Sex differences in education: Exploring children's gender identity

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Abstract

Gender stereotypes associate mathematics and sciences with boys, whereas reading and writing are typically associated with girls. This study investigated sex differences in primary school children's motivation (confidence and value) across four academic subjects (maths, science, reading and writing) and examined how their identification with stereotypical masculine and feminine traits related to their motivation in these subjects. Five hundred and thirty-two children (aged 9-11, 52% boys), from five UK schools participated. Sex differences in reading and writing motivation were wider than sex differences found in maths and science motivation. Interestingly, the extent to which children identified with feminine traits was a stronger predictor of their reading and writing motivation than their sex. Gender identity provides an innovative approach to the study of sex differences; it challenges the dichotomy inherent within sex differences research and can lead to a more critical and nuanced understanding of sex differences in education.

Keywords: sex, gender, motivation, reading, maths, science

Introduction

Sex differences are of interest to many working within education; however, sex is a binary construct, which undermines the opportunity to study and understand the nuances of gender. In education, the concepts of sex and gender are typically used interchangeably; however, sex reflects the biological differences between boys and girls, while gender is socially constructed and reflects characteristics associated with being male or female. Indeed, both boys and girls vary in the extent to which they identify with stereotypical masculine and feminine traits (i.e., their gender identity). Children's gender identity develops from socialisation experiences, where receiving feedback for gender-appropriate behaviour, modelling others (e.g., parents, peers) and direct tuition of gender roles are all contributors to gender identity (Bussey & Bandura, 1999). Gender identity has been found to predict reading and writing motivation (McGeown, Goodwin, Henderson & Wright, 2012; McGeown, 2013; Pajares & Valiente, 2001), academic behaviours (Kessels & Steinmayr, 2013), engagement in gender-typed leisure activities (Athenstaedt, Mikula & Bredt, 2009) and career interests (Dinella, Fulcher & Weisgram, 2014).

From preschool, children have been found to project beliefs about sex differences in academic abilities (Francisca del Rio & Strasser, 2013). Indeed, while the domains of maths/science have typically been identified more closely with males (Cvencek, Meltzoff & Greenwald, 2011; Cvencek, Melzoff & Kapur, 2014; Guimond & Roussel 2001; Marsh & Yeung 1998; Makarova & Herzog, 2015; Nosek et al., 2009), reading and writing have been identified more closely with females (Guimond & Roussel, 2001; Marsh & Yeung 1998; McGeown et al., 2012; McGeown, 2013; Millard, 1997; Pajares & Valiante, 2001). Drawing on the expectancy-value theory of motivation (Eccles et al., 1983), the present study sought to examine children's motivation for these different academic subjects and examine the extent to which children's sex and gender identity predicted their motivation across these

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different academic domains. Despite considerable public interest in sex differences in education, research using gender identity to gain a more nuanced understanding of the similarities and differences among boys and girls is still in its infancy. This original study therefore makes a significant contribution to our understanding of sex differences in education, by using gender identity to gain a more nuanced understanding of sex differences across four core academic domains: reading, writing, maths and science.

Expectancy-value Theory of Motivation

Expectancy value theory (Eccles et al., 1983) has been used widely to investigate sex differences in students' motivation across different academic domains (e.g., Eccles et al., 1993; Wigfield et al., 1997) and has provided some important insights (e.g., Wang & Degol, 2013). According to this theory, motivation derives from both expectancy beliefs and value. Researchers typically use a variety of terms to denote 'expectancy' (e.g., expectations of success, competency beliefs, confidence) and 'value' (e.g., enjoyment) and our use of these terms changes as we chose to adopt the terms used in the original studies. Despite this, the constructs described below are comparable to 'confidence' and 'value'. Expectancy reflects students' competency beliefs; estimations of their ability to perform well or succeed at an activity and their expectations of future success in that activity. Children make distinctions about their ability across different academic domains (Eccles, Wigfield, Harold & Blumenfeld, 1993) and these judgements are associated with academic ability (Eccles et al., 1993; McGeown et al., 2015). Value, on the other hand, refers to the extent to which students perceive an activity to be important, useful, interesting, enjoyable and worthy of their time. Students are able to differentiate between their competency and value beliefs across different academic domains (Eccles et al., 1993), although competency beliefs and value are typically correlated (Durik, Vida & Eccles, 2006). While competency beliefs tend to correlate more

closely with actual ability, value tends to be a better predictor of time spent engaging in the activity (McGeown et al., 2015; Meece et al., 2006; Wigfield & Eccles, 2000).

