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Boys, science and literacy: Place-based masculinities, reading practices and the "science literate boy"

Garth Stahl
School of Education, University of Queensland, Brisbane, Australia.
ORCID Profile: orcid.org/0000-0002-1800-8495
Twitter: @GarthStahl

Laura Scholes
Institute for Learning Science and Teacher Education, Australian Catholic University, Brisbane, Australia.
ORCID Profile: orcid.org/0000-0002-8849-2825
Twitter: @ScholesLaura1

Sarah McDonald
Education Futures, University of South Australia, Adelaide, Australia.
ORCID Profile: orcid.org/0000-0002-0454-4983
Twitter: @Sarah_McDonald_

Reece Mills
School of Education, Queensland University of Technology, Brisbane, Australia.
ORCID Profile: orcid.org/0000-0002-2156-7677
Twitter: @DrReeceMills

Barbara Comber
Education Futures, University of South Australia, Adelaide, Australia.
ORCID Profile: orcid.org/0000-0002-8364-1676

Abstract

The fields of science and literacy education continue to be shaped by pervasive gender inequality. Previous research has documented how the formation of a 'science identity' is contingent on access to science capital while research in literacy education continues to highlight how boys struggle in their literacy acquisition. Despite a robust scholarship on gendered literacy practices and gender in STEM subjects, to date, there has been little investigation of the relationships between boys' science identity/ies and their literacy practices. We draw on a case study of 24 middle school boys living and learning in two different regions (e.g. metropolitan, rural) where we focus on how boys conceive of themselves as learners in two curriculum areas: science and literacy. Bridging multiple areas of scholarship (e.g., science literacy, science identity, boys in schooling), we concentrate on the participants' *self-belief in science* and *self-belief as readers* and consider the way they inform each other in reference to place. The implications of our study concern how the *science literate boy* comes to be in reference to the construction of discursive performances of science masculinities and how they are maintained alongside literate identities.

Keywords: boys and schooling; literacy; science literacy; gender; science identity; case study

Introduction

Masculinist notions of science permeate popular culture where male scientists are portrayed as assertive "men of action" (Milam & Nye, 2015, p. 5; Scholes & Stahl, 2020) or the lone, socially awkward science geek (Carlone et al., 2015). These gendered science discourses exist alongside stereotypes about boys and literacy, where reading is often framed as a feminine activity constraining boys' engagement in such endeavors (Alloway et al., 2002; Alloway & Gilbert, 1997; Scholes, 2018). Such a framing can reduce opportunities for sustained engagement in reading which is not only a foundational underpinning of a science literate identity but critical for accessing scientific knowledge. This article addresses a significant gap in research exploring the nexus of boys' science identities and literacy practices. We are interested in how science and literacy intertwine in reference to place and how both inform the future career aspirations of young men.

Building on the work of Carlone and Johnson (2007), we theorize science identity as a conception of self in science where a science identity involves the "three interrelated dimensions: of competence; performance; and recognition" (p. 1190). We extend this framework to include boys' self-beliefs as readers and self-belief in science. As students come to see themselves as 'science boys', 'literate boys', 'science girls', or 'literate girls', there may be overlaps or synergy between identities in different disciplines or, possibly, little relation. Given how engagement with science and engagement with literacy remain highly gendered, our interest is in the relationship between a science identity and a literate identity for young men. We focus on what Lee (1997) calls "gendered subject production in school literate practices" (p. 5), with attention to the curricular location of science where we center on the entanglement of boys' discursive performances of masculinities in relation to their learning and their workplace goals.

The data presented in this article draws on a broader study of Year 8 students who were 13-14 years old (24 boys and 21 girls). The primary aim of the research was to further our understanding of how students conceive of themselves as learners, specifically related to science, and how these conceptions of self may shift depending on their identity practices around both literacy and sense of place. Schools — as places located in specific geographic sites with different social, cultural and physical histories — reflect dynamic social patterns. From Massey's (2005) perspective, schools are meeting places where individuals come together and negotiate ways of being that construct their identities, enact ways of being that reflect their gendered subjectivities,

and invest in pursuits that connect with what is valued. Places also reflect unique patterns of marginalization related to ethnicity/race, patterns of unemployment, and geographical isolation (Comber, 2015).

To explore how the *science literate boy* is constructed and influenced by experiences of place, the article focuses on boys in two locations in Australia with their own specific cultural milieu (e.g. a metropolitan location experiencing increasing ethnic diversity and social mobility; a rural area with a generational history of Anglo generational farming). We define the science literate boy as one who *knows* and *speaks* science – who has ease with science – and where their identity as a learner involves self-beliefs around science and literacy practices as mutually informing. Though, as Talafian et al. (2019) note, STEM identities are subject to change and negotiated through experimentation. The science literate boy, while at ease in demonstrating scientific knowledge – what Archer et al. (2016, p. 457) call "muscular intellect" – is able to make connections between the science learned in school and his lifeworld outside of school, although this does not necessarily contribute to an aspiration to a career in the sciences. Thus, the science literate boy both recognizes dominant, institutionalized forms of science capital (e.g., science related forms of cultural and social capital) (c.f., Archer et al., 2015) and has the capacity to mobilize these forms to his advantage should he choose. In reference to place, we see the science literate boy as more likely to be cultivated in a metropolitan area where the characteristics of place makes it easier to maintain constructions of discursive performances of masculinities alongside successful literate identities (Skelton & Francis, 2011).

The paper proceeds in five sections. First, we recount some of the main trends in research on science literacy where we highlight a silence concerning both gender and place. Second, as a significant aspect of the study of boys in schooling, we briefly consider how deficit discourses associated with boyhood and schooling contribute to their literacy learning and literacy practices. Third, in considering the figure of the "disengaged boy" in educational research, we draw attention to contextual factors influencing how boys (dis)engage with their schooling with specific attention to their literacy acquisition. Fourth, we present the research questions, methodology and findings of the broader study of boys and girls (n = 45), where the analysis focuses on the data from the boys (n = 24) living in a rural area (n = 15) and in a metropolitan area (n = 9). This is followed by a discussion and conclusion where — working across the different disciplines – we aim to expand our understanding of how the *science literate boy* comes to be.

