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Are Adolescents' Views of Mathematics Changing due to Enrollment in a Single-Sex Mathematics Classroom?

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At an early age, children demonstrate on both implicit and explicit measures the cultural stereotype that "math is for boys" (e.g., Cvencek, Meltzoff, & Greenwald, 2011). To illustrate, children and adolescents have been noted to describe mathematicians as white, middle-class males, who are perceived as being different from mathematics teachers (Moreau, Mendick, & Epstein, 2010; Picker & Berry, 2000), and as individuals who are able to solve problems that others cannot solve (Rock & Shaw, 2000). This stereotype potentially exacerbates as children age (e.g., Banjong, 2014) affecting such factors as their academic self-concept, achievement, and course preferences (e.g., Steffens, Jelenec, & Noack, 2010).

This exploratory study will add to this literature base by considering how adolescents' enrolled in single-sex mathematics classrooms in the United States, as opposed to coeducational mathematics classrooms in the same middle school, narrate mathematics as a gendered domain, as the arguments for and against single-sex classrooms as an educational option in the United States continue to be debated (Bigler, Hayes, & Liben, 2014; Liben, 2015). Relevant to this study are the three following rationales for single-sex educational environments: (1) cater to known differences between female and male students such as ability, interests and preferred style of learning (e.g., Chadwell, 2010; Sax, 2005); (2) diminish peer gender stereotyping such as the arts being more suitable for girls (e.g., Salomone, 2006); and (3) removes one's gender as a salient marker (e.g., Kessels & Hannover, 2008; Salomone, 2006), including differential treatment by teachers (e.g., Glaser, 2011). As expected, there are counter-arguments to each of these rationales (see Bigler et al., 2014). Through my scholarly work, my perspective towards single-

sex education is open as I advocate neither for the widespread implementation of single-sex education nor for its uniform discontinuance.

Literature Review

To situate this study, literature regarding gendered stereotypes in behaviors and teacher-student interactions, as well as studies regarding stereotypes specific to mathematics as a gendered domain are discussed, mostly within a coeducational setting, as similar research studies within single-sex settings are less prevalent. In general, there seems to be a societal belief that boys and girls are different in mathematics (Forgasz, Leder, & Tan, 2014), as well in other aspects such as behavior, ways of talking to others, and areas of play (Martin & Ruble, 2004; Sax, 2005). As such, teachers and students seem to adapt similar, yet erroneous beliefs in societal gender differences (Eliot, 2011; Morris, 2012); therefore, placing boys and girls on opposite poles of a binary continuum, which may deflect from considering how we may be more similar than different (Eliot, 2011). Some teachers may view girls as more mature, more organized (Morris, 2012; Warrington & Younger, 2000), possess better social skills (BenTsvi-Mayer et al., 1989), not as competitive or logical (Fennema, Peterson, Carpenter, & Lubinski, 1990) and less competent in mathematics (Riegle-Crumb & Humphries, 2012; Tiedemann, 2000, 2002) than boys. While boys on the other hand, may be viewed by teachers as more active classroom participants, more independent, and more adventurous (Fennema et al., 1990; Warrington & Younger, 2000); yet more disorderly and unmotivated (Morris, 2009) than girls. Similar studies suggests that within the classroom, teachers' interactions with students tend to favor male students more often than female students (Einarsson & Granström, 2002). Research has shown that some teacher's interrupt boys less often (Lindroos, 1995), receive more interaction exchanges, both positive and negative (Clark, Lee, Goodman, & Yacco, 2008; Duffy, Warren, &

Walsh, 2001; Jones & Dindia, 2004), and asked more questions (Altermatt, Jovanovic, & Perry, 1998; Barba & Cardinale, 1991; Younger et al., 1999). Such differences in treatment are not unnoticed by students themselves (Zittleman, 2007)

