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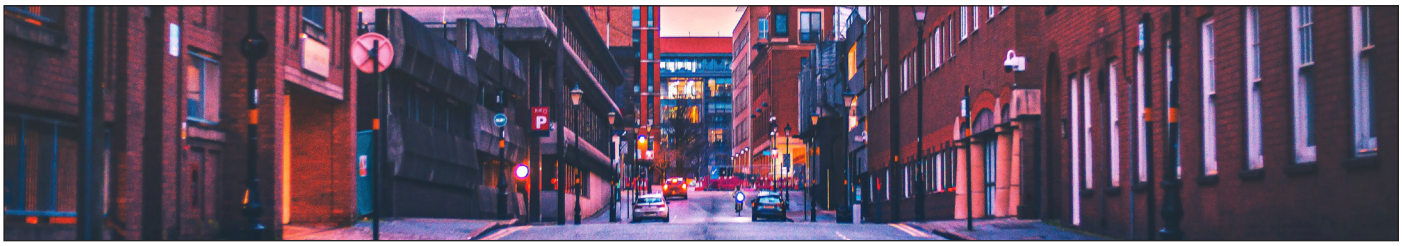

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An invisible fork in the road: The autoethnography of a female social scientist

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Abstract

Research has shown that girls' confidence and ability perception are critical to their beliefs, attitudes, and interests concerning the pursuit of mathematics and science. In historically male-dominated fields, females often have a tenuous relationship with STEM (Science, Technology, Engineering, Mathematics) disciplines. This autoethnographic study explores one girl's trajectory away from a keen interest in mathematics and science in favour of social sciences. Four central themes were identified as critical to females' interest, pursuit, and advancement into STEM careers, including gender-based socialisation; confidence, ability, and achievement; classroom environment and school curriculum; and family 'curriculum making'. The findings that impacted the divergence from STEM are revealed through interviews with the author's parents and expressed through a reflexive narrative. The findings in this paper suggest several actions that families and schools might take to support the STEM aspirations of young female students.

> "We can't separate lives from the accounts given of them; the articulation of our experience is part of our experience." (Lugones & Spelman, 1983, p. 573)

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1. Introduction and background

As a young girl, two of my favourite books were 'How the Universe Works' and 'Our Solar System'. I hoped they would show me how to get to space, and I desperately wished for a telescope for Christmas to chart my path (I got a microscope). I relish the time spent in my grandparents' basement with my brother, heads down with the vintage Erector set, and less fondly, fighting over Legos. I performed well in all of my courses in high school (secondary education equivalent), including mathematics and sciences. There was no apparent rationale for my move away from STEM (Science, Technology, Engineering, Mathematics) disciplines towards social sciences. The signs pointed to a kid destined to become a scientist or engineer as a way to get to space. Nevertheless, here I sit today, a self-affirmed *social* scientist.

1.1 Legal background and "the leaky pipeline"

I grew up before STEM as we know it today. I completed my first twelve years of school amidst times of significant reckoning and governmental legislation intended to advance exposure of girls and women to STEM disciplines, but before I fully understood the implications of Title IX. *Note: In the United States, Title IX is a law that seeks to ensure and enforce gender equality and reduce discrimination in federally funded educational programs.* I will use 'STEM' to refer to the combined disciplines I explore in my personal experiences for this study.

Until the mid-1970s, female university students were traditionally steered towards and selected majors in teaching, history, or other social sciences. In 1972, the United States government enacted Title IX of the Education Amendments Act, paving the way for higher admission of women into educational programs within the STEM fields. In 1980, the Committee on Equal Opportunities in Science and Technology was created to advise on advancing women in STEM disciplines. Statistics show a significant increase in female scientists between 1970 and 2000 and a steep increase in baccalaureate degrees awarded to female graduates between 1980 and 1987. After this point, the number of females in the computer sciences declined through the mid-1990s, and today, females continue to be underrepresented in science and engineering (Alper & Gibbons, 1993; Aspray, 2016).

This 'leaky pipeline' of women into STEM disciplines does not begin at the university level. The slow migration of girls and young women away from the 'masculine domains' has been identified as early as before school entry, continues and escalates through middle school, and climaxes by the end of students' sophomore year of high school, where there is a firm male advantage in physical science achievement as well as a distinct male advantage in life sciences and mathematics ability (Burkam, Lee, & Smerdon, 1997; VanLeuvan, 2004; Zhou, Fan, Wei, & Tai, 2017).

In a culture with historically ingrained beliefs about gender roles, unbeknownst to me, I was caught in this socio-cultural maelstrom. Unconsciously encoded to believe that 'girls don't do math' and 'girls are better at reading and writing', my die was cast as a social science practitioner – a reader, a writer, an educator, and a 'relator'. I'm not resentful, unhappy, or disillusioned about life. I'm not jealous of my brothers' careers in engineering and technology or disappointed with my parents for not pushing my interest in space. However, I feel that I missed my calling to the physical sciences to some degree.

To unpack my experience requires me to reflect on internal and external influences that guided my educational path and future trajectory. As such, this research is undertaken as autoethnography, a form of autobiographical narrative inquiry which guides one towards making meaning of life experiences. As a research method, autoethnography allows researchers to use personal experience to reflexively analyse experiences in the context of social and cultural schemas, with the goal to make life better (Adams, Holman, Jones, & Ellis, 2015). This account includes my own and my parents' perspectives, interweaving attitudes and observations with external dynamics, and allowing me to juxtapose my experience with cultural schemas during a specific period in my life. Therefore, in the present study, I address the question: *What factors or influences might have deterred my pursuit of STEM disciplines in favour of my social science trajectory?*

I hope to locate the invisible fork in the road.