Within the context of gender, expectancy-value theory predicts that both social and personal factors contribute to a child's motivation in gender-typed domains (Eccles and Wigfield, 2002). While social factors comprise other people's (e.g., parents, peers and teachers) beliefs and behaviours regarding gender, personal factors reflect a child's gender self-schema and perception of gender roles (Leaper, Farkas & Brown, 2012). These personal factors are thought to influence children's expectations for success and valuing across different academic domains.

To date, a number of reviews and studies have examined sex differences in academic motivation. For example, Meece et al.'s (2006) review found that sex differences reflected gender stereotypes; girls reported more confidence and interest in language arts and writing, whereas boys reported stronger ability and interest beliefs in mathematics and science. This pattern was reflected regardless of the motivational theory used to study this phenomenon (attribution, expectancy-value, self-efficacy or achievement goal). A more recent meta-analysis (Huang, 2013) examining sex differences in academic self-efficacy, found that academic subject was a significant moderator in explaining the magnitude of sex differences found: females reported higher language arts self-efficacy, while males reported higher maths self-efficacy (however this difference only emerged in late adolescence), and social sciences self-efficacy. Interestingly, a recent study (Kurtz-Costes, Copping, Rowley & Kinlaw, 2014) examining children's awareness and endorsement of gender stereotypes about academic abilities, found little evidence of explicit endorsement of male maths or science stereotypes; however, some endorsement of female verbal-stereotypes with increasing age, supporting previous literature with similar findings (e.g., Martinot, & Désert, 2007; Martinot et al., 2012;

Rowley et al. 2007). Research focusing on understanding sex differences in specific academic subjects (reading, writing, maths and science) are discussed below.

Reading

International studies report consistent sex differences in children's reading achievement, favouring girls (i.e., girls achieve higher reading scores on average) (Mullis, Martin, Gonzalez & Kennedy, 2003; Mullis, Martin, Kennedy & Foy, 2007; Ming Chui & McBridge-Chang, 2006). Similarly, in the country where this study was conducted (England), a higher percentage of girls, compared to boys, achieved Level 4 (4% higher) and Level 5 (9% higher) in reading (DfE, 2015). However, there is evidence of wider sex differences in the affective aspects of reading (e.g., attitudes) than in reading skill (Logan & Johnson, 2009).

With regard to the expectancy-value framework, girls typically value reading more highly than boys (Andre et al., 1999; Durik, Vida & Eccles, 2006; Eccles et al., 1993; Jacobs et al., 2002; Marinak & Gambrell, 2010; Wigfield et al., 1991; 1997), however sex differences in expectancy are less clear; although some research suggests girls have higher expectancy beliefs (Andre, Whigham, Hendrickson & Chambers, 1999; Wigfield et al., 1997), other studies have reported no evidence of significant sex differences (Eccles et al., 1993; Logan & Johnston, 2009; Pitcher et al., 2007). Recent research by McGeown et al., (2012) examined sex differences in children's reading motivation and found that children's gender identity (i.e., the extent to which they identified with stereotypical masculine and feminine traits) was a better predictor of their intrinsic reading motivation than was their sex. Furthermore, children's identification with feminine traits correlated more closely with their intrinsic reading motivation than their identification with masculine traits; however masculine traits did correlate positively with all aspects of reading motivation. This result was replicated in a later study with a different cohort of students (McGeown, 2013). Indeed, these

results possibly reflect the fact that reading is often seen as a more feminine activity (Guimond & Roussel, 2001; Marsh & Yeung 1998; Millard, 1997) and girls report spending more time engaging in reading activities compared to boys (Coles & Hall, 2002; Clark, 2011).

