

# Individual characteristics of teacher education students

Re-examining the “negative selection” hypothesis

Hilde Schaeper & Julia-Carolin Brachem

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## Importance of teachers' individual characteristics

- For teachers' professional competencies,
  - The quality of teaching,
  - The development of students' competencies,
  - And student achievement.  
(Klusmann, 2013; Roloff Henoch et al. 2015; Rothland, 2014)
- 
- "Opportunity-use model" (Fend, 2006; Helmke, 2003; Zierer & Seel, 2012)
    - Individual prerequisites (e.g., cognitive abilities, interests, personality) determine whether and how efficient learning opportunities (offered during teacher education) are used.

## Does the teaching profession attract the “right” people?

- “Negative selection” hypothesis: The teaching profession attracts people with unfavourable cognitive and psychological characteristics (Guarino et al., 2006; Zumwalt & Craig, 2008; Denzler & Wolter, 2008).
  - Teacher training is perceived as less demanding than other study programmes (Retelsdorf & Möller, 2012).
  - Hypothesis rejected for Germany when controlling for the field of study (Roloff Henoch et al., 2015).
- “Internal selection” of teacher education students
  - Candidates for upper secondary education show better cognitive abilities and openness than candidates for primary, special or lower secondary education (Klusmann et al., 2009; Neugebauer, 2013; Rothland, 2014).
  - No differentiation between teacher candidates’ fields of study in existing studies.

## Does the teaching profession attract the “right” people?

- Teacher education students have stronger social interests than other students (Klusmann et al., 2009; Roloff Henoch et al., 2015, Rothland, 2014).
- Teaching degree: Teacher candidates for upper secondary education show higher investigative and lower social interests than candidates for primary, special or lower secondary education. (Klusmann et al. 2009, Neugebauer, 2013).
- Major: Teacher candidates with a STEM major show higher investigative interests than candidates with a non-STEM major. (Kaub et al., 2012; Roloff Henoch et al., 2015).

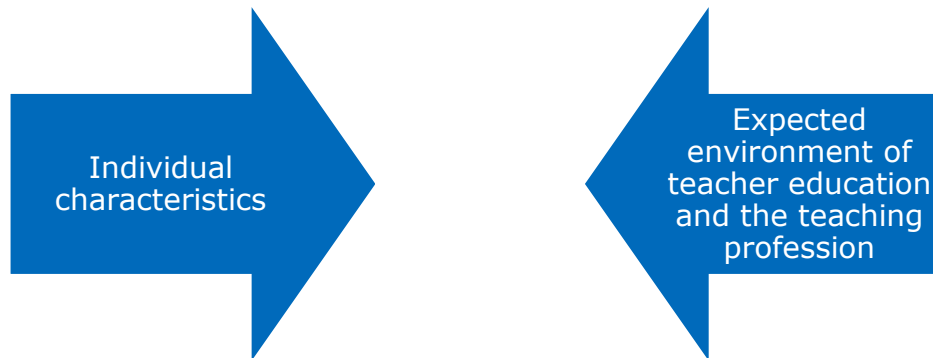
Going beyond existing studies (e.g. Roloff Henoch et al., 2015)

- Analysing a larger sample.
- Differentiating the group of teacher education students.
- Analysing simultaneously teaching degree and field of study.

- 1) “**Negative selection**”: Does the choice of a teacher training or another study programme depend on students’ individual characteristics (e.g. cognitive abilities, interests, personality)?
- 2) “**Internal selection**”: Does the choice of a specific teaching degree (e.g. primary and special education, lower/upper secondary education) depend on students’ individual characteristics?

## Explaining career choice via the person-environment-fit theory

- Vocational choices as a result of matching personal orientations with the (expected) environment of potential careers (Holland, 1997).



- **H1:** Students who are less open-minded and possess lower cognitive abilities and stronger social interests more often choose teacher training programmes instead of other study programmes.
- **H2:** Students who are open-minded and possess higher cognitive abilities, higher investigative and lower social interests more often choose a teaching degree for upper secondary education than a degree for primary, special or lower secondary education.

