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SCHOOLS: SCHOOL
CHARACTERISTICS AND
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STUDENTS IN MATHEMATICS**

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**BASKING IN THE GLORY OF SCHOOLS:
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OF STUDENTS IN MATHEMATICS³**

Our study contributes to the debate on the interaction between academic context, individual achievement, and mathematics self-concept in schools. It is known that high-achieving peers positively influence the individual achievements of all group members. At the same time, it has been shown that the self-concept of students tends to decrease in the presence of high-achieving peers, as individuals make relative judgments of their abilities vis-à-vis their peer group. Students with mediocre performance feel more confident about their abilities in a group of poor achievers (the Big-Fish-Little-Pond Effect – BFLPE – introduced by H.Marsh). On the other hand, perceived prestige of a school enhances the self-confidence of students as people tend to “bask in the glory” of others (the “reflected glory” effect). We test the two effects mentioned above – BFLPE and the “reflected glory” effect. We hypothesize that both effects are stronger in highly stratified education systems where there is a stronger explicit difference between high- and poor-achieving students, and schools are ranked by their prestige. We compare the interaction of academic context, achievement, and mathematics self-concept in stratified (Russia and Czech Republic) and non-stratified (Norway and Sweden) educational systems on the TIMSS’07 database using HLM7. Our study shows: 1) an absence of BFLPE for all four countries, i.e. the achievement of others is positively related to an individual’s math self-concept; 2) strong support for the “reflected glory” effect is found only in stratified educational systems; and 3) greater positive effect on self-concept for students with poor achievement who study in the best schools.

JEL Classification: I21, C12.

Key words: BFLPE, “reflected glory” effect, stratification, multilevel modeling, environmental effects.

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Introduction

Social comparison is embedded in a human's life in that an individual can get an impression of his or her own self only by comparison with others. Such a comparison can have a negative impact on an individual's motivation, self-esteem, self-confidence, and even achievement. The notion of self-concept was created to study such effects and is defined as "a person's perception of him- or herself. These perceptions are formed through experience with and interpretations of one's environment. They are influenced especially by evaluations from significant others, reinforcements, and attributions for one's own behavior" [Marsh and Shavelson, 1985]. Self-concept is domain-specific. For educational research, the idea of academic self-concept is especially important (e.g., math, literacy, literature, languages).

The big-fish-little-pond effect, discovered by Marsh and his colleagues, confirms that a successful environment decreases an individual's academic self-concept [Marsh and Parker, 1984; Marsh et al, 1995; Marsh et al, 2000]. This effect is larger in a stratified educational system with explicit differences between "bad" and "good" schools [Marsh et al, 2001; Trautwein et al, 2009]. Studying in a "good" school only slightly counterbalances the negative contrast of the BFLP effect due to the "reflected glory" effect [Marsh et al, 2000; Marsh and Craven, 2000].

In this article we explore the differences in environmental effect, which unites both the contrast and "reflected glory" effects, in countries with stratified (Russia, Czech Republic) and non-stratified (Norway, Sweden) educational systems. We expect to find a stronger effect in stratified systems, as students are provoked to provide social comparisons there. Furthermore, our hypotheses are tested on literal class level based on the TIMSS sample design. Sampling design of PISA, which is analyzed in the majority of BFLPE studies, allows only for school, not class, comparison. This may lead to some unexpected effects.

I. Literature review

Frame of reference (FR)

The concepts involving a frame of reference have been in use over a hundred years. In the context of our study, the notion of frame of reference is derived from the social comparison theory proposed by Festinger [1942a; 1942b]. He found that an individual's self-assessment abilities depend on his or her self-identification with a more or less successful group. This group defines a specific norm of behavior, achievement, etc., which becomes the reference point for the individual and therefore increases or decreases his or her expectations and aspirations. The frame of reference defines the group used by the individual for social comparison in the process of build-

ing a set of self-perceptions. The individual may choose different frames of reference (more or less successful), which will affect his or her self-perception and self-assessment [Altermatt and Pomerantz, 2005].

A number of studies have been examining the influence of school environment (as significant others) on the self-assessment of students and self-evaluation of their achievements. Marsh draws a distinction between the influence of internal and external frame of reference. The individual forms an external frame of reference in the process of comparing oneself with others; and the internal frame of reference is formed in the process of comparing one's achievements in one domain (e.g. mathematics) with one's achievements in a different domain (e.g. physics). It has been shown that the internal frame of reference is weak related to achievement: high academic achievement in one domain correlates with low self-assurance in a different domain [Marsh, 1986; Möller and Köller, 2001; Wang et al, 2007] have shown that the external frame of reference is culturally embedded: in Hong Kong under British rule, an individualistic outlook was more prevalent, whereas under Chinese rule a collectivistic outlook has become more common. An external frame of reference became more important than an internal frame of reference.

Chiu [2008] has shown that this effect is not universal: only in 10 countries out of 28 countries in the study did he find an unequivocal connection between negative academic achievement in mathematics and science self-concept (and vice versa). In four cases there was no observed effect. Self-concept is also affected by a teacher's individualized frame of reference (a complex of teacher strategies, assessment protocols, and feedback): in the cases where the teachers used all these techniques, student self-concept was generally higher [Luedtke et al, 2005].