Studies of Science Literacy and the Absence of Gender and Place

While investigations of *science literacy* have persisted over the last twenty-five years (Hand, 2017), there is no clear consensus around what science literacy is, though it is often conceptualized as a form of evaluation, with reading skills essential to the advancement of scientific inquiry (Pearson et al., 2010). Within the discipline of science, reading is essential not only to the continued engagement with curriculum content but also in the way it lends itself to meaning making that requires students to locate, evaluate and adjudicate conflicting information associated with socio-scientific issues (Mason et al., 2014; Pearson et al., 2010). Drew and Thomas (2017) write that science literacy is "the general, functional, and epistemological understanding of science in order to engage meaningfully with scientific information in everyday life" or what can be described as the ability to "read, write, and speak science text", where the focus is on the acquisition of deep knowledge (p. 272). Writing in an Australian context, Morgan (2013) notes that science literacy is understood "as a discipline-specific skill, to be used in the study and production of texts in science subjects, is a different interpretation, and has become increasingly of interest to educators, especially in the climate of investigating claims for decline in student literacy skills…" (p. 3). Much of the research on science literacy to date has focused on pedagogical innovation, teacher training and student academic achievement and thus the field of science literacy has not engaged with students' learner identities and the array of factors (gender, class and ethnicity) influencing such constructions.

Research into science literacy remains a longstanding and robust field of study where there exists debate around best practices for reading and constructing texts in science classrooms (Drew & Thomas, 2017; Hand, 2017; Pearson et al., 2010). Research on science literacy often calls attention to the distinct ways in which information is represented in the discipline of science (Hannant & Jetnikoff, 2017), which requires a certain set of literacy skills in terms of vocabulary, comprehension, etc. Lawless et al. (2018) write: "science literacies involve much more than just content knowledge, but also require an understanding of the representations and interpretation of scientific data, scientific explanations, projections, and the process of science" (p. 393). Other scholars position science literacy to be connections between the language of science, how science concepts are rendered in various text forms, and resulting science knowledge (Pearson et al., 2010).

These debates aside, there appears to be consensus that there is an urgent need for increased integration of science and literacy.

To date, few studies exist that have sought to explore the intersectional identities of students in relation to science literacy and, as a result, the exploration of gender and science literacy remains limited (Author et al. under review). However, some studies have alluded to the role of gender and we present three recent pieces of scholarship. Lawless et al. (2018) investigation of science literacy in a 12-week simulation of international negotiations of science delegates on global science issues found gender to have no statistical significance when comparing responses between boys and girls. In a comparative study between Canada and Australia, Woods-McConney et al. (2014) found there was little difference between male and female students in science engagement and literacy; however, in terms of school science subject enrolments (and post-school engagement), there seemed to be continued gender differences favoring males. In a third study on science literacy, Hyde and Linn (2006) assert an emphasis on gender differences is perhaps counterproductive:

> To neutralize traditional stereotypes about girls' lack of ability and interest in mathematics and science, we need to increase awareness of gender similarities. Rather than focusing on gender differences, mathematics and science educators and researchers could more profitably examine ways to increase awareness of the similarities in performance and in ability to succeed. (p. 600)

While these studies illustrate some of the ways in which literacy may or may not be gendered in a science classroom, we were unable to locate any studies of science literacy which looked at differences in terms of gender or studies which analyzed place as a point of difference.

Distinguishing between space and place, Massey (2005) emphasizes that place must be conceptualized within the "uniqueness out of (and within) the specific constellation of interrelations within which place is set" (p. 68), where place can shape people and their relations to themselves and each other. Place, as a notable silence in research on science literacies, can often be a significant determiner of the quality of one's education (Stahl et al., 2019). Puslednik and Brennan (2020) note that, "Within a rural and regional context, there are a number of challenges schools face in terms of STEM education" (p. 3) which can negatively influence the quality and

scope of what students receive. Common issues concern specialized trained teachers and whether staffing allows for senior science courses to be offered (Lyons & Quinn 2015). In Australia, students from rural schools demonstrate lower performances in science and mathematics as measured by "a significant decline in science performance as compared to their metropolitan peers" (Puslednik & Brennan, 2020, p. 3). With these silences concerning gender and place in the study of science literacy, we now focus on our second domain of study: boys as learners and their experiences with literacy.

Boys as Literacy Learners: Exploring the Complexities

For countries participating in the Organization for Economic Co-operation and Development (OECD), an educational climate of performativity has manifested through high stakes testing and measurable indicators (Rizvi & Lingard, 2010). This focus on student performance and print-based literacy practices has led to research documenting how boys often lag behind girls (Alloway & Gilbert, 1997). As a result, the underperformance of boys on national and international exams is conflated with what is commonly called the "deficit discourse" regarding boys (Francis, 2006; Hayes & Lingard, 2003), also termed the "failing boys" discourse (Epstein, Elwood, Hey, & Maw, 1998). In addressing "failing boys," educational research has highlighted particular school-based literacies as problematic for some boys (Gilbert & Gilbert, 1998; Gilbert, 1998; Martino, 1999). Boys often disengage from formal literacy practices they perceive to be oppositional to the gender norms to which they subscribe (Murphy & Elwood, 1998), which may have consequences for their participation in society (Davies & Saltmarsh, 2007).

Another consequence of the "failing boys" discourse is the rise in populist magic bullet solutions. For example, Biddulph (2004) pioneered educational programs and strategies that aimed to harness "boy energy," contending that boys' have slower development of language skills and require more kinesthetic learning opportunities, as well as an increased number of male teachers as role models (c.f. Biddulph & Stanish, 1997). Biddulph has been heavily critiqued for adopting a position that all boys are the same due to their physiological makeup, and thus they must suffer from similar issues in fostering learner identities (Connell, 2000).[1] To address the underperformance of boys in Australia, the government invested in policies to offer quick solutions (Lingard, 2003). The Australian Parliamentary Inquiry into Boys' Education, called *Boys: Getting it Right*, led to recommendations for a more "boy friendly" curriculum, assessment,

and pedagogy, as well as the increased employment of male teachers (Mills et al., 2007). This policy initiative is an example of what Mills (2003) calls "backlash politics", where such political prerogatives seek to "re-establish boys and men as the privileged subjects within educational discourse" (p. 59) and where the feminization of schooling is blamed for positioning boys as the new disadvantaged (Lingard & Douglas, 1999**)**. The backlash politics Mills (2003) describes displaces emphasis and exploration of broader contributing contextual and intersectional factors that influence the learning of boys. An impetus to broaden our understanding of the contextual factors influencing boys' engagement with learning is echoed by other scholars (Francis & Skelton, 2005; Watson, 2011).

