

Sci-fi movies as gateways to empower women students in higher education

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Abstract

The purpose of this portfolio is to examine whether using sci-fi movies can affect women students' self-perceptions about their science, technology, engineering, and mathematics (STEM) ability and career-linked self-perceptions in higher education. While women students are still underrepresented in some STEM fields, sci-fi movies offer women the opportunity to see women in STEM-based roles. Task 1 of this portfolio examines previous scholarly work focused on using sci-fi movies in classrooms to empower women students in STEM-related majors. Task 2 provides the methodology I used to conduct a survey and questionnaire, including research tools and the coding process. Task 3 of this portfolio is presented as an evidence-based report, intended to be read and utilized by teachers and curriculum developers as a practical tool to develop unit plans in the classrooms. The use of the method could also have the potential to expose the academic climate and social atmosphere that affects women students' self-perceptions. The method contains both quantitative and qualitative analysis, including questionnaires with open-ended questions and activities that accessed participant responses to different jobs. Participants were asked to watch three movies, after which their opinions about career-linked self-perceptions were analyzed by comparing their different behaviors. The findings suggest that while participants still hold embedded gender-linked self-perceptions about careers, these perceptions can be modified, and education plays an essential role in the process.

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Chapter One: Introduction

The purpose of this portfolio is to observe how representations of women in science fiction movies could be used to shape women students' career-linked gender perceptions to pursue science, technology, engineering, and mathematics (STEM) careers. The research described in this portfolio examines whether using sci-fi movies can affect women students' self-perceptions about their STEM ability and career-linked self-perceptions in higher education. For this portfolio, both quantitative and qualitative methods were used to collect and organize data. The research tools include questionnaires with open-ended questions and activities that accessed participant responses to different jobs.

The basic goal of education is to acquire knowledge and skills. In addition to increasing students' knowledge, education also shapes students' choices. The Ontario Ministry of Education (2004) sets developing values related to personal beliefs and a feeling of self-worth as education's goals as well. The relationship between movies and audiences has been discussed by many scholars, who believe that movies can affect audiences' perceptions (see Rizzo, 2012; Cloete, 2017). Previous research has found that students' self-perceptions affect their choices of educational path and thus career path after graduation (see Correll, 2001; Dasgupta & Asgari, 2004; Fouad et al., 2017; Ganley et al., 2018; Jugović, 2017; Powell et al., 2008). For example, Correll (2001) finds that men are more likely to believe they are competent in math than women are, and therefore the proportion of men's enrolment in STEM majors is higher than that of women's in higher education. Watching movies is an effective way to foster class discussions and deepen students' understanding from a pedagogical level (see Barnett et al., 2006; Barnett &

Kafka, 2007; Icen & Tuncel, 2019). Thus, my research process includes asking participants to watch movies and measures their response time about gender-linked career perceptions, which will be explained in detail in chapter three. For example, some scholars investigated public understanding of sci-fi and argued that sci-fi has the ability to blur fact and fiction by creating scenarios that make the audiences believe that what they see in the movies somehow can be realized in reality (see Frank, 2003; Kirby, 2003). Other scholars argue that sci-fi movies have the potential to break women's gender portrayals in film as traditional feminine, gentle, and maternal (Basu, 2005), and show new frontiers for women (Allen, 2018). Combining these two arguments, introducing women students to untraditional women's representations in sci-fi movies may affect their self-perceptions and offer possibilities for them to consider pursuing more masculine-linked career paths in STEM. In the context of the existing research on these topics, sci-fi movies will be used in this portfolio to test whether they can shape women students' self-perceptions to resist stereotypical female gender roles.

This portfolio begins with setting up research questions and the project rationale. A literature review (Task 1) will follow, to discuss the role of higher education, gender trends in different majors, efforts and results in gender equality in the higher education system, the relationship between movies and audiences, the representation of women in sci-fi movies, women's self-assessment and gender bias, and movies as pedagogy. In the methodology chapter (Task 2), the research process will be explained, including research tools and the coding process. I will then discuss the findings, further research suggestions, and my self-reflections (Task 3). The final Task of this portfolio is presented as an evidence-based report, intended to be read and

utilized by teachers and curriculum developers, that will encourage the use of sci-fi movies in class to resist gender-linked self-perceptions and encourage more women into STEM fields. In addition to being an informational report, the method that was used in the study could be adapted and used as a practical tool in the classroom. The use of the method could also have the potential to expose the academic climate and social atmosphere that affects women students' self-perceptions.

