Qualified for Teaching Physics? How Prospective Teachers Perceive Teachers With a Migration Background – and How It's Really About "Him" or "Her"

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ABSTRACT
As in many other countries, in Germany far too few students enrolled in teacher training specialize in physics. In this research we seek to clarify whether one possible reason is that students hold competence-related stereotypes favoring male, non-immigrant teachers. Physics is strongly associated with maleness and high competence. We predicted that student teachers regard teachers as being less competent to teach physics if they belong to a social group that is the target of negative performance-related stereotypes, i.e., if a teacher is female and has a migration background. In an experimental online study, 144 non-immigrant student teachers read about a teacher's first day at school. The target teacher's name (German or Turkish) and gender were varied between participants. A significant three-way interaction indicated that competence judgments depended on participants' gender: male and female student teachers perceived female targets as less qualified for teaching physics than men – among males when female targets were Turkish; among females when they were German. Findings were replicated in a sample of 358 non-immigrant students enrolled in various fields of study other than teacher training. Results suggest that increasing sensitivity towards perceptions of stereotypes needs to be an essential element in the professional development of teachers.

KEYWORDS
Gender stereotypes; stereotypes about immigrants; physics teachers; sub-stereotypes about teachers in different subject areas

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INTRODUCTION

Many countries are facing the problem of a skills shortage in the fields of science, technology, engineering, and mathematics (STEM). In Germany, for instance, where the present study has been conducted, the number of employees lacking in the STEM domains will have risen to almost a quarter of a million by the year 2020 (Koppel & Plünnecke, 2009). Although the shortage of STEM specialists has been noticed for a long time now, the lack of skilled personnel is still having an impact on the next generation: there are too few staff to teach and train young people in the STEM domains. This is particularly obvious in the largest occupational group engaged in training and education – schoolteachers – and for the domain of physics, which is a compulsory part of the curriculum in all school types in Germany. The recently published STEM junior staff barometer (MINT-Nachwuchsbarometer, 2014; MINT: acronym for Mathematik, Ingenieurswissenschaften, Naturwissenschaften und Technik) reports that over the course of the last decade the number of students training for a teaching career at a Gymnasium (the highest school track qualifying for university admission) in Germany has clearly risen in the language-related subject domains (e.g., for the school subject German: about 1500 graduates in 2002/2003, 3500 in 2011/2012; for English: about 1250 graduates in 2002/2003, 3000 in 2011/2012), while the numbers remained constantly low for physics (about 500 graduates in both 2002/2003 and 2011/2012). Hence, the percentage of teachers specializing in physics has decreased considerably over the years. As a result, schools today frequently have problems hiring physics teachers, therefore preventing them from offering physics courses at an advanced level, such that the few boys and girls who would be interested in enrolling on them do not even have that option: a vicious cycle has been established.

In this research, we focus on the impact of negative stereotypes pertaining to female and immigrant teachers as one possible factor contributing to the shortage of young people wanting to become schoolteachers in physics. We were particularly interested in whether these stereotypes would be held by the teachers' future colleagues, that is, by students currently engaged in teacher training.

To foreshadow our argument, we suggest that prospective teachers hold competence-related stereotypes favoring male, non-immigrant physics teachers and are therefore inclined to downgrade the competence of teachers not belonging to the group of German men: female teachers and teachers with a migration background. As will be substantiated by the empirical research detailed below, the domain of physics is strongly associated with maleness and high competence. In terms of the stereotype content model (Cuddy et al., 2009; Fiske, Cuddy, Glick & Xu, 2002) – which suggests that stereotypes about many different social groups can be described using the two core dimensions of warmth and competence –

people specializing in physics should fall into the high-competence cluster. As the empirical evidence provided below suggests, both females and immigrants are more likely to be perceived in accordance with a low-competence stereotype. Hence we hypothesize that they should be a particular mismatch with the stereotype associated with physics and therefore become targets of negative competence-related stereotypes when teaching physics. Awareness of these negative stereotypes about women and immigrants may in turn prevent women and young people with foreign roots from specializing in physics, given that stereotypes have been found to have an impact on – seemingly idiosyncratic – affinities (e.g., Beasley, 2011; Deemer, Thoman, Chase & Smith, 2014; Eccles, 2011; Ertl, Luttenberger & Paechter, 2014; Gottfredson, 2005; Hannover & Kessels, 2002; Zhang, Schmader & Forbes, 2009).

Stereotypes of Student Teachers in Germany

In Germany, students can enroll for a course of studies (e.g., physics) with the goal either of becoming a teacher or of attaining a bachelor's/master's degree qualifying for academic positions outside the teaching profession. Basic-level courses are attended by both students in teacher training and those not wanting to become teachers. However, while student teachers go on to attend courses on didactics and education science, non-teacher students enroll in more advanced-level disciplinary seminars. This is possibly one reason why teacher students and teachers are the targets of negative competence-related stereotypes. For instance, in the German media, teachers are often depicted as being less competent than professionals in other academic fields (for an analysis of relevant publications from lead journals in Germany, see Blömeke, 2005).

Scientific studies comparing the cognitive competences (intelligence, domain-specific knowledge) of different groups of students do, however, show a more diversified picture. Klusmann, Trautwein, Lüdtke, Kunter, and Baumert (2009) found (after controlling for the influence of subject of study and gender) that students wanting to become teachers at a Gymnasium differed neither in their prior scholastic attainments nor in their domain-specific competences and intelligence from students enrolled in non-teacher training (however, teacher students aiming to work at an elementary or a lower-track school displayed lower cognitive competences than non-teacher students). Spinath, van Ophuysen, and Heise (2005) found that only non-teacher students enrolled in STEM subjects, but not non-teacher students specializing in pedagogics, displayed significantly higher intellectual abilities than teacher students. Spinath et al. (2005), however, did not differentiate between their teacher-student participants according to their fields of study. Investigating potential differences between teacher students from varying disciplines, Kaub et al. (2012) found STEM teacher students to be more intelligent than teacher students specializing in non-STEM subjects.