Employing a feminist approach to my metaphorical search, I will first review internal and external factors identified within the literature that influence girls' academic and subsequent career trajectories. I then explain the methodological rationale for autoethnography and then present my road travelled through a series of reflective vignettes. Finally, through self-discussion, I attend to tie the loose ends of my journey before concluding.

1.2 Need for the study

While significant extant research addresses female pathways into STEM at the undergraduate, graduate, and post-graduate levels (Alhaddab & Alnatheer, 2015; Ellis, Fosdick, & Rasmussen, 2016; Craig, Verma, Stokes, Evans, &

Abrol, 2018; Seymour, 1995), as well as career entry (Alper, J.; Gibbons, 1993; De Vita & Giancola, 2017; Smeding, 2012), Seymour (1995), noted a lingering need to learn more about the pre-college experiences of young women who chose not to pursue STEM fields, particularly the origins of preferences, skills, and competencies at this level. Further, there is a need to examine what drives women from careers in science in favour of 'fields involving people rather than abstractions' (Alper, J.; Gibbons, 1993). Pringle, Brkich, Adams, West-Olatunii, & Archer-Banks (2012, p. 218) asserted that 'the relationship between adult expectations and the girls' self-perception as science and mathematics learners' is an area yet to be vigorously explored. I intend to lend my authentic voice and personal experience to address these opportunities within the leaky pipeline narrative. Reflection is central to the feminist project, which I now turn to as a theoretical guide for my inquiry.

2. Theoretical frameworks

2.1 Feminist inquiry

Theory presents us with organising frameworks that help us understand and interpret systems, policies, and processes which support or suppress the individual. Feminist theory is a way for women to speak to, respond to, and act according to one's own beliefs vis-à-vis her lived experiences. It is generally accepted that feminist ideology is concerned with eliminating inequality and injustice in women's lives (Hirudayaraj & Shields, 2019). As such, feminism is also a welcoming ethos; it 'includes all women in its embrace, and it celebrates the achievements and struggles of women' (Shaw & Lee, 2004, p. 448). The nature of feminist inquiry allows for and welcomes the melding of multiple vantage points, which become the foundations of research and practice (Denzin & Lincoln, 2011).

Feminist theory holds a rich yet complicated history; this should be no surprise as women's issues are weighty and complex. In the United States, the nascence of the feminist movement was anchored by first-wave feminism, which focused on human rights and gender equality (Ruth, 2001), including women's suffrage. The paradigmatic roots of first-wave feminism rested on the belief that gender was socially constructed, with either overt or unconscious beliefs about the behavioural expectations of men and women (Gedro & Mizzi, 2014).

Second-wave feminism began in the 1960s and argued that society built on patriarchal foundations sought to advance the status of men and masculinity while diminishing women (Gedro & Mizzi, 2014).

Subsequent feminist movements have ensued, including third-wave feminism, beginning in the 1990s and fourth-wave feminism in the 2010s. It is within second-wave feminism that my youthful experiences were largely situated and serve as the historical context to recount my experiences, more specifically through the feminist standpoint.

2.2 The feminist standpoint

A standpoint goes beyond the simple notion of having a stance on a matter; it is interested in 'the sense of being engaged' (Hartsock, 1983, p. 285). Inherent in a standpoint position are the personal realities and societal perspectives, often well-intended, hidden from outward view, yet deeply impacted by human relationships and environmental dynamics (Hekman, 1997). Thus, the feminist standpoint seeks to 'express [the] female experience at a particular time and place, located within a particular set of social relations' (Hartsock, 1983, p. 303). The feminist standpoint emboldens exploring womens' experiences to 'go beneath the surface of appearances to reveal the real but concealed social relations' (Hartsock, 1983, p. 304).

Indeed, the feminist standpoint is a theory of engagement as well as scholarship. It recognises 'common thread' within female experiences but also acknowledges that these threads are 'neither self-evident nor obvious' (Hartsock, 1983, p. 303). In the spirit of the feminist standpoint, the truth of the human experience vis-à-vis knowledge construction should be approached with methodological rigour. I hope to attend to this agency in this research, beginning with a review of the literature.

3. Literature review

My reflection required me first to understand some of the factors that influence girls' and young womens' entry into STEM disciplines. Therefore, I conducted a literature review using databases and search engines, including Academic Search Ultimate/EBSCOhost, Scopus, and Google Scholar. A review of extant literature served multiple purposes. First, it acted as a source of contextualising data, allowing me to situate my personal experience with public history. The literature review also served as a point of validation of my recollections as social science research, juxtaposing personal subjectivity with external objectivity (Chang, 2008) and attending to Hartsock's call for robustness in feminist research.

3.1 The autoethnography literature review

As a feminist researcher, I concur with Kathryn Blee that 'we are more honest as scholars when we acknowledge the myriad ways in which our personal lives and emotions are intertwined with who, what, and how we study' (Adams et al., 2015, p. 11). I believe that our stories can only enrich our scholarship and engage our audiences. Therefore, this study was undertaken as an autoethnography, a research methodology that allows the author to '[illuminate] multiple layers of consciousness and understanding, explicitly linking the personal to the cultural' (Campbell, 2015, p. 235).