As noted in the introduction, there is a tendency for girls and boys at an early age to associate mathematics as more suitable for males than for females. Consider the following statement from a female student describing her image of a mathematician, "I always perceive like men mathematicians with really long beards and sideburns and messy hair" (Epstein, Mendick, & Moreau, 2010, p. 53). It is not unwarranted to consider how interactions with one's peers, parents, teachers, and so forth influence one's gendered beliefs of mathematics (Eccles, Jacobs, & Harold, 1990; Gunderson, Ramirez, Levine, & Beilock, 2012; Ryan & Patrick, 2001). Recently there has been two instruments developed to examine children and adult's views of mathematics as a gendered domain, *Mathematics as a Gendered Domain* and *Who and Mathematics* (Barkatsas, Forgasz, & Leder, 2001; Forgasz, Leder, & Kloosterman, 2004). Utilizing the *Who and Mathematics* instrument, Forgasz and colleagues (2004) concluded that male students perceived mathematics as a male domain, while female students perceived mathematics as a neutral domain. These findings are dissimilar to the conclusions of Author (2014), which found female students more frequently considered mathematics as a female domain and male students more frequently perceived mathematics as a neutral domain. However, these differences may be explained by age of the students (Brandell & Staberg, 2008) or one's culture (Barkatsas et al., 2002; Forgasz et al., 2004).

In considering the three rationales for single-sex education, the scholarly work of researchers in other subject areas (e.g., science) and within different contexts (e.g., summer camps) will be drawn upon. Lee, Marks, and Byrd (1994) investigated how socialization to

gender operated similarly and/or differently in independent single-sex and coeducational schools. The researchers concluded that the dominant form of sexism in single-sex schools was gender reinforcement, which was defined as the perception of the typical female and male behaviors or styles held by society. The researchers determined the dominant form of sexism in coeducational schools was gender dominance or the stance that males are superior to females. Other studies (Fabes, Pahlke, Martin, & Hanish, 2013; Glasser, 2012; Goodkind, Schelbe, Joseph, Beers, & Pinsky, 2013) have concluded that a middle school single-sex setting may reinforce and reify gender differences, the notion that boys and girls are on opposite ends of the gender dichotomy. For example, Glasser (2012) inferred from his study that the girls in a public middle school single-sex science setting was positioned hierarchically above the males, which were viewed as lagging behind the girls, not hearing as well as the girls, more obnoxious than the girls, and as more of a distraction than the girls. Additionally, results from Fabes et al. (2013) suggest that being enrolled in gender-segregated classes increased the likelihood that participants would respond that boys are better at math and girls are better in language arts, and such gendered responses would increase by 14% with each additional gender-segregated class. This exploratory study will add to this body of literature in considering gendered views of adolescents in a public middle school single-sex mathematics setting and will be useful to the current debate regarding single-sex education, as well as theoretical generalizations regarding gendered stereotypes (Eisenhart, 2009).

Theoretical Grounding

Currently, there are three perspectives in regards to single-sex education: gender essentialism, gender environmentalism, and gender constructivism (Liben, 2015). However, this study is based on the notion that boys and girls are more similar than they are different (Eliot,

2011), which is in opposition of the views of gender essentialists (e.g., Sax, 2005), who believe that girls and boys are inherently different from hormonal processes to predispositions to observable behaviors. Rather this study is based on the ideas of gender environmentalists and gender constructivists in that external social factors such as peers, teachers, and parents (i.e., gender environmentalists), as well as individually perceived cognitive qualities and affective factors mediated and shaped by one's environment (i.e., gender constructivists), influence adolescents' views of mathematics as more associated with one gender more than another, if it all. For example, research suggests that when teachers use gender-specific language such as "How are we doing this morning boys and girls," (as opposed to "How are we doing this morning children."), children showed an increase in gender stereotypes and in-group bias (Bigler, 1995; Hilliard & Liben, 2010). This illustrates the impact of external factors on children's gendered views.

Methods

This study was investigated as part of a larger study utilizing narrative inquiry (Clandinin & Connelly, 2000) as a means to understand the experiences, perceptions, and narrated mathematics identities of adolescents' enrolled in single-sex and coeducational classrooms in a public coeducational middle school (6th-8th grades) located in a southeastern region of the United States (Author, Under Review). This paper was driven by the following research question:

- To what extent might adolescents' enrolled in single-sex and coeducational mathematics classes view mathematics as a gendered domain similarly and/or differently?