Against the background of these somewhat ambiguous findings, Ihme and Möller (2014) investigated whether students in teacher training in Germany are targets of negative performance-related stereotypes. They asked students enrolled for a master's program in teacher education to define how other students would describe

the "typical student" preparing for a teaching career. Findings indicated that teachers-to-be were aware of others perceiving them as a group low in competence. Further, in a second study involving a sample of non-students and university students from various disciplines, Ihme and Möller (2014) measured stereotypes about students in teacher training in comparison with stereotypes about law students, computer science students, and psychology students. Results showed that students in teacher training were perceived as significantly less competent than all other groups. While this research shows that there is a negative competence-related stereotype pertaining to students enrolled in teacher training in general, in our own studies we will investigate whether teachers-to-be themselves hold different sub-stereotypical views of male and female teachers with and without a migration background regarding their competence to teach physics.

Stereotypes Pertaining to the Domain of Physics

Physics is a domain associated with high difficulty. For instance, Hannover and Kessels (2004) found that German adolescent girls and boys perceived prototypical peers describing physics as their favorite subject as particularly intelligent. Using an implicit measure, Kessels, Rau, and Hannover (2006) found German adolescents to associate physics (relative to English) more easily with words referring to difficulty (than to ease). The ascription of high difficulty can result not only from real task difficulty but also from the fact that males are strongly over-represented in the domain of physics, e.g., only 25% of the students graduating from university with a BA or MA in physics in the winter term 2013/14 in Germany were female (Statistisches Bundesamt [German Federal Office of Statistics], 2014a): as men, on average, work in higher-status professions than women, children already learn to associate jobs in which males are strongly over-represented with high difficulty (e.g., Liben, Bigler & Krogh, 2001; Vervecken, Hannover & Wolter, 2013). Accordingly, stereotypes pertaining to the domain of physics involve the particular difficulty of the domain – combined with a strong male connotation.

Competence Stereotypes of Females in Germany: Mismatch with the Domain of Physics

While females are over-represented in the group of student teachers in general (e.g., for secondary school teachers at a Gymnasium: 64.7% in the academic year 2011/2012, MINT-Nachwuchsbarometer, 2014), most of them specialize in languages, the arts, or biology. As a result, there are clearly fewer female than male students enrolled in physics teacher training (e.g., 30.2% in the winter term 2013/14, Statistisches Bundesamt, 2014a) and among physics teachers in Germany (e.g., about 32% in the academic year 2011/2012, MINT-Nachwuchsbarometer, 2014). A possible explanation for this is that women are perceived – and perceive themselves – to be a mismatch with the prototypical person specializing in physics with respect to both gender and competence. For example, with regard to gender, there is robust evidence that the school subject physics and adolescents favoring physics are strongly associated with the male category in Germany (e.g., Hannover & Kessels, 2002; Kessels, 2005). Kessels et al. (2006) observed that adolescents associated physics (relative to English) more easily with words referring to males

(than to females). Further, with respect to the ascription of competence, the stereotype content model predicts that women are seen as less competent than men (Cuddy et al., 2009; Fiske et al., 2002). For instance, Asbrock (2010) found that university students in Germany ascribed significantly more competence to men than to women. While a recent study investigating implicit stereotypes about women in Germany did not replicate the female-incompetence stereotype (Ebert, Steffens & Kroth, 2014), we argue that female teachers might still be regarded as less competent to teach physics than male teachers, considering that physics is deemed to be a particularly difficult subject.

Stereotypes of Immigrants in General and of Turks in Particular in Germany

While research from other countries shows that stereotypes vary according to immigrants' country of origin and to the host country (e.g., for Switzerland: Binggeli, Krings & Sczesny, 2014; for Norway: Bye, Herrebrøden, Hjetland, Røyset & Westby, 2014; for the US: Timberlake & Williams, 2012), there are no studies systematically comparing stereotypical views of different groups of immigrants in Germany. The few available studies investigated stereotypes about immigrants in general and one particular group of immigrants, Turks. People of Turkish descent are the largest group of immigrants in Germany: 2 793 000, i.e., 17.55% of the 15 913 000 residents with a migration background (Statistisches Bundesamt, 2014b, p. 82) and 26% of the naturalized or, respectively, 29% of the non-naturalized immigrant university students have Turkish roots (Middendorff, Apolinarski, Poskowsky, Kandulla & Netz, 2013). Against this background, we targeted our experimental studies to identify stereotypes about immigrant teachers of Turkish descent.

Indirect evidence for our assumption that teachers from a Turkish background may fall prey to negative competence-related stereotypes comes from both research comparing immigrant and non-immigrant students' actual academic attainments and research on stereotypes pertaining to immigrants in general. In Germany, immigrant students in general, and students with a Turkish background in particular, obtain lower academic competence scores than their native peers and are under-represented in higher-track schools (e.g., Klieme et al., 2010). For instance, while in 2009 34.7% of all students with no migration background attended the highest school track, the Gymnasium, this was the case for only 8.9% of second-generation immigrant students from Turkey (Baumert & Maaz, 2012). Also, participation rates in qualified labor in Germany are particularly low for young adults from a Turkish background (Baumert & Maaz, 2012).