A goal of the autoethnography literature review is to 'begin to situate ourselves in story – our own story, the story told in existing writing and research on our topic or experience, and the stories told by others' (Adams et al., 2015, p. 49). As a complement to the feminist standpoint, autoethnographic literature reviews recognise that knowledge construction is uniquely a social exercise and inherently based on the vantage point of the researcher. That 'some [knowledge attempts] are better than others as starting points for knowledge' (Campbell, 2015, p. 235) should not prohibit the exploration and extension of knowledge, even if such attempts may be contested (Ellis, Adams, & Bochner, 2011).

With these caveats declared, I now turn to the literature to investigate influences on the entry of girls and young women, myself included, into STEM disciplines.

3.2 Factors influencing girls' entrée into STEM disciplines

3.2.1 Gender-based socialisation

Values, self-perception, and identity are well-documented touchpoints that steer men and women in different directions academically (Alper, 1993; Corbett & Hill, 2015; Leaper, Farkas, & Brown, 2012; Shapiro, Grossman, Carter, Martin, Deyton, & Hammer, 2015). Shapiro et al. (2015) found that both sexes anticipated gendered differences in their futures, but boys more likely than girls believed that there were some jobs that boys were better at and that boys had more career opportunities.

Influential adults portrayal of gendered roles plays a crucial role in students' interests but may also create gender-differentiated values and self-perceptions (Gilbert, 1996; Leaper, Farkas, & Brown, 2012; Smyth & Nosek, 2015). There is no shortage of evidence within existing literature to demonstrate this phenomenon; for example, mathematics and sciences as 'masculine' and the social sciences as 'feminine' (Gilbert, 1996; Seymour, 1995); the social stigma of being a girl in a boy's field (Leaper et al., 2012; Seymour, 1995); inability to give themselves 'permission' to choose STEM majors (Seymour, 1995); encouragement to pursue 'softer' sciences (Lee & Burkam, 1996; Dreves & Jovanovic, 1998); and curriculum content skewed in favour of males (Weber & Custer, 2005).

Growing up, I distinctly remember hearing the refrains 'girls don't do science' and 'girls are better at reading and writing'. These messages have stuck with me throughout my life, yet what I know better as a researcher than I did as a young woman is that perceived gender differences may indeed be a factor of childhood relationships, experiences and perceptions about identity, ability, and values (Lee & Burkam, 1996). When introduced early, I believe that these types of longstanding social mores become embedded and are difficult to unlearn. This refrain anchors my suppositions for my entrée into the social sciences – by nature of my sex, it was my destiny.

3.2.2 Confidence, ability, and achievement

Confidence is a primary influencing factor of female interest and pursuit of traditionally male disciplines. Despite efforts to improve the inclusion of women in STEM, research shows that a key rationale for the lack of and decline of women in science is loss of confidence (Adams et al., 2015; Alper, 1993; Corbett & Hill, 2015; J. Ellis et al., 2016; Seymour, 1995; Zhao, Carini, & Kuh, 2005).

Beginning in early adolescence, girls begin to question and lose ground on perceptions of their abilities in science and mathematics, and this period has been shown to be the beginning of a STEM or non-STEM trajectory (Gilbert, 1996; Lee & Burkam, 1996). As the perception of ability begins to erode, regardless of demonstrated achievement, self-efficacy and confidence in these subjects diminish. The perception increases with age and impacts the likelihood of continuing in STEM disciplines (Dreves & Jovanovic, 1998; Schuster & Martiny, 2017).

While the literature posits the criticality of girls' confidence, I am sceptical and uncertain of the role of confidence in my journey as a contributing factor to my achievement. It is not a word I would have used to describe my youthful self. To achieve, I believe one must possess some degree of confidence. I hope to elucidate my relationship with confidence through this reflection.

3.2.3 Classroom environment and school curriculum

A study of academically talented high school girls conducted by Patterson and Johnson (2017) points to confidence as a significant indicator of girls' enrolment in Advanced Placement (AP) Biology and Chemistry courses. Girls' confidence level is critical to perceptions of their abilities and, consequently, their active participation in the classroom (Corbett & Hill, 2015; Dreves & Jovanovic, 1998). When girls actively participate in hands-on labs, experiential, and inquiry learning, these experiences have the effect of enhancing their ability perception (Corbett & Hill, 2015; Dreves & Jovanovic, 1998; Schuster & Martiny, 2017).

And yet, girls who do extend their interest in STEM disciplines often ultimately pursue 'softer' subcategories, for example, biological sciences over physical sciences (Burkam et al., 1997; Patterson & Johnson, 2017; VanLeuvan, 2004; Weber & Custer, 2005). The same Patterson & Johnson (2017) study reported unexplained yet higher levels of anxiety and hesitation concerning Physics, indicating implied gender beliefs and the resulting avoidance of this domain.

While the literature indicates that curricular activities may thwart confidence, and hence, participation by girls, I take the issue of the school curriculum more literally. As will be explored in the coming sections, there were many opportunities for me to participate actively in a variety of advanced mathematics and science courses. I also believe the infrastructure of the curriculum did not permit someone with my depth of interest the time to immerse in the curriculum in a practical way.

3.2.4 Family 'curriculum-making'

Family has been described as children's 'first culture' and influences experience and future narratives (Craig et al., 2018; Hanushek, 2016). What children hear, observe, and see sends subtle and overt messages about the acceptance or appropriateness of exploring and developing 'STEM identities' (Craig et al., 2018).