The big-fish-little-pond effect (BFLPE)

Studies on frame of reference gave birth to a model comparing the class or school influence and personal academic achievement on academic self-concept [Marsh and Parker, 1984; Marsh et al, 1995; Marsh et al, 2000]. It was shown that individual academic achievement has a positive effect on self-concept, whereas the impact of class-average or school-average academic achievement is negative. This can be explained in terms of frame of reference: the average level of academic achievement represents the reference level for the students' self-concept. A higher level of class or school academic achievement sets a higher bar for self-concept, and, by extension, sets a lower perception of one's achievement and abilities. Of course, at the same time, a student's academic achievement is higher. In other words, students in a successful academic environment find themselves somewhat psychologically deprived, but, on the other hand, they achieve a greater success in specific areas. The negative effect of average level of academic achievement on self-concept is also called "a contrast effect".

Altermatt and Pomerantz [2005] reported similar results. They found that being friends with more successful peers lowers a student's self-concept while improving their academic achievement. Friendship with peers of equal academic achievement has a positive effect on self-concept, but has a negative impact on academic achievement. Students feel more comfortable in a group where the level of academic achievement does not exceed their own (and they use this group as a reference point), but in such an environment they lack motivation for self-improvement, which in turn results in less impressive academic achievement.

Marsh and Yeung [1997] argued that in academic domains, the BFLP effect is stronger for mathematics than for English language and the natural sciences. Among non-academic domains, the BFLPE is especially noticeable in sports and exercise settings. In this area, competition and self-comparison are explicit. Moreover, they are the only measure of success. For this reason, the negative effect from social comparison with the average level of other students in sports settings is especially strong [Chanal et al, 2005].

In addition, it has been shown that the students who participate in programs for gifted and talented children show a tendency for lower academic self-concept (in the domain of mathematics and reading) as compared to students from standard classes. This effect has been observed in Germany [Marsh et al, 1995] and in Israel [Zeinder and Schleyer, 1999]. It should be noted that participation in programs with higher requirements did not affect student self-concept in non-academic domains [Marsh et al, 1995].

The causality of the observed effects requires special consideration. What is the cause and what is the effect here? Does academic achievement affect academic self-concept, or does self-concept affect academic achievement? Marsh et al conducted an analysis of longitudinal data and argued that this process is reciprocal: academic achievement at time A affects self-concept at time B, which in turn affects academic achievement at time C, etc. [Marsh et al, 2005; Marsh and Yeung, 1997; Marsh et al, 2000].

Marsh and Hau [2003] have proved the universal nature of negative BFLPE in 26 countries, basing their studies on PISA data. They came to the unequivocal conclusion that the contrast effect is universal and negative. In 24 out of 26 countries they found a negative effect of a class' or school's average academic achievements on individual self-assessment. In the remaining two countries they also observed a negative effect, the only difference being that it was insignificant in these countries. Across the countries, the effect values ranged from -0.02 to -0.36. A study carried out in Australia on the effect of individual and average academic achievement on self-concept also confirmed the universal character of the BFLP effect [Marsh, 2004].

The negative BFLP effect also was shown for countries with collectivist culture [Seaton, Marsh and Craven, 2006]. In 2009, an additional study was carried out to verify the existence

and nature of the BFLP effect in 41 countries with different economies and culture. The negative effect was observed for all countries, and in 38 countries it was significant, regardless of the character of their culture (collectivist or individualistic) and economy (developing or developed) [Seaton, Marsh and Craven, 2009].

The main critique of the BFLP effect is aimed at its theoretical background. Marsh and other researchers assume that self-comparison always takes the form of “worse or better than me”, but the social comparison theory also considers the possibility that the information obtained from such a comparison will be used for continued self-improvement [Dai, 2004]. In addition, the BFLPE does not account for the influence of the group’s average academic achievement on individual achievement: students in a class of a lower academic level will be feeling bored, and students in a class of a higher academic level will not be able to keep up and will be experiencing stress and deprivation [Plucker et al, 2004].

Stratification

“Proposed policies for school choice exist in the socio-historical context of a century of de jure racial segregation in schools, decades of emigration of Whites and middle-class families from central cities and urban schools, and a well-understood nexus between income and admission to highly exclusive neighborhood or private schools [Orfield, 1992; Wilson, 1997]. In this context, fears of school choice’s further segregating children by social class and race are hardly surprising, and substantial evidence supports these fears” [Archbald, 2000].

Education systems can be divided into two categories: stratified and non-stratified. Type and degree of stratification can be assessed using a range of parameters, but, generally speaking, the presence of stratification is identified by a number of trends and features. In line with A.M.Pallas and G.H.Elder, we conceptualize the trajectory as a sequence of transitions, “inter-linked states” of a particular individual within an education system, meaning pathways as typical trajectories, or possible routes to achieve one education goal or another (see Elder in: [Bandura, 2003]). Division into tracks can exist within the same school (in which case it is also called “ability grouping”), as well as between different school types.

In the first case, there are several different programs within one school, and children are divided by their abilities. This system is typical for Russia and the USA. The school system in Germany and in Switzerland is a typical example of the second trajectory type. After elementary school, students can continue education in one of three distinct separate school types:

- Hauptschule (a school with most basic level of education that provides manual labor skills),

- Realschule (the middle trajectory that provides access to middle-level professions but does not provide access to higher education),
- Gymnasium (the only academic trajectory that allows students access to higher education).

To a large extent, the results of stratification studies depend on identification methods. A stratified system can be identified immediately due to the explicit division of different school or program types (academic or non-academic). In addition, grouping by academic achievement can be revealed by ANOVA. If the variation levels between schools or classes exceed the variation within schools or classes, then the system is likely to be stratified. Also, a number of indices have been developed to assess the percentage of different types of students (e.g. migrants, children from poor families, etc.), for example the dissimilarity index and the exposure index [Archbald, 2000].