At the same time, immigrants are hit by negative stereotypes in Germany (e.g., Zander, Webster & Hannover, 2014). For instance, Kessler et al. (2010) found that 15-year-old German school students endorsed items measuring blatant prejudices against immigrants with a mean value of 2.76 on a five-point answering scale. Asbrock (2010) found that German university students perceived Turks as significantly less competent than Germans. Glock and Krolak-Schwerdt (2013) demonstrated that German student teachers are biased against school students

with a Turkish background when judging their performance. Similarly, Zander et al. (2014) demonstrated that school students themselves judged the mathematics performance of immigrant adolescents as less positive than that of non-immigrant students. Based on this evidence, it seems plausible that immigrants in general and Turks in particular – as the largest group of immigrants in Germany and as the group of immigrants that is most strongly disadvantaged with respect to their academic attainments – are the targets of negative competence-related stereotypes.

Interactive Effects between Group Memberships of the Target Teacher and Gender of the Perceiver: The Present Research

In summarizing, we suggest that – given that the domain of physics is deemed to be particularly difficult – female teachers and teachers with a Turkish migration background are likely to be downgraded in their competence to teach physics, as they do not fit into the high-competence stereotype cluster (cf., Cuddy et al., 2009; Fiske et al., 2002). The negative stereotypes about females and Turks, however, could play out in interactive effects between the gender and ethnic group of the target teacher as well as the gender of the perceiver. Here, different possibilities are conceivable: if individuals are members of several social groups to which a negative performance-related stereotype pertains, their personal disadvantages and – concomitantly – their risk of being discriminated against on the basis of negative stereotypes can accumulate (cf., Taylor, Charlton & Ranyard, 2012). Possibly, women teachers with Turkish roots are victims of such a "double jeopardy" when judged on their competence to teach physics. It is no less probable, however, that no such effect will be observed. First, looking at real competences, there is no "double disadvantage" for females with foreign roots: in Germany, the extent to which immigrant students lag behind non-immigrants in their academic attainments does not differ for boys and girls (e.g., Autorengruppe Bildungsberichterstattung, 2006; Klieme et al., 2010). Second, recent findings suggest that it is not necessarily females but rather males with foreign roots who suffer from double jeopardy. For example, Cogburn, Chavous, and Griffin (2011) provide evidence for gendered racial stereotypes, demonstrating that males with a migration background are more likely than females to experience discrimination in academic contexts and are particularly disadvantaged with respect to their academic attainments. From previous research it is not clear whether this could hold true in the male-connoted domain of physics. Hence, we did not specify an a priori hypothesis about whether a double jeopardy effect would be observed for women from a Turkish background.

We even considered it possible that females with Turkish roots would be judged *more favorably* with respect to their competence to teach physics than females with no migration background, because negative stereotypes about women in STEM may not be as likely to be applied to women from their country of origin, Turkey (Miller, Eagly & Inn, 2014). Indirect evidence for such an assumption is provided by research comparing STEM-related affinities and academic/professional choices across nations. Here, it was found that the less affluent their country is, the more females are attracted to the STEM field. For instance, comparing the nations participating in PISA 2003, Else-Quest, Hyde, and Linn (2010) found a much

smaller effect size for the gender difference favoring boys in their mathematics-related self-concept in Turkey (.19) than in Germany (.50). Similar results were observed when comparing Germany and Turkey with respect to the effect sizes for gender differences in math-related extrinsic motivation (.45 vs. .10), intrinsic motivation (.37 vs. .10), and math anxiety (-.38 vs. -.20). Charles and Bradley (2009) calculated a gender segregation index, indicating how strongly varying study domains were separated according to gender in different countries. While in all 44 nations included in their study men were over-represented in engineering and women in humanities and social sciences, the extent of this over-representation varied systematically according to the countries' per capita GDP: the higher a country's GDP, the stronger was women's under-representation in engineering and men's under-representation in the humanities/social sciences.

With Germany having a more advanced Economic Development Index (10.09) than Turkey (7.46, data of United Nations Educational, Scientific and Cultural Organization, cited in Charles & Bradley, 2009), most families with a Turkish background living in Germany today migrated in the hope of better economic conditions and employment. Applied to our research question, this could imply that female German teachers but not female Turkish teachers will be downgraded in their competence to teach physics, as the latter are associated with a culture in which women have stronger affinities to and are better represented among experts in the field of STEM.

Also, we considered it likely that the perception of competence to teach physics would vary as a function of our participants' gender: while our non-immigrant male research participants were in the high-status group, when having to judge both a female teacher (with or without a migration background) and a (male or female) teacher with a migration background, our non-immigrant female participants were members of the group to which the female-incompetence stereotype applies. Given that various theoretical accounts predict differential outcomes, we refrained from specifying a priori hypotheses regarding the directionality of effects.

STUDY 1

Method

Research participants
Undergraduate students enrolled on the master's program for teacher education at the Freie Universität Berlin, Germany, were informed during a lecture that they could take part in an online study on person perception. Of the approximately 350 students who were told about this, 298 opened the link to the study and 187 (62.8%) completed the online study. Seven (3.7%) men and 23 (12.3%) women or at least one of their parents were born in another country than Germany. We restricted participation to students without a migration background in order to minimize variance, given the large number of other factors considered in this study. Also, the data of 13 persons with a missing value on our dependent variable were excluded from the analysis, resulting in a final sample of 144 students. Of these , 104 (72.2%) were female, which is representative of the percentage among

students enrolled on the master's program for teacher education at the Freie Universität (36.0% males, 64.0% female; $\chi^2(1)=1.548$, $p=.213$). The average age was 24.2 years ($SD =3.52$, $range$ 19-41). While 17.4% (n=25) of our participants wanted to become elementary schoolteachers, the remaining 82.6% (n=119) aimed to teach at a secondary school. Using the categorization provided by the German Federal Office of Statistics, the largest disciplinary sub-group was from *linguistics/cultural sciences* (30.6%, n=44), followed by *law/social sciences/economics* (23.6%, n=34), the STEM subjects *mathematics, natural sciences, informatics and engineering* (19.5%, n=28), and *educational sciences/psychology/elementary school teaching* (18.8%, n=27). The remaining participants studied *arts and music* (2.8%, n=4), or did not indicate their field of study (4.9%, n=7).