Foundational to our research is how boys' identities and literacy practices are embedded within overlapping and mutually constituting social, economic, political and digital forces. Theorizing literacy as a set of social practices (Barton, Hamilton, & Ivanic, 2000), identities are mediated by written texts (Gregory & Williams, 2000) where such texts become associated with different domains of life (Comber, Thomson, & Wells, 2001). In different places, some forms of literacy become more dominant, visible or influential, "embedded in broader social goals and cultural practices" (Barton et al., 2000, p. 8), and aligned with the logics of social institutions and power relationships. A critical aspect in contextualizing how boys engage with their literacies is how literacy practices related to their gendered identities are realized in the social world (Davies & Saltmash, 2007; Scholes, 2019a). With this in mind, boys cannot be treated as a homogenous group and analysis of their learner identities must include consideration of their lifeworlds. Alloway et al. (2002) suggest "any informed consideration of literacy learning and the performance of boys needs to take place in terms of current understandings of the nature, cultural context and consequences of literacy for societies, communities and individuals" (p. 24). The narrow construction of boys' relationship with literacy serves to constrain our knowledge around diversity, with emerging studies illustrating the nuanced and situated nature of boys' engagement with reading (Scholes, 2018), albeit inter-related with social class (Skelton & Francis, 2011). Clearly, boys do engage with a rich array of literacies and literacy practices and could be considered successful if a broader view of literacy was adopted (Nichols & Cormack, 2009; Rowan et al., 2002; Stahl & Dale, 2012; 2013).

What has been lacking from studies of boys and literacy practice is attention to the discursive construction of masculinities as shaped by place, and — by implication — social class.

Hopkins and Noble (2009) draw our attention to the "importance of place and context in the lived experience of gender relations and identities" (p. 814), where place — as representative of the social — structures one's gendered conception of self. Performances of masculinities, therefore, are constructed in "relation to other entities, including bodies, identities, institutions, ideas, social norms and categories, and historical and geographical contexts" (Gorman-Murray & Hopkins 2014, p. 6). In schooling, research has historically documented how boys, who are diligent and studious, can be othered as engagement with learning remains associated with femininity while laddishness — as a form of opposition to academic learning — remains a currency to attain social validation (Francis, 2009; Martino, 1999). Entwisle et al. (2007) argue that boys from low-socio-economic status (SES) backgrounds can be disadvantaged by their literacy progress before schooling, low expectations from parents and, finally, by their poor interactions with teachers. However, more recent scholarship has highlighted the differences and diversity in the ways working-class boys' position reading and the ways in which they challenge dominant discourses that position all boys from disadvantaged communities as reluctant readers (Scholes, 2019a). Scholes (2019a) asserts: "What is needed is a theoretical lens that makes visible the inter-related contextual influences at play in particular school contexts and how such environments moderate boys' reading experiences with specificity, on a daily basis" (p. 349).

It is evident that the different social and cultural backgrounds boys bring to the literacy classroom warrants serious consideration. The diversity of discursive performances of masculinities and the wide range of factors influencing their literacy practices warrants a need for more nuanced understandings of literacy-based identities in education (Alloway et al., 2002; Love & Hamston, 2004; Martino & Kehler 2007). In expanding our understanding of the construction of the science literate boy, we explore the construction of a masculine literate habitus (McDonald, 2019, p. 35) in two different places in Australia. We are interested in how boys position themselves as science learners (*self-belief in science*) and readers (*self-belief as readers*) and how this identity-work is entangled with their forming aspirations, gender identity and sense of place. In thinking of learner identities as relational — and both discipline-specific and context specific — our research asks, how do young men's *self-beliefs* around science and literacy mutually inform each other? In terms of how the science literate boy comes to be, how may their self-beliefs around science and texts inform their future career aspirations?

Constructing the *science literate boy*

Scholars continue to highlight the masculinist traditions in the sciences and the privileging of certain gendered identity practices which contribute to the furthering of inequality (Archer et al., 2014; Archer & DeWitt, 2016; Calabrese Barton et al., 2013). We are interested in "how boys 'do boy,' and the implications of their performances for their ease or difficulty in a science trajectory" (Carlone et al., 2015, p. 440). Masculinities and femininities, as discursive practices, are not fixed; further, learner identities are often conflicted and constantly evolving. In formal school contexts, learner identity(ies) "refer specifically to the conceptualizations children have of themselves as learners, but as with social identities, these are relational and pupils construct themselves and are constructed by others as particular types of learners in relation to both other pupils and their teachers" (Reay, 2010, p. 279). Learner identities are, therefore, composed of multiple, competing performances which can be both discipline and context specific (Lee, 1997). In her study of masculinities in mathematics, Mendick (2006) writes of math becoming "part of each student's gender identity project" (p. 70) where performances of gender are aligned with the curriculum. Letts (1999) writes how schooling "provides contexts through which students' identities are constructed, refined, resisted, and altered [where] attention must be paid to the ways in which certain subjects, in this case science, provide resources for, or erect barriers to, students' construction of subjectivities, or identities" (p. 106).

Figure 1 illustrates the foundational components that contribute to the construction of the science literate boy; we suggest that if one of these components is lacking or compromised, the identity becomes more fragile.

[Insert Figure 1 here]

Bridging multiple areas of scholarship to explore the construction of the science literate boy (e.g., science literacy, science identity, boys in schooling), our research addresses how a (gendered) learner identity is cultivated and maintained. Structuring the analysis is a social theory of learner identities where we focus on the boys' *self-belief in science* and their *self-belief as readers*. Building on the scholarship of Carrington and Luke's (1997) concept of a literate habitus, McDonald (2019) posits a masculine literate habitus — the literate boy — and details how literacy practices may take on multiple forms. We acknowledge the construction of the "literate" individual

is linked to the political, social, economic and cultural (Lee, 1997). Learning and aspiration are tied to community contexts and we are specifically interested in how situated, diverse and discursive performances of masculinities are realized in relation to place (Gorman-Murray & Hopkins, 2014; Hopkins & Noble, 2009; Stahl & Baars, 2015).

Methods

Overview and Context

Researching the perceptions of middle school science students was purposeful. In terms of their science identity, middle school is when intersectional dimensions to student engagement in the sciences begin to manifest (Archer & DeWitt, 2016; Corbett & St. Rose, 2011; Heddy & Sinatra, 2017; Hill et al. 2011) and where science identities and aspirations become significantly mediated by place (Stahl et al., 2019). Given the importance of reading competence in discipline literacy during the transition to middle school (Hopwood et al., 2017), this is a significant time for students' literacy development and their engagement with science education (Archer et al., 2013; Calabrese Barton et al., 2013). In terms of science literacy, at the middle school level the demands of discipline reading (e.g., technical vocabulary, complex sentences) becomes more challenging (Fang, 2006; Hopwood et al., 2017). It is also a time just before the subject of science separates into the sub-disciplines of biology, earth science, physics and chemistry, with their own literacy demands.