Research Question

This portfolio seeks to examine the following research question:

How do images of technologically-knowledgeable women in science fiction movies shape women students' career-linked self-perceptions in higher education?

Around the central question, there are some sub-questions.

Have women students' career-linked perspectives changed since childhood? If so, how?

This question aims at detailing the central question based on investigating what women students perceive to be the greatest influences on their career choices.

Who were the important people they perceived to have affected their career choices and why?

This question aims at detailing the central question by identifying who affected women students' self-perceptions and how these people can affect women students.

What kinds of connections do women students see between themselves and the characters in the chosen sci-fi movies, and what sorts of character traits do women students identify as important?

This question aims at detailing the central question by establishing what traits/abilities women students' value, and how women students see links or gaps between themselves and these traits/abilities. I hope it can provide educators with insight into these links/gaps, to throw light on future efforts to close these gaps.

From these sub-questions, educators and researchers can try to understand many women students' existing gender self-perception, and how these self-perceptions form, to the extent of thinking - at least consciously - about how education and teachers can affect women students' self-perceptions.

Research Rationale

I chose this topic because of my personal interest in the field of gender equity, especially women in traditionally male-dominated fields, and cinema. I grew up with a complicated gender identity. I do not have difficulty in recognizing my gender, but I embodied both masculine- and feminine-linked traits through my growth. As the only child in a family who favours boys over girls, my parents hold complex expectations of me. On the one hand, they hope I will be independent, pursue a higher degree, and have a successful career. They never limited me in developing my curiosity about science and engineering in my childhood. Yet, they have also internalized the idea that a girl should be gentle, virtuous, and refuse to enter any male-dominated subjects/majors. When I was a teenager, I met a woman chemistry teacher who judged that I would never catch up with boys in chemistry, because she thought that girls would fall behind with boys at high school. Her suggestion affected my choice in the science-humanities division in high school. I chose to study the humanities division to avoid chemistry,

even though I had good academic performance in chemistry and physics. Because I chose the humanities division, I was not allowed to study chemistry and physics during the last two years of high school, so I could not apply for any STEM-related majors in my undergraduate period. My teacher's gendered perceptions of students' abilities, and how they affected my choices as a student, changed my educational path and my future career totally. After graduation from university, I became a middle school teacher. During my teaching experience, I gradually realize the situation that keeps many women students outside of male-dominated subjects was not only external oppression in the form of parents' and teachers' suggestions, the patriarchal status quo maintained in, especially, STEM-related businesses, and career ceilings for women, but that some women students have internalized a self-perception of being inferior to men students in STEM, and believe that they will not have equal competitiveness to men in their future careers. From then on, I started to wonder whether I, as a teacher, could do something to develop a more equitable environment for female students.

Previous studies focus on how to advocate for gender equity by increasing the number of women in male-dominated areas. This portfolio focuses solely on women students' career-linked self-perceptions, which can be a barrier to women entering male-dominated areas in the first place, and observes sci-fi movies' role in deconstructing the barrier of women being limited in certain careers. Sci-fi movies have been used in the classroom as pedagogic tools in many courses, but the scholarship shows that most of those courses are related to science, for example, physics and geography (see Barnett et al., 2006; Barnett & Kafka, 2007). There is a dearth of using sci-fi movies in classes from a feminist perspective. I hope the discussions in Task 3 of this

portfolio can provide sparks for further research. In what follows, I explore the relevant scholarship in a literature review to situate my portfolio research (Task 1).

Chapter Two: Literature Review

The purpose of this literature review is to address whether sci-fi movies might be used in classrooms to empower women students in STEM-related majors. This review draws on previous scholarly work in the field, and examines role of: higher education; gender and student population in higher education; science and masculine-linked STEM; the relationship between movies and audiences; women's representations in sci-fi movies; women's self-assessment and gender bias; and movies as a teaching pedagogy. This review will address the problems that come with many women's education-path choices and self-assessment, especially when they choose a male-dominated area in higher education.

Role of Higher Education

The role of higher education in human development is discussed extensively in the literature. Flynn, Brown, Johnson, and Rodger (2011) state that education is a tool to develop personal value, vocational attainment and earning power in Western society. Percy and Svenson (2016) review the connections between higher education, economic, and social development, emphasizing that instead of being necessary for economic development, higher education is also essential on more holistic levels, such as human development, social justice and equality. Percy and Svenson suggest a strong relationship between a high level of education and a high level of equity, and conclude that higher level education would produce a more equitable society in the long term. Hence, Percy and Svenson advocate for a long-term societal value of higher education and suggest the societal value should be supported by policies that allocate additional resources to higher education.