Procedure

To assess how participants' perceptions of a teacher's competence to teach physics varied as a function of this teacher's migration background and gender, we had students read a brief description of a teacher's first day at school. At the end, participants learned that the teacher was a *mathematics* teacher based on the announced topic of the next lesson. By using the description of a mathematics teacher we aimed to prevent students from concentrating on our focal dependent measure: the perceived competence of the described target to teach physics. The brief vignette read as follows:

> "Imagine the following situation: A new term has begun and a new teacher, Ms. Beck, takes over the class that has been assigned to her. Ms. Beck comes in three minutes before the bell rings. When the bell rings it is – as always – still loud in the room and not everyone is seated. (…) Now Ms. Beck starts to introduce herself. She explains the things that she will prioritize in teaching. Respect is most important to her. She says that she respects all students on condition that she too will be respected. She also explains that she will never insult anyone as long as she is not insulted. (…) Now the bell rings and Ms. Beck announces that she will start her lesson on calculus of probability the next time they meet."

All participants read the identical target description but were randomly assigned to one of four conditions in which target gender and ostensible migration background (marked by a common Turkish or German surname) were manipulated: 24.3% read the description with the name of the teacher being Ms. Yildirim, 22.9% Mr. Yildirim, 28.5% Ms. Beck, and 24.3% Mr. Beck. This final assignment of our participants equally to the four experimental groups was confirmed using a chi-square test, $\chi^2overall(3)=.088$, $p=.766$, $\chi^2female(3)=.600$, $p=.439$; $\chi^2male(3)=.474$, $p=.491$.

Students were then asked to rate the teacher on various dimensions (filler items). Target evaluation of the described teacher's competence to teach in the domain of physics served as the dependent variable. Finally, students reported information concerning their age, gender, and major.

Design
The study design was a 2(Participant Gender: Male vs. Female) x 2(Target Gender: Male vs. Female) x 2(Target Ostensible Migration Background: Turkish vs. German) between-subject factorial design with competence ratings for physics as dependent variable.

Dependent measure: non-reactive competence measure
To assess participants' stereotypic perceptions regarding the target's competence to teach physics we used a non-reactive, domain-specific competence measure. Hereby, students were given a list of seven subjects, i.e., mathematics, physics, natural sciences, biology, English, German, and other languages, and were instructed to drag and drop the subjects on a graphical display of stairs that indicated ranking from 1 to 7. The critical dependent variable was the rank (value) assigned to the subject domain of physics, i.e., the perceived competence to teach physics of the person described in the vignette. The measure was non-reactive insofar as students read the description of a mathematics teacher; we expected that participants would focus on the rating in the domain of mathematics and be less likely to control their responses for the subject domain of physics. This measure has been adapted from our previous research because it exhibited good predictive validity (Gabriel, Lilla, Zander & Hannover, 2014; Zander & Hannover, 2013). For easier interpretation ranking values were reverse-coded so that now *higher* numbers indicate *higher* competence ratings (i.e., 1 not at all competent; 7 very compete competent) with $M = 4.71$ and $SD = 1.70$.
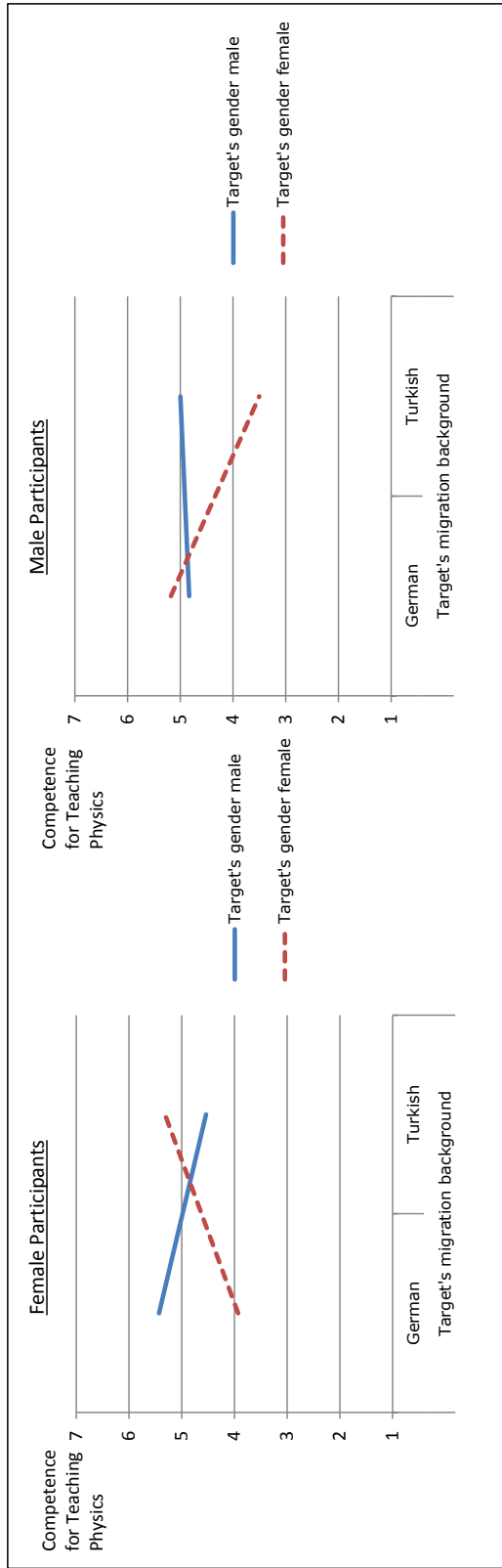
Results

Analytic strategy
We performed a hierarchical linear regression analysis for the dependent variable (i.e., competence to teach physics as focal variable), regressing it on participant's gender, target's gender, and target's migration background. We entered subsequent main-effect terms, two-way interaction terms, and the predicted three-way interaction term hierarchically. To unpack the predicted three-way interaction we conducted post-hoc probing of the interaction, separately examining focal simple slopes and simple differences between conditions (see Aiken & West, 1991). Given that the regression model included three dichotomous predictors, both effect codes and dummy codes were used (see Aiken & West, 1991). Dummy codes were used in the post-hoc probing of the higher-order interactions (see Table 1 for our coding system).