Subsequently, this led to an additional question of interest.

- How might their views of mathematics as a gendered domain influence their preference for a single-sex or coeducational mathematics class?

Context

At the time of this study, 2014-2015 school year, Lindell Middle School had implemented single-gender classes for seven years in various courses and in varying grades as a means to combat stagnant scores on standardized tests and to create enthusiasm among the teaching staff (personal communication with principal, January 11, 2013). At the time of this study, the new principal maintained implementation of single-gender classes to help boys overcome their deficits in reading and writing skills, which will inherently lead to greater scores on standardized tests; and two, to combat boys' dominance in certain subject areas such as mathematics and science (personal communication with principal, September 23, 2014). At a broader scale, the state had implemented more single-gender education options than any other state in the United States ("Single-sex education spreads", 2008).

Teachers. This study was conducted in the classroom of two seventh grade teachers. Ms. Mole taught a coeducational class and the all-girls class, and was a proponent of single-sex education. Ms. Mole has taught for 24 years, 11 of these years at Lindell Middle School. This was Ms. Mole's fifth year teaching single-sex mathematics classes. She has a Bachelor's in Science degree in Elementary Education, a Master's of Education degree in Instructional Technology, and is currently pursuing her Doctor of Education degree in Educational Leadership.

Mrs. Ely taught a coeducational class and the all-boys class. She too was a proponent of single-sex education. Mrs. Ely has taught for 18 years, nine of these years at Lindell Middle School, and five of these years teaching single-sex mathematics classes. She has a Bachelor's in Science degree in Elementary Education and a Master's of Education Degree in Teaching and Learning, more specifically in technology and online instruction.

Participants. Participants were 28 seventh grade students – 4 boys and 7 girls enrolled in a coeducational class and 12 boys and 5 girls enrolled in a single-sex class; thus, 57% of the participants were boys and 43% girls. These participants included every individual which submitted a parental and student consent form. Twenty-three or approximately 82% of the participants self-identified as White, four or about 14% as two or more races, and one self-identified as Asian. Additionally, when asked about how good they were in math, five participants (18%) perceived themselves to be average, eight participants (29%) as good, and 15 participants (53%) as excellent.

Data Source

The data sources for this study included a survey, *Mathematics as a Gendered Domain,* (Forgasz et al., 2004), and a semi-structured interview, which was the primary data source. The *Mathematics as a Gendered Domain* instrument (Forgasz et al., 2004) measures the extent to which individuals believe that mathematics is a female- (FD), male- (MD), or gendered neutral domain (ND). This instrument was selected because it brings gender, or sex, to the forefront of one's beliefs about mathematics; therefore, highlighting the salient and visible factor of single-sex environments. The instrument is composed of 48 statement, 16 statements each subscale (i.e., FD, MD, and ND). An example of a statement from the FD scale is "Girls have more natural mathematical ability than do boys." A statement from the MD scale is "Boys are just as likely as girls to enjoy mathematics." And an example statement from the ND scale is "Boys and girls are equally good at using calculators in mathematics." Participants responded to each statement based on a 5-item Likert-scale ranging from strongly agree (SA) to strongly disagree (SD). The researcher administered the instrument at the beginning of one class period and took no longer

than 15 minutes to complete. Permission to use this instrument was granted by the developer (H. Forgasz, personal communication, July 16, 2014).

Semi-structured interviews were employed to gain adolescent students' perspective and beliefs of mathematics as a gendered domain as this phenomenon cannot be explored through observation (Polkinghorne, 1988). It is their "truth" as opposed to my observations of what is true (Clandinin & Connelly, 2000; Polkinghorne, 1988). The data informing this study was collected from the following four interview questions:

1. How would you describe a mathematician? What might they look like? What might they be doing?
2. Do you think that girls are good at math? Why or why not? (Probe: Give me an example or tell me a story.) Do you think that boys are good at math? Why or why not? (Probe: Give me an example or tell me a story.)
3. Do you think that your experience with math would be different if you were a boy/girl (opposite sex)? Explain why or why not? (Probe: Give me an example or tell me a story.)
4. What do you think it would be like this year to be in a math class with both boys and girls/only boys/only girls? [dependent on participant] (Probe: Give me an example or tell me a story.) Which would you prefer? Why?

