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Mathematics and science proficiency of young refugees in secondary schools in Germany

Abstract

Reliable information on the integration of refugee students in the German educational system is scarce. In this paper, we examine refugee students' proficiency in mathematics, biology, chemistry, and physics in comparison to other students with and without an immigrant background, including non-refugee foreign-born students. We analyzed test data from 44,882 ninth-grade students, including 939 refugees, who participated in a national educational monitoring study in Germany (IQB Trends in Student Achievement 2018). In a series of regression models, we estimated the extent to which differences in students' language proficiency and their families' social background account for disparities in mathematics and science achievement. Compared to students without an immigrant background, refugee students' achievement scores were on average 15 to 17 points lower (on a scale with $SD = 10$ for all ninth-grade students in Germany). Refugees also scored substantially lower than non-refugee foreign-born students (difference of 7 to 10 points). Taking social background and language proficiency into account substantially reduced refugees' achievement disadvantage to 2 to 5 points compared to students without an immigrant background and to 1 to 5 points compared to non-refugee foreign-born students, with language proficiency explaining the largest proportion of variance. The remaining disparities correspond to a learning gain of roughly one school year in Germany. The results emphasize the importance of providing effective support aimed at fostering refugees' proficiency in the language of instruction.

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Keywords

Mathematics; Science; Achievement; Large-scale assessment; Refugee students

Mathematische und naturwissenschaftliche Kompetenzen von Jugendlichen mit Fluchtbiografie am Ende der Sekundarstufe I

Zusammenfassung

Bisher liegen kaum belastbare Informationen zur Integration junger Geflüchteter im deutschen Schulsystem vor. In diesem Beitrag untersuchen wir die Kompetenzen geflüchteter Jugendlicher in den Fächern Mathematik, Biologie, Chemie und Physik im Vergleich zu anderen Heranwachsenden mit und ohne Zuwanderungshintergrund, einschließlich Jugendlichen der ersten Zuwanderergeneration ohne Fluchtbiografie. Analysiert wurden Testdaten von 44.882 Neuntklässlerinnen und Neuntklässlern, darunter 939 Geflüchtete, die an einer Studie zum nationalen Bildungsmonitoring (IQB-Bildungstrend 2018) teilgenommen haben. Mit Regressionsanalysen prüften wir, inwieweit Disparitäten in den Kompetenzen auf Unterschiede in den Sprachkenntnissen und im sozialen Hintergrund der Familien zurückgeführt werden können. Verglichen mit Jugendlichen ohne Zuwanderungshintergrund erzielten geflüchtete Jugendliche im Durchschnitt um 15 bis 17 Punkte niedrigere Kompetenzwerte (auf einer Skala mit $SD = 10$ für alle Neuntklässlerinnen und Neuntklässler in Deutschland). Auch die Differenz zu Jugendlichen der ersten Zuwanderergeneration ohne Fluchtbiografie war mit 7 bis 10 Punkten substantiell. Unter Berücksichtigung der Sprachkenntnisse und des sozialen Hintergrunds fielen die Disparitäten mit 2 bis 5 Punkten im Vergleich zu Heranwachsenden ohne Zuwanderungshintergrund bzw. 1 bis 5 Punkten im Vergleich zu Jugendlichen der ersten Zuwanderergeneration ohne Fluchtbiografie erheblich geringer aus, wobei Sprachkenntnisse die größte Varianzaufklärung leisteten. Die verbleibenden Unterschiede in den mathematisch-naturwissenschaftlichen Kompetenzen entsprechen dem Lernzuwachs, der in deutschen Schulen ungefähr in einem Schuljahr erreicht wird. Die Ergebnisse unterstreichen die Bedeutung effektiver Sprachförderung für geflüchtete Kinder und Jugendliche.

Schlagworte

Mathematik; Naturwissenschaften; Kompetenzen; Large-scale assessment; Geflüchtete

1. Introduction

The global population of forcibly displaced people remains at a record high (UNHCR, 2019a). Within the last few years, a large number of refugees arrived in Germany, many of them at school age. They come from various origin countries, with particularly large shares from Syria, Afghanistan and Iraq (BAMF, 2018). For their future perspectives as well as for German society overall, it is crucial to ensure that these students succeed in the German educational system. At the same time, integrating the newly arrived children and adolescents is challenging for the school system, for schools, and for teachers.

Despite the relevance of the issue, we currently know surprisingly little about how successful the German school system is in supporting the newly arrived refugee children and adolescents and about the determinants of their successful integration (see El-Mafaalani & Massumi, 2019). The present study examines the competencies students have attained in core school subjects toward the end of secondary school and compares them to those of other students with and without an immigrant background, including first-generation immigrant students who are not refugees. We analyzed mathematics and science proficiencies of recently arrived refugee students in grade 9, when students can potentially obtain the first regular school-leaving certificate. At this point in the educational pathway, competencies are not only key indicators of educational success, but also pivotal for students' future paths towards the labor market or tertiary education. We further estimate to what degree achievement gaps can be attributed to differences in cultural and economic resources of students' families and proficiency in German as the language of instruction – two factors that are known to have substantial explanatory power for achievement disadvantages of students with an immigrant background (see section 1.2).

1.1 Mathematics and science proficiencies as indicators of educational success

To participate in knowledge-based and increasingly technological modern societies, competencies in mathematics and the natural sciences are indispensable (e.g., Cromley, 2009). Moreover, occupations in fields related to mathematics and the sciences open good professional prospects, as an increasing number of jobs requires profound knowledge in these domains. Developing students' mathematics and science proficiencies hence are core educational objectives (e.g., Bybee & Fuchs, 2006). In Germany, *The Standing Conference of the Ministers of Education and Cultural Affairs* (KMK) has defined *National Educational Standards* for several subjects, including mathematics and the natural sciences (e.g., KMK, 2004), which constitute mandatory learning targets for almost all students in Germany.

Mathematical and science-related contents are less specific to the cultural context and school system than contents of other school subjects, such as history or language arts. Hence, the achievement disadvantages of refugee students in mathematics and the sciences can be expected to be less pronounced than in other school subjects. Yet, the special learning conditions of refugees (see section 1.2) are likely to result in lower levels of mathematics and science proficiency compared to students who have attended the German school system from the start and also compared to non-refugee foreign-born students.