At any level of stratification, the homogeneity of the student environment will increase, be it at the school or class level. The results of such stratification and sorting provoke intense debates. Researchers discuss the extent of the influence of such a tracking on academic achievements and socio-psychological characteristics of students and its possible benefits. On the whole, researchers are concerned with the fact that, as a result of this tracking, students from disadvantaged families tend to fall into the lowest trajectory, and children from privileged families tend to gain acceptance in the highest trajectory, thus perpetuating and reinforcing class reproduction [Maaz et al, 2008]. In addition, it has been shown that, in situations where students have the option to choose their school, an even greater segregation based on socio-economical characteristics exist, thereby widening the gap between academic achievement in schools [Allen, 2007].

The influence of tracking on academic achievement is ambiguous. Some researchers have found that, in the presence of any tracking, the level of academic achievement goes down for all students, and the students with the lowest academic achievement suffer most of all [Hanushek and Woessmann, 2006].

In contrast, the results of a meta-analysis conducted by Slavin [1990] have not demonstrated the effect of ability grouping on the level of academic achievement in high school, which led to a conclusion on the low efficiency of intra-school tracking. Loveless argues that both intra-school and inter-school tracking does not cause deprivation for any group of students. Ability grouping helps students with high- and middle-level abilities. Students with low-level abilities benefit more from studying in heterogeneous groups, however this has a pronounced negative effect on students with higher abilities [Loveless, 1998].

In addition to the influence of tracking on student socio-economical characteristics and academic achievement, researchers have examined its connection with a number of socio-psychological factors. Berends [1995] has found that students from non-academic tracks have lower expectations, more disciplinary issues, and are less involved in studying than students from academic tracks. Such students also have a higher dropout rate between the 10 and 12 grades. Students from vocational tracks also tend to have a higher level of absenteeism than students from other tracks.

Stratification and BFLPE

Unsurprisingly, researchers also examined the effects of stratification in their studies of the impact of environment on student self-concept. Almost unanimously, researchers came to a conclusion that stratification (both within schools and among them) has a negative impact on student academic self-concept.

Marsh et al investigated the changes in student academic self-concept with in East Germany's transition from a non-stratified system to a stratified system. In a longitudinal perspective, they compared the character and degree of connection between self-concept and achievement for students from East and West Germany (by the time of survey, the explicit stratification in West Germany had already been existing for a long time). Researchers found that within one year after the transition of all East German students to the stratified system, the BFLP effect, previously negative and weak, increased to levels comparable to those in West Germany. In other words, the presence of explicit stratification intensified the negative impact of social comparison with more able students, thus lowering student self-concept [Marsh et al, 2001; Trautwein et al, 2009].

Generally, students from more successful schools are expected to have higher individual academic achievement. However, Marsh has shown that, with control for socio-economical characteristics, students in higher-ability schools (measured by the average level of student academic achievement) show lower individual achievement, educational and vocational aspirations, and lower academic self-concept. In addition, the researcher came to the conclusion that higher-achieving schools also have lower value-added, meaning that high-ability students reach their potential to a lesser degree. One has to conclude that in such schools the negative impact on education (i.e. the perception of oneself as a low-ability student) outweighs the potential benefits [Marsh, 1991]. The self-concept of low-ability students suffers the most from this tracking [Trautwein et al, 2009].

The negative impact of stratification manifests itself mainly in academic domain; it does not affect the non-academic characteristics, such as physical appearance, physical abilities, or

peer relations [Marsh et al, 1995]. It has been shown that, on the individual level, high-ability students have a better idea of their academic abilities [Preckel et al, 2008].

Marsh et al have also shown that in the German education system, the impact of tracking (e.g. studying in a Gymnasium vs. other school types) on student self-concept is almost identical to the negative effect of average academic achievements (BFLPE), but to a lower degree. The negative-contrast effect persists up to four years after graduation [Marsh et al, 2007].

Is the negative effect of stratification on individual self-concept a direct result of tracking, perhaps from the awareness of explicitly expressed lower or higher requirements from different tracks? Trautwein et al came to the conclusion that this is not true. Even though at first glance the tracking effect manifests itself both within stratified schools and between them, this effect can be explained by the existing grading system. Thus, the positive effect of studying in the lowest German track – Hauptschule – on student self-concept is due to the fact that teachers more often give student high grades rather than low grades, whereas the grading system in the academic track – Gymnasiums – is completely opposite. Even though ability grouping within a school helps to better correlate the students' achievements with their grades, they also explain the impact of tracks on student academic self-concept [Trautwein et al, 2006].

The positive effects of tracking have been found only for the model of internal and external frame of reference. It has been shown that average academic achievement in one domain has a positive effect on a student's self-concept in another domain, but this effect was found only in themed schools. This effect can be explained by a compensatory mechanism: since the average academic achievement leads to lower self-concept in the same domain, the students compensate their lower self-concept by assuming that they have better achievements in some other areas [Parker et al, 2013]. For example, if a student feels that she has lower skills in mathematics than most of her classmates, then she will believe that she has better skills in arts.

The Reflected Glory Effect

The compensatory effect was found not only in cases of an internal or external frame of reference. Even though overt stratification has a negative impact on academic self-concept, explicit tracking may have a positive effect as well. In countries with accepted and recognized stratification in the education system, all actors of the education process know in advance which of the tracks (school types, class types, program types) are more desirable and prestigious, and which are perceived as less desirable and inferior. It can be argued that the mere fact that a student is studying in a “good” track should have a positive effect on self-concept, since the student should have a sufficient level of skills and abilities to be enrolled in a given class or school in the first place.