Strong associations are created if the relationship between family and STEM subjects is positive, exploratory, and encouraging. It is likely that when similar attitudes are established in conjunction with positive relationships with STEM disciplines, the seed for entry to STEM is more powerful (Corbett & Hill, 2015; Craig et al., 2018). According to Dewey, experience 'cumulatively shapes how students live science, how they learn science, and ultimately, whether science becomes a part of who they are' (Craig et al., 2018, p. 626).

It is not a far stretch for me to apply Dewey's insight to my experience with the social sciences. I was raised in a family embedded in the social sciences, including education, theology, and law. As such, I cannot deny the presence of the social sciences in my family experience and how it shaped who I am today.

4. The study

This research aimed to investigate different variables in the experiences of a conflicted female student and how various experiences influenced the educational and subsequent career path in social sciences. What caused me to take the social science fork in the road? I have not been brave enough to dive deeply into this question … until now.

4.1 Methodology

The value of autoethnography lies in that it enables 'the perspective of the self in context and culture, exploring experience as a means of insight about social life, and recognising and embracing the risks of presenting vulnerable selves in research' (Adams et al., 2015, p. 103). Many scholars critique autoethnography, suggesting its position is questionable within academic research because of its individualistic nature and a perceived misalignment with traditional methods for assessing qualitative inquiry (Ellis & Bochner, 2000).

Autoethnography is an appropriate methodology for my research because while significant existing research addresses female pathways into STEM at the undergraduate, graduate, and post-graduate levels, as well as career entry, there remains an opportunity to learn more about the pre-college experiences of young women who choose not to pursue STEM fields (Seymour, 1995). Specific to this research, autoethnography allowed me to examine my experiences within the context of internal beliefs and external factors that influence pre-college women's trajectories (see Appendix A).

4.2 Research bias

The focus of this research was my personal experience and perceptions, a reflection of my early academic life, upbringing, and career path. Therefore, I am necessarily linked to the research, including inherent bias associated with my observations and analysis. As noted above, a frequent critique of feminist qualitative research is research bias (Holt, 2003). I must consider certain limitations of undertaking a study using an autoethnographic methodology.

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First, readers may find my parents' objective bias a limitation of this study; it is natural for parents to view their children through rose-coloured glasses. During semi-structured interviews, I assumed a professional yet comfortable demeanour and allowed responses to unfold organically, cautious not to lead, as discussion meandered between personal and cultural contexts.

A second possible limitation of this research is that 'memory selects, shapes, limits, and distorts the past' (Chang, 2008, p. 72). Certain aspects of reflection may be misremembered, minimised, fragmented, or idealised more or less than the actual events. Chang (2008) suggests the use of external documentation to augment autoethnographic data, noting that it may serve to 'validate or correct your personal data from the past as well as self-observational and self-reflective data from the present, help triangulation with other data sources, fill in gaps left by self-based data, and connect your private story with the outer world' (p. 112). Therefore, to help inform the contextual period of this research, I referenced my academic transcripts and personal archives.

Despite the challenges of autoethnography, one of its key advantages is that 'it offers nuanced, complex, and specific knowledge about particular lives, experiences, and relationships rather than general information about large groups of people' (Adams et al., 2015, p. 21). To increase analytic objectivity, I followed the themes from the literature review, which I believe influenced my trajectory either overtly or subconsciously.

4.3 Data collection and analysis

In advance of data collection, informed consent was received from the study participants (my parents), and ethical approval was received according to my doctoral programme protocol. Because autoethnography is a personal story, my goal as the interviewer was to create comfort so that my parents might speak authentically and evoke memories they felt relevant to the topic. The focus of the conversations was to discover the influences that had a bearing on my academic interests, development, and achievement, which led me to pursue social sciences. A guiding interview protocol was developed based on themes emerging from the literature to facilitate objectivity and mitigate possible bias; this was shared with my parents in advance to allow them time to prepare.

According to Bernard (2006, p. 7), data analysis 'is the search for patterns in data and for ideas that help explain why those patterns are there in the first place'. Two hours of interviews were conducted via video conferencing, recorded, and downloaded. Following data transcription and formatting, I completed three rounds of review to narrow the focus. In round one, I identified overarching descriptive themes, and in round two, I combined overlapping themes in alignment with the literature. Finally, in round three, I narrowed the focus to data that would provide clarity, synthesising my findings into the following vignettes, which reflect the attitudes and experiences which I posit as seminal foundations of my social science trajectory.

5. How did I get here?

Beginning this research, I could not initially pinpoint a specific point when I ventured one way down the social science path. Shapiro et al. (2015) point to social role theory and social cognitive career theory to help explain the experiential journey from interest to engagement to the pursuit of a given subject. During this journey, 'feelings of self-efficacy and expectations fuel her career interests, which, if supported, lead to career goals, and ideally, to action that moves her towards achieving her goals' (Shapiro et al., 2015, p. 4). In other words, interest, confidence, and achievement grow out of experience, exposure, familiarity, and encouragement. Therefore, I turn to a deeper examination of both internal factors (behaviours, aptitudes, and abilities) and external factors (classroom and familial), which influenced my path into social sciences.