Writing

Unlike Reading, Maths and Science, where international comparison studies (i.e., PIRLS, TIMSS) provide insight into sex differences among primary school aged children internationally, there is not a similar study for writing. However, in England, sex differences in writing attainment among primary school children are wider when compared to reading. For example, in 2015, a higher percentage of girls achieved Level 4 (8% higher in writing, 8% higher in grammar, spelling and punctuation (GPS)) and Level 5 (11% higher in writing, 15% higher in GPS) in teacher assessments of writing skills and GPS (DfE, 2015).

While the study of writing motivation has attracted less academic research than that of reading motivation, a number of studies have revealed some important insights. For example, research has illustrated that sex differences, favouring girls, exist in students' perceived value of writing (Shell, Colvin & Bruning, 1995; Pajares & Valiente, 2001) and confidence in writing skills (Pajares, 2003; Pajares & Valiante, 1996; 1997; 2001); although these differences often diminish when accounting for sex differences in writing skills (Pajares et al., 1999; Pajares & Valiante, 1999; Shell et al., 1995) or with increasing age (Pajares, 2003). In addition, research has also found evidence of a male advantage in writing self-efficacy (Pajares & Johnson, 1996). Similar to the findings of McGeown and colleagues (2012; 2013), Pajares and Valiante (2001) found that sex differences in writing motivation and achievement were better explained by children's gender identity than their sex, with writing similarly seen as a more feminine activity (Pajares & Valiante, 2001). Indeed, when students reported on their identification with masculine and feminine traits, students' identification with feminine

traits correlated more closely with their writing self-efficacy, self-concept, value and task goals. Indeed, masculine traits were unrelated, or more weakly positively correlated with these variables.

Maths

Large scale international comparison studies (i.e., TIMSS) have found sex differences in maths achievement to be negligible. While there is a pattern for sex differences to be small at Grade 4 and widen at Grade 8 (in favour of girls), results vary considerably across countries (e.g., Martin, Mullis & Chrostowski 2004; TIMSS, 2011a). Indeed, sex differences in mathematics are substantially smaller than those found in reading (Stoet & Geary, 2013). In national assessments where this study was conducted (England), the same percentage of boys and girls achieved Level 4 or above in Maths, however a higher percentage (8%) of boys achieved level 5 or above (DfE, 2015), suggesting that sex differences, in favour of boys, are evident among high achievers.

While English has typically been considered a more feminine stereotyped subject, maths has traditionally been considered a more masculine subject (Guimond & Roussel 2001; Marsh & Yeung 1998). Interestingly there is evidence to suggest that sex differences in maths attitudes and affect, favouring boys, are often wider than differences found in achievement (Else-Quest, Hyde & Linn, 2010). With regard motivation, Pajares (2005), summarised research examining sex differences in math self-efficacy, and found that, in general, male students reported higher mathematics self-efficacy compared to females (see also Eccles et al., 1993; Skaalvik & Skaalvik, 2004; Wigfield, Eccles, Mac Iver, Reuman & Midgley, 1991), despite little evidence of sex differences in actual ability (Eccles et al., 1993). However, this finding was not always consistent (e.g., Friedel et al., 2007; Kenney-Benson et al., 2006; O'Brien et al. 1999). With regard to value in maths, while Skaalvik and Skaalvik (2004) found that boys reported higher intrinsic motivation in maths, this difference

only emerged in late middle-high school. Indeed Eccles et al., (1993) found no evidence of sex differences in the value attached to maths in elementary school aged children. Similarly, Wigfield et al., (1991) found no sex differences in children's reported liking of maths, despite boys reporting greater confidence in their abilities. Interestingly, Andre et al., (1999) found that girls reported maths as more important than boys do. In terms of attributions for success, research has shown that girls are less likely to attribute their success in maths to ability; rather their successes are attributed to effort and hard work (see Meece et al., 2006). This finding has been echoed in research with teachers (Robinson-Cimpian, Theule Lubienski, Ganley & Copur-Gencturk, 2014). Research has demonstrated that primary school aged boys and girls show implicit (measured using Implicit Association Tests) and explicit (measured using self-report) math-gender stereotypes, with boys being identified more closely with maths (Cvencek, Meltzoff & Greenwald, 2011; Cvencek, Melzoff & Kapur, 2014).