1.2 Learning conditions of recently arrived refugee students

Previous research indicates that in most countries, including Germany, students of immigrant descent often struggle to attain similar achievement levels as non-immigrants. Across domains, the achievement gaps are typically most pronounced for first-generation immigrant students and smaller for second-generation students (Henschel et al., 2019; OECD, 2016a; Weis et al., 2019). Research consistently shows that student achievement, including mathematics and science proficiency, is strongly associated with students' family background (e.g., OECD, 2016a, 2019; Mahler & Kölm, 2019). Highly educated parents with prestigious jobs, high income and strong social networks typically have more economic, cultural, and social resources available to support the educational success of their children (e.g., Feinstein, Duckworth, & Sabates, 2008). Moreover, proficiency in the language of instruction is crucial for acquiring new competencies in school (Kempert et al., 2016; Prevoo et al., 2016; Stanat & Edele, 2016), including knowledge and skills in mathematics and the natural sciences (e.g., Härtig, Heitmann, & Retelsdorf, 2015). The pivotal role of language in science learning is reflected in the strong relationship between reading proficiency and science achievement (e.g., Cromley, 2009). It is therefore not surprising that the on average lower cultural and economic capital of immigrant families and the language spoken in students' families explain a large proportion of the achievement disadvantages of students with an immigrant background (Henschel et al., 2019; OECD, 2016a, 2016b, 2019; Weis et al., 2019). When analyses consider these factors, the achievement gaps are often completely leveled out or even reversed for second-generation students and considerably reduced to about a third of their initial size for first-generation students (e.g., Weis et al., 2019).

Recently arrived refugee students share many characteristics and acculturation conditions with other immigrants, particularly other foreign-born students who were not forcibly displaced (Cerna, 2019). However, in several respects, the learning conditions of newly arrived refugee students are special. Refugee students' preconditions for learning certainly are far from uniform as, for instance, the educational systems in their origin countries and their personal experiences vary greatly, resulting in differential educational outcomes of different ethnic groups (Wong & Schweitzer, 2017). Despite this variation, scholars widely agree that refugees need

to overcome more obstacles to adjust to and succeed in school (Berry, 1987; Cerna, 2019; Crul et al., 2019; Graham, Minhas, & Paxton, 2016; McBrien, 2005).

The learning experiences of refugee students can be divided into the phases before, during and after their migration (Dryden-Peterson, 2016; Ryan, Dooley, & Benson, 2008). Prior to migration, refugees often experienced traumatic situations, which can hinder their learning (McBrien, 2005; Fazel, Reed, Panter-Brick, & Stein, 2012; Wong & Schweitzer, 2019). Due to war, conflict, violence, or persecution, many school-aged refugees were unable to attend school regularly in their origin countries and often had to interrupt their education (Cerna, 2019; Dryden-Peterson, 2016), resulting in special challenges for refugees' school integration (e.g., Birman & Tran, 2017). In addition, the school systems refugee students previously attended are often less effective than the German system. For instance, in the *Trends in International Mathematics and Science Study* (TIMSS) of 2011, Syrian 8th-graders reached relatively low scores in mathematics achievement (Mullis, Martin, Foy, & Arora, 2012), even though the Syrian education system before the war was often considered more effective than the systems of many other origin countries of refugees.

During the often-prolonged migration phase, which may include several transitional residencies, school-aged refugees often attend provisional schools or no schools at all (UNHCR, 2019b). The school systems in the transition countries are often overburdened with the inclusion of large number of refugee students. For instance, in Turkey, a common transition country of Syrian refugees to Germany, many refugee children did not attend regular schools (Cerna, 2019; Crul et al., 2019). Those refugees who attend regular schools often encounter language barriers (Crul et al., 2019), impeding their competence development.

At least equally important for the adjustment of young refugees are the circumstances in the post-migration phase (Fazel et al., 2012; Porter & Haslam, 2005). In most European countries, it takes several months after arrival until refugee children enter the school system (Koehler & Schneider, 2019), with an average delay of about 6 months in Germany (Henschel et al., 2019; Will et al., 2018). Due to these interruptions and limitations in schooling before, during and after migration, refugees are likely to enter the German school system with lower proficiency levels than students who attended the German system from the start.

Moreover, the socioeconomic and cultural resources of refugee families are often limited. Refugees typically come from developing countries and their average educational attainment is lower than in Germany, also in comparison to other migrants (Romiti et al., 2016; Liebau & Salikutluk, 2016; Spörlein, Kristen, Schmidt, & Welker, 2020). In addition, the cultural resources of refugees, such as language skills and education, are not easily transferable to the new context and they often have lost their social resources. Moreover, their financial resources are often limited, and it takes time until they enter the job market in the new country of residence (Salikutluk et al., 2016). Hence, refugee families generally have limited resources at hand to support the learning process of their children. Due to the migration-related changes in their socioeconomic status and the limited trans-

ferability of their resources, the relationship between family background and refugee students' educational success may be somewhat weaker than in other students' groups. Yet, the socioeconomic family background should nevertheless be relevant for their educational success in Germany. In line with this reasoning, analyses based on data from the *IAB-BAMF-SOEP Survey of Refugees*, a representative longitudinal study of refugee households, indicate that higher parental education increases the likelihood of refugee students to attend the intermediate or academic track rather than the vocational track in the German school system (de Paivo Lareiro, 2019).

Moreover, most refugee students do not speak the language of instruction when they arrive in their new country of residence. To overcome the language barrier, the primary objective for refugees after entering school in Germany is to learn German. A considerable proportion of refugee students therefore initially attends separate classes (see section 1.3) that focus on language acquisition and put less emphasis on acquiring knowledge in other domains. Refugees attending regular classes from the start probably initially struggle to follow teacher instruction and further develop their competencies in subject domains. Initial language deficits are therefore likely to translate into accumulating knowledge gaps in subject domains, including mathematics and the sciences. This reasoning is in line with previous research suggesting that proficiency in the language of instruction is an important predictor of immigrant students' educational success (Wong & Schweitzer, 2017). Taken together, in order to succeed in the education system of the new country of residence, refugee children have to overcome several obstacles associated with lower initial competence levels due to limitations in prior schooling, limited resources of parents to support their children, and language barriers.

1.3 The educational integration of recently arrived refugee students in Germany

Data on the educational integration and achievement of refugees is generally very limited, as most studies on school achievement do not identify refugees (Cerna, 2019). Until recently, this also applied to educational research in Germany (e.g., El-Mafaalani & Massumi, 2019). Currently available are mainly findings on refugees' school participation. According to data of the *IAB-BAMF-SOEP Survey of Refugees*, the vast majority of children (> 94%) who had arrived in Germany between 01/2013 and 02/2016 attended school in the first half of 2016.¹ About one third of the students (31%) attended a preparatory class for recently arrived immigrants rather than a regular class in 2016 (Gambaro, Liebau, Peter, & Weinhardt, 2017).