Marsh et al suggested that this positive “reflected glory” effect should counter-balance the negative effect of the school’s average achievement, and tested this hypothesis in a number of schools in Hong Kong, China, and Germany. The education system in Hong Kong is highly and explicitly segregated. In a survey, parents and students were asked to evaluate the status of their school. Based on survey data, the researchers built an index reflecting the relative “glory” levels of these schools. It has been shown that this index is valid for aggregated data [Trautwein et al, 2009]. The study confirmed that “reflected glory” indeed has a counter-balancing effect on negative BFLPE. Students from schools with a higher perceived level had also a higher academic self-concept. However, the reflected glory effect is significantly lower than the BFLPE, and the negative impact of average school achievement still outweighs the positive effect of stratification [Marsh et al, 2000; Marsh and Craven, 2000]. This result was also confirmed for Chinese schools (see Hau, Kong and Marsh in [Marsh and Craven, 2000]).

For German students, researchers have found a positive effect from individual and aggregate perceptions of school or class status on student academic self-concept [Trautwein et al, 2009]. This fact also confirms the presence of a compensatory glory effect and suggests that it may be universal. Marsh et al suggest that the “reflected glory” effect should be at its highest immediately after the notification of the student about their enrollment into a “good” track. However, students eventually start paying more attention to other factors (their academic achievement and the achievement of others), which decreases the glory affect and increases the contrast effect [Marsh et al, 2004; Liu et al, 2005].

The “reflected glory” effect is not limited only to school or class status. Some researchers examined the effect of the achievement of friends on a student’s academic self-concept in terms of the “reflected glory” concept. They found that the most successful students have a higher self-concept if their friends are successful as well. In a way, they bask in each other’s glory, which partly offsets the negative BFLPE. However, for less successful students, the high academic achievement of their friends has a negative effect, since they lower student self-assurance [Molloy et al, 2010; Altermatt and Pomerantz, 2005]. Thus, the negative contrast effect is neutralized if students perceive themselves as belonging to the group of comparison [Collins, 1996].

Therefore, it can be concluded the results of studies on the “reflected glory” effect depend on the method used to assess the glory level. In studies where the best schools were identified through the opinions of students and their parents, as suggested by Marsh, the glory effect was noticeable and had a positive effect on student academic self-concept. However, in studies where the best schools were identified through average student grades, or through school type (e.g. Gymnasium), the glory effect was not observed, or could be explained by other predictors (e.g.

school grades). In other words, only “reflected glory” has an effect, but not “glory” in and of itself.

II. Our research

This study is focused on the connection between academic achievement in mathematics and student self-concept within three tiers of the academic environment: a country’s education system, a school, and a student’s academic achievement.

Our goal was to study the effect of school “quality” (defined as the school’s academic achievement) on student math self-concept in both stratified and non-stratified school systems. The following hypotheses were tested:

- BFLPE occurs in all types of school systems: in all countries, individual results of math tests have a positive effect on math self-concept, while the average level of achievement throughout the same school grade (within the 8th grade) has a negative effect on math self-concept.
- In countries with stratified school systems, students from schools with an above-average academic level have a higher math self-concept than students from other schools, regardless of their actual academic achievement.
- In countries with non-stratified school systems, the academic level of a school has no effect on student math self-concept.

Data and methods

In order to verify our hypotheses, we need to use data from international surveys, which should allow us to compare countries with stratified and non-stratified school systems on a number of factors, such as a student’s math self-concept, academic math achievement, and a school’s academic level. The data collected in TIMSS (Trends in International Mathematics and Science Study) meet all these requirements. TIMSS is a large-scale study conducted in over 60 countries. The survey encompasses students from the 4th and 8th grades, their teachers, and headmasters. For the purpose of our analysis, we have selected data from 2007 as the most recent fully available data, since the data from 2011 are still being prepared for publication.

Tab. 1. Sample size for 4 countries

Country	School N	Student N
Russia	200	4472
Czech Republic	147	4845
Sweden	159	5215
Norway	139	4627

Out of 50 participating countries, we have selected 2 countries with stratified education systems (Russia and the Czech Republic) and 2 countries with non-stratified education systems (Sweden and Norway). In our study, we presumed a causal connection between the student marks and student self-concept. We therefore selected 8th grade students because, unlike 4th grade students, 8th grade students are used to receiving marks for their efforts, and the relationship between academic achievements and self-concept should be more clear.

Variables

Math self-concept. This variable was constructed as the average for all answers to four questions: “I usually do well in math”, “Math is more difficult for me than for many of my classmates”, “I learn things quickly in math”, “Mathematics is not one of my strengths”⁴. Cronbach’s Alpha is 0.849 for Russia, 0.825 for Sweden, 0.804 for Norway, and 0.850 for the Czech Republic.

Academic achievement. During the survey, students were not asked to indicate their marks. We therefore use the results of the TIMSS math test as a measure of their academic achievement. Without doubt, this parameter has a number of drawbacks as compared to standard school marks, since the students can only make assumptions about their TIMSS scores but they cannot form any ability-perception based on these test scores. However, in a number of studies, it has been found that the TIMSS results are relatively closely connected to school marks, and can be used as their proxy. In TIMSS, the math test results are measured using five plausible values. We ranked students within schools 5 times into 10 deciles (once for each plausible value) and assigned a final value, which is the average of five ranks.

Average achievement. This is the average achievement of a school, calculated based on all five plausible values for TIMSS math tests in IDB Analyzer (IEA software).

School academic level. Since TIMSS does not have an option to measure the subjective perception of students and their parents about school quality, we cannot compare schools based on their “glory”. However, we believe that the school academic level is an important characteristic of a successful school that is valued just for its name by students and parents alike. Usually, the best schools in a city, district, or even country, are also well known. Therefore, we take the academic level of a school as a measure of a school’s quality. According to the math test, we identify schools from the top decile of a country as being the best and most prestigious.