Science

As with Maths, there is a pattern for sex differences in science attainment to be smaller at Grade 4 than Grade 8 (favouring girls), however sex differences are typically very small and results vary considerably across countries (e.g., Martin, Mullis & Chrostowski, 2004; TIMSS, 2011b). In England, there was no evidence of sex differences in science attainment at Grade 4 or Grade 8 (TIMSS, 2011b), and this pattern of no sex difference has consistently been found over previous years (1995; 2003; 2007).

Like maths, science has traditionally been considered a more masculine subject (Guimond & Roussel 2001; Marsh & Yeung 1998). In addition, as reported in maths, girls are more likely to attribute success in science to effort and hard work than innate ability (see Meece et al., 2006). In addition, like Maths, Science is typically implicitly more closely associated with males than females (Nosek et al., 2009). In terms of students' expectations of success, results are mixed, with evidence of girls (Britner, 2008; Britner & Pajares, 2001) and

boys (Andres et al., 1999) reporting higher competency beliefs in science (girls: earth science, boys: physical science), or no sex differences in science self-efficacy (Anderman & Young, 1994). Interestingly, parents also perceive boys as more competent in science and have higher expectations for their success (Andre et al., 1999). Regarding value, girls report life science as more important than boys (Andre et al., 1999). However, parents have been found to report science as more important for boys than girls (Andre et al., 1999)

Rationale and Hypotheses

At present, there is a notable absence of current research exploring primary school children's motivation (confidence and value) across different academic subjects and an examination of sex differences in this area. It is important, and useful, to conduct such a study with the same cohort of students, to allow comparisons to be drawn between different academic subjects.

More importantly, while there is a considerable body of research which has explored sex differences in children's motivation, research exploring the relationship between children's gender identity and their motivation is still in its infancy. While Pajares & Valiante (2001) and McGeown and colleagues (2012; 2013) have examined this, their research was in the context of a single academic domain: writing and reading respectively, and did not draw upon the expectancy-value theory of motivation. However, there is good reason to predict that a child's gender identity (i.e., the extent to which they identify with stereotypical masculine and feminine traits) will relate to their reported value and confidence across a number of academic subjects traditionally viewed as more masculine (maths, science) or more feminine (reading, writing). This study therefore makes a significant and unique contribution to our understanding of sex differences in primary school students' motivation.

Based on previous literature, it was expected that large sex differences would be found in children's reading and writing expectancy and confidence (favouring girls), with smaller sex differences in maths confidence (favouring boys) and negligible sex differences in maths value, science confidence and science value. Given that positive character traits are primarily included in the gender identity questionnaire, it was predicted that masculine and feminine traits, if correlated with motivation, would correlate positively with both value and confidence aspects of motivation. However, it was predicted that identification with feminine traits would correlate more closely with reading and writing value and confidence, while identification with masculine traits may correlate more closely with science and maths value and confidence. Finally, it was predicted that children's gender identity would be a stronger predictor of individual differences in motivation than sex.

Method

Participants

In total, five hundred and thirty-two Year 5 and 6 pupils (271 boys, aged 9 to 11 years (M = 9 years, 11 months)) from five schools in the South of England participated in the study. An additional 35 participants' data was excluded due to scoring over 2 standard deviations from the mean on one or more of the scales (n = 34) or missing results (n = 1). The deprivation level of each school's location was checked via the Office for National Statistics (2011): two schools scored above 90%, one scored 65% and the final two below 30% (where 0% most deprived, 100% least deprived), therefore the schools provided education for students from a range of socioeconomic backgrounds.

Measures

All children completed a two-part questionnaire.