Other scholars expand higher education's function from solely benefiting those involved in the higher education system to people who do not participate in it directly. Barnett (2000) sees higher education as "a pivotal institution in this process of collective self-enlightenment" (p. 69), and argues that it "can better assist the wider world in living at ease with supercomplexity by itself becoming an institution for the creation of new frames of understanding" (Barnett, 2000, p. 146). McLaughlin, Kowalchuk, and Turcotte (2005) also suggest that higher education provides a critical and independent space. Within this space, intellectual resources are provided for citizens, contributing, ostensibly, to more balanced and rational public discussion.

Gender and Student Population in Higher Education

The proportion of women students in higher education has increased over the past century. Although male students were typically, historically, the majority in higher education, the proportion has changed since the late 20th century, with women having acquired bachelor degrees in numbers greater than those acquired by men, regardless of race and ethnicity (Pollard, 2011). Women undergraduates show a steady rising trend, but the percentage of men is stagnant. Moreover, the gap between women graduates and men continues to widen, with more women graduating than their male counterparts (Pollard, 2011). In terms of income after graduation from higher education, the data shows that women's earning has grown since 1967 as well. Studies also demonstrate the worth of investing in education for women. Psacharopoulos and Patrinos (2004) suggest that the specific returns of investment in female education are higher than those of males. Other studies also prove that when men and women are at the same level of education, the socio-economic outcomes are higher for women (Schultz, 2002).

Despite the positive trend, women remain underrepresented in areas historically dominated by males, especially in STEM majors. Jugović (2017) demonstrates the low proportion of women in STEM, showing that less than a quarter of graduates from the higher education system in the fields of engineering, computing, and architecture are women. Casad et al. (2018) identify that the proportion of women who gain baccalaureate degrees falls behind their male counterparts in STEM majors like mathematics (42.8%), astronomy (39.6%), earth and atmospheric science (38.6%), engineering (19.8%), physics (18.9%), and computer science (18%). This situation does not exist alone in the educational realm; when it comes to the workplace, the gap becomes more apparent. First, women still earn less than men in general in STEM (Hegewisch, Ellis, & Hartmann, 2015). Second, even though financial incentives have been increased to enhance women's attendance in the STEM fields, fewer women than men become engineers after graduating from engineering (Fouad et al 2017). Such trends not only lead to stronger gender segregation in the workplace and reinforce gender stereotypes, but also contribute to the dearth of women in STEM.

Science and Masculine-linked STEM

Since the Enlightenment, there has been a distinctive and clear demarcation between science and non-science. Science is said to produce knowledge/truth through rigorous application of verification methods (Strega, 2015). Scientific knowledge is seen as more valuable than non-scientific knowledge. Hence, traits valued in science, such as objectivity, rationalism, and individualism, which are also traits associated with masculinity, are believed to be superior (Brickhouse, 2001). Furthermore, some feminist scholars analyze science as a symbolic system

in a patriarchal culture (Bleier, 1984), and other feminists argue that this binary division created not only hierarchical knowledge (Strega, 2015), but also power, which is to say that power has been produced by the process of generating scientific knowledge (Haraway, 1992). The link between masculinity and science, or the reification of masculine-linked science, reinforces the existing power construction of gender at the discursive level.

Researchers have investigated the masculine hegemony in STEM majors. Parson and Ozaki (2018), for example, explore the everyday work of undergraduate STEM students at Midwest Research University, to identify what the institutional culture norms and standards are, and how these norms implicitly inform everyday work for women students majoring in math and physics. Parson and Ozaki found that the institution values masculine-linked traits for students such as ambitious, capable of abstract and rationale thoughts, and individualistic. Women students are required to “meet expectations set according to a masculine definition of the ideal students” (Parson & Ozaki, 2018, p. 186). Some researchers also argued that there are hegemonic masculinities in organizations which lead to a “persistent belief in gender differences in abilities which maintains the status quo and affirms current inequalities as natural” (Page, Bailey, & Van Delinder, 2009, p. 1). All previous studies point to the fact that STEM subjects are male-dominated areas not only from the perspective of male students’ enrollment but from a perspective that there is a masculine-linked academic environment existing in STEM majors (Parson & Ozaki, 2018). This masculine academic environment excludes characteristics opposite to their expectation of being ambitious, abstract, rational, and individualistic. Usually, these opposite characteristics are treated as feminine-linked characteristics, leading to the result that