¹ The remaining 6% include students with missing information and students who did not attend school.

The data further show that refugees are overrepresented at lower school tracks of Germany's tracked secondary school system. A representative study of ninth-grade students in Germany, the *IQB Trends in Student Achievement 2018*-study (Stanat, Schipolowski, Mahler, Weirich, & Henschel, 2019), indicates that 34% of refugee students attended the lowest track (*Hauptschule*), compared to 11 percent of the general student population and 25 percent of first-generation immigrant students without refugee background. In contrast, only 8 percent of refugees attended the academic school track (*Gymnasium*) compared to 35 percent of the general population and 23 percent of the non-refugee first generation (Henschel et al., 2019). Analyses based on the *IAB-BAMF-SOEP Survey of Refugees* and data from the *Refugees in the German Educational System* (ReGES)-study, a longitudinal study examining a preschool and an adolescent cohort of refugees and their families in five German Federal States (Will et al., 2018), revealed similar patterns. Thus, the vast majority of recently arrived refugee students has access to the German school system; however, they are considerably overrepresented at lower school tracks.

At the same time, the recently arrived refugees have high educational aspirations. According to the ReGES-study, the majority of adolescents (72%) would ideally like to attain a school degree that allows them to study at a university. The proportion of adolescents who realistically expect to attain this degree is also very high (66%). And the aspirations of their parents are even more ambitious: 83 percent ideally wish that their children obtain a university entrance degree and 80 percent realistically expect them to do so (Will et al., 2018). These expectations are in line with the high educational aspirations of immigrants in general (e.g., Salikutluk, 2016), but in stark contrast with the school tracks they actually attend.

We currently know very little about refugee students' school-related proficiencies. The *IAB-BAMF-SOEP Survey of Refugees* included a short test assessing adolescents' knowledge in science and technology (Schipolowski & Edele, 2019), employing multilingual item presentation (i.e., in students' heritage languages and in German). On average, refugees achieved lower scores than students who had attended the German school system from the start; the mean difference was roughly equivalent to what is gained in learning during one school year in Germany. At the same time, refugees' test scores showed greater variability, suggesting that they differ considerably in their prior knowledge when they enter the German school system (Schipolowski, Edele, Pagel, & Liebau, 2019).

Taken together, it is to date largely unknown which competence levels refugee students have reached in core school subjects a few years after they entered the German school system and how they perform compared to other students with and without an immigrant background. Similarly, we know very little about the factors that could explain achievement differences and about the degree to which their role is similar for refugee students and for other students with an immigrant background.

1.4 The present study

The present study examines mathematics and science achievement of recently arrived ninth-grade refugee students in Germany. In a first step, we investigate disparities in educational achievement between refugees and students without an immigrant background (research question 1a) and compare them to the disparities found for other students with an immigrant background. We then focus on differences in achievement scores between refugees and other foreign-born students whose families were not forced to migrate (research question 1b). This comparison is particularly relevant as it provides information on the extent to which the school achievement of refugee students is specific or resembles the school achievement of other first-generation immigrant students. We expect that refugee students attain substantially lower levels of mathematics and science proficiency than students without an immigrant background and second-generation immigrants who attended the German school system from the start and typically entered it with at least basic German language skills. Given the special learning conditions and obstacles that refugees face (see section 1.2) and that they immigrated very recently, we assume that they also show lower levels of mathematics and science proficiency than non-refugee foreign-born students.

Our study further determines to what degree differences in the sociocultural family background, in students' proficiency in the language of instruction, and in the amount of schooling received in Germany and other countries account for the expected achievement disadvantages of recently arrived refugee students (research question 2). These analyses inform us whether achievement relates in a similar (or different) fashion to key learning conditions in refugees as in non-refugee migrants. We expect that, as in other students with an immigrant background, the on average lower levels of cultural and economic resources and their often limited proficiency in the language of instruction account for a considerable proportion of refugees' achievement disadvantages. Yet, given the often interrupted and limited schooling of refugee students in combination with other challenges they face, including those associated with the limited transferability of the cultural and economic resources of their families, we do not assume that these factors fully account for refugees' achievement gaps in comparison to other students, including other first-generation immigrant students.

2. Method

2.1 Study design and procedure

The data were collected between April and June 2018 in the *IQB Trends in Student Achievement 2018*-study (for an English description of the study and its results see Stanat, Schipolowski, Mahler, Weirich, & Henschel, 2020), a nation-wide

large-scale educational assessment that constitutes a central part of the national educational monitoring in Germany. The study included achievement tests for mathematics, biology, chemistry, and physics based on the *National Educational Standards* in secondary education. Standardized achievement tests and questionnaires were administered to students from a randomly drawn sample of schools based on a complex rotation design (*balanced incomplete block design*; Becker, Weirich, Mahler, & Sachse, 2019). Each student completed one of 96 different booklets containing mathematics tasks, science tasks, or both. Refugee students received regular booklets without adaptations in terms of item difficulty or language. Students also completed a questionnaire and a language test. Participation in the achievement tests was mandatory for the selected schools (except for some private schools) and students whereas completion of the student questionnaire was voluntary and required parental consent in some states. Students' parents were also asked to fill out a questionnaire on a voluntary basis.

2.2 Participants

2.2.1 Total sample and relevant subsamples

Analyses are based on a total sample of $N = 44,882$ ninth-graders from 2,253 classes in 1,462 schools. Using case weights, the sample is representative of the population of ninth-grade students in Germany across school types and tracks in all of the 16 states. Mean age of the students in the unweighted sample was 15.6 years ($SD = 0.65$) and 48.2 percent of the participants were female.

About 26.5 percent ($n = 11,889$) of the students had an immigrant background (i.e., at least one foreign-born parent), including refugees. Second generation immigrant students (i.e., both parents foreign-born, student born in Germany) made up 10.8 percent of the sample ($n = 4,869$) and 5.9 percent were first generation immigrant students (i.e., student and both parents foreign-born or refugees based on the study definition, see 2.2.1). The first generation includes non-refugee students (3.8%, $n = 1,712$) and refugee students (2.1%, $n = 939$). The immigrant status of 5,250 students (11.7%) in the total sample could not be classified as the relevant information was not available, neither from the student or parent questionnaires nor from school officials.

Due to the booklet design, not all students were administered both mathematics and science tasks. Therefore, the following analyses are based on two overlapping subsamples of students with mathematics achievement data ($n = 25,342$) or science achievement data ($n = 25,506$). Using specific case weights for these two subsamples, both are representative of the target population.

