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Pre-service elementary school teachers' expectations about student performance: How their beliefs are affected by their mathematics anxiety and student's gender

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HIGHLIGHTS

- Math anxiety can influence pre-service teachers' expectations about students.
- Pre-service teachers' expectations about math achievement are gender biased.
- Underachievement in math is extrapolated to general achievement only for girls.
- No interaction effects were found between math anxiety and math gender bias.
- Math anxiety may affects teachers' capacity to develop inclusive learning classrooms.

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ABSTRACT

We examine whether the expectations of pre-service elementary school teachers about students' achievement, and their beliefs regarding student need for academic support, are influenced by future teachers' mathematics anxiety or by student gender and socioeconomic status. We found that mathematics anxiety can negatively influence pre-service teachers' expectations about students, and that future mathematics teachers' expectations of mathematics achievement are lower for girls than for boys. These effects are independent, as we did not find significant interaction effects between pre-service teacher's mathematics anxiety and student gender. Our results also suggest that mathematics anxiety could affect the capacity of pre-service teachers to develop inclusive learning environments in their classrooms.

1. Introduction

Teacher expectations of student performance play a significant role in the interaction between teachers and students. It has long been established that teachers engage in different forms of classroom practices with students for whom they hold high or low academic expectations (Brophy & Good, 1970), such as praising high expectation students more often for their successes, criticizing low expectation students more often for their failures, waiting less time for low expectation students to answer questions, or interacting less frequently with low expectation students (Good, 1987). Children from a very young age can detect these differential treatments and infer their teachers' beliefs about them (Babad, 2009), a situation which in turn affects their own self-image and motivation (Kuklinski & Weinstein, 2001; Urhahne, 2015). A self-fulfilling prophecy or *Pygmalion* effect (Rosenthal & Jacobson, 1968) is said to take place when students internalize teacher beliefs and adjust their behavior to meet teacher expectations, leading high-expectation students to perform better and low-expectation

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students to perform worse. Such influence on educational achievement appears to be especially significant for students from culturally stigmatized groups. While two meta-analysis (Raudenbush, 1984; Rosenthal & Rubin, 1978) showed that the size of the average expectancy effect is rather small (binomial effect size of 0.1–0.2), Jussim, Eccles, and Madon (1996) found that self-fulfilling prophecy effects could be up to two and three-times larger in female students, low-income students and African-American students. The cumulative research on the effects of teacher expectations has lead contemporary scholars (Rubie-Davies, 2014; Teddlie & Reynolds, 2000; Weinstein, 2002) and education professionals (Lemov, 2010) to advocate high expectations as a key principle of effective teaching.

High teacher expectations, however, can only be achieved through a deeper understanding of the variables that influence them (Brault, Janosz, & Archambault, 2014). This line of inquiry has pointed to several student characteristics that can affect teacher expectations, such as student prior achievement (Dusek & Joseph, 1983; Jussim et al. 1996), socioeconomic status (Auwarter & Aruguete, 2008a; Rist, 2000; Speybroeck et al. 2012), ethnicity (Figlio, 2005; Strand, 2012; Tenenbaum & Ruck, 2007) and gender (Auwarter & Aruguete, 2008a; Hinnant, O'Brien, & Ghazarian, 2009). Surprisingly, there are fewer studies that relate teacher characteristics to teacher expectations. Some authors have theoretically argued that teachers with high self-efficacy could be more prone to set higher goals for their students, but empirical research has produced contradictory results (Archambault, Janosz, & Chouinard, 2012; Rubie-Davies, Flint, & McDonald, 2012). As Li (2014) notes, there is need for further research into the teacher personal traits that may influence their expectations of students. This study offers new insights into this matter by exploring the effect of mathematics anxiety in the development of teacher expectations. Mathematics anxiety is a construct that has received increased attention from teacher education research over the last decades. It is highly prevalent among students enrolled in teacher education programs – especially primary level ones (Hembree, 1990)– and it has been associated with lesser mathematical knowledge and low teaching self-efficacy (Bursal & Paznokas, 2006; Gresham, 2008; Swars, Daane, & Giesen, 2006). However, few studies have explored in depth how mathematics anxiety actually affects the skills and characteristics needed for effective teaching. For instance, we found no studies that evaluated how the mathematics anxiety level of a teacher may affect his or her capacity to make unbiased judgments about students, or how such anxiety relates to student characteristics such as gender that in turn influence teacher expectations.