5.1 Renaissance girl

> '[You were] very inquisitive, a seeker of knowledge. You were a very well-rounded student as well as someone who was interested in not just, as you say, the social sciences but also math.' -Mom

One of the epiphanies I had early on was the notion of the 'Renaissance Man'. With historical archetypes like Michelangelo, Leonardo DaVinci, and Thomas Jefferson, the idea of a person knowledgeable and gifted in a variety of disciplines was supremely appealing to me. Considering this list now, I cringe at the missing 'Renaissance Woman' on my list of inspirational figures. Lack of historical female exemplars aside, I wanted to follow the example of those brilliant polymaths, at least in my world. I see this in the variety of my academic transcripts: Symphonic Band; Orchestra; French; Chemistry; and World History. I see it in extra-curricular activities like Debate, Junior Achievement and as a volunteer with the Red Cross. Despite any talent I might have inherited from my art teacher mother (I did not), I briefly attempted to incorporate an art class into my

course schedule. I took business Calculus outside of school hours at the community university because it conflicted with Band, and I wanted to do both (more on that later). I even remember coming home and studying a Latin dictionary 'for fun'. I desperately wanted to be a 'well-rounded student', the prerequisite for acceptance to a top university according to my parents and teachers, and an attribute that was a natural complement to my insatiable curiosity about … everything.

> 'You had an innate ability to seek out things, to be inquisitive. You have to be good at that in order to see connections from different cultures and different societies and different people to something else. You were good at that. The effort comes into, I think, how you were allowed to pursue that. What is effort? Some kind of energy you put into something, right?' -Mom'

When I consider my parents' descriptions of my efforts and abilities, which here might be more accurately described as 'effortless', it seems that I am reflecting on someone else. Contrary to my Mom's description, I believed that I needed to put in effort first to translate my interest in STEM into some quantitative indicator of my ability; curiosity plus effort equals ability. Through effort, I would disprove those nameless, faceless naysayers who claimed, 'girls don't do science and math'. My Mom describes the synthesis of curiosity, effort, and ability best:

> 'I think it was more your abilities. You had a great ability for it [mathematics and sciences] because we only had to maybe explain it to you one time, and then you picked up on it. Then I can remember you always would take it and go to the next level, which shows effort on your part. You did not need a lot of push to get to the next part. That's what I would call the inquisitive part of it. It was more of a very strong innate ability to grasp subject matter concepts and then figure out how to take it to the next level, which is effort. You really didn't have to use much effort to do it because it came naturally'. -Mom

While ability and effort seemed a natural complement to my inquisitiveness, I question my Mom's connection of inquisitiveness and effort. At face value, yes, it does take effort to attend to multiple pursuits. But what was I trying to achieve by taking on all of these disciplines, and what does this have to do with the present exploration?

The issues here point me to attribution and motivation. Research has shown a consistent pattern regarding 'motivational and attributional' perceptions of ability versus effort, and girls especially have a strained relationship with STEM disciplines (Gilbert, 1996). Girls tend to attribute their success in STEM subjects to effort over ability, whereas boys tend to attribute success to ability over effort (Gilbert, 1996; Lee & Burkam, 1996).

My Mom's insight, which I give expert credibility as a lifelong educator, attributes my success first to ability and then effort. To me, the opposite was true. I needed to apply more effort as an indicator of my ability, and by extension, my achievement. These phenomena imply that girls' low STEM motivation is a factor of self-efficacy and a direct predictor of intentions to pursue particular disciplines (Corbett & Hill, 2015; Gilbert, 1996; Lee & Burkam, 1996; Schuster & Martiny, 2017).

With this contradiction between perspectives, I could not yet name effort or ability as the causal factor leading me away from STEM. The reader will realise in the forthcoming sections that despite my efforts to demonstrate abilities in STEM, the effort was likely an exercise in futility from the start.

5.2 The competition

> I distinctly remember the competition. Every Friday, Ms Honor posted rankings of her AP Algebra II/Trigonometry students based on cumulative marks, sorted from high to low. Lee and I would rush to see which of us would appear at the top of the list. Every week, back and forth for months, we vied for that coveted top spot. Although there was no actual reward, I wanted the intangible satisfaction of seeing my student number (regularly) above his.

Now that I had established my motivation – to prove my ability as an indicator of belonging in STEM – how did I plan to prove I belonged with the boys who were naturally inclined to excel in mathematics and science? I would compete.

> 'I think one could say that you had a built-in confidence. I think a portion of it was our own expectations. I think you just internally knew what you needed to do and by the same token, you're competitive. You're a competitor. I trace that back to – all the way back to elementary school. It's a kind of self-motivation. It's wanting to present oneself well. That definition speaks of self-confidence and a kind of inner motivation'. -Dad

Here again, I arrive at attribution. I don't believe I was confident first, and I certainly did not associate confidence with competitiveness. In fact, I think it was the other way around. My demonstrated motivation and confidence as

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early as elementary school recalls the notion of 'identity imprinting', a phenomenon that occurs even before a child enters school and influences the experiential journey into science and math, and later on, STEM career trajectories (Corbett & Hill, 2015; Craig et al., 2018). My Dad's characterisation of my identity imprint surprises me. For me, it was not that I was confident in my ability; it was winning the competition that bolstered confidence in my mathematics abilities. The competition provided assurance and validation that I could 'do math'.

Despite my motivation and triumph in this particular competition and the resultant increased confidence in my mathematical abilities, Archard (2012) notes that competitiveness can be a risk factor when associated with competence and success. It would stand to reason that instances of failure or underachievement can be a blow to the 'confident' student when confidence is linked to competence and success, as suggested. A study of gifted girls conducted by Perleth & Heller (1994) revealed a fear of failure instead of a sense of confidence that most impacted educational success. Ouch! That sounds familiar.