either STEM institutions reject women students or expect women students to fit the ideal masculine traits (Parson & Ozaki, 2018). Speaking back to the theoretical analysis stated above, the hegemonic masculine traits in STEM majors generate a power relationship that increases women students' risk of harassment in these major. If women are harassed in STEM-based educational environments, they may disengage from their studies and feel negatively towards STEM majors. This power relationship existing in STEM majors would make women students limit themselves based on their self-perceptions and produce gender inequity eventually. The attitudes towards women in science do not only exist in post-secondary institutions but also pervade popular culture. Movies, as product of popular culture, are part of this cultural milieu.

The Relationship between Movies and Audiences

Since the late 1890s, when motion pictures were invented, movies have played a vital role in meaning-making as a medium. Corrigan and White (2004) describe the movie as an art that is richly layered with cultural practices. This form of art is further described as creative and as a hybrid embedded in a matrix that moves between 'realism' and 'fantasy'; 'art' and 'entertainment'. Barsam and Monaghan (2010) argue that movies use a range of cinematic languages and techniques to connect the audience to the story. As a reflection of the cultures that produce and consume them, movies pervade our world. Even though most of us view movies as a product of mass entertainment and a product produced and marketed by large commercial studios, movies are not just about showing moving images. Most movies try to grab the audience's attention and take them into a pre-set world on screen. This leads to watching movies as a creative process of experiences, drawing people into an alternative world. Rizzo (2012)

reviews previous scholars' work and concludes that cinematic apparatus creates a sense of realism for audiences by concealing the means of film production and providing a "pre-existing subject position waiting to be filled" (p. 38). Although making a movie is expensive, moviemakers need to hide exactly how they make it from the audience. Hence, the audience gets lost in the screen world as the film's narrative unfolds. Moviemakers combine images, narrative, and sounds to give context and meaning to the stories in the movies. By storytelling, movie makers, as products of culture, consciously or unconsciously, often reproduce and perpetuate dominant discourses. Watching movies is more than leisure, but the process itself can be a productive time where information may be gathered and interpreted (Cloete, 2017). Therefore, movies are embedded within culture, and there is a complex relationship between movies, ideology, and audiences.

Moviemakers take audience expectations into account when making movies. According to Barsam and Monaghan (2010), giving audiences what they want is a key to entertaining consumers and in triggering their emotional responses. Bennett (1986) argues that the public are passive recipients of popular culture. Moviemakers, under this theory, treat audiences as containers that will receive, accept, and internalize the messages they want to convey.

However, whether media messages have direct effects on their audiences is debated by other scholars. Hall (1981) proposes that popular culture is not a one-way dissemination from a dominant culture to a sub-dominant culture, but a process of mutual flow. Melzer (2006) points out that "the production of meaning does not take place in a dualistic relationship" (p. 10).

Instead, the relationship between moviemakers, films, and audiences is multifaceted. Since the

movie is a cultural product, the interpretation of the product is not controlled solely by the makers' intentions. Many scholars discuss the shifting relationship between films in context and the women audience (see Kuhn 1984, Morley 1992, and Partington 1991). The content delivered by the movie is not always the same as that received by the audiences because of the audience-members multiple subjective positions. Some implicit messages may be interpreted beyond explicit messages.

Lucy, one of the films used in Task 3, for example, shows this polysemy of implicit and explicit messages. The movie tells the story of a woman who has her brain fully developed so she can control everything around her with her mind, but this power eventually causes her body to disappear. In this movie, movie makers show both a sexually-objectified and powerful female image contained within the body of the main character. Her power comes from an accidental drug leak into her system because she is forced to act as a drug mule by men. However, the drugs stimulate her brain's development and make her have the ability to pursue ultimate knowledge. The producers play with gender-linked expectations, perhaps unconsciously: the leading character embodies both stereotypic feminine-linked and masculine-linked traits. The point is that audience members will pick up on the traits differently, depending on their own subjective position. Furthermore, although Lucy's brain is fully developed, and she can control almost everything, in the end, she does everything in her power to pass the knowledge to her successor, a man, and her female body is immolated. While this movie can be seen as questioning contemporary masculinity, it also can be interpreted as reinforcing the current dominant masculine culture by destroying the female's body and reclaiming men's occupation of

knowledge.

