Journal of Experimental Child Psychology 146 (2016) 50–65

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Here, but not there: Cross-national variability of gender effects in arithmetic

Chen Shen, Marina Vasilyeva *, Elida V. Laski

Boston College, Chestnut Hill, MA 02467, USA

ARTICLE INFO

Article history:
Received 7 October 2015
Revised 25 January 2016
Available online 22 February 2016

Keywords:
Arithmetic
Strategy
Cross-cultural differences
Gender differences
Problem-solving
Math

ABSTRACT

The current study examined gender differences in arithmetic performance among first graders from the United States, Russia, and Taiwan. Children ($N = 250$, $M_{age} = 7$ years 2 months) solved simple (single-digit) and complex (mixed- and double-digit) addition problems and explained their strategies. On simple problems, there were gender differences in strategies that varied across countries but no differences in accuracy. On complex problems, there were gender differences among American and Russian students in strategy use that mediated differences in accuracy. In contrast, among Taiwanese students, there were no gender differences in strategies or accuracy. The pattern of results suggests that educational context may play a role in gender differences in mathematics.

Introduction

Understanding the nature, and in particular the extent of malleability, of gender differences in mathematics has important implications for educational practice, and thus it is not surprising that this issue has attracted the attention of psychologists and educators for decades (e.g., Carr, Steiner, Kyser, & Biddlecomb, 2008; Else-Quest, Hyde, & Linn, 2010; Fennema, Carpenter, Jacobs, Franke, & Levi, 1998; Hyde, 2005). A promising approach for exploring the extent to which gender differences can be modified is offered by cross-national investigations that include students from different educational contexts. A consistent pattern of findings across countries with diverse educational environments would

* Corresponding author.
E-mail address: vasilyev@bc.edu (M. Vasilyeva).

http://dx.doi.org/10.1016/j.jecp.2016.01.016
0022-0965/

suggest that gender differences are stable and insulated from experience. Alternatively, differences in gender patterns across countries would suggest that gender differences are malleable and implicate structural characteristics of the educational system and/or specific pedagogical approaches as facilitating or impeding gender parity in math performance.

In the current study, we took a cross-national approach to explore gender differences among young elementary school students in three countries with distinct math curricula. We examined both the accuracy demonstrated by boys and girls on arithmetic problems and the strategies they used. Looking at the strategies provided a window into children's reasoning underlying differences in accuracy. Below we review literature on the two issues central to the current investigation: cross-national research about gender differences in math performance and research about gender differences in strategy use in solving arithmetic problems.

Cross-national variability in mathematics gender differences

The majority of studies that have compared the size of gender differences across countries examined high school and upper middle school students' performance on large-scale international assessments such as Trends of International Mathematical and Science Study (TIMSS) and Program for International Student Assessment (PISA) (e.g., Ayalon & Livneh, 2013; Bedard & Cho, 2010; Else-Quest et al., 2010; Penner, 2003). Many of these investigations reveal variability among countries in the size of gender differences in math achievement. When the data are averaged across countries, a small boys' advantage typically emerges. When the data are examined by country, however, some countries (e.g., Norway, Japan) show no significant gender difference and others (e.g., Iceland) demonstrate an advantage for girls over boys. Smaller scale studies that have compared boys' and girls' math performance have also demonstrated variability in gender patterns, with differences between boys and girls being greater in the United States than in Asian countries. Byrnes, Hong, and Xing (1997) examined American and Chinese high school students' performance on Scholastic Aptitude Test (SAT)-type items and found a gender difference favoring boys among American, but not Chinese, students. Cai (1995) examined the performance of sixth graders on a battery of math tests and found gender differences among American, but not Japanese, students. Overall, both large- and small-scale studies suggest that Asian students might not demonstrate the same extent of gender differences observed among their American peers.

This pattern of findings leads to a critical question: Why do gender differences seem to exist in some contexts but not in others? One possibility is cross-national differences in mathematics instruction. Because participants in the cross-national studies of gender differences to date have typically included middle and high school students with many years of educational experience, it is possible that the observed variability in the patterns of gender findings in part reflect cross-national differences in structural educational factors such as the presence or absence of tracking and class placement. Consistent with this explanation, Bedard and Cho (2010) demonstrated that countries that practice tracking in upper grades are more likely to reveal gender differences in high school math achievement. This trend may reflect differences in boys' and girls' educational experiences resulting from a higher proportion of boys placed in advanced classes.

It is not entirely clear from the available research whether cross-national variability in gender effects also exists among younger elementary school students who have not yet received differential instruction. There are very few cross-national studies that have examined gender effects in young students' math performance, and these have not reported gender differences within or across countries. For example, no differences were found among Chinese and Finnish 4- to 7-year-old children on several numeric tasks such as number naming and counting objects (Aunio et al., 2006). Similarly, Geary, Bow-Thomas, Liu, and Siegler (1996) tested children from kindergarten through third grade from China and the United States using simple arithmetic tasks (single-digit addition) and found no gender effects on accuracy of performance in either country.

It is possible, however, that this null effect is partly due to the kinds of problems children were asked to solve. Recent work on the interaction between task difficulty and gender (e.g., Gibbs, 2010; Penner, 2003) suggests that using simple tasks or even aggregating results from both challenging and simple tasks may mask differences between boys and girls. Consistent with this view, a recent