Indeed, the drive behind the competitiveness my Dad described was not confidence so much as a manifestation of the fear of failure. I had to continue to prove my ability; competition plus success equals belonging. As it turns out, the competition was not so much with Lee, but with myself. Although my confidence in these subjects was growing, it was still nascent and fragile; one point deduction, one disparaging comment, or one loss to Lee might have upended all my progress.

Unfortunately, research has shown that in early adolescence, girls begin to question and lose ground on perceptions of their abilities in science and math, and this period has been shown to be the beginning of a STEM or non-STEM trajectory (Gilbert, 1996; Lee & Burkam, 1996). The confidence that seemed evident to my Dad and appeared to manifest in my success in mathematics was just not enough to sustain me through to an extended foray into STEM disciplines. In that competition, yes, I conquered the Trigonometry and the boy who naturally excelled, but he was supposed to – I was the outlier.

Thus, I began to question the origins of my ability. Maybe Lee wasn't as smart as he seemed. Maybe Ms Honor wasn't the best teacher. Maybe the curriculum wasn't that challenging. Maybe hearing the joke about my state's school system 'North Carolina – first in flight, 48th in education' (out of fifty states) created a logic model in my mind: If all of the factors around me were mediocre, then were my abilities overstated? When I reflect more closely on the origins of my effort, confidence, motivation, and ability, I can almost touch the cracks that began to emerge. In case internal questioning was not enough, two external factors sealed my fate, and the road began to fork even more precipitously.

5.3 You have to choose

> 'You have to choose'. This is what my guidance counsellor conveyed as we sat together to determine my senior year schedule. I had enjoyed playing the oboe for the last four years and was now the only one in my school, a responsibility I took seriously and with pride. Unfortunately, seventh period Symphonic Band conflicted with AP Physics. French, which I had started in grade three and had become part of my being, convened the same period as AP Calculus. 'You have to choose'.

I will leave it to the reader to surmise the outcome of this conversation. I was devastated then, and my eyes well now reflecting on this seminal moment. *What could have been?* As evidenced by the interaction with my counsellor, the logistics of the school curriculum were indeed a limiting factor in my ability to engage the options available – scheduling conflicts. In a randomised controlled trial focused on alleviating stereotype threat in three US high schools, Bancroft, Bratter, & Rowley (2017) found that student curriculum significantly contributes to achievement, especially for minority and female students. As a teacher in the same school system I attended, my Mom had insight into how curricula were administered.

> 'You [had] to teach students so much of this subject, that subject, and the other subject. You [had] a certain amount of math you [had] to teach, a certain amount of science you [had] to teach, and a certain amount of the non-math/science courses you [had] to teach. The curriculum was the problem'. -Mom

It is now easy to see how what my Mom calls 'curriculum equilibrium' hampered access to the breadth of courses I might have taken. An unfortunate by-product of scheduling logistics meant that I could not explore a broader range of subjects – I had to choose. The culminating effect is that I could not apply any of the internal factors that seemed to have propelled me. I could not use my inquisitiveness to extend my knowledge, nor could I compete with my classmates to build my confidence. Although I might dig deeper into the complex interplay of 'curriculum equilibrium' and achievement, I won't overcomplicate the reason for my derailment: lousy timing.

5.4 Please, pass the scalpel

> 'Boys were given more. They were allowed to take charge more … and the girls were like assistant secretaries or something like that because girls were going to be secretaries or teachers or nurses or something like that. Boys were seen as stronger in certain areas in terms of taking charge and giving directions…' -Mom

My Mom had a clear vantage point to the unbalanced leadership within classroom experiences between boys and girls, speaking as both a parent and a teacher within 'the system'. She likely saw first-hand that girls' experiences tend to be 'more passive, less demanding, and less experiential', thus thwarting opportunities to gain confidence in science and mathematics (Burkam et al., 1997; Seymour, 1995, p. 438). Conversely, boys have more active exposure, leading hands-on lab and equipment activities, while girls are more likely to serve in 'assistant' roles (Burkam et al., 1997; Seymour, 1995; Dreves & Javanovic, 1998). I am sure my Mom would not have been pleased to know my role of 'medical assistant' as Andrew, my lab partner, dissected a foetal pig over the course of a week in AP Biology II; I don't think I touched it once. This situation most certainly would have warranted a visit to my teacher and school administrators to provide 'guidance' on how I should be challenged appropriately.

The impact of girls' assuming passive roles in the classroom cannot be understated, and my role in the lab is an example of the long-term impacts on girls' self-actualisation. Girls' confidence level is critical to perceptions of their abilities and, consequently, their active participation in the classroom (Corbett & Hill, 2015; Dreves & Jovanovic, 1998). When girls are engaged in classroom activities, including hands-on labs, experiential, and inquiry learning, these experiences enhance their ability perception (Corbett & Hill, 2015; Dreves & Jovanovic, 1998; Schuster & Martiny, 2017). When girls are able to participate actively and also assume leadership roles in science classrooms, including having control of equipment, practising active experimentation, and compiling lab reports, confidence is bolstered, and perceptions of science as a male-only domain diminish (Burkam et al., 1997; Dreves & Jovanovic, 1998).

