In the wilderness and the lab, one learns to be a woman: the gendered constitution of experience in male-dominated school subjects

By

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Table of Contents

ABSTRACT

Both the wilderness and the laboratory are spaces from which women have been excluded throughout history. Today, girls in male-dominated educational spaces, such as STEM and outdoor education, continue to be outnumbered and face barriers to participation. Through educational and social practices, gender identities are (re)produced in complex assemblages of historical, social, and political forces specific to each disciplinary domain. In the context of STEM, there has been significant literature, policy and interventional attention directed to increasing girls' participation, but little movement. Outdoor education literature explores its benefits for girls but acknowledges the field's erasure of women despite efforts to address systemic inequalities. This remarkable resistance to transformation underscores the necessity for alternative narratives that accommodate the complex interplay of gender within these domains. Rather than addressing isolated barriers to girls' participation, this study troubles the foundational constructions of gender and disciplinary knowledge that fundamentally shape our understanding of girls' participation and lived experience.

Drawing on data emerging from a series of focus groups with 29 girls in Years 9-11 and semi-structured interviews with three teachers, this thesis explored the overarching research question: *In what ways, if any, are girls' experiences in STEM and outdoor education subjects shaped by gendered discourses and practices?* The methodological approach privileges two critical elements: participants' articulation and interpretation of their own experiences and the application of new materialist feminisms and posthumanist approaches. Combining these elements generates a richly textured portrayal of girls' educational journeys.

The contributions of the participants presented in this thesis reveal a crucial asymmetry in the gendered ontology of STEM and outdoor education spaces: while the masculine subject dissolves into a presumed neutral, universal figure, feminine identities have been positioned in these subjects as *other*. Nevertheless, experiences of in/equalities and belonging emerge as fluid contingent upon individual and collective material-discursive-affective entanglements. Emerging from the findings are opportunities for transformative material-discursive practices: creating opportunities

for young women to engage in meaningful intra-actions with STEM and outdoor spaces/objects; fostering collaborative, reflexive practices that challenge binary thinking about individual capacities; actively contesting the masculinization of educational assemblages; resisting superficial feminization or empowerment initiatives in favour of situated learning responsive to diverse identities; and cultivating authentic educational relationships built on trust and shared passion.

This thesis aims to tell stories that matter in new ways. By examining how gender materializes at the intersecting nodes of bodies, technologies, environments, and practices within STEM and outdoor education spaces, the work reveals gender as a fluid assemblage that continually reconfigures itself. This conceptualization destabilises traditional gender binaries present in girls' experiences STEM and outdoor education, challenging the apparent neutrality of educational practices. In summary, it argues for the disruption of both constructions of gender and of male-dominated subjects in the pursuit of fostering belonging. The study's original contribution lies in mapping these complex intra-active processes within educational contexts, thereby opening pathways for interventions that foster transformative relationships and novel forms of agential subjectivity beyond restrictive gender norms.

DECLARATION

I certify that this thesis:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university

2. and the research within will not be submitted for any other future degree or diploma without the permission of Flinders University; and

3. to the best of my knowledge and belief, does not contain any material previously published or written by another person except where due reference is made in the text.

4. has been completed without the use of generative artificial intelligence tools

Jayme-Paige Wearn

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Introduction

As when a little Girl
They put me in the Closet—
Because they liked me "still"—

Emily Dickinson, *They Shut me up in Prose*

In the poem *Planetarium* written in 1968, poet Adrienne Rich (2016) explored the life and experiences of Caroline Herschel, who is considered the first female professional astronomer. Herschel was born in the year 1750; initially provided with a basic education, she was disallowed from further education despite her aptitude, and it was decided the most appropriate pathway for her was as a household servant. It was only when she went to live with her brothers in England that she developed an interest in astronomy. Initially supporting her astronomer brother William with menial tasks related to his telescopes, Herschel went on to become an astronomer in her own right. Herschel discovered eight comets and became the first woman to have a scientific paper read by the Royal Society — a scientific society that did not admit women fellows until 1945 (Winterburn, 2015) — and the first woman to be awarded the gold medal of the Royal Astronomical Society, an honour not granted to another woman until 1996 (Bernardi, 2016). In reflecting on these experiences, Rich referred to the 'galaxies of women' who share 'every impulse of light exploding/ from the core/ as life flies out of us.' Not wanting the lives of the women who toil away in the background of glorified scientific achievements to be lived in vain, she goes on to challenge the reader:

What we see, we see
and seeing is changing

the light that shrivels a mountain
and leaves a man alive

Based on Herschel's life, Rich establishes that what we see, what we pay attention to, leads to inevitable change. Herschel's achievements did not rectify the exclusion of women in a male-dominated world — we are still talking about it over 175 years after her death — but it was a visible moment of women's potential in a male-dominated world. According to very simplified quantum mechanics, light behaves differently when observed. In our observations, we have the power to change phenomena so powerful it can 'shrivel a mountain', but so delicate 'it can leave a man alive.'

I begin this thesis — an exploration of the experience of girls in the male-dominated spaces of Science, Technology, Education and Maths (STEM)[1] and outdoor education — in this way to establish its overarching aim: to make visible the girls in these spaces and, in doing so, make way for new possibilities for disrupting the naturalisation of gendered experiences in male-dominated school subjects. My research occurs in the context of women's long history of finding ways to participate in male-dominated areas despite the structural, interactional and interpretive barriers to doing so.

The trouble with gender in STEM and outdoor education

STEM and outdoor education are male-dominated school subjects. I utilise the term male-dominated in reference to levels of participation, but also to describe the characteristics of the field which have been deemed 'masculine'. In terms of participation, the Workplace Gender Equality Agency (2019) defines a male-dominated field as consisting of 40% or less women. In South Australia – where this research was conducted – girls make up 53% of the Year 12 student population but physical sciences, specialised and methods mathematics, digital technologies subjects, physical education and outdoor education are male-dominated subjects. In contrast, health and wellbeing, biology, psychology and nutrition are female-dominated (SACE Board of South Australia, 2022). This is not unique to South Australia; similar levels of gendered participation can be found, particularly in certain STEM subjects, Australia-wide (Justman & Méndez, 2018) and internationally (Msambwa et al., 2024). There is little existing research on the scale of gendered participation in outdoor education because

[1] STEM is an umbrella term with various iterations, meaning that what is included and the way that it is taught in schools can vary. A generally accepted Australian definition of STEM includes natural and physical sciences, information technology, and engineering and related technologies, and mathematics (Palmer, et al., 2015).

research is in its relative infancy and the types of outdoor education programs vary significantly across educational settings and geographical regions, however, existing research identifies the prominent role of hegemonic masculinities in shaping student outcomes in Australian and international contexts (Blaine & Akhurst, 2023; Holland-Smith, 2022; Kennedy & Russell, 2021).

In terms of their masculinist 'nature', both the wilderness and the laboratory are spaces from which women have been excluded. At a structural level, and in terms of representation, STEM disciplines and outdoor education have remained the "domain of the white, college-educated middle-class male" (Dancy & Hodari, 2023; McNiel et al., 2012, p. 40) with a history rooted in masculinist discourses and traditions (Mahy & Wallace, 2022; Roberts, 2018), yet both fields have a veneer of neutrality which restricts their representation and status as contested spaces. STEM identifies itself through a rational neutrality that is "devoid of politics" (Philip & Azevedo, 2017, p. 527), whereas outdoor education is specifically and intricately linked with 'natural' spaces and, as such, appears a 'neutral' and 'empty' space for learning to take place in (Preston, 2014, pp. 174-175).

There are significant gaps in the research concerning both subject areas. Where STEM research focuses on inequalities and workforce participation, it rarely explores the personal and educational benefit of a STEM study. Outdoor education research focuses on areas of personal development, but it rarely explores barriers to participation. In the area of STEM, research and policy makers, such as the Office of the Chief Scientist, have problematised the lack of young women entering the STEM workforce (Hutchinson et al., 2023; Leigh et al., 2020), and research and interventions have focused on identifying and removing such barriers to participation (Bennette & Toffoletti, 2024; Dasgupta & Stout, 2014; Prieto-Rodriguez et al., 2020). McKinnon (2022) argues that current research-based and policy-driven initiatives lack evidence of their efficacy and, while some may be potentially effective, most are focused on small-scale issues, "tinkering around the edges" without the ability to implement systemic change (p. 212). Additionally, existing research on interventional programs focuses on narrow metrics, such as personal satisfaction and enjoyment (Sáinz et al., 2022), which does not necessarily translate to behaviour change or institutional change. Much of the research focuses on the 'typical' male and female and 'typical' male and female interests, often

concluding that more stereotypical portrayals of female interests in STEM would increase interest, rather than addressing systemic barriers and subjectification (Sinnes & Løken, 2014). Few studies have more critically explored "why these barriers are so persistent and hard to shift" (Powell & Sang, 2015, p. 920). Research on girls in outdoor education focuses on personal development outcomes, particularly in single-sex environments, and the ways in which they might benefit when there are no young men to dominate the experience. Little research addresses the experiences of girls in traditional outdoor education school-based programs, and in their review of the literature, Breault-Hood et al. (2017) note that there is a need for more research on the "specific needs, desires and experiences of adolescent girls" (p. 29). Broadly speaking, experiences of inequality and a multidimensional examination of intra-acting, systemic and structural barriers are missing from the research concerning both subject areas.

More understanding is needed about *how* gender differences are constructed and experienced at the secondary school level, despite indispensable research from scholars in early childhood and primary education (Black Delfin, 2021; Callahan & Nicholas, 2019; Kostas, 2022) and those who have examined the reproduction and construction of gender in the secondary school setting (Graham et al., 2017; Ingram, 2019; Wolfe, 2022a). Crucially, as Osgood and Giugni (2015) note, we need to go beyond gender differences as constructed in discourse and "to "figure" gender as multiplicities of vibrant matter, emotions, encounters, relationships and happenings that are uncertain, shifting and contingent" (p. 349). The gaps in STEM education research are quite different from those in outdoor education, and this reflects the different priorities, perspectives and stereotypes associated with each; nonetheless, their most pertinent commonality is the persistent gender inequality at all levels of participation. In taking the two fields together, we can see multiple examples of how girls are positioned and gendered in school environments as well as their understanding and negotiation of these processes and the choices they allow.

Within STEM and outdoor education, women's identities are constructed and defined by difference (Godec et al., 2024; Scholes & Stahl, 2022). Women do not become *scientists* or *mathematicians*, for example, they become *women in STEM*. The contributions of the participants presented in this thesis reveal this crucial asymmetry in the gendered ontology

of STEM spaces: while the masculine subject dissolves into a presumed neutral, universal figure – the unmarked category of the 'objective knower' – femininity remains perpetually marked, perpetually other. In these disciplinary spaces, there exists no 'boy in STEM,' precisely because maleness has been naturalized as the invisible norm against which all other subjectivities are measured and made visible (Beauvoir & Parshley, 1953, p. xv). Instead, we encounter the supposedly neutral 'STEM person' – a discursive construction that masks its inherently masculine coding – juxtaposed against the perpetually qualified, perpetually particularized 'girl in STEM,' whose very naming signals her position as the marked other within this epistemic regime. The outdoor education space provides a small window into another masculine space where the male participant is assumed neutral, and girls' participation, needs and safety requirements are additional and problematised with reference to the male norm (Tilstra et al., 2022). Within this gendering, the apparent choices and modes of participation (positive or negative) enacted by girls do not emerge from some essential nature or unfettered agency, but through complex interplays of power, discourse, and embodied experience (Hekman, 2008, p. 113; Ottemo et al., 2021). What may be claimed as natural inclination or autonomous decision-making masks a more nuanced reality: the profound disjuncture between lived experience and its interpretation within available discursive frameworks.

The profound insight embedded in Beauvoir's declaration that "one is not born, but rather, *becomes* a woman" extends far beyond a mere acknowledgment of sociocultural constructions of identity (Beauvoir & Parshley, 1953, p. 267). This *becoming* extends to a corporeal embodiment of gender, which manifests through the daily choreography of gendered performance, where the female subject both internalizes and reproduces the very structures that constitute her gendered identity (Butler, 1986, p. 36). Within the masculinised territories of male-dominated disciplines and school subjects, specific types of gender performances are required and enacted. Here, gender identities manifest through a complex matrix of historical, social, and political forces specific to each disciplinary domain. The resulting performative space creates a double bind: female subjects find themselves simultaneously cast as both subjects and objects of knowledge production, navigating a terrain where their very presence embodies a kind of epistemological contradiction within the masculine economy of the discipline.

As I was trying to distil the message of the thesis into a clear picture of girls' experiences in male-dominated spaces, I was interrupted to cover a substitution lesson, and I walked into a Year 12 Physics class with these issues on my mind. I was supervising a test, and so I had plenty of time to continue my thoughts. As I sat there mulling over my questions, I watched 15 young men and one young woman prepare for their test. Several of the young men turned to the one young woman in the class to ask if she had a spare pen. She did not. Why would she? Yet there was an automaticity in the assumption that she would be the one in the room who would be able to provide for them. The young woman completed the test first and the young men, albeit laughingly and in good humour, rolled their eyes at her and each other as she walked to the front of the room to submit it, sighed quietly and continued with their own tests. As I sat there, considering that exchange, I thought *I wish I could take a photo right now and show people what I'm seeing. Because it's this. This is what the thesis is about.*

Aim, significance and scope of the study

This thesis began with questions arising from my own observations as a teacher. I situate myself within this research with a further two small anecdotes. First, spanning four decades, I, and my female colleagues associated with STEM, had participated in science classes where we were one of the only girls. Over the following decades, we witnessed STEM weeks, workshops, government initiatives, advertising, and programs all dedicated to increasing girls' STEM participation, but we also saw very little meaningful change. The ratios of female to male students in senior classes now were similar to when we were at school. It was befuddling after so much time and effort, and I wanted to know why. Second, when, once again, I was the only female teacher on an outdoor education experience, the one female guide said upon seeing me, 'representation through minority, hey?' I realised in that moment how little time was dedicated to thinking about the experience of girls in other male-dominated subjects and the pressures that girls face. I wanted to know what insights could be gained from looking at this picture more holistically and understanding what the experiences of women in these areas looked like today.

Aim

This thesis sets out to investigate girls' participation in the male-dominated subjects of STEM and outdoor education by exploring gendered practices and discourses that contribute to the ways in which they experience and interpret the subject and their learning within it. Further, the thesis aims to open up spaces for further critical discussion by telling stories that matter in new ways. By employing a theoretical lens of new materialist feminisms, it aims to identify new ways of thinking about gender in the context of male-dominated school subjects, new stories to be told and new possibilities to be created. In so doing, it aims to provide a window into possible measures that can support girls' engagement with STEM and outdoor education.

Research questions

Acknowledging the problem of gender in STEM and outdoor education outlined above, the research presented in this thesis rests on the following overarching question:

In what ways, if any, are girls' experiences in STEM and outdoor education subjects shaped by gendered socio-material-discursive practices?

This question was explored further by investigating the following sub-questions:

1. How do young girls *interpret* their choices and educational pathways?
2. In highlighting the voices of girls, what recommendations can be made for future practice?

While it is clear to observers and scholars that girls' experiences in this area are gendered, for the purposes of this research, I put aside my own observations and assumptions and leave open the possibility that there are explanations other than gendered discourses, practices and structural inequalities. In doing so, I start with 'In what ways, if any...' if only to signal that there indeed may be other possibilities that create difference in experience and rates of participation; I began the research with an open mind to such possibilities.

Significance of the study

The significance of this thesis lies in its theoretical and methodological approach that moves away from addressing individual barriers of girls' participation in male-dominated subjects to troubling the construction of current knowledge of participation and experience (Haraway, 2016). The body of literature on girls and women in STEM is extensive, outdoor education less so; however, much of that focus is on the barriers that girls face and the efforts to address those barriers. While this is important, focusing on the barriers while working within the existing system and considering existing norms is seeing limited change and can work to essentialise girls' experience.

In considering queer education in secondary schooling, Sara Staley (2018) observed that while there had been successes, the field was in a 'stuck place' and suggested that in order to see deep-rooted social change, it was necessary to move away from research that simply looked at barriers and motivators and move toward research that embraced complexities. She posited that it would only be in moving away from such simplifications that we would be able to trouble the kinds of systemic thinking that created the problems in the first place. In considering female participation in male-dominated areas, we can see the same kinds of 'stuck' thinking, where research and interventions exist to dismantle the barriers and build motivators relating to girl's participation, without considering the complexities or the normalising effects of embedded, structural practices. Thus, I have responded to Staley's reflections and Haraway's challenge to stay with the trouble (Haraway, 2016), expecting this will lead to new ways of thinking about gender, education and participation as problems for theory and as issues that must be addressed by educators and policy makers. In taking up this challenge, I focus on two critical strategies: providing the participants with significant agency so as to examine and critique their experience and to highlight their voices, and applying new materialist feminisms, and more broadly, posthumanisms, as a lens through which to look at old problems in new ways.

While there are certainly other feminist and poststructuralist theoretical approaches which successfully challenge essentialist beliefs about gender, new materialist feminisms offer a set of tools to explore those complexities with a view of gender that takes matter — corporeal,

environmental, technological, the more-than-human — into account. New materialist feminisms offer a historically, socially, and politically situated account of the body, experience and difference, which Barad sees as "not a breaking with the past, but rather a dis/continuity, a cutting together-apart with a very rich history of feminist engagements with materialism" (Juelskjær & Schwennesen, 2012, p. 13). Coole and Frost (2010) argue that the use of new materialisms allows for a "critical and nondogmatic reengagement with political economy, where the nature of, and relationship between, the material details of everyday life and broader geopolitical and socioeconomic structures is being explored afresh" (p. 7). In addition to its potential for examining the context of girls in male-dominated subjects *afresh*, the focus on *becoming* in new materialist feminisms allows for a deep analysis of the discursive-material entanglements that lead to a rethinking of, in this case, in/equalities and difference and how they are constructed in the context of male-dominated school subjects (Sheridan et al., 2020).

Barad argues that phenomena are the "entanglement of intra-acting agencies;" the significance of the use of the term *intra-acting* being that it "queers the familiar sense of causality" (Kleinman & Barad, 2012, p. 77). In viewing more-than-human gender performativity as "an assembled enactment of multiple forces that in the very entanglement of human and nonhuman modes of life articulates a multiplicity of gender identities" (Dichman, 2024, p. 72), I recognise the constitutive effect of environments and the dynamic *intra-actions* between bodies, environments, technologies and social forces. This is instrumental to an understanding of STEM and outdoor educations, whose very spaces — the lab, nature, wilderness — are implicated as sites of masculine performances (Kennedy & Russell, 2021). Additionally, imbued in perceptions that males are more capable in STEM and in physical and technical aspects of outdoor education is a form of biological essentialism, which can only be challenged when science and the constitutive power of language is taken seriously (Jagger, 2015).

In the practice of situating knowledge (Haraway, 1988), and in recognising how data emerging from student and teacher voices are entangled in material-discursive practices, I seek to avoid ideologies about scientific objectivity for a successor science which offers a richer, better account of the world. This knowledge, Haraway (1988) argues, is partial, not universal. It does not deny meaning or bodies, rather "build[s] meanings and bodies that have a chance for life"

(p. 580). The research was constructed in such a way to provide space for the participants, those entangled in the phenomena being explored, to identify which stories matter, in both senses of the word, and to pull at the strings of their own experience (Haraway, 2016) to create that rich, complex, contradictory picture of their world. This is further developed through the methodological tool of diffraction – appropriate to the discussion of gender, particularly as it disrupts science/humanities, physical/theoretical binaries in such a way that can provide a model for thinking about gendered subjects at a school level. Wolfe (2022a), Taguchi and Palmer (2018), and Ingram (2019) provide models for thinking about girls in education in this way. I apply such models and ways of thinking to the specific context presented here and acknowledge the work they have contributed to this space.

Current efforts to address women's participation (mostly) reflect the best of intentions; however, issues arise when looking at the problem "from above, from nowhere, from simplicity" (Haraway, 1988, p. 589). When teachers, schools and pedagogical practices engage with multiple ways of knowing and modes of being, it can disrupt constructs of gender, gendering practices and stereotypical approaches to male-dominated subjects. It allows female students to engage in new ways with the subject and provides a richer experience for all students. Authentic relationships, passionate, vulnerable and enthusiastic teachers, meaningful engagement with how the world works and is connected to them and to other areas of life, and critical, reflexive conversations can become part of the entanglement and create experiences of belonging. The research processes in this thesis may be limited to a time and place, but the findings suggest not a singular practice or solution, but rather, an attention to how difference is created, the effects of difference, while "applauding difference… and embracing the embodied knowledge-praxis of young people in education" (Wolfe et al., 2024, p. 899). New materialist feminisms and the richer picture that its application generates allows for disruption and displacement and allows for new stories and new possibilities.

Ultimately, this thesis advances a critical position: the necessity of theorizing girls' subject and identity formation as a complex matrix of power relations, embodied experiences, and discursive practices within secondary school-based male-dominated fields. Moving beyond simplified accounts of identity that treat gender as a stable category or which reduce

experience to individual choice, I propose instead an analysis that captures the multiple, shifting, and often contradictory ways in which girls' subjectivities emerge through their engagement with these disciplines. This framework recognizes that identity is neither unified nor sovereign, but rather constituted through the intersection of institutional power, disciplinary knowledge regimes, and the material conditions of academic spaces. By attending to the situated nature of subject formation – its embeddedness in specific historical, social, and institutional contexts – I illuminate how girls' identities are simultaneously produced by and resistant to the masculine economy of these fields. This approach reveals not just how gender is performed within these spaces, but how the very possibility of certain subject positions is enabled or foreclosed by the power relations inherent in male-dominated disciplines.

Scope

This thesis does not set out to *compare* STEM and outdoor education, subjects which pursue different foci, hold different positions within a school and show differences in the level and type of girls' participation. Within the broader context of schooling, STEM and outdoor education have their own broad histories, philosophical, ideological and pedagogical approaches which shape the various iterations of how they are implemented at a system or school level. The data and discussion for each are not mirrored across the findings chapters, reflecting their differences. It may seem unusual to combine these two areas in the one study. However, each offers invaluable insights through their intra-actions with socio-material-discursive forces enacted in space and place, while remaining two of the most male-dominated subject areas in Australian schools. While there are some intriguing points of similarity and of difference between STEM and outdoor education, they can be considered as individual vignettes or case studies which can be read, at times, through each other.

This study explores the experiences of those who identify as girls. There are other factors, such as race and identification as LGBTQIA+ which mediate experiences in these subjects. These populations are also underrepresented and under-researched in an Australian STEM

and outdoor educational context and in the research; however, the experiences of gender were limited by those who responded to the open invitation to participate, and the participants in this study did not self-identify as belonging to these groups. Binary constructions of gender were also found in extant literature, discourses of female participation in STEM and outdoor education, and in the experiences of the student participation. As such, gendered language is used to describe these constructions, perspectives and experiences.

At this point, I want to acknowledge that I use the terms girls, women, boys, men, throughout this thesis to describe the participants, the participants discussed in extant literature, and relevant theoretical approaches. I do this for three reasons: first, the participants in this study all identify as girls despite an inclusive and open invitation to participate, so such terms reflect participants' identities and self-identification. Second, the thesis focuses to some extent on a particular discourse of *girls in STEM* which is intentionally balanced by the findings in the outdoor education research and setting. Finally, these somewhat problematic constructions of gender emerged from the fieldwork I conducted in a way that I was not expecting. Drawing on Wolfe (2022a), I uncomfortably use the term 'girl' to describe the participants to acknowledge binary and hierarchical constructions of the schoolgirl figure which render "possibilities of being student… excluded from mattering" (p. 6). Further, I drew on the work of Francis and Paechter (2015) who suggest a 'strategic essentialist' approach to deal with the problem of gender categorisation in research. While I distance myself from the term essentialist, this is an approach that uses such labels where necessary and in a temporary fashion to identify inherent power structures.

Overview of the study

I identified a pivotal time in a girl's educational journey – Years 9-11 (approximately ages 14-17), where students are beginning to choose the subjects which will, to differing extents, shape their future pathways. I wanted to speak with girls who either were continuing with their STEM or outdoor education journeys or who had previously been interested in, involved with, or identified as skilled at, STEM or outdoor education. I used focus groups incorporating a range of participatory action research techniques to explore the girls' experiences.

Participatory Action Research is 'overtly emancipatory' and aims to develop a 'deeper understanding of theory-in-practice' that can be particularly useful for practitioners and researchers in the field (Wright, 2021, p. 161). In addition to these focus groups, I used individual, semi-structured interviews with the three staff members responsible for the learning areas within their schools. This perspective created another node for analysis within a diffractive reading: a way of reading insights through each other and through multiple theoretical insights (Mazzei, 2014, p. 742).

In selecting schools, I approached schools who had a reputation for strong STEM and outdoor education program. One school respond positively for STEM and outdoor education, Lobelia High School, and one school responded positively for STEM only, Mangrove High School. The two schools are South-Australian secondary co-educational schools, one public and one private, both of comparative privilege according to the MySchool website's Index of Community Socio-Educational Advantage (ICSEA) data, but still with a cohort of students being from significantly different socioeconomic backgrounds. The aim of having different schools was not to focus on class but to compare the experience of girls who have participated in different models of STEM and different contexts of male-dominated subjects. Despite this intention, class and socioeconomic backgrounds of the students and the economic resources of the schools necessarily needed to be factored into the study given the different levels of access to programs, resources, and subject choices.

With the use of new materialist feminisms, this thesis reveals the tensions that girls experience in male-dominated subjects. I conclude that current perceptions of girls in these subjects, the language used to describe their participation, discourses of false empowerment, persistent expectations of femininity and masculinity, and approaches which rely on fixing girls or are limited to *tinkering around the edges* (McKinnon, 2022), contribute to the continuation of systems which only serve to (re)produce exclusions. Additionally, current expectations of femininity which align with fitting in socially are antithetical to current forms of participation in these subjects. I argue that understanding and addressing the 'problem' of girls in STEM and girls in outdoor education requires unveiling, and working with, a richer picture of intra-acting entanglements which have shaped how girls participate.

Overview and approach of the thesis

This thesis is comprised of three sections. The first section contains the necessary background required to contextualise the data presented in the second and third sections of the thesis. Chapter 2 includes an exploration of new materialist and posthumanist theories. These theories underpin approaches to gender and inequality and are the tools I use to analyse the student focus group and teacher interview data. In this chapter, I demonstrate how theoretical tools and lenses which take into account the multiplicity (material, social, discursive) of forces which shape us, such as those of *becoming, spacetimemattering,* agential realism, and performativity, can provide unique insight into the experiences of girls in STEM and help to reveal the complexities which occur below the surface. Chapters 3 and 4 develop the context of girls' participation and the relevant literature in STEM and outdoor education. These chapters are necessarily separated into STEM (Chapter 3) and outdoor education (Chapter 4) due to the vast differences between their approach to pedagogy and participation, and the nature of the extant literature. Chapter 5 is a short chapter which bridges the literature with the theory and methodology, leading into Chapter 6 which outlines the research processes and the methodological considerations that guided their implementation.

The second section addresses the research question by applying the theoretical tools and research methods to present the complexity of the experiences of girls in STEM and outdoor education, each starting with a 'hot spot' from the data demonstrating the material, discursive and social conditions of their experience. Chapter 7 presents the experiences of girls studying STEM at Lobelia High School and Mangrove High School and Chapter 8 explores girls' experiences in outdoor education, presenting their voices and providing an alternative experience to the one described by the students who participated in the STEM focus groups. Chapter 9 considers participants' recommendations for change, not only outlining what they wish to see happen but how these calls can be interpreted using feminist new materialist tools.

The final section of the thesis, the discussion and conclusion chapter, presents a summary of the findings. This chapter utilises diffractive reading techniques to bring together the data which emerged from discussion of STEM and outdoor education. The chapter returns to the research questions, exploring where to from here, and concludes with a work of *SF,* a technique drawn from Haraway (2013b) that uses metaphor to explore other possibilities for world building.

Chapter 2: Essentially contested: The role of new materialist feminisms in contesting essentialist perspectives of girls in male-dominated subjects

Through the lens of new materialist feminisms, this thesis interrogates how material-discursive practices in educational settings produce and mobilise gendered becomings in ways that perpetuate inequalities. This approach produces rich cartographies of the gendered terrain that young women navigate, revealing how embodied encounters with gendered expectations and institutional practices become sedimented as 'natural' through ongoing entanglements that constitute rather than reflect existing gender categories. This chapter will describe this theoretical approach, ultimately arguing the ways in which it can be used to tell new stories and create new possibilities for disrupting gendered participation and transformative approaches to gendered inequalities.

I begin by establishing the pervasive role that essentialist beliefs play in shaping the expectations placed on girls today. After acknowledging the critical work of gender and feminist theorists in challenging essentialism and contributing to new materialisms and posthumanities, I then define key concepts which underpin these theoretical frameworks. These definitions demonstrate how new materialist and posthumanist approaches can be applied to enrich our understanding of the complex, multifaceted and intra-acting forces that are entangled in the constitution of girls' experiences. Through this theoretical intervention, I establish the necessity of deploying these frameworks to locate opportunities for disruption and new ways of thinking. The chapter will conclude with how elements of, and approaches to, critical pedagogy can work alongside new materialist feminisms to think about how new ways of thinking about gender emerging from this richer picture of a girl's experience can lead to transformative practices in the classroom and in practice.

Essentialism, femininities and feminism

To understand the underrepresentation of girls in particular school subjects, it is necessary to understand the way in which the production of, and access to, knowledge is gendered. Essentialist beliefs continue to be prevalent in perceptions about what is possible for girls, in modern approaches to feminism, and in the ideas that students, and society, hold about femininity. These entrenched belief systems actively shape who girls become in male-dominated subjects, affecting not only their participation but our capacity to imagine alternatives.

Biological essentialism, the belief that an individual's characteristics are pre-determined by biology and that gendered characteristics results directly from a person's sex persists (Hopkins & Richardson, 2020). Saguy et al. (2021), for example, reported that over time, gender equality may have increased, yet biological essentialist beliefs contribute to "increase the endorsement of stereotypes" (p. 2). In their study, the majority of men and approximately 40% of women attributed differences in parenting and workplace strengths to biology. Donovan et al. (2024) found that high school biology books contain essentialist views of sex and gender, even though those views are inconsistent with the biological sciences. Additionally, Calero et al. (2024) found that while LGBTQIA+ students showed lower gender essentialist attitudes than their peers, all adolescents in their study were influenced by dominant, essentialist social expectations. These studies demonstrate the persistence of essentialist beliefs — beliefs which are not necessarily coherent or reflective of what we know about the world.

Sara Ahmed (1998, p. 90) addresses a fundamental challenge within essentialist thinking — specifically, the question of what gets included within the boundaries of essentialist categories:

> to assume the stability of woman is to conceal the borders that police what is inside and outside the meaning of 'woman'. As such, the stability of woman is an effect of power relations: that is, an effect of those who have power to define or authorize the criteria from what constitutes woman.

Ahmed argues that essentializing the concept of 'woman' is a racialized, cis-heteronormative, ableist, and classed act of normalization which "negate[s] the possibility of transformation" (p. 90). She argues that it is necessary for feminist projects to make visible boundaries, challenging the stability of categories such as 'woman'. In acknowledging that essentialist categories are neither static nor absolute (Heyes, 2018).

Concepts of femininity and masculinity are also not, as essentialist beliefs suggest, static (Wolfman et al., 2021). Femininity and masculinity have been defined by gender theorists as a hierarchical relationship of complementarity (Hoskin, 2020) that alters with time and place. Connell (2009) defines masculinity and femininity as 'projects' — 'patterns of a life-course projected from the present into the future, bringing new conditions or events into existence which were not there before' (p. 101). In Foucauldian terms, disciplinary practices of femininity require constant self-surveillance, resulting in the shaping and re-shaping of one's body and one's identity. Subjugation occurs through normalising practices; it is consequently by choice (or the illusion thereof) that women engage with such practices, perhaps subconsciously, due to the incentives (desirability), rewards (acceptability), fear (of deficiency) and punishments (exclusion and shame) that are an outcome of their choices (Oksala, 2011).

Constructions of women in STEM or in outdoor education, and essentialist beliefs about the ways in which they participate, are unique to the culture, time and place in which they exist. Critically, what it means to enact femininities or masculinities and the way this interacts with participation in these subject areas also emerges from time, place and culture. While the ways in which feminist scholars have critiqued essentialism since the 1960s will be explored in the following sections, it is instructional to look at the new influences which shape the 'boundaries' of woman. We can see, for example, 'new femininities' emerging, intersecting with modern feminisms, in ways which are interconnected with essentialism, subjugation and neoliberalism. Popular feminisms as represented in society and the media have brought forth these 'new femininities' focused on the body and on "hotness" and centred around "energy, vitality, capacity, and entrepreneurial spirit, along with public visibility and self-exposure" (Dobson, 2015, p. 32). These versions of femininity might move away from a definition of, and characteristics of, femininity that even feminist scholars such as Sontag and Friedan described

as weak and infantile (Hoskin & and Blair, 2022); however, they also reinforce a kind of essentialism. In exploring how feminism has been hijacked by neoliberalism, Bennett (2024) explores the way that slogans such as 'empower women' are used to commodify feminism and feminist identities, all while, as McRobbie (2015) suggests, representing the ideal feminist woman as the 'perfect' mixture of someone who is enterprising, living an idealised life, and who engages with traditional femininity. These feminisms and related femininities are often labelled or critiqued as white feminisms, seen as marketable feminisms which target middle-class white women in ways that contribute to widening race, class, and sexuality division and inequalities (Kanai, 2020). These constructions and expectations of women and feminism shape and organise the ways in which girls can participate in each aspect of their life.

For girls, participation in subjects, which by their very nature and the stereotypes associated with them — nerdy, dirty, physical, difficult (lisahunter, 2021; Starr & Leaper, 2024; Tilstra et al., 2022) — does not align with what it means to be feminine or with what is expected of them. Separate to barriers and experiences of exclusion they may face within the subjects, self-surveillance practices mean they withdraw from these spaces in order to maintain a cohesive identity (Dawson et al., 2020b). Persistent essentialist beliefs, as identified at the beginning of this section, create boundaries which are made invisible through gendered practices which create an assumption of stability. Through these normalising practices, there comes to be a pressure and an expectation to conform. When a subject, such as STEM or outdoor education, makes it impossible to both conform to societal gendered expectations and to the gendered expectations inherent in the subject, it communicates to girls that the subject is not for them. A theoretical approach, such as new materialist feminisms, which makes visible these boundaries, examines the ways in which equality is entangled with social practices, and considers how matter comes to be constituted through such entanglements, is therefore critical. This will be established throughout this chapter.

Situating theoretical approaches to gender

New feminist materialisms and its approach to gender have emerged in part from, and as a response to, a robust history of feminist scholarship which has challenged essentialisms and

reductionist modes of thinking about gender. This history is explored here before I outline how new materialist feminisms and posthumanisms diverge and offer an interesting way to think about girls' participation in STEM and outdoor education.

Since the 1970s, critical theorists (Butler, 2002; Firestone, 2015; Foucault, 1988; Haraway, 2013a; Irigaray, 1985) have been concerned with defining sex, gender, the nature, and production, of difference, and how these sit within existing power structures. While each making different arguments, the purpose of this critical theory is not to confirm existing oppression but to reveal power dynamics, previously rendered invisible, in such a way as to unveil emancipatory possibilities (McNay, 2022). West and Zimmerman (2009) argue that fundamentally "the oppressive character of gender rests not just on difference but the inferences from and the consequences of those differences" (p. 117).

The concept of gender became frequently used in the late 70s to elucidate the patriarchy's role in shaping women's identities and helped to pinpoint how women were conditioned to conform to stereotypes (Muehlenhard & Peterson, 2011; Scott, 1999). The distinction between sex and gender ultimately provided hope that women could deviate from their predetermined roles in such a way that elevated them from their oppression (Oakley, 1972; Withers, 2019). The nature and specificities of that separation, however, has been the subject of ongoing debate and criticism, with theorists attempting to determine how integral, if at all, the role of sex is in shaping one's identity, behaviours, abilities and interests -- in other words, how much of one's identity is 'natural' and how much is 'socially constructed' (Fausto-Sterling, 2012; Fine, 2017; Hines, 2020; Jordan-Young & Rumiati, 2012)?

In West and Zimmerman (1987), there is a turn towards seeing gender as something one 'does.' Rather than something that one achieves, such as a 'role,' or something individual, doing gender in this sense is a historically, socially, politically situated process "carried out in the virtual or real presence of others presumed to be oriented to its production" (p. 126). It is in this way that individuals come to self-regulate and self-monitor behaviours in order to fit in, or in West and Zimmerman's terms, are 'socially recruited' to appropriate *(verb and adjective)* gender identities, resulting in those behaviours being deemed natural and objective. The way in which society functions, they argue, acts as a resource for 'doing' gender

– heteronormative family practices, gendered bathrooms, clothing, and mating, to name just a few examples, are practices which have been constructed yet "reinforce the 'essentialness' of gender" (p. 137). These practices start in early childhood, but in the teenage years, adolescents are more likely to compare themselves with others and monitor each other based on gender norms. As such, the felt pressure to conform increases (E. F. Jackson et al., 2021; Mastari et al., 2023).

Poststructuralists, and scholars whose work has aligned with poststructuralism, such as Butler, Foucault, Irigaray, Cixous and Kristeva, "envisaged a radical deconstruction of… essentializing practices that locked individuals into particular subject positions or categorizations" (Davies et al., 2006, p. 88). Indeed, Judith Butler extended the concept of 'doing' gender further, writing that "one is always "doing" [gender], with or for another, even if the other is only imaginary" (Butler, 2004, p. 8). Feminist poststructuralists explore the ways in which discourse and power-knowledge regimes are deployed to create repressive practices, to equate biology with practices of femininity and masculinity, and to make possible what is both thinkable and unthinkable (Blaise, 2005; Davies et al., 2006; Hesse-Biber, 2014). This is a useful lens for considering gendered participation in male-dominated subjects. In the area of computer science, for example, Convertino (2020) writes that naturalisation of gender difference occurs through binary logics — man (subject)/woman (object) — and that a "durable equation" between masculinity and technology regulates "discursive formations of underrepresentation" in ways that render women problematic, invisible or highly visible (p. 596).

While it is critical to consider how these discursive and regulatory systems work, and particular subject positions and categorisations are certainly evident in the experiences of girls in STEM and in outdoor education, there are two limitations to poststructuralism relevant to this thesis that I explore here. The first is the need for a theory which challenges normative positions through complexifying, and engaging with the multiplicity of, phenomena. Krylova (2016) argues that poststructuralist accounts of binary oppositions and power do not always work to expand the boundaries and possibilities of gender, and the theoretical ramifications of experiences and phenomena which challenge the norm need to be better accounted for. The second limitation relates to the role of matter, the more-than-

human, and of biology in accounting for women's participation in STEM and outdoor education. This requires theory which sees biology as "a source of action, movement, and potential" which can constitute or be constituted, induce development or be hindered in its development, and which intra-acts with, and is inseparable from, cultural and historic realms (Pitts-Taylor, 2016b, p. 3).

New materialisms are not in opposition to poststructuralism, rather, they intersect and overlap in places, including critical movements by poststructuralists to account for matter and biopower (Pitts-Taylor, 2016b; van der Tuin & Dolphijn, 2010). Feminist new materialisms may be seen as a "plurality" of things that "draw on a diversity of theories, practices, experiences" (Dichman, 2024, p. 73) but as Allhutter et al. (2020) argue, new materialisms should be viewed an "*evolvement from* rather than a *break with"* other research traditions. Doing so recognises feminist critical theory's long engagement with corporeality and materiality and positions researchers to "envision a multidimensional ontology" (p. 405). It is this transversality of new materialism that sees this thesis turn to new materialisms at this point, without moving away from poststructuralist scholars entirely, in order to consider its applications for thinking about girls' participation in male-dominated subjects.

Gender in new materialist feminisms

New materialism is a term used, primarily in the humanities and social sciences, to encompass a range of theories and concepts from 'disparate philosophical, feminist and social theory perspectives' that, in common, 'emphasise the materiality of the world and everything – social and natural – within it' and consider the world and history to be 'produced by a range of material forces that extend from the physical and the biological to the psychological, social and cultural' (Alldred & and Fox, 2017, p. 1162). Some scholars consider new materialism and new materialist feminisms part of posthuman thought (Niccolini & Ringrose, 2020), and there is a movement of educational theorists who refer to 'PhEmaterialism' where 'the Ph refers to posthuman, the Fem from feminism, and the materialism from the new materialist movement' (Ringrose et al., 2020). While this is not a term I employ throughout this thesis, I acknowledge it here to demonstrate how these terms are entangled and encompass multiple perspectives. Barad (2007) explains that research which seeks to construct knowledge of

complex, entangled phenomena requires an ethico-onto-epistemological entanglement with the world and with how it is (re)made:

> 'We are not outside observers of the world. Neither are we simply located at particular places in the world; rather, we are part of the world in its ongoing intra-activity… Practices of knowing and being are not isolable; they are mutually implicated. We don't obtain knowledge by standing outside the world; we know because we are of the world. We are part of the world in its differential becoming… what we need is something like an ethico-onto-epistem-ology —an appreciation of the intertwining of ethics, knowing, and being— since each intra-action matters, since the possibilities for what the world may become call out in the pause that precedes each breath before a moment comes into being and the world is remade again, because the becoming of the world is a deeply ethical matter.' (2007, pp. 184-185).

New materialisms seek to move away from the privileging of discourse to strike a balance with the material and the corporeal (Mazzei, 2013). Removing the dualisms between mind/body, nature/culture, discourse/matter allows for a more complete picture of how difference is created. van der Tuin and Dolphijn (2010) propose that new materialisms are transversal in three key ways. Firstly, they intersect disciplines such as feminist theory, science and technology studies, and cultural studies. Secondly, they intersect paradigms, noting that cultural theories have not been able to account properly for the material and corporeal, it emphasises the material-discursive or the material-semiotic. And thirdly, it disrupts the linear temporality of epistemic movements, blurring boundaries between 'old' and 'new' ways of thinking. Considering research as an assemblage of 'bodies, things and abstractions that get caught up in social inquiry' (Fox & and Alldred, 2015, p. 400) further blurs boundaries between research/participant, disciplinary thinking, and the material/discursive.

The decision to use new materialist feminisms and posthumanisms in this thesis takes up the challenge from Ringrose and Renold (2019) to employ these as 'ethicopolitical research methodologies' which have the potential to 're-animate the regulations and ruptures of how gender and sexuality mediate children and young people's lives in schools and beyond' (p. 2).

This section provides an overview of some of the key concepts that this thesis draws on, including definitions of gender, assemblages, *becoming*, intra-acting entanglements, agential realism, response-ability and possibilities for transformation, spacetimematterings and posthumanist concepts of place. Donna Haraway, Judith Butler and Karen Barad, and their contributions to posthumanist and new materialist theory, emerge as key figures.

Defining gender

New materialist feminisms view gender as an entangled enactment, where identities are a deeply situated web woven from social, historical, political and material forces (Truman, 2019). In new materialism, gender as an attribute is not necessarily the starting place for analysis in the assemblage, rather, it appears in the reoccurring patterns and links which constitute the assemblage (van der Tuin & Dolphijn, 2010); in considering gender in this manner, new materialisms attempt to address some of the dichotomous and essentialising effects of using gender as a category of analysis. Exploring how gender is enacted, without reinforcing norms, requires an expansive definition of gender that recognises non-normative expressions and practices. For this, I turn to Butler, before explaining Butler's contributions to new materialist thinkings:

> *Gender is not exactly what one "is" nor is it precisely what one "has." Gender is the apparatus by which the production and normalization of masculine and feminine take place along with the interstitial forms of hormonal, chromosomal, psychic, and performative that gender assumes. To assume that gender always and exclusively means the matrix of the "masculine" and "feminine" is precisely to miss the critical point that the production of that coherent binary is contingent, that it comes at a cost, and that those permutations of gender which do not fit the binary are as much a part of gender as its most normative instance. To conflate the definition of gender with its normative expression is inadvertently to reconsolidate the power of the norm to constrain the definition of gender. (Butler, 2004:42)*

Butler's (2002) original, influential appraisal was that gender is not expressed, but performed through iterative, stylized acts which 'the mundane social audience, including the actors themselves, come to believe and to perform in the mode of belief' (p. 179). It is, Butler argues, the repetition of these mundane rituals which letigimise these performances and "maintains gender within its binary frame" (p. 179). In *Bodies that Matter*, Butler (2011, p. xviii) does not depart from, but expands upon, poststructuralist theories of performativity, arguing for a "return to the notion of matter, not as site or surface, but as a process of materialization that stabilizes over time to produce the effect of boundary, fixity, and surface we call matter." Rather that positing the body before the signified, which insinuates that gender follows sex, creating the effect that the body is unconstructed where gender is constructed, Butler (2011) argues that materiality is "bound up with signification from the start" (p. 6). It is not enough to say that the body is produced by regulatory norms or that the normative force of performativity works through reiteration, it is also the power of exclusion to designate what qualifies as masculine and feminine. It is these exclusions that "haunt signification" and its "abject borders" on the body, demonstrating that the process of "materialisation, while far from artificial, is not fully stable" (p. 140).

Dichman (2024) writes that new materialist approaches, to which this thinking in Butler's work contributes, take as central the complex materiality of the human and non-human in ways which recognise that agency "transcends the human body" (p. 73), and that it is in acknowledging complexities that 'one comes to locate "how power is differentiated between and within human and nonhuman bodies, and how this in turn defines a specific set of assemblages and entanglements" (p. 73). However, it is the inclusion of Barad's posthumanist notion of performativity and agential realism (Barad, 2003), which argues for an "account of the materialization of all bodies—"human" and "nonhuman"—and the material-discursive practices by which their differential constitutions are marked" (p. 810), which contributes further to an understanding of how gender is intra-activity in action. Barad's agential realism explains phenomena thus:

> Phenomena are produced through agential intra-actions of multiple apparatuses of bodily production. Agential intra-actions are specific causal material enactments that may or may not involve "humans." Indeed, it is through such practices that the differential boundaries

> between “humans” and “nonhumans,” “culture” and “nature,” the “social” and the “scientific” are constituted. Phenomena are constitutive of reality. Reality is not composed of things-in-themselves or things-behind-phenomena but “things”-in-phenomena. The world is intraactivity in its differential mattering. It is through specific intra-actions that a differential sense of being is enacted in the ongoing ebb and flow of agency. That is, it is through specific intra-actions that phenomena come to matter—in both senses of the word. (p. 817)

In this way, Butler and Barad can be read together to view gender with its unstable, materialising effects, emerging through intra-action and becoming constitutive of reality. A new materialist approach brings gender back to matter without relying on essentialism nor oppositional categories (man/woman) to explore how difference is created and how difference comes to matter. The focus on the body and its materiality as a lens in new materialist feminisms can be applied to explore how gender/sex is produced and the “inequities that are ascribed and lived by those bodies” (Coffey, 2019, p. 76). This lens is critical to interrogating the — social, material — effect of where difference occurs in girls’ lives and in the context of gendering school practices.

In taking this broad view of gender as defined in this section, we can see that gendered practices are entangled in identities in ways that have material effect, including how opportunities, or the lack of opportunity, to participate in STEM or physical activity can have affective, physiological and biological impacts that change and shape the brain, body and mind (Eliot, 2013; Fine, 2017; Malabou, 2009; Pavlidis et al., 2025; Pitts-Taylor, 2016a). This troubles essentialist *and* anti-science discourses, requiring attention to matter in the making of in/equalities and to gender as (component in) assemblage.

Gender, the assemblage, and intra-acting entanglements

Drawing on Deleuze and Guattari’s notion of assemblage, Bazzul and and Santavicca (2017) define assemblage as “a heterogeneous grouping of material, discursive, and affective entities and forces” and argue that the diagramming of assemblages reveals sex/gender to be an “emerging feature of [school] environments” (p. 57). In providing the example of the science

classroom and textbooks which pathologise feminine and masculine traits which do not align with 'appropriate' cisheteronormative expressions, they further argue that it is not enough to focus on women's inclusion in male-dominated subjects, but that it is necessary to employ theoretical resources which open up new lines of inquiry for the purpose of transformation.

In the *Cyborg Manifesto* (Haraway, 2013a), Haraway provides useful insights into fractured identities that can be applied to the experiences of the girls in this study navigating multiple ways of being girls in male-dominated subjects. She notes that identities are "contradictory, partial and strategic" (p. 107) and the purpose of the endless splitting of identities is to find a new kind of essentialism that categorises everybody neatly. Arguing that there is "nothing about being 'female' that naturally binds women" (p. 107), she proposes a search for affinity, rather than a search to identify with essentialising categories. It is in this affinity, perhaps, that a political unity which challenges dominations of gender, class, race and sexuality. Haraway notes that 'woman' is not an innocent category; inherent within it is its own practices and inequities of domination. With this in mind, it is in the "fraying of identities" (p. 109) that opens up new possibilities of resistance. Emerging from this study is a picture of girls whose overlapping, complex identities provide opportunities to think in new ways about fraying and challenging possible identities for girls in male-dominated subjects and for creating affinities which lead to resistance.