- German National Educational Panel Study (NEPS; Blossfeld, Roßbach, & Maurice, 2011), Starting Cohort 5—First Year Students (doi:10.5157/NEPS: SC5:4.0.0)
- State-wide random sample of new entrants to German HEI in winter semester 2010/2011 (Aschinger et al., 2011)
- Oversampling of teacher education students
- Data taken from
  - Wave 1 (initial self-administered paper-and-pencil survey and subsequent computer-assisted telephone interview), conducted between winter 2010 and summer 2011;
  - Wave 3 (second telephone interview), carried out in spring 2012.

## Strategy of analysis

- Groups defined (only students at universities)
  - Students training for primary and special education (TTPrim)
  - Students training for lower secondary education (TTSec1)
  - Students training for upper secondary education (TTSec2)
  - University students in study programmes other than teacher education (Non-TT)
- Controlling for field of study: distinction between
  - Students with at least one STEM major (focus: science, technology, maths)
  - Students with non-STEM majors (focus: humanities, sports, arts)
- Comparability with regard to subject area by including only corresponding fields of study (e.g., no law, medicine, engineering)



## Sample characteristics

Group	STEM	Non-STEM	Total
Teacher candidates: primary & special education	295	564	859
Teacher candidates: lower secondary education	415	349	764
Teacher candidates: upper secondary education	1,053	1,307	2,360
All teacher candidates	1,763	2,220	3,983
Other university students	1,289	1,204	2,493
<b>Total</b>	<b>3,052</b>	<b>3,424</b>	<b>6,476</b>

## Variables of primary interest

- Cognitive ability
  - Average school leaving grades (*Abitur* grade; ranging from 1 “very good” to 5 “poor”)
- Interests (based on Holland’s RIASEC model)
  - Realistic (3 items,  $\alpha = .63$ )
  - Investigative (3 items;  $\alpha = .65$ )
  - Artistic (3 items;  $\alpha = .62$ )
  - Social (3 items;  $\alpha = .70$ )

Included as composite variables ranging from 1 “very little interest” to 5 “very strong interest”

## Variables of primary interest

- Personality (Big Five)
  - Neuroticism (2 items,  $\alpha = .56$ )
  - Extraversion (2 items,  $\alpha = .75$ )
  - Openness (2 items,  $\alpha = .55$ )
  - Conscientiousness (2 items;  $\alpha = .55$ )

Included as composite variables ranging from 1 “very low” from 5 “very high”.

## Controlling for socio-demographic characteristics

- Gender
- Parents' education: at least one parent with a degree vs. no parent with a degree

## Cognitive abilities

- Roloff Henoch et al. (2015):
  - Choice of teacher education (training for lower or upper secondary education) instead of other programmes not affected by cognitive abilities
- NEPS Starting Cohort 5:
  - Highly significant effect of average school leaving grades when comparing teacher candidates (training for lower and upper secondary education) with students in non-teacher education programmes (poor grades reduce the odds of choosing non-teacher education programmes)
  - Different effects for different teacher education programmes

## Cognitive abilities

Effect of the *Abitur* grades (multinomial regression analyses controlling for gender and parents' education; bold print:  $p < .01$ )

Contrast	STEM	Non-STEM
	Odds ratio	Odds ratio
TTPrim vs Non-TT	<b>1.64</b>	<b>1.34</b>
TTSec1 vs Non-TT	<b>4.05</b>	<b>3.49</b>
TTSec2 vs Non-TT	.95	1.03
Pseudo-R <sup>2</sup> (McFadden)   n	.07   3,052	.03   3,424

- Pronounced differences between teacher education programmes:
  - Good *Abitur* grades → teacher training for upper secondary school
  - Poor *Abitur* grades → teacher training for lower secondary school

## Vocational interests

Effect of investigative and social interests (multinomial regression analyses with all interests dimensions, controlling for *Abitur* grade, gender and parents' education; bold print:  $p < .01$ )

Contrast	Interest dimension	STEM	Non-STEM
		Odds ratio	Odds ratio
TTPrim vs Non-TT	Investigative	<b>.32</b>	<b>.62</b>
TTSec1 vs Non-TT	Investigative	<b>.40</b>	<b>.60</b>
TTSec2 vs Non-TT	Investigative	<b>.56</b>	<b>.65</b>
TTPrim vs Non-TT	Social	<b>6.27</b>	<b>3.70</b>
TTSec1 vs Non-TT	Social	<b>4.15</b>	<b>2.10</b>
TTSec2 vs Non-TT	Social	<b>2.82</b>	<b>1.77</b>
Pseudo-R <sup>2</sup> (McFadden)   n		.18   3,052	.07   3,424

