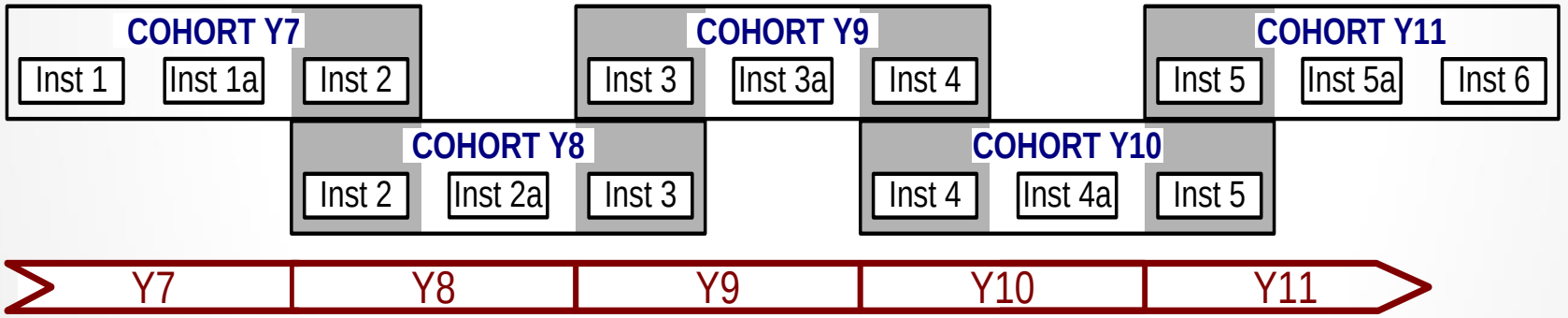
- School level patterns of completion/participation
- **School level attrition**

School name	dp1	dp2	dp3
School 1	837	738	471
School 2	132		49
School 3	382		386
School 4	224	207	108
School 5	12		
School 6	682		
School 7	170	40	
School 8	686	584	170
School 9	186	187	
School 10	405	267	15
School 11	134	103	
School 12	182	138	125
School 13	69	58	71
School 14	1103	667	602
School 15	128	53	
School 16	748	730	553
School 17	584	585	493
School 18	179	182	202
School 19	261	216	248
School 20	764	675	512
School 21	145	137	
School 22	635	569	596
School 23	45		
School 24	353	28	191
School 25	128	109	98
School 26	136	111	202
School 27	715	615	727
School 28	154	139	
School 29	548		492
School 30	105	106	
School 31	59		
School 32	341		
School 33	150	143	153
School 34	678	627	517
School 35	123	111	85
School 36	28	29	23
School 37	283		
School 38	435	436	441
School 39	167	165	141
School 40	420		

METHODOLOGICAL CHALLENGES

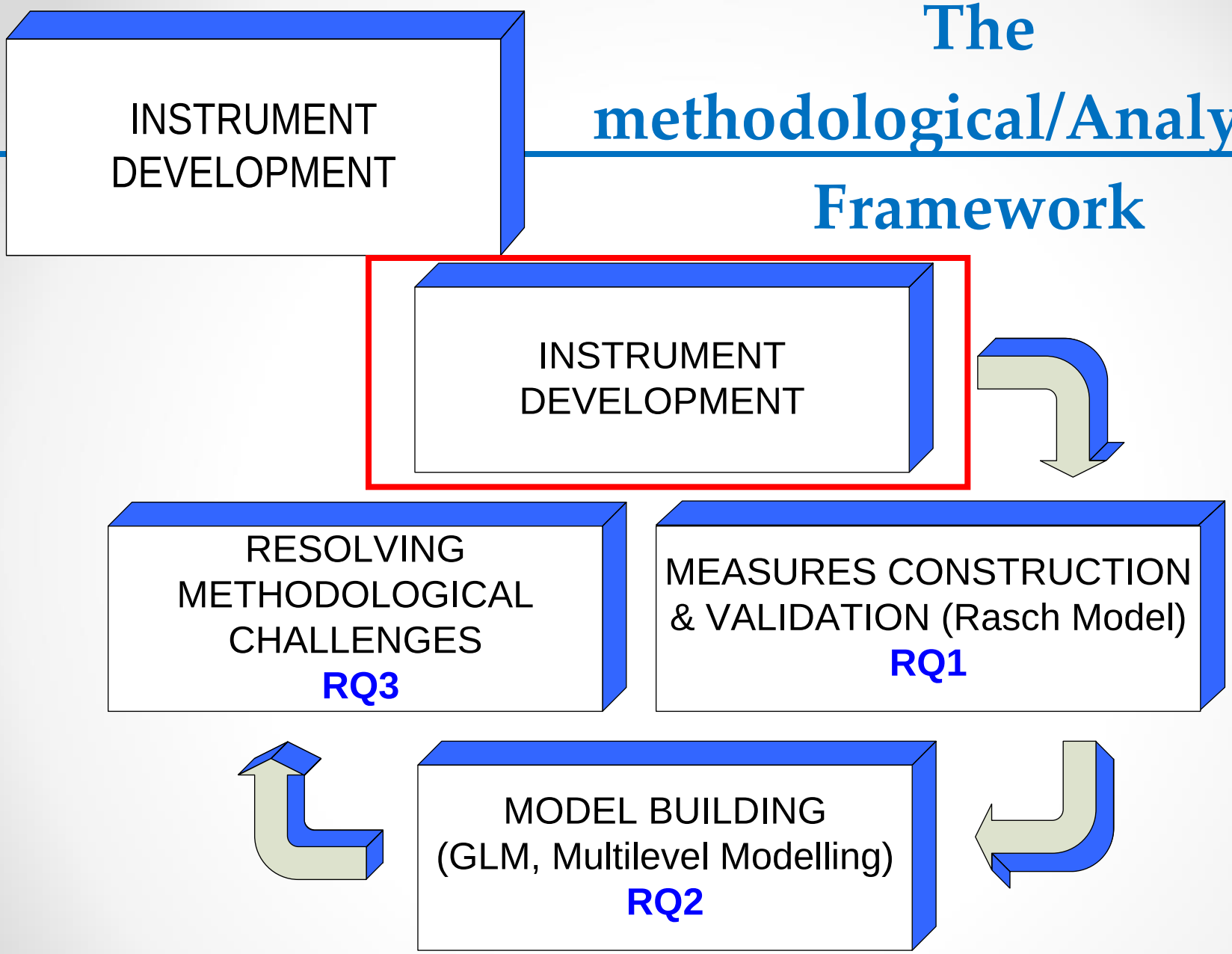
Challenge 4: Analytical

Question: How can cross-sectional and longitudinal models be combined in the context of hierarchical data structures and missing data?



Accelerated longitudinal design

The methodological/Analytical Framework



INSTRUMENT DEVELOPMENT

The Questionnaire

- About yourself and your school
  - Background information
  - Class and Teacher identifiers
  - Parental support/involvement
- Your feelings about mathematics (Maths Attitudes)
- Aspirations and intentions for after High School
- How maths is taught (Perceptions of teaching)
- Confidence in maths tasks (Maths Self-efficacy)

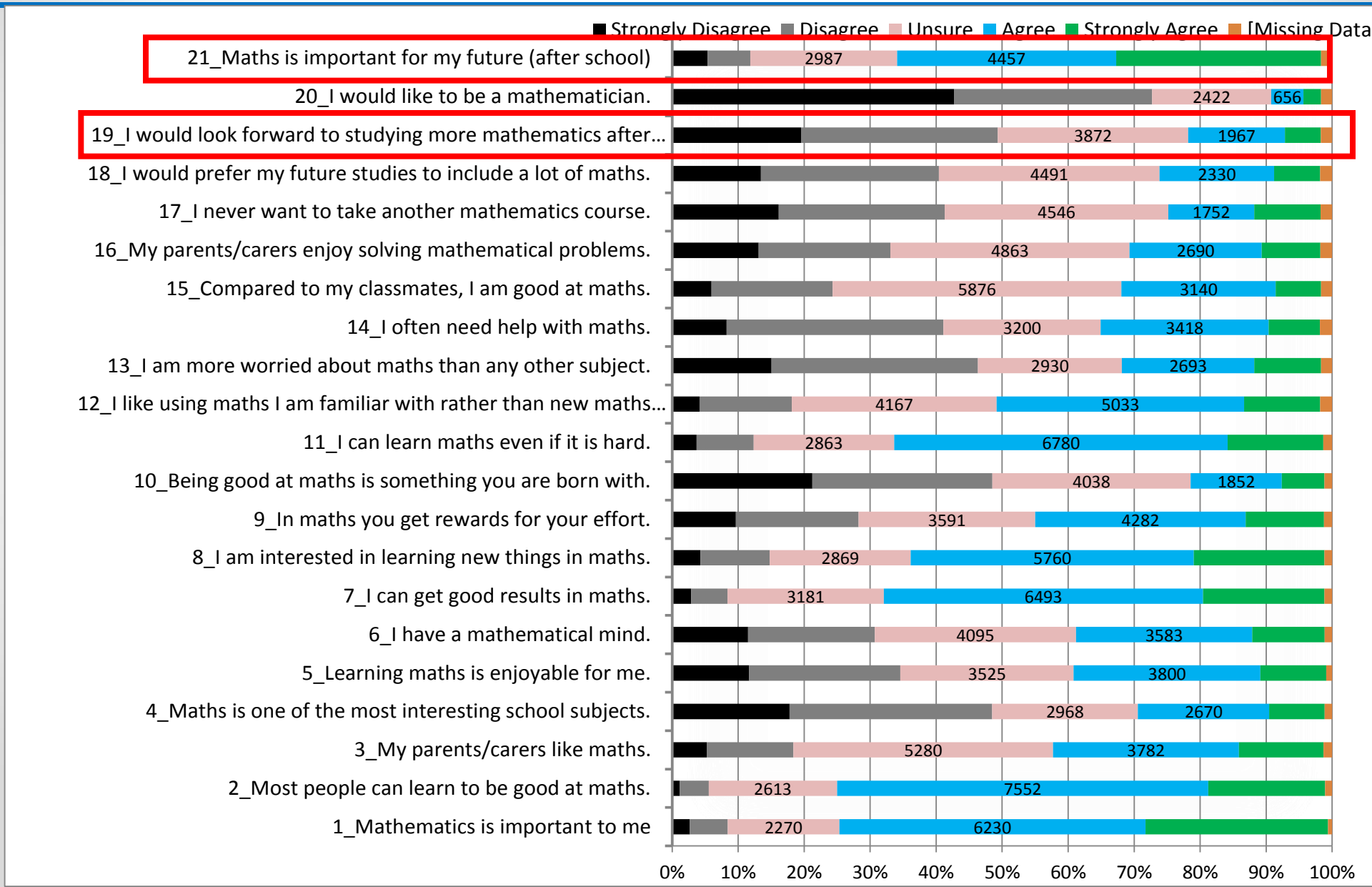
Example: Maths Attitudes

Part B – Your feelings about Mathematics

We would, now, like you to tell us how you feel about mathematics.
How much do you agree or disagree with the following statements?