Barad's concept of agential realism is useful here for thinking through subjectivities. Contrasting representation, which "takes the notion of separation as foundational" (Barad, 2007, p. 137), the ontological approach of agential realism understands that it is through "specific agential intra-actions that the boundaries and properties of the components of phenomena become determinate and that particular concepts (that is, particular material articulations of the world) become meaningful" (p. 139). The problem with representationalism, Barad argues is that it will never 'get any closer to solving the problem it poses because it is caught in the impossibility of stepping outward from its metaphysical starting place' (p. 137). Intra-actions, on the other hand, enact agential cuts between subject and object that creates meaning in ways that do not rely on fixity, rather, a "co-reliance of entities" (Bazzul & and Santavicca, 2017, p. 58). Agential realism "makes inquiries into how differences are made and remade, stabilized and destabilized" through these interactions to

produce phenomena, defined by Barad as “an entanglement of intra-acting agencies” (Kleinman & Barad, 2012, p. 77).

In this understanding, constructions of sex and gender in the context of male-dominated subjects as a phenomenon is the result of agential cuts between subject and object that create and sustain differences. Identities are produced through an assemblage of discursive, material, spatial, temporal and political factors and are more than performance. Barad suggests that “performativity is properly understood as a contestation of the unexamined habits of mind that grant language and other forms of representation more power in determining our ontologies than they deserve” (Barad, 2007, p. 133). Rather, in considering gender as assemblage, we see the ways the assemblage, the entanglement of intra-actions, constitutes subjectivities.

Becoming, response-ability and transformative possibilities

Rosa Braidotti (2014) describes a theoretical or philosophical nomadism that allows researchers to engage in new ways, suggesting that the human — researcher, participant — and the more than human — place, object, matter — are in a process of *becoming. Becoming* requires the ability to *sustain and generate* an ‘*emphatic proximity, intensive inter-connectedness’* (p. 182) with the research, or, in other words to engage in thinking that is deterritorialising and rhizomatic. Haraway (2010) reminds us that becoming is, in fact, becoming-with, and that becoming-with is about world and meaning-practices that require ‘response and not reaction’ (p. 54). Bozalek and Zembylas (2023) write that response-ability comes about through ‘an ontological entanglement with the other’ (p. 65). Barad and Haraway’s use of response-ability is about theorising, knowledge-making, practice and ethicality in ways that require attentiveness and noticing, openness to engagement, multidirectional relationships that render each other capable, and engaging in resistance as practice or acts of resistance against ‘normative closures in everyday practices’ (Bozalek & Zembylas, 2023, p. 75).

In taking this approach, this thesis recognises that participants also develop knowledge of the world as they *become-with* the world (Cozza & Gherardi, 2023). Haraway’s arguments for

richer accounts of the world (Haraway, 1988) and commitment to heightened relationality with the human and non-human worlds (Haraway, 2016) are transformative, meaning-making practices which have the ability to disrupt — ethically — processes of *becoming-with*. The use of this theory also reflects a methodological commitment to staying with the trouble, embracing the messy entanglements and their productive potential within the STEM and outdoor education assemblages for *becoming*. Through this nomadic engagement, research-creation becomes an act of response-ability that acknowledges and pays tribute to the complex becoming-with of human and more-than-human actors, participants, materials, and knowledges.

Spacetimemattering and posthumanist approaches to place

New materialist feminist scholars working in school contexts explore the objects, bodies and space that constitute identities in a classroom context. In viewing classrooms as entangled mosaics of vital matter, and bodies within the classroom as a site of vital material agency, Taylor (2013) argues that "all bodies, things and matter… are active material-discursive agency" (p. 690). Through this lens, the collective nature of embodied practices necessitates that any analysis of how gender manifests in the classroom goes beyond surface level analyses of stereotypes, practices and barriers to consider how entanglements and embodiments of the material-discursive constitute phenomena, identity and experience. Benavente (2015) argues that the conditions which create the — seemingly straightforward — normative patterns and relationships within the classroom (re)produce oppressions in ways that are invisible. Considering the classroom, or as Benavente explores, teaching with, material feminisms is "always-already" political (p. 53). In applying to the classroom context Barad's theory of *spacetimemattering*, which sees space as the "materialization of different relations happening at a precise moment" (p. 54), Benavente see the possibility for the classroom as an act of resistance.

Spaces, and one's relation to it, shapes experience. Doreen Massey (1994, p. 23) states that social change and spatial change are inextricably linked, arguing that social relations are 'stretched out over space' and their spatial forms, in turn, influence 'the nature of social relations themselves.' Applying concepts of place and space to the construction of gender

more specifically, Bondi and Davidson (2005) write that 'places and gender are mutually constitutive processes that exist in dynamic relationships across space and time.' Further, in exploring the role of new materialisms and critical pedagogies in attuning to place and developing pedagogies of place, Page (2020) writes that 'through our intra-actions with the socio-material world we learn placemaking through individual and collective embodied (perceptions with memories) practices' (p. 106). Drawing on Whitehead, Page explores the ways in which the body is an active participant in embodied perception that teaches us about 'current but also past place-worlds' (p. 108). Male-dominated spaces, with their specific constructions, intra-actions and relationships create ways of learning, intra-actions and embodied practices which shape the ways students come to know about the world.

In this thesis, place plays a significant role in the experiences of the participant: the STEM and outdoor education classroom, the lab, and nature all contain memories and experiences of affect which come to be embodied in performances of gender and of STEM/outdoor education. The findings will demonstrate that, contrary to the participants' experiences of STEM, in the participants' experience of outdoor education, historical constructions of the wilderness as a male-dominated space (Kennedy & Russell, 2021) are disrupted through pedagogical practices which disrupt and reshape constructions of place, allowing for more dynamic relationships of place and gender. Critical pedagogies in the context of embodied perceptions of place can form a 'practice of freedom' as teacher and learners become 'jointly responsible' for meaning-making, *withness,* and intra-actions as processes of transformation (Page, 2020, p. 5). This theme will emerge further throughout the findings chapters.

Critical pedagogies

In the spirit of blurring disciplinary boundaries, I draw further on elements of critical pedagogy with its focus on power, relationships and whose voice matters in educational spaces to contextualise elements of teaching and learning explored in this thesis. Page (2020) provides an example of how new materialisms and critical pedagogies can be applied to explore phenomena in education. Freire's conceptual approach to challenging banking models of education and to developing critical consciousness can be useful for applying new materialist engagements and for challenging students to think about what stories matter.

Ball and Collet-Sabe (2022) note that most teachers are committed to challenging oppressive practices and challenging student-teacher power dynamics; however, they become hemmed in by institutions and feel they are unable to challenge systems of power from within those structures, ultimately returning to, or providing some form of, the 'banking' concept of education. Banking, in this instance, refers to education as an 'act of depositing,' where the teacher deposits knowledge and the students passively 'receive, memorise, and repeat' (Freire, 2005, p. 72). Teachers and their roles also come to exist in dynamic relationships across space and time, and their own identities and intra-actions with the socio-material world are entangled with those of their students.

Critical pedagogies challenge practices which arise in the classroom from conventional narratives which position teacher and student as opposites — subject and object, active voice and passive receiver — leading to students being alienated from the process of their own becoming. Freire argues for problem-posing education where students can become active participants who 'develop their power to perceive critically the way they exist in the world with which and in which they find themselves; they come to see the world not as a static reality, but as a reality in process, in transformation' (Freire, 2005, p. 83).

The stories that we tell and create in the classroom and in research matter. Haraway (2013b) writes that, "It matters what matters we use to think other matters with; it matters what stories we tell to tell other stories with; it matters what knots knot knots, what thoughts think thoughts, what ties tie ties. It matters what stories make worlds, what worlds make stories" (p. 4). In the story of this thesis, the student and teacher participants felt a sense of powerlessness and a sense of frustration – they experienced barriers which they knew should not exist, yet there were enormous pressures to conform to existing systems which created the very barriers by which they were frustrated. In attuning to affect, and these moments of 'liveliness' in the data which emerge from an emotional stance which connects "statements, practices, objects, subjects, and processes that give form to and transform one's embodied responses" (Blackman, 2015, p. 28), we engage in practices of co-creation of stories. In the classroom, and in interactions between teacher and students, Freire's concept of problem-posing education positions students as "critical co-investigators in dialogue with the teacher"

(Freire, 2005, p. 81), providing opportunities to attend to, and tell, the stories that matter, to create conditions which allow for the co-creation of knowledge in an unveiling of reality, and to situate one's *becoming* self in their *becoming* world. A posthumanist approach to critical pedagogies further augments this focus on telling stories. Bayley (2018) suggests employing critical pedagogies which focus on story-making and ways of thinking that invite "new imaginings of alternative agencies—agencies that are nonhuman, multispecies, algorithmic, that lie deep in the earth, or newly formed in a technician's lab' to explore how 'we' became 'we' or how differences came to matter in the first place" (p. 364). In this approach to stories and to critical pedagogies, we ask, what other stories can we tell?

Chapter summary

Bringing together critical pedagogies with feminist new materialisms allows for a richer account of the practices which occur in schools, providing possibilities for challenging and disrupting normalising practices. Additionally, it provides the beginnings of a framework for students to critically reflect on their own identity construction and subjectification. These theories inform interpretations and analysis of each step of this thesis, ultimately leading to an understanding that sees inequalities in participation as the result of how gender is constructed in schools, the gendered expectations that girls' experience, and internalized assumptions and beliefs about gender that come to be seen as natural.

In establishing the theoretical lens here, I contextualise the following two chapters which present the body of literature on girls in STEM, then subsequently, girls in outdoor education. In providing this overview of the theory before the literature concerning the case studies of this thesis, I aim to foreground that this is a lens which is largely missing from the literature, but one which is critical for disrupting a field with a lot of attention, but little movement. I also aim to establish that it is not enough to simply address the problem of girls in STEM and girls in outdoor education, but it needs to be situated in a critical analysis and understanding of gender. After presenting the literature in the following two chapters, I return to the method and methodology sections to demonstrate how this thesis attempts to address those gaps.

Chapter 3: Understanding STEM and gender

A key focus of this chapter is the extant literature's exploration of the barriers that girls' face in STEM, and the solutions identified to address those barriers and increase female participation in STEM. I argue that there are three significant issues requiring further elaboration, exploration and theorising. First, addressing sociocultural factors is an important starting place however, further analytic work is needed to understand how beliefs, perceptions and attitudes come to be embodied and come to have material implications. Secondly, existing research largely seeks to address women's participation in STEM. Missing, in the largely quantitative body of literature (Fredricks et al., 2018), are the affective experiences of girls, their voices, and the way they have come to understand and problematise their own participation in STEM. Finally, there exists extensive recommendations for changes to STEM education, pedagogy and approaches; however, Chesky and Goldstein (2018) argue that many of these interventions are superficial, focusing on changing girls for STEM rather than the system – or more appropriately, multiple systems and processes – for girls. A richer accounting for girls' experiences is needed, which is not just about increasing participation, but understanding the complexities and entanglements that constitute their experience.

Participation rates and the 'leaky pipeline'

A large body of research has established that girls, statistically, follow a well-worn path in terms of their STEM engagement (Clark Blickenstaff, 2005; Dasgupta & Stout, 2014; Justman & Méndez, 2016; O'Neill, 2025; Wang & Degol, 2017). The metaphor of a 'leaky pipeline' (Berryman, 1983) is often used to describe the attrition of girls and women from STEM over the course of their education.

Girls' interest in STEM appears to decline during early adolescence and middle school (Daniels & Robnett, 2021; Dasgupta & Stout, 2014; McQuillan et al., 2023; Wang & Degol, 2017). While the specificities, ages and explanations may vary in the research, it is incontestably clear that there are significant changes in interest and engagement over the course of girls'

schooling. For example, two major studies, Microsoft, in conjunction with the London School of Economics (Bauer, 2017) and Southern Utah University (Kesar, 2018), gathered data from over 17,000 young women from Europe and the United States with the aim of exploring gendered participation. Analysis of these large datasets showed interest in STEM drops off at 15 or 16 with limited recovery and that, even with research and evidence-based interventions, these patterns did not significantly change.

The somewhat limited and narrow metaphor of the leaky pipeline rarely acknowledges the ways, or disciplines, where women do participate in STEM learning and employment (Miller & Wai, 2015). Unequal participation rates occur in specific disciplines and contexts, aligning with perceived masculine and male dominated disciplines such as physics, engineering, pure mathematics and technology subjects (Delaney & Devereux, 2019; Leigh et al., 2020); in some areas, the term pSTEM (physical Sciences, Technology, Engineering and Mathematics) has recently been used to acknowledge that there is a specific set of disciplines referenced in discussions of unequal participation rates in STEM (Ito & McPherson, 2018; Lewis et al., 2017). Australian research rarely acknowledges that there are areas where women, do in fact, equal (biological sciences) or outnumber (behavioural sciences) men (Fisher et al., 2020; Hutchinson et al., 2023; Ito & McPherson, 2018; Leigh et al., 2020). Trends in Australia (Justman & Méndez, 2016; Justman & Méndez, 2018) and like Western countries (Rosenzweig & Chen, 2023; Su & Rounds, 2015), affirm this particular reading, where girls choose 'life' sciences and boys choose 'physical' sciences. Girls who participate in male dominated STEM subjects, such as specialist Mathematics, Physics and IT, are under-represented compared to boys (Justman & Méndez, 2018).

The 'problem' of participation at school continues throughout university and into the workplace. With only 16% of Australia's STEM-skilled workforce women (Hutchinson et al., 2023) Australia exemplifies the gendered trajectories of students concerning STEM participation. And while not all STEM areas are valued or remunerated equally (Francis, Archer, Moote, DeWitt, et al., 2017; VanHeuvelen & Quadlin, 2021), pSTEM careers provide social and cultural capital (Cohen et al., 2021; Francis, Archer, Moote, DeWitt, et al., 2017) and lucrative opportunities for earning (Banchefsky et al., 2019; Leigh et al., 2020).

Thus, differences in STEM participation translates to longer term individual and collective economic impacts.

Although the metaphor of the leaky STEM pipeline encompasses a range of complex factors, establishing clear causal relationships remains challenging. Justman and Mendez (2018) found that girls were more likely to choose male-dominated STEM subjects if they attended a single-sex school or a school in a lower socio-economic area. There is also a public perception, and some research to support the idea, that girls achieve more success in STEM at a single-sex school (Docherty et al., 2018); however, findings here are inconsistent (Hughes et al., 2013; Park et al., 2018) and any increased participation associated with attending a single-sex school may be explained by higher levels of socio-economic privilege, qualified teachers, and parental characteristics (Sikora, 2014; Yazilitas, Jörgen, et al., 2013) or parents selecting single-sex schools to enhance their daughter's prospects at achieving success in STEM, thus reinforcing pre-existing familial messages, practices and support (Park, et al., 2018). The emphasis on single-sex groupings for STEM subjects has, however, led to a plethora of programs that extract girls from their programmed classes to study STEM without the perceived distraction and intimidation from the boys (Hart, 2016). These reactionary solutions tend to reinforce the very binary gender dynamics they claim to address, positioning girls as inherently vulnerable subjects who require protection from masculinized spaces rather than challenging the underlying structures that construct STEM as a masculine domain.

Key themes emerging from the literature and policy

There are four key themes circulating within the research, policy literature and educational discourse of girls in STEM which frame how issues of girls' participation can be understood. These discourses, which are overlapping and entangled but can be read separately, include:

1. Girls are just not interested in STEM. Participation rates have not changed despite significant investment, effort, and opportunity; therefore, it stands to reason that girls have limited interest in these study areas (Stoet & Geary, 2018). A girl's ability, the way they learn, and/or confidence may be used to explain loss of interest, but

ultimately, this discourse presents inevitability and naturalises a lack of interest in STEM subjects.

2. STEM can be made interesting to girls. This can occur through deliberately feminising the curriculum by including feminine topics, role models and representations.
3. There are biases that a girl experiences in their STEM education, such as lack of opportunities (Bian, Leslie, & Cimpian, 2018) and exclusion from early ages (McGuire et al., 2022), which, if they were to be addressed would make girls' STEM participation more equal.
4. Women are equally capable. Girls in STEM programs provide opportunities for recruitment, female empowerment, and to develop confidence without the 'problem' of the boys (Bennette & Toffoletti, 2024)

The language used to describe girls STEM participation is one of deficit, however, the discipline is represented as ostensibly gender neutral and economically valuable. Government papers from the Office of the Chief Scientist (Hutchinson et al., 2023; Leigh et al., 2020) and the Women in STEM Decadal Plan (2019), for example, all describe women's lower STEM earnings, exclusions, and lower representation at a senior level and note that it is at school where many women disengage from STEM. This deficit framing not only obscures gendered power relations embedded within official STEM discourse but also perpetuates a problematic logic whereby the discipline itself remains unquestioned while young women are positioned as deficient subjects who must be 'fixed' or who need something extra to fit into an allegedly neutral system. New paradigms of research which are responsive to the relationship between these themes and girls' experiences are critical.

Barriers to STEM participation

There are two particularly significant papers which have influenced understanding of, and approach to, barriers to girls' STEM participation. Clark Blickenstaff used the evocative phrase 'leaky pipeline' (2005) to structure a wider review of the literature relating to women and attrition rates in science careers. He identified the most common reasons used to explain why girls choose not to study science. These included the tailoring of science classes, pedagogy and curriculum to boys, the perceived biological differences between men and women and

expectations around gender roles, a lack of female role models and representation, the 'chilly climate' for girls in STEM classes and in the workplace, and poor experience with science education in childhood. In another review of the literature, Wang and Degol (2017) identified six different drivers leading to underrepresentation of women in STEM: cognitive abilities; relative cognitive strengths; career preferences; family, work and lifestyle values; field-specific ability beliefs; and gender-related stereotypes and biases. Different permutations of these lists are echoed across the literature; this section synthesises these, with an emphasis on exploring a lack of belonging and how limited representation limits girls' ability to see themselves in STEM, contributing to a lack of participation.

Perceptions of STEM and a lack of belonging

Across the research and policy literature, one of the more popular avenues for investigation is the perceptions that students, teachers and schools, families and society more broadly hold about STEM – particularly perceptions of who does STEM and who is talented at STEM. For example, in a meta-analysis spanning five decades, Miller et al. (2018) found that when children were asked to draw a scientist, the frequency at which they depicted scientists as male has slightly decreased over those decades; however, older students continued to depict scientists as male more frequently, suggesting that the more one is exposed to the cultural associations of science with masculinity, the more likely they are to internalise them as they age. Additionally, Rhodes et al. (2019) suggests that exposure to gendered language in childhood can lead to essentialist beliefs relating to who does STEM.

Masculinised perceptions of STEM emerge through multidirectional assemblages of intersecting discursive, material, and institutional forces that continuously reinforce gendered assumptions about STEM. These include representations in popular culture, where women are increasingly represented as scientists and simulataneously portrayed as lonely, stereotypical, subordinate, or required to balance family and life tensions in ways that indicated an incompatibility between being female and being a scientist (Bond, 2016; Eizmendi-Iraola & Peña-Fernández, 2023; Mitchell & McKinnon, 2019). Additionally, males still dominate children's educational media (Chlebuch et al., 2025) and science

communication accounts on platforms such as TikTok (Chen & Brewe, 2024). A student's community can also shape their perceptions about gender and STEM: parents may hold beliefs about which careers are suitable for their children or see their male children as inherently more able in STEM areas (Lapytskaia Aidy et al., 2021; Adam Lloyd et al., 2018; Tomasetto et al., 2015). Likewise, male students may believe their female peers are less talented (Cyr et al., 2024); teachers hold stereotypical biases which reduce girls' opportunities (Bian, Leslie, & Cimpian, 2018) and decrease their confidence while increasing boys' confidence (Copur-Gencturk et al., 2023); and society defines STEM as a masculine domain, with lower expectations of success for women (Forgasz & Leder, 2017; Francis, Archer, Moote, DeWitt, et al., 2017). Collectively, perceptions contribute to women's experience of not belonging in STEM.

The masculinisation of particular areas of science is deeply entrenched. This impedes girls' involvement in STEM can potentially lead to the problematic belief that it will be a constant struggle for women to prove themselves and achieve in STEM study and work environments (Francis, Archer, Moote, DeWitt, et al., 2017). Girls may negotiate this tension by disassociating from their feminine identity and any feminine behaviours or behaviours that adhere to female stereotypes (Francis, Archer, Moote, de Witt, et al., 2017). They may reject feminist critiques "designed to mitigate the historical legacies of sexism," seeing their own success as evidence of meritocracy, and, as a result, can advocate against their own interests (Seron et al., 2018, p. 132). In contrast, in a study investigating how girls perform their identity in places of science learning, Dawson et al. (2020b), concluded that "girls are better able to learn science in spaces where their identities are valued" (p. 676) Their research encourages places of science learning to take up an intersectional approach to these identities. Girls should not be forced to *do boy* when it comes to science and rather, should be able to embrace their feminine identities rather than reject them. The persistent association of science with masculinity and inverse disassociation of science with femininity is difficult to navigate without becoming patronising or further entrenching problematic binaries of femininity and masculinity. However, the lack of significant progress or change in this area suggests that simplistic, un-situated solutions to increasing female participation in STEM are not enough to disrupt what these binaries of 'doing boy' and 'doing girl' in STEM look like and what they communicate about who does STEM.

The persistent gender gap is also perpetuated through the gendered beliefs of educators about student capabilities, demonstrating how pedagogical practices can enact rather than merely reflect binary constructions of academic potential. This includes attributing male success to innate ability, but attributing female success to diligence (Leyva, 2017; Archer, et al., 2012). As a result, teachers have lower expectations of girls while boys are encouraged to participate more and are seen to have better autonomous learning behaviours – something which is linked closely to success in STEM and gendered expectations and stereotypes of, particularly white, males (Archer et al., 2012; Leyva, 2017; Watson et al., 2016). Teachers are also seen to communicate implicit messages about a student's abilities through their feedback, and biased grading favours boys in STEM areas (Mechtenberg, 2009). Problematic results may also arise from a place of good intentions – teachers may be more generous with praise with lower achieving students particularly when they think a student may internalise a poor performance, and this can lead to students developing a sense of mistrust in their own abilities (Meyer, 1992).

Finally, there exists a more critical body of research arguing that teachers lack awareness of the global and social culture in which STEM education exists (Gough, 2015; Yazilitas, Jörgen, et al., 2013; Zeidler, 2016). This can lead to inadvertent curriculum choices, such as selecting resources and activities that emphasise men and centre dominant masculinity, and reinforce subjects as hard for girls in particular (Archer, MacLeod, et al., 2020; Archer, Moote, et al., 2020; Archer et al., 2019). Teachers who are aware of how girls are perceived in STEM and who hold feminist beliefs do act to challenge gendered norms and inequalities; however, many teachers accept the status quo and adhere to traditional teaching methods which are less effective in challenging those norms (Masri et al., 2025). Drawing on the work of Jacques Rancière, and Jean-François Lyotard, Bazzul (2013) explains these actions: science education requires an appeal to a certain authority. In claiming 'truth' and 'neutrality', speakers refer to, and act within, the existing rules, language and examples, ones that rest on "clear assumptions about what counts as truth" (p. 248).

Girls' education and their beliefs about their abilities, situated in this context, are coloured by the above perceptions and practices. This may contribute to poorer performance, which, in

turn, can reinforce implicit and explicit messages about their abilities and suitability for specific learning areas. There is a large body of research from the field of psychology exploring stereotype threat, a concept which has been used to explain the quantitatively poorer performance of girls in some STEM contexts and in high pressure situations (Shapiro & Williams, 2012). Stereotype threat is a phenomenon thought to result from an anxiety that one's performance is going to conform to negative stereotypes about their, in this case, gender, so that girls are unable to perform as well in male-stereotyped domains (Miller et al., 2018). Galdi et al. (2014) suggest that an important component of stereotype threat is automatic associations regarding gender, which relies on an individual's propensity to self-categorise as part of a social category and awareness of the category's association with negative stereotypes. Bedyńska et al. (2019) argues that this leads to girls engaging with an intellectual helplessness which reduces one's ability to identify with a particular subject.

Many girls who are interested in STEM engage in the complex task of negotiating their relationship to STEM and balancing who they are with what they enjoy and who they feel they are expected to be (Dawson et al., 2020b; Tan et al., 2013). Stereotype threat may be manipulated and managed in some cases; however, it involves rejecting aspects of one's gender identity. Girls who have demonstrated stereotype threat behaviour by performing poorly in mathematical test conditions can improve their performance by focusing instead on their class privilege (Fine, 2005) and many women who achieve at a high level in STEM education and careers by disassociating themselves from their feminine identity (Seron et al., 2018). While these cases might demonstrate something interesting about the nature of gender identity, crucially, most women do not have the luxury of relying on their class privilege or getting to such a high level in the first place. Constantly negotiating, balancing and managing performances of identity is exhausting and difficult to achieve successfully. But again, we need to ask the questions: what about these subjects is essentially masculine? What does, or should, Physics, for example, have to do with gender identity? It is the gendered construction of – and girls' negotiation of – this knowledge that I am concerned with.

Students make gendered choices based on their beliefs about their ability. When they are hearing messages about their identity (Su & Rounds, 2015), seeing boys' performance of gender reinforced in the STEM classroom (Archer et al., 2019; Clark Blickenstaff, 2005) and

underperforming in high-pressure situations, girls may come to believe they do not have the requisite talent, and choose subjects where they and others think they do (van der Vleuten et al., 2016). In a 2019 study of female Australian senior secondary school students, Wolfe found that despite identifying as 'smart girls', students chose subjects they believed they were good at 'naturally' and which they believed others thought they were good at. This resulted in them avoiding Mathematics in Year 12, despite their interest in it (Wolfe, 2019). van der Vleuten et al. (2016) also suggest that it is not so much ability, which is the focus of much of the discourse on gendered choices, but gendered expectations and the way that students "internalise these gender role expectations in their gender ideology" (p. 186). Wolfe (2017) writes that "feelings of affective belonging and unbelonging are not binary terms but messy entangled movements" (p. 732); however, these feelings emerge through affective forces produced through their desire to belong. Girls in STEM feel excluded precisely because they desire to belong and exist in ways at school to "become the right sort of girl" (p. 732).

Lack of representation and the fraught application of role models

Women can be largely absent from girls' experiences of STEM education. The majority of STEM teachers in Australia are male, despite women making up a majority of the teaching workforce (Timms et al., 2018), and access to relatable role models of the same gender is scarce (Ross et al., 2023). Further, women are largely excluded from the curriculum. In South Australian curriculum syllabuses, for example, 98.5% of all scientists mentioned are male, and while there is a large focus on science as a human endeavour (SHE), which attempts to situate scientific progress in its human, ethical, and developmental implications, the opportunity to explore gender biases is not listed as a specific component or option for those tasks (Ross et al., 2023).

Increasing role models, however, is one of the most frequently cited recommendations for improving girls' participation and retention in STEM (Australian Academy of Science, 2019; González-Pérez et al., 2020; Milgram, 2011). Role models are considered to be useful because they make visible specific goals and demonstrate a concrete path to success (Herrmann et al., 2016); conversely, a lack of role models may make it difficult for girls to imagine themselves as successful in STEM (Starr et al., 2019). Few studies are able to provide evidence of the long-

term impact of role models on retention and STEM pathways, however, in one of the more influential and impactful programs identified in a systematic review by Prieto-Rodriguez et al. (2020) — an intervention by Ivey and Palazolo (2011) — 85% of participants stated that mentors and speakers had influenced them to consider STEM as a potential pathway. This is countered, however, by other research that finds that feminine role models in STEM can actually have a dissuasive effect on STEM identified girls compared to more gender-neutral role models. Their successful femininity on top of their STEM achievements can make them seem 'too good' and, at least for the middle schoolers in this study, made them feel unattainable (Betz & Sekaquaptewa, 2012). Further, a study by Cheryan et al. (2011) found that role models who "projected stereotypes of the field interfered with women's beliefs that they would be successful" (p. 661). These findings reveal how female role model representation can become a stuck place, where successful women in STEM must navigate the contradictory imperatives of embodying both aspirational success and accessible and relatable ordinariness — ultimately demonstrating how representation alone cannot dismantle the material-discursive structures that constitute STEM as a masculinized domain.

The right role model is a difficult balance: Hermann et al. (2016) found that role models need to be perceived as competent, but their achievements must seem attainable for their presence to be effective. Girls who are put off by STEM stereotypes may connect with role models who break stereotypes, gender or otherwise (Betz & Sekaquaptewa, 2012). Drury et al. (2011) suggest that one of the most effective characteristics of recruitment role models are ones that students identified with, and who challenged perceived stereotypes of STEM workers by appearing sociable and sharing other interests outside of STEM. Fuesting and Diekman (2017), for example, found that it was more important for participants that role models engage in, and enact, communal behaviours than be of the same gender as the participants.

Many role model recruitment programs have been created to address imbalances based on the – oversimplified -- assumption that "like is good for like" (Carrington et al., 2008). While this may not be quite so simple, as evidenced by the studies presented above, and it appears that male and female role models can be equally effective in recruitment, it is in retention that female role models can have a powerful influence (Drury et al., 2011). Drury (2011) found

that female students are less likely to experience the negative impacts of stereotype threat when they have female role models, encouraging those students to experience greater feelings of belonging. This phenomenon is also explored by Dasgupta (2011) who introduced the 'stereotype inoculation model', proposing that in-group experts and peers acted as a type of vaccine against stereotype threat. While taking these positive impacts into account, Drury cautions their readers about the unintended impact of the emphasis on role models: employing female role models to recruit women in STEM and to increase diversity in STEM can burden women with the responsibility of increasing the number of women in STEM and make women's lack of participation seem like a "female issue rather than a societal issue" to fix (p. 268).

Addressing the gaps: STEM interventions and initiatives

Many interventions and initiatives have been implemented to address both the gender gap and the overall decline in STEM participation (Prieto-Rodriguez et al., 2020). In Australia, McKinnon (2022) conducted a review of 337 programs and initiatives for girls and young women run across primary, secondary and tertiary institutions. They identified 127 scholarships, predominantly for tertiary institutions, camps, conferences, workshops, networking opportunities, classroom resources, awards, and events. For secondary age students, intervention and special programs tend to focus on workshops and extra-curricular opportunities outside of the regular curriculum. Critical feminist research has made some inroads in the area of women's participation, but this body of work makes up a tiny proportion of research within the abundant body of literature on women in STEM. Lockhart (2021), for example, found that exposure to 'feminist biology' research and writing, which de-essentialises sex and gender, was associated with increased women's graduation rates. What continues to be missing is wide-spread evaluations of program impact, meaning that there is still little knowledge of what actually works for girls in STEM (McKinnon, 2022).

McKinnon (2022) comments that public policy knows a lot about the problem, but not a lot about how to fix it; rather, a lot of money has been directed to the problem with the hope that that is enough. As Goncher and Cameron (2022) note, programs and initiatives can have

a positive impact in supporting girls and women in their education, but no one program will be enough to remove the barriers they face, and have faced, at all points of their education journey. In a systematic review of the literature on interventions aimed at secondary-school aged girls in STEM, Prieto-Rodriguez et al. (2020) found that, of the 32 interventions they studied, 11 assessed long-term engagement and of these five evidenced positive outcomes. The reasons posited for these positive outcomes included the programs supported students to develop a collective identity in STEM that helped them to see themselves as valuable within the science community, students developing strong relationships with people in the industry through collaborative projects which solved real-world problems, promoting a creative approach to STEM, and offering strong mentors. All programs showing long term outcomes addressed biases in STEM and tackled stereotypes. The following section explores in more detail some of the factors contributing to the success of such programs.

Authentic, place-based and humanitarian approaches to STEM

Programs have been developed to highlight the authentic nature and real-world experience that can come from participating in STEM. Out-of-school STEM programs provide opportunities for place-based learning with students accessing authentic and scientifically rich locations, tools and artifacts (Thiry et al., 2017). Such place-based educational opportunities contribute to reducing the disconnect between education and the science community, thus encouraging girls in their STEM pathways (Shea, 2016). An interesting emerging area, combining elements of both fields presented in this thesis, is outdoor science education, a "relatively understudied, but promising" area for engaging girls in STEM (B. Jackson et al., 2021; Stevenson et al., 2021, p. 1095). Where it might seem counterintuitive to combine two male-dominated areas for the purpose of better engaging girls, it is thought to have the potential to take the best of both worlds – girls are able to engage in risk in a managed way without the formalised pressure of the classroom, they are able to do science in a collaborative way, and they can appreciate the natural world. Perhaps breaking down boundaries within demarcating fields is a first step towards seeing – and experiencing – subjects differently.

Humanitarian-based STEM interventions are another way of encouraging girls' engagement. By the age of 14, girls are more likely to question the ability of science to have a positive influence on society and more likely to think that scientists are uncaring (Valla & Ceci, 2014). This may be informed by the focus and approach of traditional curricula and pedagogy. In contrasts, science and technology studies (STS) apply sociological, anthropological, historical and philosophical approaches to science to reveal the ways in which it is 'embedded, embodied, and enacted in particular political conditions' (de Freitas et al., 2017, p. 553). This approach was found to increase understanding of science concepts and improve student attitudes towards science (Bennett et al., 2007); Valla & Ceci (2014) suggest that this may be particularly beneficial for girls as it challenges perceptions about science. For example, a program in Aotearoa New Zealand called *Hello Café* explored a range of humanitarian engineering projects focusing on sustainability and disaster relief with girls aged 10-13. The proportion of program participants who expressed an interest in engineering as a career increased from 21% to 30%; the proportion of uninterested students decreased from 16% to 9%. One of the biggest takeaways from the program, however, was the increased awareness of what the role of an engineer is and the enthusiasm that the participants had for sharing their experiences and new knowledge with their friends, post-program. Additionally, the researchers observed that the participants felt that learning about science was completely new to them. This, the researchers inferred, was not because science was absent from schools, but because participants had not been exposed to authentic terminology and tools used in the field. In recent years, the Australian Curriculum has introduced science as a human endeavour (SHE) as a strand of the science curriculum, given equal importance to scientific knowledge and understanding. While theoretically promising, in practice, the implementation of SHE learning and tasks can be problematic, with teachers required to engage in new philosophical and pedagogical approaches. As such, they are often not done well or avoided (Paige & Hardy, 2019). Nonetheless, many researchers and practitioners see authentic programs as offering engage with applications of science in real-world settings that may reduce the impacts of classroom-based, traditionally masculinist approaches to STEM.

Conversely, Dawson et al. (2020a) explored how gender and identity tensions, along with racial and class identities, may be exacerbated in real-world locations such as science museums. They found that in these spaces, girls perform gender in different ways depending

on their preexisting relationship with STEM and gender. Performative 'good' behaviour, Dawson et al. judged to be incompatible with science learning because individuals were focused on being helpful and getting answers right rather than subject knowledge. 'Masculine' performances which — associated with being boisterous and the opportunity to flex muscular intellect — were unintelligible to adults and thus misunderstood. 'Cool' or 'silent' girl performances, which were marked by withdrawal, either through a focus on heterosexual attractiveness and attention or silence to avoid attention. Navigating competing and potentially mutually exclusive identities of doing 'girl' and doing 'science', was also complicated by a lack of representation of identities that the girls could connect with. Thus, place-based, experiential and authentic intervention learning needs to consider how the 'real-world' reflects and produces inequalities. However, they do show some promise in capturing the interest of girls and those not traditionally engaging in STEM fields.

Developmental and career trajectories

Successful STEM programs may be those that introduce knowledge about careers opportunities. For many students, the career aspirations they develop in childhood and throughout middle school are surprisingly stable (Conlon et al., 2023). In a study by Dare and Roehrig (2016), which examined the attitudes of US students towards science and STEM careers, girls were found to have generally positive attitudes to science, but less positive attitudes towards a career in science and little knowledge of careers in STEM outside of a few well-known ones. For the most part, there was little difference between the boys' and girls' enjoyment of hands-on learning and science activities, but the girls had less conceptual understanding of science and what a career in science would look like. Girls were seen to place more importance on collaboration, an approach they did not associate with science careers. When girls did learn about new careers, they were likely to find them interesting and exciting. Archer et al. (2014) evaluated a program implemented by a teacher in a UK girls' school to increase knowledge about the breadth and variety of jobs in STEM. They found improvement in three areas: 'I want to become a scientist' improved from 12% to 19%; 'When I grow up, I want to work in science' was up from 39% to 49%; and 'I think I could be a good scientist' increased from 16% to 27% (p. 41). From these findings, the inference can be drawn

– tentatively – that more knowledge about the nature of careers in science has the potential to encourage girls' engagement with STEM studies.

Gender-Sensitive STEM education

Sinnes and Løken (2014) identified three different approaches that reflect different ways of thinking about gender in STEM. First, there is gender neutral education. This approach assumes equal ability in STEM and that it is "political and social forces external to science" (p. 348) that have kept girls out of STEM. It is the societal structures and discriminatory factors that need to be addressed, rather than STEM pedagogies and practices. Content may be enriched to make it more gender neutral and include more equal representation; however, this only addresses one symptomatic aspect of the problem rather than the roots of the issue. The second approach is female-friendly science education (this is different to the girl-friendly education described in the previous paragraph), which focuses on the differences between men and women, their strengths and ability and their styles of engagement and tailors their curriculum and pedagogy to meeting the perceived needs of women. The differences may be biological or social – there is no imperative to determine where they stem from, rather the emphasis lies on understanding that gender differences produce different ways of engagement with STEM. As a result, a stronger focus on girls in the class is required: women's interests, such as health, would be more strongly represented and more discussion of biases in STEM would take place. The problem with this approach is that it assumes some fundamental similarities between women and their interests and that some issues are 'women's interests'. An alternative take on this approach lies in the work of Dare & Roehrig (2016). They worked with science teachers who eschewed gender norms and who associated physics equally with males and females, finding that students benefited when their teachers applied girl-friendly practices. Girl-friendly education, in this usage, does not mean feminising STEM but rather engaging in practices — equally beneficial and 'friendly' to boys — such as positively influencing a student's science self-concept, applying learning to practical and real-world applications, and moving away from memorising facts to a focus on integrated practices of science.

Gender-sensitive educational approaches, grounded in postmodern feminist epistemologies and Haraway's situated knowledge (1988) framework, recognize that multiple rather than singular narratives enable a more nuanced comprehension of complex, often gendered, realities. In this third approach, educational experiences might focus more on individual differences and interests without separating them into categories based on sex. There would be an increased focus on the "social, political, cultural and psychological dimensions of science" (p. 354) and a philosophical underpinning that science is not a fixed body of knowledge, rather, knowledge of it is changing, growing and deepening. Elements of these approaches can be seen within the literature and the proposed interventions on increasing the number of girls in STEM; however, as Sinnes & Løken (2014) note, few explicitly identify their specific approach. It is this third approach which is of most value to this study. It provides a way of approaching STEM that complicates and troubles existing paradigms of STEM and of gender.

Chapter conclusion

There has been significant effort expended on improving the participation rates and engagement of girls in STEM, but research continues to struggle to account for why things are not really changing. It can be difficult for schools to know where to focus their efforts, given the complexities and numerous barriers converging from multiple directions. Rather than the tokenistic female empowerment gestures, feminising the curriculum or the STEM classroom, or bringing in role models for recruitment, I suggest a disruption to the underlying approach to STEM. Authentic, issues-based, relational learning where teachers are sensitive to gendering practices appears to be a promising start.

A significant lacuna that the literature has identified, and one which prompts further investigation, is the need for a more integrated and embedded approach to the research which attempts to explain this gendered gap in STEM education and choices. Much of the research, even that which explores the problematic nature of stereotypes unwittingly contributes to the idea that there is something fundamental about girls that shapes their participation in STEM. This produces similar outcomes of exclusion and marginalisation. Yazilitas, Svensson, et al. (2013) called for a more thorough understanding of how

explanations of choice interact, and research design that reflects the complexity and multidimensional nature of the factors attributed to gendered choices – this call remains pertinent. The research design and methodology of this thesis, as outlined in Chapter 5, responds to this challenge by exploring holistic factors that contribute to the participants' everyday experience of STEM, situating them in their social, historical, cultural and political context and examining the entangled nature of identity and how difference is created.

This overwhelming focus on inclusion and bringing women into STEM is the focus of Chesky and Goldstein's 2018 critique. They note that policy and media imagery promotes gender normative images of girls surrounded by spaces and objects connected to STEM, suggesting that girls can fit neatly in STEM spaces *and* fulfill society's feminine expectations. They note that this is often presented in a way that seems tokenistic and observe physical and symbolic disconnection within the images of the girls and the STEM objects and spaces. Heybach and and Pickup (2017)term these practices *gender washing* or *painting pink* and challenge the presentation of STEM as an objective, ahistorical, apolitical discipline. They argue that an uncritical analysis of gender has led to a focus on increasing girl's confidence in STEM solely to fit within the caricature of STEM presented to them, and/or a focus on 'creating *feminized* environments in which STEM is made more appealing to women/girls,' rather than a focus on simply providing institutional access to STEM (Heybach & Pickup 2017, 625, italics original). Further, Bennette and Toffoletti (2024) found that programs appealing to girls through the *girlification* of STEM — using the word 'girl' in program names, using 'girly' images and lots of pink — focused on empowerment, while using non-technical language and other phrases which implied they needed someone to help make STEM simple for them, reinforcing stereotypes about a lack of ability. These discourses of empowerment promoted an individualistic approach to gender equality, which, ultimately makes women responsible for fixing issues of underrepresentation.

Willey (2016, p. 994) argues that new materialisms, which are concerned with 'thinking creatively, capaciously, pluralistically, and thus irreverently with respect to the rules of science and about the boundaries and meanings of matter, life, and "humanness,"' converge with, and perform the central project of, feminist science studies. Key, and overlapping, theories from feminist science studies — Haraway's *situated knowledges* (1988), Harding's

strong objectivity (1992), and Barad's *agential realism* (2007) — establish knowledge as partial and situated while desiring to 'to lay bare the political effects of all scientific truth claim' (Willey, 2016, p. 1007). Further, feminist science studies establish the argument that 'gender presents onto-epistemological questions for scientific knowledge that often go unasked in the contemporary efforts' (Heybach & and Pickup, 2017, p. 615). Much of the research and literature presented here and which exists on the subject of women and girls in STEM feature women and girls as subjects, but they do not employ gender as an onto-epistemological tool to question how knowledge is produced. As a result, there is little which exists to lay bare to the political effects of such claims.

Chapter 4: Understanding outdoor education and gender

Outdoor educational research has a strong focus on the role of femininities and masculinities in the outdoors, and how expectations of femininity communicate messages about who does and who does not belong in the outdoors. Feminist outdoor education literature in particular challenges constructions of masculinity, the exclusion of women in the field, and the value placed on physically challenging activities compared to, for example, social and emotionally challenging activities; however, it also argues that outdoor education provides a place to be free to some extent from the expectations and pressures of gender norms for girls and can therefore be an area of transformation. Posthumanist approaches to outdoor education are emerging, exploring spatial and temporal agentic forces of *becoming-with* the wilderness – further explorations of the role of gender, the body, and matter within this literature has the potential to open up new possibilities for this disruption. Missing from extant research is any significant analysis of participation rates or efforts to increase participation outside of some findings that girls may benefit from single-sex outdoor expeditions. It is also important to note that while there is a strong awareness of the field's masculinist roots, outside of research evaluating single-sex co-curricular opportunities to participate in voluntary programs, girls' experiences are notably absent from the literature. Broadly recognised barriers to girls' engagement are confined to their discomfort within outdoor education spaces and the tension and complexity of navigating pressures to be feminine in behaviour and appearance in a masculine space. The chapter will also explore the literature evaluating interventions and the pedagogical approaches which have evolved to create a more inclusive environment for students in outdoor education.

Unlike the work on girls' participation in STEM, there is little research strategies to increase girls' participation in outdoor education. In a search of the databases, including SCOPUS, Web of Science, Informit, Google Scholar, ERIC, and of relevant outdoor education journals, such as Journal of Experiential Education and Journal of Outdoor and Environmental Education, there were no specific papers that addressed young girls' choices regarding outdoor education. The findings presented later in this thesis will contribute to this knowledge.

I argue that, while this body of literature is sparse, research and practice suggests possibilities for disrupting its historically masculinised roots and male-dominated participation. To begin, I contextualise girls' participation in outdoor education, before exploring the role of femininities, masculinities, representation, role models and risk in contributing to the tensions and contradictions that girls might experience in outdoor education.

The origins of outdoor education

Outdoor education occurs in the outdoors and in natural settings, where learning occurs in an experiential manner, and the relationship between self, others, and the environment are explored. It encompasses a range of practices, contexts, and approaches which aim to develop technical, interpersonal and risk management skills, and connection to nature, through approaches which range from traditional to experiential, place-based and reflexive pedagogies (Dyment et al., 2018; Dyment & Potter, 2015; Kennedy & Russell, 2021). Outdoor education has existed in South Australia as a senior school subject since the mid-1980s (Maniam & Brown, 2020, p. 35; Polley & Pickett, 2003). Related to outdoor education as a discrete subject are practices such as outdoor learning, adventure learning, and experiential learning which can occur within other subjects or as extra- or co-curricular programs.

The beginnings of outdoor education set out to address perceived declines in society, particularly in its youth, in the early 20th century. According to Kurt Hahn, the man responsible for the beginnings of many adventure and experiential programs that exist to this day, there were evident declines in fitness (due to modern methods of locomotion), initiative (due to an epidemic of 'spectatoritis'), memory and imagination, skill and craftsmanship, self-discipline, and, worst of all, compassion (van Oord, 2010, p. 256). Hahn's association with the British and German elite, and his interest in Plato's Republic and the development of a class of ruling intellectual (male) elite through adventure, have been critiqued (van Oord, 2010; Vernon, 2020). However, he is also widely celebrated for his progressive approach to education and principles of experiential learning, such as learning outsides the traditional classroom and in outdoor environments, encouraging risk-taking, letting students take responsibility for their own learning, inclusion and diversity, knowledge through service, exploration, observation, and moral independence (Vernon, 2020). Early outdoor education also drew on philosophies

and educational and experiential learning theories developed by John Dewey and William James who advocated for student agency and involvement in learning and the role of nature and experiences in character development (Cross et al., 2019). While these antecedents have contributed to the potential of outdoor education to be a unique site of personal growth, uncritical adoption of its principles can lead – and has led – to the (re)production of gendered, classed and racialized exclusions (Warren, 1998). Despite this legacy of supposedly progressive pedagogical innovation, outdoor education's foundational architecture, and its masculinist underpinnings, demonstrate how seemingly transformative educational practices can simultaneously reproduce the very hierarchies they claim to transcend when deployed without critical attention to the socio-material-discursive forces that shape them.

Traditional outdoor education, particularly when applied as a subset of physical education, has employed a "utilitarian approach to nature," viewing it as a "site for human activity" (Lugg, 2004; Townsend, 2011, p. 69); however, recently, a place-based approach to outdoor education has taken shape (Amanda Lloyd et al., 2018). Place-based education, particularly in the context of outdoor education, moves away from skills and activities to fostering lasting relationships and connection between students and places, particularly those of local significance. In the context of increasing awareness of the current climate emergency, the purpose and definition of outdoor education has, in many cases, also expanded to embrace an eco-pedagogical movement and there has been an increased focus on connections with nature and opportunities for sustainability (Riley, 2018).

The benefits of contemporary outdoor education

Proponents of outdoor education have long touted the personal and social development benefits to fortify its position in schools' curriculum and programs. There are 'physical, emotional, mental and spiritual benefits' (Avery et al., 2018, p. 801) as well as the physical health benefits associated with activity and spending time in natural spaces, such as longer life expectancies, reductions in chronic diseases, reducing stress and anxiety, and improving sleep (Pretty & Barton, 2020; Wang et al., 2024). Outdoor education has also been shown to help students to develop their communication skills and ability to work autonomously (Paisley

et al., 2008). Scrutton and Beames (2015) conclude that the nature and quantity of data is evidence that outdoor adventure programs benefit students (see also: Hattie et al., 1997), even if we are yet to identify the reasons why they do (see also: Holland et al., 2025; Holland et al., 2018; Mann et al., 2022; Mann et al., 2021; Whittington & Mack, 2010).

For girls specifically there are added benefits. Evans et al. (2020) suggest that outdoor education programs are an opportunity for girls to increase their confidence, body image, self-esteem, self-worth, and assertiveness. In 2011, Whittington et al. reported the additional benefits of same-sex outdoor education programs of reduced competitiveness, compulsory heterosexuality, and concerns about appearance. Whittington et al. (2016) found that girls who participated in the Dirt Divas program — a mountain biking focused day program for girls aged 10-16 — showed higher levels of resilience as a result of the supportive and reflective approach to challenges and risk-taking that experiential learning programs provide. In a study of 100 girls who participated in an adventure-based experiential education program, Whittington & Mack (2010) found, through self-reporting and evaluation, girls developed their physical and moral courage. This translated into showing courage in their everyday lives, and they provided examples of what this looked like, including "trying harder, overcoming challenges, taking the initiative, and trying something new" (p. 177). Outdoor education may also challenge girls' gendered understandings of their self. While there is some discussion of women in outdoor education counteracting stereotypically masculine behaviours with elements of visible femininity, Breault-Hood et al. (2017) report that girls who participate in wilderness experiences can feel freed from gendered expectations. Adolescent women's self-confidence and body image can improve after completing the physical challenge of an expedition as they appreciate their body for what it has been able to accomplish. Consequently, they are able to see themselves in a more positive light (Breault-Hood et al., 2017).

