



# The impact of students' gender-role orientation on competence development in mathematics and reading in secondary school<sup>☆</sup>



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## ABSTRACT

Gender differences in mathematical and reading competences have been widely reported for years. In an attempt to explain these differences, the effect of socialization outcomes (in this case, students' gender-role orientation) on gender-specific competence growth is explored. The study was conducted using data from the German National Educational Panel Study. The participants were 3374 students (48.5% female), whose reading and mathematical competences were assessed in grades five and seven. Students' gender-role orientations were assessed in grade six, as well as their interest in mathematics and German. The results confirmed expected gender differences in both domains in grades five and seven, with girls being better in reading and boys being better in mathematics. As an important point of this study, the results revealed that girls who endorsed an egalitarian orientation towards gender roles displayed higher competence development between grades five and seven in both domains than did girls who held a traditional gender-role orientation. Boys holding an egalitarian gender-role orientation displayed higher competence development than boys holding a traditional gender-role orientation in reading but not in mathematics. This text discusses the results and presents ideas for further research in the area of gender roles.

## 1. Introduction

Even though educational policies have an agenda of equal opportunities for everyone, a gap between boys and girls has been reported for years in competence levels in mathematics and – even more prevalently – in reading. These findings should raise the question of whether every student is supported in reaching their full potential. International large-scale assessments like PISA, TIMSS, and PIRLS have consistently shown gender differences in mathematics (e.g., Hammer et al., 2016; Mullis, Martin, Foy, & Hooper, 2016; OECD, 2016; Reiss, Sälzer, Schiepe-Tiska, Klieme, & Köller, 2016) as well as in reading (e.g., Mullis, Martin, Foy, & Drucker, 2012; OECD, 2016; Reiss et al., 2016; Weis et al., 2016). Although these gender differences are relatively small in their effect sizes (for a review see Else-Quest, Hyde, & Linn, 2010), they have been consistently found as early as at the beginning of school in various studies (e.g., Niklas & Schneider, 2012).

In addition to the extent of research showing gender differences in competences, there is an increasing number of research findings that explain the origins of these interindividual differences. Studies have focused on affective-motivational factors, such as domain-specific

anxiety (Hill et al., 2016; OECD, 2015), domain-specific interest as a part of intrinsic motivation (Schiefele & Csikszentmihalyi, 1995; Wigfield & Cambria, 2010), and domain-specific self-concept (Marsh, 1989; OECD, 2015; Stankov & Lee, 2014), as determinants of competences and factors in the formation of gender differences in competences. According to these studies, girls display greater anxiety (Bieg, Götz, Wolter, & Hall, 2015; Götz, Bieg, Lüdtke, Pekrun, & Hall, 2013), lower interest (Preckel, Götz, Pekrun, & Kleine, 2008), and lower self-concept in mathematics (Marsh & Yeung, 1998; Skaalvik & Skaalvik, 2004) than boys, whereas boys report lower intrinsic motivation and interest (Retelsdorf, Köller, & Möller, 2011; Stanat & Kunter, 2002; Wolter, Braun, & Hannover, 2015) as well as lower self-concept in reading and languages compared with girls (Marsh & Yeung, 1998; Skaalvik & Skaalvik, 2004).

The expectancy-value theory (e.g., Eccles & Wigfield, 2002) describes a theoretical model of the mechanisms at play in the development of interindividual differences in academic choices. The model reveals multifaceted determinants of gender-specific academic choices, which might later be transferred into gender-specific competences.

According to the expectancy-value theory (Wigfield & Eccles, 2002),

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in addition to previous performance, children's perceptions of gender roles play a critical role in the development of academic expectations and task values, which are assumed to be important determinants for motivation and achievement. Based on this theory, children's perceptions of gender roles are influenced by their socializers' beliefs and gender stereotypes. Children's perceptions, on the other hand, have an impact on their expectancies and task values, mediated by their interpretations of their experiences, achievement-related goals, and self-concepts. Eccles and colleagues (e.g., Eccles, Barber, Updegraff, & O'Brien, 1998; Frome & Eccles, 1998; Jacobs & Eccles, 1992) provided an array of research revealing the importance of socializers' and individuals' expectations and the value that is placed on the respective domain.

Against the background of research showing that competence domains are perceived as being gender stereotyped (e.g., Steffens & Jelenec, 2011), in this study, we presume that boys and girls expect different learning outcomes and place different values on domains if these domains are perceived as being associated with their own gender group. We argue that students who endorse traditional gender roles (cf., Athenstaedt, 2000) also incorporate gender stereotypes with respect to subject domains. Therefore, students with egalitarian gender-role orientations should be less influenced by the expected traditional gender roles and be more inclined to not only put effort into the stereotypical domain but also to engage in the domain that is not associated with their own gender group (Heyder & Kessels, 2013; Kessels, Heyder, Latsch, & Hannover, 2014). We thereby focus on the impact of students' egalitarian or traditional gender-role orientation on their mathematical and reading competence growth between grades five and seven.