Data presented in this paper were drawn from a broader study, which worked across two school sites (one rural, one metropolitan), that sought to identify how students perceived science literacies in their classrooms and their aspirations around this science work. The first school in our study, River Valley High School (all names are pseudonyms), is a Year 7 – 12 government secondary school located approximately 150kms north of the largest city in the state. The community is made up of mostly white Australians of Anglo or European heritage (Australian Bureau of Statistics, 2016) where the diversity is in terms of generational farming and seasonal workers. Corbett (2015) writes how rurality "has been understood in development terms as the space that modernity and capitalism leaves behind" (p. 124) where, in terms of formal literacy, rurality is often associated with deficit or with illiteracy (p. 127). The second school, Heyson High School, is a Year 8 – 12 government secondary school which is ethnically diverse and located in the "leafy-green" suburbs of the capital city. The specific council area where Heyson High is

located is economically diverse bordering a wealthier suburb. Heyson was also a school which ran a STEM acceleration program[2] affiliated with a local university.

Participants

Working closely with the science leaders in the two school sites, we recruited Year 8 (12-13-year-old) students (24 boys and 21 girls). Students who volunteered to be part of the study were required to present a parental permission form. We recruited 15 boys living in the rural area and nine boys living in a metropolitan area.

Data Sources and Collection

Through the use of semi-structured interviews, students were invited to discuss a range of issues related to their experiences with science in the classroom and outside of school. Conversations were wide-ranging from literacy practices in their science classrooms to marches for climate change with parents to David Attenborough nature documentaries. Students discussed favorite books they had read, their habits around reading, how reading was fostered in the home, and how easily they could become distracted. The semi-structured interview foregrounded student's perceptions of themselves as learners. Self-perception is integral to a learner identity and longstanding strong predictor of academic achievement (Jones & Grieneeks, 1970) and STEM identities (Talafian et al. 2019). The semi-structured interview schedule allowed for a certain flexibility where participants had the space to discuss what was important to them. A range of factors contributed to the success of the interviews. For example, the research team drew on strategies such as humor to establish a rapport so that participants were comfortable. We made a continuous effort to listen without interruption.

Analysis Procedures

A professional transcription company was used and the interview audio files were listened to several times and checked against transcripts to ensure accuracy. Re-listening to the recording and reading the transcripts facilitated a deeper interpretation of the data. The data analysis used various coding techniques. First, the research drew upon open coding (or inductive coding) to determine initial concepts and categories that related to participants' conceptions of science, their experiences and their future career aspirations. This open coding was informed by recent research

on science identity and learner identities broadly (Carlone et al., 2015; Reay, 2010). In the first stage, several peer debriefing team meetings were held where various possible codes were discussed and vetted (Guba & Lincoln, 2004). Once the coding template was established, all four team members and a senior research assistant coded the interview transcripts in NVivo 12 according to 15 main nodes (e.g., Good scientist, Self-perception – how good at science, Family Influence, Literacy at home, etc.) and 120 stem codes. Any discrepancies in coding were discussed until a consensus was reached and a code assigned. Typologies were not assigned to the participants in an effort to problematize research which "typologizes boys' behaviors as different 'kinds' of masculinity" (Francis, 2009, p. 647), which has been a feature in studies of boys in science (Archer et al., 2014; Carlone et al., 2015).

Ethical considerations

Ethics approval was sought and attained both from the university funding the research and the Department of Education for the state.

Findings: Boys as Science Literate Learners: Self-belief in science and self-belief as readers

Part 1

Hand (2017) writes: "Students are very adept at understanding what their roles are and how much voice they have within different learning environments. As such, this understanding guides how much they become part of that environment and their willingness to engage with the language practices framing that environment" (p. 21). The boys we spoke with engaged in multiple and competing performances of masculinity, which *can* and *do* vary across time (Carlone et al., 2015) and context (Archer et al., 2016). Depending on political, social, economic, and cultural factors, some performances will be validated and ascribed greater status than others. We first supply three tables which serve as a snapshot of the range of practices, identifications, and rationales boys engaged with. This allows for surface level comparisons of career aspirations, self-beliefs and literacy practices across locations before presenting a more nuanced analysis drawing from the semi-structured interviews. The categorizing of the boys (e.g., low, average, high) was attributed by the researchers from the nodes/codes and their overall interviews.

Table 1 indicates that the boys who described themselves as good or capable readers ("average" to "high" in *Self-belief as readers*) were apparent in both the rural and the metropolitan sites, though slightly more common in the metropolitan. These are the type of boys Scholes (2019a) describes as having "positive interpretations of their experiences of self" and "experiences of reading" (p. 350), a determining factor for their continued engagement with their schooling.

Table 1: Self-belief as readers

[Insert Table 1 here]

Across the entire cohort there was evidence of reading "tapering off", which could be due to the increasing literacy demands associated with post-primary study (Hopwood et al., 2017). There were instances when boys — such as Noah and Tom from River Valley High — categorized themselves in terms that reflect school-based criterion (e.g. not an "advanced reader"). David, who believed he was a low reader, indicated that he had never had much help and that he struggled with reading. Charan (born in Dubai with Pakistani heritage) and Chaminda (born in Pakistan), both English as a Second Language (ESL) students from Heyson High (metropolitan location), also considered themselves low readers. For these boys, however, there was a sense of striving to improve their positioning, as Charan worked to increase his vocabulary and Chaminda — as we see later — strived to read broadly.

In terms of "Literacy at home", Table 2 indicates that students in the metropolitan area spent more time reading. For example, Charan elaborated about how he read often and Chaminda had daily routines that included occasionally reading before bed. There was more evidence of them challenging themselves to read more sophisticated texts where they used words like "fluency," "vocabulary" and "actual plot." In contrast, boys in the rural area who described themselves as "low" readers, and often openly delineating their various struggles with reading, were less inclined to read. For instance, we see David reading rarely, and Tom, who was uninterested in reading, having limited reading interactions (e.g. manuals and comics).

Table 2: Self-belief as readers, literacy at home

[Inset Table 2 here]

When we align post-secondary "aspirations" and interest in "post-school science" with "self-belief at science" (Table 3), those who were "high" in *Self-belief at science* unsurprisingly favor careers requiring some degree of science knowledge, though this pattern was more clearly represented by the boys living in the metropolitan area. This relationship suggests a *Self-belief in science* — as a self-concept — is influential for how they see their possible future, but also how this self-concept is also mediated by their geographical location, or place. In terms of their literacy, the boys in the metropolitan area tended to have clear routines around home reading practices highlighting the relationship between science literacy — *Conception of self as a reader* — and science capital in the construction of the "science literate boy" (see Figure 1).