Femininities and masculinities in outdoor education research

The literature on outdoor education seeks to work through the paradoxical nature of gender equity in a male-dominated field. Authors (Holland-Smith, 2022; Humberstone, 2000;

Kennedy & Russell, 2021; Warren, 2016) note that outdoor education has been, and continues to be, a manifestation of hegemonic masculinity, and some have posited that:

> asking women to develop skill sets that support a historically hegemonic male-based system of outdoor adventure education is questionable… [given that] women's ways of knowing and being might provide an alternative site of knowledge within the field of outdoor education (Warren & Loeffler, 2006, p. 108).

Changing the way women's ways of knowing are valued and challenging the place of technical and strength skills as a sign of success challenges outdoor education as a masculine space, but it also suggests that strength and technical capability are male traits. Women are of course capable of performing technical and strength skills and should be provided with opportunities to equally develop in those areas (Warren & Loeffler, 2006), yet if they do possess "exceptional outdoor skills," they are viewed as a "superwoman," capable of feats beyond the abilities of the 'average' woman (Warren, 2016, p. 361). While acknowledging that there is no essentialist difference that creates experience, how experiences have been gendered — socially, historically, politically, culturally — manifests in different outcomes and needs for women participating in the field (Pinch, 2002) and different perceptions about women's participation (Warren, 2016).

Kennedy & Russell (2021) argue that outdoor education spaces have been read as masculine spaces because they emerge from a visual and historical association with rugged individualism and challenge, toughness, and adventure. The authors use Raewyn Connell's (1987) concept of hegemonic masculinity as a framework for understanding the relationship between hegemonic masculinities, emphasised femininities, and other performances of gender in outdoor education (Connell & Messerschmidt, 2005; Scott, 2015). Hegemonic masculinities shift with social context and are not necessarily the most common expression of masculinity, rather they are patterns of hegemonic behaviours which legitimise hierarchies, subjugation and othering (Connell, 1987, 1995). Kennedy and Russell (2021) argue that men who enter the caring and feminised spaces of education often engage in compensatory behaviours that align with hegemonic masculinities, such as being strict and competitive, in order to recuperate their position within the patriarchal hierarchy. These compensatory behaviours

are enacted in spaces like outdoor education which are seen as an 'appropriate' place to perform hegemonic masculinity that may be incongruous in regular classroom settings. When male teachers and peers understand outdoor education as a place to enact hegemonic masculinities, they see feminine expressions, and by extension, those who engage with femininities, as other in the space, leading to unintentional and intentional exclusion.

Hegemonic masculinity also informs how students are perceived. Pinch (2005) paints a picture of expectations that the presence of boys naturally makes more sense in outdoor education spaces. Along with beliefs that boys were stronger, funnier, more competitive and less bossy than girls, their study recorded that the participants saw boys as 'acting' and girls as 'thinking'. Pinch notes that in some groups, the boys did indeed take the lead on group hikes and would often forge ahead even when the path was unclear. On top of that, if girls had intentionally been placed at the front to give them a turn leading, the boys would overtake them when the girls would stop to consider their options – no one questioned the removal of the girls as leaders in these moments. An older, also influential, study did in fact seek girls' perceptions of their place in outdoor spaces. Culp (1998) found that girls perceived boys to be tougher and that it was more acceptable for them to get dirty. They also found their participants believed they would feel less constrained in single-sex programs. However, Pinch argues against "viewing men's experiences and women's experiences as essentially different" in Australian outdoor education. Rather, in understanding gender "as a process" or an "interplay between social practice and social structure," they suggest that girls' prior experiences determine their level of comfort and their behaviours in outdoor education (Pinch, 2005, p. 2).

For many young women, outdoor spaces are unfamiliar territories. MacBride-Stewart (2022) found that it is, consequently, difficult for young women to understand how normative feminine identities are enacted in outdoor spaces and what gendered expectations and inequalities look like in these environments. Demonstrating the cultural resistance to full inclusion, and the tension that even adult, expert women face in navigating femininity in the outdoor education environment, a mother and daughter recounted their gendered experiences working as outdoor education guides in an autoethnographic essay. Despite their careers taking place 30 years apart, central to their reflection was the internalised pressure

both women felt to adhere to feminine standards of beauty and to resist the "dominant culture's inscription of femininity, namely weakness" (Oakley et al., 2018, p. 376). Both mother and daughter felt the need to be exceptional, to 'beat the boys' and be a 'superwoman' or, as one participant in Evans and Anderson (2018, p. 19) stated, "you have to be a little bit better to be half as good…" Such experiences are consistent with research exploring how women navigate masculine environments. Evans et al. (2023) describes the process of 'defensive othering' as common in sporting environments, where women align themselves with the dominant and valued male characteristics associated with the field. They observe that women in sport, and I argue, outdoor education, accommodate and apologise for, and perhaps mitigate, their masculine behaviours through maintaining feminine standards of beauty and behaviour. In doing so, they attempt to avoid breaching gendered expectations, but at the cost of increased pressure to conform to, and succeed at, the limits of both masculinity and femininity (Oakley, et al. 2018). This situation highlights how gendered norms in outdoor education environments co-opt women into embodying conflicting and contradictory roles. In this impossible situation, individual efforts to resist are never enough to change the underlying conditions that make outdoor spaces predominantly masculine.

In outdoor education, its masculinist history and appearance and contemporary hegemonic masculinities establishes gender relationships and hierarchies. For young women who feel pressure to perform valued femininities, the dirt, mud and weather of the outdoors and the challenges of outdoor activities creates a tense engagement. Positive framing of engaging with hybrid femininities, or multiple forms of femininities, where young women accepted differences, made elements of outdoor education, such as getting muddy and being more physical, more accessible (MacBride-Stewart, 2022). While discussions of masculinities and femininities — and how they circulate and are enacted — are useful for understanding the nature of inequalities in outdoor education, more consideration is needed of how such categorisation of all behaviours as forms of femininities and masculinities, based on who is performing them, contributes to schemas of difference and, in turn, different opportunities in these spaces.

Complexities of girls' participation in outdoor education spaces

The existing research highlights three key elements— women's representation in outdoor spaces, limited role models, and the lack of comfort and safety that young women may feel in outdoor, risky spaces — that can make outdoor education spaces feel less welcoming for girls.

Representation and inclusion of women in the field

With much of the literature on exclusion and inclusion of women in outdoor education focuses on the invisible or missing adult women (Warren et al., 2014), evidence is needed to determine if, or how, this might impact girls' choices and participation in outdoor education. From the existing literature, however, it is possible to determine that older women would be largely absent from girls' experiences. Mitten et al. (2018) write that there is an 'invisibility cloak' over women in outdoor education (see also: Gray et al., 2017). There continues to be a perception that men have a 'paternal inheritance' to the profession, with influential men, such Hahn, Dewey, Thoreau, being claimed as 'father' of outdoor education. Mitten et al. (2018) note that the Wikipedia article describing contributors to outdoor education listed 17 men and no women – women are rarely described as the 'mother' of anything, yet it was a woman — Marina Ewald — who was a co-founder and active director of programs attributed to Hahn. Gray et al. (2017) provides a number of reasons why women continue to be erased from visibility and excluded from leadership, including that women are less likely to be self-aggrandizing and to put forward their achievements, women suffer from imposter syndrome, women's leadership can be, or can be seen as, more relational, and that there is a "mismatch between concepts of "heroism" and gender roles" in the field (pp. 50-51). While a poststructuralist analysis would argue that women have been positioned in such a way to feel they need to be more humble and relational, and to feel they are not as deserving of their achievements (Davies, 1991), these explanations position women's invisibility as a women's issue, where women are responsible for behaving in such a way that secures their equality. This, as Gray et al. (2017) point out, leads to 'feminist fatigue.' Regardless of the dynamics, this invisibility cloak is not only an issue of being seen – it is an "indicator of how power shapes knowledge in OE" (Gray et al., 2017, p. 50). Knowledge is further shaped by the hidden

curriculum of outdoor education — the lessons that are taught through what is excluded from the curriculum, embedded in practices, in linguistic sexism, and in a lack of positive messaging about women in the outdoors Warren et al. (2019). It is this context which contributes to the continued masculinisation of outdoor education and in which girls' participation occurs.

In addition to girls having few women in the field to look to, there are sparse images of women in popular media in outdoor education related activities. Those that are available tend to align with socially valued femininity. McNiel et al. (2012) found that in magazine advertisements associated with the field, women were predominantly portrayed as having a passive role or positioned in relation to their family, either participating in family trips or being there as an escape from their families. Highly successful women in their fields were presented as unique and exceptional, however, they were often featured in ways that conformed to dominant expectations of femininity, wearing feminine colours or fitted clothes in ways not evident in advertisements featuring men. Language reinforced these messages, such as describing these highly accomplished individuals as 'chatting' or describing her clothes as allowing her to go from "yoga mat to the mountain" (p. 50). With few images of outdoor identities available, in combination with those that are available portraying an idealised femininity that is incongruent with outdoor education experiences, it is challenging for girls to visualise possible identities in the outdoors.

Role models

Female role models in outdoor education can be powerful for encouraging participation and, resulting from the missing women in outdoor education as described in the previous section, the need for more female role models has been advocated (Allen-Craig et al., 2020). Malterud et al. (2023) found that "cool female role models" (p. 81) in adventuring and mountaineering sports in Norway, who celebrate attributes such as "badass, laidback and hardcore' (p. 81) while also engaging in traditional femininities, were able to 'expand the patterns of behaviour that are available to them" (p. 81) and contribute to a reconceptualization of what had been "an entirely masculine discourse" (p. 79) for the people who looked up to them.

However, pressure to be a role model may place a burden on women in a field where women are already experiencing feminist fatigue (Saunders & Sharp, 2002). Alongside expectations that female leaders must be 'superwoman', there are tensions arising from outdoor education leaders' technical skill – skills that may be esteemed and seem unattainable to those who are learning from them (Warren, Risinger, Loeffler, 2018). As in STEM education, there have been positive effects from men role modelling non-masculine traits, and, in describing a study by Schindel and Tolbert (2017), Kennedy and Russell (2021) suggest that students engaged positively with a male teacher who exhibits an alternative masculinity and a "pedagogy grounded in a politicized ethic of care towards self, other, and the natural world" (p.166). They call for more research into performance of alternative masculinities as a way of disrupting hegemonic masculinities in outdoor learning. The answer to the complexities of female role models and girls' participation in outdoor education may not be men or women role models but rather, disrupting the gendered meanings of outdoor education.

Risk and discomfort

A key aspect of outdoor education continues to be supported risk-taking or engaging in activities where there is a perceived risk (Brown et al., 2021). Mitten (2017) writes that physical risk-taking in outdoor and adventure education is explicitly and implicitly encouraged through its alignment with achievement and winning. This approach perpetuates a power dynamic that positions humans over nature and act to 'separate people and encourage having power over each other' (Mitten 2017, p. 177). It also reflects and reproduced gender binaries and the meanings of masculinity and femininity in outdoor education.

Girls experience a different relationship to risk compared to boys in outdoor spaces (Clark, 2015). In the context of a general awareness that young women have of the risk of violence in public spaces (Solnit, 2001) and fairy tales which teach girls to stay out of the woods (Evans et al., 2020), most wilderness activities occur in places which are isolated, seemingly compounding risks of which women are all too aware (Evans et al., 2020). Clark (2015) engaged multicultural, London-based girls in a longitudinal, mixed methods study to explore this relationship between risk and outdoor spaces, finding that girls were subject to risk discourses in ways that boys were not. Parents voiced their concerns and required greater

supervision of their daughters' outside play, and teachers communicated similar messages. In this study, parents', teachers', and society's fears about girls' safety in their neighbourhoods "rested in a characterisation of girls (in particular) as weak and defenceless [which served to] regulate girls' activities and embodied capacities" (p. 1018). This was extended to girls' participation in physical activities at school, where they were also spatially restricted and surveilled. Boys dominated sites of outdoor physical activity, such as football pitches, and girls' participation was unwelcome and complicated by fears about their perceived vulnerability and need of extra supervision. There is some evidence to suggest that girls and women are just more likely to admit their fears than boys (Ewert, 1988) and Clark (2015) argues that participation can be an act of resistance that allows for reconstitution of those very spaces; however, navigating real fears and real barriers remains complex and gendered. Outdoor education proponents argue that participation in outdoor adventure challenges allows young women to take control of their environment, take positive and appropriate risks, and increase experience in a safe, incremental manner (Boniface, 2006; Tsikalas & Martin, 2015). Thus, outdoor education can assist in increasing girls' sense of belonging in the outdoors (Boniface, 2006). It should be noted that this narrative of increased belonging and empowerment through calculated risk still exists within a framework which assumes outdoor environments to be neutral territories to be conquered. This approach to challenge and risk limits possibilities for becoming-with the more-than-human world in ways that transcend the human/non-human dualism, foreclosing possibilities of intra-actions with place, which in turn foster deeper connections and a greater sense of belonging.

There is also evidence to suggest that approaches to risk (re)produces hierarchical gender binaries associated with traditional outdoor education. In a study of outdoor and adventure education professionals, Tilstra et al. (2022) found that there was a binary perception of risk-taking: boys were seen to take more physical risks, such as charging head without planning, or engaging with 'hard' activities and girls were understood to take more emotional risks, such as being vulnerable and sharing. Due to their apparent emotional maturity, girls were assumed by program leaders to be more mature and were given more responsibility and autonomy outdoor adventure activity risk-taking. Consequently, their needs when it came to risk-taking were considered secondary as the leaders believed that the boys required more of their attention. There are other examples of where girls' needs, safety and comfort were

considered secondary or not at all in outdoor education. In a study of the packing lists provided to students before an outdoor expedition to ensure their safety and comfort, period products and gendered clothing, such as sports bras, were either omitted from lists or put in an additional category of needs separate to the general categories under which they might otherwise belong, for example toiletries or clothing (Tilstra et al., 2022). Tilstra et al. (2022) argues such practices are a message that girls' safety and comfort requirements is not the norm and requires additional consideration. Presenting these needs as 'extra' can be seen as "preparing students to enter a masculine space where the boys' experience is considered to be the neutral norm and the female experience as a gendered deviation" (Tilstra et al. 2022, p. 186).

Modern outdoor education pedagogical approaches focus on increasing feelings of safety, comfort and resilience through emphases on personal growth and development which, at times, may be cultivated by invoking fear and discomfort (Reed & and Smith, 2023). Blaine and Akhurst (2023) compared the experiences of young women and young men after their participation on a 21-day journey program and determined that it was individual differences that explained most disparities in the measures they tested for (including achievement, initiative, intellectual flexibility, emotional control, self-confidence and leadership) - with the exception of resilience, against which girls consistently scored lower on self-reporting tools. Blaine & Akhurst (2023) posited that adolescent girls may have lower physical self-concept, different perceptions of what the intended outcomes of their participation should be, and they may perceive the programs to be designed for males and do not expect to get as much out of it. These findings suggest that the intended impacts of outdoor education activities are gendered and as such, more gendered analysis can provide insights into role of risk and physical challenge in any personal growth aspects of outdoor education.

Adult women in outdoor education also experience risk, discomfort and exclusion. Women report "problematic work environments, sexual harassment, questioning of their technical outdoor skills and competency, and gender-role stereotyping" (Warren et al., 2018, p. 247). Culp (1998) found that rather than blatant discrimination, women faced a subtle undermining which affected their participation. Women failing to conform to the male-dominated culture of outdoor education or failing to rise to 'any challenge' are actively excluded and isolated, so

they perceive their choices as either continuing in a field where they are not accepted or to leaving (Philpott, 2017).

Encouraging girls' participation in outdoor education

There are few studies that reliably determine correlations between programs and interventions, participation and outcomes, particularly in an Australian context and specifically for in-school outdoor education classes and programs. The research addressing the benefits to girls of participating are typically drawn from the US where there is a culture of attending summer camps and where 17% of the estimated 12,000 camp programs offer a female-only experience (Whittington et al., 2016). Outside of single-sex schools, middle school aged girls in Australia have far less access to these programs. However, some studies are indicative of potentially impactful interventions. Research indicating positive intervention outcomes is most prevalent in the instance of all-girl, single-sex opportunities. Programs such as *Find Your Voice* exist to address the barriers that middle school age girls face in participating in outdoor learning and recreation activities (Evans et al., 2020). This intervention includes trained counsellors educated in self-efficacy theory who provide positive feedback and reinforcement, encourage the girls to celebrate their own and others' successes, and to manage physical and wellbeing challenges to facilitate participants' success through positive instructions and frameworks. Advocates for all-girl, all-women programs found that programs such as Find Your Voice allow girls to challenge stereotypes and increase confidence when they create supportive and collaborative environments and provide opportunities for reflection and create competency and confidence through skill development and access to technically competent role female role models who are open with their own challenges (Whittington, 2018). Such findings demonstrate that young women may feel more freedom from the pressures of gendered expectations in an outdoor, single-sex environment; however, gender shapes how, when and in what manner they can participate. Further, such conclusions precariously frame girls' belonging in outdoor spaces as dependent only on the presence of other women and certain pretexts about empowerment. This pattern of messaging about women in male-dominated spaces, particularly those with a veneer of

neutrality, undermines girls' material capacity to belong all while promising inclusion and empowerment.

Other research has focused how to increase young women's feelings of belonging in outdoor education spaces. Strategies have included actively facilitating friendships during programs and providing young women with more choice and autonomy in participating in outdoor programs and planning activities (Culp, 1998). In Culp (1998), participants believed that providing opportunities for autonomy and leadership might mitigate some of the pressure and constraints that young women feel hold them back from participating fully, offering empowerment and dependence not often experienced in their daily lives. Megyesi (2011) also identified choices of activity as an incentive to girls participating in outdoor programs. Furthermore, they recommended that girls should be well-prepared for taking risks by being informed about safety precautions and relevant skills, further contributing to their feelings of autonomy. Another recommendation from both studies was allowing or facilitating friendships within the programs. Girls participated more fully when they had friends to support them in these spaces that were often outside of their comfort zones. Culp (1998) also recommended that where possible, young women should be kept with existing or continuing peer groups for a sense of cohesion. Both studies suggest that young women look for support in navigating the gendered and unfamiliar outdoor education environments.

In the 1990s, pedagogical approaches to outdoor education were introduced, focusing on 'slow pedagogy,' emotional literacy, reflection, connecting with nature, and examining one's place within it. These approaches, which influenced outdoor education programs to varying extents, took gender and "female ways of knowing and being in the outdoors" and the potential to challenge gender norms seriously (Birrell et al., 2018, p. 486). Wigglesworth et al. (2018) suggests that the process of journaling, one of the practices incorporated in newer pedagogical approaches to outdoor education, may facilitate challenging conceptions of femininity. Reflection, debriefing and dialogue have also become key elements in practice in outdoor education (Dyment et al., 2018; Dyment & Potter, 2015), but Wigglesworth (2018) suggests that journaling in the moment can increase critical consciousness, a "sociopolitical educative tool that encourages individuals to question the nature of their social and historical location" (p. 795). Critical consciousness can be explored through questions such as:

> What am I wearing to climb, and why? What are the technologies I employ to climb the rock and how are these manufactured? What is deemed a successful climb, and by whom? What bodies are privileged by this understanding of success? How might I be damaging the rock in my practices? Whose "nature" is this? How do you climb like a girl? (Wigglesworth 2018, p. 796).

In asking these questions, students of all genders are encouraged to unpack the "embodied knowledges and values that we uphold in outdoor education" (Wigglesworth 2018, p. 790), challenging the messages that outdoor education may ordinarily communicate about gender.

Scholars argue that outdoor education has the potential to "[break] down the gender norms held more broadly in society" and to challenge gender binaries (Evans & Anderson, 2018, p. 9) and for spaces of outdoor recreation to 'function as sites to challenge normative gender roles and stereotypes that define women as inferior' (McAnirlin & Maddox, 2022, p. 337). Warren (2015) elaborates that feminist approaches to outdoor education include more collaborative problem-solving, and Birrell (2018) also suggests that outdoor education space needs to, and can, become more feminine by changing the macho nature of programs and including more collaboration and less competitiveness, more awe and wonder and appreciation of place, and more time for sharing and reflection. However, Kennedy (2023) argues that male outdoor education leaders continue to lack awareness about experiences and inequalities their female colleagues and student participants face, contributing to continuing hegemonic masculine practices. While challenging these masculine approaches may amplify any positive benefits that girls receive from participation (Blaine & Akhurst, 2023), framing orientations such as wonder, sharing and reflection as feminine may serve to reinforce binaries of masculinity and femininity rather than disrupt them. Analysis challenging binaries is largely absent from the outdoor education literature however the pedagogical approaches of outdoor education certainly provide possibilities for incursion into challenging normative practices of gender.

Chapter conclusion

These theoretical interventions reveal a partial vision of the girls in outdoor education assemblage. In this vision, we see overlapping agentic forces of gender and place which require further critical examination, and the way that current practices which are framed as neutral continue to (re)produce masculinised environments in ways that create co-constitutive entanglements of all bodies in outdoor assemblages.

Outdoor education research largely takes the position that gender is socially constructed (Tilstra et al., 2022), and often incorporates a feminist approach which recognises the impact of the social and cultural context on understandings and experiences of outdoor education (Avery et al., 2018). Limited representation of women, few role models and a de-gendered understanding of risk may be barriers to girls' participation but even if not empirically supported, framing them as such has the potential of 'bringing women in' and placing responsibility for change on women's and girls' shoulders without addressing gendered understandings of outdoor education. Mitten suggests a shift to exist in an 'ecology of relationships' (2017) where a person sees themselves as entangled and intertwined with other beings in a world of connections. Seeing the world through this lens resists processes of othering; rather, in viewing the world as an ecology of relationships, "integration and differentiation go hand in hand" (Mitten 2017, p. 175). Mitten (2017) argues that outdoor education provides an opportunity to engage with the human and the more than human world, creating windows to educate people about systems thinking which in turn encourages them to examine their relationships with each other and the more than human, and their role and responsibility within those entanglements.

Mitten's (2017) arguments point to the value of new materialist and posthumanist feminisms in exploring girls' experiences of outdoor education. Specifically, they bring to the fore the role of place and the way that young women interact and are entangled with spaces, place and the non-human. This is particularly the case when exploring 'nature,' the location of outdoor education experiences and its entanglement with the feminine. Exploring the "conceptual links between different categories of domination" including between *nature* and *woman*, Plumwood (1993) writes that the "category of nature is a field of multiple exclusion and control, not only of non-humans, but of various groups of humans and aspects of human life which are cast as nature." Critical ecofeminist and materialist approaches explore how

the parallel and symbiotic dominations of the 'human over the non-human with male domination over women' are embedded deep in "social, economic, and political structures" (Gough & Whitehouse, 2019, p. 333). Alaimo (2018) argues that poststructuralist accounts and critical ecofeminist approaches can reimagine and disrupt this relationship. As a 'gender minimising' feminist, she had come across in her work many women who had not only "inventively recast specific concepts of nature [but who had] conjured up rich, generative alternatives to essentialisms by imagining nature as an undomesticated space for feminisms that subverted gendered, and sometimes racial and class hierarchies and identities" (p. 47). Gough and Whitehouse (2020) argue that the intersection between new materialist feminism and ecofeminism provides for a more inclusive feminism and one which challenges its proponents to "denaturalize nature *and* deculturalize culture" (p.1422).

Outdoor education, particularly with its pedagogical approaches committed to reflection, sharing, and slowness, is a potential terrain for applying feminist new materialist analysis to destabilise traditional norms and categories. Critical new materialist pedagogies give educators working in eco-environments a "gentle push to explore alternative accounts of relationality, accountability, and deep reciprocity by investing their thinking, teaching, and learning practices with an immanent, more-than-human eco-ethics" (Carstens & Geerts, 2024, p. 4). Drawing on Haraway and her influence on new materialist philosophies and pedagogies, Carstens and Geerts (2024) remind us that critical pedagogies drawn from critical new materialisms need to "tell more nuanced stories," teaching situated, embodied, partial forms of objectivity which highlight the material harms that have emerged from "centralising objectifying stories of so-called progress" (p. 9).

Chapter 5: Bridging the gap: contextualising the STEM and outdoor education literature

The previous two chapters exploring the literature on STEM and outdoor education are very different in focus, character, composition and scope. These differences reflect distinct societal and educational values towards STEM and outdoor education. Outdoor education as a subject does not hold the same societal value or intellectual capital as STEM. The ability to participate in outdoor education is usually reflective of socioeconomic privilege and schools in Australia offer limited participation opportunities (Caufield, 2022). Australian schools with the necessary resources can commit significant time, financial and marketing resources to a program of camps, extracurricular activities and extended alternative learning programs because of their strategic commitments to developing well-rounded, resilient, and capable individuals or because they are seeking market differentiation (Allen-Craig & Carpenter, 2018). As outdoor education more obviously aligns with personal development than career pathways and economic opportunities, there is less public consciousness and policy focus on gendered inequalities in participation and experience and less pressure to implement strategies to mitigate those inequalities. The scale of participation in STEM is much greater at school, national and global level; in Australia it is an area which all students are required to engage with for most of their schooling. Given its governmental, policy and institutional priority, significant resources and research are directed at increasing participation and securing the future workforce. These differences are reflected in the body of literature, its scale and its priorities.

These differences also reflect approaches to gender within each field of research, internally diverse as they are. STEM research and initiatives focus on the need to increase female participation (Bennette & Toffoletti, 2024), whereas outdoor education research and pedagogy is more focused on the way the subject has the potential to empower girls through their participation (McNatty et al., 2024). Feminist outdoor education research sees gender inclusiveness as part, even a result, of a wider pedagogical focus on the environment, connection to nature, and a focus on relationships and personal growth (Warren, 2016). While outdoor education offers a critique of constructions of some aspects of gender, particularly masculinity (Kennedy & Russell, 2021), with few exceptions, neither field of research seeks to disrupt constructions of gender and femininity within the subject. This has the potential to

communicate an unintended message that there is a need to 'fix' girls – their choices to participate, their interest, their engagement – or incorporate more 'girl interests' into subjects – rather than disrupt the gendered meanings of the field. To pursue disruption, it is necessary to untangle and pull at the webs of girls' embodied, entangled experiences of each subject, constituted by the social, cultural, historical, political and material threads that are woven together into the phenomenon of young women's participation in male-dominated subjects.

The literature's under-developed uncritical approach to femininity or masculinity seems often to translate into simplified questions of the barriers and motivations to young women's participation in male-dominated fields of study. Staley (2018) explores the way that the discourse of barriers and motivators can lead researchers and educators to seek prescriptive and simplistic solutions. These solutions may remove barriers faced by individuals, but without situating the problem in its historical, social and systemic roots, little change will occur. In some situations, it may reinforce the structural inequalities, gendered interpretations of subjects and the binary thinking that contributed to the issue. For example, many thoroughly researched and evidence-based strategies have been implemented to increase girls' participation in STEM, often with little meaningful change. This has led some (Stoet & Geary, 2018) to argue that there is something biological or inherent about girls' disinterest in STEM (Richardson et al., 2020). In a socio-material approach, dominant ways of conceptualising and discussing barriers cannot account for "embodied, sensory experiences and intra-actions" with that material (Løken & Serder, 2020, p. 124). Staley (2018) states that our education systems are rooted in 'rigid and repetitive ways of thinking' which is why we see the same dilemmas repeatedly addressed. Static participation rates are an example of 'stuck places' (Ellsworth, 1997), but as Lather (1998, p. 495) writes, the task when encountering stuck places is "to situate the experience of impossibility as an enabling site for working through aporias" as a way to 'keep moving' and 'produce and learn from ruptures, failures, breaks and refusals' Hegemonic and institutional discourse frame, control, and, paradoxically, provide the method for dismantling, the 'problem' of girls in STEM and outdoor education. Staley argues the need for embracing the impossible and paradoxical, for leaning into the discomfort by working within those stuck places, and to disrupt normalising practices.

Haraway might call this ‘staying with the trouble’ (2016), not as a way to solve the problems of the future, but to understand the present.

In staying with the trouble, it consequently becomes response-able to wonder whether new alternatives or *lines of flight* (Deleuze, 2007) are possible. Haraway calls “training the mind and imagination to go visiting,” “pos[ing] and respond[ing] to interesting questions,” “propos[ing] together something unanticipated,” and “being obligated to speak from situated worlds” through the act of listening to a story the practice of “cultivating response-ability” (2016, pp. 130, 132). In arguing for the need to stay with the trouble and for a response-able approach to the problem of gender in male-dominated subjects to disrupt stuck-ness, I return to the opportunity that new materialist feminisms and posthumanist theories offer for a rethinking of, and possible points of departure for, gender and STEM (Burnard & and Köbli, 2024). In outdoor education, emerging research acknowledges the role of nature and the more-than-human in constructing experiences and knowledge in the wilderness, particularly attuning to matters of sustainability. Ecofeminist perspectives in the literature related to outdoor education also acknowledge historical conflations of women and nature as ‘other.’ Yet, there is room for a serious account of the way gender, place, bodies and movement are entangled in the assemblage of young women’s experience of outdoor education. Likewise, the descriptions of inequality and STEM identity in the STEM literature offer room for thinking about the material-discursive-affective forces entangled in the makings of in/equalities and the subjectivities and identities produced through the assemblage (Bazzul & and Santavicca, 2017; Wolfe, 2022a). In applying these theoretical approaches, there is an acknowledgement of the fluidity and connected nature of experience. In telling those stories, it opens up possibilities for disruption. Returning to an earlier quote from (Haraway, 2013b, p. 4): It matters what stories make worlds, what worlds make stories.’

The research methods and methodologies outlined in the next chapter explore the processes of capturing, listening and attuning to those stories and how they will be told.

Chapter 6: Method and Methodology

Donna Haraway's S*ituated Knowledges* (1988) has been central to decisions on method and research processes in this thesis. In this work, Haraway explores the tension between the desire of scientists to uncover knowledge that is legitimate, objective and liberatory, and the clear, ideological biases that occur when knowledge is decontextualized and unlocated. Given its cultural weight and privilege, *science* develops a mystic quality – its 'facts' become seemingly unquestionable and any argument against it deemed irrational in the face of its apparent logic. In acknowledging that we need a better paradigm than simply countering it with experience or pointing out methodological biases, Haraway argues that the real question then becomes *what counts as knowledge?* In seeking to define what knowledge is, she calls for a new, or embodied, objectivity, which locates the process of knowledge production in lived experiences. This results in situated knowledges that are neither objective scientific method nor subjugated experiences, but both. This 'not either, but both' approach provides a paradigmatic model when it comes to thinking about how gender is enacted, mobilised and experienced in schools. It is not social or biological processes, not scientific 'facts' about the science of sex differences or feminist critique, but both. It is only in acknowledging the *partial* perspectives of both accounts that knowledge can be produced which is both *visionary* and *liberatory* (Haraway, 1988, p. 587). In engaging with partial, embodied and relational ways of knowing, I aim to open up spaces for transformative engagements with the socio-material-discursive complexities of gendered becoming in educational contexts.

Situating myself as researcher

I insert myself as researcher in here, in the tradition of string-figuring, speculative fabulation, situated knowledges and *becoming-with* the data as researcher (Haraway, 2013b; Haraway, 2016; Taguchi, 2012). Installing myself in the flow of conversation (Taguchi, 2018), I was affected by the pressure that these young women had on them to conform, and I shared physical feelings of exhaustion in thinking about how they navigated their experiences.

As Wolfe (2022a, p. 9) writes of her experience as teacher/researcher, “I am never outside of the entangled assemblages of research-teaching (historic material-discursive practices) that I am creating through and with.” I think about this as I am both surprised and not surprised by most of the participant’s contributions, as they are deeply embedded in the experiences I have shared with students over my 20 years of teaching, and my own time as a student in STEM and outdoor educational settings. As Wolfe proceeds to say, the research and data presented here “only materialize from the measurements conducted within my research creation” (p. 9), and these instruments and measurements are certainly shaped by these experiences. I am part of the data creation.

To situate oneself in the research is not about listing “identity categories, but [forming] a complex cartography of becomings” (Strom et al., 2019, p. 7); rather, it shifts the research away from universalising claims to knowledge and towards a situated perspectivism. Like the participants represented here, I am a white woman who grew up on Kaurna land and experienced many forms of privilege. I attended public and private schools, similar to, but not the same as, schools included in this research. The two subject areas I have identified with the most in my own teaching have been English and science and my best results when I was a student were in English and physics. I say this to acknowledge that my experience has created entry points to theory which disrupts dualisms and binaries of conventional gendered thinking, such as new materialism and posthumanism. In engaging with these theories, the data becomes embedded in this situated perspectivism.

Finally, I found attending the focus group discussions as researcher/educator/participant to be encouraging. Not just as an educator to witness a group of such highly articulate, intelligent, thoughtful participants discussing important issues, but because it was a shared experience through which understanding and empathy emerged. I often wondered what things would have been like if I had been able to participate in similar discussions when I was their age.

The research processes

School context

Students from two schools participated in this study. The decision to include these schools related to their characteristics of being co-educational, metropolitan schools with strong STEM and outdoor education programs, with different approaches to the teaching and learning of STEM and outdoor education. Lobelia High School is an independent school with a more traditional, silo-based approach to STEM. In the year data collection occurred, the school population was approximately 900 students, which consisted of 42% girls, and was in the 97th percentile according to the Index of Community Socio-Educational Advantage (ICSEA) (ACARA, 2024). Mangrove High School is a public school which had been recommended to me as a school with an 'innovative' approach due to its use of project-based and integrated learning. At this time, Mangrove High School was approximately 1300 students made up of 48% girls. They were in the 67th percentile according to the ICSEA (ACARA, 2024). In working with Lobelia High School, the opportunity to explore outdoor education arose, which provided another point of diffraction, another partial story incorporating the experiences of girls in male-dominated subjects.

Focus groups

The research was conducted in accordance with the Flinders Human Research Ethics Committee approved approach (#8507 for the pilot project and #2030). Once the schools agreed to participate, the appropriate person within the school distributed the information statement, parental consent form and student assent form to the parents of all students in Years 9-11 in the case of one school or a smaller population within that group in the other. Additionally, they communicated with staff members and distributed the relevant information statement and consent form. The schools did this using their usual channels of information distribution. This process was designed to limit any feelings of compulsion. There was no direct contact between me and the participants until the adult participants forwarded their consent to participate or, for the student participants, their parents had forwarded consent. Before any further communication with a student participant took place, they signed an assent form.

29 students from the two the schools provided their assent and consent to participate in one of the four focus groups. Seven students from Lobelia High school participated in the first pilot focus group session. A further eight students from Lobelia High School participated in the STEM focus group sessions and another eight students in the outdoor education focus group sessions. Six students from Mangrove High School also participated in STEM focus group sessions. The student participants were in Years 9-11 and ranged in ages from 14-17. They each identified as female and had experience of being positioned as a girl in STEM or outdoor education. These year levels were selected as students at this age are, perhaps for the first time in their educational journey, provided some autonomy in the subjects they choose and are able to make choices based on their preferences and their imagined and possible future pathways. Focus groups with student participants were the primary and most significant aspect of the research and data collection. Focus groups were an effective way of gathering data as they allowed for student voice, critical reflection and discussion, and the group setting with peers allowed them to delve deeper into issues. Through conversation they were able to explore and build upon their ideas, memories, and their understanding of the experiences they shared (Linhorst, 2002).

With each new group of students, the first activity was to introduce myself and the project and to explain the ethical practices to which I had committed. I gave students copies of the assent form and explained how their contributions would be treated, where data would be stored, the efforts that would be taken to increase their confidentiality and the limitations of that confidentiality due to the nature of focus groups, and the outline of each session. I explained sessions would be audio recorded and, while they were welcome to leave at any time, I was unable to stop the recording. In each subsequent session, students were reminded of the principles of ongoing, informed consent and their right to choose their level of participation in the discussions or withdraw without fear of consequence or concern.

Once these details had been covered, group norms were established, and each group member made a commitment to respect each other and their privacy. We discussed avenues for support if anything within the sessions brought them discomfort, including speaking with me if they had feedback on the sessions or wanted clarification. We discussed how that might be done while respecting the privacy and identity of other members of the focus group as well

as how they might share experiences with the group while respecting the privacy and identity of other students and teachers in the school. I asked them to consider focusing on trends rather than single incidents and where it was necessary to speak about an individual, even if it was a positive example — for example, a specific teacher who had been really successful at making science enjoyable — to avoid using names and to keep to general terms where possible.

The student participants' time and contributions were acknowledged with a $30 gift card. This amount was chosen as a sum that, for their age group, would show appreciation for their participation and efforts without being significant enough to compel or incentivise them to participate. While this practice is "not unproblematic" (Head, 2009, p. 335) as it can alter the motivations of participants without careful consideration of all related factors, paying participants can serve to reduce some power imbalances between researcher and participant and show respect for the participants (Head, 2009). The final session occurred over a pizza lunch. Many of the participants had found the focus groups to be a positive experience and felt some relief to find out that there were others with similar experiences. The lunch acknowledged that shared experience and my gratitude for their time and contributions.

Focus group session outlines

While there was a plan for each of the four sessions, topics naturally spilled over into subsequent sessions and as one thread was pulled, the connections, networks, patterns and assemblages that constructed their experience were revealed in ways that did not always fit neatly into a set plan. Allowing the exploration of tangents better constructed a picture of the complexities and interrelated nature of their experience.

The first session of each set of focus groups was broad in nature and was designed to familiarise participants with the focus group protocols and encourage them to feel welcome to contribute in any manner they chose. The participants were asked about their subject choices and what had motivated them to choose, or not choose, STEM or outdoor education. They were asked about their influences and role models, thoughts about possible careers and

how they saw their choices around STEM or outdoor education impacting their future, and, broadly, what gender stereotypes they had noticed. In this first session, participants were also invited to consider topics they would like to discuss in future sessions, how they wanted to structure sessions, and when they wanted them to take place.

The second and subsequent sessions began with a recap of the previous session and invited participants to share any reflections they may have had during the previous week. Participants were also provided with a list of discussion topics and some paper and coloured pens and pencils. They were invited to record any thoughts, words or ideas that arose for them, or to draw images that might represent their thoughts on the topics being discussed, or to just use it for doodling or doing something with their hands. This interaction with material and the non-human within the space helped to create additional, more-than-voice data.

The second focus group session explored experiences of STEM and outdoor education that may have been gendered in nature, interactions with peers and teachers that shaped how participants saw themselves or their peers in these subjects, barriers they had faced in their learning, and any issues of gender inequality they had observed. We also explored gendered experiences relating to STEM or outdoor education outside of the classroom, including how these subjects were perceived in society and in the media. Participants were invited to share how they navigated barriers, how perceptions and stereotypes related to the subject impacted their choices, and how they saw their identity as a young woman in STEM or outdoor education.

The third session was designed to explore whether having critical discussions about gendered experiences of STEM could have potential mitigating effects. This session's approach drew on the work of Costa and Mendel (2017) who taught critical approaches to science to secondary school age girls in Austria. The topics they used form a solid introduction to thinking about science in a critical way, including the science of sex/gender and its relationship to the practice of science. I presented them with short excerpts from relevant research and asked them their thoughts on the findings, whether they thought proposed research-based interventions might

be helpful for them, and what they had found to be supportive and what had worked for them.

In the final session I invited the groups to engage in speculation and *what ifs?* One STEM group imagined what a day at school would look like if their experience was not shaped by their gender, and they created a narrative account of that day. The other two groups engage with questions about what they would change and made recommendations for improving their experiences of participating in male-dominated subjects. What emerged from this was fascinating and useful and, if the process was to be repeated, a stronger focus on building what ifs into each session would have been useful.

In the outdoor education focus groups, a collective decision was made to condense the four sessions into three. Students were frequently out on expeditions, they had greater time constraints, and I sensed a further session would have become burdensome. This decision also reflected the differences in their experience compared to the students who participated in STEM. There is an extensive discourse surrounding girls in STEM that is visible to students. As such, there was a lot to talk about. While there was some discourse of equality and gender in outdoor education, there were no extensive discourses around the subject, and students felt they had shared all of their thoughts and experiences by the end of the third session. This was an interesting finding, one that does not necessarily show up in the analysis below, but important for framing and understanding participants' experiences.

Interviews with staff

The three staff interviewed for this research were heads of their faculty and well-experienced teachers. The staff member responsible for outdoor education in their school was male, and there was one female and one male staff member responsible for science, and to some extent STEM opportunities and learning more broadly, in their respective schools. The heads of faculty were responsible for areas of curriculum, the subject area staff team, extracurricular activities relating to their subject area, and were also teachers of the subject.

Staff participants were given the choice to conduct the interview over Microsoft Teams, Zoom or in person. The heads of science both chose to be interviewed through the Microsoft Teams

platform and the head of the outdoor education learning area chose to be interviewed in person. Consent, data storage and usage, and the use and treatment of audio recordings were discussed. Due to the individual nature of the semi-structured interviews, staff were given the opportunity to withdraw consent at any time or to ask for their interview recording to be deleted. They were provided with the opportunity to request a transcript of their interview and the opportunity to make amendments within two weeks of the interview if they so wished; however, none of the interviewees chose to do so. I conducted, recorded and transcribed semi-structured interviews with staff once the focus group sessions had taken place.

In taking data as assemblage, these interviews provided another point for diffraction. In conducting these interviews, I placed them in such a way to create a point of interference in the pattern. In this way, as Haraway (1992) advocates, we can map the effects of difference in ways that lead to elsewhere and new knowledges.

The purpose of these interviews was to provide another perspective of the relationship between subject and gender, relevant information about the school context, the barriers and motivators they had observed, and an understanding of what, if any, interventions or support had been implemented and observations of their success. The participants were asked about their own experiences of STEM or outdoor education, their own reflections of gender in the context of their subject, their observations on participation rates within their subjects and what they had seen to be effective.

Methodological considerations relating to data collection

Methodological considerations related to participant voice and narratives of difference underpinned the research methods. Given the new materialist feminist theoretical approach to this thesis, it was critical to be mindful of how participant voices were captured and how difference was treated in order to expand possibilities for gendered identities in male-dominated fields, rather that (re)producing the very differences and systemic exclusions that I was aiming to critique.

Participant voice and participatory action research through focus groups

Focus groups were used to create a collective account of the present experiences of girls in the male-dominated subjects of STEM and outdoor education, using gender as a navigational and organisational tool. Focus groups, used as a social research tool since the 1990s (Caretta & Vacchelli, 2015) provide an insight into the participant's social world. Interactions between participants, in their own language, allow for more authentic responses, and the conversational nature allows participants some thinking time, stimulates ideas, and prompts elaboration and specificity (Wilkinson, 1998a, 1998b).

Focus groups, in this instance, were also implemented to foster student empowerment and interaction, and provide meaningful opportunities for the participant's voices to be heard (Morgan, 2010). According to Fletcher (2005), meaningful student voice in education research "acknowledges the diversity of students by validating and authorizing them to represent their own ideas, opinions, knowledge and experiences throughout education in order to improve our schools" (p. 5). Attempts at eliciting genuine student voice needs to acknowledge the inherent power imbalances within institutional and organisational practices, such as those found in schools and in the boundaries between researcher and participant. Taylor and Robinson (2009) explore how power imbalances might be considered in the process of aiming for transformation in qualititative research with student participants. Drawing on the work of Giroux (1981) and Freire (1972), Taylor explains that power imbalances exist in the rigidity and inflexibility of institutions, and that genuine choice, which can lead to authentic student voice, is often over-ridden by implicit power imbalances. Research process decisions, particularly relating to the focus group, such as encouraging the participants to have a say in how the sessions were structured, how they wanted to contribute, and even small details, such as how I, as the researcher positioned myself amongst the group were intended to encourage student autonomy and voice; however, it needs to be acknowledged that these actions may have only temporarily minimised or disguised power imbalances, rather than dismantling them.

I drew on principles of participatory action research (PAR) in further considering how students could be encouraged to confidently share their ideas. The right to speak is critical to the PAR

framework and as such, it is a beneficial tool for working with young people (Glassman & Erdem, 2014). Further acknowledging the importance of voices in the margins, as described in standpoint theory (Harding, 1991) and further complicated in situated knowledges (Haraway, 1988), I drew on the work of Freire (2021), who believed that increasing critical consciousness was instrumental for emancipation of oppressed individuals. These principles acknowledge that communities that experience a set of problems are able to define, analyse and work towards solving those same problems, which informed my focus on collaboration and involving people in theorising about their practices (Kemmis et al., 2014). Young people are assigned the role of 'other' in relation to the dominant culture. As such, they should be "given opportunities to develop a relationship between their feelings of the moment and the cognitive strategies that are crucial for their survival" (Glassman & Erdem, 2014, p. 217). The third session of the focus groups, in particular, was designed to allow the participants to put into practice aspects of praxis and conscientisation (Freire, 2005, 2021). In this session, they were provided with problems and examples emerging from the research and invited to critically and collaboratively co-investigate them as a reflection of the world in which they live. In doing so, they were empowered to denounce dehumanising structures and develop an awareness of their own relationship to the myths, stereotypes and structures that formed barriers to their own full inclusion.

Understanding difference without reproducing it: Diffraction, SF, and the modest witness

Researching and writing about a phenomenon risks replicating and (re)producing the problem through contributing to discourse. In *The Promises of Monsters*, Haraway (1992) offers a theory and model of diffraction for producing "not effects of distance, but effects of connection, of embodiment, and of responsibility for an imagined elsewhere that we may yet learn to see and build here" (p. 295) and of understanding how difference is created. According to Haraway, where reflection and refraction 'produce "the same"' by mapping where the difference occurs, diffraction patterns, rather, map "where the *effects* of difference appear" (p. 300). Reflection and refraction give an "illusion of essential, fixed position," whereas diffraction requires more "subtle vision" that can lead to 'elsewhere' (p. 300).

Haraway argues for articulation, not representation. Rather than possessing 'new objects', an articulation of the human and non-human in a social relationship, necessarily mediated through language, "from people's points of view, through "situated knowledges"" (1992, p. 313). Explaining that *to articulate* in Old English meant to make terms of agreement, Haraway writes that 'to articulate is to signify. It is to put things together, scary things, risky things, contingent things' and it is to ask *who are we?* instead of *who am I?* (p. 324). Bayley (2019, p. 362) builds on Haraway's questions to further ask, *how did we become human in the first place?* Nature, or biology's discursive constitution as *other* obscures the ability to see it. Haraway (1992) argues that to see nature better, we need a new relationship with it than the one we have created through "reification and possession" (p. 296). To do this means to, firstly, decouple ourselves from the belief in science and technology — and its histories — as a "paradigm of rationalism" and, secondly, to reconfigure who the 'actors' are in nature and culture. The object of knowledge becomes an active 'material-semiotic actor'. As such, "the siting/sighting of [nature] is not about disengaged discovery, but about mutual and usually unequal structuring, about taking risks, about delegating competences" (p. 298).

Taguchi (2013) suggests that Deleuze offers a model to avoid the tendency to produce the same kind of thinking that created the problem. Deleuze & Guattari in *A Thousand Plateaus* (1987), provide three images of a tree to represent three different approaches to thinking and to knowledge. The first is of a tree with a principal root. In this Cartesian image, the phenomenon appears "underpinned by a representational and binary logic" (p. 707). The second image is of a tree with a root system. This image may have multiple roots, but the tree is confined within the limits of the roots. The third type of thinking is represented by a rhizomatic root system which is not limited but spreads out in all directions as a multiplicity of entanglements. This kind of thinking shifts the focus from what is produced to how it is produced (Mazzei, 2013a). Gough and and Gough (2017) suggest that the question therefore is, "what do we, as becoming-posthumanist educational researchers do? How do we work and how have we entered into composition with other bodies?" (p. 1112). Drawing on Barad (2014), they call for "an iterative (re)configuring of patterns of differentiating-entangling" (p. 1113).

In the context of this thesis, it is the biological and discursive essentialism implicit in much of the framing of girls in STEM and in the outdoors that creates the kind of thinking limited to the first and second image of the tree. Reconsidering Haraway's entanglement of naturecultures (2003), and nature as agentic rather than as essential, provides another point of view, another interruption to the pattern of diffraction through which we can further map the *effect of difference.* Viewing the phenomenon as rhizomatic, as an entanglement, can help avoid getting stuck in the framework and the types of thinking that created the problem. By examining the issues of gender in STEM and in Outdoor Ed in a way that attends to the material and discursive, there might be a much more subtle understanding of difference and how it is created, opening new possibilities. Building on this understanding, we can start to use speculation as a way of imagining new possibilities of 'elsewhere'.

Alternative modes of thinking created through stories can engage with entanglements and rhizomatic thinking to open up new possibilities. Haraway writes that, "it matters what stories we tell to tell other stories with; it matters what concepts we think to think other concepts with" (Haraway, 2016, p. 118). To stay with the trouble, Haraway employs a theoretical model of *SF* — modes of attention that are string figuring, science fiction, speculative fabulation, speculative feminism, science fact, so far. Engaging in worlding practices and telling situated stories and thinking from situated histories (131) create obligations to open up spaces and possibilities. When considering speculative fiction and fabulation, Haraway argues that we cannot "denounce the world in the name of an ideal world" (91), rather it is in *staying with the trouble* and *becoming-with* that we become capable. Like diffraction and other modes of *SF,* it is about pattern-making and mapping to see where the edges and effects lie. Truman (2018, p. 31) describes the practice as one that "defamiliarizes, queers perception, and disrupts habitual ways of knowing" in ways that are compatible with another mode of *SF* — science fact. This approach was explicitly utilised in two ways: firstly, in their final sessions, focus groups were asked to co-create a speculative narrative, imaginatively exploring what could be; and, secondly, I transformed my own journalling, annotations and curiosities into a short work of speculative fiction, which I have included in the final chapter. Additionally, it inspired a more generalised approach to the focus group sessions and to data collection and analysis, that is, of paying attention to what stories appear to matter and what concepts we think through these stories with.