When I think back on my opportunities for leadership roles, what comes to mind is performing melancholic solos from Wagner's concertos or leading group discussions on select works from the *Norton Anthology of English Literature*. Although enriching, I admit that neither of these 'leadership opportunities' likely lent themselves to a future in STEM. While dissecting a foetal pig may not have been enough of a cognitive or confidence leap to push me to Physics, it was nonetheless a missed opportunity to challenge not only my skill in science but to extend a leadership opportunity that might have propelled my confidence as a future physical scientist. Perhaps I should have taken up that scalpel.

5.5 The McDowell family curriculum

> My parents were the most intelligent people I knew, and their collective intelligence enamoured me. My Mom taught multiple subjects (making her a polymath in her own right), and my Dad was the most eloquent orator speaking from the pulpit every Sunday. Their words carried weight with me and still do. It is not lost on me that I still seek to emulate aspects of them both as an instructional designer and practising Toastmaster.

Two significant influences come to mind when I think of my 'first culture' (Craig et al., 2018; Hanushek, 2016) and family curriculum (Craig et al., 2018; Shapiro et al., 2015). First, as people of colour, my parents' beliefs about being educated and school achievement were paramount; education was the centre of our family orientation. More specifically, a *university* education was at the centre of our family orientation. As such, I was raised with an unspoken urgency and exigence impressed upon me that education was the way to avoid future obstacles. Their parental ethos identified education as a deeply ingrained ideal, imperative for advancement, and rightfully so. As recently as 2013, a National Center for Educational Statistics study showed, regrettably, that when compared to the Coleman Report of 1965, the black-white achievement gap had not significantly diminished (Hanushek, 2016). My parents were tenacious in their efforts to prevent my brothers and me from falling into this achievement gap:

> 'Because we are persons of colour and because both your mother and I recognise the nature of the prohibitions placed upon persons of colour. It was just absolutely important for us given that the culture in which we live. It was just understood that the way up was through education; there was no other way. That's just it. Because, again within this community of colour of which we are a part, we understood what the disadvantages would be if that [college] were not the case'. -Dad

While our racial background may not have resonated in this way in my younger mind, a university education was essential to overcome the racial inequity my parents saw and experienced. I see now that only the end game mattered; English or Physics did not matter; Band or French did not matter; Biology or Trigonometry did not matter:

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> 'High school (secondary school) was only a hurdle to overcome when it was understood or should have been understood that as a member family, we're looking beyond high school'. -Dad

John Dewey has long informed our thinking by providing schemas that help us contextualise the importance of experiences; this contextualising continuum informs how we absorb and process experiences (Craig et al., 2018). Part of my contextualising continuum includes my parents' experience as people of colour seeking the best possible outcomes for their children. According to our family curriculum, what I focused on was not important as long as I continued to track towards completing university. Through my parents' eyes, the best possible outcome was achieved through education.

While my parents' fight against the achievement gap was undoubtedly an undercurrent in our family, through the eyes of my younger self, there is a more obvious part of the equation. My immediate ecosystem was not comprised of mathematicians or scientists. The scientists I knew were doctors examining my eyes or giving me vaccines; or a lone female Chemistry teacher, sadly a concept I remember finding odd yet intriguing; 'She knows chemistry, so why is she a teacher?' What children hear, observe, and see sends both subtle and overt messages about the acceptance or appropriateness of exploring and developing STEM identities (Craig et al., 2018). My case demonstrates both sides of the coin. While I never received an overt message not to explore STEM in greater depth, what I heard, observed and saw in the McDowell family curriculum was always, unquestionably rooted in the social sciences, succinctly described by my Dad:

> "My father, of course, was a lawyer. His brother was an architect. My mother was a librarian and an English teacher. Basically, we really did fall to the social sciences. I think that's the trade of an educated family as well." -Dad

As I reflect on the disciplines and professions that I observed as a child, I am not surprised that I gained familiarity and comfort with the social science business. Indeed, McDowells were educators, clergy, writers, readers, missionaries and 'people people'. As I conclude the findings from this reflection and think about the breadth of accomplishment in my family curriculum, I realise my journey has gone from sadness and questioning to pride and gratitude.

6. Discussion

When I introduced feminist ideology in section 2, I intentionally paused to capture a moment in time. It was necessary to understand the evolution of the feminist movement, as each period scaffolds and enables subsequent advancement of women's socio-cultural position. For me, a reflection of the evolution of the feminist movement is all at once insightful to my experience and makes me acutely aware of those unspoken, invisible tenets that my younger self was not privy to, but certainly developed as a by-product of societal dynamics; the work feminist advocates and scholars were working to change.

In this reflection, I have tried to be true to the goals of the feminist standpoint – to draw directly from the realities that shaped my experiences and to 'define the nature of claims' (Hekman, 1997, p. 341). I have also tried to bolster the dominion of the feminist method, as called upon by Hartsock, 'to connect everyday life with the *analysis* [emphasis added] of the social institutions that shape life' (Hekman, 1997, p. 343).

When I began this exploration, I presumed that my ultimate pursuit of social sciences was just what girls did; after all, girls were better at the 'soft stuff'. For someone who has been described as inquisitive, with demonstrated ability and effort, it seems a lazy excuse, something I would not tolerate now as both a feminist and a PhD candidate, the latter of which requires all of these attributes. Nevertheless, today I'm an instructional designer, not an astrophysicist.