Table 3: Self-belief in science, aspirations
[Insert Table 3 here]

Based on Table 3, the boys in the rural area appeared to have aspirations that reflected the local community and many identified career trajectories that aligned with the agriculture sector (e.g., farming, winemaking) or mechanics. Noah, who aspired to be a farmer, was the only boy from River Valley High who was considering studying science post-secondary. His self-belief centered around how he was as an average reader although he described reading for pleasure through the summer holidays. While both Tom and David identified as low readers and did not plan to continue with their science education when they finished high school, Tom enjoyed the hands-on side of science and David considered himself as knowledgeable in this subject.

In contrast, the boys at the metropolitan school, located about 20 minutes from the central business district of an Australian city, tended to align their aspirations more with white collar sector jobs (e.g., architecture, medicine, engineering). Charan was committed to following a science related pathway in his quest to become a biomedical engineer which perhaps inspired him to improve his reading vocabulary. Harry (high reader, reads often), who aspired to be an architect or a robotics engineer, listened to university science lectures with his Dad, who was studying biomedical science. Harry also read *Science Daily* on the Internet, explaining: "sometimes I just check that out for fun. It's really interesting, some good papers on there. You can search up

anything, and it will just come out with it. There is just absolutely anything to do with science. You can get paleontology related papers, and then you've got just normal engineering…"

Table 3 also highlights several patterns that contribute to our understandings of boys' science literacy practices. The boys who aspired to be farmers or mechanics — professions that require a sophisticated level of science knowledge — often did not have a strong self-belief in science, where their words suggested they did not see science as part of their lives. Previous research has noted that conceptions of science can often be centered around a dated image of a man in the white lab coat though there is evidence this is beginning to shift (c.f. Carlone & Johnson, 2007; Letts, 1999; Scholes & Stahl, 2020). While many of the boys evaluated their self-belief in science according to grades, some emphasized a tension between fluency and comprehension pointing to the speed of reading potentially related to expectations around performativity and pressure to excel in standardized tests.

Part 2

Tables 1, 2 and 3 drew largely on codes that emerged from the data to provide an overview of the patterns between the boys' self-belief in science, self-belief as readers, and aspirations. Some apparent patterns: a stronger confidence in reading ability in the metropolitan area; students from a non-Anglo background as having aspirations requiring extensive post-graduate study; the capacity to delineate between progress as a reader and not practicing enough. Focusing on three boys in each locale, we now turn to the semi-structured interview data to focus on the words of the boys regarding their *self-belief as readers* to further our understanding of the science literate boy.

Metropolitan

Jacob, who attended the school in the metropolitan area, aspired to be a writer and illustrator. He self-identified as a good reader where reading at night was part of his bedtime routine. In terms of his interest in science, he was an avid rock collector and read to learn facts related to his hobby.

Interviewer: When do you read about science?

Jacob: Science? Often I'll read ... some of the Guinness World Record books but, and they have science sections in them so I go to those sections and read those. I've also got a bunch of books on rocks, I collect rocks, and that's to do with science geologists, a part of science. And I ... I read them and I read boo- I've got a big book of a thousand facts of science so I read that sometimes.

Interviewer: Okay, and when you read about science what influences you the most?

Jacob: What do you mean exactly?

Interviewer: What compels you? What interests you?

Jacob: What interest me inside the books?

Interviewer: When you read about science.

Jacob: Like geology, the geology or, and stuff, as I said rocks. I have a collection of thousands of rocks, some are crystals, some shiny, just some quartz, just some just plain old rocks. I sometimes just pick up random rocks off the ground and chuck them around because I fidget and that's just what happens. I love rocks and I know a lot of facts about them.

In the above comments, Jacob's subjective positioning is one of a "reader" and the way this contributes to sustained engagement around science related materials. Within Jacob's speech, there are also echoes of what Archer et al. (2016) call "muscular intellect", involving "highly confident, assertive—sometimes aggressive—displays of scientific knowledge and talking science, that is, doing science through the medium of language" (p. 455), as well as masculinist notions of science where male scientists are constructed as "men of action" (Milam & Nye, 2015). Accordingly, Jacob believes he is pretty good at science as he "got an A in science last year", although his science related reading takes place primarily at home as opposed to the science classroom (Scholes et al., 2021). In terms of his science identity, Jacob takes up the position of what Carlone et al. (2015) call the "smart science boy", where there appears little struggle around performing this identity. Jacob's identity would have been closely aligned with the typology of "young professors", where he abides by the rules and is supported by this family (c.f. Archer et al., 2014). Jacob was proud that he was accepted into the STEM acceleration program at his school "with 21 other students and it's heavily focused on science and stuff. So, I love science." While he believed people

would say he is "into science" he did not aspire to study science post-secondary, which may be related to his aspirations to be a writer, as Jacob explained:

> Jacob: Well, I'm in the STEM [acceleration program] class right now, but that's not actually what I wanna do when I'm older. I'm in this because I enjoy it and I wanna learn facts, but actually I want to be an author or an illustrator when I am an adult, because I really enjoy writing books and drawing, I have an incredible imagination.
> Interviewer: Okay. Okay. Do you think your future job might involve science in some way?
> Jacob: Potentially yeah I could write science fiction, or I could draw scientific diagrams. I don't know, but maybe.

Shay, who also resided in the metropolitan area, was proud to describe himself as "into reading" and detailed how he read obsessively at home. He aspired to study science post-secondary as he believed it would be essential for his career trajectory as an urban architect. Shay's enjoyment for particular aspects of science played into his perceptions of himself as a science learner. However, Shay was articulate in explaining how he "ticked all the boxes" for what we would assume were the school or academic criteria he perceived essential to be a good reader.

> Interviewer: Okay, why do you think that?
> Shay: I'm extremely fast, my family keeps repeating that and as I read they also notice I take in every word, I don't just skim through, I take in every single word that I read. I've read the *Harry Potter* books 18 times in the last time, that's actually precise.
> Interviewer: Wow, you're really into reading!
> Shay: Yeah, I'm into reading, I'm good at it, I tick all the boxes.

Shay's pride echoes Mendick's (2006) study of masculinities in mathematics where she describes young men having an "investment in technical rationality" and proving oneself to others (p. 75). The words of Shay bring to mind learner identity(ies) as "the conceptualizations children have of themselves as learners" where they identify strongly as a particular type of learner (Reay, 2010, p. 279), and how they invest in these identities.