This paper attempts to address this gap. To do so, we use an experimental setting with a Chilean sample of pre-service elementary school teachers in order to study how mathematics anxiety and gender stereotypes might influence how they envision learning results and need for specialized support in hypothetical students of theirs.

1.1. Teacher expectations: accuracy and bias

Ready and Wright (2011) offer a framework to operationalize and study the concepts of expectation accuracy and bias, distinguishing three possible scenarios. If teachers' perceptions of students' skills are consistent with objective assessments, they are accurate and unbiased; if teachers' perceptions differ from objective measures in a random manner, perceptions are inaccurate but unbiased; but if teachers' perceptions differ systematically from objective assessments based on students' characteristics, one might conclude that their perceptions are inaccurate and biased.

Educational psychologists have established that most of the time teachers' expectations are largely, but not completely accurate (Jussim & Harber, 2005). A first wave of research on this issue used a cross-study perspective to measure the accuracy of teachers' perceptions (Jussim et al. 1996). The authors considered the average correlation between teacher expectations and student achievement found in previous studies, and the average size of expectation effects found in experimental settings. By subtracting the average size of expectation effects from the correlation between teacher expectations and student achievement, the authors established indirectly that teachers' perception are about 75% accurate. A meta-analysis of 77 studies by Südkamp, Kaiser, and Möller (2012) looked at the median correlation between teacher expectations and student performance in standardized achievement tests, arriving at a similar result. They found that teachers' judgments were about 63% accurate. However, as Ferguson (2003) notes, one should focus on the inaccurate component of the predictions in a “glass half empty” fashion. For instance, if the remaining variance is systematically related to student characteristics, then some perception bias takes place.

Two of the most commonly studied sources of perception bias in teachers' expectations are student socio-economic status and student gender. The perception bias caused by socio-economic status shows a direct association largely consistent across studies: teachers tend to have higher expectations for students of high socio-economic status and lower expectations for students from disadvantaged backgrounds. This phenomenon has been observed at pre-school (Speybroeck et al. 2012), first and second grade (Rist, 2000) and secondary education (Gregory & Huang, 2013). Regarding student gender, the direction of the perception bias is more complex, as it seems to vary according to the domain assessed by teachers. Hinnant, O'Brien, and Ghazarian (2009) finds that teachers have higher expectations of reading ability for girls than boys, while other studies have suggested higher expectations for boys in the fields of mathematics (Spelke, 2005).

1.2. Mathematics anxiety as a source of expectancy bias

Mathematics anxiety is commonly defined as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations” (Richardson & Suinn, 1972). Two independently conducted meta-analysis demonstrated that mathematics anxiety has a significant negative correlation with mathematical performance and achievement, consistent across gender, grade levels and ethnic groups (Hembree, 1990; Ma, 1999). Some authors attribute the achievement gap to avoidance of mathematics and learning opportunities: highly mathematics anxious individuals take fewer mathematics elective courses than do low-anxiety individuals, both in high school and college (Hembree, 1990; Scarpello, 2005). In the context of cognitive research, mathematics anxiety has been associated with working memory deficits, independent of the individual's overall competence in mathematics (Ashcraft & Kirk, 2001, Ashcraft, & Moore, 2009; Ramirez, Gunderson, Levine, & Beilock, 2013).

An emerging trend in the literature has focused specifically on the presence of mathematics anxiety among future teachers. Studies conducted in college settings have consistently found that education majors show a higher prevalence of mathematics anxiety than those in any other fields (Baloglu & Kocak, 2006; Bessant, 1995; Hembree, 1990). More specifically, Hembree (1990) pointed out that university level students preparing as primary teachers presented the highest levels of mathematical anxiety among seven specialization areas included in the meta-analysis. Also mathematics anxiety in future primary teachers is strongly and negatively