## Personality

- Small increase in pseudo- $R^2$  (STEM: from .18 to .19; non-STEM: from .07 to .08); according to the likelihood-ratio test, the null hypothesis that personality variables have no effect should be rejected; but BIC statistics for STEM students indicate that model without personality variables should be preferred
- Small or insignificant effects of neuroticism and conscientiousness
- Bigger and highly significant effects of extraversion and openness:
  - Teacher candidates are more extraverted than non-teacher education students
  - Teacher candidates are less open-minded than non-teacher education students
  - Differences between teacher education programmes not pronounced

- When controlling for subject area, no general negative selection effect regarding *Abitur grades*, but negative selection into teacher training for primary and lower secondary education
- No general negative selection into STEM in terms of *cognitive abilities*, but negative selection among teacher candidates enrolled in upper secondary education programmes and among university students in non-teaching programmes (results not reported)
- Good match between *vocational interests* and degree programme:
  - Students with high *investigative (research) interests* are more often found in non-teaching degree programmes (and in STEM majors; results not reported)
  - Students with high *social interests* are more often found in teacher training, especially in programmes for primary and special education (and in non-STEM majors; results not reported)



- It is important to take the heterogeneity among teacher training students into account:
  - In terms of the subject(s) chosen
  - With regard to the “level” of the programme (i.e., training for primary education, for lower secondary education, for upper secondary education)
- When comparing teacher candidates and other students, results depend on the definition and delimitation of subject areas: special attention must be paid to ensuring comparability

- Next steps:
  - Refine the definition of STEM and non-STEM majors
  - Use better indicators for cognitive abilities (results of competence tests in German and mathematics)
  - Impute missing values
  - Include additional predictors
  - Examine the consequences of individual characteristics for the use of learning opportunities, the development of competencies, and the quality of instruction

Thanks for your interest!

Questions?

Comments?

Hilde Schaeper  
Email: [schaeper@dzhw.eu](mailto:schaeper@dzhw.eu)

Julia-Carolin Brachem  
Email: [brachem@dzhw.eu](mailto:brachem@dzhw.eu)

German Centre for Higher Education Research and Science Studies (DZHW)  
Lange Laube 12, 30159 Hannover, Germany

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## Additional slides

## Strategy of analysis

- Using the study of Roloff Henoch et al. (2015) as a “reference model”
  - Choosing adequate comparison groups
  - Controlling for field of study
  - But no longitudinal approach: Individual characteristics were measured after the participants have taken up higher education.
- Going beyond the approach of Roloff Henoch et al (2015)
  - Differentiating the group of teacher education students
  - Including students training for primary and special education



## Method

- Multinomial logistic regression (using Stata)
- Coefficients reported
  - Odds ratios (OR): factor by which the odds of one outcome versus another outcome (e.g., for choosing teacher education for upper secondary schools vs. non-teaching university programmes) are expected to change for a unit change in the predictor, holding other variables constant
  - Interpretation:

$OR \approx 1$	no effect
$OR < 1$	negative effect, decrease of the odds
$OR > 1$	positive effect, increase of the odds

## Cognitive abilities

Effect of the *Abitur* grades (multinomial regression analyses controlling for gender and parents' education; bold print:  $p < .01$ )

Contrast	STEM	Non-STEM
	Odds ratio	Odds ratio
TTPrim vs Non-TT	<b>1.64</b>	<b>1.34</b>
TTSec1 vs Non-TT	<b>4.05</b>	<b>3.49</b>
TTSec2 vs Non-TT	.95	1.03
Pseudo-R <sup>2</sup> (McFadden)   n	.07   3,052	.03   3,424

TTPrim vs TTSec1	<b>.41</b>	<b>.38</b>
TTPrim vs TTSec2	<b>1.72</b>	<b>1.30</b>
TTSec1 vs TTSec2	<b>4.26</b>	<b>3.39</b>