Table 1
Coding System for Dichotomous Variables: Gender (Participant and Target) and Migration Background (Target)

Dichotomous Variable	Effect Coding	Dummy Coding I	Dummy Coding II
Gender		Male	Female
Male	− 0.5	0	− 1
Female	+ 0.5	+ 1	0
Migration Background		No MB	MB
German	− 0.5	0	− 1
Turkish	+ 0.5	+ 1	0

Competence ratings

A hierarchical linear regression analysis was performed to examine the hypothesis that perception of skills in teaching physics varies systematically as a function of participants' gender, as well as of the target's gender and ostensible Turkish migration background (see Table 2 for an explanation of beta coefficients, changes in variance and amounts of variance). There was a significant three-way interaction, b=4.131, SE=1.226, ß=.303, $t (136)$=3.369, p=.001, d=0.58, driven by the different evaluations of male and female participants. The three-way interaction was plotted (Figure 1) following the suggestions of Aiken and West (1991). The regression of competence ratings for the domain of physics on target gender was plotted at the two levels of target migration background (no/yes) and target gender (male/female), with two panels representing the results of female (left panel) and male participants (right panel), respectively.

Figure 1. Perceived competence to teach physics plotted as a function of participant's gender (panels), target's gender, and target's migration background in Study 1.

Table 2: Regression Statistics for Perceived Competence to Teach Physics as a Function of Participant's Gender, Target's Gender, and Target's Migration Background in Study 1.

Variables	Step 1				Step 2				Step 3			
	B	*p*	β	*t(140)*	*B*	*p*	β	*t(137)*	*B*	*p*	β	*t(136)*
Intercept	4.699	.000		29.461	4.662	.000		29.502	4.718	.000		30.781
Gender Participant (GP)	0.127	.690	.034	0.399	0.248	.436	.065	0.781	0.178	.563	.047	0.580
Gender Target (GT)	-0.429	.135	-.126	-1.503	-0.347	.274	-.102	-1.099	-0.468	.129	-.138	-1.526
Migration Background (MBT)	-0.007	.980	-.002	-0.025	-0.304	.340	-.089	-0.958	-0.256	.405	-.075	-0.836
MBT*GT					1.162	.042	.171	2.056	0.217	.724	.032	0.354
GT*GP					-0.038	.952	-.006	-0.060	0.216	.725	.032	0.352
MBT*GP					1.161	.069	.171	1.832	1.003	.104	.148	1.636
GP*GT*MBT									4.131	.001	.303	3.369
R^2	.017				.068				.140			
R^2 Change					.051				.072			
F Change	0.805				2.506[+]				11.354[***]			

Note. [+] $p<.10$, [***] $p<.001$; Gender of Participant and Target effect-coded: males = lower, females = higher. Migration Background of Target effect-coded: German = lower, Turkish = higher.

Female participants
There are two different in-groups: each female participant (see left-hand panel in Fig. 1) can rate a target that (a) belongs to the same in-group with regard to ethnic category (i.e., the German males) or (b) belongs to the same in-group with regard to gender (i.e., the Turkish females). We first examined (a): here, simple difference tests showed that females who were given the description of a German female teacher (i.e., Ms. Beck) regarded this member of their own group (i.e., German female teacher) as significantly less suited to teaching physics than those female participants who were given the description of a German male teacher, i.e., Mr. Beck, *b*=-1.501, *SE*=0.449; ß=-.441, *t (136)*=-3.343, *p*<.001, *d*=-0.57; see also Figure 1. More than that, (b) female participants perceived their own group (i.e., German female teachers) as significantly less competent than those participants who were given the description of a Turkish female teacher, i.e., Ms. Yildirim, *b*=1.387, *SE*=0.439; ß=.408, *t (136)*=3.160, *p*<.01, *d*=0.54, whom they rated as (by trend even) more competent than those female participants who were given the

description of a Turkish male teacher, i.e., Mr. Yildirim, *b*=.782, *SE*=0.454; ß=.230, *t (136)*=1.722, *p*=.087, *d*=0.295.

Male participants
Post-hoc probing of the interaction showed a markedly different pattern for male participants (see Fig. 1, right-hand panel). Male participants perceived the teacher who (a) belongs to the same in-group with regard to ethnic category (i.e., the German female teacher) as being as suitable for teaching physics as their own group (i.e., the German male teacher), *b*=0.348, *SE*=0.677; ß=.102, *t (136)*=0.515,n.s. Also there was no significant difference in the evaluation of male participants who were given the description of an ostensibly Turkish male teacher and that of those who were given the description of a German male teacher, *b*=0.167, *SE*=0.771; ß=.049, *t (136)*=0.216, n.s. However, those male students who were given the description of the ostensibly Turkish female teacher Ms. Yildirim rated her as significantly lower in competence than did those male students who were given the description of the German female teacher Ms. Beck, *b*=-1.682, *SE*=0.708; ß=-.494, *t (136)*=-2.375, *p*<.05, *d*=-0.407.