2.2.2 Identification of refugees

The study definition of refugees included all ninth-graders who had arrived in Germany as refugees in the year 2014 or later. Identification of refugees was based on information by school officials which was available for 97.9 percent of the students. If this information was unavailable, we used questionnaire data on the country of birth and the time of immigration into Germany. In both cases, we did not consider students as refugees if they were born in the European Union or in a country which signed the Schengen Agreement. General exclusion criteria (see Stanat et al., 2019, 2020) were applied to refugees and non-refugees alike. Most noteworthy, students were only included in the study if they had attended a German school for at least one year.²

Based on these criteria, 939 students were identified as refugees. Among those with valid information on their birth country ($n = 762$), the by far largest proportion of refugees in the sample was born in Syria (47.1%), followed by adolescents from Afghanistan (18.8%), Iraq (9.1%), and Iran (4.6%). For all other countries, percentages were below 2 percent. Note that birth countries were quite different for refugees than for non-refugee foreign-born students, with the latter most often indicating Poland (14.7%), the Russian Federation (10.2%), and Romania (5.3%) followed by Syria, Turkey, Bulgaria, and Kazakhstan (about 4% each) and a large number of other countries (each below 3%).

2.3 Measures

2.3.1 Achievement tests

Achievement in mathematics, biology, chemistry, and physics was assessed with items developed by teams of teachers and experts in mathematics and science education based on the *National Educational Standards* in secondary education (for item examples, see Stanat et al., 2019). Mathematics items covered all five proficiency domains described in the educational standards: *Numbers, measurements, space and shape, functional relations, and data and chance*. In biology, chemistry, and physics, analyses for the present article focus on the domain *subject knowledge*. For all four subjects, a wide variety of items was employed, including items with closed and open response formats. The number of test items for each subject is given in Table 1.

² This criterion led to the exclusion of about 8 percent of the ninth-graders identified as refugees in the schools.

2.3.2 Language test

A C-test was used as an indicator of students' proficiency in German. C-tests are a variant of the cloze principle (Klein-Braley, 1997): In a short coherent text, every second half of every second word is missing; participants have to fill in the gaps in a meaningful and linguistically correct manner. C-tests are widely used as indicators of general language proficiency (e.g., Eckes, 2017). In the study at hand, two different texts were used with 30 gaps each. Note that the test was designed as an L1 test and exhibited a floor effect for refugees (i.e., 77% of the refugees solved 5 or less out of 30 items correctly), yet the variability of scores for this group was large (see below).

2.3.3 Sociodemographic information

The student and parent questionnaires contained questions about the socioeconomic and cultural background of the family, including the number of books at home as an established indicator of cultural capital (Jerrim & Micklewright, 2014) and the occupations of the parents. Foreign-born students and their parents were also asked to indicate the number of books at their (former) home in their origin country. This information was used for refugees in the analyses, if available, otherwise we used the information given for Germany. Information on parents' occupations³ was used to derive the *International Socio-Economic Index of Occupational Status* (ISEI; Ganzeboom, 2010) which reflects the average education level and income associated with the respective occupation. The highest ISEI value of the students' parents (HISEI) was subsequently used as an indicator of socioeconomic status (Mahler & Kölm, 2019).

The questionnaires further assessed parents' and students' countries of birth and how long the students had visited a school in Germany and schools outside of Germany, respectively. Foreign-born students were further asked to indicate since when they lived in Germany. Information from the student and parent questionnaires were combined in order to reduce the amount of missing data on the respective variables.

2.4 Data preparation and statistical analyses

Data preparation and parameter estimation closely followed the procedures described by Becker et al. (2019). Accordingly, for all variables used in subsequent analyses, missing values were replaced using multiple imputation. The percentages of missings that had to be imputed are provided in Table 1. Person parameters

3 If one or both parents were currently unemployed, they were asked to provide information about their last occupation.

(i.e., proficiency scores) for the students in mathematics were derived from a constrained two-parameter logistic (2PL) model with all mathematics items loading on the same dimension whereas scores for the sciences are based on a multidimensional Rasch (1PL) model. However, contrary to the usual practice in educational monitoring studies, in the present study missing values on the test items were ignored for parameter estimation because language barriers can lead to an increase in missing values which, in turn, is likely to produce biased proficiency estimates if missing responses are treated as incorrect (Köhler, Pohl, & Carstensen, 2017). For each student and subject 15 *plausible values* (PVs) were drawn and subsequently standardized to $M = 100$ and $SD = 10$ in the total population of all ninth-graders. This is a different reporting metric than the metric used by Stanat et al. (2019) as the scores are not directly comparable.

Language proficiency scores are based on a unidimensional Rasch model applied to the C-test data to derive *Weighted Likelihood Estimates* (WLEs).

Correlations, means, standard deviations, and regression coefficients were calculated with the Mplus 8.3 software based on the 15 PVs for each subject and all 15 imputed data sets. Case weights were used in all analyses. The complex structure of the sample (i.e., students nested in schools) was taken into account in the estimation of standard errors which also reflect differences in the reliability of the measures in each of the subpopulations (e.g., for refugees).

3. Results

To provide an overview of the bivariate relationships between the variables in the (sub)populations that are subsequently analyzed using regression models, Table 1 shows correlation estimates between test scores, cultural capital, and SES variables in the total population and the in subpopulation of foreign-born students (including refugees). For the latter, we also included the variables pertaining to how long students have already lived in Germany and how long they attended schools in Germany and abroad. Additional correlational analyses distinguishing between refugees and non-refugee foreign-born students are available in the appendix (see Table A-1).

For both the total population and foreign-born students, achievement scores in the four subjects were highly correlated, with the strongest correlations among the science subjects. Mathematics and science proficiency were also strongly associated with language proficiency in the total population and in the group of foreign-born students, with similar correlations for all four subjects. The relationships between achievement scores and indicators of socioeconomic status and cultural capital were also substantial, yet somewhat lower for foreign-born students.

In the subpopulation of foreign-born students, the analyses indicate that students who resided longer in Germany and students who attended a school in Germany for a longer period of time showed better test results. There are notewor-

thy mean differences on these variables between refugees and other foreign-born students: On average, the refugee sample had resided in Germany for about 2.9 years at the time of testing, had attended a German school for 2.4 years and schools outside of Germany for 6.2 years. By contrast, non-refugee foreign-born students reported having lived in Germany for 8.2 years, had visited a school in Germany for 6.0 years and schools in other countries for 3.4 years on average. Note that these are rough approximations as the information was missing for a considerable proportion of cases (see Table 1).