Chaminda, who had a low self-belief as a reader, aspired to traditional male dominated careers (military, police, NBA player) and embodied Archer et al.'s (2014) typology of "Normal" boys – boys who are interested in science but do not hold science/related aspirations (p. 12). His self-belief centered around not identifying as a strong reader, yet he still read regularly: "I really like reading Manga and stuff like that. Novels that I like to read. I like reading the *Hunger Games*…. And I also like crime books. There was one that was really good I can't remember the name now." Although classified as ESL, and with some difficulties with spelling, Chaminda appeared to have appropriated the value of reading and he visited the school library weekly and read while his friends played chess.

> Interviewer: So can you tell me about yourself as a reader?
> Chaminda: I'm not really a stronger reader. Literacy really isn't really my strong point. But I do like reading. So if I do get a [inaudible] book I'll probably spend the whole day reading it.
> Interviewer: Until you're finished?
> Chaminda: Yeah.
> Interviewer: And so you said literacy isn't your strong point. Why would you say that?
> Chaminda: Well, I'm not really good at spellings and stuff. And reading I kind of get confused with the words sometimes. What they are but I'll probably know what the word is.
> Interviewer: The spelling puts you off?
> Chaminda: Yep.

Echoing a wider trend in the data, the criteria for rating himself in reading appears to be related to one school-based criterion such as spelling. For Chaminda, reading was related to his home practices.

> Sometimes at home [I read about science]. I like the stars and the space and stuff. We had the super blue blood moon or something and my mum and me were reading about that. There was an article about that and then we stayed up to look at it. We didn't get much 'cause it was cloudy.

This reading at home appears to foster connections between the applicability of science and the various future career aspirations he was entertaining, which involved becoming a police officer or going into the military.

> Interviewer: Cool. Do you think that your future job might involve science in any way?
> Chaminda: I think if I was a cop then yes it would. Being, I think it's called, I forgot the name, the scientist ...
> Interviewer: Forensics?
> Chaminda: Yeah forensic scientist. And that would help with that. Even in the military that would probably help. It probably will help as well just in sports, your energy, your statistics, how to, science would probably help in that. What to eat, drink.
> Interviewer: So you think science would be involved in both of those. And military as well?
> Chaminda: Probably eating and drinking and helping drills and stuff.

Chaminda was able to make connections between the science learned in school and his lifeworld outside of school, an integral aspect contributing to the formation of the science literate boy (Figure 1). While science was clearly a part of his lifeworld, for Chaminda there was still some indecision around studying science post-secondary.

> Interviewer: Do you think you would like to study science in years 10, 11, and 12?
> Chaminda: Yeah.
> Interviewer: Why?
> Chaminda: Well probably cause if I wanted to be a police officer I'd probably need it. Just if I was in a case or something, I'd probably need it just to find out the small things. A fingerprint could help me a lot. Things like that would be really good.
> Interviewer: And what about when you leave school? Do you think you would study when you leave school?
> Chaminda: Maybe in university. But I'm not really sure. Cause I don't really think that science would be career for me.

Here we see three examples of boys living in the metropolitan area who describe their enjoyment for reading including science related reading at home (e.g., Jacob), in contrast to research concerning boys' underperformance and disengagement (Entwisle et al., 2007). There is considerable evidence of their science identity as deemed competent where the young men have multiple spaces to perform and be recognized (Carlone & Johnson, 2007) which fosters an ease in demonstrating scientific knowledge. They appear confident in performing the "smart science boy" (Carlone et al., 2015) able to make clear connections to their future. Though, this seemed more pronounced for Jacob based on his involvement in the STEM acceleration program — a form of science capital (c.f. Archer et al., 2015) — and more fragmented for Shay and Chaminda who are not a part of the program.

Rural

In contrast, the boys we interviewed in the rural area, whose aspirations centered primarily around farming and mechanics, did not seem to ascribe the same self-beliefs to their reading (Table 2). Common language used was "I don't pick it up well," "gets side-tracked" and "I struggled with it." There were also decidedly less examples of "muscular intellect" and general confidence in science (Archer et al., 2016), which compels us to consider not only the relationships between literacy and science but also how identities are constructed across disciplines (Lee, 1997). In her research on working-class boys and reading, Scholes (2019a) writes about how boys position reading and the ways in which they challenge dominant discourses highlighting the "complex patterns that contribute to social practices, such as reading, include multiple contextual environments, where the individual cannot be divorced from the social network in which they are embedded" (p. 347). Social networks and situated experiences in rural and metropolitan areas differ significantly and are entangled in lived experiences related to economic contours, ethnicity/race, sexuality, religion, patterns of employment, and thus, we can assume, influence how boys become science literate. Tom, who lived on a farm and talked about verbal traditions and how agricultural knowledge was passed down from his grandfather, did not particularly enjoy reading.

Interviewer: Tell me about yourself as a reader, what type of reader are you?

Tom: I'm a slow reader.

Interviewer: Okay, why do you say that?

Tom: Just because I probably wasn't ... I don't read that often, I just probably don't practice enough.

Interviewer: 'Cause you've just come back from your summer holidays, so now you're getting back into reading a bit more.

Tom: Yeah, I didn't read a book over the holidays.

Tom's conception of self as a reader was low and he described himself as uninterested in reading, although he read manuals related to farming and comics (considered stereotypical "boys" reading practices, according to Kehler & Cassidy, 2017). We see how when Tom did read it was related to geographies of place — his experiences living on a farm in rural Australia and the daily work of his family.

Tom: I don't like reading.

Interviewer: Okay, but you must read something.

Tom: Well, I like reading tractor manuals and stuff.

Interviewer: Oh, tell me about that.

Tom: Seeing how they work and seeing what new stuff's out.

Interviewer: What else is in a tractor manual?

Tom: They've got all the compartments, like the gearstick and how all the [inaudible] work and stuff.

With an aspiration tied closely to place, Tom aspired to be a farmer and did not plan to study science post-secondary. That is not to say he did not believe he was good at science (his rationale being "Cause I like hands-on work, and I think I'm alright at it"), although he preferred the practical side of the subject (perhaps related to his interest in farming that has traditionally been related to more manual embodied labor). Here we see a significant interplay between aspirations, learner identities and place. In terms of how a science literate boy is constituted (Figure 1), Tom distanced himself from a science identity but still held an average conception of himself in science. Living in a distinct place with its specific cultural, social and labor practices remains a powerful

force influencing student aspirations (Comber, 2015; Massey, 1995; Stahl, 2015). Tom's *self-belief in science* and his reading practices suggest that certain literacy practices are valued in particular ways (Barton et al., 2000). There is a focus on the embodied (e.g. practical side to science, farming aspirations) with reading practices positioned outside sanctioned ways of being (e.g. "reading is kind of boring"). Though his words suggest he did not view this as proper reading, he was engaged with reading tractor manuals — a powerful science-based text.