	(Please circle the appropriate number in each line)	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
1	Mathematics is important to me.	1	2	3	4	5
2	Most people can learn to be good at maths.	1	2	3	4	5
3	My parents/carers like maths.	1	2	3	4	5
4	Maths is one of the most interesting school subjects.	1	2	3	4	5
5	Learning maths is enjoyable for me.	1	2	3	4	5
6	I have a mathematical mind.	1	2	3	4	5
7	I can get good results in maths.	1	2	3	4	5
8	I am interested in learning new things in maths.	1	2	3	4	5
9	In maths you get rewards for your effort.	1	2	3	4	5
10	Being good at maths is something you are born with.	1	2	3	4	5
11	I can learn maths even if it is hard.	1	2	3	4	5
12	I like using maths I am familiar with rather than new maths topics.	1	2	3	4	5
13	I am more worried about maths than any other subject.	1	2	3	4	5
14	I often need help with maths.	1	2	3	4	5

Example: Maths Attitudes



Example: Maths Self-Efficacy

5. How confident are you to **calculate the range of a set of numbers** such as:

A rugby team played 7 games.

Here is the number of points they scored in each game.

3 5 8 9 12 12 16

(a) Work out the range.

.....

Not confident at all **Not very confident** **Fairly confident** **Very confident**

"In this section, we are asking you to say how confident you would be at using mathematics to solve different problems. We don't ask you to actually solve the problems."

MEASURES CONSTRUCTION & VALIDATION (Rasch Model)
RQ1

Measurement

- 'Theoretically': Rasch Analysis (IRT)
  - Partial Credit Model
  - Rating Scale Model

- 'In practice' – the tools: Winsteps software

- Evidence from statistical indices:
  - Item Fit Statistics (to ensure unidimensional measures)
  - Differential Item Functioning (DIF)
  - Person-Item maps for hierarchy
  - Qualitative checks

Example: A measure of maths disposition

1	Mathematics is important to me.
4	Maths is one of the most interesting school subjects.
5	Learning maths is enjoyable for me.
8	I am interested in learning new things in maths.
17	I never want to take another mathematics course. [R]
18	I would prefer my future studies to include a lot of maths.
19	I would look forward to studying more mathematics after school.
20	I would like to be a mathematician.
21	Maths is important for my future (after school)

- Initial validation with all available data (long format)

Item Fit Statistics

- Item fit statistics to indicate how accurately the data fit the model, providing evidence in support (or not) of the unidimensionality assumption.

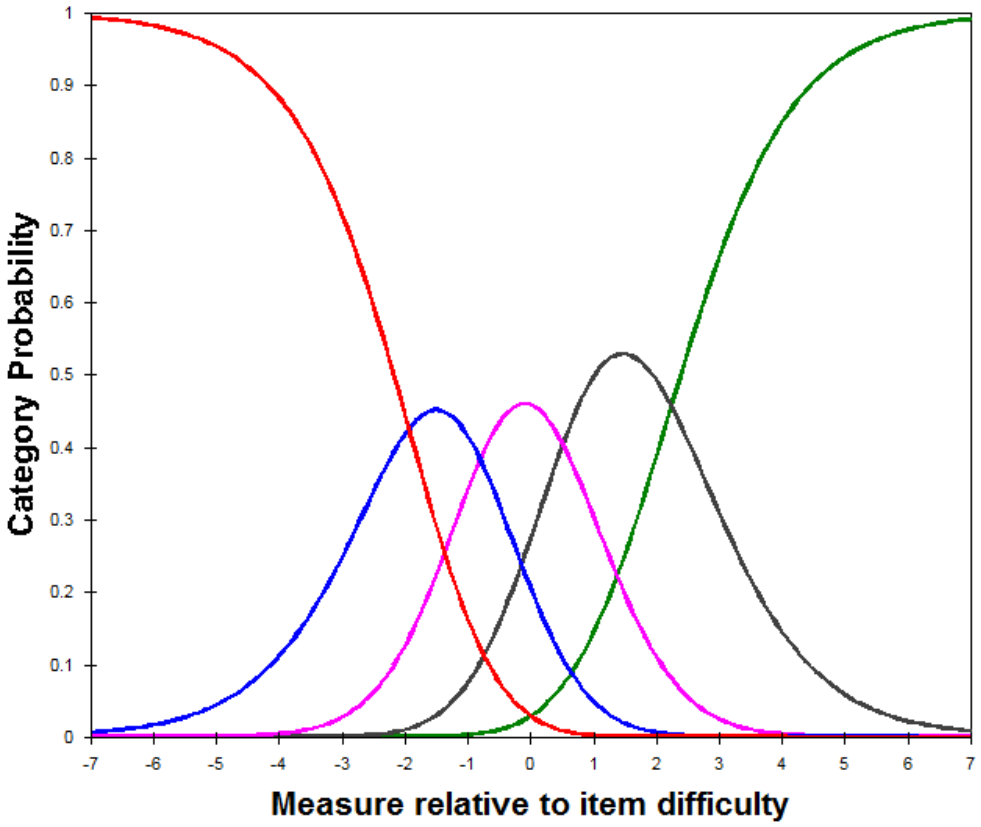
ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
1	119826	30547	-1.57	.01	.93	-8.8	.91	-9.9	.69	.69	59.3	54.0	statement1
2	82107	30418	.59	.01	.85	-9.9	.85	-9.9	.78	.73	53.8	47.6	statement4
3	91439	30454	.09	.01	.80	-9.9	.80	-9.9	.79	.73	54.2	47.6	statement5
4	109298	30395	-.93	.01	.84	-9.9	.83	-9.9	.74	.71	56.6	50.4	statement8
5	97413	30170	-.29	.01	1.48	9.9	1.72	9.9	.62	.73	47.6	48.2	statement17
6	82637	30182	.53	.01	.68	-9.9	.70	-9.9	.80	.73	59.0	47.1	statement18
7	77153	30180	.83	.01	.77	-9.9	.76	-9.9	.78	.73	57.3	47.9	statement19
8	57508	30194	2.04	.01	1.18	9.9	1.13	9.9	.66	.70	56.3	56.0	statement20
9	114163	30198	-1.28	.01	1.53	9.9	1.51	9.9	.60	.70	43.6	52.5	statement21
MEAN	92393.8	30304	.00	.01	1.01	-3.2	1.02	-3.3			54.2	50.1	
S.D.	18822.5	139.2	1.08	.00	.30	9.3	.34	9.3			5.0	3.1	

Item 17: I never want to take another mathematics course (reversed),
Item 21: Maths is important for my future (one of the most difficult)

Category Statistics and ICCs

Category Statistics and Item Characteristic Curves (ICCs) are examined for the appropriateness of the Likert scale used and its interpretation by the respondents (i.e. communication validity).

	(Please circle the appropriate number in each line)	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
1	Mathematics is important to me.	1	2	3	4	5
2	Most people can learn to be good at maths.	1	2	3	4	5
3	My parents/carers like maths.	1	2	3	4	5
4	Maths is one of the most interesting school subjects.	1	2	3	4	5
5	Learning maths is enjoyable for me.	1	2	3	4	5

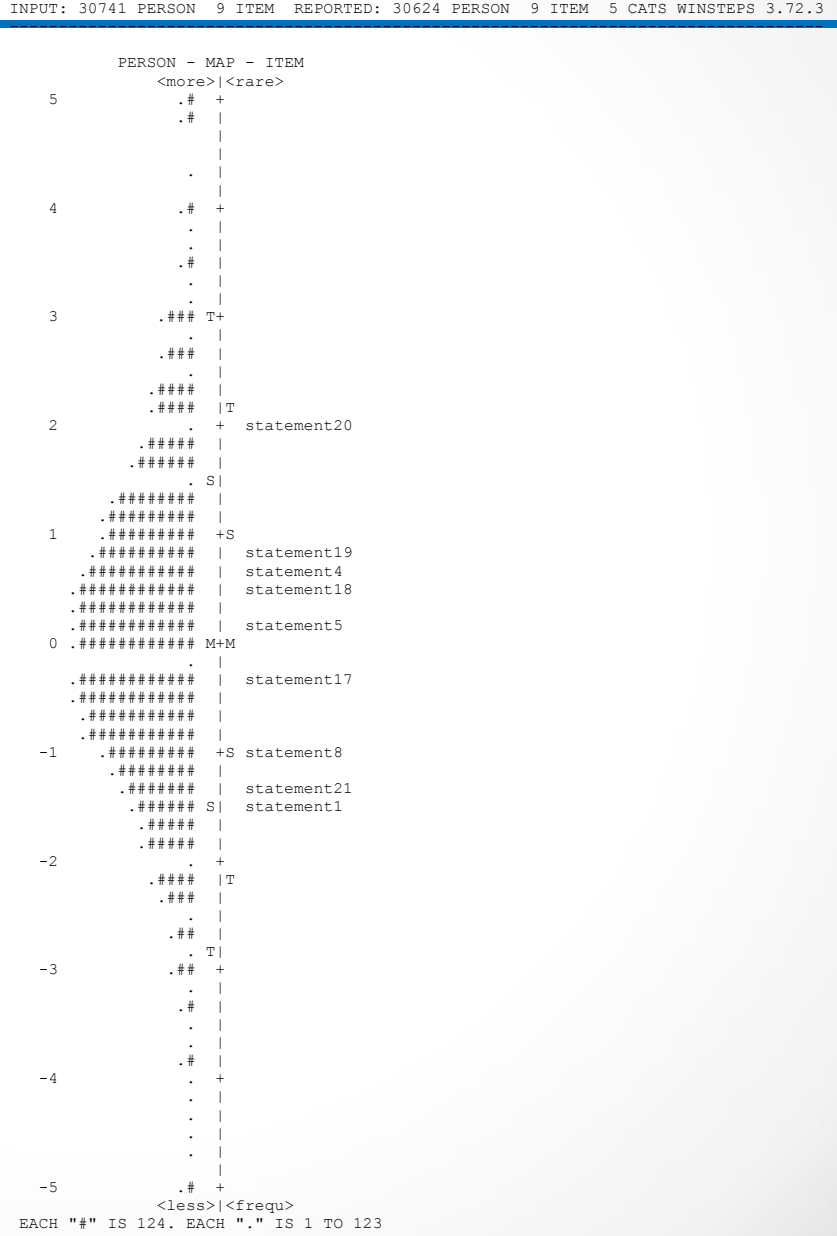


Person – Item Maps

- Person – item maps and the item difficulty hierarchy provide evidence for substantive, content and external validity.