Table 1: Correlations between the variables used in analyses for the total population and in the subpopulation of refugees and other foreign-born students

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Mathematics achievement	.93	.66	.70	.76	.61	.29	.35	.26	.27	-.17
2. Biology achievement	.72	.87	.82	.82	.62	.23	.33	.31	.30	-.18
3. Chemistry achievement	.74	.89	.87	.84	.60	.22	.31	.35	.36	-.24
4. Physics achievement	.79	.89	.90	.89	.63	.24	.33	.36	.35	-.18
5. Language (C-test)	.68	.70	.68	.70	.93	.21	.37	.42	.44	-.32
6. Socioecon. status (HISEI)	.40	.36	.35	.37	.37	–	.31	.11	.08	-.02
7. Cultural capital (books)	.45	.44	.43	.45	.45	.43	–	.18	.18	-.12
8. Duration of stay Germany ¹	–	–	–	–	–	–	–	–	.83	-.63
9. Time in school Germany ¹	–	–	–	–	–	–	–	–	–	-.67
10. Time in school abroad ¹	–	–	–	–	–	–	–	–	–	–
Number of items	415	59	64	67	60	–	–	–	–	–
% missing in total sample	0	33	33	36	2	16	11	11	28	12
% missing 1st generation ²	0	36	33	36	9	22	8	19	33	13
% missing refugees ³	0	36	34	36	18	37	20	34	44	27

Notes. Values below the diagonal are correlation coefficients for the total sample ($N = 44,882$), values above the diagonal are correlations in the subpopulation of refugees and other foreign-born students ($n = 2,651$). Values in the diagonal are reliability estimates (if applicable). Percentages of missing values for the achievement scores represent design-related missings in the subsamples of students receiving mathematics booklets and sciences booklets, respectively ($n_{\text{Mathematics}} = 25,342$, $n_{\text{Sciences}} = 25,506$). ¹ Foreign-born students only. ² including refugees. ³ $n = 939$. All correlation coefficients are statistically significant ($p < .05$), exceptions are grayed out.

3.1 Disparities in achievement scores in mathematics and the sciences

Group differences in mathematics and science achievement with and without statistically controlling for language proficiency and social background were estimated with a series of regression analyses for each of the four subjects. In a first step, we analyzed differences in achievement scores between refugees and students without an immigrant background, not taking into account any covariates (research question 1a; see model 1 in Table 2). For comparison purposes, we also estimated disparities in achievement for other students with an immigrant background.

Table 2: Regression models for mathematics and science achievement with immigrant background, social background, and language proficiency as predictors

	Model I		Model II		Model III		Model IV	
	<i>b</i>	(<i>SE</i>)	<i>b</i>	(<i>SE</i>)	<i>b</i>	(<i>SE</i>)	<i>b</i>	(<i>SE</i>)
Mathematics								
Without immigrant background	102.1	(.25)	101.1	(.18)	100.5	(.12)	100.2	(.11)
2nd generation	-4.4	(.35)	-1.1	(.32)	-0.9	(.25)	0.2	(.25)
1st generation non-refugees	-6.0	(.58)	-2.6	(.51)	-0.2	(.41)	0.9	(.41)
Refugees	-14.8	(.71)	-9.9	(.68)	-2.9	(.72)	-2.4	(.69)
Socioeconomic status (HISEI)			2.4	(.11)			1.3	(.09)
Cultural capital (books)			3.0	(.10)			1.4	(.08)
German language proficiency					6.5	(.10)	5.5	(.10)
<i>R</i> ²	.09	(.01)	.29	(.01)	.46	(.01)	.50	(.01)
Biology								
Without immigrant background	102.2	(.24)	101.1	(.18)	100.4	(.12)	100.2	(.11)
2nd generation	-4.3	(.37)	-1.0	(.32)	-0.6	(.25)	0.3	(.25)
1st generation non-refugees	-8.4	(.57)	-5.4	(.48)	-1.7	(.40)	-1.2	(.39)
Refugees	-14.9	(.62)	-10.2	(.66)	-2.4	(.65)	-1.9	(.66)
Socioeconomic status (HISEI)			2.0	(.11)			0.8	(.09)
Cultural capital (books)			3.1	(.12)			1.3	(.09)
German language proficiency					6.8	(.09)	6.0	(.09)
<i>R</i> ²	.10	(.01)	.27	(.01)	.50	(.01)	.53	(.01)
Chemistry								
Without immigrant background	102.2	(.25)	101.2	(.18)	100.5	(.13)	100.3	(.12)
2nd generation	-4.6	(.36)	-1.5	(.31)	-1.0	(.26)	-0.1	(.25)
1st generation non-refugees	-7.1	(.56)	-4.2	(.47)	-0.6	(.39)	-0.1	(.38)
Refugees	-14.7	(.66)	-10.2	(.69)	-2.6	(.71)	-2.2	(.71)
Socioeconomic status (HISEI)			1.9	(.11)			0.8	(.09)
Cultural capital (books)			3.1	(.12)			1.3	(.09)
German language proficiency					6.6	(.09)	5.8	(.09)
<i>R</i> ²	.10	(.01)	.26	(.01)	.47	(.01)	.50	(.01)
Physics								
Without immigrant background	102.2	(.25)	101.2	(.18)	100.6	(.12)	100.3	(.11)
2nd generation	-4.2	(.36)	-0.9	(.31)	-0.6	(.24)	0.4	(.24)
1st generation non-refugees	-7.5	(.55)	-4.4	(.49)	-0.9	(.40)	-0.4	(.40)
Refugees	-17.3	(.66)	-12.7	(.66)	-5.1	(.65)	-4.6	(.65)
Socioeconomic status (HISEI)			2.0	(.11)			0.9	(.09)
Cultural capital (books)			3.1	(.11)			1.3	(.09)
German language proficiency					6.7	(.10)	5.8	(.10)
<i>R</i> ²	.11	(.01)	.29	(.01)	.50	(.01)	.53	(.01)

Notes. Regression coefficients for 2nd generation, 1st generation non-refugees, and refugees represent differences in achievement scores on the reporting metric compared to students without an immigrant background. Continuous variables (HISEI, books, language proficiency) were z-standardized. All coefficients are statistically significant ($p < .05$), exceptions are grayed out. *b* = unstandardized regression coefficient, *SE* = standard error, *R*² = determination coefficient.