In encouraging readers to 'stay with the trouble,' Haraway seeks "to generate new ways to grapple with old ideas" (Moxnes & Osgood, 2019, p. 2). Post-qualitative approaches, such as staying with the trouble, which require a mixing of old and new and methodologies entangled with ontology and epistemology (Lather & St. Pierre, 2013; Pierre, 2014), are also consistent with principles of critical pedagogy. In critical pedagogy, this type of research might be termed the bricolage. This is a concept which blurs boundaries of critical traditions in order to acknowledge the complexities of power relations – something which allows for a criticality that empowers and emancipates (Kincheloe et al., 2011, p. 162). In this spirit, alongside of the focus groups that take place with student participants, subject area leaders were given the opportunity to bring their perspective. Each aspect of the data was placed alongside each other and read diffractively through each other and through theory.

Finally, I was concerned with the researcher's role – my role – in the construction of knowledge and the extent to which inequalities and stereotypes are reproduced throughout the research process. Haraway offers the modest witness — a figure in who is about 'telling the truth, giving reliable testimony, guaranteeing important things, proving good enough grounding… to enable compelling belief and collective action' (Haraway, 1997, p. 22). This avoids *misplaced concreteness*, and instead applies critical tools emerging from the intersection of science and society in a practice of *yearning* for "knowledge projects as freedom projects" (Haraway, 1997, pp. 268-269). In this *post*- mode of being (Lather & St. Pierre, 2013), the role of the researcher needs to embrace and "acknowledge *multiple ways of knowing* in a relation with each other — together" (Osgood et al., 2019). Lather (2016, p. 335) argues that reshaping and reframing objects in this way challenges researchers to rethink themselves and, in doing so, there holds a promise for advancing critical practice. Situating oneself in the present and becoming with the research can create 'networks of learners' that focus on empowering, or making power, rather than taking power (p. 339).

Embracing this challenge and locating myself within the data, I kept a journal during the data collection process, reflecting on the ways in which I may be considered a node within the diffractive pattern of data collection. I reflected that, while I aimed to dismantle power in both the context of conducting the research and as a result of the research, I brought with

me the power of the university as an institution and my role as a teacher. Drawing on my role as a teacher was useful in that some student participants may have felt more comfortable with a teacher asking them questions that a researcher, which to them is a more abstract concept. I occasionally shared anecdotes from when I was a student taking those subjects, both as a means to critically explore why things may not have changed, but also, to remove some of the power imbalance in in the immediate; however, this comes with the risk that participants' responses were shaped by my experience. Taking this approach, however, and rethinking my role as researcher, meant a collaborative, co-construction of knowledge emerging from shifting and shared roles of researcher, student, teacher within the groups.

Working with data

The audio recordings of the focus groups and interviews were initially uploaded and stored in password-protected cloud storage belonging to the university. Transcripts were created using the Microsoft Word transcription tool and then compared with the audio. These were annotated with the reflections I had recorded at the end of each session, further observations, and connections between data points and existing research and theory. I noted their silences, hesitations, interruptions, tone and approach and this became part of the data and part of the knowledge construction process.

In working with the data, diffractive reading and its theoretical underpinning resists easy categorisations, rather it seeks "hot spots' that spark 'fascination or exhilaration . . . incipience, suspense or intensity" (MacLure, 2013, p. 173). MacLure writes that the act of dwelling in such moments and watching them expand like crystals is "part of an ethical obligation to relieve research subjects… from the banality and the burden of the ethnographic and other codes that hold them in place" (pp. 173-174). Starting with these hot spots, and with the use of tables and charts, I engaged in a mapping of the assemblages or "mapping the ways things are coming together, the directions, speeds, and spaces of connections, and what the assembled relations enable to become or also block from becoming" (Ringrose & Renold, 2014, p. 774). This process, while messy, allowed for the complexities of girls' experiences to be interrogated and explored.

In selecting 'hot spots,' I started with moments that stuck out to me from the focus group sessions or the interviews with the teachers, or moments that evoked a strong sense of insight and engagement in the focus group sessions. These moments were highlighted during the session or interview, in my self-reflection journals and annotations of transcripts afterwards, or emerged in repetitions and themes across the interviews and focus group sessions. As described by Ringrose & Renold (2014), disjointed moments, entangled in space, time and matter, propel forward the generation of data and form, and in Barad's words (2014) form agential cuts, which do not produce absolute separation but forms infinitesimal multiplicities. Entanglements, they write, are "not unities" nor do they "erase differences." Rather, entanglements require differentiating, or *cutting together-apart* (Barad 2014, p. 176).

Moments were then read through data and theory, plugged into each other, a process outlined by Jackson and Mazzei (2022) and described in the methodology. In plugging data into theory, the most relevant theorists became Haraway, Latour, Butler, Barad and Scott. Others, such as Foucault, were used in the initial stages and were useful for thinking in new ways about theory and knowledge but what emerged in the process of 'plugging in' the data was something different. As Mazzei (2014) describes, reading through multiple, diverse, even disparate theoretical accounts — Barad has critiqued Butler's focus on cultural and discursive factors, for example (Højme, 2024) — allows space to "open up different questions and knowledge" (p. 744) and provoke new insights into the experiences of girls in STEM and outdoor education. Because of this process, the following chapters do not separate results and discussion; rather, findings, practice and theory are interspersed, reflecting how each has been 'plugged' into another.

One of the benefits of focus groups was that students bounced ideas off each other and add their contributions, building a more complete picture of their experience. This situated their experience and including their conversations provides a richer understanding of that experience, while respecting the context of their contributions. Belzile and Öberg (2012) note that 'participant interaction is said to be the hallmark of the focus group method' (459) yet it is often absent from presentations of data. They found that socially oriented researchers focus on these interactions as a way of sense-making that is built in the interaction of people,

thoughts, ideas, and arguments. In my approach to thinking of data as co-constructed and more than human voice, or 'voice-thought as assemblage', I recognised interactions in speech and between participants in time and space; this 'exceeds the traditional notion of the individual' (Mazzei, 2013, p. 734). As such, I have chosen to include excerpts and threads of conversation as the default method of presenting data from the focus group discussions. Additionally, while focus groups provided a limited window into the material conditions shaping the girls' experience — the STEM or classroom space, how they interact in the classroom space and with each other, their uniform, colours —, their interactions and the relational connections they formed between each other, their memories, and their experiences of educational, social and material practices focused attention on the affective forces generated through their everyday experience of gender, STEM and outdoor education (Lupton, 2020, p. 985).

The teacher interviews provide another component in the research-as-assemblage. Teachers and schools are entangled in the experience of the student participants and the teachers provided valuable observations from a different perspective. As well as providing opportunities for hot spots at an individual level, the data emerging from these interviews provided another point of diffraction. Data from the student focus group was plugged into theory, which was then plugged into the teacher interviews to generate new ways of knowing. This process was particularly revealing in the context of outdoor education, where the teacher had thought critically about his own role in the production of gendered experiences. Reading the data this way allowed each moment to become richer with meaning, and a more complex picture of the student's experience emerged. The binary thinking and categorisations that often emerged from the STEM data were challenged, providing for new possibilities for how we see participation in male-dominated spaces.

Diffraction as an analytical tool

In physics, diffraction describes the process of waves when encountering an external object, and the pattern which results from their changing behaviour. In diffractive analysis, this metaphor is used to underpin the notion that knowledge is not created in isolation but rather created by 'different forces coming together' (Mazzei, 2014: 743) and forming new patterns

predicated on the old. Diffraction offers an alternative to essentialism, in the sense that it is 'an iterative (re)configuring of patterns of differentiating-entangling' where there is no 'absolute boundary between here-now and there-then' (Barad, 2014, p. 168). In this sense, diffraction provides an appropriate metaphor for considering gender and identity construction – forces meet to form new iterative entanglements and cuts in ways that cannot be reduced to a dichotomous split. Reading data diffractively requires the researcher to explore and identify the intra-activities between the researcher and the data and which emerge to constitute the phenomenon in question (Taguchi & Palmer, 2018).

Haraway's string figuring where metaphorical knots are pulled from within the data to see what unravels provides a starting point for thinking about diffractive analysis (Moxnes & Osgood, 2019). Multiple feminist and critical theories are used as a lens to view that knot and its entanglement and the data can be 'plugged into' theories and data points (Mazzei, 2014). Diffraction results in a move away from traditional methods of research where "qualitative interview data has been treated as pure, foundational, truth-as-presence" to a kind of analysis where "data and theory stay on the move, seeking connectives and assemblages to interrupt (and to be interrupted)" (Jackson & Mazzei, 2013, p. 269). Rather, in taking as foundational that "data is partial, incomplete, and always being retold and remembered" (Jackson & Mazzei, 2013, p. 263) and working to "diffract rather than foreclose" (Mazzei & Jackson, 2012, p. 747), Jackson & Mazzei (2013) outlined the three 'manoeuvres' they used in the 'production of knowledge—emerging as assemblage, creation from chaos—not as a final arrival but as the result of plugging in: an assemblage of "continuous, self-vibrating intensities"' (p. 263). These manoeuvres are: "putting philosophical concepts to work via disrupting the theory/practice binary," "being deliberate and transparent in what analytical questions are made possible by a specific theoretical concept," and, "working the same "data chunks" repeatedly to "deform [them], to make [them] groan and protest" (Foucault, 1980, p. 22-23) with an overabundance of meaning" (p. 264). Emerging from this process is the creation of new knowledge and an understanding of the suppleness of data points. Diffractive analysis and reading in this thesis uses a blurring and overlapping of feminist theories which can be employed to interpret the co-constitutive relationship between matter and meaning, and the concomitant relationship between "being/becoming (ontology) and knowing (epistemology)" (Lenz-Taguchi & Palmer, 2013, p. 673). Lather (2013, p. 638) exhorts

researchers to work beyond the reflexive turn to see networks of knowledge production, rather than single, isolated experiences. To achieve this, the “smallest cuts” matter, and can be followed through to a “new way of thinking” (Osgood and Robinson, 2019, p. 99).

I draw on diffraction as an approach to acknowledge the multiplicities and intra-actions that overlap in the production of research, and the role of theory in drawing out new questions. It seems particularly appropriate to use a methodology that draws on principles of physics and applies them to a reading of phenomenon such as girls in STEM. The breaking down of the STEM/Humanities binary that it models provides space for thinking about the problem differently while avoiding the temptation to reproduce dichotomous ways of thinking about gender and STEM. The role that nature plays in outdoor education also provides for interesting explorations of intra-acting agencies.

Chapter summary

As well as the methodological approach, which allowed for deeper insights into the network of historical, political, social and educational structures and barriers which girls face in these subjects, it is the focus group method and approach, particularly and on a practical level, that lends itself to new insights in this thesis. This is not the first research in this area which uses young women as participants and there are many examples of research which seek to encourage girls to speak on issues related to gender and STEM, or, to some extent, gender and outdoor education; however, to my knowledge, it is a rare example of research which lets the girls’ experience drive the direction and opens the area up to them to communicate what aspects of their experience feel relevant and what is of particular concern to them. It is also notable in providing opportunities to critically explore phenomena and collectively explore how they have come to develop their own understandings, stereotypes, beliefs about gender, and identity.

The methodological approach used in this research, with its complexities and multiplicities will inevitably produce insights into the problem that are unique. The challenge perhaps is in replicating the process; however, with a focus on approach and the guiding ideas and questions related to the topic, these insights can be built on further through additional

processes which would contribute to a more complete picture and a richer understanding of experience.

Chapter 7: Who belongs in the lab? Constructions of masculinities and femininities in STEM

How do you think women scientists, engineers and coders are represented?

I don't think they are, for the most part, are they?

— focus group participant.

The following chapter explores the complexity of traversing assemblages of gender and femininity in STEM and the powerful socio-material-discursive tools that police the boundaries of gender in schools and educational institutions. Drawing from the perspective of girls who navigate these terrains, it examines: the manner in which feminine behaviours are praised and expected in some contexts and denigrated in some ´masculine' contexts, such as STEM; how discourse morphs to create unique but equally effective barriers to STEM participation; and the affective responses and material dynamics involved in shaping identity in masculinised domains. This paints a picture of girls' participation in STEM as complex and often strained.

This chapter also reveals the extent to which these students exist in a particularly dichotomous and cis-heteronormative framing of the world and of femininity and masculinity. Wolfe (2022b) writes that these contextualised, specific, non-linear entanglements require us to acknowledge schooling as a political act. Wolfe draws on Barad's conception of response-ability, which, according to Barad, is "a matter of inviting, welcoming, and enabling the response of the Other," where questioning is used to interrogate "accountability for the specific histories of particular practices of engagement" (Kleinman & Barad, 2012, p. 34). In doing so, Wolfe argues further that "school practices, as material-discursive making events, matter" (2022b, p. 1044), and response-ability requires us to account for the way differences get made. These practices in schools naturalise the gender binary (Graham et al., 2017); by professing to be gender neutral in approach and curricula, hidden gendered practices naturalise the gender binary, making non-gendered objects such as school subjects appear as masculine or feminine, and leaving "social binary inequalities unquestioned" (Myyry, 2022, p. 1075). These practices become naturalised in ways are taken up by students and embodied in ways that are reflected in everyday language, interactions and identities. In practice, this

dichotomous understanding of gender limits students' abilities to choose their subjects, interests and behaviours freely.

I begin this chapter with a 'hot spot' that emerged in the research process — a compelling moment within the assemblage of relationships that is research (McMain & Lundeen, 2025). This moment highlights the tensions and contradictions in the representations and expectations the participants held, and felt held to. The participants shared their perception that they could not be seen as feminine in a STEM context:

Eloise: You feel like you need to be more masculine as well, like you can't be in a lab coat with black mascara or lip gloss on [laughs] you have to be in a lab coat with a…'

Maeve: …a beard!

Eloise: It is one thing I think about a lot is how, if you are a girl in STEM, you sometimes feel like you can't be feminine. Just because you're a girl in STEM, it doesn't mean you don't enjoy stereotypically feminine things, which I think is pretty unfair.

Penelope: Yeah, going from that, I'm a pretty outgoing and bubbly person, and I think that people associate me being loud with being dumb, and the fact that I'm really energetic and am always babbling on, people assumed that I was just stupid. So when I started my math and science classes, I felt the need to be more reserved and kind of fit that quiet nerdy science girl stereotype. Obviously that didn't last because I can't help it!

Nora: Yeah, it's this whole idea that if you're a smart girl, and you're interested in STEM, that you would wear more masculine things because you're going into a masculine career, and it's this whole idea of, if you're going into STEM, then you're trying to be a guy. I'm like, no, I'm just completely comfortable with who I am, but for some people, they think you have to be really masculine, you have to be like the guys – you can't be a really feminine girl and go into that career path. It's sort of this idea that that if you go into a field that's for whatever gender, you have to act like that.

In this discussion, the participants demonstrate the extent to which they see femininity at odds with STEM and STEM spaces and objects. In a subject perceived to be associated with intelligence, they see feminine qualities not only as incongruous, but in opposition to the qualities associated with STEM. This leads to an association between masculinity and intelligence, and femininity and, in Penelope's phrasing, stupidity. This exists within a broader context, which Nora points to, of one's actions, behaviours and appearance needing to align with the gendered nature of the field. The ways in which women are presented in the field further contributes to, and complicates, how they feel about femininity in STEM spaces:

Scarlett: Yeah, the images that we have of women scientists are often very glamorised with them wearing lab coats, with lipstick and heels, but it's never real science work.

Hallie: I think we've mentioned this before, but it comes back to those kids' toys, the fun ones are the boys' ones where they get to make volcanoes and things like that, but the girls ones are making bath bombs.

Each element in this hot spot works to communicate something about the participants' understanding of feminine representations in STEM — the juxtaposition of the beard and the lipstick, discourses of femininity and STEM, depictions of women in lab coats and heels, the tension that the students felt between wanting to be able to express femininity and affective responses to feminine portrayals which felt patronising and tokenistic, and the material agency of childhood toys. Each element is not, as Ingram (2019) explores in the context of girls and their school formals, independent or pre-existing, rather, "intra-active relations of entanglement" (p. 2). The intra-actions of bodies, space, time and the non-human—or *spacetimematterings*—involve continual "(re)makings of space and time" that are not separate from but "*of* space and time" (p. 2), blurring boundaries between past, present, and future, and between student and STEM phenomena. Participants' past experiences with toys, alongside their encounters with laboratory spaces and objects representing femininity like lipstick, became entangled in their moment-by-moment understanding of what a scientist looked like. These material-discursive intra-actions demonstrate how identities and

knowledge emerge through the continuous and shifting co-constitution of temporal, spatial, bodily, and material agencies rather than through predetermined categories.

'Masculine' spaces not only ostracise women, they serve to reinforce hierarchies of hegemonic masculinities and femininities. While, Harding (1991, p. 298) points out, feminist science is not *feminine* science, and there is much to critique about social constructions of masculinity and femininity in this image, the denigrating of feminine qualities and the exclusion of students of all genders who exhibit these qualities needs to be carefully addressed. Ingram (2019) argues that posthumanist theories "open up relational and non-hierarchical ways of thinking about educational practices" (p. 2). In this hot spot example of femininity in STEM, this means that it is not only the social forces that shape their experience, but the material-discursive-affective forces which are co-contributors to knowledge production.

Evident in this hot spot moment are the complex, multiple agentic forces that are entangled in their experience. From here, we can unpick threads such as feminine and masculine constructions in STEM, lessons that participants have learned about who belongs in STEM and the experiences that have shaped their own feelings of belonging, how femininity becomes associated with ease, relationships and representations and the complex feelings that participants have about their own empowerment and pressure to represent. This chapter explores those threads and, further, establishes the need for a critical approach to the gender binary and entanglements of masculinity and femininity in schools at an institutional level. The focus group discussions further establish an argument for new ways of thinking which deconstruct dichotomous and binary boundaries in such a way to provide space for new, multiple and complex identities.

The gendering of subjects

STEM and masculinity

Ideas of masculinity and femininity play a significant role in the STEM classroom. According to Skeggs, femininity becomes embodied through the conflation of two distinct forms of

feminine labour: the visible work of appearing feminine through dress and presentation, and the performative work of enacting qualities culturally associated with women, such as being "caring, supporting, passivity and non-assertiveness" (Skeggs, 2001, p. 297). The labour of looking feminine in this context comes into conflict with the dominant expectations of masculinity in STEM. In this context, femininity is trivial, unserious and silly. We can further extend our analysis when taking into account not just the psychological and corporeal material factors, but the non-human agentic matter that we may ordinarily find in STEM spaces and explore their role in shaping and constituting gender. Objects such as lip gloss or, as in the examples described in this section, artefacts of science or technology, become agentic forces, and gender comes to be intelligible through these material-discursive intra-actions (Ringrose & Rawlings, 2015). Reinforced by iterative performances of cultural norms, sex, and the body which both construct and naturalise identities (Butler, 2011), the result is that it does not make sense to be a STEM student wearing lip gloss, but *sitting at computers hacking away at numbers* (Maeve) comes to be associated with masculinity — and not wearing lipgloss — in a way that seems natural. This reveals how educational and social practices obscure their deep entanglement with gendered power relations, making the exclusion of femininity from STEM appear as inevitable rather than as the product of ongoing material-discursive processes.

This section explores the participant's associations of STEM with masculinity, and more broadly, the characteristics they associated with subjects that made them 'gendered.' The conversations that took place in the focus group, and which build on the hot spot beginning this chapter, demonstrate participants' and their peers' preoccupation with these ideas. The participants' contributions demonstrate the kind of discourse that serves to maintain STEM as a typically masculine domain. When asked who does STEM, they described a particular kind of male, but they also explored some of the motivations that girls might have:

Matilda: I just think men are seen as more [suitable for STEM] in high school. Actually, not just high school, but in general, men are seen as more analytical and good at problem solving, whereas women are often told they are more creative. Which is not true necessarily. Lots of women are analytical and it's not really a gender thing, you can do anything. I just think males are told more that science would fit

them better because they are males and then, because they do it, they become more analytical and problem solvy [sic].

Maeve: I've noticed, particularly with digital tech, that it is quite masculine, I think. I'm not sure if that's because it actually is, or if it just comes across that way, or it is just because we perceive it that way because we consider digital tech to be just guys sitting at computers hacking away at numbers or whatever. But there's nothing really that I think I've ever found in digital tech that's been super girly - it's always something like robots which are associated with like boys' toys and stuff like that, compared to, I don't know, building a flower or something that is considered more feminine.

Matilda and Maeve's comments suggest that the students believe there to be a certain way of *doing STEM* that overlaps and intersects with their conceptions of *doing gender*. The description of a subject as masculine or feminine emerged without prompting in their discussions, conforming to constructions of gender and of subjects they both embraced and rejected. While girls could take 'boys' subjects' and, to some extent, boys could take 'girls' subjects', there appeared to be a consensus that there were, in fact, 'boys' subjects' and 'girls' subjects.' When the Mangrove students were asked to explain what they thought made a subject masculine or feminine, they offered the following:

Zara: The arts are always seen as feminine subjects because they are easy… and things like maths and STEM and woodwork and things like that, that are harder, are seen as male subjects.

Florence: And also, with the subjects that seem more physically demanding, like woodwork and things like that, boys are seen as typically stronger, whereas girls are more delicate and careful, yeah?

Zara: Yeah, because I feel like there's always a push for women to get into male subjects because for so long it's been depicted as women aren't as much as men, they're worth less, and things like that [and pushing them into male subjects gives them

a chance to be equal], but it's always still unbalanced, because even in primary schools, they had talks about getting girls into sciences and maths, but there was never a talk with the boys encouraging them into subjects that seem feminine.

Zara: I kind of get sports [seeming more masculine] because, physically, guys have more muscles. It's stupid because girls can do just as much. But there's a kind of twisted logic to it. But with computer science and tech and things like that, we all have the same brains. There is no difference between genders as to what you can do with computers.

Matilda: I think maybe it's just because they don't think women are as smart or as capable. I think that in the stereotypes, men are perceived as being able to understand more complex things, because that's always been, you know, men have always been the people in history I guess to do that and be the person who's in charge, and so they are viewed as people who can understand the more complex things. That things are too complex for woman and too hard I think is like a big stereotype, that probably affects it. It's really depressing, isn't it?

The participants perceived that male-dominated subjects were more highly valued than female-dominated subjects. They saw that the characteristics ascribed to male-dominated subjects, such as being more demanding, tougher, and requiring analytical and problem-solving skills, came to be associated with masculinity in a way that defined femininity and female participation in opposition. Participants observed how characteristics attributed to male-dominated subjects — being more challenging, requiring analytical and problem-solving skills — had become naturally associated with masculinity, positioning femininity and female participation in opposition. Though they disagreed with this gendering of subjects and characteristics, participants understood that participation offered opportunities for self-improvement primarily through association with masculine attributes and male-dominated fields perceived as more valuable:

Nora: [STEM] comes off as this difficult elite thing where only these few people are ever going to be good at it, but when it comes to the arts, there's this whole attitude where it is fine to just try your best.

Eloise: There's definitely a mindset that doing a STEM subject kind of gives [students] this higher up position.

Florence: Yeah, I feel if it is women in a male subject, that's like women empowerment and things like that, but I feel like sometimes when females choose one of the feminine subjects, some people would think of that as showing they're not confident in themselves.

Somewhat contradictorily, there were competing tensions where the participants felt that the particular kind of masculinity associated with STEM could also have a negative impact on their reputation. There were frequently references in the focus group discussions to STEM subjects or those interested in STEM subjects being 'nerdy' or 'geeky,' which they saw as a reason why girls would not want to be associated with the field. The participants felt that by choosing these subjects, they would be drawing an unwanted kind of attention to themselves and that this did not fit with how they wanted to be seen, especially as many of the participants observed, *being a teenage girl and trying to fit in can be really hard (Mischa)*. Participants saw that, male or female, STEM identities were difficult to separate from 'nerd' labels or identities across contexts. For example, they observed representations of girls and women on television having to perform a kind of nerdiness to be intelligible:

Nora: You'll see if a girl is being portrayed as someone who's interested in the sciences and math. She's always an introvert. You can never be extroverted and dramatic and be this really exciting person and go into STEM. It never seemed like that. It's always like, oh, she's this nerdy, unique character that's like I'm going against. I'm not like other girls, I'm into science.

These representations and stereotypes had an impact on how the participants saw themselves in STEM. Observations in a study by De las Cuevas et al. (2022) were that the

secondary student participants they worked with did not see words like 'geek' as a negative stereotype necessarily, but saw those interested in careers like engineering as fitting with the nerd-genius stereotype – where they were either nerdy and socially awkward or geniuses obsessed with technology, with neither category fitting with their perception of feminine identities, stereotypes and social expectations. The participants did not necessarily see nerdiness as a negative, either; however, they did see it as at odds with femininity. One of the participants noted that girls in STEM were difficult to make sense of:

Maeve: *It's hard to label girls in STEM. There's understandable categories for boys in STEM, like nerdy, and boys who are sporty are jocks, and girls in the Arts… etc. It like we don't have the language to create those identities about girls in STEM.*

Further complicating associations of masculinity and STEM are the implicit biases that some of the participants shared, despite having confidence in their own talent and skills. The following conversation, further anonymised due to the likelihood that participants in the group will recognise the speakers, illustrates a persistent association of masculinity, confidence, leadership and ability:

Student 1: I think teachers are pushing a lot more girls to get into tech subjects now. They used to be like, 'Oh you can be here if you want' but now they're really encouraging girls to be here so they can do well and because they know lots of girls enjoy it, but they don't have the confidence to continue. So the teachers encourage them to keep going in future years. But that's keeping the girls in. I feel like that could be a good thing, but I also think the massive push for equality… I don't know. My uncle is in the fire department and he was telling me that they're bringing in or thinking about 50/50 women and men. I think that's great, equal opportunity and all that. But if it comes down to me being stuck on top of a burning building, I would much rather some 80 kilo man carrying me down. When it's life or death I choose the man. I don't mean to be sexist but do you know what I mean?

Student 2: I think that in itself is kind of created by sexist views that men are stronger, and I kind of know what you mean and men are generally stronger, but I do think that it's all kind of created by the fact that we think and believe that men are more able to save you in a situation than women are.

Student 1: Look, I'd be happy if a woman tried out and she's just as strong. But if they're hiring four people, I'd rather all men or three men and one woman than two men and two alright women.

The participant provided this as an analogous example for women in STEM. At first glance, this might reflect some concerning and intrinsic sexism; however, the challenge – and the possibility – of focus groups is that students often had contrasting opinions and approaches, not just to each other, but to themselves. Initially, as described by (Wolfe, 2019), the girls tended to resist considering their own subjugation and their first impulse was to believe that there was nothing holding them back – in fact, Student 1 had earlier in the conversation said just that. The participants' beliefs, feelings and wonderings existed in a gendered knot of tensions, conflict and disjunction. Doshi (2022, p. 1145) theorises this phenomenon as "experiencing liminality," an in-between position at the crossroads of gender and market-oriented individualist ideologies that generates ambiguity and uncertainty by "ignoring, denying, and normalizing particular (gendered) experiences and later, the admittance of the same experiences that were denied earlier."

Further, the students in the focus groups' frequent and casual use of terminology such as boy, male or masculine subjects or girl, female for feminine subjects was a way of categorising the world that made sense to them, even if they did not ascribe to the underlying premises of such labels. While much of the discussion of girls in STEM conflates femininity with female sex, the denigration of femininity in STEM contexts has been explored further in three papers by a small group of scholars: In the first paper, 12- and 13-year-old British girls associated femininity with superficiality, powerlessness and vanity. And yet, respondents described physics as "hard" and "hands on"... and "you wouldn't expect a girly girl to be doing something like that" (Francis, Archer, Moote, de Witt, et al., 2017, p. 1105). In a second paper, Archer, Moote, et al. (2020, p. 350) identified femininity as associated with incompetence and

inauthenticity in physics and noted that female physicists tended to display "performances of female masculinity." Archer, MacLeod, et al. (2020) also tracked a group of girls interested in physics who initially saw themselves as 'girly,' but gradually began to downplay and regulate performances of femininity to align with their subject participation. Finally, Francis, Archer, Moote, DeWitt, et al. (2017b) found that physical sciences has a persistent masculine association due to them being thought of as hard, serious and manual subjects which required 'natural' intelligence. All papers noted that dichotomous conceptions of masculinity and femininity deterred students from participation in STEM. In these papers and the findings presented in this section, we see that the persistent devaluation of femininity exposes how STEM operates, not through gender-neutral meritocracy, but through masculinist epistemologies that systematically position supposedly masculine ways of knowing as superior and which devalue ways of knowing coded as feminine. As such, the gender gap in STEM participation is not a problem that can be solved by "tinkering around the edges" (McKinnon, 2022), but a structural feature of STEM assemblages that require the rejection of femininity to maintain their intelligibility.

Constructions of femininity in education settings

The construction of subjects and ways of knowing that are perceived to be feminine further demonstrates how gendering practices operate to maintain hierarchical binaries.

Counter to the subjects and characteristics associated with masculinity, such as STEM, were those associated with femininity and subjects that girls took. In fact, just the presence of more women within a science is enough for it to be perceived as a 'soft science' (Light et al., 2022). The participants identified psychology as one of the sciences for which it was expected for their female peers to choose and explain that it is because of its association with emotions:

Nora: It also goes back to the stereotype that men can't express their feelings, they can't have those emotional talks because they're too masculine and uptight, whereas girls can go into that field and have *nice little chats about their feelings* [sarcastically].

Hallie: I was watching a documentary a while ago about how we subconsciously teach boys and girls different things. Or we might subconsciously, if we had a baby and we think it's a girl, we might be more likely to give it a toy like a doll, whereas if it's a boy, we're more likely to pick them up and move them around, and give them bigger toys, like rocking horses, and pick them up and put them on it and interact with them.

In interpreting their own experience, the participants described how the objects they interacted with, and were encouraged to interact with, had a material-discursive effect, in that they came to use their bodies in passive ways, in opposition to boys, who were taught to be the *doers.* Gendered embodiment of these characteristics and broader patterns of constraint align with seemingly positive valuations of feminine traits. The term benevolent sexism embodies an ideological set of attitudes which limits women to 'acceptable' roles by viewing them as prosocial, moral, caring, emotionally intelligent and able to complement masculine strengths (Glick & Fiske, 1996; Glick & Fiske, 2011). Benevolent sexist behaviours may appear to be warm and affectionate in tone, but limit women to feminine and subordinate stereotypes, undermine their motivation, success and ability to perform in their roles, and, despite its more positive tone, is unlikely to be perceived as positive by the recipient (Glick & Fiske, 1996; Hopkins-Doyle et al., 2019). The participants at Mangrove High reflected on the messages they had received about their career options, particularly as several of them had expressed a desire to enter medical and healthcare fields:

Ivy: I think in high school it's fine, we can do what we want, but it changes when we start to think about careers. Many of us said we wanted to go into medical fields, and I think a lot of women are kind of pushed into nursing whereas a lot of males might be pushed into being a doctor. I think maybe because women are viewed as more like caring than men and more like motherly, that's why they pushed to be nurses because it's more working with people and medicine. You have to be good with people as well, whereas a doctor, it's essentially just the same as a nurse, but with leadership, and men are often viewed as leaders rather than women are because they are seen as stronger.

Matilda: [I think there is some accuracy in that stereotype because] women are brought up to be carers and to be kind to people and look after people more so than men. So, I think some women are more motherly and caring, but that's only because we've been told that's what we should do and how we were raised.

The participants saw that careers associated with women were less valued even when they were being praised, further reinforcing hierarchical relationships between femininity and masculinity. Pulling at strings, the participants explored the limits of the seemingly positive intentions which underpin benevolent sexism by asking whether these traits, which are spoken about so positively in women, would also be revered so highly if they were performed by men. One thing that both groups experienced and found common was that you could be a girl in STEM, but you could not be a boy in arts or in 'feminine subjects.' The focus group participants described how boys in female-dominated subjects were treated:

Summer: In dance, it's pretty much all girls, but when a boy does dance, he's constantly reminded that he shouldn't be there.

Florence: I think [stereotypes] socially impacts people a lot, like a guy won't choose visual arts, because their friends will tell them they should be doing woodwork or something less creative, even though they may be way more creative than a female in their class. Because of the way social structures impact them, their friends won't accept it if they're not doing the stereotypical thing.

Penelope: I think, on the opposite end of the spectrum, particularly in the arts and the performing arts, there is a significant amount of stigma surrounding guys who even put their name down to be involved in things. There's such a stigma that you must be gay to be a dancer or whatever. Growing up around boys who are dancers, I've seen it be really damaging to them and they cop a lot because of it – it makes them start to question their identity.

Participants understood they could choose STEM if they truly desired, and sometimes felt considerable pressure to do so, but recognized their male peers would face bullying for selecting 'female subjects.' They perceived that if stereotype-breaking efforts focused solely on enabling girls to access previously forbidden domains, this would perpetuate the notion that girls' traditional interests and work were inherently less valuable. Such limited approaches would also ensure their male peers continued missing out on important learning opportunities within feminised domains:

Eloise: Both ways neither person has equal options. It can't just be that girls do 'boy' subjects. Until boys do subjects that are seen as girls' subjects like arts and humanities, it's just going to be like it always has been.

According to Kostas (2022) the comments that the participants' male peers receive become "powerful discursive tools for policing gender boundaries" that come to define legitimate and successful ways of doing gender (p. 66). The antifemininity that fuels this discourse is often left unexamined (Winer, 2021). While these tools work to keep boys out of feminine spaces, these gender boundaries and this oppositional discourse comes also to shape what is acceptable in masculine spaces, such as STEM. Whether it is limiting possibilities through benevolent sexism which encourages women into limited, traditional pathways or policing boundaries of masculinity and femininity, the participants were keenly aware of the boundaries that policed the behaviours and characteristics that were acceptable in each subject area.

Wolfe (2022a) writes that "to be educated is often a way to become legitimate within a society (particularly for bodies who are undervalued) as a pathway to become understood and assimilated within dominant cultural norms" (p. 145). The participants in this study self-identified as intelligent; however, they understood they needed to behave in certain intelligible ways for other people to perceive them as intelligent and to accept them. Participants felt that, logically, they were equally capable as their male peers and that gendering subjects, careers and characteristics is problematic; however, their perceptions, interpretations and experiences are entangled in the material-discursive-affective forces which construct and constitute their experience of gender and of STEM. In seeking to move

away from such categorisations and hierarchies, posthumanist new materialist theories view reality not as constituted through opposing dualisms, but as intra-active, dynamic forces that are in a continuous process of becoming. Viewing the phenomena of gendered subjects this way opens up possibilities for thinking in new ways about how subjects come to be gendered; this includes pulling at the threads of the past.

Foundational experiences

Children's career aspirations are formed at an early age, and they often remain surprisingly stable even across lifetimes, despite the child's initial lack of understanding about what the job entails. Studies continue to find that these aspirations are gendered and align with traditional ideas of masculine and feminine careers (Conlon et al., 2023). Hierarchical and institutional relations are already at work in early childhood to naturalise gender differences (Callahan & Nicholas, 2019), and who is and is not allowed to participate in certain activities and spaces comes to be self-regulated as children internalize and embody gendered expectations, bodies, identities and interests (Graham et al., 2017). Consequently, girls are excluded from masculine places from a young age and required by social expectation to participate in sedentary activities outside of where the main action takes place (Kostas, 2022). Concepts of active and passive, masculinity and femininity are theorized as relational – they only make sense in relation to each other. Connell and Messerschmidt (2005) define masculinity as a "configuration of practice organized in relation to the structure of gender relations" (p. 843). What this means in practice, writes Paechter (2006) is "masculinity becomes 'what men and boys do', and femininity the Other of that" (p. 254). As such, masculinity is associated with activity and femininity is associated with passive withdrawal away from the action and from interest in things. When women do participate, it then comes to be framed in oppositional terms to what is perceived to be a masculine domain – STEM and STEM learning places. The participants saw the media as perpetuating stereotypes of males as the 'doers':

Ava: I don't know because... well, I wasn't brought up to think that men do the more hands-on tasks but, in a lot of shows and movies and stuff, you've got the men

chopping down trees, they're building cubbies whatever, and that kind of just adds to the stereotype which has moved through the generations.

Mischa: We're so surrounded by social media these days, and you have all these local models on there, and when you look at the guys, they're all really built and toned and you look at the girls and they're all really skinny and things like that…. and the girls in all these photo shoots are out shopping and they're doing fun stuff and out socialising with their friends and all the guys are there, like Ava said, chopping down the trees, building stuff...

In previous studies (Fleer, 2021; Lyttleton-Smith, 2019; Speldewinde & Campbell, 2023) as well as in this one, girls describe ways in which they have been excluded from STEM from a young age, and consequently 'taught' that they did not belong in STEM. Fleer (2021), in particular, provides some context for understanding why girls become progressively less interested and skilled in STEM than their male counterparts. Rather than a lack of initial interest, Fleer describes patterns of gendered behaviours which exclude girls from STEM spaces and, ultimately, curtail their interest and preclude them from formative STEM experiences. Fleer's synthesis of empirical research reveals that girls demonstrate equal initial interest in STEM spaces but face increasing exclusion as they age, often being physically blocked from STEM areas or equipment and pushed out by male peers. The research demonstrates how girls create safe play spaces from a young age, choosing toys that don't attract boys' interest to avoid harassment and domination, while showing that teacher presence in STEM areas during free time encourages girls to return to these male-dominated spaces. This pattern exposes how STEM spaces are actively produced as masculine domains through everyday practices of exclusion, revealing that girls' apparent disinterest in STEM emerges not from inherent preferences but from their accommodation to hostile spaces that systematically render their presence troublesome.

Students in the focus groups were invited to share their early experiences of STEM. For the students, particularly the Lobelia High School group, experiences of exclusions were formative experiences and shaped the way they interacted with STEM and their understanding of where

they belong. One student described a robotics elective she wanted to try in Year 5 where she ended up being the only girl out of 20 students which she dropped out of:

Nora: I stopped doing it because there was a big group of kids, so they were really rowdy and it was just a very intimidating experience. I was always at the back of the class trying to figure things out on my own, so it wasn't a very enjoyable experience. Especially as a young kid, there was always a gendered area, as in the girls hang out in one area and the boys hang out in another, and they never really mixed much.

The boys felt confident to participate and act in such a manner because there was a group of them whereas Nora was alone. Riegle-Crumb et al. (2017) propose that it is male peers who contribute to the 'chilly environment' for the girls in class, given their majority and dominant status within the class and field. Nora noted that the female teacher often gravitated towards her and really encouraged her to keep going, told her she was doing well and tried to keep her safe, but even at 10 years old, she interpreted this gesture as the teacher also being outnumbered and looking for some solidarity from another woman in the room. In this description by Nora, space and place are agentic forces which become entangled in the assemblage of primary school girls in STEM. Intra-actions of space, place and peer relations come to produce knowledge about who does STEM and how they do it. In being pushed out of the space where the action was taking place, not only does it look like there are no girls participating, it also reinforces the perception that the boys are the active ones in that space while Nora passively tries to work things out on her own, without the benefit of collaboration with her peers. STEM places therefore, in Nora's construction of the world, come to be associated with exclusion. Additionally, the symbolic and physical isolation that Nora and other participants experienced limited opportunities for them to validate their presence in that environment and prove their abilities (Lester et al., 2016).

The participants felt that the language used by teachers and others continued to reinforce the pressure they felt to behave and not stand out:

Scarlett: I feel like there's less pressure on guys to be nice 'cause there's this image that guys are awful, or is it, like they're just like that. Like you hear the phrase a lot, oh, he's such a teenage boy. It's an image people are really familiar with. I feel like guys have a lot less pressure on them because they're seen as teenage boys.

Nora: They're just sort of expected to be rowdy and immature, or just kind of idiots. If you're in a class and boys are being horrible, they just get away with everything 'cause they're guys. Whereas if girls were doing it, everyone would be like, oh my, you're being so rude to me right now, I can't believe this. It's just because there's this ingrained idea that you're supposed to be polite and nice.

Girls learning experiences are systematically diminished by commonly held beliefs that view them as naturally content to sit back and listen quietly, while boys are positioned as requiring movement, hands-on activities, and entertainment to learn effectively (Abrams, 2023; Gurian, 2010; Idrizi et al., 2023; Lillico, 2020). Additionally, teachers, parents and students are more likely to see boys as brilliant and, as such, have different expectations for them in terms of success and behaviour (Sáinz et al., 2020). The continuance of these beliefs may even be supported by casual observations of classrooms like Nora's, where it appears that the boys *are* active and hands-on and the girl appears to be sitting quietly on the periphery of the action; however, Nora was keen to be part of the action and her withdrawal indicated her exclusion rather than a lack of interest or a desire to figure things out on her own. Most research has moved away from gender-based learning styles having established that there is no biological basis or evidence to support assertions of difference (Eliot, 2013; Halpern et al., 2011; Whitehead, 2011) and teaching to a learner's preferred style is not necessarily optimal education (Rogowsky et al., 2020); it is likely that where girls are quiet, it is due to a lack of confidence and self-esteem rather than any innate sense of femininity (Beeman, 2022). It may in fact be that girls also prefer the active, hands-on learning that has been developed and implemented with the boys in mind. Two of the participants at Mangrove High School shared that the girls in their Year 8 science class had all gone on to choose science, something of a rare occurrence according to the statistics. When asked if they could explain why they thought this might be the case, they explained that their Year 8 Science teacher gave them lots of

opportunities to be active, to experiment and to engage with hands-on learning and this would have made science interesting for them.

Being active as a trait associated with masculinity has a material-discursive effect. The expectations of hegemonic masculinity structure boys' relationships with others and with space; within these structures and performances, physical activity and taking up space comes to define masculinity in ways that dislocate girls from 'male' spaces (Kostas, 2022). Where girls were given the opportunity to interact with spaces, such as bush kinders or the Year 8 science classroom described by the girls at Mangrove High, they have the opportunity to become unbounded by stereotypes and act contrary to expectations. This led to the participants at Mangrove High seeing femininity as something that does not belong in STEM more than the women themselves not belonging. This perception reflects an ongoing association of femininity in opposition with science, where femininity is discursively produced as "antithetical to masculine rationality" where signs are read so as to mark it off as "antithetical to 'proper' performance to an incredible degree" (Walkerdine, 1989, p. 268). The paradoxical inference that energetic boys were bright and in need of engagement whereas — as the participants believed — people saw energetic girls as 'too much' or 'ditzy', rendered feminine STEM identities, if not impossible, illegible.

Why are you doing that? Peer perceptions of girls choosing STEM

One of the frequent ways that it was made clear to the participants that their participation was not normal was in the questions they received when they chose STEM subjects, such as, why are you doing *that*? Or the assumption amongst their peers that girls would not be as good at STEM as boys or that there were some subjects that were more acceptable for them to choose. When asked how much these experiences affected their decisions, participants acknowledged that there is a power to these stereotypes and expectations, both for girls and boys:

Florence: I think it very much socially impacts a lot of people, like guys won't choose like visual arts because their friends might tell them, you should be doing woodwork or something like that, not a visual art subject that's creative. Even though the kid might be way more creative than another female in their class, but because of the

way the social structures are and how people fit into them, like their friends won't accept it if they want to do things outside the stereotypical thing. So, I think that drives a lot of kids to choose their subjects in high school depending on what their friends, that kind of stuff.

Ivy: I think it depends on the person, really like how outgoing they are and whether they are able to not care what people think or whether they like get like worried about what other people think. I think depending on the type of person you are, depends on whether you listen to it or not.

Although their parents' encouragement was influential, it was friendships that were particularly important in girls' explanation of choices. Most of the participants were concerned about other teenagers generally and how their actions, as perceived by their peers, would affect their social status. The 'nerdy' stereotypes around some of these subjects was something they considered when making their choices. Participants believed it was detrimental socially for girls to stand out for the 'wrong' reasons and they did not feel they always had the confidence or strength to take that on.

Mischa: I think it's also like the school environment, we're all friends and that, but teenagers can be really mean (background: definitely, yep) and it's also [the effect of] if you're seen as nerdy, you're like, no, I can't be seen as nerdy because teenagers, we're going through stuff, we're really mean to each other sometimes.

Van der Vleuten et al. (2018) found that girls whose friends upheld more traditional gender norms were less likely to choose STEM, and boys who had more same-sex friends were more likely to choose STEM. As with the participants in their study of students in the Netherlands, the influence of friendship groups for the participants in this study was significant. They acknowledge that it was sad that this was how things were:

Mischa: Like we look at for example who got into an extension program for science, and there's only a few girls in it. I know that a lot of girls in my grade have said, oh, I don't really like science, and I was like, why? And they've said, well, it's just never

> really appealed to me, and I was like, well why? Why doesn't it appeal to you? And they just said, I just don't. I've just been surrounded by boys the entire time. And I'm like, well that's just sad.

Particularly in the case of privileged girls, which is an experience that the participants at Lobelia High acknowledged, Charles and Allan (2022) argue that the relationship to feminism, gender and politics is a "complex entanglement of resistance and reproduction with regard to gender, race and class" (p. 266). There is a desire to fit in and adhere to accepted forms of the neoliberal subject which "gather around the figure of the feminine, and particularly the young woman" (Allan & Charles, 2014, p. 335) in ways that can embody and reproduce norms while simultaneously resisting them. One student mentioned that the students in the school were very supportive and they were free to make their own choices about subjects, interests and behaviours, but moments later expressed they did not want to stand out by participating in a subject that seemed masculine and 'nerdy'. This simultaneous rejection of, and acquiescence to, such limitations reflected complex entanglements of resistance and reproduction. As is consistent with studies of middle-class girlhood, the embodiment of norms is not automatic or something essential but "mediated morally, symbolically and relationally" (Allan & Charles, 2014, p. 336). For the participants, their level of desire to fit in socially influenced the extent to which they felt compelled to embody these gendered norms.

Perception of girls' abilities in STEM

Across all levels of schooling, students, parents and teachers perceive boys to be more intelligent and competent (Bian, 2022; Lazaro & Bian, 2024; Musto, 2019). Stereotypes which depict boys as more talented have been found to be stronger in high-achieving students and in more developed countries (Napp & Breda, 2022). Boys are also more likely to be given opportunities to showcase and explore academic talent (Bian, Leslie, & Cimpian, 2018). At secondary school, teachers and parent tend to attribute girl's success to hard work rather than innate skill (Archer et al., 2012; Francis, Archer, Moote, DeWitt, et al., 2017). There is also a perception that success in STEM is reliant on innate brilliance and intelligence (Kelly, 2023). This incompatible position for girls, who perceive they both have to work harder *and*

be naturally talented, can impact motivation (Smith et al., 2013; Wang & Degol, 2017). Evans et al. (2023, p. 543) explains that because "men are more likely than women to be presumed as having ability for a "masculine" task," women can be viewed with suspicion in masculine domains and, as such, be required to prove themselves and their competence in a way that men are seldom required to do. Where these studies drew attention to the way teachers and society more broadly tended to view boys as talented and naturally gifted and girls as hard workers, the Lobelia High School girls experienced something infinitely more complex:

Maeve: I think they'll [the teachers and the institution] probably say more that the girls are gifted and don't have to work for it and the guys work really hard because in some senses this gives the boys more credit.

Eloise: I actually think it's a bit broader than that. I know one boy who people will always say it comes naturally to him. But when you talk to him about the amount of homework and how late he's staying up to revise, he's working incredibly hard, but there's this perception that he's naturally gifted.

When asked 'do you think he feels uncomfortable telling people how hard he works?':

Eloise: Absolutely, because it doesn't correlate [with his image], I guess.

Maeve: It could probably be a bit embarrassing as well if someone just assuming that you're really smart, but then you're actually saying, Oh no, I'm doing all this work. He might be a bit embarrassed that he's actually trying really hard.

Maeve: It's sort of supposed to be comforting, like whatever you do to try, you don't want to be too open about it.

The participants observed they and their peers attempted to outwardly act in ways that served to reinforce the perceived relationship between ease, natural ability, STEM success and masculine performances.

The inverse of the feminine being antithetical to STEM is that scientists and science are actively associated with masculine traits (Hand et al., 2017) and girls who like physics are perceived to be more masculine and less feminine than other students (Kessels, 2015; Ottemo et al., 2021). As some of the participants felt uncomfortable about being associated with masculine traits it impacted their desire to participate in STEM.

Teachers and classroom comments

While teachers could have an exceptionally positive impact on students and, in some cases, the participants identified a particular teacher as a reason for continuing with STEM, they could also, often inadvertently and unintentionally, turn students away from the subject or reinforce gender stereotypes. Teachers' adherence to myths about the diligent, hardworking girl and the talented, brilliant boy can reinforce gendered dichotomies (Paule, 2015). Teachers' implicit biases can lead to more extension opportunities for boys (Bian, Leslie, Murphy, et al., 2018) or to them setting the bar lower for stigmatised groups (Carlana, 2019). One example of this, which may have stemmed from the best of intentions, was described by one of the participants at Mangrove High:

Matilda: I don't do tech anymore, but when I did, the teachers used to check up on the girls in the class a lot more than they checked up on the boys. It wasn't done in a very condescending way, like I didn't feel at the time that they thought we couldn't do it, but thinking back on it, I noticed that they checked up on me more than they did the boys. They kind of left the boys to do it, whereas they often asked the girls if they were okay, because it was just kind of assumed that we would need more help.