Another boy we spoke with, Finn, told us "I want to be a dirt bike mechanic for a company like Yamaha or KTM" because he said he liked the "hands-on stuff" which is frequently associated with working-class masculinity (c.f. McDowell, 2005). Finn found many of the concepts difficult in science at school and subsequently believed he was not that good at science. He was not really interested in science and had no aspirations to study science post-secondary. Finn used to read a lot, but he was now "more interested in stuff outside now" and saw himself as a middling reader.

> Interviewer: Okay, I mean, do you think you're a good reader?
> Finn: Maybe. I'm not a bad reader but I'm not necessarily a good reader.
> Interviewer: Okay, why do you say that?
> Finn: Because I can read stuff but it's not necessarily hard but it's like my mum can read a whole page really quickly and I take a lot longer.
> Interviewer: Okay. Okay, it's about the speed of reading?
> Finn: Yeah.

When Finn did read it was "usually magazines about motorbikes and stuff", which we probed further.

> Interviewer: Okay, cool. Tell me about those magazines? What do they feature in them?
> Finn: They might have the new bike that came out, they might do a study thing on it, they might have a section about new riderwear from say a brand.
> Interviewer: Okay, new riderwear like the outfit?
> Finn: Yeah, helmet and boots and stuff.

Finn believed he was "not good at science" and yet, his interest in mechanics lead him to explain how a motor runs — "the pistons, sorry, because they have all the forces making them like they go up and down and make the motor run and stuff." In terms of how a science literate boy is constructed (Figure 1), we see how Finn incorporated aspects of science literacy into his subjectivity. He displayed an enjoyment of science and was able to verbalize scientific principles. Yet, Finn's particular performance of masculinity did not align with the science literate boy — he had low self-belief in both his abilities as a science student and as a reader and, importantly, his particular ways of engaging in science are not recognized as forms of science capital, raising questions as to what the institution values as well as what counts as science capital.

While the attention to motorbike magazines and tractor manuals is interesting, there is no evidence that the young men we spoke to in the rural area saw this as science reading in the traditional sense. Based on the research, this connection did not seem present for the majority of the students regardless of gender (c.f. Stahl et al., 2019). Other research on learner identities — specifically girls living in urban areas in science who would be considered non-traditional — has focused on hybrid practices to establish a science identity drawing on "traditional and nontraditional resources and that re-inscribe new meaning into the cultural and scientific symbols that frame their participation and position across a range of communities" (Calabrese Barton & Tan, 2008, p. 223; see also Calabrese Barton et al., 2008). This raises some questions regarding how students construct themselves as learners (e.g., "science boys," "literate boys," "science girls," or "literate girls") and how forms of literacy are validated in certain ways.

When we asked Aiken how he was at science he said, "I don't know, probably at standard", saying he "Got Cs on most of my science stuff." Yet, Aiken was clear that people at school would say he was into science and technology, and that he was committed to his aspiration to become a sports engineer, which stood out among the other boys in the rural area. However, when speaking about science, Aiken focused on the practical "I enjoy the practicals a lot. Because they're hands on, don't get to do much stuff like that." When discussing his future career aspirations, Aiken was clear that, as a sports engineer, he wanted to be involved in design and drew on his knowledge of engineering.

Interviewer: …what kind of job do you think you'd like to have as an adult?

Aiken: Well, I want to make skis and wakeboards.

Interviewer: Oh okay.

Aiken: I want to be a sports engineer.

Interviewer: Sports engineer?

Aiken: Yeah.

Interviewer: Fantastic. Okay, [water] skis and wakeboards. Okay. Cool. So what inspired you toward that?

Aiken: I go skiing all the time, just sometimes I design wakeboards and stuff.

Interviewer: Okay cool. Fantastic. Okay. So, do you think your future job might involve science?

Aiken: Probably?

Interviewer: How so?

Aiken: Because the shape of the board and just what you're making involves science, like the shape of it and the weight, and all the different factors in it.

Aiken went on to describe how he speaks to his family about "how stuff works" where he was able to articulate knowledge commonly associated with physics.

Aiken: Well, the other day I was explaining about what the difference between different rockers on a wakeboard are and stuff.

Interviewer: Mm-hmm (affirmative)-

Aiken: So it's like the shape of it-

Interviewer: Yeah.

Aiken: If it's flat three different parts or smooth.

Interviewer: Yeah. Okay, so the way it-

Aiken: And what it changes. So if it's three certain parts and it's split at those three parts, it will give you more prop, but it won't be as smooth to land on.

Interviewer: Okay.

Aiken: And then if it's continuous, it won't give you much prop, but you'll land real smoothly.

In terms of literacy, Aiken read a wide range of texts from "funny books" to magazines about sports "I've got a lot of water-skiing magazines and…couple cricket [ones]." He also spoke about how he read before bed every night stating "my mum's a teacher, so I've got to read a lot" though he is quick to also point out "I guess I kind of enjoy it." The words of Tom, Finn and Aiken capture some of the complexities for boys in the rural area and also highlight the "gendered subject production" (Lee, 1997, p. 5) that occurs both in school and outside of school. While not discounting how subject disciplines become a significant aspect of each student's "identity project" (Mendick, 2006, p. 70), there appears to be quite a bit of identity work for the boys which occurs with literacy at home (Table 2), though this is significantly influenced by place.

Discussion

In investigating the entanglement of boys' discursive performances of masculinities in relation to their learning, the article has highlighted the usefulness of exploring the inter-related dimensions of young men's lives — specifically their conceptions of self in science, their aspirations and their reading practices as influenced by place. Drawing on Lee's (1997) work, she notes how "particular kinds of literacy constitute the literate in particular ways, while in turn, literate subjects both s*erve and constitute* the socio-cultural domain in its specificity" (p. 13). In exploring the participant's *self-belief in science* and *self-belief as readers,* we see the construction of the "science literate boy" as an amalgamation of different factors, each one mutually informing.