Unstandardized regression coefficients (b) in Table 2 represent the difference in the average test score for the respective subpopulation compared to students without an immigrant background on the reporting metric standardized to $M = 100$ and $SD = 10$ points in the total population of all ninth-graders. Corresponding group means and standard deviations can be found in the appendix (see Table A2).

The results were similar for the four subjects. Without control variables, disparities for refugees amounted to about 15 points in mathematics, biology as well as chemistry and 17 points in physics. In other words, proficiency scores were approximately 1.5 standard deviations lower for refugees than for students without an immigrant background. By comparison, disparities were also substantial but considerably smaller for non-refugee foreign-born students. The smallest disparities were found for second-generation immigrant students.

3.2 Estimation of group differences in achievement taking language proficiency and social background into account

To examine the extent to which disadvantages of refugees in mathematics and science achievement can be attributed to differences in social background and language proficiency (research question 2), we extended model 1 in several steps (see Table 2). In model 2, socioeconomic status and cultural capital were added to the regression. Model 3 estimates how group differences change when controlling for German language proficiency. Model 4, finally, shows the differences in achievement for the groups when taking both social background and language proficiency into account.

The results were again similar for the four subjects. Differences in the achievement scores of refugees as well as other immigrant students compared to students without an immigrant background were partially accounted for by group differences in socioeconomic status and cultural capital (model 2). Although the students with an immigrant background still had significantly lower scores, disparities for all subpopulations were substantially smaller after controlling for these background variables. However, the disparities for refugees still amounted to between 10 and 13 points. In comparison, disparities for non-refugee foreign-born students were reduced to about 3 to 5 points and the disparities for the second immigrant generation were almost negligible after including social background variables in the analyses (group difference of about 1 point).

The explanatory power of language proficiency for differences between students with and without an immigrant background in mathematics and science achievement was very substantial (model 3).⁴ Most importantly, controlling for individual differences in German language proficiency considerably reduced the achieve-

4 It could be argued that by coding spelling mistakes as incorrect answers, the language test did not adequately capture the relevant language skills of refugees, as correct spelling is not required to follow instructions or to complete the achievement tests. We therefore re-coded the language test for a random subsample of refugees and non-refugees without

ment gap for refugees to about 2 (biology) to 5 points (physics). Disparities for second-generation students and non-refugee foreign-born students were very small in this model and often not statistically significant when differences in language proficiency were taken into account.

Entering both the social background variables and the language test scores into the regressions (model 4) yielded similar results as model 3, showing that group differences were primarily associated with the general proficiency in the language of instruction. Notably, the differences in mathematics and science achievement between refugees and students without an immigrant background were small but still statistically significant.

3.3 Differences in mathematics and science achievement between refugees and non-refugee foreign-born students

We now turn to a direct comparison of mathematics and science achievement between refugees and other foreign-born ninth-graders (see Table 3). Limiting regression analyses to first generation immigrants also allows for including their duration of stay in Germany, time spent in schools in Germany, and time spent in schools in other countries, as these variables are only meaningful in this subpopulation.

As implied by the results described above (see 3.1), without control variables refugees' average test scores were significantly lower than the average test scores of other foreign-born students (research question 1b; group difference of about 7 to 10 points; see model 1 in Table 3).

In subsequent models, we again added covariates to determine their explanatory power for these achievement differences (research question 2). When the social background variables and the language test score were included in the analyses (model 2), differences in mathematics and science achievement between refugees and non-refugee foreign-born students were substantially reduced to about 2 (biology) to 5 points (physics), but they remained statistically significant in all subjects. To check whether the remaining differences between refugees and foreign-born non-refugees could be attributed to differences in the duration of their stay in Germany, the time spent in schools in Germany, or the time spent in schools abroad, we also added these variables to the regression (model 3). This did not change the overall pattern of results; with the exception of biology, the group differences were still significant and of similar magnitude as in model 2.⁵ Note that

taking spelling mistakes into account and repeated the regression analyses using these language test scores. The results were practically identical to the results reported here.

5 Surprising is the result for model 3 in mathematics: adding the last set of variables resulted in a larger difference in achievement between refugees and non-refugees compared to model 2. However, considering the large confidence intervals for the respective regression coefficients, the difference between the coefficients for refugees from models 2 and 3 is not significant.

Table 3: Regression models for the estimation of group differences in mathematics and science achievement between refugees and other foreign-born students (1st generation non-refugees)

	Model I		Model II		Model III	
	<i>b</i>	(<i>SE</i>)	<i>b</i>	(<i>SE</i>)	<i>b</i>	(<i>SE</i>)
Mathematics						
1st generation non-refugees	96.2	(.60)	100.8	(.48)	100.0	(.63)
Refugees	-8.8	(.85)	-3.8	(.83)	-4.7	(.93)
Socioeconomic status (HISEI)			1.7	(.33)	1.7	(.33)
Cultural capital (books)			1.0	(.38)	1.0	(.37)
German language proficiency			5.1	(.39)	5.3	(.41)
Duration of stay Germany					-0.2	(.35)
Time in school Germany					-0.3	(.35)
Time in school abroad					-0.0	(.22)
<i>R</i> ²	.15	(.03)	.45	(.03)	.45	(.03)
Biology						
1st generation non-refugees	93.7	(.58)	98.3	(.44)	98.6	(.61)
Refugees	-6.5	(.82)	-1.5	(.87)	-1.2	(1.0)
Socioeconomic status (HISEI)			0.8	(.35)	0.7	(.35)
Cultural capital (books)			0.9	(.34)	1.0	(.34)
German language proficiency			5.3	(.42)	5.3	(.42)
Duration of stay Germany					0.4	(.33)
Time in school Germany					-0.0	(.37)
Time in school abroad					0.3	(.18)
<i>R</i> ²	.10	(.02)	.41	(.03)	.42	(.03)
Chemistry						
1st generation non-refugees	95.1	(.56)	99.3	(.45)	100.0	(.61)
Refugees	-7.6	(.81)	-2.9	(.92)	-2.2	(1.0)
Socioeconomic status (HISEI)			0.7	(.37)	0.7	(.36)
Cultural capital (books)			0.8	(.36)	0.8	(.36)
German language proficiency			5.1	(.42)	4.9	(.42)
Duration of stay Germany					0.3	(.33)
Time in school Germany					0.2	(.31)
Time in school abroad					0.1	(.19)
<i>R</i> ²	.14	(.03)	.40	(.03)	.40	(.03)
Physics						
1st generation non-refugees	94.8	(.56)	99.2	(.45)	99.3	(.63)
Refugees	-9.8	(.80)	-5.0	(.88)	-4.7	(1.0)
Socioeconomic status (HISEI)			0.9	(.34)	0.8	(.33)
Cultural capital (books)			0.8	(.38)	0.9	(.37)
German language proficiency			5.1	(.41)	5.2	(.41)
Duration of stay Germany					0.4	(.34)
Time in school Germany					0.0	(.39)
Time in school abroad					0.4	(.19)
<i>R</i> ²	.20	(.03)	.46	(.03)	.47	(.03)

Notes. Regression coefficients for refugees represent differences in achievement scores on the reporting metric compared to other foreign-born students (1st generation non-refugees). Non-dummy variables (HISEI, books, language proficiency) were z-standardized. All coefficients are statistically significant ($p < .05$), exceptions are grayed out. $N_{\text{Mathematics}} = 1.507$; $N_{\text{Sciences}} = 1.461$. b = unstandardized regression coefficient, SE = standard error, R^2 = determination coefficient.

due to the pronounced collinearity of the time-related variables (see Table 1), the regression coefficients for these variables should be interpreted with caution.