The interviews were conducted in a teacher workroom during participants' enrichment period (11:00-11:54) and lasted an average of 22 minutes. The researcher transcribed the interviews verbatim.

Data Analysis

The survey data was analyzed by first converting the Likert Scale into numerals: 1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree, and 5 = strongly agree. Mean scores per participant were calculated for each subscale with the highest mean score being an indication of participants' current gendered perception of mathematics. For instance, suppose a participant scored a mean score of 3.34 on the FD scale, 2.89 on the MD scale, and 4.67 on the ND scale. This implies that the participant believes more strongly that mathematics is a gender-neutral domain.

The interview data was analyzed structurally as the coding was already "chunked" into two general themes, beliefs of mathematics as a gendered domain and "appropriate" behaviors and actions based on one's sex, due to the nature of the four interview questions (Saldaña, 2013). Essentially, these were self-standing units of data (Saldaña, 2013). Each participants' responses were read and reread to gain a bigger picture that was then captured in a brief participant summary. Within the holistic analysis, participants' use of pronouns were considered (e.g., he, she, or they; Biber, Conrad, & Reppen, 1998) as one indication of equating mathematicians and mathematics as more suitable for females, males, or neither females or males. This coding scheme also lends itself to a frequency count by type of class, which aids in answering the two research questions of this study (Saldaña, 2013), as a way to look for similarities and differences.

Results

In this section, key learnings from the data analysis are discussed in regards to the research questions of this study.

Research Question 1

The first question guiding this study was how adolescents' views of mathematics as a gendered domain may be similar and/or different based on enrollment in a single-sex or

coeducational mathematics classroom. Results from the survey suggests that regardless of type of class, the participants in this study more often perceived mathematics to be a gendered neutral domain as opposed to a female or male domain (see Table 1).

Table 1. Survey results by type of class

	Female Domain	Male Domain	Neutral Domain
Coeducation	1 (9%)	1 (9%)	9 (82%)
Single-sex	1 (6%)	1 (6%)	15 (88%)

Note. Percentages are not based on total sample size, but the number of participants by type of class.

Yet results from the interview data suggests a different view of participants' perceptions of mathematics as a gendered domain (see Table 2) both in regards to one's mathematical ability and in the manner in which boys and girls behave in a mathematics classroom.

Table 2. Narrative results by type of class

	Female Domain	Male Domain	Neutral Domain
Coeducation	8 (73%)	1 (9%)	2 (18%)
Single-sex	7 (41%)	3 (18%)	7 (41%)

Note. Percentages are not based on total sample size, but the number of participants by type of class.

As shown in Table 2, participants' narrated views of mathematics as a gendered domain differ some from the survey (see Table 1). In the coeducational class, differences in perceptions were from mathematics as a gender neutral domain to a female domain. Similarly, in the single-sex class setting, differences in perception were typically of mathematics as a gender neutral domain to a female domain (n = 6) or a male domain (n = 3). When participants spoke of this perception in regards to one's ability, girls were typically viewed as earning higher grades, having a conceptual understanding, and retaining information more often than boys. Using a logical argument, a coeducational female participant stated,

> I think it was one of the teachers last year. But she said that it's been proven that more girls go to college than boys. So I figured well you have through math class to go to college. So I figured you know more girls would be better at math than boys.

One male enrolled in a single-sex class even stated that girls are pushed by adults to do better in mathematics than boys; even though he could not articulate or support this claim. On the other hand, boys were typically viewed as making lower grades and asking the teacher for help. For the four participants who perceived mathematics as a male domain, reasons were that "boys' minds are more geared to math" (Single-sex, Male) and/or they care about mathematics more than the girls.