Whether the teacher had genuinely identified struggling students and offered appropriate support, acted from assumptions about girls' capabilities, overlooked boys who might have needed similar assistance, or inadvertently damaged girls' confidence in the classroom cannot be determined from this account. What remains clear is that Matilda perceived a difference in treatment and interpreted it through the lens of perceived personal inadequacy, ultimately

experiencing a diminished sense of belonging compared to the seemingly natural place of boys in that space.

At Lobelia High, the students discussed the impact of teachers' comments on themselves and peers. Their frustration often stemmed from feeling undervalued, and this often related to physical strengths and qualities. Even though it was not on first reading, directly related to STEM, participants often vented their frustration about comments they had heard often, particularly in the formative years of primary school, such as, 'can I have a couple of big, strong boys to help me carry something?' or physical education teachers asking boys to do demonstrations. One participant said that she was constantly told that she was uncoordinated and unskilled in PE; however, performed at a state level in her sport. It was that lack of opportunity to prove themselves that most frustrated participants, and they saw these comments as contributing to women's inevitable lack of participation. This feeling was augmented by flippant or joking comments that teachers made that further reinforced stereotypes:

Ava: I had a conversation with another student today, and they said that one of their teachers, I don't know why they had seen this, but they had seen their mum mowing the lawn, and asked them, 'why is your mum mowing the lawns and not your dad?' and I know that that it was probably just a joke, but those things stick.

The group also shared stories of older students and adults in their life whose pathways had been influenced negatively by a teacher. In both cases, it was a teacher's comment that left people feeling like they were not good enough to pursue their goals and they let them go. The participants reflected on the impact that teachers could have:

Mischa: I think it's definitely a thing that what teachers say can definitely influence what you do because they're so much older and you look up to them and they're wise and they've gone through all this study and things like that and you think they're so knowledgeable that you look up to them and you take what they say in in a way that it sticks with you for a very long time.

Imogen: Back to those teachers' comments, sorry, I mean, it is quite sad to think that what one teacher might say to a student could change their career path and that teacher might not even think about that comment, like they might never think about it again, but little do they know how much it has impacted the person who it was said to, it's just quite sad to hear, I think...

Such stories had an impact on participants, who then questioned their own abilities in that field. The students in the other Lobelia High focus group also spoke about an implicit pressure to prove themselves to the school and to the teachers, even though they could not pinpoint any reason or any example of where they had been made to explicitly feel this way. This feeling might provide a possible suggestion as to why a teacher's off-hand comment might have such an impact, however:

Maeve: I think if anything we're worried if we're not good enough at something, in this case STEM, that they might like, I mean I don't know who the 'they' is, but that someone might stop us from participating in that, you know, our teachers might say, oh, you shouldn't be doing this subject.

Harriet: I would say that it almost feels like an audition, you feel that if you're not doing it that well, they're like, well, you're out! It's like, again, if a guy was doing that, I don't think they feel that. It's more like, oh well, you're not that good at it but you can just keep doing it.

These statements demonstrate the ways in which the participants had come to embody the messages they had taken from their teachers' comments, actions and jokes about who was capable to do certain kinds of tasks. Each opportunity they missed had material consequences: the consequence of not having the same opportunities to participate in physical tasks can lead to less opportunity to build those same muscles; in a similar way, when teachers discourage students to participate in STEM, either explicitly or implicitly, or by not facilitating the same opportunities because they assume that the boys can do it better, they miss out on opportunities to develop brain matter. It is in this way that matter has critical future consequences.

Perceptions of sexism

The participants believed they would likely be sexualised, or experience sexism because of their participation in STEM. The way people thought of women in male-dominated industries was particularly troubling for them:

Harriet: I feel like [representations of women scientists} are sexualized a lot.

Nora: I feel like really any woman in uniform or a lab coat is going to be sexualized a lot. Either in Halloween costumes or in gross TV shows but…

Penelope: If I Google…

Harriet: If you look up schoolgirl and then you look up schoolboy… We actually did this at recess. It's pretty different. Then if you look up girl doctor…

Penelope: …or schoolgirl. It just comes up with a Halloween costume, and it's like [really sexualised]. Then if you look up school boy, it is just a caricature. This [showing an image] is what you get when you search 'nurse'. It's just yucky.

Eloise: But that's just what you get. And when you search doctor it's totally different.

Participants perceived that if they were to pursue such careers, they would experience discomfort, difficulties and sexism because they were working in a male-dominated workforce:

Ava: I think it's because a long time ago it was more male dominated, so it would be really hard for women going into that working environment to feel connected, and because they don't want to be in that environment it just stays the same. If I was in a class or at work, and I had only boys around me, it would be hard to work with them, but if I had more girls around, then it just feels more comfortable.

They felt that the media had a role in continuing the stereotype that science careers, and other prestigious and intellectual positions, were more for men that women. Additionally, the traditional media contributed to the idea that women continued to play a role in supporting men in their careers and, consequently, there was added pressure for women to do it all:

Florence: Yeah, [women are seen as] maybe not as driven, or perhaps, more in the sciences, I think men would be taken more seriously because they are going to take it more seriously. I think it might be because maybe because men have always kind of been in that field and in history, it's always been men and so therefore it's kind of more natural for them. But maybe also, to an extent that maybe women are there to just kind of prove a point. They're not there because they enjoy it but to prove that they can do it.

Ivy: I was watching *Young Sheldon* the other day and he was studying in a group with a girl and a boy and they were in this advanced engineering, whatever it is, class in uni. Whenever they were at Sheldon's house, Sheldon's mum did the washing for the boy in the group and she cooked them and fussed over them. The girl got really mad. After a moment, she went to Sheldon's mum and she said, 'It's because of you that I don't get any respect in my field, 'cause you do all this stuff for them and then I don't get any respect 'cause they see me the same, just someone who's there to look after them.'

When asked if they saw this attitude as still being prevalent, acknowledging that *Young Sheldon* is set in the 1980s, they felt quite strongly that it was, even if not like it was in the past.

General: Yeah, yeah. There is.

Florence: Yeah, so we've still seen it, but I think there's now more of a push for people to recognise that women can still do everything. We've even had a few talks at schools that were trying to get women into engineering and things that seem more like a man's job.

Matilda: Yeah, I think that it still exists, because I see some TikToks about it with girls talking about how it still exists, like when they're in fully male dominated classes at university and stuff that the men do make jokes at them. Sexist jokes about going back into the kitchen rule, you know all that stuff. And so I think there is actually still quite a lot of sexism in these kinds of subjects. But if you go and seek out support, you'll find it now. You might have to go and seek it out still, but it is there. I think that's the difference.

Ivy: I set the kitchen on fire in Home Ec so the boys stopped making jokes like that. The food still didn't even cook!

The discussion during a Lobelia High focus group session also reflected an assumption of sexism in the workplace as well as a frustration at the tendency to focus on what women should do in male-dominated spaces rather than on the systemic problems that led to inequalities. They saw this resulting in any success that a women might achieve being attributed to forced inclusion initiatives or external factors:

Penelope: I think it's a really common thing that's probably used against us is that when you achieve something, people will be like, but you only got that because people are trying to make you feel better, like you're not that good like, you just look like you got it because you're a chick and they thought it'd be nice to encourage you.

Eloise: Yeah, and I feel like sometimes the language surrounding these issues isn't how it could be, because sometimes we talk about it like the woman is the barrier or you're facing issues because you're a woman, but the actual barrier is sexism. Because being a woman is, that's not the problem. The problem is that sexism exists.

Nora: And there's also a lot of misogyny in the workforce. Like a male colleague will be like, oh, she is just here because she's a woman and we needed more women

here, or the stereotype of women just sleeping up the ladder. You're never seen to be there because of your own hard work, but because a man helped you.

Maeve: I'm not sure if it's just seen as a man helping you, but there's always some other explanation why you're successful.

Georgia: They don't validate the work that you actually do, they always think you just get to the top magically.

Baker (2010), noting that there is a perception that girls are beneficiaries of newfound and equal conditions where individuals are free to choose their path, found in a series of interviews with girls that they held on to the belief they could achieve anything they wanted if they wanted it hard enough, despite, in action, actually revising their aspirations to more traditionally feminine pathways when encountering barriers. Regardless of the reality of the workforce, the perception that had been communicated to these students through media, families, and school affected how they saw these careers and careers more broadly.

The participants were concerned about being on their own in subjects they found difficult, but they were also thinking ahead to the future:

Nora: With science, because there's this perception that there are so few women in science and barely anyone does it, people think that if you go into it, it's going to be very hard and isolating, and you're going to be surrounded by guys. And if you don't typically get along with guys as well, you're not going to be drawn to it as much.

Scarlett: I mean, it's sort of ingrained in us that we are delicate and easily harmed, and that we have to protect ourselves from men.

Nora: Just the very idea of maybe being alone, or being the only girl in a whole group of guys, I feel incredibly unsafe if I was ever in that environment. I want to get out of it immediately, no matter how nice the guys are.

While attending this conversation's *liveliness* first felt as a 'sense articulated as an emotional stance of attitude' (Blackman, 2015, p. 28), and the frustration and sometimes fear that haunts and unsettles each statement, it becomes possible to see the ways girls' participation comes to be entangled in the affective forces that shape their experience. In considering the "educational assemblage," or the gender and STEM assemblage, as a "multiplicity of affective events" with its "perpetual notion of becoming," I focus on the patterns which overlap to locate where in/equity emerges (Wolfe, 2022a, p. 4). In doing so, these discussions identify repeated experiences which remind the participants, through discourse, through spaces, through time and history that they do not belong. It is with these embodied experiences that they *become* to see themselves as separate to constructions of STEM.

Connections and identities

One aspect of the participant's experience which challenges the separation that girls might feel when considering STEM is the authentic connections and relationships they have built with teachers, role models and particular representations of women in STEM. In this section, I turn to the participants' experiences of role models and representation; what they have found helpful or not so helpful, the role their families and teachers play as role models, and representations in the curriculum and media all contribute to an "entanglement of intra-acting encounters" (Davies, 2014, p. 735).

Role models

Role models are one of the primary solutions proposed to counter the participation gap of girls in STEM in the research and policy documents. Role models are considered to be useful for creating and modelling possibilities, allowing students to define specific goals and providing concrete paths to success (Herrmann et al., 2016); conversely, a lack of role models is thought to make it difficult for girls to imagine themselves as successful in STEM (Starr et al., 2019). The use of role models in STEM can also be problematic in that it can have the added effect of burdening women with the responsibility of increasing the number of women in STEM and by making it seem like a "female issue rather than a societal issue" (Drury et al.,

2011). Some researchers have found that it is important to have women specifically as role models for younger women and girls in STEM (Atkinson, 2018); however, Cheryan et al. (2011) found that it is the stereotypical traits of STEM that are perceived as masculine, and women who exhibited these traits were as powerful a deterrent to girls considering STEM as men who exhibited these traits were. It may be that effective role models are ones that students can identify with, regardless of gender, who challenge existing stereotypes about STEM (Cheryan et al., 2013), and who have communal behaviours and show interests outside of STEM (Cheryan et al., 2011; Dasgupta, 2011; Drury et al., 2011; Fuesting & Diekman, 2017). This was reflected in the focus group discussions where they saw role models as having both positive and negative impacts:

Maeve: I think in the STEM area, it can kind of go the wrong way if, for example, a female sexed teacher was kind of being perceived as more masculine it could go to the wrong way that like women are not allowed to be in STEM unless they come off as more masculine.

On the other hand, personal connections were important when it came to role models and could positively influence participants. When the Mangrove High School focus group was asked about what qualities made for a good role model, one student said:

Ivy: I don't really have many female role models in my life, but I do have some male role models and it tends to be people I feel I can trust not to let me down.

Matilda: For me and the people I think of as role models in STEM particularly, I think what makes them good is that they're just cool and really nice to talk to, and you can ask them questions and they're going to be able to answer them because they're smart and want to help you. It's a mixture of them being nice people, but also teaching you and, through that, showing that they're very skilled at what they do.

Zara: And they tend to be really passionate. Even just with how they talk and how they teach, you can tell how passionate they are about what they do. They can inspire you with who you could become and what you could do in the future.

Passion and enthusiasm were qualities that the participants identified on several occasions as having a positive impact on how they felt about a person in a role model position. It had the power to create a connection where there might not ordinarily be one:

Matilda: A couple of us have just finished this women in STEM program, where we go to the university and there's sessions on different areas of STEM. I think it's really good because it's just a group of girls who are really interested in STEM, so it's very focused and we learn a lot. They talk about being a woman in STEM as well, so it educates us on what we can achieve as women in STEM. I think it's a really good thing that school has done for us.

When I asked if programs like that might be helpful to reduce the attrition rate of girls in STEM, Matilda responded:

Matilda: I think so, because you get to see women at university who are really passionate about what they do, so I think it encourages us to keep going because you can see other women who are really enjoying it and are successful outside of high school. I think it's the most important part because while you're at high school, you worry about what it might be like after school, and you think that it might be geared more towards men, and then you see these women who are enjoying what they do and are successful at it and it's really helpful.

Participants in both schools' focus groups also, as foreshadowed by the literature, discovered potential pathways through their exposure to in-group experts. Multiple participants expressed variations of this comment (Zara, Nora, and Matilda): *One of the women was a [a range of job titles]. I didn't even know that was a job! There's some really cool jobs out there and you don't even know they exist unless you find out almost by accident.*

This experience was contrasted with their everyday experience when, in another session, Matilda noted that it was physics that seemed to be the most masculine subject at the school, and observed:

Matilda: I don't think there's any female physics teachers at this school, is there?

The lack of visibility of women in these roles had gone largely unnoticed until the opportunity to participate in the university-based program and to discuss these topics in the focus group. The Head of Science at Lobelia High had an enthusiastic belief that if they could *just get [girls] in the room* and have *excellent, enthusiastic women teachers* that the inherent value and fascinating nature of the subject will keep them there. While this certainly will not solve all the issues, women in faculty and instructional roles have been found to have a longitudinal positive impact on female students' sense of belonging (Bettinger & Long, 2005; Sullivan & Bers, 2018). In taking a step back, Conner and Danielson (2016) found that exposure to female scientists benefited the boys' perception of STEM, scientists and themselves as much as it did the girls, leading to the conclusion that disrupting ideas about 'gender-matched roles' benefits everyone.

Despite a lack of visibility of female science teachers in some areas, and the potential for teachers to make discouraging comments, many of the participants considered some of their teachers to be role models, particularly those whose actions reflected a critical approach to gender or who challenged traditional notions of who belonged in STEM. The way that teachers approached their subject, and reflected on their own relationship with, and attitudes to, gender, shaped the kind of role model they became. It was that same teacher who was interviewed in his role as Head of Science at Mangrove High School. He spoke of his own choices and reflected that, had things been different, he would have chosen nursing as a career, but had not felt comfortable with how such a female-dominated area might reflect on his own identity. Contrary to how students saw him, he described himself as a fairly traditional teacher who did not think his classes were particularly fun; he was just really enthusiastic about teaching, science, and wanting to *instil passion and a love of inquiry in his students (teacher)*. This self-reflective, passionate approach, which included an awareness of how he had been limited by narrow constructions of gender and social perceptions, meant that he created experiences which challenged stereotypes — perhaps without even being conscious of it — and, as a consequence, students identified him as a successful role model. He explained that when a teacher is passionate about their teaching and they are able to form

connections with their students on an individual level, this translated to student enjoyment and belonging in a way that could even overcome perceptions of 'nerdiness' or having subjects and teachers that exhibit stereotypical traits of STEM.

When asked about role models in STEM, many of the focus group participants at Mangrove High saw their middle school science and maths teacher, coincidentally the teacher interviewed, as a role model and someone who had encouraged them with continuing. In fact, it was this teacher who took the class, mentioned earlier, where all the girls in the class had continued with science. When asked to elaborate on their experience further, the participants talked about how he made it engaging, his passion for the subject, and how he made them feel confident to take risks:

Ivy: I hated maths and science before coming here and I know a couple of my other friends who came here felt the same way. But I think now, we all are still doing it after that experience. I don't know why really. He just made it really engaging and there were lots of experiments. The teacher just really made a difference to how I viewed it and it made a difference to a lot of people in our class. And now our class is mostly quite academic achievers – they're really good at maths and science.

Ultimately, the students felt that the best role models and the teachers that most inspired them to continue with STEM were those they connect with on a personal level:

Nora: I learn better when I feel like I have a connection with my teacher, when I feel like I can talk to my teacher about anything and when I feel close to my teacher. And that is just about them being themselves. Teachers come across as more personable when they're just being themselves, so when teachers are not trying to fit this social norm, you generally will just learn better because…

Harriet: …. you just view them as a person.

Scarlett: … you can ask them questions.

For the participants, experiences of role models had a powerful, positive impact when they felt they were genuine and where they did not (necessarily) conform to stereotypes. In other experiences of role models and representations, there could be negative ramifications which reified certain, but limited, acceptable feminine identity performances in STEM and this could impact their interest in STEM, their sense of belonging or their confidence; however, in their critique of stereotypical, seemingly well-defined identities, and their search for unfaithful repetitions, it opened "possibilities for resignifying the terms of violation against their violating aims" (Butler, 1997, p. 337).

Role models and representation have the power to create reflections, which can only cause the same to be reflected back (Van Camp et al., 2019). In an examination of Foucault's use of the image and imagination, Reid (2018, p. 196) argues that "freeing up individuals from the state of subjection requires the ability… to alter the image in ways that bring an end to the reality of their identification with it." In these focus group discussions, we see the way that relationships and connections (re)make possibilities for interrupting what images of women in STEM look like and possibilities for belonging. And, as Wolfe (2022a, p. 148) writes, it "is clear is that students first and foremost need to affectively belong to educational places and spaces in order to flourish."

Representations

It has been found that girls in STEM learn more effectively and are more engaged when learning spaces, content and pedagogy reflects their identities, knowledge and values (Dawson et al., 2020b). This is not unique to the STEM classroom. In the teaching and learning literature, representation is seen to contribute to a sense of belonging (Trowler, 2010) and a sense of belonging is associated with higher levels of achievement and ongoing participation and a greater sense of positive wellbeing and self-efficacy (Allen et al., 2018). Clark Blickenstaff's influential review (2005) identified the absence of women in the curriculum as one of the contributing factors to the 'leaky pipeline,' despite proponents calling to address

this gap since the 1970s. The participants in this study similarly noted that there was an absence of women represented in their STEM curricula. Participants at Mangrove High noted that learning about women in science had not occurred in their science class:

Florence: I was just thinking when you were talking, I'm doing History right now, which is why I thought of it, but during the war, the war was held up by a lot of women too, because women were the ones who took over being engineers and working at home, but that's not acknowledged that much, and therefore people, like men, even now think that men are the important ones and who do the more important things.

Ivy: Well, we looked at Enigma coding, and a woman kind of created the Enigma coding, but I had it in my head that a man… I kind of understood that it was a man who made the first computer. It's like they kind of hide what women have done in history and we do the same thing because men in history have been so prominent.

For the focus group at Lobelia High, they had also learnt about very few scientists as part of the curriculum outside of a few key figures:

Eloise: And I guess we keep focusing on representation of women, but when we think about representation in the curriculum, we think of people like Shakespeare or Marie Curie or Einstein and they're all historical people. I think we just repeating the same people over and over again.

Penelope: Yeah, there's so many that are just repeated. Like we don't know about any women or people of colour in STEM. We might know two or three, like Marie Curie, and even then, we barely know what they've done.

This lack of knowledge made them feel they were missing out on learning about things that were more relevant to their lives and, also, on learning about how their world worked and things that were just interesting and new. Eloise and Penelope went on to suggest that

learning about scientists such as Professor Gilbert who worked on the AstraZeneca vaccine would have the benefit of representing living women who they can relate to in the curriculum and helping students to better understand the science that is relevant to their lives right now. This experience was not isolated to these students. According to Fedunik-Hofman (2018), the recent NSW physics curriculum included 47 scientists in the first 17 years, none of them women.

Generally, participants could not name any scientists, male or female, that they had explicitly learnt about in class; however, there were visual representations in the form of posters and media content where specific scientists had been mentioned. Marketing and curriculum materials show visualisations of women — the front cover of the Year 12 Physics SACE workbooks, for example, shows a woman in a lab coat on one book and a woman sitting under a Newton's Cradle on the other. These images do not tend to depict real people, rather, they are cartoon images or young women, who may be real but are nameless, posing for photos for catalogues and university brochures. For the participants, these efforts backfired; they found that these efforts to represent women felt forced and unnatural and, as a result, it highlighted that there was a women in STEM problem and they were being targeted to fix it:

There was a desire for genuine and authentic representations of women in the curriculum, not just to see an image of themselves represented, but because participants were excited to learn about what women were doing in STEM. Curriculum content choices are never neutral, they reflect and represent cultural and hegemonic worldviews of those who have power to make those decisions. Decisions about what to teach what and what to include in the classroom construct 'symbolic representations of the world,' bringing with them the weight of institutional authority in ways that come to define the world for young people (Graham et al., 2020, p. 551; Mustapha & Mills, 2015). In the exclusion of women from their curriculum and the classroom, or in decisions not to remove some of the stereotypically masculine representations (Wang & Degol, 2017), the STEM world came to be defined as masculine for the participants.

“We’re girls in STEM – we can do anything!’- being used as women in STEM and false discourses of empowerment and choice

The ‘girls in STEM’ phenomenon created a particular experience of STEM for the participants in this study. Some of the students at Mangrove High were given opportunities to participate in a university-led program for girls in STEM and were able to appreciate an experience that may not have ordinarily be afforded to them; however, the Lobelia High School students, in particular, were cognisant of their positioning as women or girls in STEM and felt that these opportunities to participate in girls in STEM programs were more about optics:

Harriet: We’re girls in STEM!

Maeve: We can do anything!

Despite their joking and irony, and their awareness of the commodification of the girls in STEM discourse, being in the selected group of girls who were involved in these programs, reinforced “‘post-feminist’ motto[s] of ‘girl power’ and the neo-liberal ‘DIY’ mentality” (Allan, 2009, p. 147). For these students, reconciling the external messages of empowerment with their lived experience was disorienting. They felt the irony of the phrase ‘girl in STEM’ being equated with equality and empowerment given the barriers they faced and the absence of reality reflected in those sentiments:

Eloise: One perspective through which I see being a girl in STEM is… well I kind of use it ironically and sarcastically. I’m a ‘girl in STEM’!

Penelope: It’s a thing we do now to take photos of ’women in stem’ [laughter, referring to cliché images of women in STEM, not women they encounter in real life]

Eloise: Because sometimes it feels like…

Harriet: … a joke.

Eloise: Like you're just a girl in STEM. You're not a student in STEM. That's one of my biggest critiques of that kind of terminology because sometimes you just want to be another person. You don't want to have to be the gender representation or the person filling the quota.

Nora: Yeah, there's a pressure in feeling like, 'Oh yes, I'm the one making this company diverse, I am here because I am a woman and to represent women'.

Harriet: Although obviously the push for women in STEM is a great attempt at trying to show diversity, it is just that it almost sometimes borders on tokenism.

This somewhat transparent veneer of empowerment allowed for superficial incursions on the road towards equality while maintaining the status quo. The participants who took part in STEM programs were taught life skills, which they did see as incredibly 'useful and helpful' programs, but they did feel that the boys did the '*real* STEM elsewhere.' This is consistent with elements of neoliberal, choice or post-feminism where the illusion of choice is celebrated but choices are carefully curated and options and opportunities are limited (Doshi, 2022). As Francis, Archer, Moote, de Witt, et al. (2017, p. 1102) points out, the maxim that 'anyone can be anything' emerges from discourses of neoliberal individual agency and positions gender inequality as a thing of the past. It then becomes a very difficult position for students to navigate – if they believe the message they can do anything, it is then only logical that they internalise and individualise any discomfort they experience or barriers they face. For some of these participants, this meant that they chose to remove themselves from situations where they felt this discomfort.

One student, a self-identified feminist, reflected on narratives of choice and the extent to which she felt her choices were made freely:

Harriet: I had a bit of a battle with myself last year about the fact that I love pink and dance and the arts and all the things the patriarchy tells us that girls are supposed to love, and I had a point where I was like "F [sic] this", I'm not going to keep doing

these things that I actually do love, because I'm a feminist but I didn't really understand feminism at that time.

Harriet had attempted to disassociate herself from who she was previously, and she reflected that this was not the answer either:

Harriet: I really battled with it. And then I thought "Shit Harriet, you can do both". It doesn't have to be one or the other. I actually didn't enjoy being the opposite of what I was. I liked being what I was trying to be, which was like challenging the idea, but it was the fact that I had liked the way I was before, and I realised that I had often chosen to be that way. I wasn't pressed into it. Yeah, there was the ingrained ideas in me from, like we were born in 2005, there was still such a pink presence when I was born, like pink balloons, a pink room. But I could have repainted my room, and I didn't. You know, I like those things, and it was this idea that I had had the choice, I just didn't realise that I had actually made it. I'd chosen it to be that way and it wasn't because of societal pressures, so I just went back to the way I was.

While Harriet's views and understanding will continue to evolve, there was a deep level of critical social and self-reflection here — pulling at strings, trying to unravel where and how her choices interacted with inherent social expectations**.** Lockhart (2021) found that the way that research presents issues matters, concluding that research that reinforces essentialist representations of gender and sex differences is more likely to have a negative impact on women's participation rates and the experiences that they have in the field, whereas a critical feminist biology paradigm that de-essentialises sex and gender corresponds with an increase in participation and graduation rates. The critical conversations in which the focus group participants engaged provided them with an opportunity to reflect on, and pull at the strings of, their choices in a way that de-essentialised sex and gender. The picture they created of the complex, interwoven threads that bind, limit and open up choice shows the potential of these kinds of critical approaches to research and progress.

Where the Mangrove High students felt that they had to succeed to overcome people's low expectations of women, the Lobelia High participants felt that there was a pressure to succeed because they had an opportunity that women of that past did not and, consequently, felt they were made to feel they should be grateful just to be there:

Eloise: It just really irritates me that people want me to feel grateful for these opportunities that I'm given because they weren't given to my mum or my grandma. Why would I not be angry that they didn't have that? And I think that's because maybe from a young age, girls are always told to react politely and considerately and not express anger the way boys would, and I think that's so unfair — emotion doesn't have a gender. You're allowed to feel however you feel and that's entirely valid and it's just so unfair. it's especially like, if I say I want to pursue a career in medicine, there's a sense that that's awesome you can do that now, but it should be more infuriating that if I were born 50 years ago, I couldn't have done that.

Maeve: It's kind of like there's a big deal made of it, like, 'Oh my gosh you're doing science!' Stop being surprised if we do what is being offered to us… why shouldn't we choose it if you're giving it to us as an option? People are going to do it and that's fine.

Scarlett: And why's it being 'given' to us anyway?

Penelope, in another conversation, said that the perception that you had to represent as a girl in STEM turned people away from choosing those subjects:

Eloise: It's a lot of pressure, too. And It's definitely how your friends view you, too, like 'oh, you're just a girl in STEM'. It is kind of like a joke almost — it's funny. It's funny to me that like I'm just a girl in STEM and not just Eloise in STEM. If you're a boy in STEM, you never hear that used.

Maeve: Yeah, you're a boy in STEM, like what? (feigning surprise, laughing)

Nora: Yeah, if you're a boy, you're just doing a subject.

Eloise: Yeah, that difference makes it clear that they deserve to be there just as they are.

Maeve: You would hear that though if a guy was doing visual art, like, omg, you're doing art.

Eloise: Yeah, that's a 'boy in art' or you get a 'boy in drama' or something like that.

Nora: But if you're a 'girl in STEM', people are all like, 'you're paving the way for the future of the next generation, well done.'

The extent to which the participants felt they needed to represent other women was somewhat surprising; however, it was also this group who had been consistently exposed to the 'girls in STEM' discourse and, additionally, expressed greater concern for standing out amongst their peers. As Nora suggested, finding ways to make girls feel welcome without 'overcompensating' was important for making them feel they could belong without also drawing attention to them. For the participants, the 'girls in STEM' discourse, alongside the reality of 'girls in STEM' felt disingenuous and reminded them that their participation was, in their words, 'something different.'

Pressure to participate

It takes extra work for girls to pursue science whilst being themselves (Dawson et al., 2020a). This is because, amongst other things, their identity work can complicate their science identity (Thompson, 2014). A particular aspect of that work was revealed in the focus group sessions, and that was the additional pressure that these students felt to participate in STEM. This manifested in both an internalised pressure to achieve and be seen as capable and an externalised pressure to please others. The girls in this study felt a pressure to participate in

STEM – partly to demonstrate their intelligence and their ability to perform in male-dominated areas, partly as an acknowledgement of their place in history and the opportunities they had been given, and partly to fulfill the school's efforts to see girls representing in STEM:

Maeve: I think the main thing I wanted to share in coming to these sessions is that, and I feel like a lot of you have probably experienced this, but as soon as a girl, especially, is labelled as smart or intelligent, they often get to this point where they are pushed into STEM because there are so few girls in STEM. My experience is that as soon as I showed that I was good at maths or science or that I liked doing those subjects I felt a lot of pressure and like I was pushed into those subjects, whereas I would actually prefer to take more arts subjects.

Nora: There's often this whole pressure situations, where you feel, or you're made to feel, that it's your responsibility, that you have to represent girls in STEM. It's like, they sort of push you into those options. Like, you have this opportunity now, you can actually do these subjects that are specifically for men, you need to take that opportunity.

Nora's phrasing of 'subjects that are specifically for men' quite alarmingly revealed a deeply entrenched perception about STEM. With STEM being perceived as both a masculine subject and an area that is complex and serious, they saw that choosing other subjects could be perceived as a sign of weakness:

Matilda: Yeah, I think that when you are in a situation or an environment where you know people are kind of thinking that you are not going to be as good as them or that you're not going to do well with it... you feel the pressure to be better. You feel like you have to prove that you can do it, and you shouldn't have to feel like that. You shouldn't have to feel that if you're average at something, but you enjoy it, that there's that pressure. You don't have to be the best everything.

Ivy: Even though I think that's true, and it might just be my personality, I'm a bit like I always wanted to choose the option no one else is doing, because I want to be different. I want to be good at that thing that no one else is necessarily good at. I definitely think that women and girls feel that they have to prove themselves when people think they aren't as good at something, but maybe I'm just really competitive!

The participants saw that the opportunities that arose from being a woman at this point in history was a source of some pressure:

Penelope: It probably comes from us [as women] not having the opportunities. Obviously we have all been lucky to have opportunities now, but years ago women didn't have these opportunities and so the need for us to prove ourselves and be better than the guys to show why we deserve it is probably still a little bit prevalent — probably more subconsciously than consciously, like none of us are going into class and being like I need to be better than the boys, but subconsciously it does feel like we just need to prove that we are good at this.

The specific girls in STEM discourse and opportunities which arose from these efforts meant that teachers and schools were often seeking girls to represent them or fill places in programs:

Harriet: But there's a lot of pressure coming from people who just want to help. I think it was Ms. [Head of Digital Technologies] that organized it, but we were focusing on girls in STEM a lot [at the time], and a lot of women that work in that field came to the school. It was just a presentation for girls, and we all had to sit down and listen to them trying to get us to be more interested, and it was the sort of like, well it's your responsibility because we need to get more women in STEM, and it felt like they were just there to recruit almost.

While some students in the focus group appreciated some 'girls in STEM' opportunities, as they were infrequent in their experience or because they had had a good experience as a result of the personal connections they made with the workshop's presenters, others came

to resent being made to feel that the reason they were being encouraged into STEM was because of their gender.

Femininities and classed interactions with STEM

Class, and its interaction with femininity, is one of those areas which has further effected girls' participation in STEM. Skeggs (2001) defines femininity as "the process through which women are gendered and become specific sorts of women" (p. 297) noting that an individual's access to social positioning, texts and different forms of capital mediates their ability to engage in the dialectic between the becoming and the created subject — all in the interest of the global market. As such, femininity comes to look very different depending on social position, age and race. While class was not something that was intentionally explored in the focus groups, it became evident that there were noticeable differences in how each group had reflected on their own femininity and the pressure they felt to be seen as 'feminine.'

For the group at Mangrove High School, being perceived as feminine was not so much of a concern and it is, at this point, important to note that while most of the participants were not socioeconomically disadvantaged, they did not have the same privilege of choice that the group from Lobelia High School did. Career and financial security played a much bigger role in their choices and in their discussions. Walkerdine (2003) suggested the need to reclassify femininity "through the positioning of the female worker as the mainstay of the neo-liberal economy, and the place of upward mobility through education and work as the feminine site of the production of the neo-liberal subject" (p. 238); while she was talking about Britain in the early 2000s, it is equally the case in Australia in more recent times, where one's relationship to femininity is mediated through neoliberal structures. For Australian young women, this influences their openness to STEM careers as socioeconomic factors share a positive correlation with STEM participation (Cooper & Berry, 2020; Murphy, 2019), educational and social wellbeing (Allen et al., 2022), and with levels of attainment (Chesters, 2019). This positions STEM participation for women as not only a gender issued but as a socioeconomic one. Blackmore (2019) explores a feminist view of education as, contradictorily, both a site of social change and a site where inequalities are reproduced (p.

184), but, critically, in current economising approaches to education, a site for "merely building human capital" (p. 186).

While it is not possible to compare experiences of class across two sites, it was clear that different socioeconomic pressures impacted the way that the participants thought about choice. For the students at Lobelia High, they had both the privilege and the expectation to perform femininity which both expanded and limited their potential, whereas the students at Mangrove High were driven to overcome feelings of discomfort in male-dominated spaces by the promise of secure jobs and financial situations.

Class and expectations of femininity

It was predominantly the students at Lobelia High School who felt that STEM spaces restricted their performances of femininity and felt strong pressure from social expectations to conform to those performances. Students from Mangrove High School had a different experience. Most recounted spending much of their early childhood in play with older brothers, cousins, uncles and dads, and the phrase, a 'bit of a tomboy' to describe themselves was used throughout the focus group sessions. One student, when asked the childhood experiences that shaped their identity and gave them confidence in the present, described her formative experiences:

Ivy: I grew up with an older brother, so I got all his hand me downs, all his old toys, old clothes and everything. So like growing up, I was very much like a tomboy and I didn't like see girls and boys toys because I grew up getting whatever my brother and my older cousins got.

Ivy was asked if she believed her childhood experiences had contributed to her interest in STEM:

Ivy: I feel like if you're like only exposed to like one sort of thing, that's definitely going to cause... If you are not able to experience like the other genders or other sort of

activities and stuff, you're not going to grow up to be interested in them, so they can really shape even school and careers and stuff.

Another participant observed that gendered experiences had shaped her, but she now felt the agency to develop her own identity:

Zoe: Like when I was still young it did, now that I'm teenager it is different, but like when I was younger, I think it shaped like how I saw girls and boys, but like now I'm a teenager, I Just do whatever I'm drawn to.

These more 'boy-like' experiences, as participants described them, did seem to provide with more confidence to participate in male-dominated spaces. Tomboys, according to Craig and LaCroix (2011), enact types of masculinities, often related to skills or interests rather than appearance, or eschew feminine identities because of their associations with weakness or passiveness. Doing so provides a temporary protection and allows them to interact in a more confident manner in STEM spaces; however, this momentary and seeming destabilization of the gender binary exists only within the framework that they have been granted access, and the patriarchal system retains power and the status quo through being in control of granting the exceptions. Consequently, this is not an example of equality, but an exception. Ivy and Zoe were able to acknowledge that their experiences were somewhat exceptional and they felt grateful to have had access to older males who could provide access to, and confidence in, these spaces. While they were, of course, right to feel appreciative of these connections, the fact that it allowed them to be an exception demonstrates the reliance on exceptional individual connections to fix systemic exclusion. This reveals the ways girls are required to seek out and cultivate counter-narratives rather than there being a broader questioning of the underlying material-discursive conditions that necessitated such compensatory relationships in the first place.

While the Mangrove High students saw some freedom in being 'a bit of a tomboy,' the Lobelia High participants critiqued the label, and the tone of the discussion reflected a different level of acceptability:

Georgia: With the tomboy thing, if we're not like super girly as a kid or we like hanging out with boys more than we do girls, we're put into this box as a tomboy, and that stereotypes us as if we just want to be a boy, or hang out with boys, or do boyish stuff.

Harriet: Which comes back down to being under the male gaze – if you're the girly girl, you're the one appealing to guys, and if you're the tomboy you're the one that wants to get along with the guys. You're either the friend of the guys or you're the romantic interest of the guys, but it is always is linked back to them somehow.

The different approaches to being seen as a tomboy reflect the diverse expectations that these group of girls faced in a way that is consistent with existing explorations of femininity and class. In a study of privileged girls at a private primary school, Allan (2009) found they were subject to class discourses that contained an enduring expectation of 'proper,' respectable femininity; however, with the rise of neoliberal post-feminism discourse, there was a shift in what was permitted for middle and upper class girls, and they were now expected to balance respectable performances of femininity with heterofeminine values of sassiness, sexiness and success. In a neoliberal context, individuals are expected to "publicly perform their worth" and "correct life choices" and, as such, social class becomes corporeal and material (Francombe-Webb & Silk, 2016, p. 654). Middle-classed femininity comes to be associated with respectability, heterosexuality, and embodied, neoliberal discourses of self-improvement in a way that is celebrated rather than pathologised (Allan & Charles, 2014; Francombe-Webb & Silk, 2016; Rottenberg, 2022; Wilkes, 2024).

For these students, STEM, with its masculinist characteristics and stereotypes, did not align with the expectations and performances of femininity available to them; however, they also had the privilege of other choices being made available to them because of their family, education and social positioning, and this meant they did not need STEM jobs for security. Consequently, they had the privilege of viewing STEM more as an option that they discarded, rather than as something they were excluded from.

Choice and privilege

One of the classed factors that impacted choice was the support that participants received from their families. While differences arising from different socioeconomic backgrounds were noted, the students in both groups overwhelmingly received support from their families in their endeavours, with some nuance in the way that support was provided. This difference ultimately came to impact their approach to choice. In the Lobelia pilot session, one student noted:

Ava, 14: At home, we're encouraged to do STEM but we're told that we can be whatever we want to be, as long as we have a reason for it.

A student at Mangrove High School recounts similar messages that she has received from her dad; however, this one comes with more of a caveat:

Ivy: He wants me to just try and everything. He doesn't care what I go into, and he doesn't care how successful it will make me. He just cares that it's something that I want to do. The only time that he's ever been like worried is if I've chosen something that's going to make me struggle for the rest of my life, like I'm going to be struggling to live basically, but other than that he just wants me to be happy. He couldn't care less what I go into.

While most participants attributed to their families a lot of their confidence to be able to take STEM regardless of barriers, for one participant, it was seeing their parents and family members struggle financially with the types of jobs they had been forced into that had influenced her STEM pathway:

Summer: I don't want to end up in a job I don't enjoy, so that's like pushed me to try to get good grades in school and try and go for the harder subjects that will get me the job, right?

For the students at Mangrove High School, STEM careers were associated with stability, and they felt pressure to work towards stability rather than their dreams:

Chloe: I'm planning to go into the medical field, but really it's my dream to have my own business, but there's no reliability in it. Whereas with a degree in healthcare, there's a lot of stability. With science, there's pretty much no risk and I think that's why a lot of people choose it.

For the participants from Lobelia High, on the other hand, there was an expectation that they would be successful in whatever they chose to do and that the people around them would support them with that. If they did not receive that success or support, or feel like they could achieve in that area, they had the privilege of withdrawing from. In reflecting on the production of femininity as an ideal, a concept emerging out of the eighteenth century, Skeggs (2001) wrote of the result that femininity came to have "an affinity with the habitus of the upper classes, of ease, restraint, calm and luxurious decoration" (p. 299). The students in the Lobelia group expressed a preference for choosing subjects based on comfort and social ease.

In one of the focus group sessions, where participants were reflecting on the male-dominated subjects they had stopped taking, one of the participants explained that she loved robotics, but assumed that it would get to the point where it would get quite hard:

Harlow: Robotics was my *favourite* subject. Until the exam. But I loved it! I'm glad I am not doing it anymore because I'm happy with the decisions and direction I have, but I loved it. [I would not have wanted to continue] because then it gets to coding and the reason I enjoyed it was that it was just fun and no pressure. I liked the creative part. But I wouldn't have enjoyed where it went to next. I couldn't have done what they're doing now.

The Lobelia High students also gave examples of withdrawing from STEM subjects in order to avoid social discomfort and because they did not have people at home who could support them. For these participants, it was important to appear confident and avoided unwanted attention, something that was very difficult to do in masculine dominated spaces where one

was perceived to be less capable or who stood out before they had even started. In the pilot session at Lobelia High School, the participants observed that if the boys asked questions, it must be a good question and something they would not be expected to know, whereas if they asked questions, they felt like they were bringing attention to themselves and that it was 'a silly question' which they would know if they were better at the subject. Choosing the easier option allowed them to retain their feminine respectability, perform classed expectations of feminine ease and comfort, and not stand out.

On the other hand, the Mangrove High students reflected the findings of how working-class girls create discourse strategies to navigate their identities in science (Godec, 2018). One of the discourse strategies identified in this study was the rendering of gender invisible. They found that where other studies had reported self-exclusion from male dominated spaces, 'drawing on the discourse of gender invisibility [helped the participant to construct] her participation as more "intelligible".' Further strategies identified in this study included the centring of women in science, the reframing of science people as caring and nurturing, and a cultural discourse of the desirability of science. While the paper itself did not examine why or indeed whether these phenomena are unique to working class students, the present study did show that the students from Lobelia were more likely to self-exclude as opposed to the students from Mangrove who engaged in these types of discourse strategies.

Femininity and ease

As femininity, particularly middle and upper class kinds, was, and has been, associated with ease, school subjects seen as 'female subjects' were viewed, or understood to be viewed, as easier and less rigorous by the students in all of the groups — in fact, it was their lack of rigour that seemed to define them as feminine for the participants. The association of feminine subjects with being easy was a common and dominant thread throughout both school's focus groups, with both acknowledging the problematic nature of this association and misconception.

Nora: There's also this idea that girls are delicate whereas boys can 'survive anything'.

Scarlett: I remember when I was young and me and my brother went out riding our bikes with dad, I was always upfront and a better rider, and whenever people met us, they assumed I was the boy and he was the girl because I was the more active one.

Nora: With girls, the main reason like whenever I ask them like why they don't want to do a science, it's because they deem it too hard. Like it's this whole idea of like, oh, it's way too difficult. It's way too complicated. You don't want to go into that. It's boring. And then guys you often see them going into those subjects that the girls you see find boring and difficult and you see guys thriving in those and choosing those. So I don't know why that is. It's just an observation, I guess.

This is where choice feminism becomes a useful model of feminism for students to embody. When all choices are a feminist choice, it becomes easier to say that you're a feminist and you're about gender equality, while at the same time, avoiding the barriers rather than addressing them. Choice feminism provides the embodiment of this narrative -- a depoliticised feminism, which encourages individual women to think of their choices as independent rather than a reflection of systemic structures (Čakardić, 2017; Thwaites, 2017). Liss and Erchull (2010) found that many girls report a sense of empowerment, drawing the conclusion that many may not be aware of the continued existence of gender discrimination. The participants were asked what they thought might help and how that might change:

Scarlett: I don't know. I don't think it's a conscious thing. Still, I still think it's, just mentally, even in the marketing. So if you're trying to market something to the girl you'd put pink and purple. And you'd make it for them.

Nora: [on being in male dominated environments] Yes, yeah, it's like really intimidating. Like you never see like a very feminine or soft girl go into STEM.

Scarlett: Although that could be a cause rather than and effect….

Nora: But you see them as a very tough strong girl going into STEM. Like you have to be able to take on those masculine traits to be able to live in a world like that. I think, coming back to that idea of choosing the easy way, I think often the perception is that boys choose the easy way out 'cause they're lazy. Girls choose the easy way out 'cause it's safer. I mean, it's sort of ingrained in us that we are delicate and like, easily harmed and we need to protect ourselves.

While the participants first identified that the problem with STEM is that it is seen as 'boring' or 'too difficult', as the discussions progressed, they would return to the idea of needing to be tough to be in STEM, or at the very least, be resilient enough to get to the point where they could just ignore any social or gendered dynamics. While choice feminism stances could be helpful for producing the illusion of choice, such critical conversations revealed other factors that continued to create limitations and barriers.

Chapter Discussion

In discussing the materiality of femininity, Butler suggests that feminists should not be taking materiality as irreducible, rather, they should be conducting a critical genealogy of its formulation (Butler, 2011). In reading the participants experience with theory, we attend to history; after all, writes Gandorfer and Ayub (2021, p. 3), "Who or what has ever encountered—that is, sensed and made sense of—a concept, or even a word, that was not an entanglement of matter, history, forces, political and legal structures, chemical reactions, and physical intra-actions?" Skeggs (2001) reminds us that experiences of femininity are marked by historical constructions and an association with ease and respectability. Hagner (2008) further reminds us that this period was also characterised by misleading scientific methods employed to use the brain and body to consolidate stereotypes like these and consolidate hierarchies in the wake of political unrest and revolutionary thinking. However, how matter is created in each interaction is also of interest. As Wolfe (2022b) writes, schooling is a political act. It is in this environment and in interactions between peers, school and physical space that difference create new patterns which are "the *effect* of difference and mark where learning has occurred" (Murris & Bozalek, 2019, p. 1508). The participants are

attuned to this difference and their conversations explored the nature and effect of the patterns which were created by difference.

These practices do not simply limit students to separate yet equal spheres, however. Rather, they maintain the status quo where girls are deemed to be less than the ideal cis-gender male student, as representations of 'the figure of the (white, cisgender, male, hetero) scholar emerges with belonging at school itself' emerge alongside the 'the masculine enmeshment with anointed high-value subjects such as math, science and technology through 'deeply-sedimented historical process[es]'' (Wolfe, 2022a, p. 63). Binary representations are, drawing on Derrida (1994), innately hierarchical. This hierarchy is present throughout the focus group discussions, where the participants associated STEM with words such as 'elite'. In this chapter, that idea is further elaborated on, particularly including where the participants referred to 'male' and 'female' subjects as hard and easy, respectively, and to stereotypes which depict males as inherently more capable, with a sense of ease and automaticity. They did so, despite their own rejection of these premises for the most part. Ever-present throughout the focus group discussions is a tentative relationship to the concept of empowerment. The rise of post-feminist, neoliberal discourses among teenagers and in educational institutions over the last two decades (Öchsner & Murray, 2021; Ringrose & Epstein, 2017) has led to the paradoxical situation where gender inequalities are acknowledged, but understanding of structural power relations are replaced with individualised negotiations of inequalities and choices (Lamberg, 2023). This situation means that girls are required to internalise and regulate their own performance of successful femininity through disciplined subjectification (Gill, 2007:155). The expectations regarding successful femininity in this context means that girls feel pressure to not only conform to particular identities, but to also feel they are *choosing* to conform, even if it is done with a sense of irony (Sandall, 2024). It is in this context that we see a resurgent patriarchy emerging in ways that 'restabilise… the heterosexual matrix' (McRobbie, 2007, p. 726; Sandall, 2024). These practices of self-regulation are further mediated through social media. Camacho-Miñano et al. (2019, p. 653) employ the term postfeminist biopedagogy to describe content which 'interpellate[s] women to work on their body' in a highly gendered, and never-ending project of self-improvement, all articulated through a discourse of empowerment and choice.

In returning to the research questions, we can conclude that the participants' choice of their educational pathways are shaped not just by their gender, but by their individual experiences, their socioeconomic position, the expectations of femininity that they, society and their peers hold, and from material, discursive and historical intra-actions which contribute to their knowledge of girls in STEM. These experiences shape their interpretations of the role of femininity in their lives and how it manifests in their choices; however, it is the tensions and sometimes contradictory opinions they simultaneously held which demonstrates the multiplicities and entanglements that forms the assemblage of girls in STEM. Applying new materialist feminisms and posthumanist theories recognises that there are no simplistic answers to in/equality, but it does open up possibilities to consider participation and in/equalities differently. In string figuring, and pulling at the threads of overlapping patterns which create patterns of interference, space is created for new possibilities and for 'something else' to emerge (Haraway, 1992, p. 299).

Chapter 8: Who belongs in the outdoors? Constructions of masculinity and femininity in the Outdoors

'modes of life inspire ways of thinking; modes of thinking create ways of living. Life activates thought, and thought in turn affirms *life'*

- Deleuze (2001, p. 66)

The outdoors has not always been a welcome place for expressions of femininity and feminine identities. Traditionally the domain of white, privileged males, there has been little 'conceptual leeway' for women to undertake such idealised masculine ways of being and traits, such as 'strength, independence and adventurousness' (Stanley, 2020, p. 244). Women who engage in outdoor activities, such as wild camping and hiking, engage in an 'explicit pushing back against the machinations of power that inscribe how women are supposed to behave' (Stanley, 2018, p. 133) and 'outdoor recreation spaces function as sites to challenge normative gender roles and stereotypes that define women as inferior' (McAnirlin & Maddox, 2022, p. 337).

The participants in this research did not simply push back against conformity, but found new ways to engage with outdoor education, which, as this chapter explores, embraces multiple ways of knowing. They were motivated to enrol in outdoor education for several reasons, including the encouragement of friends and peers, families and family experiences of the outdoors, teacher support, and because they saw it as an opportunity to do something different from the ordinary stressors of their daily lives. All of these reflections take place in the context of prescribed imaginaries of femininity and masculinity. While some of these factors are explored in more depth in this chapter, it is participants' experiences in their outdoor education subject and the journey they undertake through their participation which provides insights into the ways in which they feel they belong in outdoor education spaces, femininity and masculinity in that space, and the pressures they feel to conform. The relationships they developed and the focus on interpersonal skills in the subject allowed them to make new meanings and to interpret differently their experiences of gendered expectations. For the participants in this study, interactions with place, teachers and guides, and their peers shaped and challenged their perceptions of who belongs in the outdoors.