Part 1. Motivation (confidence and value) in reading, writing, maths and science. An adapted version of Eccles et al. (1993) questionnaire was used to measure children's confidence in and value of reading, writing, maths and science. Using a seven-point likert scale, children were asked questions which reflected their confidence in the four subjects (4 items: e.g., "How well do you expect to do in ___ this year?" Options: not at all well – very well) and value of the four subjects (4 items: e.g., "For me, being good at___ is" Options: not at all important – very important). Therefore, children completed eight questions for each subject: Maths (value, α = .78, confidence, α = .83), reading (value, α = .78, confidence α = .82), science (value α =.78, confidence α = .82) and writing (value α= .79, confidence α = .81). The order of academic subjects was counterbalanced within the study.

Part 2. Gender identity questionnaire. The Children's Sex Role Inventory Short Form was used to assess gender identity (see Boldizar, 1991). This inventory measures traditional masculine traits (10 items: e.g., competitiveness: 'When I play games, I really like to win') and feminine traits (10 items: e.g., compassion: 'I care about what happens to others'). Questions were answered using a 4-point Likert scale: 4 = very true of me, 3 = mostly true of me, 2 = a little true of me, 1 = not true of me at all. Reliability analysis was carried out on the questionnaire using Cronbach's alpha. Reliability was sufficient for masculine traits (10 items, α = .65) and good for feminine traits (10 items, α = .81).

Procedure

Ethical approval was sought and granted from the second author's institution. Primary and junior schools in the South of England were invited to participate via an email to head teachers. Students' parents were given the option to opt their child out of the study via a letter sent from schools. The second author visited each school and students were given information about the project and were also provided with the opportunity to opt out if they wished. Part 1 of the questionnaire (subject value/confidence) asked students to report how

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much they liked and felt confident in different school subjects, whereas Part 2 of the questionnaire (gender identity) asked students how they would describe themselves and what they liked and disliked doing. The gender identity questionnaire was completed second, to ensure gender stereotypes were not primed prior to students' responses to their academic motivation. Two practice questions were provided and read students were informed that they could raise their hand at any time to clarify issues. During questionnaire administration, all questions were read aloud by the second author, to ensure reading skill did not affect completion.

Results

Descriptive statistics are provided below for the whole sample and split for boys and girls.

---Insert Table 1 here ---

Significant sex differences, favouring boys, were found in children's identification with masculine traits, $F(1,564) = 64.32$, $p<.001$, $\eta_p^2 = .102$ and favouring girls, in identification with feminine traits $F(1, 564) = 153.62$, $p <.001$, η_p^2 .214. Regarding value and confidence in the academic subjects, there were a number of significant sex differences, with widest differences reported first. Children varied in their writing value $F(1,564) = 33.46$ $p <.001$, $\eta_p^2 = .056$, writing confidence $F(1,564) = 20.20$, $p < .001$, $\eta_p^2 = .035$, reading value $F(1,564) = 16.88$, $p < .001$, $\eta_p^2 = .029$, reading confidence, $F(1,564) = 10.50$, $p = .001$, η_p^2 =.018, maths confidence, $F(1,564) = 7.22$, $p < .01$, $\eta_p^2 = .013$ and value of science, $F(1,564)$ = 4.82, $p < .05$, η_p^2 =.008, with girls reporting greater confidence and value in reading and writing, and boys reporting greater maths confidence and science value. No significant sex differences were found in children's confidence in science $F(1,564) = 1.64$, $p > .05$ or value of math $F(1,564) = 2.05$, $p > .05$. Children's reported value of reading and maths were

highest of the subjects, followed by writing and finally science. Children reported feeling most confident in their reading skills, followed by maths and writing, and lastly science.

Correlations were carried out to examine the relationship between children's identification with masculine traits, feminine traits, and their reported value and confidence in the four academic subjects. There was no correlation between children's identification of masculine and feminine traits, $r = .03$, $p > .05$.

--- Insert Table 2 here ---

Children's identification with feminine traits and their reading and writing value and confidence was statistically more closely correlated that the relationship between their identification with masculine traits and their reading and writing value and confidence (indicated by z-scores). Differences in science and maths were not statistically significant.