For the most part, participants' perception of whether girls or boys are more suitable for mathematics were based on dichotomous behaviors and actions, placing girls and boys on opposite ends of the spectrum. Girls were more likely to be viewed as "playing school" or taking on the role of "good student," behaving and acting within the institutional norms and expectations of school and adults (Morris, 2012). The dichotomous behavior and actions are as follows and in no particular order:

Quiet↔Loud

Active ↔ Passive

Mature ↔ Immature

Patience ↔ Impatience

Like Math ↔ Hate Mate

Independent ↔ Dependent

Persistent ↔ Not persistent

Pay attention/Listen ↔ Play/Goof off

Complete homework ↔ Go outside and play

These statements and relationships were common regardless of whether participants were enrolled in a coeducational or single-sex mathematics class. By way of an example, boys were stated as “not really learning and just slacking off. Not really caring about their work. Not really listening. Not really focus. Too worried about thinking about girls and all that” (Coeducation, Female).

Those who viewed mathematics as gender neutral domain claimed that anyone can be good at mathematics as long as they put forth effort and pay attention in class. For example, “Anybody could be good at math. It’s their effort put forth in learning” (Coeducation, Female). Or as stated by a male enrolled in a single-sex setting, “Every person can be good. Same with like if a boy can do football, a girl can do football and still be as good as a boy,” which as stated here seems to position boys as superior to girls, at least in football. Moreover, findings from the interview question regarding participants’ view of a mathematician were generally neutral in that participants used the pronoun “they” more often than she/her or him/his, and did not note physical characteristics typical of one gender or another. For example, as stated by a coeducational female, “If you were in a crowd of people, you can’t be like oh my gosh that person is wearing a pink shirt, they’re a mathematician. They pretty much look like normal people...” Yet, this notion of being normal seems to suggest that mathematicians are not typically perceived as such (Moreau, Mendick, & Epstein, 2010) On the other hand, many of the participants described mathematicians as smart(er) individuals, wearing a lab coat and glasses, and being absorbed in solving mathematical problems; which are common stereotypical views of mathematicians (Picker & Berry, 2000).

Research Question 2

The second research question was to gain an understanding of how adolescents' views of mathematics as a gendered domain might influence their preference to be enrolled in a single-sex or coeducational mathematics class, if at all. For four of the participants, specifically four boys enrolled in a single-sex class, their views of mathematics being more suitable for females seemed to impact their preference for two different reasons. One, two boys preferred to be in a class with girls and boys because "there's even smarter people there to compete with." Two, two boys preferred to be in a class with only boys because it would even the academic "playing field" (Single-sex, Male). Beyond which gender is more suitable for mathematics, this notion that boys and girls behave differently in a mathematics class was a prevalent reason, typically girls are quiet and boys are loud, which is a distraction and makes it difficult to concentrate (n = 11, 39%). For a few of these participants, girls seemed to possess some super power in that they have the ability or the presence to quiet the room. Additionally, girls were viewed as causing "drama," as girls are more likely to be worried about "who is dating who" (Single-sex, Male), spreading rumors, and/or focused on "their hair or their makeup" (Coeducation, Female).

The most common influence for preferring a single-sex or coeducational mathematics class was the environment (n = 12; 43%). Nine participants felt more comfortable in a single-sex environment and four in a coeducational environment. Generally speaking, participants stated that their preferred class was freeing in that they were less embarrassed to be active members of the classroom – volunteering answers, completing problems on the whiteboard, and/or speaking more openly and sharing ideas to their peers. For instance, "You know everyone in the class, which makes it fun. And nobody's mean when you get the answer wrong. In a room with boys and girls, sometimes they can be a little judgey" (Single-sex, Male). For a few of the female participants who expressed this reason, there seemed to be a "girls-only club," in that girls

seemed to have an understanding amongst one other that excludes boys. “I think because the girls they understand, like they know what math, they understand the math that I'm doing. . . . I know that all the other girls in my class, they basically go through what I go through in life” (Coeducation, Female).