I start this chapter with another 'hot spot' — a moment that 'glowed' in the outdoor education focus group data (MacLure, 2013). Within this moment a range of themes are evident, which are explored throughout this chapter. These include perceptions about what it means to belong in the outdoors, authentic relationships and social and emotional safety, femininities and masculinities, and changing perspectives about outdoor education — that is, the intra-acting entanglements that have the potential to trouble constructions of gender *and* of outdoor education.

The moment began with the participants discussing their perceptions about the differences between how they participated in outdoor education compared to the boys in their class:

Maeve: I think they're [boys] there looking for an adventure, whereas maybe we're just looking for… I don't know…

Adeleine: An experience?

Maeve: Yeah, an experience. In general, it doesn't have to be crazy and difficult and challenging, just something to experience.

Heidi: I noticed when we were out [on one of our trips], you could really tell that the boys liked being out there and challenging themselves, but I think as others have said, it's about that experience and a bit of time for us that, and I don't know if this is true, maybe we use it in more of a mental kind of way than the boys do.

Maeve: The boys are looking for a challenge. They want to do the hardest thing, the longest hike, whatever it is, they want to do the hardest version, whereas we're more interested in sitting and enjoying…

Emilia: Making bracelets…

Maeve: Yeah, making bracelets, even if it's more feminine or girly and not as outdoorsy…

Quinn: We find it more enjoyable.

Attuning to the materials — leaves, sticks, grasses — in their hands, matter and meaning becomes entangled, and it becomes difficult not to dwell on the material's history, its place, and one's intra-action with it (Jukes, 2020). Interestingly, the girls did not consider themselves as 'outdoorsy' as the boys, despite activities like bracelet making taking place with found objects (sticks, leaves, grasses), sitting in the dirt, after a day kayaking to a remote location to camp. At first glance, it may seem that making bracelets does indeed conform to traditional gendered practices as the girls manage their bodies in ways they feel comfortable with, sitting 'passively' making craft; however, nature itself is a component of the assemblage, and in these masculinist environments and intra-actions with sticks, mud, leaves, and matter which challenges expectations of femininity, the act itself also becomes something that pushes back against normative material-discursive practices of gender and of traditional outdoor education.

Contrary to depictions of outdoor education as a masculinised space, it was also the teachers and guides who supported these behaviours, encouraging reflexive practices and interactions with the environment as an essential element of outdoor education. The teachers valued what may have been seen as traditionally feminine practices and encouraged the young men in the class equally to engage with other modes of being, such as bracelet making. The participants reported that the teachers and guides encouraged the class to engage with challenge *and* play, being active *and* passive, and finding the 'middle ground' — encouraging the boys to also slow down, be creative and appreciate a sense of place while encouraging the girls in their ability to rise to physical challenges:

Emilia: We have talked about this quite a bit, not in class but on trips, especially with Annie because she is quite curious about this as well, but just to reflect on our motivation compared to the boys and to kind of almost shift both of us so we're at the same point. So make them more aware of that how it is important to slow down and also to make us more aware of how it can be beneficial to like speed up.

Time, movements, nature and landscapes in outdoor education can shape thinking in ways that provoke new lines of flight (Jukes et al., 2022). I further read the image generated in the data of the whole group sitting together on the ground, chatting easily while they create with found objects, through the quote from Deleuze at the top of the chapter — who, in his work on Nietzsche, writes that "modes of life inspire ways of thinking; modes of thinking create ways of living. Life activates thought, and thought in turn *affirms* life" (Deleuze, 2001, p. 66).

As spatial and temporal movements are enacted and intra-acted with differently in this mode of life, rather than just doing 'girl' activities and 'boy' activities, can this disruption trouble the way we think about gender? About traditionally masculine environments? About matter? By looking at this vignette with a new materialist feminisms lens, and engaging with the '"scientific stories that challenge the fixity of matter" (Willey, 2016, p. 135), we can also ask how might matter and biological stories transform when we challenge the historical forces and stories that have made matter come to matter in the way that they have? Such questions reveal the potential to transform not only gender narratives but the very basis upon which masculine environments are constituted.

Outdoor education as a journey

Outdoor education is unique in that a significant component of the subject takes place outside the classroom and on expeditions and journeys. Engagement with agentic, more than human landscapes contribute to shaping pedagogical approaches in outdoor education. Drawing their inspiration from Deleuze, Jukes et al. (2023) describe journeying in outdoor education as "more than a straightforward pedagogical practice; it becomes a mode (or way) of life for a group as they travel" (pp. 117-118). Throughout this chapter, I use the notion of the journey to describe two modalities of journeying: journeys in the form of expeditions and the journey of becoming-with that the participants took together in and through their participation. The modes of life encountered in these temporary experiences has the potential to activate new ways of thinking about gender and gendered expectations and to open students to new possibilities of participation. These modes of life and ways of thinking are unique to specific

environments — some thoughts, Jukes et al. (2023) tell us, are only possible while sitting on a river in a canoe, and these thoughts will be different to the thoughts that can only be thought while on a mountain's summit or sitting on a surfboard in the ocean. This journeying became an important component of students' outdoor education experiences, one that shaped their gendered understandings and experiences of outdoor education.

There are complexities in considering women's place within the masculinised terrains of outdoor education. This is reflected in the use of a common metaphor in outdoor and adventure education — that of the hero's journey and quest. In the hero's journey, one will experience the call to adventure, the slaying of dragons, and the return to normal life, transformed and enlightened by the journey and the conquest. The problem with this, Karren Warren (1985) wrote, is that this heroic quest metaphor rarely has meaning for women — the ability to heed the call to adventure is rare (they are more likely to meet barriers rather than inspiration), and the idea that one enters the wilderness boldly to conquer challenges assertively transfers more readily for men than women on their return to their ordinary lives; women are more likely to be met with hostility than applause if they show such confidence and independence in their daily life. McDermott (2004) notes that Warren sees the myth as unsuitable for women because of the *experiences* they bring with them — and because of the concept of 'conquering' nature more broadly — however, they argue that the idea that a hero's quest metaphor is unsuitable for women has led to the re-essentialising of difference and reinforced myths about female fragility. These two perspectives reflect the complexities of considering how to enhance women's experience of belonging in outdoor education as both perspectives may remain true. Rather than thinking about outdoor education as a hero's quest, with its traditional approaches and concepts of conquering and physical endurance, the concept of outdoor education as journey opens up possibilities for new ways of thinking, and, in turn, the participants' discussions and explorations provide insight into the possibilities this mode of life can create.

Different ways of thinking: personal growth and challenge

For the girls in this study, participation in outdoor education did not seem like a natural choice, rather it required some courage and time to make the decision to enrol as they were wary of male-dominated spaces:

Emilia: I don't necessarily think it's like them thinking they're dominant, but I think it's just that they're more extroverted and have more confidence than some of us, so it kind of almost does seem like that they're a bit overpowering sometimes. So if you walk into class and if it's full of boys, you're like, oh my…

Heidi: It's not necessarily that they're like dominant in a way that they put us down or make us feel lesser or anything like that. It's just that they're a bit more out there and care less.

Adeleine: Yeah, they don't really care as much about what other people think of them, it just doesn't bother them as much.

Isla: Girls just have a lot more anxiety about that kind of thing.

The participants contrasted this initial hesitation with how they were now feeling about their participation, where they were pleasantly surprised by their feelings of belonging and their experiences of personal growth. It was in the difference between their feelings before and after taking the subject that we can see how outdoor education is perceived to be a place where girls do not belong, yet approaches within the subject made it possible to challenge how they interpreted their participation and created a sense of belonging:

Freya: I just feel like when you're on camp, you see more of the real side of people, but obviously when you're back at school, you have to hold your soul back…

Adeleine: Yeah, you're more vulnerable…

Freya: Yeah, you need to have certain standards and present yourself in a certain [gendered] way, but then I guess when you're in the outdoors, you can just be yourself and there's less pressure.

According to Gray (2019), outdoor and adventure learning experiences based on a *challenge by choice* approach can help to build and fortify students' psychological resilience, expanding their capability to adapt and respond to stress. In contrast to how they experienced other aspects of their educational life, participants felt they were able to challenge themselves, rather than be challenged by the subject in outdoor education. This different mode of thinking created an environment where they felt they could belong, and where they could challenge themselves without feeling the need to prove anything. In turn, it made their continued participation in outdoor education more attractive. This mode of thinking was further facilitated by concepts of place. The outdoors provides opportunities to feel uninhibited and to *just be*. The combination of an unfamiliar environment and the break from the pressures at home meant that the participants felt free to let their emotions go, in contrast with the expectations to keep it together in their everyday lives (Anthonissen, 2011). The participants described the ways in which this sense of place impacted them:

Heidi: I think when you're in the outdoors, you start to think differently. You start to focus on different things…

Adeleine: Appreciate them…

Heide: Yeah, appreciate. I don't know because it's different to like the normal school day or like the normal life you have. Not everyone has the luxury of being able to go out outdoors and that sort of stuff everyday. So I guess when we do, even if it's just for a couple of days or a week, we switch mindsets very quickly and start to focus on different things and you build different skills because you're focusing on different things.

They saw this way of thinking and way of being as unique to the experience and inaccessible in their everyday lives; however, being able to have these eudaimonic experiences offered for

them a “higher or broader level of functioning and personal development” (Knobloch et al., 2017, p. 657), and place came to be agentic in the constitution of their experiences. One of the participants went on to say that in some ways it is quite an emotional experience for them: *I think I have cried on pretty much every trip that we have been on* (Emilia). This was something to which the other participants could relate. Emilia didn’t consider this a bad thing, in fact, she appreciated the opportunity to be in that environment, think about things and get them out. While there is often a gendered perception of crying, and the extent to which people cry and find crying acceptable is dependent on the extent to which they endorse attitudes and behaviours consistent with their gender (Sharman et al., 2019), it is recognised, admittedly in research which did not use gender as an organising tool, that there are a range of heightened emotions that participants progress through on outdoor group-based expeditions, arising from the challenges, fatigue, group dynamics and fears they face. Another perspective is that affect emerges from encounters with nature, and these encounters can provide new perspectives about oneself and one’s life in their ‘real world’ (Douglas et al., 2024). For the participants, the opportunity to operate at a different speed in a different place made different ways of thinking possible.

Additionally, the participants valued the way challenges were presented and the opportunities they had to make their own choices. The participants saw this approach to challenges as an important feature of their experience and one which appealed to different people for different reasons:

Adeleine: I think it’s different for each person because people like different things. I think a lot of the guys like the hiking, and that’s the challenge for them, whereas personally, I like the rock climbing because it’s just something different.

Maeve: We get a lot of choice over what we do and what our priorities are.

This level of choice provided the participants a point of entry at a level of challenge they felt comfortable with, particularly at the beginning when they were still unsure about their participation. Having that choice and developing agency through these encounters meant they were now comfortable being active participants in the subject. For these outdoor

education students, many trips and expeditions were self-planned and directed; according to the staff member interviewed, this met the criteria set by the state's curriculum board and permitted a challenge by choice approach to outdoor and experiential learning. Vernon (2014) argues that the concept of challenge by choice and structured autonomy is paradoxical, as the intended democratisation of challenge by choice is broken down through the "privileging structural norms of individualisation" (p. 22). He notes that students and educators tacitly, perhaps unconsciously, seek to renegotiate alternative experiential education spaces to 'trouble' this pedagogical paradox, and, by doing so, they "collaborate to construct and continuously reconstruct the learning space" (p. 40). The participants felt that in schools when students had to *walk this many kilometres in a day* or where the focus was on pushing oneself beyond one's limits, the level of physical exertion might be *off-putting* (Maeve). On the other hand, they felt that their experience of challenge meant they got more out of the experience, and that more students, particularly girls, felt comfortable participating, because *they can do things together and at their own pace* (Harlow):

Adeleine: I think even when we have to do a lot of the same activities, like say for example when we did bike riding, we had two groups, a fast and a slow group, so even if we all want to have the same experience, we can do it at our own pace.

For these participants, the self-directed and challenge by choice nature of the subject meant that it was accessible, and while they learnt the required technical skills, the focus on individual progression and learning at one's own pace meant that there was less competition between students, and between the boy and girl cohorts. This, in turn, led to less concern that they did not belong as girls, and participants began to interpret outdoor education as a socially safe place where they could make their own decisions about what they felt comfortable with. The variety of activities, particularly activities that were either new to the group or ones they did infrequently also meant that there was less perceived pressure to perform:

Emilia: Even if we're not good at something it doesn't matter as much because everyone has their strengths and weaknesses. So even if I'm really bad at rock climbing, and

Harlow might be incredible, there's no judgement that I'm bad at it because I might be really good at sailing and Maeve, not so good.

There was a sense that the participants were on the same type of journey with their peers, where they all experienced successes and areas of challenge, accepting and identifying that their successes and challenges were not the same as other people, but they were all in the same situation, even in their appearance:

Freya: Everyone looks like death on camp.

Isla: Yeah, everyone is going to look like a bit of a drowned rat on camp so we don't really mind that we are all going to look the same.

It was clear that the self-reflection and critical thinking that the participants engaged in as part of this subject was a necessary tool for them to navigate a subject where they did not initially feel like they belonged. Their self-directed openness to complexity within the broader pedagogical approach to challenges provided them with a sense of agency and empowerment that they did not experience in other male-dominated spaces, such as sport and physical education. Routinely identifying their progress and successes through debriefing and self-reflection had a positive effect on their motivation and self-efficacy (Bilgin et al., 2015; Cavilla, 2017). In interviewing the lead teacher for outdoor education at Lobelia High, it was evident that this was a feeling he had worked to carefully cultivate. He explained his attitude towards choice evolved throughout his teaching experiences, saying, *the more years I have been teaching, the more I see how much [students] appreciate and respond to having responsibility for making those choices,* realising that the older methods, which he had started out with, that focused on 'toughing it out' did not always make for the best outcomes.

The journeys that the participants undertook — in this case, the journey from their initial hesitation to the different modes of life which became possible as they travelled with each other through different spatial and temporal movements — existed outside of their quotidian experience. This allowed them to think differently about challenge, pace, appearance and emotion. All of these factors have gendered components reflecting perceptions that women

may be more emotional, care more about appearance, or want to take easier options (Blaine & Akhurst, 2023), but in these contexts, students had time to reflect with curiosity and were encouraged to make the choice that was right for them. Journeying together and seeing others share their own strengths, weaknesses and preferences that did not align with their usual understandings of gender and the expectations that come with it, opened up new possibilities for the way they saw the world around them. Or as Jukes et al. (2023) write, "journeying provides an alternative way of living to the normal lives of our students (for a time) that activates their thinking in particular modes whilst leaving them open to encounters" (p. 118). These shared journeys open temporary spaces where gender expectations abate, creating fleeting but significant possibilities for reimagining relations with self, others, and the environment through encounters which conventional educational assemblages rarely accommodate.

Social connections as driver, not just outcome, of experience

Friends, peers and family had a significant impact on students' choices and their experiences of outdoor education. Perhaps because of the nature of the subject, and it rarely being a prerequisite for future employment or educational pathways or an expected choice, participants shared they had asked older students, friends and family for advice when considering their choices. They did this in regards to outdoor education more than they did for other subjects. The enthusiasm that significant others had for the subject influenced the participants to see outdoor education positively. Significantly, friends' and peers' advice contributed to a kind of social safety necessary for navigating gendered spaces and risk. This social safety emerged from seeking tacit approval from peers that they respected, outdoor education aligning with their family-related identity, and negotiating with peers to ensure they would not be alone or heavily outnumbered in a very male and masculine environment:

Emilia: I talked to some of the people who did it last semester and they seemed to really enjoy it.

Quinn: My family and I go camping a lot outside of school, and I'd heard good things from [people who had previously done] outdoor ed, like that we get to do a lot of cool things and get to go outside of the classroom and get a lot of opportunities. And then I spoke to my friends about it, and they were interested in it as well. So we decided if we could all do it together would be a lot more fun and I've heard really good things.

In common with one of the participants studying STEM, some of the participants from this focus group had made an agreement to enrol in the subject together. When asked whether they thought having spoken to other students increased their confidence to choose it, they extrapolated that it made them feel more confident going into the subject:

Quinn: Yeah, it definitely helped a lot, because I knew we'd be in it together. It just made me feel a bit more confident that whatever we were going into, we would still have fun, but it turned out that outdoor ed was really fun on its own anyway.

Emilia: For us, I think it's a bit more of a comfort thing. Especially as this is the first time we've had an opportunity to do a subject like this, so we didn't know what we were in for. To know you have a good friend makes it easier.

The participants believed that boys had it much easier when it came to those kinds of decisions:

Isla: I reckon for the boys it's probably just, oh, my mates are doing and I want to have fun with them, it's a bit more of a following thing.

Heidi: I feel like for guys there's a lot less stress around choosing subjects. I feel like boys don't necessarily worry as much about having no one, they just think, oh, I'm going to go have fun in the subject.

When asked why they thought this might be the case, they attributed their perception to past experiences:

Heidi: I guess we might perceive some of the boys as being a bit dominant over us, or, because there's just so many of them, they just kind of… I don't know…

Adeleine: Probably from past experiences like that, we've had compared to them… I suppose they're a little bit more comfortable with just associating with other people that they don't know where we sort of go in and feel like [a sound to express discomfort] if we don't really know anyone, so from experience we know it's more comfortable to have someone.

The participants in this focus group prioritized their social safety and observed their female peers doing the same; however, they became more aware that even by considering their potential comfort in the subject there was something different about their experience, especially when they perceived the boys in their class as being able to make decisions more easily. This contrast revealed for them that there was something unique about their experience that made them different from those — boys — who typically participated. This contributed to a gendered understanding of social spaces which indicated that there is always something additional that women need to do, such as extra considerations, finding social support, to participate.

In providing social support and connection for each other, the participants saw the influence of their friends as largely positive, but they acknowledged that this had not always been the case. Whereas now they pushed each other as friends to go outside of what they saw as their comfort zone, when they were younger, they had observed themselves and others choosing easier options to stay with their friendship groups.

Harlow: [On camps] we could pick our level of ability, and a lot of us based that on our friends rather than based on what level you actually thought you were at. That might have been a part of [the reason people did not enjoy those outdoor adventure experiences] 'cause people weren't pushing themselves even though they knew that they could probably do better and they might enjoy it more if they actually set themselves a challenge, but they were afraid or scared.

Maeve: I think we're all pretty strong-willed women, and a lot of that didn't really stop us, but I see others, when they're choosing camp groups, they're only choosing because of their friends. And they're not incapable, they're just choosing not to challenge themselves based on their friends.

Emilia noted that it might seem to me like they are all 'one friendship group' now, but those friendships had emerged out of putting themselves into those situations, to the point where they now actively made decisions to challenge themselves and take up these opportunities together. In a study of outdoor adventure learning programs connected with an all-girls school, Richmond et al. (2018) found that social connectivity was one of the major outcomes of these programs, with the challenges, and being away from home, causing participants to see each other in a new light and bringing people closer together. Maeve and Harlow joked that their connections had been formed over *stupid things* and *crying together*, but as in the Richmond et al. (2018) study, these experiences had allowed them to form a bond that would have otherwise been missed and it was one that motivated them to keep choosing these experiences. This links back to the concept of journeying, and the alternative way of living and travelling together in a particular time and place, opening up possibilities for intra-acting entanglements — in this case, with each other. For the participants, the element of social connection and social safety was the first key to feeling they were able, or perhaps even allowed, to participate. This gendered navigation conveys an insight into what impacts motivation in these male-dominated subjects, where social safety needs to be negotiated before participating in these areas.

Social barriers and perceptions of who belongs in outdoor education

The participants shared a view of the connection between males, conquering challenges and physical rigor. As discussed earlier, participants in outdoor education saw the boys as wanting to do 'the hardest thing.' Conversely, the participants were surprised when they came across women whose gender presentation was more obviously coded feminine also wanting to do the hard things:

Quinn: I think a lot of times when we have female teachers, it will be female teachers who are very tomboy like, or have that nature about them, but when we were speaking with Remi [the guide], she was a little bit more of a girly girl, but she still had all these amazing Outdoor Ed skills, and it was good to see that you don't have to be a tomboy kind of person to do really well in an Outdoor field.

Adeleine: I remember when [a teacher] ended up doing the walk twice, and when she told us that she was about to do it again, I was like, what? You're doing what again?! Whereas I think if it was one of the male teachers or guides that had said it, I would have been like, oh, okay, cool. I don't know. It was just kind of weird that, just because she's a girl, it kind of blew my mind that she was doing it again.

Maeve: I was kind of blown away when she told us she had done [a very long distance, multi-day hike]. I've always wanted to do that, but I've never considered doing it alone. I think because of the fact that I'm a girl and I'm worried about what would happen because I'm a girl.

In this reflection, Quinn, shared a moment which had initially surprised her, a moment which had made her question the perceptions she held about the capabilities of a 'girly girl' presenting woman. It was not so much that she was surprised to see a woman, but that she was surprised to see skill in the absence of masculine coded presentations. In the gendering of the space and the apparent limited iterations of performances that were available, the participants were encouraged to reconsider their own perceptions of what women do in the outdoors and of what they are capable.

Finken et al. (2018) define gender stereotypes and identities as more-than-human participants in research encounters, noting that participants (human, space, gender stereotypes, identities, artifacts) are entangled in a process of *becoming-with,* and are constituted in each encounter. For the participants in this study, stereotypical approaches to gender and expectations of femininity and experiences counter to their expectations were entangled in their *becoming* students in outdoor education. Cordelia Fine (2005) explains that even if one does not personally subscribe to particular stereotypes — such as seeing boys as

capable, fun and strong, while seein girls as passive, serious and weak even when engaging in the same behaviours (Callahan & Nicholas, 2019) — they can exist at an implicit level. This occurs when previous experiences, the frequency of two objects being linked (in this case, women and bushwalking), concepts of self and others, and external opinions and representations are synthesised to form stereotypes that operate on a subconscious level. While in one recent study it was only the men that showed either implicit or explicit biases favouring men in sport more broadly (Sunderji et al., 2024) and with outdoor education possessing some of the fundamental characteristics of sport (Humberstone, 2000), the participants in this study reflected that they did, in fact, hold implicit assumptions that were contrary to the beliefs they held. The participants were able to identify several experiences which may have led to such an assumption, including hearing of their friends' experience of outdoor education at a single-sex boys' school:

Maeve: It's really physical, they do like runs every morning and stuff. And yeah, it's just it's such a physical thing, whereas I feel like if anything they should be taking the time to just sit down and enjoy the place they're in.

Freya: I mean, they are all boys…

Maeve: Yeah, they're all guys, but they're being forced into these races and these competitions, and you don't want to be the last one because it would be really embarrassing.

The participants' interpretation of this example was that the boys in this group — at least the boys they spoke with — did not necessarily enjoy this approach to outdoor education, rather, they were forced to it because that is what boys do. They contrasted this experience with their friends who attended a single-sex girls' schools who had a more reflective experience:

Isla: [I know people who] go on similar trips at all-girl schools and it's definitely not as physical, it's more *where they become a woman* [italics added to reflect their emphasis].

Rather than the feeling of wellbeing girls may benefit from by participating in outdoor education programs, (McNatty et al., 2024), the programs described by participants appeared to be more focused on empowerment and rites of passage in outdoor environments. These programs separate individuals from society and immerse them in new and ritualistic experiences, intended to free them from what has been holding them back and transform them to adult- or womanhood (Bell, 2003). These different approaches to outdoor education shaped participants' understandings of outdoor education, even when it was not their own experience; the participants found neither of these gendered constructions of outdoor education appealing, and the idea of *becoming a woman* in the wilderness slightly patronising, yet they saw these approaches as the norm in ways that influenced their own understanding of gender and outdoor education. Addressing the perception that women inherently prefer spiritual and reflective experiences of the wilderness and men naturally prefer challenging, conquering approaches, McDermott (2004) argues that this kind of essentialist thinking "fails to recognise the diversity amongst women (and men), and the multiple realities they live [… It] privileges gender over other organising principles" (p. 287).

In the different approaches to outdoor education evident in these examples from the participants' friends, we see gender as the primary organising factor. In Maeve, Freya and Isla's commentary, material-discursive practices and components intra-act to create an intelligible reality — the school processes and approaches to outdoor education based on their own configuring of gender, the students who take part believing, this is what boys/girls *do*, the parts of the story which are selected to be recounted to friends in other schools — all matter, in both senses of the word. Each of these components intra-act in ways that constitute the universe's *becoming* and how it contributes to the stories that they tell us about themselves and their reality (Barad, 2003). The participant's journey to new understandings and perceptions, however, offer new lines of flight from socially held constructions of what girls/boys do and what they want to do in the wilderness.

Encounters with discomfort and the gendered outdoors

The masculine character of outdoor education has faced increasing contestation from scholars and practitioners in recent years. This challenge has emerged through shifts toward

experiential learning, increased choice, and philosophical approaches to care and place (Gray, 2018a, 2018b; Wattchow & Brown, 2011). Despite these transformations, stereotypes paradigmatic to outdoor education—toughness, rugged individualism, and privileging of 'hard' technical skills—continue to persist (Kennedy, 2022), and the girls' participation was shaped by what they experienced as stereotypes.

Given the active physicality of outdoor education, which directly contrasts with widespread expectations positioning girls as more passive in their learning (Cárcamo et al., 2021; Pownall & Heflick, 2023; Schmidthaler et al., 2023; South Australian Commissioner for Children and Young People, 2022; Wallner & Aman, 2023), the participants were asked if they felt pressure to act in certain ways in outdoor education environments:

Quinn: I mean yes and no, like I think we all feel comfortable to speak up in the classroom, but I think some of the guys in there are just very loud and that's just what they're like. That doesn't mean we're afraid to say something, though.

Maeve: I think it's separate. I mean, when we're in the classroom, the boys are definitely more wild, jumping around, and we're kind of sitting there trying to get some work done. But when we're outdoors, I think it's different. We're kind of on the same level and sometimes the boys are less energetic than the girls when we're outside.

The journey through different spaces — the classroom and the outdoors — permitted different modes of life which did not only make different thoughts possible but different intra-actions with place and with each other. In the more conventional environment of the classroom, the participants experienced normative constraints and dynamics of gender. These were slightly ameliorated by the relationships and meanings they had constructed on expeditions. It was on these expeditions, however, that they could fully embody and enact the sense of belonging and freedom that characterised their alternative mode of engagement with the world.

Generally, the participants actively resisted and rejected barriers that might hold them back from participating in activities, but they had also critically reflected on these barriers. It was in being able to identify stereotypes and misconceptions that they were able to reject them, but they also perceived that other people did not necessarily understand:

Maeve: There's definitely the idea that this is a tough subject, like physically tough, and then if you're not physically fit, you can't do it, which I think is just stupid, because that's not at all relevant to what we do.

Isla: Yeah, I think a lot of people… I've gotten comments from other people being like, why are you doing outdoor ed? and like, that's, you know, weird. A lot of people may find it hard to understand why people would want to go out and do your business in a hole and all of that.

The participants recognised that they enrolled in the class with different initial motivations and skills from the boys. Nevertheless, where the boys, who had enrolled to go on adventures rather than to 'learn' were now a lot more interested in the theory, they had followed the opposite trajectory and were appreciating the adventure and challenge side of outdoor education:

Quinn: We (the girls in the class) probably started out that enjoyed… well, did well at the theoretical side, and now, we're understanding… well I guess we always understood, but now we're pushing ourselves with the physical side.

Harlow: Yeah, I'd also say I think it takes something mentally challenging and physically challenging to be able to like self-reflect. It's definitely when you're in that zone of stress and that difficult situation, I feel like that's the growing point…. I think people get that drive to really push themselves to their limits from different things, but in a way, it's also just a social norm what each gender or sex should be driven by and I think, with outdoor ed, the subject kind of challenges that.

Maeve: I would say that one of the best, one of the most memorable camps for me was, I think, Year 9 camp, because it was *so* hard. I wouldn't necessarily say that as I'm in that environment, walking up that hill in 40-degree heat with a massive pack and no water. You don't really think that in the moment, but afterwards, you're like….

Emilia: Wow.

Maeve: Yep, wow. That was such a good experience.

Despite explaining that some of their best days were the toughest, and that practices of debriefing and self-reflection helped them to grow in moments of struggle or adversity, there persisted an underlying assumption that the girls and the boys in the class would have been motivated by different reasonings when choosing the class. This was reinforced by the perception from those outside the subject that the physical nature of the course would be uncomfortable, tough and a 'weird' choice. There was a tension in this experience. On the one hand, the participants were given choice and a way to engage with the subject in an emotionally safe way and, in doing so, they enjoyed the physical nature of the subject in a way that far exceeded their expectations. This challenged the stories they held about their participation and belonging in this environment. On the other hand, other people's perceptions, and the way they had observed their friends participating on camps — using the options provided by choice to secure emotional safety by limiting their engagement with masculinised concepts of risk and physical toughness — reinforced their understanding that it was not necessarily normal for them to belong in the outdoors.

The need for, and appreciation of, authentic relationships and social safety emerged at multiple points throughout the focus group discussions. Dionne (2021, p. 251) argues that relationships are "necessary for a person to *be* a person," disposing "the knower to adopt new noticing capacities, for example new corporeal availabilities toward matter and matter's dynamic and unique agential capacity." Of course, relationships and roles in relationships are gendered (Campos González & Madureira Ferreira, 2025), and Ahmed (2010) argues that gendered expectations and performances are complicit in the tying women's happiness to

the compulsion to make other people happy, creating conditional and dependent relationships. However, in a feminist new materialist approach to an ethics of care, "materiality can matter otherwise" and the effects of material-discursive entanglement can be responded to otherwise, in ways that "activate or participate in a new trajectory of mattering" (Dionne, 2021, p. 231). In these stories, and those in the following section, we see examples of how the participants acted in ways which re/shape identities and participated in a new trajectory of mattering. Wolfe et al. (2024) writes that "[w]e feel-think-make knowledge with the world around us" (p. 899). In the actions that the girls take, such as the forming of alliances and participating in a subject where they may not have otherwise, they are feeling-thinking-making differently, re/creating their world and the educational space.

Authentic connections and belonging in the outdoors

This section describes the ways in which authentic connections and representations increase the participants' feelings of social safety and belonging in outdoor education. This is not limited to increasing the visibility of women in the field, but belonging occurs through deep, entangled and embodied connections which shape their experience and their becoming as students of outdoor education.

Role models, teachers, and authentic connections

At times, teachers, guides and older students acted as role models for the participants — someone they looked up to, who inspired them to pursue the subject, and who affected the way they saw themselves and the world around them (Kearney & Levine, 2020). It was the authentic nature of relationships with teachers and guides which made an impact. Seeing how adults approached challenges impacted how they perceived gender and challenge in the outdoor environment.

Consistent with findings that role models of any gender can be effective and that role models who exhibit counter-stereotypical behaviours in gendered fields can be particularly effective

(Olsson & Martiny, 2018), the participants identified their male teacher as a role model, citing him as the decisive reason many of them chose to participate:

Maeve: I think Mr [the outdoor education teacher] pushed a lot of us into it.

Isla: Everyone really! [All laughing, someone in the background says, 'made us!']

It was the way that the teacher identified their potential and potential interest in the subject and encouraged them individually that helped them to overcome many of the barriers to initial participation. The staff member recognised that in the outdoor education component of his role, participation skewed more heavily male. In the other component of his role, which was related to humanitarian and environmental service learning, he saw the opposite. He identified that the girls in those areas were often seeking experiences outside of the classroom and he thought they would appreciate outdoor education but did not necessarily have the confidence to choose it. He saw part of his role to empower students, and while he did not have the resources to do that for every student, he was able to target those students who had shown interest in other forms of experiential learning, and he did see the culture changing:

Teacher: Roughing it [has been] easier for males, but I'd love to change that mindset, and I think we're seeing more of the right students engaging. By that I mean they have an interest in that area, and perhaps they didn't have the confidence or feel empowered to take those opportunities on, whereas now I feel like because there's supportive staff and a culture growing within our school, more students are stepping out of their comfort zones to embrace those experiences that they wouldn't have previously, because it just would have been too hard, or they didn't know about the opportunity, or they just felt that it was biased towards other people rather than themselves.

In the final focus group session, the participants discussed the ways in which the teacher created an inclusive, comfortable, and supportive, but challenging, environment. It was this approach that enabled the participants to develop authentic connections with their peers,

with him as the teacher, and with the adults who would accompany them. One study showed that girls in an outdoor education experience developed a wider range of adaptive functioning behaviours than their male peers due to the social relationships they developed throughout the experience (Allan & McKenna, 2019). It was these relationships, and the way the teacher also encouraged their male peers in developing these relationships, that was one of the aspects of the class they most appreciated:

Maeve: I think if we didn't have the class we have [having just noted that outdoor education tends to attract pretty easy-going [people] and we had a different teacher that we didn't respect, all of it would be a lot harder. We would not be doing the same thing.

Emilia: [our teacher] tries so hard to make everyone feel included. He tells the guys to go sit with the girls, and you work with whoever, because he tells you that it doesn't matter and everyone can do it.

Maeve: It's so natural, though – it's not really forced. But also, the teachers that have done quite well with us are the ones who have been the most open. He will talk with us for ages about whatever, so I think the ability to be vulnerable is probably really important, especially in this situation, to make everyone comfortable.

Harlow: He's also really good at noticing people's strengths and weaknesses and encouraging you with both. Just generally, I really appreciate a teacher who will tell you when you're wrong, too. I just really appreciate teachers who are honest and teachers who I can be honest with.

Maeve: Yeah, it's that respect. But it's on the right level, too. It's not cruel. It's the right leader, too. You know what their intentions are. If they're telling you that you're doing a bad job, it's not because they want you to feel shit, it's so you can get better.

In a new materialist approach, relationships and community are made and remade through intra-actions with each other and with the world. The degree to which communities are entangled and response-able to the other determines how those communities *become* (Nikolić & Skinner, 2019). 'Patterns of care' (Nikolić & Skinner, 2019, p. 895) were visible in the way the participants described their connections with teachers and other adults; it was through these connections they became entangled in a community of response-ability in ways encouraged them to see not just adults, but peers, in their common worlding practices and as part of these patterns of care.

Despite this experience, the participants appreciated the opportunities they had to see women as role models and mentors, and this may reflect the exception to the finding that the sex of the role model is insignificant, being that in areas where there are greater gender inequalities, same-sex role models can matter more (de Gendre et al., 2023). There were aspects of the female role models' approach, including their openness to building authentic connections, that mattered to the participants in ways they did not expect:

Adeleine: We had this instructor on a camp, Remi. She came on camp with us and I really enjoyed that. She sat with us at the back and we just bonded over the pain of bike riding and just all camp things and it was just sort of girl related and it was nice, but it was probably something I never really would have thought of before, whether having a female teacher there would have helped or not. But it was good to know she was there by the end of it. I was like oh, actually yeah, like I could go, you know, say anything I wanted and feel comfortable with it, because we'd just bonded over it.

It was the permission from someone in a role model type position to feel that things were hard, but you could keep going anyway, that the participants appreciated from the women role models they had encountered. It was these kinds of journey thoughts, only possible while riding a bike together with this group of people in this terrain that made these thoughts possible. In a following session, the participants remembered a camp where their group had been accompanied by a school employee and described it as 'the best camp' because they had her accompanying them. When asked what they appreciated about their approach:

Harlowe: She is just the most nurturing person and she was so supportive of anyone who was struggling and so giving. She was so capable while at the same time, she was vulnerable and acknowledged when she found things difficult. It was just really good to see that self-awareness.

Maeve: I remember times on camps where we've had male guides and they've always just been about getting from point A to point B. And then we've come across other groups with a female guide and they're having so much fun. They're playing games and singing and laughing as they're coming down the mountain.

It was the experiences of togetherness and the making of a patterns of care which entangled them into common-community with an affective intensity (Thorpe et al., 2023). These connections challenged the participants perceptions they had to enact particular performances in the outdoors. Warren et al. (2018) identifies that the challenge for women outdoor leaders is that they need to prove themselves to be capable while not being seen as *superwoman*, which is an impossible identity for female students. While their experiences of women and outdoor learning had been, more often than not, marked by absence, teachers and guides who had challenged the superwoman identity by showing vulnerability and modelling self-management and emotional regulation skills helped students to see possible identities and ways of approaching challenges (Owens & Browne, 2021).

Outdoor education was able to provide a sense of belonging for the students; however, this did not necessarily come about as the result of female representation or participation. While the participants did not necessarily feel female presence mattered to them, they realised that it was so normalised in their experience that they had not even realised how few adult females had been part of their experience of experiential and outdoor education programs:

Maeve: I think we all probably have had mostly male teachers through camps and stuff like that. So it's probably become normal. If you're having a girl related problem, you go and talk to another girl in your group, you don't talk to a teacher, so it's probably something we don't think about, because it's just become normal.

Freya: I remember on Year 8 camp, we had all male teachers and about halfway through camp, Ms [one of the year level leaders] came down to visit, and I was like, oh! There's actually other females out here [the participants laughed here and joked about the experience of remembering that adult females existed on school camp]!

Isla: I know! I was just kind of like, oh! Because I hadn't seen a schoolteacher that was female on camp and it was just interesting. I mean, obviously we're used to it, but also, I didn't realise it until I saw it.

Anon: And even if there are female teachers on camp, they tend not to participate. They often just stay at base camp and be a supervisor or move between groups instead of doing the activities, which is a bit of a letdown. I mean, c'mon!

For the participants, these early experiences were perceived, in contrast with their more recent experiences as described above, as an unmaking of patterns of care. This lessened the degree to which they were entangled in the world of outdoor education, as they perceived it at this time. However, this experience is reflective of the outdoor education workforce. Women are still a minority in the outdoor education workforce, even more so in positions of leadership (Gray, 2016, 2018b). While they may not experience overt exclusion, prejudice in the form of devaluing their contributions, assumptions about their skill and competency level, and scarce representation in leadership has led to 'critical underrepresentation' (Gray, 2016, p. 27). The issue of female, or any, school staff participating only in limited ways is complicated, as they are rarely there by choice, and depending on a number of factors, may not be equipped to participate fully in the kinds of journeys that students take in their experiential learning programs. The result is that women are often missing from the student experience.

Representation

Representation of women in outdoor education can be sparse and lack diversity; however, the participants were influenced positively by the limited examples of representation that they encountered. Generally, images of outdoor education and adventure activities contributed to this lack of representation by presenting singular visions of the independent, adventurous, man engaging in activities designed to conquer the wilderness (Yates, 2022). Increasingly social media is being used to represent women in the outdoors which, while significant, still requires further progress.

The participants were asked what they thought they would see if they were to google images of terms such as outdoor education, wilderness and adventure:

Emilia: [Someone] strong and sporty… probably pretty male dominated.

Heidi: Like a male rock climber…

Quinn: [laughing] that's what I was thinking!

While this was not necessarily the case when I googled those terms (but perhaps my algorithm has been influenced by the extent of feminist outdoor education literature in my search history), for these students, it was the perception that this would be the case that was more important than the reality. As discussed earlier, some of this representation, or the perception of the representation, infiltrated their own attitudes, beliefs and behaviours in ways that led to unwanted assumptions about their own, and other women's, abilities. The participants were asked if the representations, like the one described above impacted their relationship with the subject:

Heidi: I think if, for example, we were being shown how to do a rope set up to climb by a woman, you'd be, oh, they know how to do this, like what? but then I guess, in a sense, some people might just underestimate the ability that us women have to know and learn skills and to be able to reteach them as well. You have these questions, like where did they learn to do that? Or, why are they doing that? I

guess you just don't have those same thoughts when a male's doing it. It just doesn't seem that impressive then.

As with the groups of participants discussing STEM education, these participants saw a need for more diverse media representation, especially in media targeted towards young children and a greater range of non-gendered toys. When asked what they thought might disrupt stereotypes, they kept returning to this idea of increased representation, and some of the participants felt that images they had seen on social media had positively influenced their own participation in outdoor education. Social media accounts provided them with an avenue to see women represented in the outdoors:

Isla: You see people that have done outdoor ed in the past, on their instagrams, they post these really cool photos of where they've been and what they've been doing. I think that kinda shows how cool it can be. I think it was last year that I saw some of their photos and I thought, oh yeah, outdoor ed can be fun and that was an influence.

Women are increasingly represented in the outdoors on social media platforms. Photos on social media increase the visibility of women in the outdoors and play an important role in 'increasing social capital and in power recognition' (Weatherby & Vidon, 2018, p. 343). When used well, social media may "have the power to create a new lens through which women present and respond to one another… [and can] offer an alternative path forward or broaden the range of representations" (Christie et al., 2018, p. 166). However, in an analysis of hiking Instagram accounts, Stanley (2020, p. 249) found that it is predominantly 'legible diversity' — cis-heterosexual, white, young, and conventionally attractive women — displayed on much of these platforms. Additionally, photos of women in the outdoors on social media tend to display symbolic dominance of nature, with individuals positioned overlooking landscapes or displaying a mastery of skills or adventures that are typically masculine, or, increasingly, posing in such a way to connote strength and power. In doing so, they may further entrench traditional, hegemonic masculine approaches to nature (Weatherby & Vidon, 2018). Social media may be a useful and powerful tool for increasing representation, particularly for students like the ones in the focus group who are young, white and socioeconomically

privileged; however, it also has the power to (re)produce inequalities, injustices and hierarchical messages about who belongs in the outdoors.

For Maeve, it was not just about representations on social media, it was about what those older students represented to her personally and about what they made visible:

Maeve: I think one thing that was a big factor in why I chose outdoor ed was because I looked up to the people that had done it previously. So a lot of them I either knew or I just had like really good memories of watching the outdoor ed class, you know, getting their gear out of the shed and getting ready for camps, and they would all be having fun and laughing and it just looked like so much fun.

Maeve noted that it was because of her extra-curricular activities and older siblings that she had had the opportunity to know some of the older students at some level; however, she was also aware that other students would not necessarily have had the same experiences as her or been able to witness those older students having so much fun. She also knew that if it wasn't for those experiences, she may never have considered outdoor education because; being an alternative subject, she felt that many people did not really understand what it entailed or what it was like. Where the participants saw girls their own age as needing to be restrained and feminine to be popular, they felt that older girls in 'real life' or on social media brought with them a social status that challenged what it meant to be popular and 'cool', as contact with older students lends credibility and 'diminish[es] students' preoccupation with popularity and status' (Brown, 2011, p. 183). This example reminds us that real opportunities for change often arise, incidentally, at the edge of structures, not as a result of established systems and practices. Without meaningful change, most students will not have access to these same opportunities or possibilities for transformation.

An underlying principle of new materialisms is that "thinking in dualisms makes it impossible to map the complexity of socialization processes" (Höppner, 2017, p. 2). Rather, socialisation occurs through ongoing material-discursive processes, located within specific "historical, social, cultural and biographical contexts," which shape the stories that we tell about

ourselves (Höppner, 2017, p. 5). For these participants, those stories included what they needed to feel emotionally and physically safe enough in this gendered environment to participate. These stories included what they told themselves about who they and their families are — they belonged to a family that enjoyed the outdoors, for example, the friendships that they made to feel more supported in their choice, and their older peers and guides who had been someone to look up to. Through a new materialist lens, the connections they made and the everyday iterations and intra-actions which occur in those connections and relationships become materially embedded and produce a feeling of belonging; for example, the feelings they had when watching the older girls getting ready for an expedition is experienced in the moment of their own participation, as nostalgia allows them to "hold on to the ephemeral human and non-human elements that are associated with belonging" (Wyn et al., 2020, p. 15). If they saw the older girls as being strong and independent by participating, they, now in that same position, could embody those same qualities and that could become part of their story.

Valuing and devaluing of femininity and feminine skills

Hard and Soft skills

The field of outdoor education has historically prioritised and promoted masculine values and traits (Kennedy, 2023). While the participants' experience of this was obscured in outdoor education, the discussion led to the participants sharing their experiences of physical education, where they felt masculine traits were more explicitly valorised. This contrast helped them to better understand their experiences of outdoor education; therefore, as well as addressing implicit biases in outdoor education, this section also further discusses the explicit biases that the participants had in physical education.

Attempts to address some of the issues associated with traditional approaches to outdoor education have seen a focus on 'soft skills.' In outdoor education, soft skills refer to people skills, personal attributes, leadership skills and decision-making practices. While these skills

have been deemed critical for outdoor education, they are often invisible and undervalued in practice (Baker & O'Brien, 2020). Additionally, framing skills as *hard* and *soft* communicates an oppositional and hierarchical dichotomy that contributes to hard skills being valued over soft skills (Baker & O'Brien, 2020). Some scholars (Mitten et al., 2012; Warren et al., 2019) have identified this framing as a form of linguistic sexism and part of the 'hidden curriculum.' Owing to the stereotype that women have better interpersonal and emotional skills, the labelling of these skills as 'soft' communicates an association between femininity, women, and being 'soft.'

Despite the critique of this language, the participants appreciated the focus on the teacher's focus on 'soft skills,' and they saw his focus on group and interpersonal skills as beneficial to their experience and to their sense of belonging and comfort within the group:

Heidi: I think for the most part we don't experience those things [leaving women out and devaluing the feminine] so much because [our teacher] and our class are quite inclusive…

Isla: And when we're out on the field, [our teacher] is always pushing us to express ourselves and be ourselves and not, you know, put on the face that we do at school.

It was something that the teacher was actively trying to cultivate, and he felt he had come to value soft skills as a result of observing female guides and the positive impact that their approach had on all students. He identified that his understanding of the role of gender in outdoor education was continuously evolving. Having been in the field for *a long time*, he reported that, in his observations, the ability to participate came down to individuals, and this is how he had traditionally approached thinking about participation in the subject. Recent experiences, such as working with female guides, helped him realise there were barriers he had been unaware of:

Teacher: Everything I have done, I see it on an individual level, so each person individually, whether that is their idiosyncrasies, I guess for want of a better word, or

> behavioural attributes. There's no pattern that sticks for me. It's more, what's that person's upbringing? What's the support system at home and, therefore, what does that experience mean to them? I really believe that it's individual as opposed to gender stereotyped. Now, I see the gender conversation is probably more around access [than ability]. You know, how are they getting involved? Why are they not getting involved? And that's still something that I guess society still really dictates…. Working with Annie [one of the guides], she's amazing at all of this, including facilitating and being a really good mentor, and from her, I certainly learned a bit around some of the barriers. It's easy for me [to get involved in anything] and I think anyone can do anything if they put their mind to it, but having a daughter and in working with people like Annie and some of the other female guides, [I have started to see] that it is more the barriers, and understanding how people see their place in society, and that is something I have considered in my leadership role and teaching in that space. I'm not an expert but it is something I am really keen to have more conversations about how we can change some of that.

Male outdoor education teachers have been increasingly aware of gender biases in their practice; however, Kennedy's (2023) research demonstrates that a lack of self-reflection by some male practitioners leads to blind spots and tacit support for gender hierarchies. It may be the practice of self-reflection exhibited by the teacher in this study was instrumental in creating an environment where hierarchical values were reduced. It was clear from the interview with the teacher that significant self-reflection had helped him to get to the point where he was now. Feminist ethico-onto-epistemologies recognises that "as knowing subjects we are becoming with the world" (Cozza & Gherardi, 2023, p. 55). It was from the series of encounters and *becomings-with* female guides, participants, family, nature and their intra-actions that the teacher had embraced new ways of knowing.

This transformation encouraged the teacher to challenge gendered expectations in the outdoors. In conducting interviews with outdoor education leaders, Davies et al. (2019) also found that breaking gender roles and encouraging gender incongruency could help curb any

sexist behaviour that emerged within student groups. One male interviewee in their study also noted that it felt easier for them to pull students up on sexist and hypermasculine behaviours. Drawing on Ahmed (2017), the authors discussed the importance of allies within social movements, particularly given the way women are discouraged from speaking out against sexist behaviour by being positioned as the 'feminist killjoy' (Davies et al., 2019, p. 224). The participants observed that the male teacher was able to challenge tendencies towards hyper masculinities in their peers and encourage gender incongruency in ways that allowed for more freedom.

Popularity, masculinity and belonging

Despite the physical and technical requirements of outdoor education being historically associated with masculinity (Warren & Loeffler, 2006), the participants did not feel that their presence went unrecognised in the masculine space of outdoor education, as other studies have demonstrated (Tilstra et al., 2022, p. 182). They did have some experience of this, however, in the context of the male-dominated sports in which they participated, where the masculinist association with physicality and technical skills meant they had to fight to belong. MacBride-Stewart (2022) found that young women frame their understanding of outdoor education through the lens of organised sport and traditional physical education. As young women were more likely to be unfamiliar with outdoor landscapes, they saw physical education — the subject where they had come to understand the restrictions that were placed on them and the gender norms that guided their participation in outdoor spaces — as a way of understanding their experiences. For the participants in this study, their experiences of gender in physical education had informed their expectations going into outdoor education experiences:

Harlow: Every time I go out there, I feel like I have to prove myself. You're not there to have a good time, it's more like you're fighting for your spot. And you're fighting [in this case older males] who are stronger and more experienced than you.