- A common scale (in logits)

→ person scores for further analysis (later)



Differential Item Functioning

Why explore DIF?

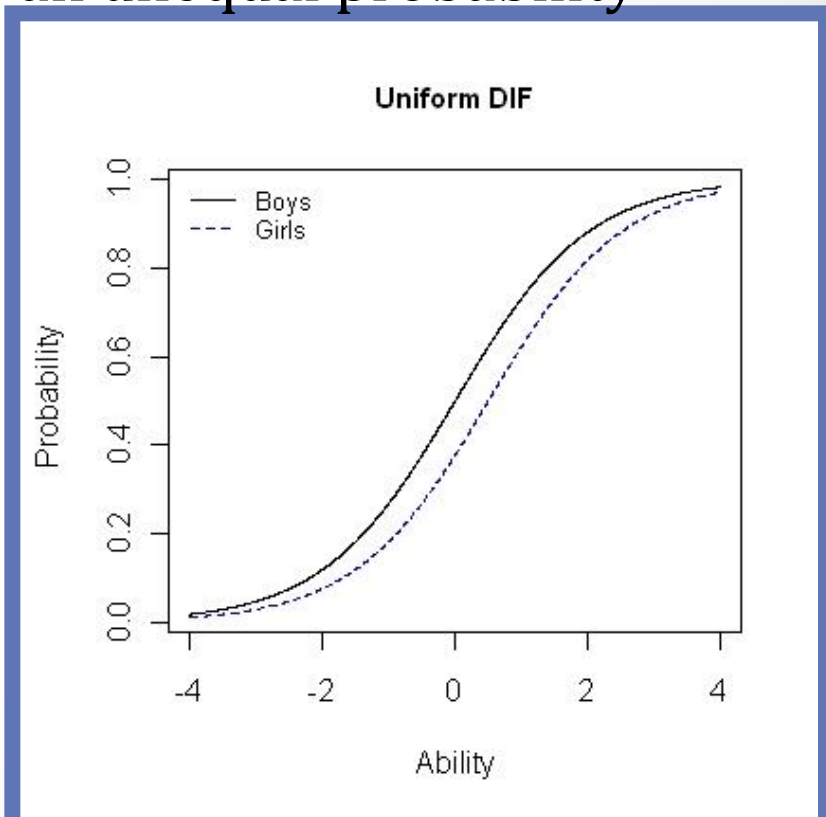
- Meaningful comparisons require that measurement equivalence holds
- Violates assumptions of Unidimensionality and Parameter invariance
- It is a potential source of bias in person measurement
- When developing new tests, items displaying DIF would normally be revised or discarded.

What is DIF

The differing probability of examinees from different subgroups but with the same 'ability' responding correctly to an item. OR

An item is said to be with "DIF" when respondents with equal ability, but from different groups, have an unequal probability of item success.

Example: Boys consistently outperform girls across ability levels for this item.



DIF examples from this study

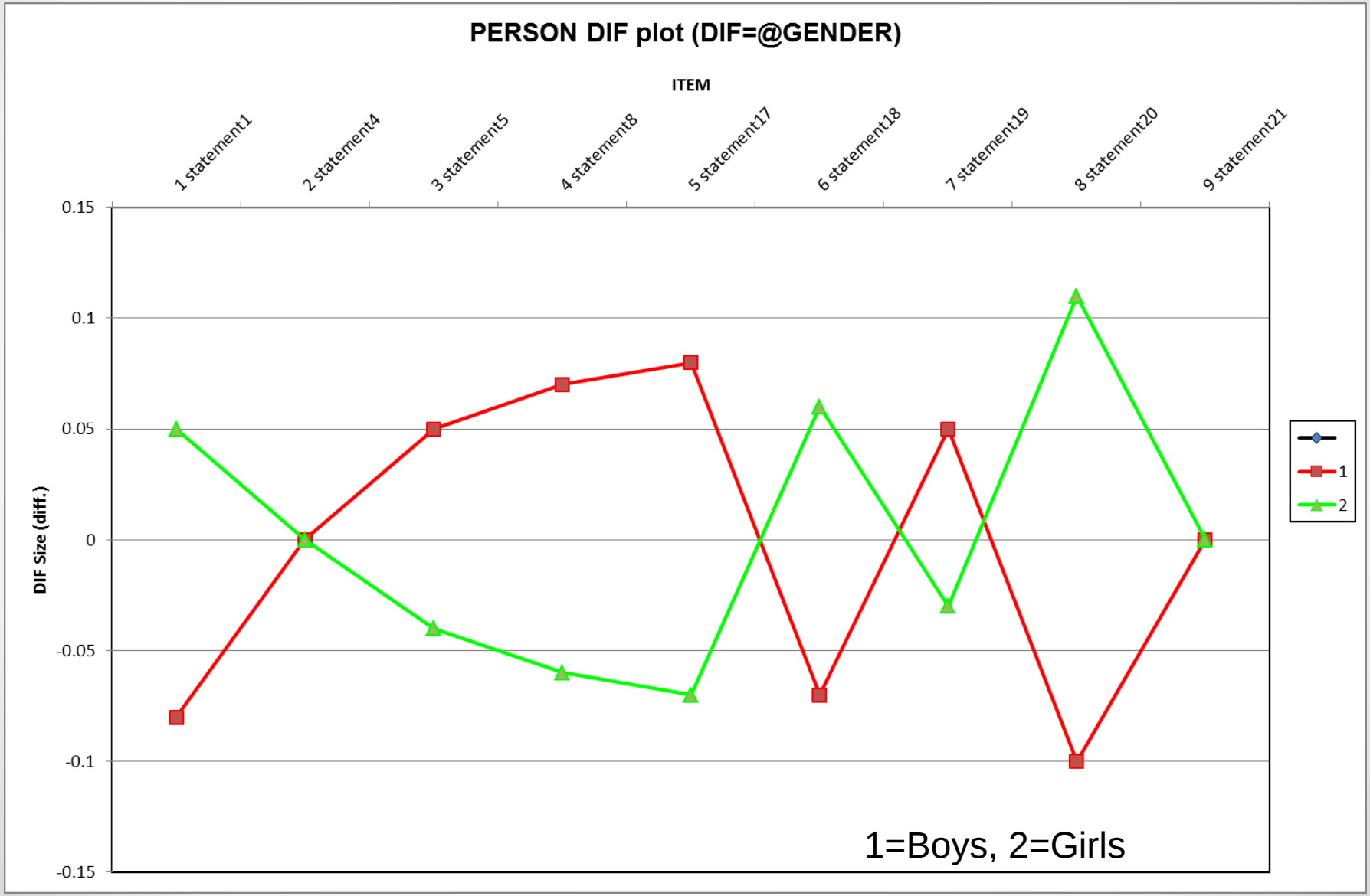
- Differential Item Functioning (DIF) suggests potential group differentiation, which is important when an instrument is used with different groups or at different occasions