## Cognitive abilities

The effect of the *Abitur* grade (multinomial regression analysis controlling for gender and parents' education)

Contrast	STEM	Non-STEM
	Odds ratio	Odds ratio
TTPRIM vs Non-TT	1.64 ***	1.34 **
TTSecI vs Non-TT	4.05 ***	3.49 ***
TTSecII vs Non-TT	.95	1.03
TTPRIM vs TTSec1	.41 ***	.38 ***
TTPRIM vs TTSec2	1.72 ***	1.30 ***
TTSec1 vs TTSec2	4.26 ***	3.39 ***
Pseudo R <sup>2</sup> (McFadden)   n	.07   3,052	.03   3,424

## Cognitive abilities

The effect of the *Abitur* grade (multinomial regression analysis controlling for gender and parents' education)

Contrast	STEM	Non-STEM
	Odds ratio	Odds ratio
TTPRIM vs Non-TT	1.64 ***	1.34 **
TTSecI vs Non-TT	4.05 ***	3.49 ***
TTSecII vs Non-TT	.95	1.03
TTPRIM vs TTSec1	.41 ***	.38 ***
TTPRIM vs TTSec2	1.72 ***	1.30 ***
TTSec1 vs TTSec2	4.26 ***	3.39 ***
Pseudo R <sup>2</sup> (McFadden)   n	.07   3,052	.03   3,424

## Vocational interests

Effect of vocational interests (multinomial regression analyses controlling for *Abitur* grade, gender and parents' education)

Contrast	Interest dimension	STEM	Non-STEM
		Odds ratio	Odds ratio
TTPrim vs Non-TT	Realistic	1.00	1.40 ***
TTSec1 vs Non-TT	Realistic	1.03	1.54 ***
TTSec2 vs Non-TT	Realistic	1.09	1.28 ***
TTPrim vs Non-TT	Investigative	.32 ***	.62 ***
TTSec1 vs Non-TT	Investigative	.40 ***	.60 ***
TTSec2 vs Non-TT	Investigative	.56 ***	.65 ***
Pseudo-R <sup>2</sup> (McFadden)   n		.18   3,052	.07   3,424

## Vocational interests

Effect of vocational interests cont. (multinomial regression analyses controlling for *Abitur* grade, gender and parents' education)

Contrast	Interest dimension	STEM	Non-STEM
		Odds ratio	Odds ratio
TTPrim vs Non-TT	Artistic	1.43 ***	.94
TTSec1 vs Non-TT	Artistic	1.27 **	.97
TTSec2 vs Non-TT	Artistic	1.25 ***	.99
TTPrim vs Non-TT	Social	6.27 ***	3.70 ***
TTSec1 vs Non-TT	Social	4.15 ***	2.10 ***
TTSec2 vs Non-TT	Social	2.82 ***	1.77 ***
Pseudo-R <sup>2</sup> (McFadden)   n		.18   3,052	.07   3,424

## Vocational interests

- Realistic interests
  - NEPS Starting Cohort 5: no effect for students with STEM majors, positive effect of choosing teacher education instead of other university programmes for students with non-STEM majors
  - Roloff Henoch et al.: negative effect for choosing teacher education instead of other programmes when enrolled for STEM, no effect for students with non-STEM majors
  - Divergence can be attributed to different definitions of STEM and non-STEM majors (we excluded engineering)

## Personality

Effect of Big Five personality factors (multinomial regression analyses controlling for *Abitur* grade, interests, gender and parents' education)

Contrast	Big Five dimension	STEM	Non-STEM
		Odds ratio	Odds ratio
TTPrim vs Non-TT	Neuroticism	.79	.97
TTSec1 vs Non-TT	Neuroticism	.77 **	.94
TTSec2 vs Non-TT	Neuroticism	.85 *	.93
TTPrim vs Non-TT	Extraversion	1.18	1.22 **
TTSec1 vs Non-TT	Extraversion	1.33 **	1.54 ***
TTSec2 vs Non-TT	Extraversion	1.40 **	1.44 ***
Pseudo-R <sup>2</sup> (McFadden)   n		.19   3,052	.08   3,424