Discussion

The insights gleaned from the results contrast that of previous research, which have found that children and adolescents associate mathematics with males more often than females (e.g., Barkatsas et al., 2001; Cvencek et al., 2011). Participants in this study typically associated mathematics with neither gender or with females. Future research could shed light on why this historical societal stereotype may be changing or to consider if the view of mathematics are based on false premises such as grades and culturally “appropriate” masculine and feminine traits (e.g., Orr, 2011), as the perceptions of participants in this study were based on current experiences. Classroom observations over a substantial period of time may reveal subtle gendered stereotypes in mathematics. Furthermore, it is inconclusive as to whether being in the presence of one’s same sex peers accounts for the participants’ perceptions of mathematics as a gendered domain are due to one’s class type. There are other factors within and outside the classroom setting that potentially influence this stereotype such as previous achievement, motivation, parents, and teacher interactions. Therefore, an additional study including the interplay of such factors is warranted to understand the potential for a connection between class type and gendered stereotypes in mathematics. On the other hand, findings from this study seem to support the research conducted by Lee and colleagues (1994) and Fabes and colleagues (2013) that concluded that single-sex environments had a tendency to perpetuate, or at least not diminish, differences in gender roles in the mathematics classroom such as girls are quiet and

boys are loud. Clear dichotomous gendered actions were articulated and aligned with characteristics “typical” of each gender as a homogeneous group. This suggests that simply removing the salience of gender from the classroom is not enough to diminish taken-for-granted assumptions (Fennema et al., 1990).

These dichotomous behaviors and actions based on one’s sex was also one reason that participants considered in claiming their class type preference, coeducational or single-sex mathematics classroom. Further, drama and distractions as other reasons stated by participants, supports one of the arguments for single-sex education in the United States. A notion that adolescents create a culture focused on how they look and not on academic attainment, which distracts students from focusing on learning. Mael (1998) refers to this as “the rating and dating” culture. In his study of adolescent society in ten high schools in the United States, Coleman too asserted, “Boys and girls together distract each other. Whether this distraction takes the form of dressing to impress the other gender, competition for teacher time and attention, or sexual harassment, there is no question that distractions exist” (as cited in Streitmatter, 1999, p. 36). However, if one’s preference is based on being comfortable in their classroom environment and their willing to be an active member of the classroom community, maybe students should have more of a voice in their education as opposed to being dictated by policy (Cook-Sather, 2002).

References

Altermatt, E. R., Jovanovic, J., & Perry, M. (1998). Bias or responsivity? Sex and achievement-level effects on teachers' classroom questioning practices. *Journal of Educational Psychology, 90*(3), 516-527.

Author. (2014)

Author. (Under Review).

Banjong, D. N. (2014). Same performance but different perception: Female stereotypes in mathematics emerge in fifth grade. *International Online Journal of Educational Sciences, 6*(2), 258-268. doi: 10.15345/iojes.2014.02.001

Barba, R., & Cardinale, L. (1991). Are females invisible students? An investigation of teacher-student questioning interactions. *School Science and Mathematics, 91*(7), 306-310.

Barkatsas, A. N., Forgasz, H., & Leder, G. (2001). *The gender stereotyping of mathematics: Cultural dimensions*. Presented at the 24th Annual Mathematics Education Research Group of Australasia Conference. Sydney, Australia.

Biber, D., Conrad, S., & Reppen, R. (1998). *Corpus linguistics: Investigating language structure and use*. Cambridge: Cambridge University Press.

Bigler, R. S. (1995). The role of classification skill in moderating environmental influences on children’s gender stereotyping: A study of the functional use of gender in the classroom. *Child Development, 66*, 1072–1087. doi:10.1111/j.1467-8624.1995.tb00923.x.

Bigler, R. S., Hayes, A. R., & Liben, L. S. (2014). Analysis and evaluation of the rationales for single-sex schooling. *Advances in Child Development and Behavior, 47*, 225-260. doi: 10.1016/bs.acdb.2014.05.002

Brandell, G., & Staberg, E. M. (2008). Mathematics: a female, male or gender-neutral domain? A study of attitudes among students at secondary level. *Gender and Education, 20*(5), 495-509. doi: 10.1080/09540250701805771

Chadwell, D. (2010). *A gendered choice: Designing and implementing single-sex programs and schools.* Thousand Oaks, CA: Corwin.