Finally, multiple regression analyses were carried out to examine the extent to which children's sex and their identification with masculine and feminine traits predicted their value and confidence in reading, writing, science and maths.

--- Insert Table 3 here ---

With regard to reading and writing value and confidence, children's feminine traits were the strongest predictor; however, sex also predicted writing value and confidence (but not reading value and confidence when entered simultaneously with gender identity). Regarding science and maths, sex predicted value and confidence in both, with little difference in the extent to which masculine and feminine traits predicted science and maths reading and value.

Discussion

The present study examined sex differences in children's motivation (confidence and value) across academic domains stereotypically associated with boys (maths, science) and

girls (reading, writing). In addition, the extent to which children's gender identity (identification with masculine and feminine traits) predicted their motivation across the different academic subjects was examined.

Firstly, as predicted, girls reported significantly higher reading and writing confidence and value, while boys reported greater maths confidence and science value; these results aligned with gender stereotypes of these academic subjects (Cvencek et al., 2011; 2014; Millard, 1997; Nosek et al., 2009; Pajares & Valiente, 2001). In addition, the sex differences in reading and writing motivation were considerably larger than those in maths and science motivation. Indeed, this is consistent with past literature, where sex differences in reading and writing motivation (favouring girls) are more consistent (e.g., Eccles et al., 1993; Pajares & Valiante, 2001) than sex differences in maths and science motivation (which sometimes favour boys, girls or report no differences) (e.g. Andres et al., 1999; Eccles et al., 1993; Wigfield et al., 1991). Therefore, the sample of children, on which this research is based, demonstrate a pattern of results which has been reflected internationally, in different studies and with different cohorts of children.

The focus of this research study was on the extent to which children's identification with masculine and feminine traits correlated with, and predicted, their motivation across the different academic subjects. Consistent with McGeown and colleagues (2012; 2013) and Pajares and Valiente (2001), children's identification with feminine traits correlated more closely with their reading and writing value and confidence than did their identification with masculine traits (differences were particularly marked for the 'value' dimension of reading and writing motivation). As stated earlier, value tends to be a stronger predictor of children's engagement in activities (McGeown et al., 2015), therefore this has potential consequences for children's frequency of engagement in these types of activities. Indeed, girls do report

spending more time engaging in reading activities (Johnsson- Smaragdi & Jönsson, 2006), providing further opportunities to develop their literacy skills.

With regard to science and maths, differences between correlations with masculine and feminine traits were not significant; there was a trend for feminine traits to be correlated more closely with value in science and maths and masculine traits to be correlated more closely with confidence in both, however this was not significant.

Regression analyses were carried out to examine the extent to which children's sex and gender identity predicted their value and confidence across the different academic domains. Sex predicted both confidence and value across all subjects, except reading, where identification with feminine traits (value, confidence) and to a lesser extent masculine traits (confidence) predicted students' reported motivation. These results align with McGeown et al., (2012) who found that children's gender identity was a stronger predictor of their reading motivation than sex. For writing, gender identity was also a stronger predictor, particularly feminine traits, mirroring results found previously by Pajares and Valiente (2001). Of interest was the inclusion of maths and science in this study as such analyses has not, to the authors' knowledge, been conducted previously. When entered simultaneously, feminine traits were a stronger predictor of science and maths value, while differences between correlations with masculine and feminine traits for confidence were negligible.

In the present study, among primary school aged children, there was little evidence of sex differences in maths and science motivation. Indeed, research suggests developmental changes from childhood to adulthood in the extent to which maths and science specifically are seen to be masculine orientated subjects (Lindberg, Hyde, Petersen & Linn, 2010), this perception increasing with age. Research shows that sex differences in children's confidence in science widens with age (Andre et al., 1999) and differences are also reflected in attainment, where sex differences in maths and science widen with increasing age (Robinson-

Cimpian et al., 2014). Furthermore, in adulthood, substantial sex differences are found in orientation towards careers in Maths and Science (Halpern et al. 2007).