Gender. This is a standard binary variable, where (1) signifies a girl, while (2) represents a boy.

⁴ This set of variables is constructed for evaluating math self-concept. Initially a four-category variable was suggested by IEA, but we modified the construction method of this variable in order to facilitate further calculations.

Analysis

The analysis was carried out using hierarchical linear modeling in HLM7 software. We built four separate models for each of the four countries (Russia, the Czech Republic, Sweden, and Norway), since the number of countries was not enough to bring in a third country level into a single model (it would be impossible to estimate variances, though sufficient for correcting standard errors). In addition, the purpose of our analysis was mostly to identify and compare existing connections and their directions, rather than the magnitude of effects, and this goal is achievable from comparing four multi-level models.

Overall, in order to test our research hypotheses, we have specified several two-level regression models. The first level was for individuals (students) while the second level was for schools (8th grade). The first level predictors are presented by individual results of the math test and a student's gender. The results of the math test were aggregated at the school level (Level 2), thus providing us with one of the Level 2 predictors. For schools (at the 8th grade), we also used one more parameter, defined as the school academic level. In order to avoid colinearity, in each model we used only one Level 2 predictor at a time.

We constructed two types of multilevel models. The first one reproduces the classic Marsh's BFLP model and includes results of the math test aggregated at the school level. The second one tests the effect of "glorious schools" as it includes school academic level. In a broad sense the models are almost the same, but we suppose that the "reflected glory" effect may appear only for the schools from the top decile, which is taken into account in the second type of our models.

The average TIMSS scores amounted to 450 +/-113 points in the whole sample, which gives a very large range of variation. This may make it difficult to compare the effects for schools where most students received low scores, and schools where most students got higher scores. For this reason, we used a student's rank within the school represented as a decile in math achievement to ensure better comparability between results obtained from different schools. This procedure allows identifying students with lowest and highest scores within the same grade, and we presume that, to a large extent, student self-concept depends also on their awareness of their own place in the academic rating.

For such samples as TIMSS, it is important to use weighted coefficients. In our case it should be reasonable to use two types of weighted values, one for the individual level and one for the school level. TIMSS does not provide appropriate weighted coefficients. They were constructed according to the method developed by E.Gonzalez et al. Applying both weighted coefficients, we get a proportional sample that factored in the actual sample sizes and ratios from the total sample, and allowed a good comparison for different countries.

Results

The first hypothesis concerns classic BFLPE. We assume that high individual math achievement should increase a student's math self-concept, while average grade results should decrease a student's math self-concept, regardless of the school type. In order to test this hypothesis, we built Model 1, which includes individual math test results as the Level 1 predictor, and average per class test results as the Level 2 predictor.

Tab. 2a. Model 1: Classic BFLPE for Russia and the Czech Republic

	Russia			Czech Republic		
	β	SE	P	β	SE	P
Intercept	1.858	0.067	<0.001	1.617	0.048	<0.001
Class level						
Average achievement	0.003	0.0007	<0.001	0.003	0.0007	<0.001
Individual level						
Math achievement	0.144	0.006	<0.001	0.153	0.003	<0.001
Gender	-0.011	0.033	0.725	0.145	0.024	<0.001
Interaction effects						
Average achievement \times Individual achievement	-0.0002	0.0001	0.068	-0.0003	0.00008	<0.001

Table 2b. Model 1: Classic BFLPE for Sweden and Norway

	Sweden			Norway		
	β	SE	P	β	SE	P
Intercept	1.762	0.037	<0.001	1.757	0.058	<0.001
Class level						
Average achievement	0.002	0.001	0.049	0.006	0.002	<0.001
Individual level						
Math achievement	0.134	0.004	<0.001	0.155	0.006	<0.001
Gender	0.225	0.020	<0.001	0.134	0.022	<0.001
Interaction effects						
Average achievement \times Individual achievement	0.0001	0.0001	0.268	-0.0003	0.0003	0.298

Tables 2a and 2b show that the individual achievement indeed has a positive impact on a student's math self-concept ($\beta=0.144$ for Russia, $\beta=0.153$ for Czech Republic, $\beta=0.134$ for

Sweden, and $\beta=0.155$ for Norway). However, we found that average grade results also have a positive effect on a student's math self-concept, which contradicts the classic big-fish-little-pond effect. A positive relationship was found for all four countries (β for Russia=0.003, for the Czech Republic=0.003, for Norway=0.006, and for Sweden=0.002), which confirms that the observed effect is indeed universal. The interactive effect of individual and average test results is not significant for all countries, but only for the Czech Republic. Individual academic achievement, as well as average grade results in the mathematics, both increase a student's self-concept in mathematics. Regardless of the stratification system, achievement has an impact.

The second hypothesis states that in stratified school systems the perceived prestige of schools causes an increase in the overall level of self-concept, regardless to individual and average academic achievement. In order to test this hypothesis, we used samples only from Russia and the Czech Republic, since only these two countries have a distinction between "good" and "poor" schools, including the existence of such a distinction in the student perception. At Level 2 we add a parameter indicating a school's academic level (schools from the top 10 decile). This makes us remove average math results from the analysis, since usage of both these predictors in the model would result in multi-collinearity. For Level 1 we also added the gender effect as a control variable. The impact of school "quality" (perception of the school as "good") on the student's math self-concept, taking into account individual academic achievement, was modeled as the interactive cross-level effect of these predictors.

Our analysis shows that the effect of a school's high status on a student's math self-concept is positive and significant in both countries ($\beta=0.675$ for Russia and $\beta=0.445$ for the Czech Republic), as shown in Table 3.