- Different groups: gender, year group, etc

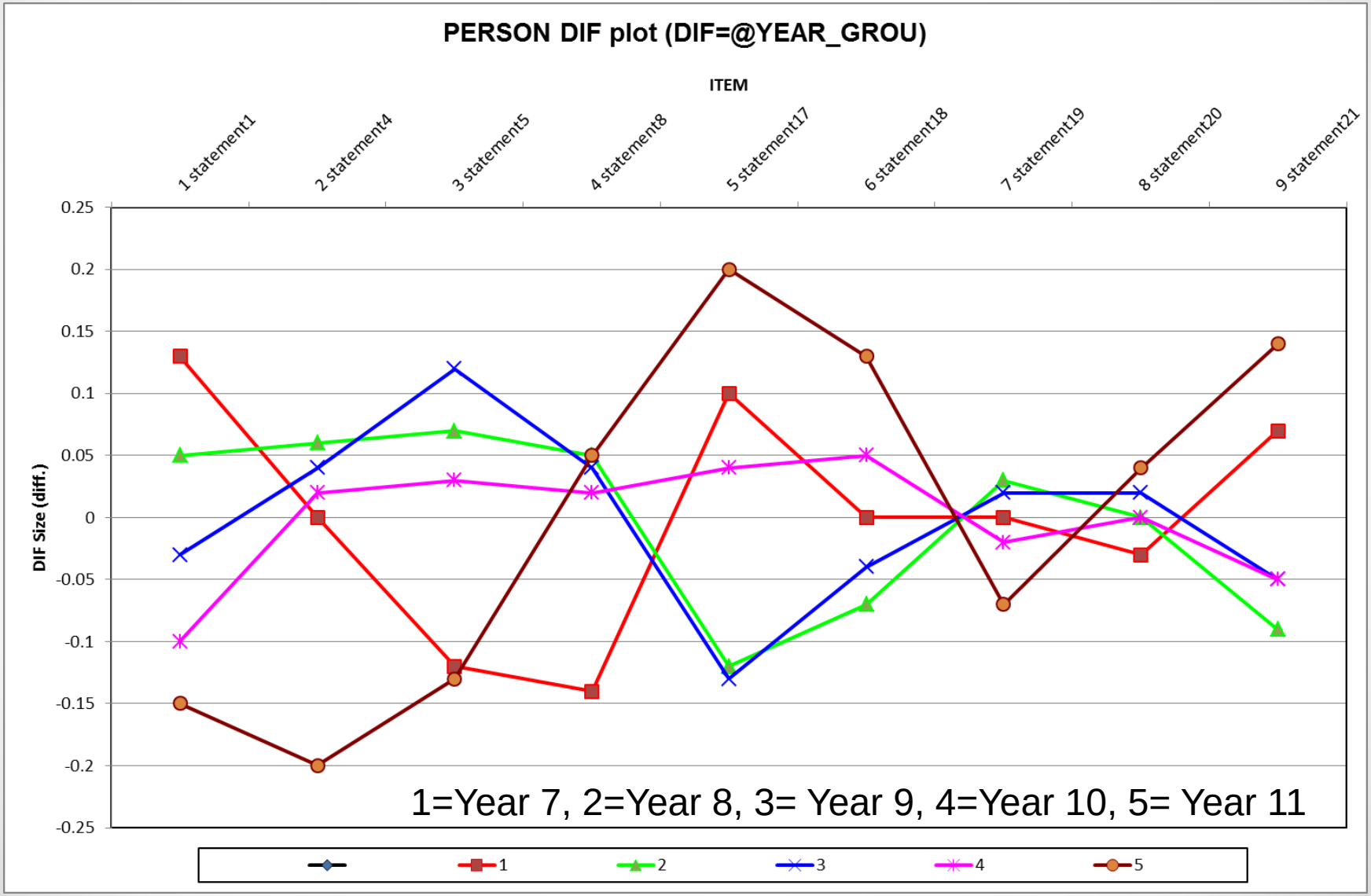
- Different occasions: DP, cohort

Size (up to 0.5 logit not concerning) and statistical significance of difference

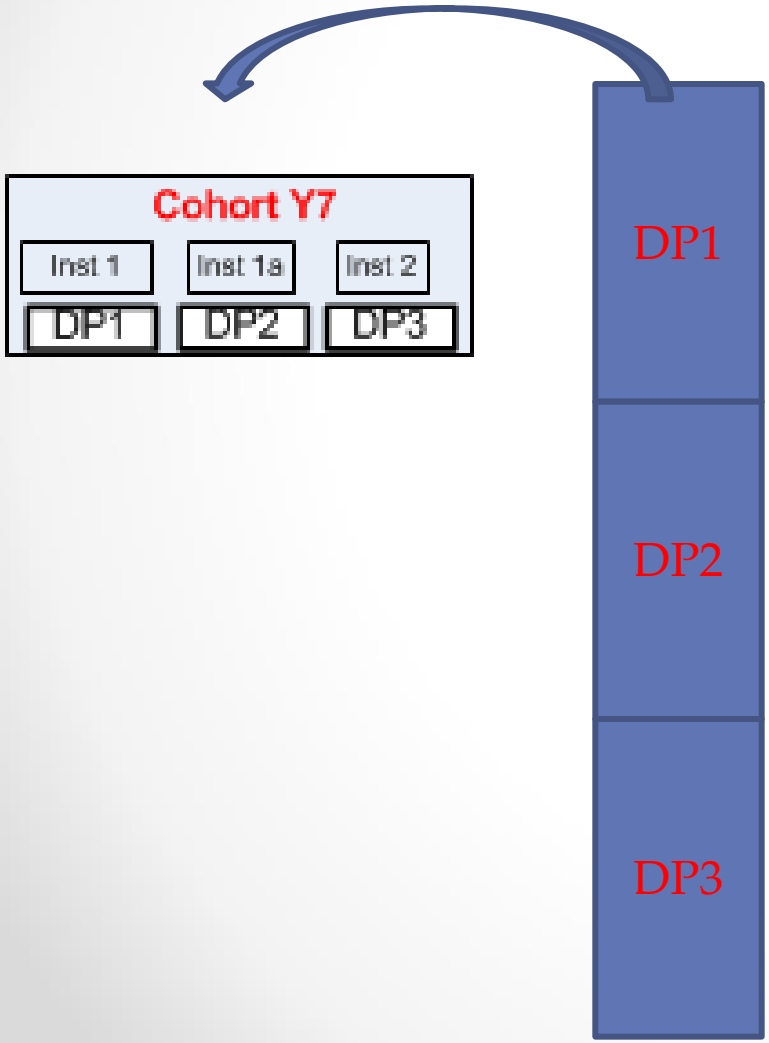
DIF by gender



DIF by Year Group

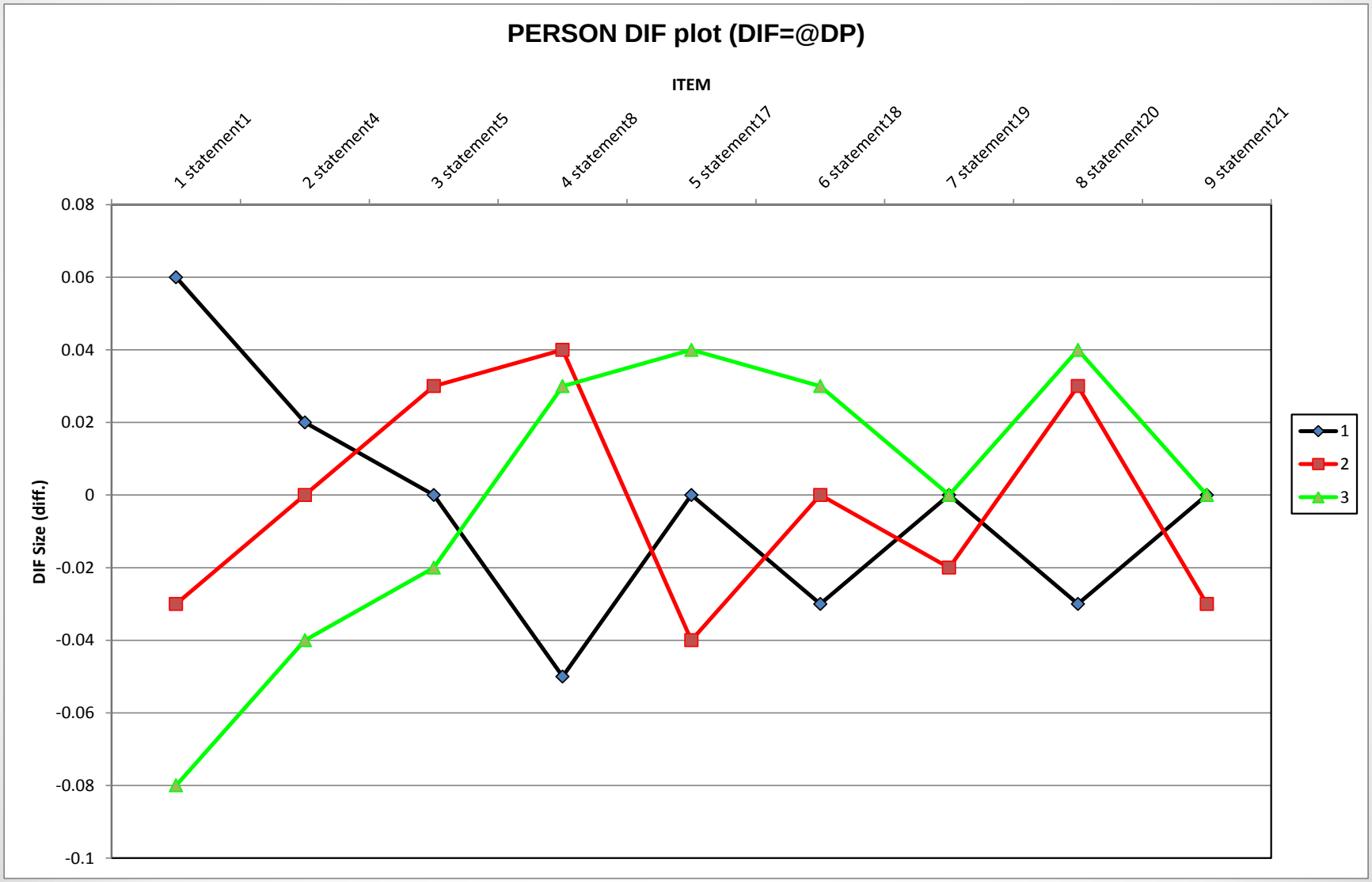


Longitudinal Analysis

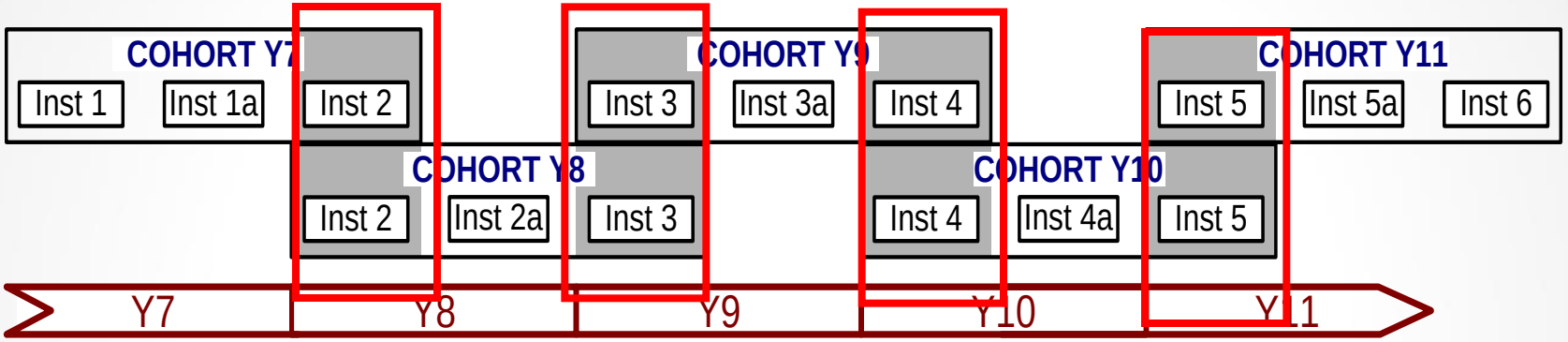


- For common instruments
- DP1,2,3 pooled together
- Analyse
- Check for DP DIF
- If OK, take measures back to longitudinal dataset

DIF by DP


PERSON DIF plot (DIF=@DP)
ITEM
1 statement1
2 statement4
3 statement5
4 statement8
5 statement17
6 statement18
7 statement19
8 statement20
9 statement21
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
DIF Size (diff.)
1
2
3