As a cultural product, movies play a role in the socialization of women. Some research shows that children model their behaviors and expectations of women on media representations of femininity (Tuchman, 2000). The impact of movies unavoidably causes some concerns. Rosen acknowledges that movies have adjusted how they represent women over time, but she also argues that movies present distorted images of women and fill the heads of female audiences with these images (Rosen, 1975). While movies also present a distorted image of men, Rosen's research focuses on representations of women in all genres of popular cinema. Although women may be misrepresented differently in family dramas versus action films, her point is that they are usually misrepresented. Haskell argues that movies have reinforced a narrow definition of femininity (Haskell, 1987, p. 4). Rizzo (2012) indicates that the "feminine subject is understood through her relationship to the masculine subject and not through her own specificities" (p. 37). That is to say, women often see themselves through a male gaze. To clarify these arguments, Cook and Johnston used a concept that they call an "empty sign" (Cook & Johnston, 1988). They explain that in movies, men and masculinity are signified as the activity, while women and femininity, as the opposite of men and masculinity, are signified as passivity. In this way, women are represented as incomplete men, without any specificities that belong to women themselves.

When these ideas are applied to characters in movies, male audiences search for differences between themselves and female characters to establish their masculine identity, while women seek connection with women characters in movies. This may lead to female audiences'

identification with the idealized female image in the movie (Doane, 1987). To create an ideal woman who cannot be accessed is another way to fill in the empty sign. Rizzo (2012) claims that any universal concept for women dispels diversity between women, rather than creating the epitome of femininity. Since this epitome is often built on the assumption that the ideal woman is not like other 'ordinary' women, the ideal woman is perfect: she is a collection of all the characteristics that are opposite to masculine traits. Although she does not exist in the real world, she is meant to represent all women. Rizzo (2012) agrees with Doane's argument, which is that the generalized category 'woman' is "a process that eliminates women's differences so as to produce a singular generalized category or an ideal woman. As a result, this ideal is not actually accessible to women" (p.44).

As more and more scholars engaged with women's representations on the screen, in 1971, the first feminist film journal, *Women and Film*, was launched, marking the established inquiry into the relationship between feminism and film. Feminists have tried to enrich female images in movies through different kinds of expressions. For example, at the advent of feminist film studies, some feminists tried to express women more honestly and accurately by making documentaries (Kuhn, 1984). Since then, alternative images of women spread from documentaries to other movie genres, such as action, family comedy, and drama (Nulman, 2014). The expression of the women's representations is also deepened by exploring women's psychology rather than just presenting an image of women (Johnson, 2004). Pioneering feminist movies directly reject the norms and conventions of popular movies in order to produce alternative movie language that might provide "non-patriarchal" expressions (Hollows, 2012, p.

50). Various work by scholars suggests that complex women are replacing the traditional empty sign of women. As time moves on, there are more images of women in movies, including in the science fiction genre.

Women's Representations in Sci-fi Movies

People tend to think of sci-fi movies as speculation about the potential wonders of technological progress (Barsam and Monaghan, 2010). Black (2002) describes sci-fi movies as a literalist medium that can present objects not just based on reality but also on something that appears to be realistic. Because sci-fi movies often occur in the future, movie makers can speculate on the future effects of contemporary scientific trends. Through the technical means of various sounds and images, this beautiful fantasy is presented to the audience. From the technical performance of sci-fi movies, this rational imagination based on contemporary science provides audiences with plausible information, even though it is often not scientifically accurate. Frank (2003) concludes that sci-fi movies are good at blurring the distinction between fact and fiction. Additionally, more movie makers are willing to assume the future impact of contemporary culture and politics. Barsom and Monaghan (2010) suggest that "the genre's focus is on humanity's relationship with science and the technology it generates" (p. 89). This means that sci-fi movies can have a humanist orientation. Basu (2005) cites the viewpoint of Sobchack (1987) that science fiction tries to imagine an unexplored and unfamiliar situation by changing space and time, in which society or individuals, including women, are influenced by real or imagined science in the field of social interaction.

At the same time, women in real life are often marginalized by a variety of shackles.