Tab. 3. Model 2: "Reflected glory effect" in stratified school systems

	Russia			Czech Republic		
	B	SE	p	β	SE	p
Intercept	1.790	0.069	<0.001	1.566	0.049	<0.001
Class level						
School quality	0.675	0.174	<0.001	0.445	0.084	<0.001
Individual level						
Math achievement	0.149	0.006	<0.001	0.158	0.004	<0.001
Gender	-0.010	0.032	0.745	0.147	0.024	<0.001
Interaction effects						
School quality \times Individual math achievement	-0.060	0.024	0.015	-0.047	0.009	<0.001

However, it is interesting to examine whether the “reflected glory” effect will compensate the negative effect of a school’s average achievement on a student’s math self-concept. The interactive effect clearly supports Hypothesis 2: the mere fact of studying in a “good” school gives a strong boost to a student’s self-concept, even for students with low individual achievement. The effect from studying in a “good” school is decreasing with an increase in the level of individual academic achievement, and disappears for students with very high scores: the math self-concept of the best students from ordinary schools is comparable to the self-concept of the best students from the best schools (Fig. 1 and 2).

Fig. 1. Cross-level effect for Russia

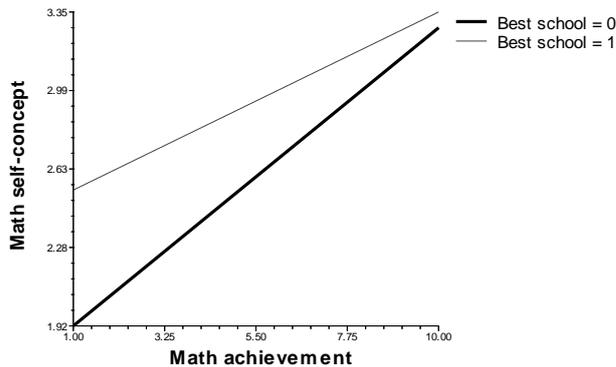
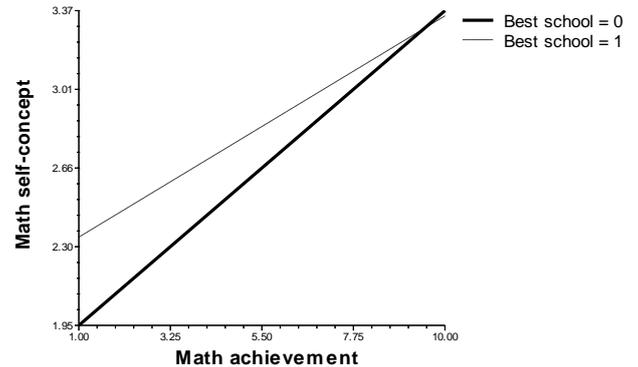
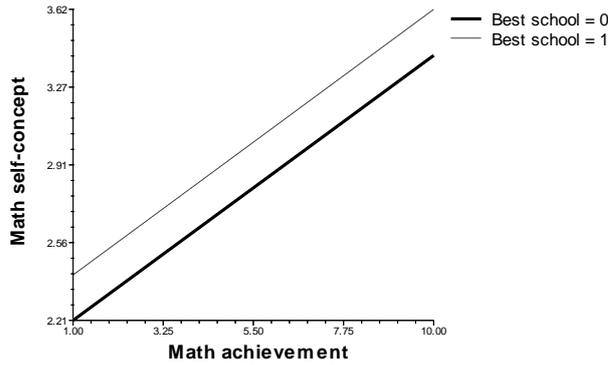
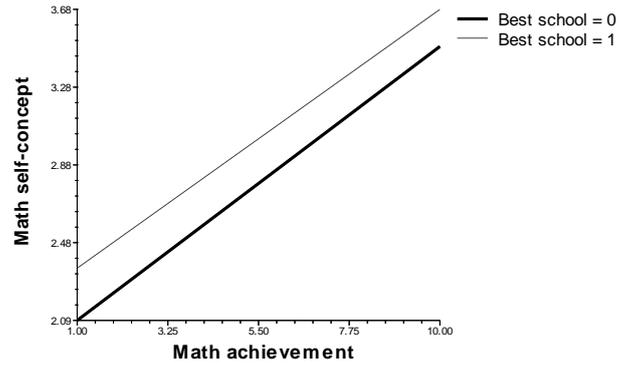


Fig. 2. Cross-level effect for the Czech Republic



The only observed difference for Russian and Czech schools can be attributed to the gender effect. In the Czech Republic, boys have a higher self-concept than girls. This effect is not surprising. However, there was no observed difference in math self-concept between girls and boys in Russia.

Hypothesis 3 postulated that in the countries with non-stratified school systems the interactive effect of a school’s academic level and an individual’s academic achievement should be negligible – that students do not make a distinction between good and average schools. At the same time, we also may expect that the fact of studying in a school with a high academic level should have an impact on a student’s self-concept. According to Marsh, this effect should be negative, since the requirements to students in such schools are usually higher than in schools with lower academic levels. In order to test this hypothesis, we built Model 3, which was identical to Model 2, but used the data from two countries with non-stratified school systems: Sweden and Norway.

Fig. 3. Cross-level effect for Sweden**Fig. 4. Cross-level effect for Norway**

Our analysis has confirmed the hypothesis: the interactive effect between a school’s academic level and individual academic achievement was insignificant for both countries ($\beta=0.0003$, Sig.=0.980 for Sweden; $\beta=-0.009$, Sig.=0.728 for Norway). There is almost no difference between intercepts for the students from the best schools and from ordinary schools. In addition, this difference is random. In other words, a student’s math self-concept will increase with individual academic achievement in the same way in both school types, and students from the best schools do not have a higher basic level of math self-concept, in contrast to the effect observed in the stratified school systems (Fig. 3 and 4).