4. Discussion

The present study determined the mathematics and science achievement of forcibly displaced students who have recently immigrated to Germany and compared it to the outcomes of other students with and without an immigrant background. The study further examined the degree to which key factors that are associated with immigrant students' educational disadvantages also account for the school achievement of refugee students. Using a dataset from a large representative sample of ninth-grade students, we found that, consistently across the four tested school subjects, refugee students reached considerably lower achievement scores than all other students, including non-refugee foreign-born students. The achievement gaps of 15 to 17 points compared to students without an immigrant background are equivalent to the learning gains of several school years in Germany – the *IQB Trends in Student Achievement 2018*-study reports average increases of up to 5 points per school year at the end of compulsory education in the total population (see Stanat et al., 2019). With estimated disparities of 7 to 10 points depending on the subject, refugee students' test scores also differed considerably from those of non-refugee first generation immigrants. These results suggest that much needs to be done in order to overcome educational disadvantages of refugees in the German education system.

Given the challenging learning conditions of refugee students (see section 1.2) and the relatively short time-period since their arrival in Germany, their substantial achievement disadvantages are not surprising. Yet, there is some indication that refugee students do better at school in other receiving countries. In a representative Australian study, the vast majority of refugee caregivers indicated that their children performed at or above average in school 2–3 years after arrival (Lau et al., 2018). Similarly, a review covering eight studies examining educational outcomes of refugee students attending secondary schools, most of them in North America, concluded that they reached similar educational outcomes as their native peers (Graham et al, 2016). Yet, the composition of the refugee populations in these studies differs from the refugee population in Germany in terms of their origin countries. Moreover, most of the studies were conducted in English-speaking countries, and the refugee students may have possessed some English skills at the time of their arrival. Even more important, the studies used grades, reports of caregivers/parents or teachers or information on school enrollment and completion as indicators of school success rather than achievement test scores. Some of these measures are prone to bias, most represent only broad categories that do not adequately reflect individual differences, and some may have less predictive validity for future educational and vocational success than achievement tests. The findings of our study are therefore not directly comparable to these findings. To arrive at a

more complete picture of how successful education systems are in integrating refugee students, international studies assessing multiple indicators of integration including the results of achievement tests are required.

As expected, differences in socioeconomic and cultural resources partly explained the achievement gaps between refugees and other students. The disparities between refugee students and students without an immigrant background were reduced by about one third when analyses considered parents' socioeconomic background and cultural capital. Yet, the family background explained the achievement gap to an even larger extent in non-refugee immigrants and particularly second-generation immigrants. This indicates that a mechanism that is well-established for other immigrant groups, namely that social inequality accounts for a considerable proportion of migration-related educational disparities (see section 1.2), also applies to refugee students. Yet, the effect seems to be somewhat smaller in this group. A potential explanation for this finding is the restricted transferability of the socioeconomic and cultural capital of refugees (see section 1.2). For instance, newly arrived refugees did not yet have many opportunities to accumulate cultural goods such as books in the receiving country or to find jobs corresponding to their educational background or vocational training. Consequently, their socioeconomic and cultural situation in Germany does often not reflect the socioeconomic and cultural resources they possessed prior to migration, which presumably have a strong impact on the educational success of their children. The current study addressed this issue by using information on the number of books refugee students' parents possessed in the origin country and on their last occupation prior to migration. However, when parents had started working in Germany below their qualification level or when information on the situation prior to migration was missing, the indicators did not assess their resources adequately. In consequence, it seems likely that the family background indicators are somewhat less valid for refugees than for the other groups examined in this study.

Proficiency in German as the language of instruction proved to be an even more important predictor of refugees' mathematics and science achievement than family background. Accounting for German language skills greatly reduced refugee students' disadvantages compared to students without an immigrant background; the remaining 2 to 5 points roughly equal the learning gains of one school year. The magnitude of this disparity is in line with previous findings for declarative knowledge in the sciences showing that recently arrived refugee students lag about one year behind a representative sample of ninth-graders in German schools (Schipolowski et al., 2019). Interestingly, refugees could take the tests administered by Schipolowski et al. (2019) in their first languages or in German, thus reducing potential effects of (limited) language skills.

For other foreign-born students, the estimated effects of German language proficiency were also pronounced in the present study. In all domains, accounting for German proficiency reduced first-generation immigrants' disparities compared to students without an immigrant background to a fraction of the initial effect; in mathematics and chemistry, the differences were no longer significant. German

proficiency by itself further explained 40 percent of the variance in mathematics and sciences achievement. These findings are in line with previous research, which consistently highlights the importance of the language of instruction for school learning and achievement of students of immigrant background (e.g., Kempert et al., 2016; Prevoo et al., 2016), including recently arrived immigrants (e.g., Suárez-Orozco, Bang, & Onaga, 2010). Note that the tests used to assess mathematics and science proficiency in this study were presented in German and that they posed considerable language demands in instructions and items. The close link between students' German proficiency and their test performance thus most likely stems from two sources: refugee students' actual proficiency in the tested domains, which relies on their language skills, as it, for instance, affects their capacities to understand classroom instruction and to seek clarifications from teachers and peers, and their ability to demonstrate their proficiency in the tests.