Accelerated longitudinal design



Cohort @Start	Start Year	End Year	Start New Year	Total
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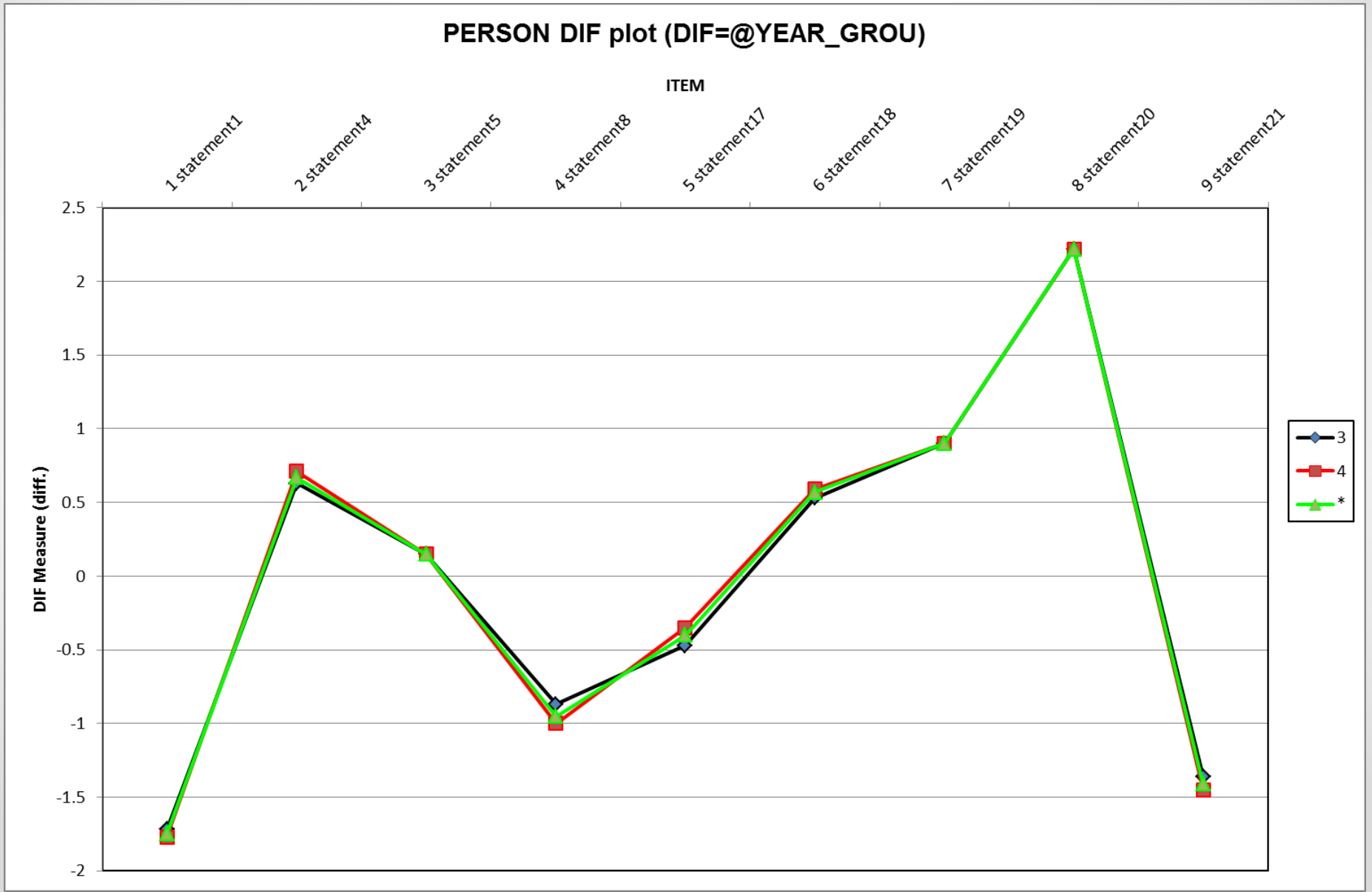
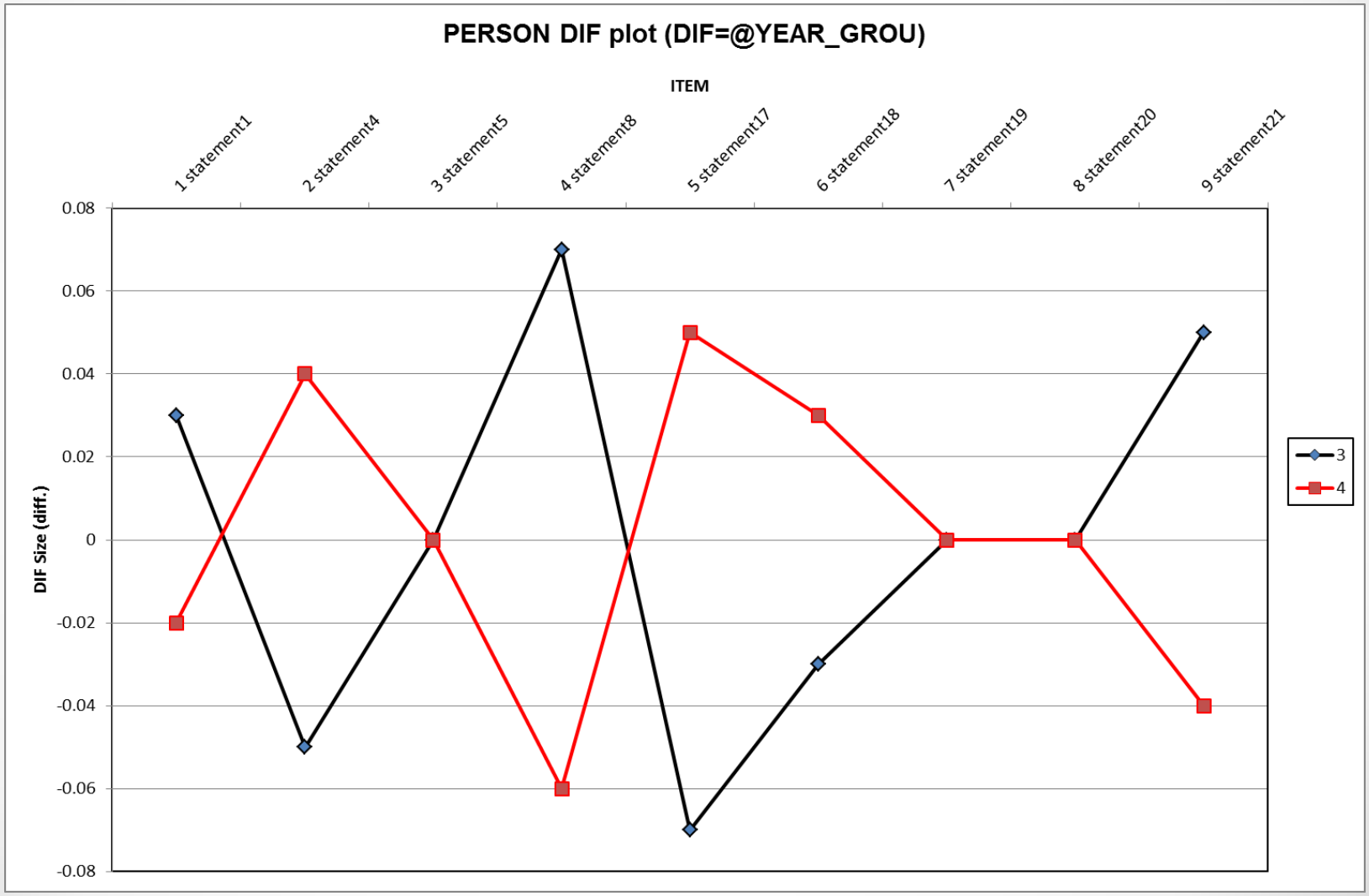
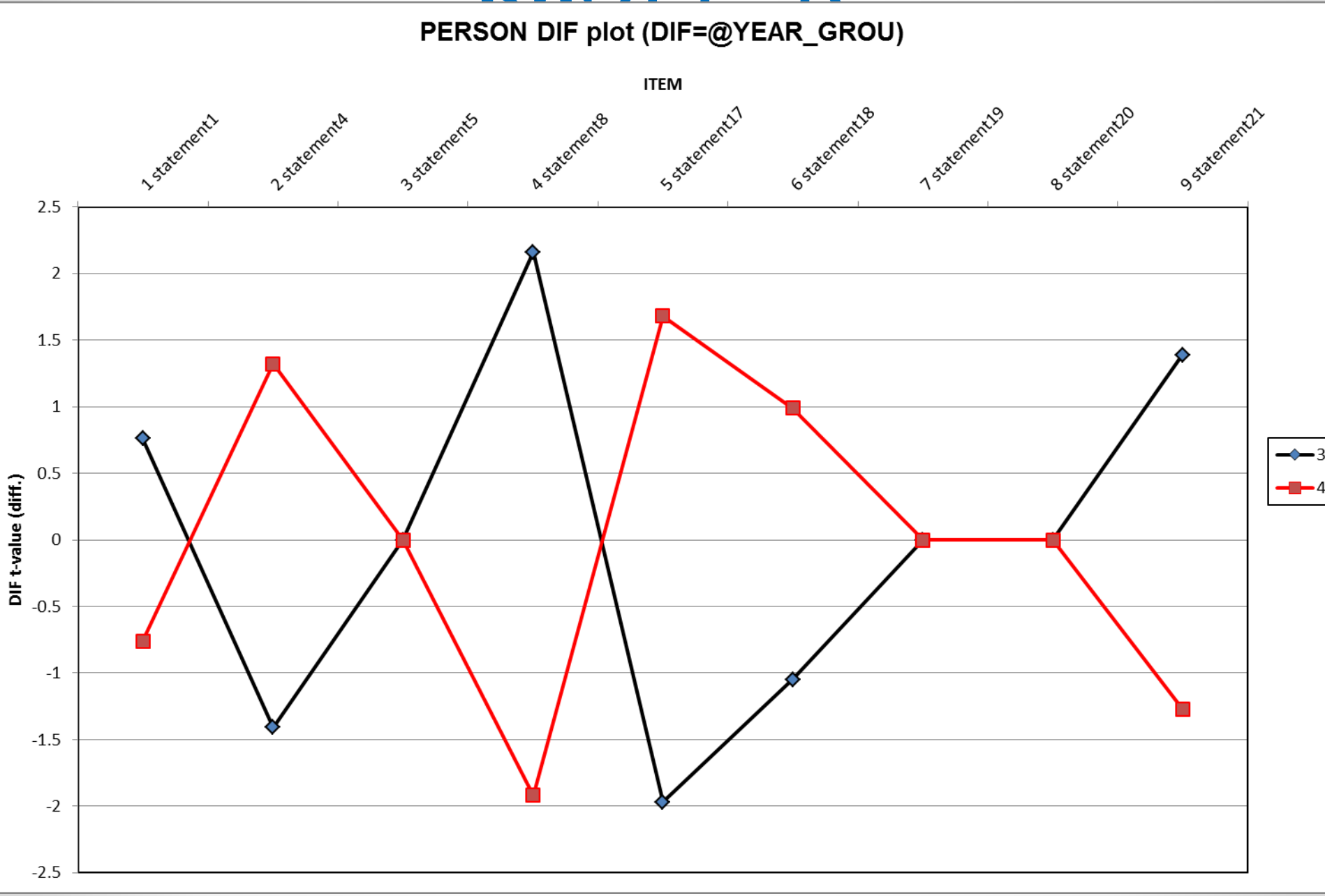
Year 11	1835	768	144	**2747**
Total	**13630**	**8683**	**7154**	**29467**