Clandinin, D. J., & Connelly, F. M. (2000). *Narrative inquiry: Experience and story in qualitative research.* San Francisco, CA: Jossey-Bass.

Clark, M. A., Lee, S. M., Goodman, W., & Yacco, S. (2008). Examining male underachievement in public education: Action research at a district level. *NASSP Bulletin, 92*(2), 111-132. doi: 10.1177/0192636508321155

Cvencek, D., Meltzoff, A. N., & Greenwald, A. G. (2011). Math-gender stereotypes in elementary school children. *Child Development, 82*(3), 1-14. doi: 10.1111/j.1467-8624.2010.01529.x

Cook-Sather, A. (2002). Authorizing students' perspectives: Towards trust, dialogue, and change in education. *Educational Researcher, 31*(4), 3-14.

Duffy, J., Warren, K., & Walsh, M. (2001). Classroom interactions: Gender of teacher, gender of student, and classroom subject. *Sex Roles, 45*, 579-593.

Eccles, J. S., Jacobs, J. E., & Harold, R. D. (1990). Gender role, expectancy effects, and parents socialization of gender differences. *Journal of Social Issues, 46*, 183-201. doi: 10.1111/j.1540-4560.1990.tb01929.x

Einarsson, C., & Granström, K. (2002). Gender-biased interaction in the classroom: the influence of gender and age in the relationship between teacher and pupil. *Scandinavian Journal of Educational Research*, 46(2), 117-127. doi: 10.1080/00313830220142155

Eisenhart, M. (2009). Generalization from qualitative inquiry. In K. Ercikan & W. M. Roth (Eds.), *Generalizing from educational research: Beyond quantitative and qualitative polarization* (pp. 51-66). New York, NY: Routledge.

Eliot, L. (2011). Single-sex education and the brain. *Sex Roles, 69*, 363-381. doi: 10.1007/s11199-011-0037-y

Epstein, D., Mendick, H., & Moreau, M. P. (2010). Imagining the mathematician: young people talking about popular representations of maths. *Discourse: Studies in the Cultural Politics of Education, 31*(1), 45-60. doi: 10.1080/01.596300903465419

Fabes, R. A., Pahlke, E., Martin, C. L., & Hanish, L. D. (2013). Gender-segregated schooling and gender stereotyping. *Educational Studies, 39*(3), 315-319. doi: 10.1080/03055698.2012.760442

Fennema, E., Peterson, P. L., Carpenter, T. P., & Lubinski, C. A. (1990). Teachers' attributions and beliefs about girls, boys, and mathematics. *Educational Studies in Mathematics, 21*(1), 55-69.

Forgasz, H. J., Leder, G. C., & Kloosterman, P. (2004). New perspectives on the gender stereotyping of mathematics. *Mathematical Thinking and Learning, 6*(4), 389-420. doi: 10.1207/s15327833mtl0604_2

Forgasz, H., Leder, G., & Tan, H. (2014). Public views on the gendering of mathematics and related careers: international comparisons. *Educational Studies in Mathematics, 87*, 369-388. doi: 10.1007/s10649-014-9550-6

Glaser, H. M. (2011). Arguing separate but equal: A study of argumentation in public single sex science classes in the United States. *International Journal of Gender, Science, and Technology, 3*, 71–92.

Glasser, H. M. (2012). Hierarchical deficiencies: Constructed difference between adolescent boys and girls in a public school single-sex program in the United States. *Journal of Adolescent Research, 27*(3), 377-400. doi: 10.1177/0743558411409933

Goodkind, S., Schelbe, L., Joseph, A. A., Beers, D. E., & Pinsky, S. L. (2013). Providing new opportunities or reinforcing old stereotypes? Perceptions and experiences of single-sex public education. *Children and Youth Services Review, 35,* 1174-1181. doi: 10.1016/j.childyouth.2013.04.004

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles, 66*, 153-166. doi: 10.1007/s11199-011-9996-2

Hilliard, L. J., & Liben, L. S. (2010). Differing levels of gender salience in preschool classrooms: Effects on children's gender attitudes and intergroup bias. *Child Development, 81*, 1787–1798. doi:10.1111/j.1467–8624.2010.01510.x.