The participants frequently returned to experiences in physical education to describe their sense of belonging in outdoor education. The relationship they observed between sport and

masculinity, which is how they had previously understood their participation in physical endeavours and how that participation was inextricably linked with popularity, contrasted with their evolving thoughts on that relationship. The participants often found it easier to describe what outdoor education was not like — physical education. As their experiences in outdoor education were so different to what they were used to, it was hard for them to identify experiences that may have been gendered, because, if they were occurring, they did not necessarily look or feel like other gendered experiences. As such, they did not always have the frameworks or language to notice or critique gendered experiences in the same way when they did occur; however, they were able to compare it to other male-dominated experiences to describe what it was, for the most part, not.

Where popularity for boys at school centres around sporting ability and physical prowess, other factors that may increase popularity are characteristics such as humour, intimidation, 'doing' heterosexuality, and being clever without trying too hard (Read et al, 2011). For girls at school, however, there is a similar focus on social interactions, seeming effortless, and 'doing' heterosexuality; however, significant to being popular is the need to be "pretty, fashionable and attractive". These performances of femininity need to balance 'doing' heterosexuality with being *nice*, *passive*, and being a *good girl* (Read et al., 2011, p. 171). When it came to physical education, there was an expectation that the participants, and their female friends, not try too hard or stand out or it would impact their social standing:

Emilia: It's complicated, because I think we can all think of girls who are really good at PE, like phenomenal, like they try, but not too hard that she might be ridiculed for it. People want to avoid labels. I feel like that's why girls don't put in a lot of effort, because they know that they're going to get judged for it, whereas guys are more careless — it's not odd for guys to put in effort during PE, it's very normal.

Heidi: It's like when we play [games], when boys would hit and they were playing their games, they'd be so loud and dramatic about it, but if any of us girls made noise, they'd look at us and thing we were so weird.

Isla: But it's ok for them to be excited about being involved…

Heidi: It's almost like they expect us to be quiet and not very involved, it's like…

Emilia: Yeah, let them have the spotlight [*sarcastically, imitating a patronising tone*].

Metcalfe (2018) identifies physical education as a setting where boys are able to accrue social capital through shows of athleticism and traditional forms of masculinity. These practices further entrench "traditional representations of gender (in which sport is congruent with the male identity and othered for a female identity)" (p. 691). It is in this context that gender is heavily policed.

While the participants also felt the PE was a paradigmatic example of a male-dominated subject, in that they felt boys actively and physically impeded on their space and a lot of their teachers unconsciously supported the boys in ways that made the girls in the class feel smaller, they were aware that the girls also acted in ways to make themselves smaller to retain their popularity. This was not unique to their experience of PE:

Speaker A: I think a lot of girls in our year level and in other year levels dumb themselves down, even though they're not, I don't know why they do it… just to make themselves more attractive.

Speaker B: And it's still that fear of being judged.

Speaker A: Yeah, they're not able to…

Speaker C: …push themselves as much as guys…

Speaker A: … yeah, but embrace….

Speaker C: …their inner selves [in a somewhat self-mocking tone]

Speaker A: Yeah! It sounds a bit corny, but that is what it is. They can't let people see what their capable of.

Speaker B: I feel like they think that if they are true to themselves, then that's too extreme.

Speaker A: Yeah, she's 'a sweat'.

Speaker B: Or a try hard.

Speaker C: Or a teacher's pet.

Speaker B: Which are not things a girl wants to be associated with!

Speaker D: Like certain groups will judge you a lot, whereas yeah, I guess the further down in the kind of social rankings that you get, people are more you know inclusive of you and it's really just about you know if you're a nice genuine person and they don't care how you look, they don't, you know, care what you do with your life.

Even though popularity was seen as important by the participants, who acknowledged that they and their social circles were seen as popular and actively took steps to avoid being seen as 'unpopular,' their participation in outdoor education gave them an opportunity to take a break from the gendered and social expectations which dictated their popularity. While popular students generally need to invest in performances of femininity, as they are performances which are legible for authenticity (Read et al., 2011), the outdoor environment makes this investment difficult. Interactions and existing with nature and the non-human — time, dirt, sand, wind, water, limited access to amenities and only having what you can carry — made focusing on appearance somewhat futile, and the need to move oneself from one place to another, by foot, climbing, kayaking or biking, limited any opportunity to be passive. There was again a tension between their identities in the outdoors and the person and gender they felt they needed to perform when back at school; however, they noted that these experiences had encouraged them to reevaluate how they felt about their need to attain and

retain their popularity through conforming to those gendered expectations. They felt that being in the outdoors helped them to 'be themselves' as the more equitable environments they had experienced on camps had changed how they felt about shrinking themselves to fit in. Isla acknowledged that she was not quite there yet, but she was almost at the point where she would rather spend time with less popular groups who were nice and genuine than be seen as popular and conform to feminine expectations.

The participants also acknowledged that the boys who took outdoor education were 'different,' and this helped them to experience a more equitable environments:

Heidi: And I don't know this, but I think the people, like some of the boys who play footy and soccer and all of that, they probably worry more about needing to fit in, and needing to be with a certain group of people, because that's what's more acceptable to be, whereas the people in Outdoor Ed probably don't care as much and are happy to be themselves than be pressured by other people to be like this or that or have this interest or opinion…

The participants felt that this may be the case because the class group in outdoor education was often working towards a shared goal. They felt they were able to prioritise this goal over worrying about how others saw them or how they saw themselves, as success was often related to arriving safely at their destination or being able to eat or get tents up before it was dark. To do this, they needed to work together, and, in these moments, it was problem solving and ideas which were valued within the group. As others have found (Nugent et al., 2019), situational and survival needs in the wilderness become more important than gender performance. The practical communication required, and the debriefing practices afterwards, helped each of the students to understand each other and to develop interpersonal skills, empathy and community (Stuhr et al., 2016). As Heidi notes, it is getting through these experiences together that brings them close and allows them to be more themselves. Returning to the concept of journeying, these thoughts are only possible when they are working together in this mode. In doing so, they discover new ways of thinking about each other, themselves, and how they belong.

While outdoor education and learning in nature has the potential to deconstruct normative gender roles (Blaine & Akhurst, 2023), particularly if educators are aware and prepared to disrupt constructions of gender (Decker & Morrison, 2021), it also provides the opportunity to focus on shared goals, share a sense of agency, and engage in collaborative problem solving. These opportunities contributed to an environment where the participants felt more free from gendered expectations and the need to conform to gendered standards of popularity. It is important to note, however, that this experience of inclusion is unlikely to occur as a matter of course; without the focus on interpersonal and group skills and the teacher encouraging the group to examine the way they each demonstrated leadership in group situations, it is likely that gender may play a larger role in group dynamics, and girls in the group may be less heard, as might be the case in other educational groupwork situations (Stoddard et al., 2020; Wieselmann et al., 2020).

Dunne (2022) also explores why there may be a different dynamic in the spaces of outdoor learning. In nature, "young people, things and (outdoor) places are always 'becoming' in relation to each other through dynamic and messy intra-actions" (p. 33), co/re-created through "memory, social relations and embodied interactions" (p. 34). In outdoor education, nature can thus be (re)storied and (re)produced simultaneously and across time as gymnasium/escapism/journey, allowing for both educator and student to have a different relationship with space and to create new possibilities. Countercultural movements, such as the 'slow adventure,' says Dunne, can go some way to de-masculinising spaces, cultivating relationships and stories of nature and young people and ways of becoming that reflect wider diversity and increased access.

Chapter Discussion

I conclude this section exploring girls' participation in outdoor education by exploring what can happen when we take matter — corporeal, non-human, space, time — seriously. Advocating for a serious account of the body in feminism, Elizabeth Grosz (1994) explores the way "the "mind" or psyche is constituted so that it accords with the social meanings

attributed to the body in its concrete historical, social and cultural peculiarity" (p. 27). Additionally, she argues that feminists could learn from Merleau-Ponty's location of experience "midway between mind and body" and his account of experience as 'always necessarily embodied, corporeally constituted,' and understood "between mind and body… in their lived conjunction" (p. 95). In both the opening vignette and the participants' accounts, outdoor education generated new modes of embodied becoming — whether through sitting in dirt with hands working alongside nature matter, or feelings of exhaustion, sun, bodily fatigue, movement written into their aching legs. These material encounters transformed how participants inhabited their bodies, as such experiences "give meaning to the ways in which the body is occupied" within more-than-human assemblages. (p.115). Meyer and Borrie (2013, pp. 296, 317) write that "how we engage and express our bodily selves has much to do with our gendered identities" and "bodily engagements in wilderness" can "provide space and opportunity for the fullness of self and the wildness within." For the participants, disruptions of time, place and movement allowed for different corporeal and sensory intra-actions with the world, creating new possibilities of becoming (Barad, 2007, p. 178; Frid, 2021; Hackett & Somerville, 2017; Payne & Wattchow, 2009) and of experiencing gender and gender identities. Breault-Hood et al. (2017) suggests that, for girls confined by gender roles and social pressures to conform, outdoor education programs can shift the focus "from how one's body looks, to what one's body can do" (p. 32). For the participants in this study, this shift additionally gave them more confidence to make choices about their participation and their future, independent of the confines of gender roles and social pressures they previously experienced. Windsor (2015) writes that "social assemblages are defined by the lines of flight they can sustain" (p. 164). In this chapter, the participants' contributions make possible new departures and lines of flight which recognise that concepts of gender in outdoor education are not pre-existing, rather there is fluidity and opportunities to push at the boundaries.

In the journeys that the participants took, both in the form of expeditions and as a way of thinking about the journey they had been on together through their participation in the subject, they engaged in new ways of life and thinking which could only be possible in these modes. These new ways of life and thinking offered points of departure for thinking about gender and outdoor education. These points of departure: in doing what they saw as 'girl' activities in male-dominant environments' in seeing boys' being encouraged to join them,

which communicated that there was value in 'their' activities; and in becoming materially stronger, both physically and mentally through challenging their thinking and their bodies, they were able to construct new knowledge about themselves, the subject and gender in ways that challenged their previous experiences. For these participants, this new mode of being was experienced affectively as a sense of freedom and release. While they recognised that it may not always have been as perfect, they were almost elated in their discussions that they were able to participate in a male-dominated field where they were able to take up shared space, where they were not told they had inferior abilities because they were a woman as they were in other physical and sport spaces, and where there was not a burden to act or look masculine or feminine. In communicating their feelings in this way, it demonstrates the extent to which their everyday experiences are burdensome. It also demonstrates that there are ways of doing male-dominated subjects differently. Not a feminised version, but a way of disrupting the subject which agitates against binary approaches to gender by including and valuing multiple modes of being and of life.

Chapter 9: What participants wanted

> And then I would get home and I would go to the store, and there's no girls and boys section in the store and I would go and buy a fire truck…
>
> — focus group participant.

In the process of interpreting the educational dynamics that have contributed to girls' marginalization within STEM and outdoor education, the potential to critique practices and, simultaneously, generate strategies of resistance emerged. In reflecting on what they had appreciated and would have wanted, the participants considered possible strategies and approaches they believed would increase participation and feelings of belonging in male-dominated subjects. These suggestions focused on a desire to build meaning and, in doing so, a 'chance for life' (Haraway, 1988, p. 580). This shorter, somewhat more practice-focused, chapter, concludes with an exploration of their wants and desires through the lens of new materialist feminisms and posthumanist theories. First, I begin this chapter with a final 'hot spot' vignette.

The participants from Mangrove High were asked to construct a narrative of imaginings and possibilities, outlining a 'perfect day'. In being asked to tell this story, they were able to think outside of their everyday experience and imagine what could be possible. Ordinarily, the structures of an institution limit what knowledge is possible in ways that appear natural. While changes may occur within the structure, these are largely superficial as the causes and roots that construct and limit the creation and production of knowledge tend to remain the same (Daniell, 2022; Marcuse & Kellner, 2013; Staley, 2018). In speculative fabulation, Haraway draws on "myth and metaphor to understand the complexities of the world we are creating" (Lally, 2022, p. 512). In this way, the intention is that one can move outside existing structures to imagine what is possible.

Participants deliberately focused on a day in junior primary school, identifying this spacetime as a critical juncture where transformative practices could most profoundly disrupt gendered limitations. They envisioned that such early interventions would produce students who, by

the time they reached participants' current age, would inhabit pedagogical spaces radically unbound by gender constraints:

Chloe: In a perfect world there would be no stereotypes, no one would be afraid to do something they like because of their gender and things like that, and I think starting to educate people on that at the youngest age is the most beneficial so that then like the next generations understand. They understand that you can do whatever you want no matter what and their gender wouldn't hold them back.

Matilda: I'm thinking of what a perfect day would be like if I was in primary school. I think a really good day would be that you wake up and you can do whatever you want for a while, and then you go to school. In your classes, I think it would be great if there's a good, balanced variety of subjects, and there's some male teachers and some female teachers and all the boys and the girls they sit together. And there's maybe like a class that I went to on adversity that people were teaching me some stuff and then I would go to STEM and STEM would be good and we learned science. And then I would get home and I would go to the store, and there's no girls and boys section in the store and I would go and buy a fire truck.

Florence: I think just more hands on stuff like playing with fire trucks and things that I'd want to do. I know you have to do lessons but sometimes you have to just explore a little bit and have some free time to learn in all these different areas of STEM. Not just [having teachers say] you have to do such and such at such and such a time.

In this exchange, we see a desire for something different, and perhaps, a desire participants held for their childhood selves — to be free to play with fire trucks and all this represents. Some phrases, such as the use of *no one would be afraid* and *gender wouldn't hold you back*, reveal their deep, affective response to their participation in these fields. Equally, their desire for balance, for sitting together, for reflection on experience, and for opportunities to explore and intra-act with their material world, suggests their desire for belonging — socially, materially and affectively. Building on the themes from this vignette and the suggestions raised during the focus group sessions, the following chapter examines participants' desire

for stronger connections to their learning, a clearer sense of how it relates to their futures and their understanding of the world as well as a greater sense of social safety through support from peers and teachers.

Making informed and socially safe subject choices

Løken (2014) argues that educational choices are about far more than interest and subject-based motivation; they are about "doing identity" (p. 285). Choices are motivated by the cultural and social discourses in which the subjects exist as well as the expectations, stereotypes and prejudices that one experiences. For the participants, there were concerns about how subjects reflected their identity. It was assumed that being surrounded by other girls would provide them with a way of maintaining their identity; however, equally, there were some logistical and practical considerations arising from their amorphous understandings of the purpose and direction of their subjects. The following section explores the ways in which students desired to be more informed and to feel increased feelings of social safety in these subjects.

The need to increase awareness about STEM or outdoor education

The outdoor education participants felt they lacked knowledge of the subject before they enrolled, yet once they were inside the subject, it was clear to see what it entailed and its benefits. On the other hand, unless the STEM participants had a particular job in mind for which STEM was a prerequisite, it was more difficult for them to see what the subject offered them. To attract and maintain participation, both STEM and outdoor education participants saw the benefit in having older girls, particularly, work with younger students by demystifying the subject and showing them, as Adeleine said, *it's not just a bunch of activities* and *see, there are girls in Outdoor Ed*!

Isla: Yeah, I think it would be important to have a chat with the younger girls about outdoor ed and just say that, just because you didn't like camp, still don't completely rule out outdoor ed. Because I know for a lot of girls, their experiences

of camp spoilt it for them a little bit, and an older girl having a conversation with what outdoor is really like might help them to see that they could enjoy it.

Emilia: I guess girls can be scared to step into it and they will be like, 'Oh, I'm going to feel so out of place' or all this sort of stuff, so I guess, with that kind of sense, just making them feel welcome and I guess just making them aware of what it is and what they'll be doing. All of that sort of stuff which will make it a bit easier for them.

Isla: But even like just things like us coming to talk to the middle school girls about doing it into year 10. It's almost Inspiring them to do it like they see us and they're like, oh, you know they're actually you know, half the class are girls now. So you know, maybe I can do it, too.

As Maeve noted earlier, it was because of her extra-curricular activities and older siblings that she had become involved in outdoor education. Despite how they saw themselves, the participants also realised they were now the older, cooler girls in the eyes of the younger students and recognised the opportunity for themselves to be role models for younger students. They felt that a semi-structured or intentional program to facilitate connections would inspire younger girls to get involved. This was something they would have appreciated. Seeing girls their age or just a little bit older succeed would also be validating:

Adeleine: I feel like even seeing a girl win the senior prize for Outdoor Ed would be really good. I think you would think, oh, if she can do it, I can do it.

The STEM participants also saw the benefits of having older students visit to talk with them about what STEM subjects looked like in future years. The group suggested and discussed the possibility of older secondary and university students visiting to talk about what they were working on, what success looked like and what strategies they used to learn and to problem solve.

Audrey: I know what Biology or English or Art would be like in Year 12 or maybe even at uni, but I have no idea what [a subject like Digital Technologies] would look like in future years.

Ava: I think that if they were to show how what we're doing now could develop into what we'd be doing in Year 10, then 11, then 12, and then into the future, where the world's revolved around technology then that would give you more of an uplifting feel and you'd be more interested to pursue an IT career maybe.

Throughout the focus groups, the participants described missing opportunities to develop STEM knowledge, thinking and skills, whether that was in the toys they were given, the times they were pushed to the side in STEM spaces, or in the kinds of games boys played and which were separate from their experience. Additionally, in not seeing older girls in these subjects, they constructed their own knowledge about the kinds of people who do these subjects. As knowing subjects, *becoming-with* their world (Cozza & Gherardi, 2023), their becoming becomes rendered and characterised by absences, abberations, and tensions. Educational practices and systems need to better recognise the sociomaterial impacts that gendered intra-actions with the world have, and work to address the gaps in experience. A first, practical step may simply be having older girls explain what they may have missed, so they can visualise where they are going. Nonetheless, positioning older girls as primarily responsible for bridging experiential inequities rather than demanding fundamental transformation of educational practicess that produced these problematic entanglements in the first place risks perpetuating such gendered norms and values.

Creating more exciting visions for the future

Participants acknowledged that the skills gained in outdoor education could benefit their careers — a topic explored later in this chapter — but career relevance was not a primary reason for their participation. Careers, and an inability to see themselves in certain careers, was primarily a concern for the STEM focus group. As well as not really understanding how

their current study related to future years of study in STEM, these students felt their perception of what careers were available was limited:

Scarlett: I feel like there should be something where they literally look at the jobs in STEM, because I have no idea because it's not something that is discussed a lot. There could be a whole alleyway of jobs I've just never heard of. I hear a lot about, especially as a drama student, you get told that you don't just have to be an actor, you can be a director or a writer, or in sound or lighting or technical or producing things…

Nora: Yeah, there's loads of jobs you could go into…

Scarlett: But you don't really hear anything about that in science, they never discuss the jobs you could do.

It was not only a lack of knowledge about the types of careers, or what they looked like, it was also difficult for participants to imagine themselves in a STEM career:

Maeve: Most people here see subjects as more of a skill or something that you just need to get into the career that you want, not something to really focus on completely. Most people are taking because they need it for something else and to be able to do another thing, they don't really take it because they want to do that – they don't really think I want to be a biologist or a chemist.

Nora: Yeah, it just sort of goes back to that idea that there's probably lots of jobs that are actually interesting or in those fields, but whenever there would be a 'women in STEM', presentation, they would always try to introduce jobs that might sound interesting. In most cases they fall flat completely because it often just sort of goes back to your sort of sitting at a desk and it goes back to that sort of stereotypical idea of, oh, I'm just gonna be looking at a desk typing code or doing like just really boring stuff. And that doesn't really excite anyone to want to do it.

Participants perceived that, as with their childhood toys, when it came to careers, boys were able to dream big and do all the fun things:

Nora: When you think of female scientists, it doesn't really come to mind because you never really think of a girl being able to… work at NASA.

Scarlett: Yeah, I think more like pharmaceutical, or something with medicine.

Nora: You start thinking small [when you're a girl] when it comes to STEM, but with guys, it's like oh I *could* work for NASA. It's like all these ideas come to mind of what they can do.

The participants were asked if they thought they would see STEM as a more glamorous field if they believed they could go and be an astronaut or find a cure for cancer:

Nora: Definitely. Again, if you have opportunities, you want to do something big. You don't want to do something meaningless.

The general desire amongst this group for 'exciting' jobs reveals their personal aspirations; however, it also reflects socialised, classed and historical constructions of success and how these, too, remain gendered while constantly shifting in appearance. The construction of success here was not a woman working away in a lab or at a desk coding, no matter how important the project might be. Adamson (2017) argues that the rise of the celebrity CEO and related autobiographical content creates a vision of success consistent with postfeminist and neoliberal discourses which promotes a very narrow, allowable version of femininity and success. The discourse of empowerment and excitement of girls in STEM is at odds with their experiences of STEM and the kinds of careers they knew about.

Two specific examples emerged where they learnt about more diverse jobs for women in STEM. Penelope mentioned that the role models and in-group experts who had visited spoke to them about good jobs suited to women's skillsets in STEM. These included managing teams and communicating with journalists and industry partners, jobs which conveyed to the

participants a, presumably unintended, message about acceptable ways of participating in STEM for women. While these jobs did not necessarily provoke enthusiasm, another example came from the experience of the students who had been able to participate in the university-based STEM program. In this program, they had been exposed to women working in jobs of which they had never heard. As a result, they had come to realise that there may in fact be more possibilities to explore and, as a result, they became more open minded and keen to explore potential exciting science careers.

Preparing students for leaving school may be one of the key functions of schooling (Reiss & Mujtaba, 2017) but teachers' limited awareness of STEM pathways can limit student's career choices (Knowles et al., 2018). While schools have been encouraged to focus on the skills that students may need for the ambiguous Australian job landscape of the future (Tytler, 2020), it appears in this instance, that more education is needed (perhaps for both school staff and students) to open doors to new possibilities in STEM careers. This, of course, needs to be coupled with addressing why girls feel they do not get to dream big.

Making subject choices

The participants identified logistical issues in how school was structured to limit STEM participation. With students in Stage 2[2] at the time of this study only being required to take four subjects and a compulsory Research Project subject, this left little room for other choices — particularly considering STEM pathways usually require more than one STEM subject and English is a prerequisite for most Australian universities. At least for the students in the focus groups, school timetables often scheduled STEM subjects in such a way to create conflicts with other choices they would have made, based on norms and assumptions that the students who pick an optional science, for example, may not also want to choose, for example, human rights or dance. Subjects like human rights, perhaps, with its association with care, or dance, with its association with creativity, come to be coded as feminine, in opposition to the ways that STEM is coded, leading school administrators to, 'logically,' position them in a school day in opposition to each other. This is an example of where the non-human, in this instance,

[2] Stage 2 is the final year of secondary schooling in South Australia.

timetables, intra-acts with gender and identity in such a way to limit the subject positions available:

Eloise: [When you get to more senior years] it's kind of, for some people, including myself, it's hard to choose that one area that you enjoy because saying I am a STEM person kind of cuts you off a bit from like everything else.

In practice, Gutiérrez and Calabrese Barton (2015) argue that schooling is structured in such a way to maintain the value placed on the students at the top — the ones succeeding in traditional subjects associated with academic achievement and excellence. This is something that the participants felt, but because these hierarchies and values are embedded in structures and are not explicit nor necessarily deliberate, they found it difficult to articulate why they felt like they did.

While the participants were unable to identify how STEM students were prioritised or what led to the perception that they were in a 'higher up position,' the impact of this perception was the subsequent belief that STEM was more difficult and unattainable than other subjects. Being unable to pinpoint why they felt this way led to discomfort the participants preferred to avoid. Participants discussed staying within their comfort zone and avoiding what was understood as the difficult choice, and they strongly linked their choices to what they perceived themselves to be good at, a sentiment displayed in the following comment:

Mischa: You go from having no choice at all to having all these choices, and everyone is like, well I'm just going to go with what I feel most comfortable with and what I know the most about.

Career choices that involved STEM subjects meant that some students needed to prioritise particular subjects, despite their discomfort, although where they could limit their discomfort, they would:

Chloe: I chose a full year of chemistry, biology and physics because I will need them to get into forensic science, so those are sort of the best choices for next year that

are related to that, and I'm choosing general maths, because methods is very stressful!

Methods (officially known as 'Mathematical Methods' in the SACE curriculum) was seen as stressful, and a subject to avoid if possible, by the participants because of its test-heavy assessment schedule. This discomfort echoes findings that girls are more likely to perform worse on tests in subjects like mathematics, as they perceive that test reflects their innate mathematical ability, rather than their effort, as a project might do. This belief, coupled with feelings they are not 'naturally' talented in these areas like others might be, lead to feelings of stress which impact their performance — further reinforcing their feelings of inadequacy (Fine, 2005).

Peers: A critical mass

Peers were one of the most influential factors for the participants when making choices about male-dominated subjects. Whether they had chosen not to continue with STEM because they did not want to stand out or be alone in the class, or they had been able to overcome the feelings of isolation and were now in more senior classes where they could focus more on their own achievement and work, all participants had considered friendships and the presence of other girls when they were choosing their subjects. A widely agreed upon sentiment within all three groups was summarised by Mischa's comment, *if there were more girls in STEM, more girls would choose STEM*. Participants felt they stood out in STEM classes, and this would be even more the case if they continued with STEM as a career. This was particularly the case for the students at Lobelia High, whose friendships stood out as more influential in their choices.

As we saw in the previous chapter, the participants in outdoor education made an agreement with peers to ensure they were not alone (as they saw it) in the subject. This was something that one of the STEM participants spoke about also:

Imogen: It was kind of a conversation at the end of last year when we were choosing our electives and I was saying that I wanted to do art tech, but I wasn't sure if anyone

was going to be there doing it with me so I convinced someone to do art tech with me, but they said they'd only do art tech with me if I did digital technologies with them. Those two subjects are very male dominated, so I feel like having experience both of them at the end of the year now has been good.

Ava: In my art tech class, which is a more manly sort of subject, we had two girls in the class and maybe 15 or 16 guys.

Imogen: My parents really encouraged me to do art tech and digital technologies, too.

Ava: Same with my dad.

Willow: I feel like the popularity of classes is based on what your friends are doing or are looking forward to doing. I feel like a lot of people would actually choose different subjects if they were choosing just for themselves instead of their friends.

For the participants, being one of only a few girls in the class in male-dominated classes increased their feelings that the subject was not for them. The feeling of being alone heightened their belief that if they asked a question or needed help that they would stand out. Given they felt that they could not ask questions in class, a lack of support outside of class meant that participants found themselves at a gender derived impasse:

Audrey: If I'm stuck with other subjects and I'm not in class, I can ask people at home or at school and they will be able to help or at least be able to tell me how to get help, but the only place to get help with technology is the technology teachers. It's hard for me... so it's kind of a big leap to jump into something you know you can't get any help with and you're going to have to do it all on your own.

One of the participants' suggestions to alleviate this feeling was a basics stream. The perceived expert/beginner binary in the class, aligning with the female/male binary where boys outnumbered the girls, made them hesitant to ask questions. They saw that a basics stream could develop their confidence and allow them to learn without subjecting them to

the kinds of anxiety that subjects like digital technologies might bring. Whether or not this would be useful, or, indeed, whether girls would choose this option if it was available, is beyond the point. What the participants' suggestions and explorations revealed was that decisions about subject choices were informed by a desire for increased social safety and confidence while preserving coherent identity performances.

The participants thought the answer to increased social safety in STEM spaces was the presence of more girls or peers in a similar situation to them, so that they were not 'alone.' This perhaps indicates more about how safe they currently feel in gendered pedagogical space, rather than it being the solution to girls' participation in male-dominated spaces generally. More-than-human agentic forces, such as classroom spaces, objects and practices, and the connections that they make with and within the subject, are also implicit in their ability to feel socially safe in the gendered classroom. Schools interested in increasing female participation in male-dominated subjects may benefit from considering how they can increase feelings of social safety, not just by connecting students to peers in the classroom, but through a more disruptive approach which rethinks how subjects are gendered and how all students in the subject can increase their feelings of belonging.

The role of teachers

The participants identified the qualities in teachers they felt contributed positively to their experience. While some of the qualities have been explored in the previous two chapters, I highlight here the specific quality that participants felt contributed to their likelihood to choose, or to continue, in male-dominated subjects: the teacher's ability to make them feel safe. This might sometimes have been related to the teacher's gender, but mostly, it did not.

The outdoor education participants, who often worked with more than one teacher or guide on an expedition, thought that having at least one female teacher would make girls more comfortable in choosing to participate:

Maeve: I think if you were given the choice and someone said to you, you can have a female and a male instructor or two males, I think a lot of us would say oh, a

female. That would be good because we get both. We get a female to relate with and someone that will be there for us. You also might have a male there, so it's not like dominant either way. But I feel like having a female there does benefit the way you feel in terms of comfort and safety.

One student from Mangrove High said that she liked the female teacher they had because she felt she was able to make that connection with her, although she was not sure if that was because they were female or because the teacher was just nice:

Chloe: I have a female science teacher and personally I have liked it a bit more. I feel like I could talk to her more that my other science teachers, and I just think she's a bit more accepting of me in science.

As Matilda and Scarlett discussed in Chapter 6, the participants found that the most important thing a teacher could do to make them want to continue with a subject was to accept them and make them feel safe to ask questions and to learn with. This was extended by Maeve and Harlow's description of their teacher being open and vulnerable with them about their own strengths and weaknesses. These examples were not necessarily about the teacher's gender:

Nora: I like teachers and I do better in classes with the teachers, whether male or female, that are just sort of, I don't know, more casual. And they're just a person, you don't see them as a guy teacher or a girl teacher. They are just someone I feel comfortable telling them anything. It is just that sort of comfortable environment where you don't feel judged.

It appears that "strong relationships with adults and with peers are more important for girls' engagement in math and science than for boys" (Fredricks et al., 2018, p. 290); participants identified that having the ability to talk to one's teacher and not feel judged was important for their sense of belonging in all of their educational spaces, but they did not encounter these teachers as frequently in male-dominated subjects. It may be that expected or recuperative performances of masculinity by teachers, whether female or male, in male-dominated subjects created barriers to authentic connections (Cheryan et al., 2011; Kennedy & Russell,

2021; Masri et al., 2025). Participants' experiences largely support the findings that teachers who approach their classrooms with feminist and critical reflection and who cultivate rapport can have a positive impact on girls' motivation and interest (Krämer et al., 2016; Masri et al., 2025).

Classroom approaches to male-dominated subjects

In highlighting the voices of the girls in this study, two key implications for future practice emerge. First, the participants found a sense of belonging when the subject required genuine collaboration to solve authentic, real-world challenges and problems, such as finding a place to camp and arriving on schedule. This practice not only allowed students to participate, but it gave them responsibility and agency to contribute in a way that assumes their belonging in, what has traditionally been, a male-dominated environment. It is important to note, however, that these problem-solving approaches were coupled with an approach that valued and reframed strengths and weaknesses and highlighted communication and empathy. Outdoor education, particularly within the framework of experiential learning, offers possibilities for mainstream classes and educators due to this "habit of systematic reflexivity" (Blenkinsop et al., 2016, p. 354). This foundational element allows space to hear from voices and non-human agents that have traditionally gone unheard, to reflect on inter/intra-actions with the world, and to consider the questions that are needed for cultural change and reflection on one's place within the system (Blenkinsop et al., 2016). These practices felt transformative to the participants precisely because they did not feel gendered, at least not in the same way they were used to experiencing in male-dominated environments. Returning to the vignette at the start of this chapter, we see a desire from those students to be in learning spaces where they are free from gender, which manifests to them as taking up equal space, sitting together. In the act of working together, guided by critical reflective practices, which helped all students to engage thoughtfully in the process and intra-act with their world. Collaborative problem-solving supported by systematic reflexivity and values education could perhaps be a pedagogical tool used in other male-dominated environments to increase social cohesions and feelings of belonging and equality.

A second key implication is the need for an approach which encourages students to critically reflect on and be educated about the ways in which gendered expectations and practices shape their choices and experiences. Pietri et al. (2018), noting that it was important for students to be able to relate to women scientists, found that tertiary students who were taught about gender biases were better able to identify with other female scientists and were more interested in interacting with them in the faculty. Additionally, (Katsantonis, 2024) found that the introduction of justice-centred STEM pedagogies which promoted the sharing of perspectives through intergroup dialogue — in this case between male and female STEM students – could help to challenge inequity and privilege. Critical conversations about gender biases and gendered inequalities led to a greater sense of belonging and it was believed that it would have a protective effect against future discrimination and isolation. The focus groups were asked if they could see any benefit to these kinds of discussions about biases and sexism in STEM:

Nora: Yeah, when you see other women who are overcoming those barriers, you want to be with them in that movement. There is definitely a sense of solidarity.

Maeve: If you achieve in STEM, it's a big deal because you've done it on your own.

Penelope: Or it's common that being a woman is used against us. When you achieve something, people say that the only reason you got that award or whatever it is is because people are just being nice. You're not actually that good, they're just being encouraging to you because you're a girl.

Eloise: I feel like sometimes the language surrounding these issues doesn't reflect how it could be. Sometimes the language makes it feel like the woman is the barrier, but the actual barrier is sexism.

Maeve: So you know, like we're fighting back against it. But if you don't have that education, and that's what you've grown up with, that's what your parents have grown up with, and you're not taught that there could be another way…

Nora: Or you're not exposed to anything else or told you could be a scientist…

Georgia: It's like if it doesn't even occur to you to fight for it, you're not going to be fighting for it.

Engaging in critical conversations and critical consciousness through the location of injustices (Freire, 2021) can foster 'eye opening experiences' and, in turn, provide a greater sense of agency (Kumlu, 2024). The students at Mangrove High discussed the benefits of having conversations like the ones that they had been able to have during the focus group sessions:

Georgia: I'd say that sure, maybe some boys and some girls learn differently, but some girls learn differently to other girls. I know with the girls in our class, we all learn differently. No one's the same, yeah? I learn completely differently from some girls and similar in some ways to some boys. It's just because that's the way your brain works, so it's not specifically gender, it's just that people learn differently.

Florence: I feel like I'm like more aware now that other people are thinking the same thing as me, especially with tests and STEM and sexism and how that is experienced. I now realize that other people actually recognise and feel that as well. And it's kind of surprising how the six of us have all had very similar experiences…

Matilda: I think we're all *very* different people…

Florence: Yeah, really different, but we've had similar experiences because of society and school and things like that.

Matilda: I think it's the same for me. It's made me more aware of some of the sexism that goes on in schools but also all the people who think and feel the same and who have been through the same thing.

Rose: I think if all six of us have experienced the same things, then most people probably have.

The need for critical reflection extended to the discourse of girls in STEM and how schools spoke about girls who participated:

Nora: We need to make it look like there's more women in STEM than we think without drawing attention to it. Because sometimes it feels like when people are saying, 'oh look, there's a woman in STEM', it gives the impression that you're just highlighting one of the actually very few women in STEM and what you're doing is exaggerating the fact and saying, 'look! We have women here – we're not completely sexist!'

Returning to the vignette, Matilda imagined a class where she would learn about adversity. This emerged from a discussion about the ways in which talking about their experiences in the focus group had been helpful to identify the ways gender and gendered expectations informed their experience. Matilda felt that if they had the opportunity to engage in those conversations regularly, it would remind them and others that there are alternative modes and ways of being to engage with. Haraway (Haraway, 2013b) reminds us that "looping threads and relays of patterning" in string figuring is a world-making act, "opening up what is yet-to-come" (pp. 9-10). Talking about theirs, and others', experiences "from materiality and their place in the world" (Osgood et al., 2020, p. 53), in entangled partnership with each other can "prompt or create practical opportunities for those participating in its production – in knowledge-making in action – to become otherwise" (Fairchild et al., 2022, pp. 138-139).

Hands-on activities

The previous chapters have explored the ways in which femininity has come to be associated with passivity and masculinity associated with doing. This has led to the perception that boys need hands on learning to succeed, whereas girls require collaboration and discussion (Fredricks et al., 2018; Pinkett & Roberts, 2019). The students at Mangrove High cited hands-on activities, and the opportunity to be active in STEM classes, as elements which drew them into science in the first place:

Ivy: I'm a really hands on learner, so I hate sitting and feeling like it's a lecture even if I find what's being said interesting. Whenever he wanted to teach a concept, he would get us in the lab and show us and get us doing things. And he would make up his own experiments to explain things to us. He would show us chemical reactions and that's how I understood what a reaction is, or we would cut open a pig's heart to understand how the heart works. It was just a side that I never saw at primary school where they would show you a picture or you would do a worksheet. It just showed us a really fun side of science when we first got to high school and it made me think, 'Oh, if I keep going, I'll get to keep blowing things up and cutting them open.' I thought if I did three sciences and maths in Year 12, I would be getting to do that kind of thing all day. But I think really it was the trust that he had in us. We were really young and probably very immature and occasionally we did get in trouble for not doing things properly, but every time he made us feel like we could do it. I think he really empowered us. I felt like I could actually do it.

Statements like Ivy's re-iterate the importance of feeling safe has. They also have implications for programs and opportunities designed to attract and recruit girls into STEM. There was a frustration expressed by the participants that boys were seen as more hands-on and active than them, and they felt restricted by these perceptions. I suspect that, if we take knowing subjects as deeply entangled processes of becoming, practices which restrict how one intra-acts with their non-human and material worlds lead to a gender enforced separation from knowledge production and a richer understanding of the world. In practice, response-able response to this separation have teachers challenging the ways they think girls interact with their world and fostering opportunities to materially intra-act with their world. The following two sections demonstrate participants' desire for connecting their learning and their self, in ways they had hitherto not had access to because of the gendered nature of their male-dominated subjects, further expressing a desire not for a femininising of curriculum but an ungendering.

Valuing other ways of knowing and other perspectives in STEM

The foundations of modern science established a model of science, which was designed, as it was seen at the time, to embody all the rational, refined and systematic characteristics of the modern, white, well-educated gentleman (Haraway & Goodeve, 2018b; Potter, 2001, 2006; Shapin & Schaffer, 2011). Donna Haraway (Haraway & Goodeve, 2018b) provides the lab report as an example of where scientific processes have been designed to excludes ways of thinking which appear *feminine*. Robert Boyle, often cited as the 'father' of chemistry, developed this style of scientific reporting in the 17th century. While the language of the report is ubiquitous today, for much of its history, this same language was indisputably marked as the language of the white, well-classed, European males it was intended for and designed to preclude others who might taint their pure version of science. It is easy, even convenient to think that Boyle's beliefs and instructions belonged to another more sexist and racist time; however, STEM spaces continue to be associated with male brains, bodies and masculine characteristics, and the knowledge they produce is limited to the practices they engage with. Asking whether there are other ways of doing things is pertinent at this point in history.

The girls in the Lobelia High School focus group, despite wanting to express what they saw as their feminine side, were not looking for a 'feminine' science, but a well-rounded study of the issues and how science interacts with society, history and ethics – something they saw as limited by the current pedagogical practices and tools of STEM. To counter a masculinist version of science, which did not make room for their gender or social identity, they saw a solution in a STEM which did not isolate itself from other areas in its exploration of how the world works. The students found the isolation of STEM knowledge problematic:

Mischa: I think you're always told that you need a really logical head for it, and you need to be thinking straight. I've had it [in a class] where someone will say, but these people will be hurt by this, and the science teacher will actually say, 'you need to have a logical head, you need to stop thinking about people,' and I just sat there and was like, wow, are you kidding? Because you're basically sitting there and

they're telling you to stop thinking about all your emotions and the effects on people and just think about the logic, which is impossible.

Ava suggested there was some merit to learning to balance emotions and logic and seeing the bigger picture. In agreement, the participants discussed the need for learning these skills for future careers, particularly ones like medicine:

Mischa: You definitely need emotions for all decisions, because you're going to need to think about how it's going to make someone else feel and how it's going to affect people, but then too much emotion can sway your decisions. You can't just ignore emotions altogether, because if you start ignoring your emotions, that's when, mental health and illnesses can come into play and things like that...

Ava: And I think, if you are a doctor and aren't sympathetic at all and you're just all about the numbers and the results and you just said to a person, right, you've got this disease and you just don't show any sympathy for them…

Violet: You need to show some sort of emotion for them otherwise you're going to be seen as a bad person. If you can't say, I'm so sorry but this is what's happening, then you're not going to be seen as a good doctor, even if you know everything.

The participants expressed frustration that their science classes, particularly, did not provide opportunities for exploring the context of their learning. In contrast, one participant provided an example of where they had been able to contextualise their science learning in history, philosophy and society and explained how enthusiastic that made them for learning more. For their Stage 2 Research Project, they had chosen to examine HeLa cells, the first cells found to be able to survive and be replicated outside of the human body. Trillions of these cells, which were taken from Henrietta Lacks during a cancer treatment and shared without her consent, were sent and stored in labs and biobanks around the world (Johns Hopkins, n.d; 2010; Nisbet & Fahy, 2013; Skloot, 2017). It was in exploring this contradiction within science — its potential for both great benefit and great harm — that sparked the participant's deeper interest in pursuing science; however, it also made her, and the other participants with whom

she shared her research, frustrated, and in some cases surprised, that this was not something they had learnt about in science:

Eloise: When you learn about this, you realise that science has not had very ethical origins.

Penelope: And this is why science and humanities shouldn't be in opposition. And why philosophy should be part of science.

Eloise: I feel like philosophy might not be part of science, but it should be the root of science because it's how you make things fair and ethical.

Maeve: It's really interesting how the public these days thinks about the Nazi experiments and scientists as atrocities and in the history books we write about Nazi scientists as awful, terrible people. There are a lot of other crimes that are being committed and unethical things, even today, but when we think of science being unethical, we think of [what we learnt in history and] the Nazi war crimes, and it's very tunnel vision.

Penelope: You do quite a lot of ethics as part of psychology, but I don't think I've ever done it in other subjects. Maybe safety, precautions and accurate recording of results? We've never talked about it in bio, and I think that would be important.

Maeve: Like when you do a dissection in bio, there's been lots of incidents where people have been silly or stabbed at the parts, waved them around.

Penelope: We just did one a couple of days ago with a lamb's heart. We just whipped it out. There was no talk about how it should be treated, people just assume that we're 17 so we should know not to be stupid, which is probably true, but there was no talk about whether they were ethically sourced, how they were sourced, how they should be treated with respect. I mean, you had to ask what animal it was.

Maeve: What you do in the science classroom is so different from what you would do as a scientist. When you do pracs and experiments, you're just learning facts and names of body parts. You don't really know what it would be like if you're going to become a scientist or ever think about ethics.

Participants provided other examples such as the teaching about propane in chemistry to cover their molecular formula but left out the history of their use in crimes, protests and accidents as well as the ethical considerations needed to be made in its sourcing, storage and use. Or the financial exploitation of people by pharmaceutical companies and the use of science for profit. The participants passionately shared their knowledge and took opportunities to learn from each other, and their enthusiasm for science and learning was evident; however, they did not feel that these conversations belonged in most of the science education they received, and they had a desire to integrate elements of the humanities and philosophy into their learning.

The participants identified Science as a Human Endeavour (SHE — presumably a coincidental acronym yet a reminder of the gendered inflections of this approach) tasks as a place where this kind of learning is intended to take place in the curriculum. Science as a Human Endeavour is one of the three major strands for Science in the Australian Curriculum from F-12 and at SACE level. SHE tasks are designed to explore the nature and development, and the use and influence of science (ACARA, n.d). The reaction to these tasks was mixed: some participants felt they were tokenistic and the Heads of Science interviewed expressed surprise that students had mentioned them positively; however, one student found that the SHE tasks mirrored in some ways how she preferred to learn:

Nora: I like learning on my own because you get to go into the personalised types of things. It's things more like the SHE task, where you get to pick your own topic and do your own research. Whereas, [normally] in school, it's whatever the curriculum is. I think if STEM was more like SHE tasks generally, where you're given the overall topic and then you get to choose a new invention or finding, and you can decide if you want to do something about new developments in DNA

knowledge or the development of birth control then you can, and it becomes more of a relevant and interesting thing.

Matilda: Well, one of the assignments we do is SHE, which is science as a human endeavor. I would say that science, as an overall subject and biology and all the different areas, they don't necessarily tie them in with real world issues and stuff or how they work in the real world. But I think SHE is quite good. I don't think everyone likes SHE, but I quite like SHE. Because it you get to research by yourself to see… well, you get to choose the topic and then see how it affects you and humans and society. When I did BioMed, I researched a new type of cancer research, which was nano-bombs and I got to see how that technology could affect society and how it could be used to help people and also what its limitations are. I think, as an assignment, SHE is quite good even though it's quite hard.

Zara: Yeah, I think a lot of people when they think of maths and science, they just think of textbooks, but [SHE] kind of makes you see the real-world implications.

Students also saw this kind of thinking available when they had been involved in integrated or project-based units.

Zara: In Year 9, we had a full STEM project that went for the whole term. I think most people found it quite boring, but I actually found it really interesting because it was maths and science together, so the teachers made it really interesting.

Ivy: The space shuttle project? That was actually really good. It brought everything you had learnt about biology and physics and chemistry and then maths, but it was just like a puzzle that you put all together again.

When asked if the participants thought those kinds of projects might help to keep more girls interested in STEM, there was a lot of agreement that they would:

Matilda: Yeah, because I think even if you don't like a particular area of STEM, if you get to put it all together, it's more enjoyable and more diverse. And you also get to do more, so it's more interesting, and you get to learn more as you go along, which I think is better than the normal way of doing it [which is to teach each discipline in discrete units using more traditional methods of teaching and assessment]. How we do it now is fine, but if you don't like physics, for example, you have to do a whole term of physics, and you think, I don't like this. But when you do it all together, you get to work with other people who maybe like what you don't, and so you get to do what you're interested in but you can see it all come together. And it's more engaging and fun, but you also learn off the people in your group. You all share ideas and [the ones who are more interested in other areas] can explain why it works, and you think, 'Oh! I didn't know that!'

A number of studies have explored the benefits of going beyond traditional disciplinary silos and designing a STEM curriculum that is integrated, cohesive and focused on real-world applications, particularly for students who have not traditionally engaged positively with STEM (Hwang et al., 2024; MacDonald et al., 2019; Sahin, 2019; Seo et al., 2023). There have also been a small number of STEM programs for girls which have explored the impact of embedding STEM learning in real-world and humanitarian contexts. One of these programs (Goodyer & Soysa, 2017) was a trial study of secondary school age girls in Aotearoa New Zealand who were given the opportunity to participate in humanitarian engineering workshops. After participating in this trial, girls were more enthusiastic about engineering and more likely to consider it as a career; however, the researchers determined they needed to be more explicit about the link between the work that students were doing and engineering as a career for the intervention to be more effective. While it may be that women are socialised in such a way that humanitarian engineering is more appealing (Park et al., 2021), this kind of situated science appealed more to the participants than the opportunities that they had had to participate in what they saw as a more girly, 'feminised' version of science, as it appealed to their desire for authentic explorations of the world. In considering both examples, it is important to note that situated, embedded, contextualised versions of STEM are not just a tool to increase female participation; rather, they may benefit everyone (Kelley & Knowles, 2016).

Real world applications

A significant topic of discussion with the outdoor education focus group was how outdoor education prepares students for life and encourages new ways of thinking about the world and themselves. Before taking the subject, many of the participants in the group had not realised how much of the learning was focused on issues that were important to them and developing skills and knowledge they could apply to their own life. One of the key issues they had explored, both inside and outside the classroom, was sustainability. Participants shared that it was common practice for groups to empty out their waste at the end of each trip to see a visual representation of how much waste they had generated during that time and to discuss ways they could limit it or deal effectively with the waste they had in front of them:

Emilia: I think the whole sustainability thing, like seeing what you're doing and how you can change it to be more sustainable [is the most valuable].

As in the STEM focus group discussions, these participants enjoyed considering issues, making cross-curricular and ethical links, and considering how to apply it to their lives:

Emilia: [I really enjoy] the research that we do... this time it was National Parks and last time I looked at an issue of hydrology. And just going to places, whether it's with school or with your family or whatever, and seeing the issues that are there and thinking about the possibilities there are to make it better. Just having that thought process behind everything you do in the outdoors.

It has been found that young people who participate in effective outdoor education and skills programs are more likely to become adults with positive environmental attitudes and environmental stewardship behaviours; this is related to the critical thinking skills and real-world application of skills that are fostered through these programs (Cottrell & Cottrell, 2020). For these participants, the experiential aspect of exploring issues led to a greater engagement with their learning and a change in how they see the world.

For students in STEM, careers were a significant part of the real-world implications for the subject and one of the barriers they faced was the difficulty in translating what they were doing in high school STEM subjects to careers in STEM. For the students in outdoor education, motivations to take the subject were unrelated to careers and, apart from one participant, they did not consider a career in an area related to outdoor education:

Isla: I think outdoor ed is definitely an area I would consider pursuing a career in. I've always enjoyed school camps and I've always pushed myself to choose the hardest option. I hadn't talked to anyone about who's doing it, I just wanted to do it because that's what I wanted to do. I knew there probably wouldn't be many girls — in my first semester of it, there were only two other girls — but I didn't really mind. I just wanted to do it because that's what I love doing.

Isla: It's not something you necessarily do to find a career.

Heidi: Yeah, it's not something perceived by society as a proper job, like an office job or a lawyer. I think because it's something that's a bit newer, people don't think you can do it.

Adeleine: I think even if you're not looking for a career in outdoor ed, it's just a good skill set to have for different careers. Even if you know it's not really related in any way to outdoor Ed, it's just like a way of thinking and a knowledge base that you have that you get from outdoor ed. I think that's the useful part.