Finally, of the academic subjects, children reported the least confidence and value of science. This likely reflects the fact that science is not a core academic subject in primary schools, unlike reading, writing and maths. In recent years, there has been increasing interest in introducing science to children at a younger age, given the agenda to increase interest and productivity in STEM areas. It appears that this may be necessary, to raise children's motivation in this subject area.

Educational Implications

Similar to Stoet & Geary (2013) who highlight the need for a more nuanced understanding of sex differences in educational attainment across different academic subjects, the present study suggests there is a need for us to develop a more nuanced understanding of sex differences in motivation. Indeed, simply focusing on sex, without considering children's gender identity, arguably creates an unhelpful dichotomy which can lead to an overly simplified understanding of differences in motivation at school.

This research contributes considerably to our understanding of sex differences and gender stereotypes in primary school, as the majority of research to date has been carried out in secondary school settings. Nevertheless, in a primary school study by Robinson-Cimpian et al., (2014), teachers were found to rate the maths proficiency of boys higher than that of girls (after accounting for differences in achievement and behaviour) and conflate student behaviour with proficiency; teachers needed to perceive girls as working harder and behaving better than similarly achieving boys to rate their ability equally (Robinson-Cimpian et al., 2014). It is imperative that teachers are aware of these implicit associations, and challenge gender stereotypes in their classrooms.

Among older pupils, a number of research studies have explored methods to increase girls' interest and attainment in science. For example, research has shown that girls report greater scientific interest when science concepts are presented in the context of feminine topics (likewise boys interest is higher when presented in context of masculine topics) (Kerger, Martin & Brunner, 2011). Alternatively, Souchal et al., (2014) highlight the value in considering messages given to students regarding assessments. For example, in their study, boys and girls performed at a similar level when receiving assessments following a science class which they thought were designed to help their learning. When assessments were proposed to compare and select students, girls' performance reduced. Indeed, this supports earlier research demonstrating that girls underperform when placed in situations that activate negative stereotypes about their weaker abilities (e.g., Appel, Kronberger & Aronson, 2011; Huguet & Regner, 2007). While these approaches have been used in science specifically, they may have value in other academic domains (e.g. maths, reading, writing).

In addition, while there has been considerable recent interest in encouraging more girls into STEM related careers (e.g., National Academy of Sciences, 2006), and thus challenging early stereotypes that science and maths are more masculine subjects, there has been far less focus on narrowing the sex gap in reading and writing, in terms of gendered perceptions of these academic domains. The results of this research study highlight the importance and need to do so.

Indeed, efforts to address sex differences in education must begin as early as possible. Research has shown that girls are more likely to transcend gender boundaries (McGeown 2013), possibly because stronger social sanctions exist against males participating in feminine activities (Dwyer, 1974). Different types of interventions have the potential to be applied across numerous academic domains and hence challenge gender stereotypes negatively affecting boys or girls. These could include providing children with opportunities to develop

skills and achieve success in gender stereotyped domains (Master et al., 2017), ensuring consistent use of gender fair language within all academic subjects (Vervecken & Hannover, 2015) or ensuring resources (e.g., textbooks, stories) are also gender fair and/or challenge gender stereotypes of different academic domains (Abad & Pruden, 2013). Indeed, effective approaches to engage students in the full range of academic subjects are likely to be numerous; however greater understanding of how specific school subjects activate gender stereotypes, and the age at which this begins, will allow researchers to support teachers to redress these differences.

Limitations and Future Research Directions

With regard to limitations, the present study did not include measures of attainment as schools did not agree to provide these. Nevertheless, McGeown et al., (2012) found that while children's gender identity significantly correlated with their reading motivation, it was unrelated to their reading attainment, suggesting the influence of gender identity may be more in the 'affective' aspects of these subjects, rather than attainment. Despite this, future research should, if possible, include attainment outcomes. In addition, it would be interesting to conduct the same research study with an older cohort of students to explore a wider range of academic subjects at secondary school level (e.g., drawing comparisons between those which typically activate gender stereotypes and those which are generally considered gender neutral). Furthermore, comparisons across the various science subjects (i.e., biology, physics, chemistry) would be of interest as past research has noted differences in this area (Makarova & Herzog, 2015). Finally, longitudinal research studies would further our understanding of the direction of causality regarding gender identity, gender stereotypes, attainment and motivation. Indeed, exploring sex differences in education from a gender identity perspective offers an innovative approach for future study to advance our

understanding of how students' self-reported attributes are associated with their attitudes, behaviours and choices in education.