The relationship between place, masculinities, and aspirations is well documented (McDowell, 2005; Stahl, 2015) and previous research has illustrated how experiences within working-class communities can lead young men to adopt aspirations that require lower levels of skill and further training (Stahl & Baars, 2016). The boys in the rural area, whose aspirations were centered primarily around connections with traditions related to place such as farming and mechanics, appeared less engaged with both formal conceptions of science and literacy both at home and in school. Massey (1993) sees places as "articulated moments in networks of social relations and understandings" (p. 67) which lend to meaning making practices around what is valued. Thrift (1997) states, "The difference between location and place is that places have meanings for us which cannot be reduced to their location" (p. 160). The link between the work of farming and science was largely not made, signifying how "many working class youth may possess many skills, bodied of knowledge, objects and social connections that could be considered science

capital if they were legitimatized and used as such" (Wilson-Lopez et al., 2017, p. 247). In terms of a science identity, this calls attention to the interrelationship between place, labor and embodiment where spaces of manual labor contrast with traditionally cerebral spheres of high-tech industry, business services or science (McDowell, 2005). However, these old binary distinctions between a cerebral, rational middle-class masculinity and a working-class, hard, manual masculinity are increasingly changing (Stahl, 2015).

Focusing on place, we wonder how much of the boys' identities reflect their situated experiences. Keeping Carlone and Johnson's (2007) "dimensions of competence; performance; and recognition" (p. 1190) in mind, for instance, Jacob was very proud to have been selected to be part of the STEM extensions class at his metropolitan school. Finn, on the other hand, was struggling with science as he found "it pretty hard with all the different concepts and stuff that there is in it" — and had already identified that he preferred doing hands on things (inspiring his career aspiration to be a dirt bike mechanic). Thinking about Finn's words, it is clear he was engaged with diverse literacy practices and could be considered successful if a broader view of literacy was adopted in his formal schooling (Nichols & Cormack, 2009; Stahl & Dale, 2012; 2013).

Finally, in considering the science literate boy, we call attention to the science geek and how the boys resist and perform this subjectivity. There was very little evidence across the cohort of the boys othering performances of masculinity tied to the "science geek" (Archer et al., 2013), which has been noted in other studies on masculinities and learner identities (Renold, 2004), especially for high achieving "boffin" boys (Francis, 2009; Mendick, 2006). However, there was some evidence in both locales of boys being bullied for adopting pro-science beliefs in school. Charan, who was based in the metropolitan region said, "I like science. It's very interesting and fun to understand, but I also keep a limit because, here in school, I think people maybe bully me about that like they do at recess." Where, similarly, Ash, who was based in a rural area, asserted "No, I don't really show that I'm into science, but I am… At my primary school I used to get picked on, and all that, so I've been trying to act out that I don't really like science, but I do." Lee (1997) asserts: "subjectivity is an effect of constant struggle among competing discourses and conscious and unconscious forces. It is multiple and fragmentary, both fragile and aggressive, constantly in a process of renewal" (pp. 17-18). With this in mind, the words of Charan and Ash

highlight the struggle and the fragility of being a science literate boy where if one of these components is lacking, or compromised, the identity becomes more fragile.

Two main limitations framed the study. First, we did not observe lessons or speak with teachers; therefore, all the data is from the perspective of the students we interviewed. We cannot comment on the quality of instruction in either the rural area or in the metropolitan area. Rural areas particularly have been noted for facing challenges in the delivery of science education (Puslednik & Brennan, 2020). Second, we did not have a clear sense of the children's family-based cultural capital which has been relevant to other scholarship on science aspirations (Calabrese Barton et al., 2013) and which Archer, DeWitt and Wong (2013, p. 73) astutely note can contribute significantly to making science aspirations more "think-able".

Conclusion

While Hand (2017, p. 16) argues that "issues related to identity, power and agency have driven much of the field" of science literacies, there are significant gaps in research exploring science identities and text practices around science as well as their relationships to place and aspirations. We know that studies of science literacy are overwhelmingly focused on classroom life and formal pedagogy rather than considering how students are science literate in diverse ways which are often not recognized by the school environment (Author et. al. under review; National Research Council, 2007; Stahl et al., 2019; Archer et al., 2016). We are interested in how the science literate boy comes to be, where we seek to problematize what we know about science literacy as well as delineate how boys construct themselves across different subject areas (Lee, 1997).

The study highlights how place fosters opportunities for competence, performance and recognition of science identity (Carlone & Johnson, 2007) as well as the ways in which young people internalize place and community. The research emphasizes how *doing masculinity* is done in reference to both disciplines and place as well as how gender performances complicate "the binary construction of gender and the binary construction of curriculum" (Mendick, 2006, p. 105). Though, in considering Figure 1, how boys come to occupy multiple subject positions appears significantly influenced by place. For example, in terms of the discursive performances of masculinities, for those boys living in the rural area, it is worth considering that the science identity they perform within limited opportunities for competence, performance and recognition is more

fragile as they go against the grain. This fragility connects with Mendick's (2006) study of masculinities in mathematics, where she calls attention to "working-class class pretenders" (p. 75), where certain disciplines may feel like an uncomfortable fit for students, which can undermine their progress.

Sustained engagement with reading — especially reading at a high level —is important for post-compulsory science participation. Drawing on the proposed theoretical lens (Figure 1) to explore the relationship between literacy and science also compels us as researchers to think about disciplinary literacy not as simply about skills acquisition and practice but also about identities (Lee, 1997). Guzzetti and Bean (2013) and Stahl and Dale (2012; 2013) call attention to how adolescent males construct their identities through a variety of literacy events whether fostered in the formal school setting or in their wider lifeworlds. We accept that analysis of learner identities should also include attention to intersectional factors – specifically ethnicity – and we have not elaborated on this in detail. The metropolitan school site was more ethnically diverse with sizeable immigrant population. The students had aspirations attuned to more conventional science careers; there were also more examples of 'young professors'.

To conclude, in exploring the gendering of science literacy — and the construction of the science literate boy — it becomes essential to move beyond narrow measures of literacy (Martino, 2001) and consider the wider complexities of *literacies* (Barton et al., 2000) as embedded in experiences of place. This is not to say a similar approach would be needed to consider the *science literate girl* as portrayals of girls and their literacy practices have illustrated females as one homogenous group of high achievers that needs disrupting and further investigation (c.f., Scholes, 2019b). Overall, the findings encourage critical engagement with key arguments about the discursive performances of masculinities in relation to learner identities while the data suggests a need for more research on the gendering of science literacies specifically in reference to place.

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Endnotes

1. Connell (2000) refers to Biddulph as a "pop-psychologist" (p. 5) and warns of the precarious nature in assuming all boys subscribe to one type of masculinity.
2. The STEM acceleration program requires students to pay $80 to sit a test though there is a discount for families on School Card. Additionally, it requires a statement of support from both the parent and the teacher and a commitment of two years with a cost of $100 AUD each year.

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