No g in education?

Martin Brunner*[*]

Max Planck Institute for Human Development, Center for Educational Research, Berlin, Germany

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Astract

This study investigates the relationships of domain-general cognitive abilities and domain-specific verbal and mathematical abilities to students educational characteristics when two theoretically grounded, but competing structural models are applied. In the standart model, a single latent ability causes interindividual differences in the corresponding measures. In the nested-factor model, interindividual differences are cuased by two independent cognitive abilities: general cognitive ability and domain-specific ability. The two models were examined using data from 29,386 ninth graders. The results show that findings on the relations between domain-specific abilities and students' socio-economic status, general school satisfaction, educational aspirations, domain-specific interests, and subject-specific grades may differ substantially depending on the structural model applied. Implications for educational research and measerement as well as for students' motivational and cognitive development are discussed.

Значимо ли присутствие генерального фактора (G) в образовательном пространстве?

Мартин Бруннер

Резюме

Данное исследование рассматривает взаимосвязь между общей когнитивной способностью и специфическими вербальными и математическими способностями, с одной стороны, и основными характеристиками школьников, с другой, при сравнении использующихся здесь двух теоретически обоснованных, но конкурирующих структурных моделей. В первой, стандартной модели, одна единственная латентная способность обуславливает межиндивидуальные различия в соответствующем измерении. В другой модели, nested-factor model, межиндивидуальные различия обусловлены двумя независимыми когнитивными способностями: общей когнитивной способностью и специфической для определенной области знаний способностью. Две модели проверялись на выборке, состоящей из 29386 девятиклассников. Результаты показывают, что данные о взаимосвязи между способностями в определенной области знаний и такими характеристиками школьников, как социо-экономический статус, общая удовлетворенность школой, желание учиться, интересы в разных областях знаний,

удовлетворенность классом, могут существенно отличаться в зависимости от применяемой модели. Значение данных результатов для исследований и измерений в области образования, также как и для мотивационного и когнитивного развития школьников обсуждаются.

* University of Luxembourg, The Faculty of Language and Literature, Humanities, Arts and Education, EMACS Research Unit, Campus Walferdange B.P. 2, L-7201 Walferdange, Luxembourg. Tel.: +352 466 644 9512.
E-mail address: martin.brunner@emacs.lu.

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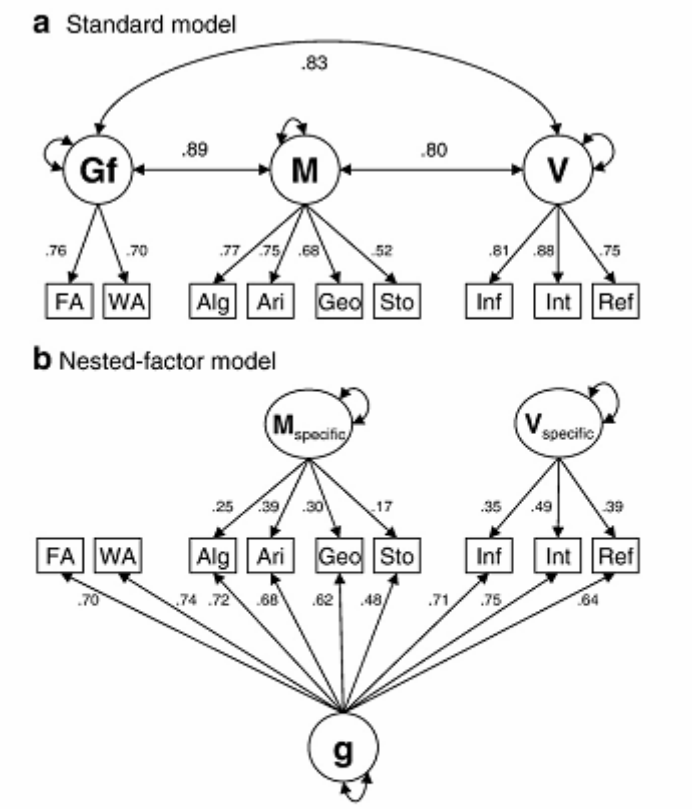

Fig. 1. Structural conceptualizations of cognitive abilities in (a) the standard model and (b) the nested-factor model, showing the corresponding standardized model parameters. All model parameters are statistically significant different from zero ($p<.01$, one-sided test). To ensure clarity of presentation, residual terms of the manifest variables are omitted. *M*: mathematical ability, *V*: verbal ability, *Gf*: fluid ability, $M_{specific}$: specific mathematical ability, $V_{specific}$: specific verbal ability, *g*: general cognitive ability.