Tab. 4. Model 3: “Reflected glory effect” in non-stratified school systems

	Sweden			Norway		
	β	SE	p	β	SE	P
Intercept	1.737	0.037	<0.001	1.726	0.066	<0.001
Class level						
School quality	0.206	0.117	0.081	0.277	0.138	0.047
Individual level						
Math achievement	0.133	0.004	<0.001	0.156	0.007	<0.001
Gender	0.223	0.019	<0.001	0.135	0.022	<0.001
Interaction effects						
School quality \times individual math achievement	0.0003	0.012	0.980	-0.009	0.025	0.728

The effect of a school’s academic level on a student’s math self-concept is positive and significant at the 10% level ($\beta=0.206$ for Sweden and $\beta=0.277$ for Norway), which also contradicts the standard BFLPE. Despite the frame of reference effect, students from the country’s best schools display a higher math self-concept than students from other schools. In Sweden and Norway, gender has a stable and significant impact: boys have a higher self-perception in mathematics than girls ($\beta=0.223$ for Sweden and $\beta=0.135$ for Norway).

General Results

As we have found, in all countries except for Russia, boys show a higher level of math self-concept than girls do. In stratified education systems, such as Russia and the Czech Republic, a school's status has a significant impact on a student's math self-concept. Even students with low academic achievements in the best schools have a higher self-concept than students with equally low academic achievement in other schools. However, we have not found an impact of the "glory" effect (or school-status effect) on the best students, who have an equally high level of self-concept regardless of their school's academic level. This effect has not been found for countries with non-stratified school systems (Sweden and Norway): in these countries there is no connection between math self-concept and school status when controlled for individual achievement. In any of the examined cases, we have not found a classic negative impact of a school's average academic achievement on individual math self-concept (contrast effect).

III. Discussion

Absence of negative contrast effect

The absence of a negative contrast effect (i.e. negative impact of a school's average academic achievement on a student's math self-concept) can be explained by a difference between the TIMSS samples used for this study and the PISA data typically used by H. Marsh. It should be noted that in the only case where Marsh et al used the TIMSS data they were only testing the frame of reference effect, not BFLPE.

The main difference in the sample designs concerns the strategy of student selection. In TIMSS, just one class from the same grades in every school was used for the survey (4th or 8th grade), and only rarely were additional students from other classes of the same grade enlisted. In PISA, 35 students within the same age bracket were selected for survey. Therefore, not only students from different classes of the same grade became pooled together, but also students from different grades: fifteen-year-old students may come from the 8th, 9th, or even 10th grade. In this situation, it is hardly reasonable to believe that a sample composed of such pooled students can serve as their reference group, or that such a sample can be used as the context for the students.

In our study, we do not claim that the contrast effect observed by Marsh on the PISA data is invalid. Rather, it may be the result of more complicated mechanics, which have not been examined previously. A more detailed study should help to clarify and explain this mechanism, and it should compare the analysis results for different Level 2 units: classes, grades, and students of

the same age bracket (e.g. all 15-year-old students). Such an analysis can be carried out using data collected by the Sociology of Education and Science Laboratory (SESL) in St. Petersburg, the Moscow region, and Tomsk. However, analysis of these data is included in future plans of the SESL.

Glory Effect

Social comparison takes place on several different levels, from the individual level (and even the intra-individual level, if we recall the internal frame of reference) to higher levels, e.g. the country level. While building up their self-concept in the field of mathematics, students take into account their own academic achievement, the achievement of their classmates, school type, and school status. The number of levels taken into account by an individual depends, to a large extent, on his or her horizons (for example, see the “horizons for action” concept suggested by [Hodkinson and Sparkes, 1997]). If an individual’s social horizons are wide enough, the individual may consider how his or her country’s educational system relates to others, especially if the individual meets students from other educational systems at international academic olympiads.

Our study confirms that there is a positive connection between a school’s status and a student’s math self-concept. Such a relationship was observed earlier in Hong Kong and China [Marsh et al, 2000; Marsh and Craven in: Marsh and Craven, 2000; Hau, Kong and Marsh in: Marsh and Craven, 2000]. However, in our study we have not found any negative effect of a class’s average academic achievement on a student’s self-concept, and for this reason we cannot evaluate the counter-balancing effect of a school’s glory on the negative-contrast effect from a comparison with other students.

Our data show a noticeable positive effect of studying in one of the top 10% schools in the country on students with low academic achievement, which contradicts the results of some earlier studies [Trautwein et al, 2009; Marsh, 1991]. The mentioned researchers came to a conclusion that students with low academic achievement suffer the most from tracking, even taking into account the glory effect of their class or school. When among students with better achievement, they should experience the negative contrast effect to a larger degree. In contrast to these findings, we have found that the fact of studying in a school with a well-known high academic level in mathematics is the only possible basis for forming a student’s perception of having a high level of mathematical abilities. In all other cases, the student’s comparison of oneself with other students casts them in a negative light, even in a class with a low average academic level. The higher a student’s academic level, the less that student needs the school’s glory for their self-concept. Students with the highest academic achievement in mathematics have a high level of self-concept in all school types, since they always benefit from social comparison.

In Germany, researchers have not found any connection between the school glory effect (defined as belonging to a certain track) and a student's academic self-concept [Marsh et al, 2004; Liu et al, 2005]. This was possibly due to the specific methods of identifying schools with a recognized "glory" effect. In the study in Germany, researchers identified school types (and class types within schools) based on the formal division (Gymnasium, Realschule, Hauptschule), without taking into account variability within each school type.