I also learned through this exploration that I had a complicated relationship with confidence and ability. As with many adolescent girls, I struggled with confidence for any number of reasons, mostly superficial and having to do with what I'll call 'social interests and influences'. As indicated in extant research, girls tend to diminish their capabilities, believing their success results from effort instead of ability. I was a textbook example of this phenomenon, and yet it seems I had some reckoning that something was amiss with this mindset. Through 'the competition', my confidence grew – I was 'doing math' doing it effortlessly, and doing it well. And yet, it was not enough to propel me further, no thanks in part to bad timing with course scheduling.

My Dad vehemently described me as a competitor. I had never to this point considered myself a competitor, at least not in the traditional sense. After reflecting through this process, it is true – I compete daily with myself, which is why I find myself disappointed to have to acknowledge that

my parents saw in me qualities I might have translated into a STEM education and career; a 'capable', 'motivated', and 'confident' 'competitor'.

'You have to choose' never should have happened, and again, it is not something that I would let pass today. I've grown into too much of a dogged problem solver to allow scheduling conflicts to impede my goals. Today, we benefit from remote synchronous and asynchronous learning, allowing learning to traverse space and time constraints. In this reflection, one of my 'ah-ha' moments was the impact of leadership opportunities in the science classroom. Extant research posited significant disparities in pre-college girls' and boys' curriculum and classroom experiences, marked by different experiences, roles, and activities. Retrospectively, I see this as another gateway to confidence and a missed opportunity.

I did not speak of achievement in the sense of high grades with respect to my family, but in the sense of the absolute urgency and necessity to complete university. A university degree qualified my brothers and me for equal opportunities, to not be diminished in society, and to realise that we belonged wherever we wanted to be, regardless of societal expectations. That it didn't matter to my parents what I was interested in as long as I graduated is a revelation that had never occurred to me. Whatever I was doing in high school was working, so there was no need to intercede. My parents saw the long game (university) and saw me tracking towards that significant achievement (graduation). To me, this is all at once profound, upsetting, and perplexing. I now better understand and respect their position; and am deeply grateful for the foundation they set, which continues to propel my educational pursuits, even as a 'mature' PhD candidate.

While my previous reflections might have inferred these factors, I can understand how, as an adolescent and teenager, I may not have been able to name these factors as discrete influences. In a final pointed question to my Dad, I asked how it was, with all the signals, that we, together, did not follow through on my 'STEM identity'.

> 'With regard to STEM and the extent to which certain courses or certain interests or support is reinforced. I think if there's a failure, on our part, it may have been in that direction'. -Dad

Prior to submitting this paper, I had the opportunity to connect with my closest friend in junior high school, Candida, after thirty years. I told her about this research and asked if she remembered that I wanted to be an astronaut, to which she immediately and animatedly responded, 'Yes, I do! You were such a smarty!' Conducting this autoethnographic study elucidated many qualities I had not known before yet seemed evident to others. It has left me pensive and wistful as I uncovered internal and external influences that left an indelible impression on my life. Reflecting on my missteps, regardless of internal or external orientation, only serves to stir the competitor within me to follow my Dad's message to 'continue pursuing'.

7. Final thoughts

Existing literature has called for more robust inquiry into girls' pre-university experiences with respect to STEM disciplines. Specifically, there is a need to delve more deeply into girls' self-perceptions and beliefs about ability and external influences and expectations that impact girls' relationship with sciences and mathematics. To address the call to action, this study sought to explore my 'invisible fork in the road', the visible and discrete factors contributing to my social science trajectory. My retrospective was situated within a framework of cultural and societal expectations of perceived gender roles during junior and high school. The findings in this study show that one can never be sure why we arrive at our destinations until one takes the time to explore the rationales, going deeply beyond superficial assumptions.

Existing research supports the link between family and significant adults as strong influencers and agents of girls' and young womens' interest in STEM disciplines. As evidenced by the present study, these influential individuals cannot overestimate what more passive approaches, no matter how well-intended, have in girls' lives, especially those who demonstrate ability, motivation, and confidence. Those who surround young women must be observant, vigilant, and purposeful in helping capable young women pursue their interests; this includes creating positive experiences for females at an early age, both within and outside of school. Schools can foster sustained STEM interest and achievement of female students by constructing curricula that challenge with active inquiry lab work, opportunities to demonstrate leadership, and connecting content in meaningful ways to students' prior experiences. Outside of school, families can create 'family curricula', exposing girls to museums and activities that encourage and nurture a "fluid inquiry mindset" (Craig et al., 2018, p. 637).

It should be noted that the present study did not examine additional factors such as family, social or economic status. These factors would be valuable to future conversations on the evolution of young women from diverse demographic

backgrounds into STEM disciplines. Additional study isolating confidence, perceived abilities, and self-efficacy, evaluated through the framework of intersectionality, would also contribute to understanding motivations and deterrents to young girls' pursuits of STEM.

This study shed light on the conflicted feelings of an aspiring girl astronaut trapped in the body of a future female social scientist. I hope that this study serves as an instructional message to those who surround young women. I hope these reflections are a call to action to girls never to deny the interests that captivate them; they should not feel compelled to disavow this part of their identities. Multi-talented, curious young women must also be aware of the external forces, societal power structures, and cultural dynamics that impact their experiences. Successful female scientists, technologists, engineers, and mathematicians must serve as *vocal* role models. Perhaps even women like me who didn't quite get there can provide girls with the encouragement, support, and strategies to overcome obstacles, blossom, achieve, and flourish as they relentlessly pursue their dreams.

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