In a later part of the discussion, Adeleine elaborated on the ways of thinking that she found useful:

Adeleine: I think it's just confidence and believing in yourself. Even little things, like you come across a big hill that you have to hike up and you think, 'oh, I have to do this? Can I do this?' And then you do it, and you think, 'oh, that wasn't so bad!' I've put myself down thinking I wasn't going to be able to do it and then I do, so it leads to more confidence and just a better mindset.

The teacher hypothesised that the long-term effect of these skills came from the real-world consequences that existed when learning in the outdoors, and the participants identified this personal growth as one of the most valuable reasons to choose the subject.

James and Williams (2017) argue that students acquire knowledge best when their learning is immersive, experiential and contextually conceptual, as effective outdoor learning programs do. Outdoor learning also appears to have positive impacts on participants' wellbeing and psychology, such as gaining a sense of fulfilment, resilience, and connectedness (McNatty et al., 2024). In this case, it appears that these benefits have contributed to the participants' ability to focus on skill development, personal growth, and making connections to the real world, to other learning, and to their futures. In another study, Schindel and Tolbert (2017) explored the role that authentic care or an ethic of caring as a theoretical framework can have on challenging essentialist gender stereotypes. With subjects such as outdoor and environmental education conducive to exploring "how structural and sociopolitical contexts shape the ways in which we care for or about each other and the environment" (p. 27) and for examining hierarchical relationships with humans and non-human others, Schindel and Tolbert (2017) found that, by implementing authentic care frameworks, teachers can help students to challenge essentialist positions and gendered stereotypes.

While the participants may not have been able to articulate how the gratification they found in experiences which connected with their world related to gender, it was the contrast of being in a male-dominated subject and finding meaning that encouraged them re-evaluate their experiences in other male-dominated subjects and environments. In these examples, it was not about making a subject more feminine, but authentically connecting them to place, their world, and providing experiences, where caring was an expectation for all students and not gendered coding.

Chapter conclusion

This chapter provides recommendations or explorations for schools who aim to increase girls' participation in male-dominated subjects. It encourages a rethinking, perhaps, of what girls want and offers incursions into how male-dominated subjects may be thought about differently to include non-normative participants through acts of speculative fiction, challenging school practices and embracing an ethics of care. This includes thinking about how to connect learners with the subject, through embedding their learning in their 'real world,' in their futures, and in the context of authentic relationships with their teachers and peers. Critically reflecting on institutional and individual biases about gender and on perceptions of how some learners learn is also critical, as is co-constructing this knowledge with the people who experience the impact of such biases. In this chapter, we see more contributions from the STEM focus groups, as a result of the outdoor education focus group finding it far more difficult to suggest any changes or to identify their negative experiences. There may be a number of reasons for this, including that the participants were pleasantly surprised by their experience, but, emerging from the data, it may also be because outdoor education, at least in the experience of these students, appears to be a subject where there has been a commitment to thinking differently about gender and about how the subject is approached. As Wolfe (2023) explores, it may be that "affirming affective pedagogical events may amplify girls'… capacity" thus establishing "a more affirming and equitable community within all classrooms, but particularly those dominated by the most privileged in society" (pp. 775, 785).

In participatory engagements, insights and analysis emerge from partial perspectives (Haraway, 1988; Pihkala & Karasti, 2022) and "what counts as "truth" is always contingent, contextual, and emergent, dependent on enactments of agential cuts" (Lupton, 2019, p. 1999). Acknowledging that for the participants in this study, their wants and desires are entangled in the knowledge they have *become-with*, the institutions and agentic forces that have shaped their becoming, and the lively discussion in which these thoughts and opinions emerged, the agential cuts I make here produce insights into the areas of their experience where participants feel they needed something different. Ultimately, these expressions of desire were for greater meaning, agency and social safety to be part of their experience of male-dominated subjects. Toohey (2018) writes that, "affect and desire reference embodied learners who are multiply entangled, and who yearn to more fully engage with the world,

rather than remove themselves from it," and the participants as learners in this study certainly expressed, as consistent with Toohey's definition, desire as an "eagerness to experiment, to extend one's capabilities" (p. 942). In thinking about what the research assemblage — event, researchers, instruments, methods, participants, abstractions, matter (Fox & Alldred, 2017) — can offer the research question (Lupton, 2019), it may be that, for schools, the practice of engaging with girls about their experience and co-developing critical approaches to navigating their experiences, as occurred through the process of the focus groups, is a response-able response to the data illuminated in this chapter. Haraway's (2016) notion of string figuring as a practice, of pulling at encounters as one might with knots, can serve to "[remind] us of our responsibilities to reach out, respond, and take action" (Pihkala & Karasti, 2022, p. 105).

Chapter 10: Discussion and Conclusion

The research presented in this thesis advances our understanding of how gendering practices reflects and reinforces gendered ways of participation in male-dominated educational spaces. It challenges conventional narratives and inherited assumptions about male-dominated subjects by centring girls' perspectives and experiences. With the aim of adding to existing research with new ways of telling stories that matter and opening up spaces for critical discussions, I set out to present a rich picture of the lived experiences of a group of girls' navigating gender norms and assumptions read through their participation in STEM and outdoor education. In doing so, the data presented throughout the thesis is far-ranging and can be viewed almost as a series of vignettes which comes together to form a tapestry of the participants' quotidian experiences of their schooling and participation in male-dominated subjects. The data uncovers how feminine identities have been positioned in these subjects as *other*; how these students have been conscripted into narratives of 'girls in STEM' or 'girls in outdoor ed' in ways that separate and define them as antithetical to the hegemonic, neutral male figure in these fields; and how participants' experiences of in/equalities are fluid and dependent on their individual and collective material-discursive-affective entanglements.

While this is not a comparison study of STEM and outdoor education, insights from each case study can be read through the lens of the other, and their similarities and differences reveal aspects of experience in ways that looking at them alone could not. In considering each of the contributions, recollections, and opinions presented through the findings of this research, I take the approach of Wolfe (2022a): "Each pedagogical encounter here is considered as a unique, but connected event, making visible the differential potentials of capacity for affecting and being affected, enabling or disabling bodily action and growth with students that have consequences for matter and mattering" (p.105). If we were to summarise each case study, we might say that current approaches to STEM aim to better engage and interest women, and it is within these limitations and frameworks that the student participants' interpretations and recommendations emerge. Outdoor education, on the other hand, offers potential insights into approaches which disrupt and de-gender male-dominated subjects. In this context, the participants' interpretations and imaginings are also limited by their

experience; however, their affective response to these practices demonstrate that there are transformative possibilities within the approaches and practices that they experienced. In aspiring to be a *modest witness* (Haraway, 1997), this final chapter employs diffractive reading as a tool to fill in those critical details. The modest witness — a figure in Haraway's work who is about "telling the truth, giving reliable testimony, guaranteeing important things, proving good enough grounding… to enable compelling belief and collective action" (Haraway, 1997, p. 22) — avoids *misplaced concreteness*, instead applying critical tools emerging from the intersection of science and society in a practice of *yearning* for "knowledge projects as freedom projects" (Haraway, 1997, pp. 268-269). This concept challenges the masculine-coded scientific ideal of disembodied objectivity while insisting on rigorous accountability for one's partial perspective.

In reading diffractively, or plugging data into theory into data to generate new questions as modelled by Mazzei (2014), I present the following tentative answers to the questions driving this research, with a focus on: how girls interpret their choices and educational pathways, specifically experiences of gender and constructions of difference; how they interpret and perceive their experiences of choice and of exclusion); and the implications for practice, when we acknowledge participants' desire for embedded, real-world, authentic learning and connections with educators.

SQ1: How do girls *interpret* their choices and educational pathways?

As limitations and opportunities to push back

It is not simply that the participants' experiences in male-dominated subjects are gendered, their schooling experience broadly is gendered (as explored by Ingram, 2019). This is reflected in the sentiment participants expressed on multiple occasions that conforming to expected expressions of gender identity, not standing out, and not trying too hard were all necessary for fitting in and for being popular. With participation in male-dominated subjects not being the expected choice, the participants felt they were drawing attention to themselves in a way that might impact them socially. It is an experience of limitation. Without strong support

networks — like the one the girls created for themselves in outdoor education or families or teachers — the structural barriers can be too difficult to overcome.

Haraway writes that there is a need for a theory of difference whose "geometries, paradigms, and logics break out of binaries, dialectics, and nature/culture models of any kind… These things matter politically" (Haraway, 1990, p. 129). In *The Promises of Monsters* (1992), she states that it is difference, rather than identity, that has led to political struggles; consequently, it is the construction of difference where I now focus. Histories of difference are marked on the subject, a subject who is "generated, along with other cyborgs, by the collapse into each other of the technical, organic, mythic, textual, and political [and] constituted by articulations of critical differences within and without each figure" (1992, p. 329). Of Haraway, Braidotti (2006) writes that she "invites us to think of what new kinds of bodies are being constructed right now; that is, what kind of gender-system is being constructed under our very noses" (p. 198). In the data, we can see that educational practices become complicit in this construction of difference.

Further, Butler explores the concept and formation of identity and its limitations. In *Gender Trouble*, Butler (2002) asks the questions: "To what extent do regulatory practices of gender formation and division constitute identity, the internal coherence of the subject, indeed, the self-identical status of the person? To what extent is "identity" a normative ideal rather than a descriptive feature of experience? And how do the regulatory practices that govern gender also govern culturally intelligible notions of identity?" (p. 23). In Butler's notion of the cultural matrix, gender identities which follow the cultural laws that establish and regulate the political relations of sex are deemed intelligible, while those which do not are seen as "developmental failures or logical impossibilities" (p. 24). It is those identities, however, that provide "critical opportunities to expose the limits and regulatory aims of that domain of intelligibility and, hence, to open up within the very terms of that matrix of intelligibility rival and subversive matrices of gender disorder" (p. 24). Identity categories, therefore, become "sites of necessary trouble" (Butler, 2013, p. 14), because, as Jackson and Mazzei (2022, p. 75) summarise, "they are out of control to fully signify; what is excluded always returns to disrupt its meaning."

In taking these two readings together diffractively, and troubling the 'innocence' (Haraway, 2013a, p. 109) of categories to which participants have been assigned through educational and social practices, we find that the pressure and limitations of gendered expectations and intelligibility significantly impact the participants. Intelligible identities in the participants' STEM experience have associated femininity with quiet passivity and 'sensible' approaches to one's appearance. There was some pushing back against those stereotypes — Penelope getting to the point where she could no longer stay quiet and serious in her STEM classes, the desire for hands on learning, the discomfort they expressed with perceived expectations that channelled them into health and caring professions — and these push backs work to disrupt normative ideals; however, it was clear that participants observed their experience as different from the boys and performances of gender identity were largely naturalised. The physical intra-action with movement and space in outdoor education — moving their bodies to power they kayak or getting muddy while sitting in the dirt cooking dinner in a circle with the rest of the group — for example, signalled participants' belonging and was a physical symbol of the disruption of gendered norms in male-dominated spaces.

As spaces, places and objects that come to matter

Here we return to how matter matters by constructing, as Haraway (1998, p. 77) advocates, theories of difference that rupture nature/culture binaries. The participants' embodied histories—gendered toys and outdoor experiences, being positioned outside playground and classroom action while boys actively engaged, feeling unable to ask questions in Year 8 STEM classes, encountering visible histories of women's exclusion from STEM and invisible histories of women in outdoor spaces—carry both cultural and corporeal significance. These material-discursive encounters shape not just how participants think about gender and pedagogical domains but how their bodies come to inhabit educational spaces and what physical-intellectual capacities become available to them. In STEM, we can look at how cognitive differences are (re)produced in the brain/body. As Christine Malabou provocatively writes, "humans make their own brain, but they do not know that they make it" (2009, p. 1). Here, she is referring to the ability for the brain's synapses to grow or decline in volume through practices of use, and for the brain to adapt and modify itself based on experience, education and training. Girls' collective experiences of STEM have physically made their brain through

their unique experiences. This is not to say, as some might, that boys' brains are wired differently and, therefore, they are going to find STEM easier; rather, it is to say that the construction of difference in matter is not inevitable, but it is inextricably linked with the cultural, social, historical and political. In outdoor education, participants' confidence in their body increases with use (Breault-Hood et al., 2017). Ontological entanglements with the other and with matter are not only about knowledge-making. Attentiveness to the being/becoming of self and other is about ethicality and *response-ability* — the capacity to respond while welcoming and enabling the response of the other (Bozalek & Zembylas, 2023). It is critical for schools and teachers to be aware how opportunities they provide can lead to material difference in their students.

In Barad's agential realism approach, matter is not fixed, but a 'dynamic, intra-active becoming that never sits still.' As such, spatiality and temporality must be accounted for in the ways that '"environments" and "bodies" are intra-actively co-constituted' (Barad, 2007, pp. 170, 180). The physical nature of outdoor education and the way participants are encouraged to take an active role in their learning and doing disrupts stereotypes of passivity and constructions of the gendered schoolgirl; agency is produced through intra-activities of *spacetimemattering* (Barad, 2007, p. 178). The conflict between who girls are allowed to be in outdoor education and outside of it has not been erased, and participants are continually navigating opposing expectations and constructions of difference. Experiences of capability, success, and freedom from (some of) the confinements of gender in outdoor education provide points of rupture from the constructions of femininity and popularity that have shaped participants schooling so far. Embodiment of these experiences inscribed new possibilities for being/becoming and from this, the confidence to enact new possibilities emerge.

While entanglements with space — place, nature, intra-action with the non-human artefacts of outdoor education — open up possibilities in outdoor education, space becomes entangled in practices of exclusion in STEM and in descriptions of PE. The contraction of available space becomes a key feature of girls' experience in masculinised environments, as hegemonic performances of masculinity appear to be afforded physical, mental and metaphorical space in the room (I use masculine here to distinguish from the *statistically* male-dominated

environment that the girls in outdoor education experience). Compare Nora's experience of sitting in the back of the room in Year 5 robotics while boys dominate the space and the equipment to experiences described by some of the outdoor education participants of cooking together and debriefing sitting on the ground in a circle. Their position in space becomes another way through which difference is constructed and identities regulated. Intelligible identities of masculinity and femininity in STEM are regulated and logic communicates that these spaces are not for them.

The experience of STEM is different, and constructed as different, for women. Without reference to each other, the STEM participants identified parts of the outdoor education experience as something they thought would help girls be more motivated in STEM — intra-action with equipment, nature and each other through hands-on learning and problem-solving, and contextualised learning. While they did not label it as such, they saw these opportunities for authenticity as ways to construct their different experiences, differently. Response-ability requires us to acknowledge that student capacity for action and agency emerges through intra-actions, where "in/equity is not a dichotomy but a pulsating diffraction that emerges in indeterminate waves as events collide" (Wolfe, 2022a, p. 5). By entering systems of power/knowledge, it creates "inescapable possibility for changing maps of the world, for building new collectives out of what is not quite a plethora of human and unhuman actors" (Haraway, 1992, p. 327). Through experiences of gender and its construction in space, time and matter, identities are regulated; however, some of the experiences described here, to return to the earlier quote from Butler, become "critical opportunities to expose the limits and regulatory aims of that domain of intelligibility." For the participants, inequality was not a feature of all their experiences in male-dominated spaces; constructions of space and place allowed for either more expansive or more constricted limits of these domains of intelligibility. Response-able responses require new and critical ways of thinking about how spaces are constructed and intra-aced with in male-dominated spaces.

As affective forces that guide choice

In terms of the participants feelings around choice, many felt they had the ability to choose STEM, and even felt pressured to choose STEM — either for its association with steady (but not necessarily obvious or exciting) careers or from a pressure to represent. However, in choosing STEM, they had accepted they would be outnumbered and would not fit in. Even the students who had made a strong, conscious decision to *be themselves* in STEM knew that, in doing so, they would be performing identities incongruent with the space in which they found themselves.

This pressure to represent weighed heavily on many of the participants and, as capable, high-achieving students, they were often called upon to represent girls in STEM. Additionally, many of the participants referred to the fact that because they had an opportunity which other women in the past had not, there were also internalised pressure to represent. Upon reflection, I would have liked to have pursued this line of discussion further; the participants seemed to hold the belief they were one of the first generations to have this opportunity and it would be interesting to know if this originated from specific cultural messaging they were being exposed to or if it was simply because they saw so few older women in STEM and assumed that the reason for this was a lack of opportunity. Regardless, the girls felt this pressure to participate, while at the same time, their lack of belonging and other social pressures caused them to withdraw. This conflict meant that while they knew they *could* choose the subject, it came with a lot of baggage, pressure and expectation. As some of the participants said, if you can take an easier option, why wouldn't you?

While the participants were surprised by the extent of their shared experiences, there was also difference between individuals, ages and backgrounds. For example, with less experience and strategies to navigate their encounters, the younger participants in this research felt less confident to participate in these subjects than the older students. The private school students were also more concerned by fitting in than their public student counterparts. The difference in the way the students perceived their experiences emphasises the problem with one size fits all models, serving to remind us that girls are not a homogenous group, nor do they have the same needs or motivations. It also reminds us of the need to listen to the voices of current students while contextualising their voices in the wider research and cultural moment.

The participants in STEM and outdoor education who attended a private school shared common concerns and hesitations related to engaging in activities which were seen as

unpopular, counter to expectations of femininity and of their group, and which were seen as trying too hard. While the experiences of the students in outdoor education had made them question these social norms, generally, the participants in these focus groups were motivated by fitting in. The conceptualisation of 'male subjects' was demotivating for these students, because participation in them signalled a break in social roles and norms, but for the students from the public school, the conceptualisation of male subjects could be a motivating factor, a way to prove they could do the hard and challenging tasks and not take the 'easy option' of feminine subjects. While these experiences were categorised by gender in their experience, it was not necessarily the same experience. There was a shared acceptance that subjects were gendered, but their experience of gender was constructed by narrower institutional discourses and cultural norms, and classed expectations.

The heightened discourse of 'girls in STEM' in the private school context was well-intentioned but it established new meanings of girls in STEM which came to play a role in defining girls' experience. Foucault (1979) writes that where subjects of exercised power once remained hidden, disciplinary power requires subjects to always be, and be able to be, seen. This becomes a "mechanism of objectification" (p. 201) where objects can be arranged according to an established order. Subject positions with increased visibility can allow increased surveillance, regulation and self-regulation (Jones, 2015). For these participants, experiences of girls in STEM encouraged them to participate in STEM while conforming to particular feminine STEM identities. Most of the participants saw what was being offered as a separate imitation, where possible identities were confined to limited configurations while the 'real science happened somewhere else.' This all occurred within a field which they did not identify with; consequently, offering the possibility of existing in this limited, but too visible way, did not serve to motivate them. This experience was contrasted with those of the Mangrove High students who did not feel the universalising phenomenon of the 'girls in STEM' discourse. When they had participated in programs designed for girls in STEM, they had appreciated the opportunity to access women scientists who were passionate about their work. This suggests the importance of providing opportunities which are not based on an assumed woman in STEM or their gender coded preferences, but ones which foster authentic connections with meaningful science work and the women who do it.

Acceptance of social and gendered practices and norms also limited what the participants were able to notice. Scott (1999, p. 63) writes that "without meaning, there is no experience" and that symbols, metaphors and concepts play a powerful role in defining human experience and personality. While the teachers and leaders implemented many of Warren's (2019) suggestions to counter the impacts of the hidden curriculum, such as facilitating dialogue, implementing an ethics of care, and modelling non-gender stereotypical behaviours, participants' experiences were highly gendered in ways that they had, until the discussion, been unaware of. That they had not really noticed their teachers and guides had *pretty much all been male* suggests that the existence of men in these domains had been naturalised, so much so that they were surprised by the existence of others. In this way, participants/ perceptions of their experience as reasonably gender neutral and equitable was different from their experience where they were significantly underrepresented in terms of the gender composition of participation. The difference in the experience of girls in outdoor education to those in STEM, who were also outnumbered, is that they were encouraged to deconstruct their experience and their beliefs about belonging and their identity and ability in the subject. Most significantly, when we read the experiences of the girls in STEM and the girls in outdoor education, we can see that the perceptions of their experiences have an impact on the way they feel about the subject and their self-constructions of identity.

At this point, I turn again to Haraway (1988); I read the above reflection on experience through Scott's conceptualisation through the lens of situated knowledges. Rather than being trapped by the "tempting dichotomy" of two poles (science and experience) when it comes to objective knowledge production (Haraway, 1988, p. 576), embodied objectivity or situated knowledges acknowledges *both* subjectivity and vision as multidimensional. It argues for 'politics and epistemologies of location, positioning, and situating, where partiality and not universality is the condition of being heard to make rational knowledge claims' (p. 589) and difference to be biologically theorised as situational not intrinsic (p. 594). A partial situated account of the experiences described by the participants and the construction of experience generate new ways of thinking about a student's freedom to choose their pathway. It is clear the participants did feel significant barriers and limitations in their choice; however, it is in the questioning of seemingly objective knowledge that there lies some freedom. Even in the short sessions, co-constructions of knowledge through critical practices and questioning

provided new possibilities for affective responses of belonging. This research illuminates how partial, situated knowledge production through critical collective dialogue created momentary ruptures in naturalised gender constructions, allowing participants to recognise previously invisible patterns of exclusion. These findings suggest that educational interventions must move beyond universalizing approaches to gender inclusion, instead attending to the specific material-discursive conditions that produce differential experiences of belonging across educational assemblages.

As part of a bigger picture

Finally, although there is hope for the constructions of difference that lead to barriers and limitations to be challenged through critical practice and acknowledgement of the partiality of experience, the participants linked their experience to that of boys who are bullied in, or feel they are unable to choose, 'female subjects,' believing that nothing would change for them until it all changed. The narrative of girls in male-dominated subjects exists within a cultural framework that is based on rigid, persistent binaries. The participants articulate the existence of the inverse: boys face discrimination in what have been determined as feminine subjects, an inverse which reinforces hierarchical gendered matrices and what is determined as valuable. In 1969, Firestone (2015) noted that the gains that women had made throughout history took place within the systems and conditions that produced the oppression and that 'within such a repressive structure, only a more sophisticated repression can result' (p. 57), leaving women to wonder why they had won revolutions, but still felt unsatisfied in ways that were inarticulable. This feeling is present in the focus group sessions. Participants knew they were 'equal now' but found it difficult to articulate what that looked like. Where Staley (2018) might advocate for a disruption of master narratives, Firestone calls for nothing short of dismantling the entire 'superstructure' would be adequate. Firestone developed a three-strata dialectical model which addressed sex, class and cultural binaries, where "culture develops not only out of the underlying economic dialectic, but also out of the deeper sex dialectic" (p. 171). In Firestone's conceptualisation of culture, the technological mode (the empirical sciences) is divided from the aesthetic mode (arts and humanities). Firestone argues that the technological mode has evolved to a pre-revolutionary stage — as 'capitalism

intensified the worst attributes of patriarchalism' (p. 166), so has it done for the sciences, which grew out of the bourgeoisie, developing its method in order to 'amass knowledge for development of modern industry only in order to amass capital' (p. 163). This association with the bourgeoisie, and its mechanistic method of objectivity, and over-precision, sees this technological mode developed from the 'male principle.' Donna Haraway (Haraway & Goodeve, 2018a) fleshed out this argument, with an examination of how the scientific method is built on the principles and uses the language of the rational, well-classed gentleman. Robert Boyle, who is credited with developing the structure of the 'prac' or lab report, associated any emotion with weakness and a lack of modesty, feminine attributes that had no place in the sciences, and as such, no part in the scientific process. He developed a process to ensure a limited and confined objectivity was adhered to by using repetitious and limited processes, only describing what is strictly observable, rather than contextualizing that understanding in its impact, scientifically, politically socially or historically. Firestone advocated for a breakdown of cultural categories, suggesting that the elimination of the sex dualism that form the origins of the cultural division, and the 'reintegration of the male (technological mode) with the female (aesthetic mode), [would create] an androgynous culture surpassing the highs of either cultural stream, or even the sum of their integrations. Otherwise, scientists are doomed to simply replicate and rehearse social inequalities and capitalistic functions, and be, in her words, nothing more than a 'cultural technician.'

Social and philosophical examinations of schooling have, as Firestone's critique, been 'studying the operation of institutions only within the given value system, thus promoting acceptance of the status quo' (2015, p. 63). Ball and Collet-Sabé (2022) returned to this question in an epistemological critique of the school, pointing out, in the tradition of Foucault, that the school itself is by nature a normalising institution; efforts to make schools more inclusive, which have been the focus of significant research and pedagogical efforts, seek "another version of the same thing" ultimately delivering in "new and old ways, division, exclusion, normalisation, and categorisation" (p. 987). The reinforcement of binaries and norms (in this case gender) in schools through a hidden curriculum which universalises a specific vision of an ideal student is instrumental in maintaining the status quo. Repetition and rehearsal of preconceived gender identities, enacted in response to expectations and the

imaginary other (Butler, 2004), are naturalised and in turn, naturalise gender inequalities and renders alternatives unthinkable. Constructions of gender in schools may seem inevitable, but unless we pull at these gendered knots and engage in practices which think otherwise about the way it has always been, we will continue to work within the given value system and wonder why nothing is really changing. By challenging the apparent neutrality of educational structures and practices, we might begin to imagine pedagogical encounters that enable more expansive possibilities for becoming-with in STEM and outdoor education beyond the limiting binary configurations that currently reside in the foundations of male-dominated subjects.

SQ2: In highlighting the voices of girls, what recommendations can be made for future practice?

As identified in each of the three findings chapters, the participants expressed a desire for social safety and, primarily, their recommendations focused on actions they imagined would lead to increased feelings of social safety and belonging. The extent to which teachers, and the authentic connections the participants made with teachers, became another hot spot, whose narrative thread throughout the data glowed with meaning, reflecting potential for creating transformative experiences.

Teachers and schools have a place in liberatory experiences. Teachers and role models who implement practices for co-constructing knowledge about the world, who critically reflect on one's place in the world, and who take opportunities to connect with the students' identities and worlds can help to challenge divergent gendering practices. As Freire writes, "what is really essential in this process is that both the teacher and the students know that open, curious questioning, in speaking or listening, is what grounds them mutually — not a simple passive pretense at dialogue. The important thing is for both teacher and students to assume their epistemological curiosity" (Freire, 1998, p. 81). The work of critical pedagogues presented in this section further supports the need for epistemological curiosity and the recommendations which the participants expressed.

While discussion of positive role models is prevalent in the literature, it was the desire that each group expressed to *connect* with their teacher and with their learning that was significant; discussions of role models, whether school, family-based or experts in the field always returned to a sense of connection. The part of this which intersects with the benefits of positive student-teacher relationships is not new, and many studies have explored the role of positive student-teacher relationships in providing the psychological safety and support required for students to be active in their learning and resilient in facing challenges: in STEM (Burns et al., 2022; De Loof et al., 2021; Morrison et al., 2021); for engagement more broadly (Hofkens & Pianta, 2022; Klem & Connell, 2004; Pianta et al., 2012); and for disengaged students or those with challenging behaviours (McNeilly, 2019). However, there is limited, but recent research that has also found that teachers are hesitant to be vulnerable in the classroom as many have an intuitive and learnt belief that it is more appropriate and professional to show strength and confidence in the classroom; however, those that do elicit student trust and model self-reflection and problem-solving skills (Lai et al., 2024; Romney & Holland, 2023). This study contributes to this literature, demonstrating the motivating effect it has on students as well as its potential for contributing positively to a sense of belonging for girls in male-dominated spaces.

While a number of studies explore teachers' gender stereotypes in STEM (Zhou et al., 2023), their implicit and explicit role in perpetuating gender discrimination (Rogers et al., 2021), and teachers' effectiveness as role models (Starr & Simpkins, 2021), the students in this research saw the potential for their relationship with their teachers, and the vulnerability and passion they had for their subject, to be both motivating and an aspect of their experience which protected them from the structural and explicit barriers they faced. Their discussion about teachers who had a positive impact was not the result of being asked about their teachers; rather, they were asked about aspects of their experience that were positive, motivating and helpful – it was in this context that they spoke at length and repeatedly about the role teachers had in encouraging them to continue with the subject, to help them feel safe and a sense of belonging in a male-dominated space, and to motivate them through their passion and enthusiasm.

Where outdoor education differed, and perhaps contributed to further recommendations for practice, was in a pedagogical and philosophical approach which formalised practices of relationship building, self-reflection and inclusivity. The students spoke about specific, individual STEM teachers who had made an impact and who stood out as particularly passionate or who they trusted. When speaking generally of their STEM teachers, however, they believed they were excellent at what they did, but — as found in other studies (Tidemand & Nielsen, 2017) — their STEM teachers were primarily focused on subject content and curriculum delivery. They felt that this environment, with its seemingly neutral practices, did not do enough to compensate for, or counteract, their feelings they did not belong nor challenge practices of exclusion. However, in speaking with both the focus group and the outdoor education leader, it seemed opportunities to develop these relationships developed informally, and also through structured debriefing and a commitment to external processing of one's learning, thinking and approach to challenges. Participants identified a number of factors influencing and motivating their choice to participate, and continue their participation, in outdoor education, notably related to the connections they made and the ways they came to think differently through their participation. These choices are troubled by gender, but these connections, ways of thinking, and pedagogical approaches to outdoor education have helped to ameliorate the impacts of those complexities and tensions they navigate. The ability that educators had to foster that sense of belonging simply by developing relationships and sharing their own vulnerabilities was surprising, and this has potential implications for teachers outside of outdoor education. In encouraging self-reflection and challenging students to engage with new modes of being and becoming (fast/slow, active/passive, masculine/feminine), the teacher and group leaders were able to contribute to this process and to changing the students' narrative they held about themselves and the subject. Rather than focusing on barriers and withdrawing, the participants' approach to challenges became one of growth and of the journey. Debriefing opportunities helped them to reflect on that progress, solidifying the journey of transformation and helping them to apply that growth back in the real world (Evans & Acton, 2022). Gray (2019) argues that effective outdoor education leaders create opportunities for interpersonal connections and for developing communication and empathy skills and psychological resilience. The challenge she identifies is how to communicate the value of those experiences and embed them in the

school's values and practices. The challenge I add, in highlighting these positive experiences, is how to translate these practices meaningfully to other domains.

Another important finding is the impact of a teacher who engages with critical thinking around gender on the motivation of girls in male-dominated spaces. The focus groups (one in STEM, the other in outdoor education) spoke of two specific male teachers who had motivated them; both were interviewed and shared they had reflected on their role in perpetuating gender stereotypes and inequalities and had made a commitment to deconstructing their own gendered behaviours and gender stereotypes in their practice. This would suggest that teachers who show vulnerability, translate critical thinking about inequalities into their classroom, and who create a safe environment for students to share their processes and challenges can have a positive impact on the nature of gendered participation in their classrooms.

Similarly, it is not new for conversations about educational practice to include calls for real-world authenticity and to demonstrate its role in engagement and motivation; in fact, John Dewey wrote that "before teaching can safely enter upon conveying facts and ideas through the media of signs, schooling must provide genuine situations in which personal participation brings home the import of the material and the problems which it conveys" (Dewey & Hinchey, 2018, p. 248). These calls for authenticity are often contextualised in problem-based learning (Laur, 2013), 21st century skills (Stanley, 2021), and assessment and future work integration (Ajjawi et al., 2024). Nachtigall et al. (2024) writes that authentic context-based learning experiences are more complex than traditional learning environments, but when implemented with sufficient instructional and socio-emotional support, they are likely to stimulate "positive motivational and emotional reactions" (p. 3483). Güth and van Vorst (2024) explains that the role of authentic, context-based learning in science education is to connect learning concepts to the real-world and to stimulate situational interest through the provision of choice. In doing so, it demonstrates why it is necessary to learn about science and provides students an opportunity for congruence with their personal values and interests, both resulting in higher student motivation.

Whether or not this translates to motivation in practice, the participants believed this kind of learning would engage them in a way that was meaningful to them. What is unique to this study is the student's articulation of their learning needs as one of the solutions to addressing the male-dominated nature of their learning environment. As mentioned earlier, if science teachers do engage with socio-scientific issues, they are likely to reduce issues to their scientific content. This can be due to curriculum demands and additions to the curriculum being burdensome, a lack of confidence in their knowledge of the issues and in their ability to respond to questions and to handle discussions, and the more ambiguous nature of assessment (Tidemand & Nielsen, 2017). It should be noted that the heads of science were both surprised that the participants expressed surprise that students wanted more of this, as they often did not enjoy parts of the curriculum which explores socio-scientific issues or those that were more project-based. It may be that the challenges for teachers in addressing issues meant they were looking for more genuine choice and engagement with the issues.

For the participants in outdoor education, their interests and their interactions with place and their environment drove their explorations. While the teacher supported them with parameters, the geographical, environmental and technical content knowledge, and building their research and writing capacity skills, the student and teacher co-constructed an understanding of the issue as their knowledge and inquiry evolved and the teacher did not need to know everything. By working through this process, they were able to develop a better understanding of their world and spoke about how they noticed those issues more as they went about their daily lives.

Returning to theory, Biesta (2017) argues that there is a role for the teacher in emancipatory education. A key step in the process of emancipation is demystifying the workings of power and of ideology — it is only when we have an awareness of how power works and how our consciouses are socially constructed can we begin to liberate ourselves and others. Biesta writes that the modern logic of emancipation requires an outside intervention, in the form of a teacher who, for example, knows more about the conditions of the student, but is not subject to the same workings of power; however, this logic creates "dependency at the very heart of the act of emancipation" and creates a false hierarchy based on the idea that the emancipator has some kind of objective knowledge (p. 55). According to Biesta, these

problems with modern logic, a logic underpinned by Freire's conceptualisation of banking education where students are receptacles for knowledge to be *banked*, are why Freire is not aiming merely to free the oppressed from the oppressor, but focused on "liberating them both from the inauthentic and alienated way of being in their linked identities of oppressor and oppressed" (p. 56). The answer for Freire lies in *praxis* or *teacher-as-fellow-inquirer.* To achieve this, it is necessary to "trust in the oppressed and their ability to reason" (Freire, 2005, p. 66), for "apart from inquiry, apart from practice, individuals cannot be truly human" (p. 72).

Despite significant efforts to address inequalities, education for girls today continues to be gendered, teachers continue to promote stereotypes, and students feel 'extreme pressure' to conform to gender stereotypes (Skipper & Fox, 2022). Social media and political influences have contributed to an antifeminist backlash, worsening, rather than improving, the situation for young women in recent years (Iñigo et al., 2024; Roberts & Wescott, 2024; Wescott et al., 2024) The participants expressed a desire to be free from gender confines and to engage in meaningful learning that helps them to demystify the processes and powers that shape their experience.

This lengthy, but important quote from Maxine Greene (Greene & Macrine, 2020, p. 84), does an excellent job of summarising many of the feelings that the participants had about their learning:

> *Situatedness; vantage point; and the construction of meanings all can and must be held in mind if teachers are to treat their students with regard, if they are to release them to learn how to learn. Their questions will differ, as their perspectives will differ, along with their memories and their dreams. But if teachers cannot enable them to resist the humdrum, the routine, or what Dewey called the "anaesthetic," they will be in danger of mis-educative behaviour, ending in cul-de-sacs rather than in openings (Dewey 1931, p. 40). If situations cannot be created that enable the young to deal with feelings of being manipulated by outside forces, there will be far too little sense of agency among them. Without a sense of agency, young people are unlikely to pose significant questions, the existentially rooted questions in which learning begins. Indeed, it is difficult to picture learner centred classrooms*

> *if students' lived situations are not brought alive, if dread and desire are not both given play. There is too much of a temptation otherwise to concentrate on training rather than teaching, to focus on skills for the workplace rather than any "possible happiness" or any real consciousness of self. Drawn to comply, to march in more or less contented lockstep (sneakered, baseball-capped, T-shirted), familiar with the same media-derived referents, many youngsters will tacitly agree to enter a community of the competent, to live lives according to "what is."*

The participants were not able to articulate a connection between the feeling that schools were not providing them opportunities to construct situated, meaningful knowledge about the world they experienced and the feeling they were not being included or *regarded*, yet they had a feeling that the abstract curriculum, which they found difficult to relate to their lives, was indeed part of their gendered experience of the subject. For them, learning devoid of situatedness did lead to cul-de-sacs, ultimately resulting in many of them walking away from subjects entirely. They wanted to ask questions and explore, both STEM and their place in the world, but were not really sure how. And while they were frustrated by many of the barriers and inequalities they witnessed, they had, for the most part, accepted the status quo.

Teachers who are vulnerable and are fellow-inquirers, passionate about their learning, can help to build trust in students and can help girls to break free of some of the limitations of gender — here, we can contrast the example of Audrey who did not want to put her hand up to ask a question because she did not want to stand out when it seemed the boys understood with Scarlett who said she could learn with teachers to whom you can ask questions because you feel safe. While outdoor education-style debriefing sessions may not always work in an inside classroom, practices of explicit and external processing of challenges and barriers help individualise strengths and weaknesses and reduces stereotypes. Learning situated in social and planetary issues can assist students to feel regarded or respected. And finally, explicitly teaching critical thinking about stereotypes, barriers, and the 'feelings of being manipulated by outside forces' may be useful to counteract some of the systemic barriers that girls face. While students in the focus group saw these kinds of discussions as beneficial, and some advocated for them to be formal lessons in their schooling, these can also occur through involvement with external role models, like the female guides in outdoor education or the

women that the Mangrove High students met in their university visits. While individual teacher practices cannot alone dismantle systemic inequalities, this research demonstrates how educational assemblages might be reconfigured through pedagogical approaches that foster liberatory connections—creating opportunities for young women to question established norms, develop critical awareness of power structures, and imagine new possibilities for themselves beyond the limitations of gender. Ultimately, this work calls for educational practices that move beyond token inclusion toward fundamental transformation of the conditions that shape how and what students can become.

Summing up the research questions:

In the data, we see a profound anxiety present which permeates girls' experiences. Gendered lenses shape not merely their participation in male-dominated spaces but their everyday thoughts, actions, and embodied presence at school. Through applying new materialist feminist and posthumanist theoretical tools, the findings illuminate how possibilities for young women emerge through complex image assemblages — memories of what they have witnessed, future imaginaries, and encounters with others — that mediate truth while obscuring the human and non-human forces producing these images. Latour (2002), in his study of images and of science, complicates the image and its reflection of truth. In quoting Marie-José Mondzain, "La vérité est image mais il n'y a pas d'image de la verité" or "truth is image, but there is no image of truth" (p. 2), Latour (2002) explores the role of the image to mediate truth. He explains that human hands are not shown in many sacred icons, as to show the human hand reminds the viewer of the work the human hand did in creating the image and weakens the image's claim to truth. He argues that the same is true of science and the "images that create scientific objectivity," asking the question of the image in art and science, "What would happen if, when saying that some image is human-made, you were increasing instead of decreasing its claim to truth?" (p. 7). In reading diffractively, we look for patterns of interference — we take the image and look for the work that has gone into creating it.

When read diffractively, the resulting account reveals the complexities the participants have been required to navigate, often without having the language or the opportunity to articulate the contradictory pressures they felt. Uncovering the human (historical, social, political)

influence in the creation of these images — or testing whether these images hold up or fail to hold up in situated worlds — is a materialsocial practice upon which truth-telling is contingent (Haraway, 2023, p. 166). In aiming for truth-telling, the data reveals the ways in which the human, and the non-human, influence girls' motivations, choices and participation in male-dominated subjects. Returning to the concept of stuck places, and in troubling the hot spots and images emerging in this data, we can see that the factors and forces which shape experience occur on multiple, deep and sometimes hidden levels — knots within knots; however, ultimately, the result is that girls come to be constituted and excluded in such a way that limits and impacts how they feel they can participate in these subjects. In yearning for *this knowledge project to be a freedom project*, the application of critical tools of new materialist feminisms and posthumanist theories open up new possibilities and epistemological curiosities for thinking about experience, where limitations and exclusions are located, and how, as response-able researchers, readers and educators, we can enact new lines of flight and practices that shift and disrupt current trajectories.

In opening up this space, opportunities emerge from the findings for transformative material-discursive-practices: to ensure girls are able to intra-act in meaningful, authentic, shared ways with STEM and outdoor education spaces, places, artefacts and objects, allowing them full access to become-with their world; to engage in collaborative, reflexive practices which foster new ways of thinking about individual strengths and weaknesses and which challenge students to consider their intra-active presence and their response-ability to support each other in classroom assemblages; to challenge the continued masculinisation of spaces, curriculum, practices, representations and language; to resist attempts to feminise learning or falsely empower but rather embed learning in the world of the learner, a world which is not just for a singular vision of an ideal student but of students with frayed identities; and to foster meaningful connections built on trust, authenticity and passion for the subject.

Implications of the research design and the nature of experience

This thesis presents the perspectives and voices of 29 girls and 3 teachers with experiences of STEM or outdoor education. Returning to theory, in Joan Scott's (1991) conceptualisation

of experience, she challenges the framing of evidence as “uncontestable” and an “originary point of explanation” (p. 777). When analysed in this way, she is concerned that accounts of experience naturalise, rather than question, difference by taking the identities of those documented as self-evident: “The evidence of experience then becomes evidence for the fact of difference, rather than a way of exploring how difference is established, how it operates, how and in what ways it constitutes subjects who see and act in the world” (p. 777). In a 2014 interview (Hesford & Diedrich), Scott explained that her doubts about evidence being self-evident led her to important questions, such as, what is included and excluded by the use of the term experience? and, how can the impact of experience on individual psyches be measured?

In reading the data through theory and this conceptualisation of experience, additional new questions emerge related to experience, perception of experiences, and the universalising of experience. What factors, for example, might trouble the accuracy of the experiences reported in this work? How might the participants’ perceptions of their experiences be different from their experiences? How does language (discourse) establish meanings and limit the interpretation of their experiences? Can we make any assumptions that those experiences or even the perception of those experiences are directly linked with participants’ choices, and how can we capture the impact of that relationship?

The institutions of schooling and science further gave authority to the terms of sexual difference. In schools, gender is (re)produced through policy, social and cultural norms, curriculum, spatial arrangements and peer group relations (Ingram, 2019). Science has been used to legitimise these (re)productions; this is reflected in the biological essentialism of the characteristics associated with masculine and feminine subjects. Contextualising the participants’ sharing of experience in Scott’s critique of experience, how the participants interpreted their experiences, and consequently, the resulting analysis, can be limited by the very systems which produced the in/equalities; any contribution that was shared in the focus groups was thence preconditioned by available discourse, established meanings and pre-determined organising categories. Despite these limitations, the nature of the focus groups meant that variations in experience were presented, which encouraged participants to reflect upon and discuss how those differences were produced. The presentation of existing research

and theory additionally gave them some language to critique their own experience. In these tensions, new ideas, and differences, they were able to find some slack within those boundaries to test and hold up their own experience to light. In future research, there may be some benefit in extending the research methods to include observations, particularly to account for interactions with the more-than-human and for further insight into the material conditions which shape experience.

There is also the problematic binary inherent in this research. It is intended to critique the male-dominated nature of educational spaces and the navigation of those spaces for those who do not traditionally adhere to such performances of masculinity; however, the discourse of 'girls in STEM' and the demographics of the participants who accepted the invitation to participate created a focus on girls in these disciplines. There are gender and racial identities that have been excluded from the wilderness and from STEM requiring significant attention and not explicitly present in this research. While there is some excellent scholarship emerging in this area particularly in regards to race, to queer STEM identities, and in higher educational contexts (Burns et al., 2023; Friedensen et al., 2021; Kairns et al., 2024; Leyva et al., 2022; Nash & Moore, 2024; Voigt & Reinholz, 2020), there are also gap in understanding the experiences of secondary school-age students and students from diverse backgrounds, including Aboriginal and Torres Strait Islander students, those from rural area, and students from low socioeconomic backgrounds. Without genuine collaboration between researchers, students, and teachers with lived experience in the development and conduct of this specific research project, I feel that some of those stories are not mine to tell. Findings from this research may be useful in other contexts and for other identities; however, it is limited to the group of people represented in the data.

Young men's experiences would provide other perspectives in the research. Young men's experiences of STEM are underrepresented in the research, which is further evidence of their natural, accepted place in these domains — their participation is not a phenomenon to explore — however, many young men do not identify with STEM or physical domain stereotypes (Jaremus et al., 2024), and, for a healthy and scientific literate population, it is also important to support and understand their lack of participation. It is also necessary to understand the experiences of young men in STEM as, like one of the participant's male peers

described in this research, things are not always as they seem, and their experiences contribute to a deeper understanding of how the naturalisation of binaries occur.

It may appear in reading this thesis that outdoor education is a paragon of educational excellence and a model for deconstructing the male-dominated and binary nature of educational institutions; however, while the experiences of girls' described here provide many insights, the reality is that students with the same teacher in the same school may have vastly different experiences, and the experience of outdoor education for these students is unique to time, place and context, as is that for the STEM focus group participants. There are, I am sure, schools who are delivering different approaches to STEM, although it has been some time since I have come across one; had we been able to work with students from a school like this, we may have had different results. Related to this, it would be useful to conduct research at sites that emphasises STEAM (science, technologies, engineering, arts and mathematics). This may give some insight into how impactful integration can be on breaking down some of the gender binaries and exclusionary gender practices.

Finally, as a researcher/educator, I am part of the research assemblage. I was surprised by the extent to which configurations of masculinity and femininity guided participants' experience and their choices. In a 2012 interview, Barad explains that in diffraction, objectivity in research is not about "offering an undistorted mirror image," but it is about "accountability to marks on bodies, and responsibility to the entanglement of which we are a part" (Tuin & Dolphijn, 2012, p. 52). I wonder how much by own ignorance and unwitting performances may have contributed.

To conclude...

In the final focus groups, I asked students what a world would look like that did not create the kinds of barriers, pressures and expectations they experienced. In the spirit of situating myself as researcher/participant/educator, I kept a journal throughout the data collection process. Here, I bring my reflections and the student's contributions together in a work of *SF,* a craft tool for repositioning the world, a 'means of moving within and through a relentless

artifactualism, which forbids any direct si(gh)tings of nature, to a science fictional, speculative factual, SF place called, simply, elsewhere' (Haraway, 1992, p. 295).

This narrative intends to bring together the experiences of the participants, their speculations and their articulations of the trouble — a work of co-construction. It acknowledges the narrow definition of STEM that reduces learning to a shadow of what it could be; we live on a land with a deep and rich history of science, knowledge and understanding that is missing from the classroom and we miss opportunities to contextualise learning in such a way to make meaningful and unexpected connections. It considers the creation of material difference through our interactions with the human and non-human, and draws on Haraway's *Cyborg Manifesto (2013a),* questioning what it means when technology as extension of self does not reflect one back. Finally, it acknowledges our body and brain's capabilities. Neural pathways grow and are pruned by interactions with the world, and we become richer through access to those interactions:

Bodies of light

The light wrote itself onto their bodies. Each surface, each other, each moment had its own quality of light that marked itself with varying intensities on the bodies existing within the space. Atlas picked up bits of light as they walked through the room, some constructive interference amplifying the intensity with which they were marked, some destructive interference creating patterns of shadow. Each creating Atlas' shape. It was important to acknowledge the light that existed before they had arrived, before this place of learning, before the patterns and shapes that they had come to be created through different movements and diffractions. Then, there was a different way of understanding light. Not an understanding that had evolved to particles and waves, but one that infused the land with strength. A thriving luminosity infusing the space that Atlas moved through. With each step, the bounce and motion of Atlas's foot created kinetic energy, joining with the other footsteps in the room, harvested to power the light that someone in another space and time would read, coincidentally, about Henrietta Lacks.

Atlas' exploration for the moment was kinetic energy, to discover how what they could learn could be used to improve the world, but for who? They thought. Linear narrative formula is a colonial by-product. Atlas picked up the objects to play with, to explore, looking around at the others engaged in similar activities, but exploring their own path until now. Observing River lift the first metal ball of a Newton's cradle letting it fall, Atlas noticed the light marked on her hand by the ball and the shape of light slightly shift in River's being as they figured out the relationship between mass and velocity.

Atlas felt like doing things differently today and set out to trace the genealogy of knowledge, wanting to understand how knowledge was constructed. Atlas frowned. Technology, an extension of being, only reflected violet light, but Atlas looked down and only saw reds and yellows and some patches of green.

People with violet or indigo light, they're better at this stuff, they have a higher frequency, more energy, said Nova, reflecting blues and patches of indigo and violet in shape.
Why do you think that is? asked Noah, the teacher. What do you think the benefit of longer wavelengths or lower frequency waves might be? What is beautiful about orange or yellow light? Or all of the colours?

Andromeda, whose noticed the conversation from within the space. Look, they said. You can always get some violet. Andromeda picked up a rubber band, some straws and some skewers, some old CDs that had been kept for this purpose and made a makeshift wind-up car. Herschel, who was standing next to Andromeda at the time, lent over to help with the figuring out of how the rubber band was wound or which bit went with which other bit. With each piece touched, the violet grew and spread within their being, and a light flicked on when they figured it out.

I've noticed that the colours of who we are change as we interact with each other and with things, said Andromeda. But the longer wavelengths give time to think more deeply, to put into perspective, to reflect on who we are.

That’s really interesting, Andromeda, said Noah. So do you think we could add some other colours to what you just learnt, Andromeda and Herschel? And do you think we could find other colours in the technology, Atlas? Maybe we can change the algorithm with our looking so that next time you’re looking or someone else is looking it reflects more of who we are? Or maybe we can figure out how to write it in or one day be the colour that the technology reflects? What do you think?

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