Discussion

Consistent with our expectations, the negative performance-related stereotypes regarding females and Turkish immigrants played out in interactive effects between the target teacher's group memberships and the gender of the perceiver: we did not find a blatant derogation of teachers with an ostensibly Turkish migration background or of female teachers in general. Rather, a three-way interaction indicated that target teacher's gender and migration status and research participant's gender concomitantly influenced the perception of the target's competence to teach physics. The very different pattern of findings for male and female participants suggest that male and female participants hold different sub-stereotypical views on male and female physics teachers with or without a migration background. Male participants without a personal migration background regarded female Turkish teachers as least suited to teaching physics, suggesting a double jeopardy for this group. In contrast, German female participants held the lowest expectations for female German teachers. It seems they did not apply the negative stereotype regarding women to female physics teachers in general, but adhered to the negative stereotype only when having to judge members of their in-group: females with no migration background.
Since we had refrained from specifying directional hypotheses as to how exactly target teachers' group memberships and the gender of the perceiver would interact, the three-way interaction we have found in Study 1 needs replication. In our second study we now predicted a priori that we would find the same pattern of results. Also, we wanted to replicate the pattern in a larger sample of students enrolled in diverse disciplines outside teacher training at various universities in Germany. In particular, in Study 2, we aimed to replicate:

(1)   the finding that German females rated other German women as significantly less competent to teach physics than Turkish women;

(2)   the finding that German males perceived Turkish women as significantly less competent to teach physics than German women.

STUDY 2

Method

Recruitment
Materials exactly replicated those outlined in Study 1. A version of the online questionnaire was sent out to the makers of the SoSci-Panel, which is a non-commercial open platform in support of scientific research in Germany (Leiner, 2012) and evaluated in a double-blind peer-review procedure. After successful evaluation the questionnaire was sent out to the panel. 845 persons clicked on the questionnaire. Of these, 654 actually took part in the study. This response rate of 80.8% is comparatively high in relation to other online studies (average response rate of 71.9% reported in Batinic & Moser, 2005).

Participants
Participants were 654 students enrolled in diverse disciplines outside teacher training at various universities in Germany. Ninety-nine (33.5%) of them did not complete the questionnaire and 30 (10.1%) reflected the intended purpose of our study, and therefore were excluded from the analysis. Seventy-six (25.7%) of the participants or at least one of their parents were born in another country than Germany. Those participants were excluded for the same reasons described in Study 1. Another 72 (24.3%) reported studying to become teachers and were excluded because we were interested in replicating our central findings in a sample of persons who were not studying to become teachers. The data of six persons (2.0%) were excluded because of a missing value on our dependent variable. Finally, 13 participants (4.4%) were excluded because they fell into two of the above-mentioned categories. Of the remaining 358 persons, 119 (33.2%) were male and 239 (66.8%) were female. They were on average 23.5 years old (*SD*=3.27 *range* 16-36). The largest disciplinary sub-groups were law/social sciences/economics (27.7%, n=99), followed by STEM (21.5%, n=77), linguistics/cultural sciences (15.9%, n=57), educational sciences/psychology (11.5%, n=41), medicine and pharmacy (8.7%, n=31), arts and music (1.4%, n=5), and other subjects (4.5%, n=16). 8.9%, n=32 did not report their subject.

Procedure and measures
Procedure, instructions, and measures were identical to Study 1. Participants were distributed equally across conditions, $\chi^2 overall(3)$=0.757, p=.384, $\chi^2 female(3)$= 0.531, p=.466; $\chi^2 male(3)$= 0.108, p=.742.

Results

As in Study 1, a hierarchical linear regression analysis was performed to examine the hypothesis that the perception of skills in teaching physics varies systematically as a function of participants' gender, as well as of the target's gender and ostensible Turkish migration background (see Table 3 for beta coefficients, changes

in variance and amounts of variance). Again, there was a significant three-way interaction, $b=3.238$, $SE=0.563$, $ß=.295$, $t (350)=5.747$, $p<.001$, $d=0.614$, which was, as in Study 1, driven by the different evaluations of male and female participants. The three-way interaction was plotted (see Figure 2).

Table 3. Regression Statistics for Perceived Competence to Teach Physics as a Function of Participant's Gender, Target's Gender, and Target's Migration Background in Study 2.

Variables	Step 1				Step 2				Step 3			
	B	P	β	$t(354)$	B	p	β	$t(351)$	B	p	β	$t(350)$
Intercept	5.051	.000		67.532	5.047	.000		68.595	5.044	.000		71.609
Gender Participant (GP)	0.193	.198	.066	1.291	0.240	.103	.083	1.635	0.273	.053	.094	1.939
Gender Target (GT)	-0.729	.000	-.264	-5.171	-.714	.000	-.259	-4.882	-0.806	.000	-.292	-5.719
Migration Background Target (MBT)	-0.223	.114	-.081	-1.584	-.275	.062	-.100	-1.869	-0.255	.071	-.093	-1.811
MBT*GT					1.106	.000	.201	3.995	0.556	.049	.101	1.974
GT*GP					0.163	.577	.030	0.558	0.366	.195	.066	1.299
MBT*GP					0.657	.026	.119	2.237	0.775	.006	.141	2.749
GP*GT*MBT									3.238	.000	.295	5.747
R^2	.080				.131				.206			
R^2 Change					.051				.075			
F Change	10.254***				6.902***				33.029***			

Note. *** $p<.001$; Gender of Participant and Target effect-coded: males = lower, females = higher. Migration Background of Target effect-coded: German = lower, Turkish = higher.