Jones, S. M., & Dindia, K. (2004). A meta-analytic perspective on sex equity in the classroom. *Review of Educational Research, 74*(4), 443-471.

Kessels, U., & Hannover, B. (2008). When being a girl matters less: Accessibility of gender-related self-knowledge in single-sex and co-educational classes and its impact on students' physics-related self-concept of ability. *British Journal of Educational Psychology, 78*, 273–289.

Lee, V. E., Marks, H. M., & Byrd, T. (1994). Sexism in single-sex and coeducational independent secondary school classrooms. *Sociology of Education, 67*(2), 92-120.

Leman, P. J., & Tenenbaum, H. R. (2011). Practising gender: Children's relationships and the development of gendered behaviour and beliefs. *British Journal of Developmental Psychology, 29,* 153-157. doi: 10.1111/j.2044-835X.2011.02032.x

Liben, L. S. (2015). Probability values and human values in evaluating single-sex education. *Sex Roles, 72,* 401-426. doi: 10.1007/s11199-014-0438-9

Lindroos, M. (1995). The production of 'girl' in an educational setting. *Gender and Education, 7*(2), 143-156. doi: 10.1080/09540259550039077

Mael, F. (1998). Single-sex and coeducational schooling: Relationships to socioemotional and academic development. *Review of Educational Research, 68*(2), 101-129.

Martin, C. L., & Ruble, D. (2004). Children's search for gender cues: Cognitive perspectives on gender development. *Current Directions in Psychological Science, 13*(2), 67-70.

Moreau, M. P., Mendick, H., & Epstein, D. (2010). Constructions of mathematicians in popular culture and learners' narratives: a study of mathematical and non-mathematical subjectivities. *Cambridge Journal of Education, 40*(1), 25-38. doi: 10.1080/03057640903567013

Morris, E. W. (2012). *Learning the hard way: Masculinity, place, and the gender gap in education.* New Brunswick, NJ: Rutgers University Press.

Orr, A. J. (2011). Gendered capital: Childhood socialization and the "boy crisis" in education. *Sex Roles, 65,* 271-284. doi: 10.1007/s11199-011-0016-3

Picker, S. H., & Berry, J. S. (2000). Investigating pupils' images of mathematicians. *Educational Studies in Mathematics, 43*(1), 65-94.

Rock, D., & Shaw, J. M. (2000). Exploring children's thinking about mathematicians and their work. *Teaching Children Mathematics, 6*(9), 550-555.

Ryan, A. M., & Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *American Educational Research Journal, 38,* 437-460. doi: 10.3102/00028312038002437

Saldaña, J. (2013). *The coding manual for qualitative researchers* (2nd ed.). Los Angeles, CA: Sage.

Salomone, R. C. (2006). Single-sex programs: Resolving the research conundrum. *Teachers College Record, 4,* 778–802.

Sax, L. (2005). *Why gender matters*. New York, NY: Doubleday.

Steffens, M. C., Jelenec, P., & Noack, P. (2010). On the leaky math pipeline: Comparing implicit math-gender stereotypes and math withdrawal in female and male children and adolescents. *Journal of Educational Psychology, 102*(4), 947-963.

Streitmatter, J. L. (1999). *For girls only: Making a case for single-sex schooling.* Albany, NY: SUNY Press.

Tashakkori, A. & Tedlie, C. (1998). Mixed methodology: Combining qualitative and quantitative approaches. *Applied Social Research Methods, No. 46*. Thousand Oaks, CA: Sage.

Younger, M., Warrington, M., & Williams, J. (1999). The gender gap and classroom interactions: Reality and rhetoric? *British Journal of Sociology of Education, 20*(3), 325-341. doi: 10.1080/01425699995290

Zittleman, K. R. (2007). Gender perceptions of middle schoolers: The good and the bad. *Middle Grades Research Journal, 2*(2), 65-97.