Conclusion

The present study found that in the later stages of primary school, relatively wide sex differences exist in children's reading and writing motivation, favouring girls; however, sex differences are less evident in maths and science motivation. Interestingly, the extent to which children identified with feminine traits was a stronger predictor of their reading and writing motivation than their sex.

Focusing on children's gender identity removes the dichotomy associated with sex differences research and encourages researchers and practitioners to consider the similarities among, rather than solely the differences between, boys and girls. As a result, a focus on gender identity should lead to a more critical, complex and deeper understanding of sex differences in education, which should ultimately benefit students as they progress through school.

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Table 1. Descriptive statistics for gender identity and motivation (value/confidence) across academic subjects

	All				Boys		Girls	
	Mean	SD	Skewness	Kurtosis	Mean	SD	Mean	SD
Masculine	27.17	4.37	.096	-.300	28.52*	4.27	25.72	4.01
Feminine	30.66	5.24	-.463	-.098	28.33	4.83	33.18*	4.44
Read value	22.18	4.96	-.943	.466	21.36	5.20	23.06*	4.54
Read conf	22.80	4.57	-.947	.559	22.20	4.55	23.44*	4.51
Write value	21.04	5.28	-.808	.283	19.84	5.66	22.34*	4.49
Write conf	20.52	4.81	-.626	.083	19.66	4.90	21.45*	4.54
Science value	17.54	5.58	-.119	-.688	18.04*	5.62	17.01	5.51
Science conf	18.30	5.11	-.380	-.329	18.56	5.14	18.01	5.08
Math value	22.11	4.67	-.819	.070	22.38	4.90	21.81	4.34
Math conf	20.74	4.78	-.629	.085	21.26*	4.85	20.19	4.60

Note: * Denotes statistically significant difference in favour of boys or girls.

Table 2. Correlations examining relationship between gender identity and motivation (value/confidence) across academic subjects

	Reading value	Reading confidence	Writing value	Writing confidence	Science value	Science confidence	Maths value	Maths confidence
Masculine	-.003	.117**	.081	.143**	.137	.241**	.188**	.244**
Feminine	.406**	.294**	.433**	.367**	.217**	.196**	.196**	.142**
z-score	-7.17**	-3.04**	-6.26**	-3.93**	-1.35	.77	-.14	1.74

Note: * or ** for masculine and feminine traits denotes statistically significant relationships with variable of interest (e.g., reading value). * or ** for z-scores denotes statistically significant difference between masculine and feminine traits with the variable of interest (e.g., reading value). For both: * $p < .01$, ** $p < .001$.

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Table 3. Multiple regression analyses examining the extent to which sex (boy/girl) and gender identity (masculine and feminine traits) predicts motivation (value/confidence) across academic subjects

	R^2	Final β	p		R^2	Final β	p
Reading value				Reading confidence			
Sex		-.021	.657			.055	.255
Masculine		.003	.934			.143	.001
Feminine	.165	.415	.000		.105	.273	.000
Writing value				Writing confidence			
Sex		.095	.037			.091	.049
Masculine		.124	.002			.183	.000
Feminine	.203	.393	.000		.165	.331	.000
Science value				Science confidence			
Sex		-.215	.000			-.100	.038
Masculine		.078	.067			.218	.000
Feminine	.100	.319	.000		.107	.249	.000
Math value				Math confidence			
Sex		-.132	.006			-.147	.002
Masculine		.154	.000			.204	.000
Feminine	.088	.262	.000		.097	.216	.000