As in Study 1 we found that female participants rated Turkish female teachers as significantly more competent to teach physics than their own group, i.e., the German females, $b=1.220$, $SE=0.245$; $ß=.444$, $t (350)=4.973$, $p<.001$, $d=0.532$. Also, as in Study 1, male participants perceived Turkish female teachers as significantly less competent to teach physics than German female teachers, $b=-1.174$, $SE=0.332$; $ß=-.427$, $t (350)=-3.537$, $p<.001$, $d=-0.378$.
We further replicated the other effects reported in Study 1: in Study 2, female participants also regarded German males as more competent than German females, $b=-1.710$, $SE=0.227$; $ß=-.620$, $t (350)=-7.538$, $p<.001$, $d=-0.806$. They also regarded Turkish females as even more competent than Turkish males, $b=.465$,

SE=0.231; ß=.169, *t (350)*=2.013, *p*=.045, *d*=0.215. This effect was even more pronounced than in Study 1, where it was only marginally significant.

As for male participants, as in Study 1, we found that they did not consider German males to be better suited to teaching physics than German females, *b*=-0.457, *SE*=0-296; ß=-.166, *t (350)*=-1.547, n.s. Further they did not and do not see a difference between Turkish and German males, *b*=-0.111, *SE*=0.320; ß=-.040, *t (350)*=-0.347, n.s.
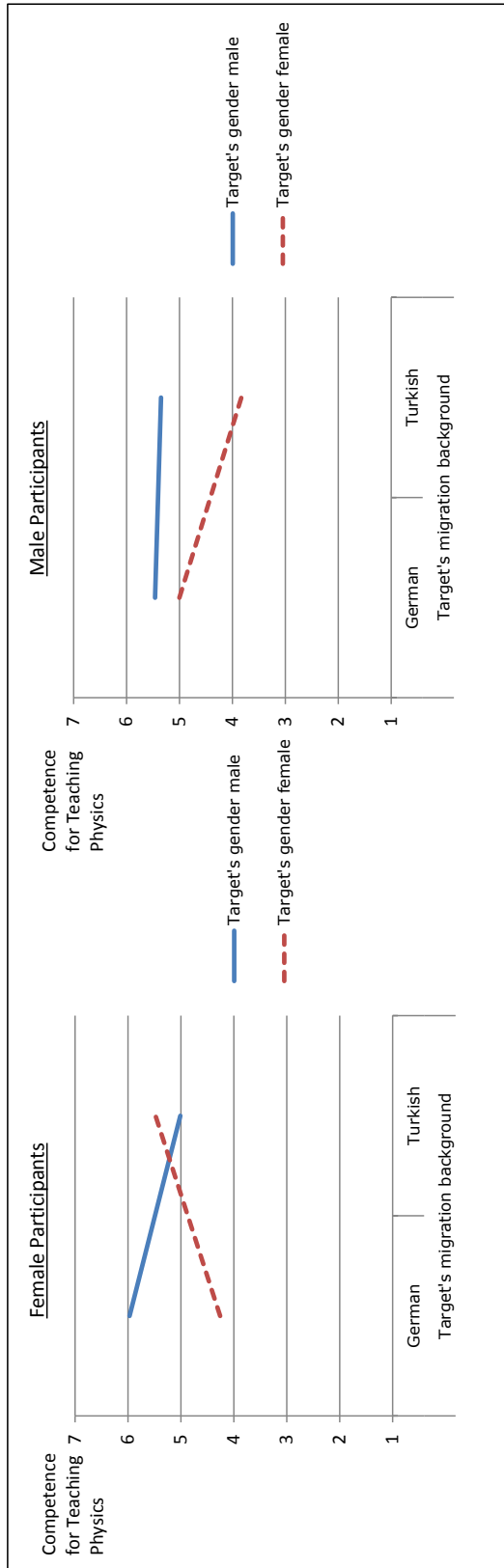
Figure 2. Perceived competence to teach physics plotted as a function of participant's gender (panels), target's gender, and target's migration background in Study 2

GENERAL DISCUSSION

The primary question that this research addressed was whether university students enrolled in teacher training, i.e., teachers-to-be, would perceive schoolteachers' competence to teach in the domain of physics – an area strongly associated with maleness and high difficulty – differently, as a function of the target being either German or from Turkish roots and of the target's gender. We also examined perceivers' gender as a potential moderator of these evaluations. In our first study, we used a sample of master's students currently studying at a German university to become teachers. We did not specify directional hypotheses as to how the two negative stereotypes we considered of relevance – the *female-incompetence stereotype* and the *Turkish-incompetence stereotype* – would play out with regard to the shape of statistical interactions. Results showed that (a) male participants ascribed the lowest competence in teaching physics to the "double out-group", Turkish female teachers, and (b) female participants ascribed the lowest competence in teaching physics to the "double in-group", German female teachers. In a second study, using a larger sample of university students enrolled in diverse subjects other than teacher training, we predicted and replicated these core findings as well as the overall pattern of the three-way interaction.

Interestingly, we found a main effect neither for the gender nor for the ethnic background of the target teacher. Rather, stereotypes played out only in interactive effects with the gender of the perceiver. Hence, while our findings hint at the existence of a female-incompetence and a Turkish-incompetence stereotype – as we will elaborate on in more detail below – they conflict with the view that these stereotypes are applied in a blatant and general manner. This can be explained by the fact that university students in general can be assumed to consider themselves to be non-prejudiced and to aspire not to apply the well-known negative stereotypes about women in physics and about immigrants' academic attainments. The complex interactive effects involving the gender of the perceiver show, however, that, nevertheless, our participants' perceptions of the target teachers were influenced by the female-incompetence and the Turkish-incompetence stereotypes.

Differences in Ascription of Competence depending on Perceiver's Gender and Possible Explanations

Our results further suggest that male and female students adhere to clearly distinguishable sub-stereotypes about male and female teachers with Turkish or German roots: women ascribed high competence to teach physics to German men as well as to Turkish women, but particularly low competence to German women; men ascribed lower competence to female teachers with an ostensibly Turkish background than to all other teacher groups.