In Russia and the Czech Republic, certain types of schools (e.g. gymnasiums, lyceums, etc.) are officially considered to have a higher academic level than other schools. However, it is hard to believe that, on average, any gymnasium is more famous and has a higher academic level, than any other type of school. On the whole, a group of well-known and respected schools in a city is much more narrow than the group encompassing all gymnasiums in the city, which may lead to the absence of the "reflected glory" effect when comparing all Gymnasiums with all other types of schools. This is one of the possible reasons explaining why our method, with all its limitations, has revealed the effect of studying in one of the best schools in the country on the student's self-concept.

Stratification Effect

The school glory effect works only in countries with stratified school systems. Students can form a perception about the best or worst schools only in a system with explicit stratification. It is probable that only in the presence of overt stratification can students consider the school level in their process of social comparison. In an environment where all schools are similar, there is no reason to pay attention to students from unknown schools: it is enough to compare oneself with others from the nearby environment.

It has been found that the effect of social comparison and the negative contrast effect became more obvious in stratified systems, as compared to those in non-stratified systems [Marsh et al, 2001; Trautwein et al, 2009]. Our results strongly confirm these findings. In non-stratified systems, students who study in one of the best schools in the country are simply not aware of this, since a school's status is not confirmed officially. In stratified systems, however, researchers observe the opposite effect. For example, a school in Russia can be elevated to the status of gymnasium only if its students demonstrate high levels of academic achievement in different areas. Therefore, in absence of an explicit division of schools and classes based on categories of "good" and "poor", the level of social stimulus is significantly lower. High academic achievement is encouraged, but it does not give any grounds for enrollment into a better class or a chance to be enrolled in a university. In Germany, for instance, this chance is provided only by Gymnasiums.

In stratified systems, very rarely do children get into “good” classes or schools by chance. Most often this is a result of their efforts or the efforts of their parents. In any case, they are aware that they differ from most other children. This alone should affect their academic self-concept, even though their enrolment in a gymnasium was due to the high status of their parents and does not reflect the actual abilities and achievement of the children [Marsh, 1991].

Recommendations

From our preliminary comparison of four countries with different levels of stratification, we can suggest that, in the presence of stratification, the tendency for social comparison is stronger, which causes relative psychological deprivation of students with below-average academic achievement from less successful schools, as compared to similar students from countries with non-stratified education systems. The social significance of this effect is difficult to estimate. Even though students from stratified systems experience heavy pressure from the “little fish, big pond” effect (which was found in our study in an indirect way), at the same time they get an additional incentive for higher academic achievement. Further studies are required to investigate whether this incentive gives an additional advantage to students from these countries as compared to those from non-stratified systems.

Limitations

It is important to be aware of a number of technical and substantial limitations in the process of interpreting and interpolating our study results.

As for methodological part, first of all, for the second analysis level it was only possible to choose schools (and a specific grade within the school), but not any specific classes from these schools. This limitation was dictated by the TIMSS data: during the survey, only one class in a particular grade was interviewed. Such methods absolutely exclude the opportunity to study at the class level, as it is equal to the school level.

The second limitation, also dictated by the TIMSS design, was the representativeness of the sample of schools at the country level, but not at the city level. This was not crucial for testing the main points of BFLPE, but it did affect the analysis of the best schools for testing the “reflected glory” hypothesis. In our analysis, the best schools were selected as the schools in the top decile of the math test, which means that we have to make a comparison across all schools in the country. This is statistically correct but does not make much sense from a practical point of view. Usually students give their perception of the school level based on their notion of schools from their home city only, not of all schools in the country. However, in this case we presume

that the best schools in the country should also be the best schools in their cities as well, and this justifies the method of identifying the most prestigious schools.

As for results, firstly, even though we talked about the school glory effect, we actually measured the fact that schools from our sample were included in the top 10% of the most successful schools in the country. Ideally, we should have taken into account the opinions of students and their parents about the best schools in their city, or at least in their region, since the country level is too high. Unfortunately our data do not permit conducting such an evaluation.

Secondly, our awareness of the stratification system in Russia allows us to postulate that it is important to include class level in our analysis, and not just at the school level, since in many schools we can observe ability grouping: children are divided into different classes depending on their academic achievement. In our case, we include in the analysis only one class with no idea of its standing in amongst the grade. This limitation can be removed only by choosing a different database.

Thirdly, data from four countries do not provide a sufficient basis for comprehensive conclusions on the stratification effect. However, a comparison between countries gives us interesting preliminary results and indicates a direction for further studies. The main problem with investigating the stratification effect between countries is the different character of stratification that exists in these countries. In some countries this affects school types (such as in Germany and Latin America). In other countries, class types. While still in other countries stratification is observed in the types of courses selected by students (as in the USA). And yet in some countries we have to deal with mixed systems (as in Russia). For this reason, the task to unify the stratification indicator and make it work for a holistic model of 40 to 50 countries poses a great difficulty. However, this is exactly our goal and the goal of many other researchers (e.g. F.T.Pfeffer).

The latest limitation is a conceptual limitation for the whole framework of research on the BFLPE. Even though we aim to investigate and explain the results of social comparison, in fact we do not identify the comparison targets, since we assume, for simplicity, that the students compare themselves with their classmates, students from the same group, and so forth. Evidently, the process of comparison is very personal for every individual, and even two students from the same class will hardly display a similar set of reference targets for comparison. However, for more detailed investigations in this direction, we would need to carry out a more complicated and subtler network research, which, to a large extent, would limit our options in comparing our results on an international scale. The method used in the current study gives us the middle ground between the chance to examine the details of social comparison and the chance to compare our results with those of other researchers on a large scale.

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