### 1.1. The relationship of gender-role orientation and gender stereotypes

A person's gender-role orientation describes their beliefs about normative gendered behaviors (such as the division of labor) and rules of social interaction or gendered clothing (e.g., Athenstaedt, 2000; Athenstaedt & Alfermann, 2011; Eagly, Wood, & Diekmann, 2000). A person with a traditional gender-role orientation, for example, would endorse the idea that women should remain at home with the children or assume home-keeping and care-taking tasks, whereas men should be the "breadwinner" of the family. In contrast, an egalitarian-oriented person would endorse an equal task division as well as equal occupation opportunities for women and men and would also associate the same abilities with women and men.

A person's gender-role orientation depends on social factors, such as gender, age, and education (Athenstaedt, 2000). According to Athenstaedt (2000), on average, men display more traditional gender-role orientations than women. Furthermore, older people are more traditionally orientated towards gender roles than younger people, and people with a higher education as well as their children have a more egalitarian gender-role orientation than people with a relatively lower education.

Gender-role orientation also develops differently in boys and girls during adolescence. Galambos, Almeida, and Petersen (1990) found an increasing gender difference in the endorsement of gender-role attitudes during the sixth and eighth grade. Female students expressed increasingly egalitarian attitudes in higher grades, whereas male students, who already endorsed more traditional attitudes on average, further intensified their traditional attitudes over the years.

As much as gender-role orientations consist of men's and women's behaviors, there are also gender stereotypes regarding specific subject domains. According to Tobin and colleagues' gender self-socialization model (Tobin et al., 2010), gender stereotypes are defined as the association of certain attributes with the gender groups. Previous research suggests that boys and girls hold the explicit stereotypes that languages are a female domain and mathematics are a male domain (e.g., Cvencek, Meltzoff, & Greenwald, 2011; Steffens & Jelenec, 2011; Steffens, Jelenec, & Noack, 2010). Children as young as two and a half

years old identify specific behaviors and characteristics as being associated to women and men (for an overview, see Ruble, Martin, & Berenbaum, 2006), and by the end of elementary school, children apply the concept of gender stereotypes to more abstract constructs, such as academic domains (for a review see Signorella, Bigler, & Liben, 1993).

As a result of learning about gender stereotypes, children might incorporate stereotypical expectations into their self-concepts and adapt their academic engagement according to stereotypes. Despite previous findings on the effect of gender stereotypes on students' domain-specific self-concepts and competences (e.g., Schmader, Johns, & Barquissau, 2004; Steffens & Jelenec, 2011), research on the impact of students' gender-role orientation remains relatively scarce. Nonetheless, previous findings indicate that the relationship regarding the impact of gender-role orientation should be similar to that regarding gender stereotypes. In this study, we thereby aim to investigate the impact of students' gender-role orientation on their competence development in mathematics and reading.

### 1.2. The impact of gender-role orientation and gender stereotypes on domain-specific competences

Previous findings point to a relationship of gender stereotypes and gender-role orientation with competences in school contexts. Hadjar, Grünwald-Huber, Gysin, Lupatsch, and Braun (2012) showed that the traditional gender-role orientation in a group of eighth-grade students was related to lower school achievement in general (i.e., to grades) for boys and girls. Steffens and Jelenec (2011) revealed that girls had a lower self-concept and lower competences in mathematics when they also showed strong stereotypes with respect to mathematics being a male domain in implicit association tests. Boys, on the other hand, had higher mathematics self-concepts and competences when they also had higher mathematics-related stereotypes. However, the impact of implicit gender stereotypes was not found for languages domains (Steffens & Jelenec, 2011). Furthermore, Plante, La, de, Aronson, and Théorêt (2013) found that sixth- and eighth-grade students' endorsement of stereotypes in mathematics and reading predicted their grades in the corresponding domain. In line with the expectancy-value theory (Eccles & Wigfield, 2002), this relationship was mediated by their competence beliefs and task values. Beyond this finding, Schmader et al. (2004) showed through a questionnaire study that female undergraduate college students who believed that status differences between genders were legitimate also endorsed the stereotypical belief about women's lower mathematical abilities and had a lower self-perception of their own mathematical competence.

Hence, previous studies have revealed that a) gender stereotypes about mathematics and reading have an impact on school achievement and that b) gender stereotypes are related to traditional gender-role orientations. Nevertheless, elaborate research on the impact of students' gender-role orientations on their competence development in gender-typed domains is missing. As mentioned above, based on research on subject-related gender stereotypes (e.g., Cvencek et al., 2011; Steffens & Jelenec, 2011), we presume that students should benefit from an egalitarian gender-role orientation in their competence development (e.g., Hadjar et al., 2012), most notably in the subject domain that is not associated with their own gender group.

### 1.3. Hypotheses

**H1.** In line with findings of PISA, TIMSS, and PIRLS, there are gender differences in domain-specific competence. Boys outperform girls in mathematical competence, whereas girls perform better than boys in reading competence.

Against the background of previous research that has confirmed a relationship of gender stereotypes and gender-role orientations with academic competence, (H2a, H2b) students' gender-role orientation

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