Findings for our male research participants can be explained by a "double in-group bias". Our non-immigrant male research participants were members of the high-status group with respect to both their gender and their ethnic group. This can explain why a double jeopardy effect was observed when the target teacher was

female and seemingly had a Turkish migration background. As a result of being a member of two social groups to which negative competence-related stereotypes apply, they were ascribed lower competence in teaching physics by male perceivers than would have been predicted from the application of either of the two negative stereotypes (cf., Taylor et al., 2012).

More challenging is the interpretation of the interactive effect we found in both our studies for the female research participants. By ascribing more competence to teach physics to male than to female non-immigrant teachers, they endorsed the negative stereotype about women in physics with respect to their ethnic in-group. When judging teachers with Turkish roots, however, our female students attested higher competence in teaching physics to female than to male teachers.

Members of dominant social groups can maintain a positive social identity and positive self-esteem by engaging in in-group favoritism, as was obvious from our male, non-immigrant participants perceiving the competence of members of the "double out-group" – female Turkish teachers – as comparably low. This can, however, less likely be achieved by members of subordinate groups. Individuals from low-status groups have often been found personally to endorse the negative stereotypes about their group. In our study, female students adhered to the female-incompetence stereotype when ascribing higher competence to teach physics to German men than to members of their own in-group: German women.

Jost, Banaji and Nosek (2004) suggest that such phenomena of out-group favoritism stem from a general motive of justifying the existing social system and are, paradoxically, particularly likely to be observed among those who are most harmed by the status quo of intergroup relations. By evaluating members of the dominant group to which one does not belong more positively than one's in-group, low-status groups can rationalize and imbue the social system with legitimacy, and, via internalization of their own inferiority, reduce cognitive dissonance and thus experience their disadvantaged status as less negative. As applied to our studies, female research participants downgraded the physics-related competence of members of their in-group, thus justifying German women's low affinities towards and strong under-representation in the domain of physics (see also Bell & Burkley, 2014).

Interestingly, our women participants did not apply the female-incompetence stereotype when judging the physics-related competence of a female teacher with Turkish roots. This is possibly because female students in particular are aware of the fact that women in less affluent countries have stronger affinities with and are more advanced in the STEM field (cf., Charles & Bradley, 2009; Else-Quest et al., 2010), and therefore they do not downgrade females' competence to teach physics when the teachers apparently have a Turkish background. By exclusively ascribing lower competence in teaching physics to the in-group of non-immigrant women, female students could also reduce the threat associated with negative performance-related stereotypes about their own group.

As was shown by Dar-Nimrod and Heine (2006), the threat emanating from the negative stereotype about females in STEM can be eliminated when women are provided with an experiential, rather than a genetic, account of females' underachievement. By downgrading the physics-related competence of the in-group of German females, but not the competence of female teachers from Turkey, our female research participants can justify both (a) the status quo regarding the underachievement of their in-group and (b) their in-group's under-representation in the domain of physics, while implying that this gender difference is not innate but, rather, varies according to culture-specific socialization. Importantly, this pattern of findings was replicated in our second study in a sample of German students enrolled in various subjects outside teacher training. This suggests that these perceptual patterns are not specific to the group of potential future teacher colleagues but can be generalized to adult academics, i.e., among others, also to the parents of their potential future students.

Implications for how to Increase Young People's Attraction to STEM in the Future

We started out by asking whether negative stereotypes that German university students hold about teachers' competence to teach physics can contribute to an explanation of why so few students enrolled in teacher training specialize in the domain of physics. Over the course of the last few decades in Germany, again and again, public campaigns and educational endeavors have been launched, the goal of which was to strengthen girls' and women's participation and performance in the STEM field. While these efforts were aimed at changing the image of the STEM domain, to provide positive female role models, or to foster girls' competence in basic skills such as mathematics, the findings of our research suggest an additional perspective on how to tackle the issue. They suggest that, in contemporary Germany, females feel quite comfortable about girls' and women's strong under-representation in STEM and are ready to engage in out-group favoritism and in denigrating the competence of females. As a result, they may experience the status quo gender segregation as legitimate, natural, or even inevitable, thus reducing cognitive dissonance about their own group underachieving in STEM and leaving the field of the most prestigious careers and best-paid jobs to males (cf., Bell & Burkley, 2014; Jost et al., 2004).

The findings by Charles and Bradley (2009) point to the fact that politicians, educators, and scientists concerned with how to foster females' advancement in the STEM field must not believe that gender segregation will automatically decrease as countries advance economically and implement gender-egalitarian values. Hence we should not be under any illusion that in the future too Germany, not *despite* but *because* of its economic modernization, will see a shortage of young people, particularly women, wanting to advance into the STEM field. That is why, possibly, it may be of great value in the future to particularly address, encourage, and support girls and women from less-privileged personal backgrounds to get involved in STEM, given that stronger personal materialist pressures are supportive of norms to engage in a career with good prospects for employment and income, irrespective of its gender connotation (cf. Charles & Bradley, 2009).

In contemporary Germany, on average, Turkish families still have a significantly lower socio-economic status than families with no migration background (Baumert & Maaz, 2012). Hence, adolescent girls with Turkish roots may be particularly responsive to measures supportive of a career in STEM, as they should be especially interested in being trained for an occupation that does not only offer good economic prospects but is also associated with a high-competence stereotype that is incompatible with the negative competence-related prejudice that these young people are often exposed to. Clear messages addressed to immigrant girls about advancing into STEM may also help them overcome the threat associated with the stereotype we found in our male research participants who judged female teachers with a Turkish background. By addressing immigrant girls in particular, politicians and educators can convey a sense of belonging and of positive expectations about their competencies, thus preventing the negative effects of stereotypes from taking effect (cf., Steele, 1997).

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