## Personality

Effect of Big Five personality factors cont. (multinomial regression analyses controlling for *Abitur* grade, interests, gender and parents' education)

Contrast	Big Five dimension	STEM	Non-STEM
		Odds ratio	Odds ratio
TTPrim vs Non-TT	Openness	.84	.69 ***
TTSec1 vs Non-TT	Openness	.81 *	.64 ***
TTSec2 vs Non-TT	Openness	.77 ***	.75 ***
TTPrim vs Non-TT	Conscientiousness	1.25 *	.86 *
TTSec1 vs Non-TT	Conscientiousness	1.32 **	1.06
TTSec2 vs Non-TT	Conscientiousness	.99	1.04
Pseudo-R <sup>2</sup> (McFadden)   n		.19   3,052	.08   3,424

## Individual characteristics: comparison of means

Variable	STEM				Non-STEM			
	TT Prim	TT Sec1	TT Sec2	Non-TT	TT Prim	TT Sec1	TT Sec2	Non-TT
	a	b	c	d	e	f	g	h
<i>Abitur</i> grade	2.23 <sub>b,c</sub>	2.55 <sub>c,d</sub>	2.09 <sub>g</sub>	2.12	2.26 <sub>f</sub>	2.61 <sub>g,h</sub>	2.20	2.18
Realistic interests	2.69 <sub>d</sub>	2.75	2.86 <sub>g</sub>	2.87 <sub>h</sub>	2.55 <sub>h</sub>	2.63 <sub>h</sub>	2.49 <sub>h</sub>	2.38
Investigative interests	3.01 <sub>c,d,e</sub>	3.12 <sub>c,d,f</sub>	3.43 <sub>d,g</sub>	3.77 <sub>h</sub>	2.75	2.69	2.70 <sub>h</sub>	2.83
Artistic interests	3.18 <sub>c,d,e</sub>	3.00 <sub>d,f</sub>	2.89 <sub>d,g</sub>	2.54 <sub>h</sub>	3.48	3.45	3.42	3.41
Social interests	4.21 <sub>c,d,e</sub>	4.05 <sub>c,d</sub>	3.83 <sub>d,g</sub>	3.22 <sub>h</sub>	4.36 <sub>f,g,h</sub>	4.14 <sub>h</sub>	4.01 <sub>h</sub>	3.75

Scheffé multiple-comparison test for a – b, c, d, e    b – c, d, f    c – d, g    d – h  
    e – f, g, h    f – g, h    g – h

Subscript: significant mean difference ( $p < .01$ )

## Individual characteristics: comparison of means

Variable	STEM				Non-STEM			
	TT Prim	TT Sec1	TT Sec2	Non-TT	TT Prim	TT Sec1	TT Sec2	Non-TT
	a	b	c	d	e	f	g	h
Neuroticism	2.81	2.72	2.66	2.72 <sub>h</sub>	2.85	2.76	2.73	2.82
Extraversion	3.79 <sub>d</sub>	3.86 <sub>d</sub>	3.79 <sub>d,g</sub>	3.45 <sub>h</sub>	3.87 <sub>h</sub>	3.98 <sub>h</sub>	3.68 <sub>h</sub>	3.68
Openness	3.66	3.58	3.55 <sub>g</sub>	3.52 <sub>h</sub>	3.78 <sub>h</sub>	3.73 <sub>h</sub>	3.82 <sub>h</sub>	3.95
Conscientiousness	3.94 <sub>c,d</sub>	3.85 <sub>c,d</sub>	3.74 <sub>d,g</sub>	2.54 <sub>h</sub>	3.86	3.86	3.89	3.84
Females	0.89 <sub>c,d</sub>	0.78 <sub>c,d</sub>	0.62 <sub>d,g</sub>	0.49 <sub>h</sub>	0.89 <sub>g,h</sub>	0.85 <sub>g</sub>	0.75	0.79
Parents with a degree	0.46	0.37 <sub>c,d</sub>	0.49	0.49	0.48 <sub>f</sub>	0.31 <sub>g,h</sub>	0.48	0.51

Scheffé multiple-comparison test for a – b, c, d, e    b – c, d, f    c – d, g    d – h  
    e – f, g, h    f – g, h    g – h

Subscript: significant mean difference ( $p < .01$ )