DIF (measure)


PERSON DIF plot (DIF=@YEAR_GROU)
ITEM
1 statement1
2 statement4
3 statement5
4 statement8
5 statement17
6 statement18
7 statement19
8 statement20
9 statement21
DIF Measure (diff.)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
3
4
*

DIF (size)


PERSON DIF plot (DIF=@YEAR_GROU)
ITEM
1 statement1
2 statement4
3 statement5
4 statement8
5 statement17
6 statement18
7 statement19
8 statement20
9 statement21
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
DIF Size (diff.)
3
4


PERSON DIF plot (DIF=@YEAR_GROU)
ITEM
1 statement1
2 statement4
3 statement5
4 statement8
5 statement17
6 statement18
7 statement19
8 statement20
9 statement21
DIF t-value (diff.)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
3
4

Constructed and validated measures

- A measure of 'perceived parental involvement/support'
- Mathematics disposition: (the higher the score the more disposed the student is towards further study or engagement with mathematics)
- Mathematics 'identity': (the higher the score the more positively/strongly the student relates or identifies with mathematics)
- Mathematics Self-efficacy
- Perceptions of teaching:
  - Teaching Variation: the higher the score on this measure the more diverse the maths lessons are (from students' perspective).
  - Transmissionist teaching: the higher the score the more 'traditional' or teacher-centred the practices as reported by the students.

Person scores → further analysis

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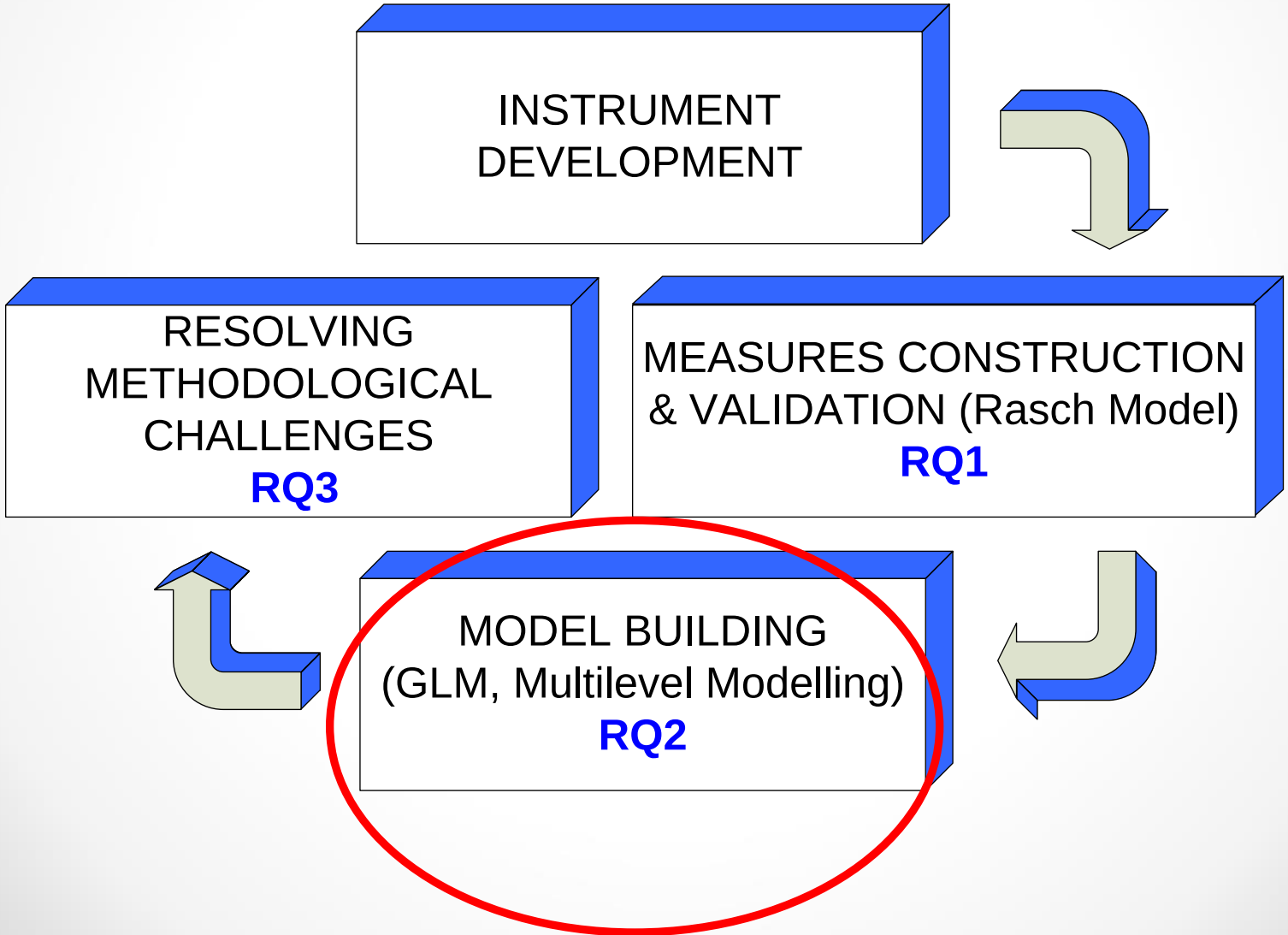
TABLE 18.1 cross-cohort 9-10 (17 February 2014). ZOU638WS.TXT Jun 20 8:04 2019
INPUT: 3824 PERSON 9 ITEM REPORTED: 3815 PERSON 9 ITEM 5 CATS WINSTEPS 3.72.3