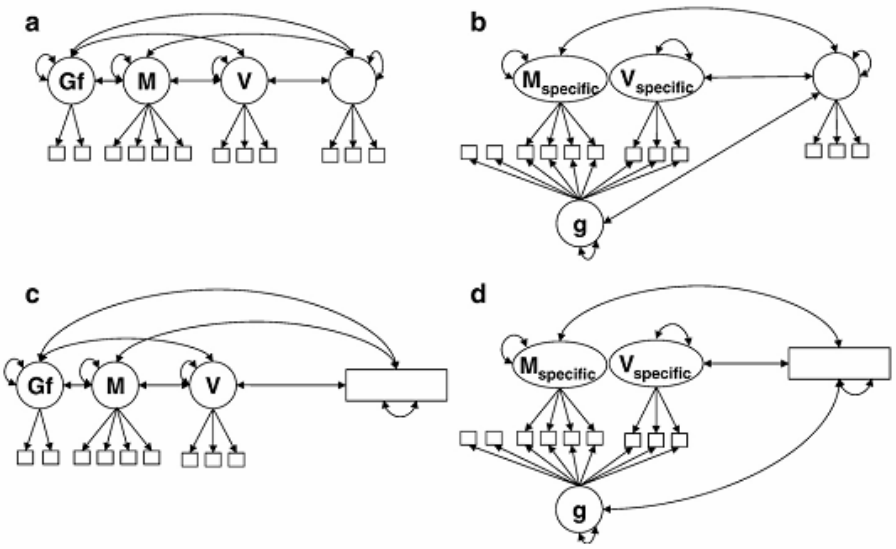

Fig. 2. Generic models applied to investigate the relation of cognitive abilities in terms of the standard model (a, c) and the nested-factor model (b, d) to students' educational characteristics. Models a and b were used to analyze the relation of cognitive abilities to domain-specific interests and school satisfaction. Models c and d were used to investigate the relation to students' socio-economic status, grades, and educational aspirations. To ensure clarity of presentation, residual terms of the manifest variables are omitted. *M*: mathematical ability, *V*: verbal ability, *Gf*: fluid ability, $M_{specific}$: specific mathematical ability, $V_{specific}$: specific verbal ability, *g*: general cognitive ability.

Table 1
Measures of cognitive abilities: Descriptive statistics

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Algebra (Alg)	*.84*								
2. Arithmetic (Ari)	.58	*.71*							
3. Geometry (Geo)	.52	.53	*.61*						
4. Stochastics (Sto)	.40	.39	.33	*.66*					
5. Figural analogies (FA)	.51	.48	.47	.32	*.91*				
6. Word analogies (WA)	.52	.48	.44	.33	.55	*.85*			
7. Information (Inf)	.52	.50	.44	.37	.48	.53	*.57*		
8. Interpretation (Int)	.54	.52	.45	.39	.50	.57	.71	*.73*	
9. Reflection (Ref)	.47	.44	.38	.32	.43	.49	.59	.67	*.53*
M	0.09	0.01	−0.03	0.24	0.03	0.04	−0.08	−0.06	−0.17
SD	1.41	1.36	1.41	1.18	1.08	1.27	1.09	1.05	1.20

WLE scores for cognitive abilities were estimated with a population mean of zero and without restrictions on the population variance. Deviations of the means from zero can be expected due to sampling error and the correction of WLE estimates for differential test booklet difficulty in a multi-matrix sampling design (see Adams & Wu, 2002, for technical details). Correlations, means, and standard deviations were computed with the Full Information Maximum Likelihood estimator. The diagonal contains reliability estimates obtained from the corresponding item response models.

Table 2
Correlations between students' educational characteristics and cognitive abilities under different structural conceptualizations of cognitive abilities

Students' educational characteristics	Standard model			Nested-factor model		
	M	*V*	*Gf*	$M_{specific}$	$V_{specific}$	*g*
Socio-economic status						
ISEI	.34	.35	.33	.05	.09	.35
Number of books	.38	.41	.40	*.01*	.11	.41
Interests and school-related attitudes						
Interest in mathematics	.22	−.05	.10	.35	−.26	.09
Interest in reading	.20	.36	.29	−.22	.20	.31
School satisfaction	.17	.19	.18	*−.02*	.05	.19
Grades						
German	.10	.20	.14	−.10	.13	.15
Mathematics	.29	.13	.23	.22	−.12	.22
Educational aspirations						
Intention to enter higher education (dummy coded, with 0 indicating no and 1 indicating yes)	.48	.43	.44	.11	.06	.46

Cognitive abilities were represented as latent variables in the standard model and the nested-factor model. Domain-specific interests and school satisfaction were represented as first-order factors (see Fig. 2a and b). Measures of students' socio-economic status, grades, and educational aspirations were represented as manifest variable (see Fig. 2c and d). Correlations in normal print are statistically different from zero ($p<.01$, two-sided test); correlations in italics are not statistically different from zero ($p \geq .01$, two-sided test). Grades were z-standardized ($M=0$, $SD=1$) within schools to account for systematic school-specific differences in grading leniency. Positive correlations with grades indicate that higher cognitive abilities are associated with better grades. *M*: mathematical ability, *V*: verbal ability, *Gf*: fluid ability, $M_{specific}$: specific mathematical ability, $V_{specific}$: specific verbal ability, *g*: general cognitive ability.