Our analyses focusing on first-generation immigrant students with and without refugee background provide insights into the similarities and differences between these two groups. Not surprisingly, differences in the family background and, particularly, in German proficiency also accounted for a considerable proportion of the disparities between refugees and other foreign-born students. Yet, as expected, even after considering these factors, a significant achievement gap between the two groups of 1 to 5 points remained, suggesting that additional factors contribute to the achievement disadvantage of refugees. Moreover, differences in the time spent in Germany, at a German school, and at schools in another country did not further reduce the disparities between refugee students and non-refugee foreign-born students once language proficiency and social background were taken into account. It thus seems that the achievement gaps are not due differences in schooling or length of stay *per se*, but rather to the groups' differential command of the language of instruction and other factors not considered in our analyses. This is surprising as interruptions in schooling and limited schooling experiences are often assumed to affect refugees' learning outcomes (Cerna, 2019; Dryden-Peterson, 2016). It is possible that our indicators did not capture refugees' pre-migration school experiences in enough detail. For instance, we did not assess how often students could temporarily not attend school in their countries of origin, where armed conflicts were often taking place for years. Furthermore, information about school attendance was missing for a considerable proportion of cases.

Other possible explanations for achievement gaps between refugees and other first-generation immigrants include pre-, peri-, and post-migration conditions (Ryan et al., 2008), including less effective education systems in refugees' origin countries as well as overburdened education systems and language barriers in transition countries, such as Turkey and Lebanon. Refugees hence may have entered the German school system with larger learning disadvantages than non-refugee immigrants. In addition, refugees have often experienced traumatic events, which can further impede their learning progress and the extent to which parents are able to support their children (McBrien, 2005; Wong & Schweitzer, 2017). Post-migration stressors, such as insecure residence status, crowded housing conditions and expe-

periences of rejection or discrimination, may affect refugee students' learning as well (Drydon-Peterson, 2016; McBrien, 2005).

Our study is limited in several respects. Its cross-sectional design does not allow to draw causal inferences or to analyze developmental processes. For newly arrived refugee students, it would be particularly interesting to investigate how their competencies develop over time in order to disentangle the degree to which the assessed competencies reflect what students had already learned before they arrived in Germany and what they have learned after their arrival. Furthermore, refugees in our study completed regular booklets in German. Administering translated versions of these booklets would potentially provide a more precise estimation of their mathematics and science proficiency and of the extent to which the achievement scores reflect domain knowledge on the one hand and language skills on the other. At the same time, in school and in vocational training, refugee students in Germany typically need to apply, further develop, and demonstrate their mathematical and scientific competencies in German. The ecological validity of our findings is therefore high for the German context.

Despite its limitations, our study provides several important insights and implications. It is the first empirical study determining the magnitude of achievement disadvantages of recently arrived refugee students in Germany based on established instruments and on data for a large representative sample. Moreover, it revealed similarities but also differences between refugee students and other foreign-born students. The disadvantages of refugees are much larger than the disadvantages of other first-generation immigrant students. These disparities cannot be fully explained by differences between the two groups in their sociocultural family background, German proficiency, residence time in Germany, time spent in a German school or in schools abroad. This suggests that additional mechanisms are at play in the case of refugees, which is in line with the notion that refugees have to overcome special challenges to succeed in school (Cerna, 2019; McBrien, 2005). The pronounced disadvantages of refugee students at the end of compulsory schooling underline how important it is to further support them in their learning after their transition to vocational training or to programs designed to prepare them for vocational training. Also, our findings emphasize once more that language proficiency is a key for educational success and needs to be an important focus in further developing educational quality in the German school system.

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APPENDIX

Table A1: Correlation estimates for refugees and non-refugee foreign-born students, respectively

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Mathematics achievement	–	.66	.70	.75	.61	.33	.38	.11	.12	-.12
2. Biology achievement	.48	–	.84	.84	.62	.26	.34	.22	.21	-.18
3. Chemistry achievement	.52	.68	–	.85	.62	.24	.32	.25	.26	-.24
4. Physics achievement	.60	.69	.69	–	.60	.25	.33	.21	.20	-.16
5. Language (C-test) ¹	.29	.38	.28	.37	–	.25	.37	.32	.35	-.33
6. Socioecon. status (HISEI)	.21	.14	.16	.20	.12	–	.35	.13	.09	-.08
7. Cultural capital (books)	.07	.12	.08	.11	.15	.16	–	.11	.10	-.09
8. Duration of stay Germany	-.04	.06	.05	.00	.03	-.02	.01	–	.79	-.69
9. Time in school Germany	-.08	-.03	.00	-.04	.00	-.07	.00	.43	–	-.74
10. Time in school abroad	.09	.16	.11	.22	.05	.16	.02	-.19	-.24	–

Notes. Values below the diagonal are correlation coefficients for the subsample of refugees ($n = 939$), values above the diagonal are correlations for the subpopulation of non-refugee foreign-born students ($n = 1,712$). All correlation coefficients are statistically significant ($p < .05$), exceptions are grayed out.

¹Note that a floor effect was observed for refugees in the language test score (i.e., 77% of the refugees solved 5 or less out of 30 items correctly).

Table A2: Means and standard deviations for mathematics and science achievement test scores, the language test score, socioeconomic status (HISEI), and cultural capital (books) of refugees and other students with and without an immigrant background in Grade 9

	Mathematics						Sciences							
				Biology			Chemistry			Physics				
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Total population	25,342	100.0	(.27)	10.0	(.26)	25,506	100.0	10.0	100.0	(.26)	10.0	100.0	(.27)	10.0
Without immigrant background	15,705	102.1	(.25)	9.4	(.24)	15,712	102.2	9.5	102.2	(.25)	9.5	102.2	(.25)	9.4
2nd generation	2,724	97.8	(.40)	9.5	(.38)	2,782	97.8	9.3	97.5	(.38)	9.4	98.0	(.38)	9.3
1st generation non-refugees	979	96.2	(.60)	10.1	(.58)	947	93.7	9.5	95.1	(.56)	9.4	94.8	(.56)	9.6
Refugees	528	87.4	(.70)	8.4	(.59)	514	87.3	7.8	87.5	(.63)	8.2	84.9	(.64)	8.0

	Language (C-test) ¹			HISEI			Cult. capital (books)			
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
	Total population	44,882	0.00	(.05)	1.87	(.39)	20.6	3.50	(.03)	1.52
Without immigrant background	27,743	0.47	(.04)	1.76	(.40)	19.8	3.83	(.03)	1.45	
2nd generation	4,869	-0.53	(.06)	1.56	(.48)	19.6	2.84	(.04)	1.34	
1st generation non-refugees	1,712	-1.35	(.09)	1.73	(.99)	22.3	2.77	(.07)	1.49	
Refugees	939	-2.94	(.09)	1.43	(1.1)	21.5	2.15	(.07)	1.21	

Notes. *SE* = standard error. ¹ Weighted Likelihood Estimates (see text).



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