PERSON: REAL SEP.: 2.57 REL.: .87 ... ITEM: REAL SEP.: 49.23 REL.: 1.00

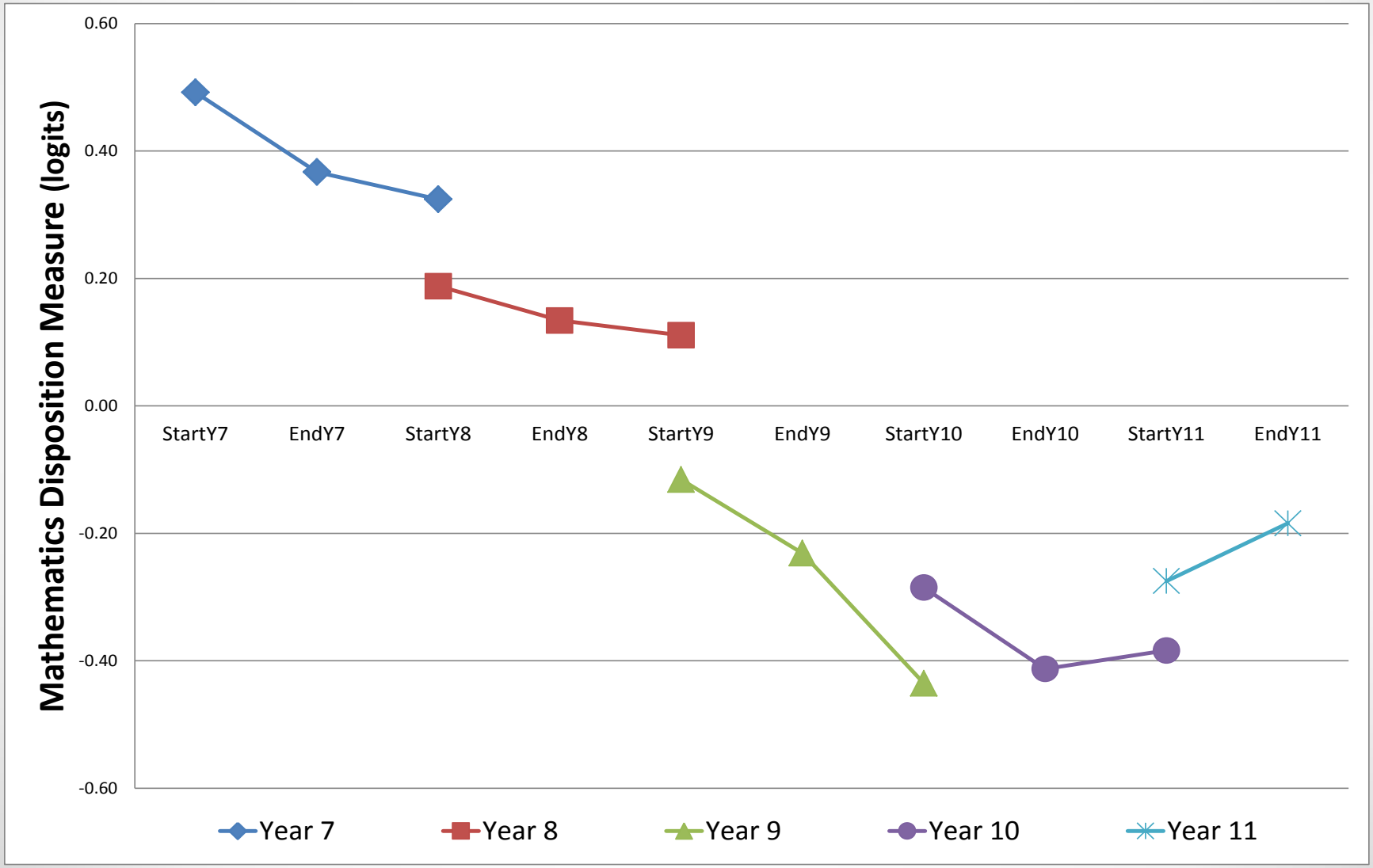
PERSON STATISTICS: ENTRY ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	PERSON
1	38	9	2.27	.53	1.57	1.1	1.35	.8	.67	.61	66.7	59.7	4
2	12	9	-3.53	.66	.57	-.6	.44	-.4	.62	.46	77.8	71.5	4
3	36	9	1.75	.49	1.50	1.1	1.34	.8	.64	.64	55.6	54.9	4
4	36	9	1.75	.49	.55	-.9	.61	-.8	.66	.64	66.7	54.9	4
5	17	9	-2.03	.48	1.01	.2	1.15	.4	.48	.62	55.6	54.9	4
6	28	9	.10	.43	.65	-.7	.70	-.6	.64	.69	44.4	47.1	4
7	29	9	.28	.43	.46	-1.4	.47	-1.3	.80	.68	66.7	48.7	4
8	27	9	-.09	.43	.91	-.1	1.09	.4	.00	.69	44.4	46.6	4
9	32	9	.87	.45	1.13	.4	1.15	.5	.87	.67	44.4	48.6	4
10	23	9	-.82	.43	.43	-1.5	.43	-1.4	.94	.68	66.7	48.2	4
11	13	4	-.15	.64	.65	-.4	.76	-.1	.90	.60	25.0	47.7	4
12	34	9	1.29	.47	.34	-1.7	.36	-1.7	.90	.66	66.7	48.7	4
13	33	9	1.07	.46	.76	-.4	.92	.0	.34	.66	44.4	48.7	4
14	31	9	.67	.44	.48	-1.3	.45	-1.4	.70	.68	66.7	48.7	4
15	28	9	.10	.43	.69	-.6	.79	-.3	.52	.69	66.7	47.1	4
16	20	9	-1.39	.45	2.49	2.5	2.17	2.0	.55	.66	11.1	48.5	4
17	37	9	2.00	.51	.48	-1.1	.46	-1.2	.86	.62	66.7	58.3	4
18	35	9	1.51	.48	1.03	.2	.89	-.1	.85	.65	55.6	51.8	4
19	15	9	-2.52	.52	3.15	2.9	2.52	1.9	-.02	.58	22.2	60.8	4
20	26	9	-.27	.43	1.86	1.7	1.83	1.6	.56	.69	22.2	45.9	4
21	23	9	-.82	.43	1.88	1.7	1.89	1.7	.10	.68	22.2	48.2	4
22	29	9	.28	.43	.85	-.2	.89	-.1	.46	.68	44.4	48.7	4
23	24	9	-.63	.43	1.30	.8	1.29	.8	.54	.69	22.2	48.4	4
24	29	9	.28	.43	.11	-3.3	.11	-3.3	.94	.68	88.9	48.7	4
25	28	9	.10	.43	.68	-.6	.69	-.6	.75	.69	44.4	47.1	4
26	28	9	.10	.43	2.36	2.4	2.15	2.1	.65	.69	22.2	47.1	4
27	36	9	1.75	.49	.47	-1.2	.65	-.7	.52	.64	66.7	54.9	4
28	36	9	1.75	.49	.71	-.5	.76	-.4	.00	.64	66.7	54.9	4
29	35	9	1.51	.48	2.13	2.0	1.77	1.5	.46	.65	55.6	51.8	4
30	22	8	-.37	.45	.63	-.7	.63	-.7	.69	.69	50.0	46.0	4
31	26	9	-.27	.43	1.20	.6	1.24	.7	.54	.69	55.6	45.9	4
32	25	9	-.45	.43	1.11	.4	1.06	.3	.86	.69	55.6	47.9	4
33	32	9	.87	.45	.72	-.5	.82	-.3	.43	.67	66.7	48.6	4

The methodological/Analytical Framework



Mean Maths disposition, by cohort



Relevant methodological Literature suggestions

- Longitudinal analysis under the multilevel framework
  - Growth curve (latent trajectory) models
  - Dynamic (autoregressive) models
  - Fixed, random, mixed effects models …
- For accelerated designs
  - "the growth curve is estimated on a combination of longitudinal and cross-sectional information" (Hox, 2010, p. 110)
  - Suggested Procedure: each cohort analysed separately and then combined (formulation and testing of 'linkage model')
- Further Complications
  - Most examples/applications for 2-level "occasion within subject"
  - Here multilevel in schools (and classes) as well
  - No class information at DP3 (new academic year)

Preliminary Modelling

- 2-level longitudinal models (level 1: DP, level 2: student)
  - xtreg (stata)
  - xtmixed (stata)
  - runmlwin (mlwin within stata)
  - Both by cohort separately and combined
- 3-level growth curve models (DP, students in schools)
  - Separate cohorts
  - combined
- New variable for linkage: age

age	year_cohort 1	2	3	4	5	Total
11	3,924	0	0	0	0	3,924
11.5	2,628	0	0	0	0	2,628
12	2,508	3,034	0	0	0	5,542
12.5	0	1,958	0	0	0	1,958
13	0	1,646	2,710	0	0	4,356
13.5	0	0	1,798	0	0	1,798
14	0	0	1,514	2,127	0	3,641
14.5	0	0	0	1,531	0	1,531
15	0	0	0	1,342	1,835	3,177
15.5	0	0	0	0	768	768
16	0	0	0	0	144	144
Total	9,060	6,638	6,022	5,000	2,747	29,467

- Treat cohorts as dummy variables
- Estimate fixed effects in the form of interactions with cohort (Plewis, 2009)

```
MLwiN 2.30 multilevel model                     Number of obs      =     28130
Normal response model
Estimation algorithm: IGLS
```

Level Variable	No. of Groups	Observations per Group Minimum	Average	Maximum
school_id	40	12	703.3	2145
unique_use~r	16614	1	1.7	3

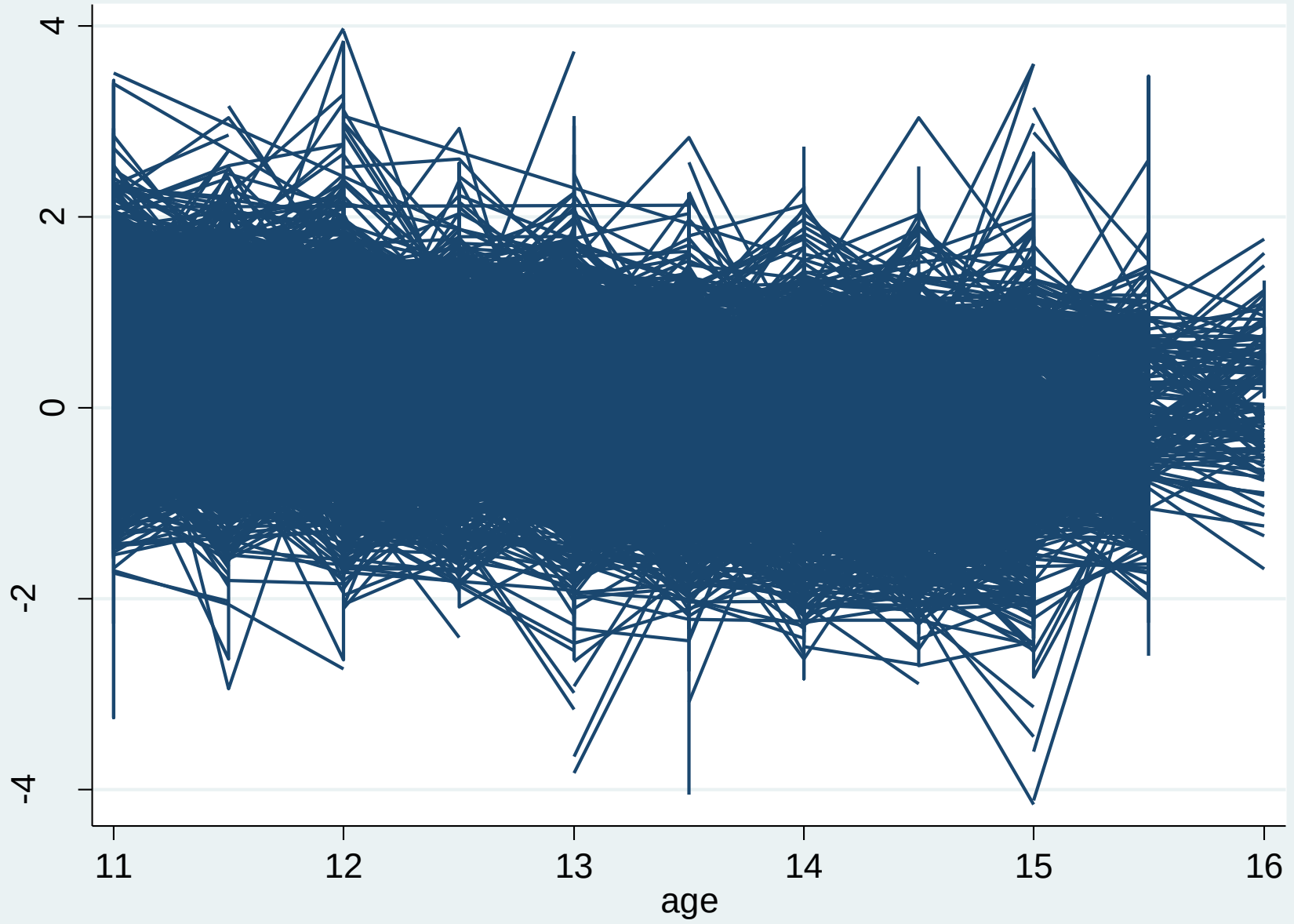
```
Run time (seconds)    =       4.53
Number of iterations  =          3
Log likelihood        = -44995.602
Deviance              =  89991.203
```

mathsdisposition	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
cons	.2654768	.1892702	1.40	0.161	-.1054859	.6364396
age	-.1088022	.0160247	-6.79	0.000	-.1402099	-.0773944
_Iyear_coh~2	-.021217	.0310303	-0.68	0.494	-.0820352	.0396012
_Iyear_coh~3	-.1110374	.0415801	-2.67	0.008	-.1925328	-.029542
_Iyear_coh~4	-.0480477	.0557697	-0.86	0.389	-.1573544	.061259
_Iyear_coh~5	-.00816	.0693778	-0.12	0.906	-.144138	.1278179
_Igender_2	-.233826	.02014	-11.61	0.000	-.2732996	-.1943523
Iability~2	.7430826	.0352745	21.07	0.000	.6739458	.8122194
Iability~3	1.426746	.0353747	40.33	0.000	1.357412	1.496079
Iability~4	2.31953	.0385862	60.11	0.000	2.243902	2.395158
parentalsu~t	.1588398	.0076943	20.64	0.000	.1437592	.1739203
TeachingVa~n	.3169403	.0089465	35.43	0.000	.2994055	.334475
TeachingTr~e	-.1162968	.0189731	-6.13	0.000	-.1534833	-.0791102

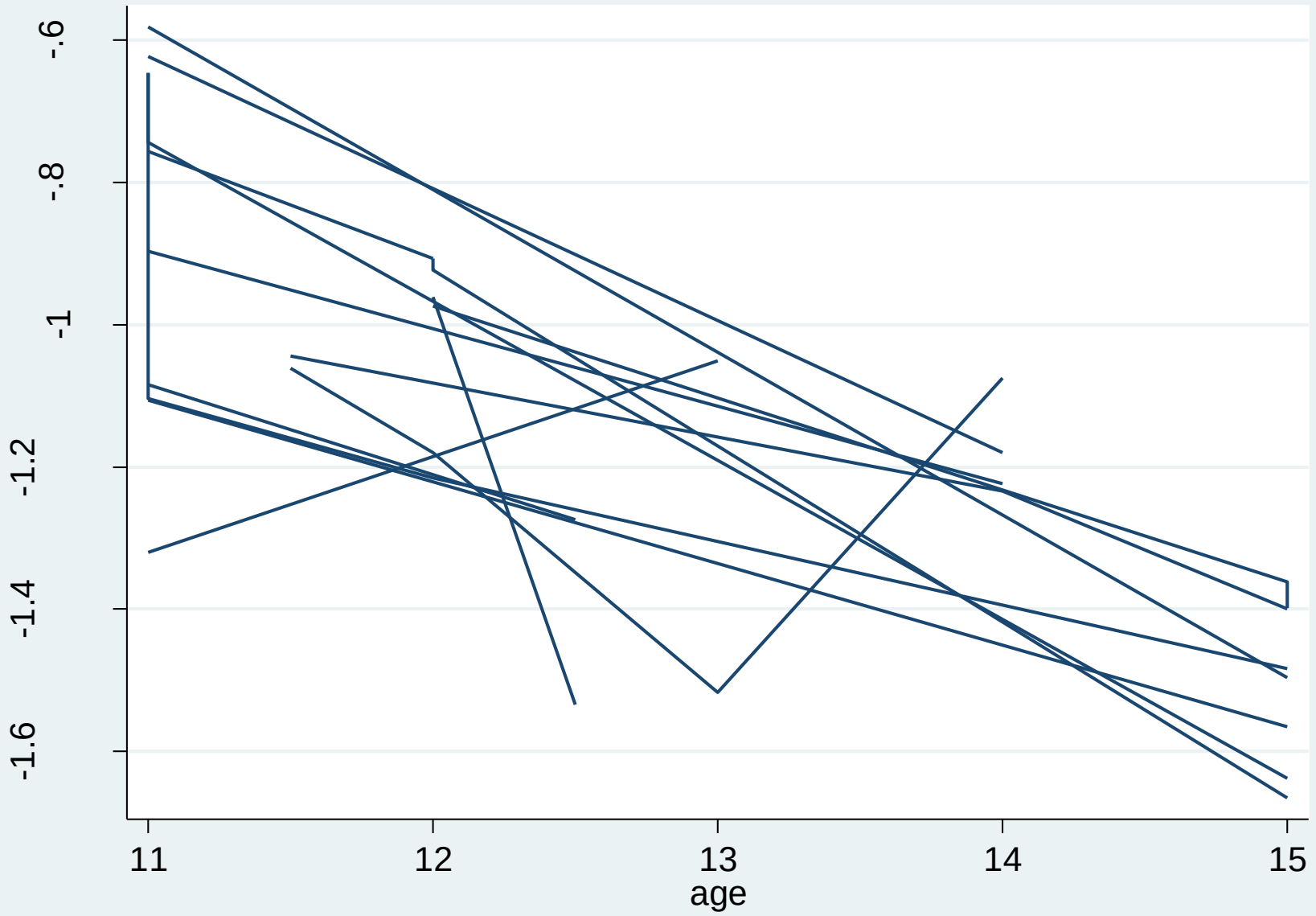
Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
Level 3: school_id var(cons)	.0501309	.0126577	.0253222	.0749396
Level 2: unique_user_number var(cons)	.7319179	.0156322	.7012793	.7625565
Level 1: dp var(cons)	.8630708	.0110958	.8413234	.8848182

- Level 3 ICC (school): 0.0305
  - The correlation in disposition between schoolmates is 0.03
  - OR 3% of the variation in dispositions lies between schools
- Level 2 ICC (student): 0.4449
- Level 1 ICC (time): 0.5246

‘Growth curves’ of students



‘Growth curves’ of schools



Concluding points / Further work

- Demonstration of an approach to measurement invariance (across time)
- Evidence of declining dispositions
- Effect of teaching style on decline (and other variables)
- Possible to link and model progression from Year 7 to 11
- Improve and test the models (age*cohort interactions, etc)
- Consider additional complexity (levels and variables):
  - Class level (for first year: DP1 and DP2) and teacher background and teaching style
  - Cross-level interactions ?
  - More student background variables
  - School level variables
- Non –linear growth?

Person scores → further analysis
Consider errors?

18-638WS.txt - Notepad

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TABLE 18.1 cross-cohort 9-10 (17 February 2014). ZOU638WS.TXT Jun 20 8:04 2019
INPUT: 3824 PERSON 9 ITEM REPORTED: 3815 PERSON 9 ITEM 5 CATS WINSTEPS 3.72.3

PERSON: REAL SEP.: 2.57 REL.: .87 ... ITEM: REAL SEP.: 49.23 REL.: 1.00

PERSON STATISTICS: ENTRY ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.		INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	PERSON
1	38	9	2.27	.53	1	57	1.1	1.35	.8	.67	.61	66.7	59.7	4
2	12	9	-3.53	.66		57	-.6	.44	-.4	.62	.46	77.8	71.5	4
3	36	9	1.75	.49	1	50	1.1	1.34	.8	.64	.64	55.6	54.9	4
4	36	9	1.75	.49		55	-.9	.61	-.8	.66	.64	66.7	54.9	4
5	17	9	-2.03	.48	1	01	.2	1.15	.4	.48	.62	55.6	54.9	4
6	28	9	.10	.43		65	-.7	.70	-.6	.64	.69	44.4	47.1	4
7	29	9	.28	.43		46	-1.4	.47	-1.3	.80	.68	66.7	48.7	4
8	27	9	-.09	.43		91	-.1	1.09	.4	.00	.69	44.4	46.6	4
9	32	9	.87	.45	1	13	.4	1.15	.5	.87	.67	44.4	48.6	4
10	23	9	-.82	.43		43	-1.5	.43	-1.4	.94	.68	66.7	48.2	4
11	13	4	-.15	.64		65	-.4	.76	-.1	.90	.60	25.0	47.7	4
12	34	9	1.29	.47		34	-1.7	.36	-1.7	.90	.66	66.7	48.7	4
13	33	9	1.07	.46		76	-.4	.92	.0	.34	.66	44.4	48.7	4
14	31	9	.67	.44		48	-1.3	.45	-1.4	.70	.68	66.7	48.7	4
15	28	9	.10	.43		69	-.6	.79	-.3	.52	.69	66.7	47.1	4
16	20	9	-1.39	.45	2	49	2.5	2.17	2.0	.55	.66	11.1	48.5	4
17	37	9	2.00	.51		48	-1.1	.46	-1.2	.86	.62	66.7	58.3	4
18	35	9	1.51	.48	1	03	.2	.89	-.1	.85	.65	55.6	51.8	4
19	15	9	-2.52	.52	3	15	2.9	2.52	1.9	-.02	.58	22.2	60.8	4
20	26	9	-.27	.43	1	86	1.7	1.83	1.6	.56	.69	22.2	45.9	4
21	23	9	-.82	.43	1	88	1.7	1.89	1.7	.10	.68	22.2	48.2	4
22	29	9	.28	.43		85	-.2	.89	-.1	.46	.68	44.4	48.7	4
23	24	9	-.63	.43	1	30	.8	1.29	.8	.54	.69	22.2	48.4	4
24	29	9	.28	.43		11	-3.3	.11	-3.3	.94	.68	88.9	48.7	4
25	28	9	.10	.43		68	-.6	.69	-.6	.75	.69	44.4	47.1	4
26	28	9	.10	.43	2	36	2.4	2.15	2.1	.65	.69	22.2	47.1	4
27	36	9	1.75	.49		47	-1.2	.65	-.7	.52	.64	66.7	54.9	4
28	36	9	1.75	.49		71	-.5	.76	-.4	.00	.64	66.7	54.9	4
29	35	9	1.51	.48	2	13	2.0	1.77	1.5	.46	.65	55.6	51.8	4
30	22	8	-.37	.45		63	-.7	.63	-.7	.69	.69	50.0	46.0	4
31	26	9	-.27	.43	1	20	.6	1.24	.7	.54	.69	55.6	45.9	4

Thank you!

Questions? (or Answers?)

Suggestions welcome!

Acknowledgements and links

ESRC grant RES-061-25-0538

Lawrence Wo for data management

Patricio Troncoso-ruiz for preliminary longitudinal analysis

Project website: www.teleprism.com

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