These shackles not only restrict women physically but also mentally. As I will discuss in the next section, women are often conditioned by cultural beliefs, and this gender belief affects women's self-assessment so as to affect their education-path and career choices. DeRose (2006) makes a detailed connection between the definition of powerful and tough women. She believes that because of women's sexual objectification, women's voice and diversity are ignored and even erased from sci-fi literature. Basu (2005) also argues that some women strive for recognized status outside the family in real life, which echoes back to the above discussion that movies can provide different representations for women audiences and affect audiences' perspectives. Sci-fi movies have the potential and opportunity to portray women in a new and liberating light, and to portray them as different characters from traditional images of women in various media, including movies. To cater to the broad scope of women's desires, women expect to be portrayed differently, both in real life and in movies, and science fiction shows this potential (Basu, 2005).

As I have pointed out in the above section, Cook and Johnston argue that men are signified as the activity, while women are signified as passivity (Cook & Johnston, 1988). This active masculinity is often shown in movies with a male hero surrounding by females. Women are often relegated to the role of supporting actress or love interest. Basu (2005) analyzes the representation of women in 2,644 movie scenes in 50 sci-fi movies produced in the United States between 1930 and 2003 to check whether women's representations are different from previous research by examining demographic variables and behavioral traits, such as age, race, human/cyborgs, weight, height, dress, marital status, parental status, industry, and occupation. In previous studies, Basu notes that most female characters were described as young white women.

Their physical qualities were valued more than their intelligence. Their employment situation was often unclear or not very optimistic. Although the characters' marital and parental status became more and more unimportant with the passage of time in these movies, other aspects were still similar when Basu compared the sci-fi movies between 1930 and 2003. Basu (2005) concludes that there is no significant change in women's portrayal in sci-fi.

However, Matthews (2018) argues differently. Matthews (2018) analyzes Scarlett Johansson's role in four movies. In *Under the Skin*, her character is essentially an alien dressed as a human female. In *Her*, her voice is a computer operating system. In *Lucy*, the character's brain is fully developed due to a drug overdose, and she becomes an omniscient being who is eventually physically annihilated. In *Ghost in the Shell*, her character's body is fully mechanized, except that her brain is human. None of these representations are traditionally feminine-linked. Similarly, in the movie *Star Trek: First Contact*, movie makers provide a social order that relies on women, a "cyber-queen" (Balinisteanu, 2007). These women's representations are undoubtedly different from traditional, gentle, maternal female images. For instance, the cyber-queen in *First Contact* claims that she will bring order to chaos – often violently.

However, even with these non-traditional representations, Matthews (2018) argues that although the characters begin with female ascendancy, they conclude with the deterioration of the female character and with the reassertion of the very foundations of the male hegemony. One thing Matthews stresses is that Johansson's characters are all physically destroyed in the end, with men taking her place. Matthews argues that "each Johansson character is precluded from being understood in human terms...feminism is equated with dehumanization" (Matthews, 2018,

pp.10 - pp.11). Stevens (2018) suggests that *Lucy* reinforces the split between mind and body. She argues the Cartesian divide between mind and body is pervasive within sci-fi texts, and that it reproduces a sexist discourse that associates men and masculinity with the mind, and women and femininity with the body. Due to the continuous development of Lucy's brain, Stevens regards the gradual disappearance of Lucy's body as a compromise: Lucy's feminine-linked body (notably played by Scarlett Johansson) is immolated to the point where she becomes nothing more than a (masculine-linked) mind, downloaded into a computer system. Similarly, Lucy is not the only character who shows rebellion against masculinity but is eventually eliminated by men characters. The cyber-queen in *Star Trek: First Contact* is portrayed as a female authority that is a threat to the male hero in the film and is eventually erased (Balinisteanu, 2007).

Similar to Matthews and Stevens, Ying (2015) acknowledges that the role of women in some sci-fi movies is still within a framework that may reinforce the existing structure of patriarchy even in posthuman science fiction texts. But she also argues that the images of the female body interact with and resist the existing institutionalized system as well. She cites Mary Choy from *Queen of Angels* as an example. Mary is a policewoman who has chosen to have her body extensively altered by nanotechnology to enhance her abilities (like Scarlett in *Ghost in the Shell*). Ying sees the transformation as a coupling between the female body and the machine, thus breaking the boundary between the body and technology. The contradiction is that on the one hand, the woman's body is constructed by social culture, which means that women cannot get rid of the existing social and historical reality to view their bodies in a detached way; but on

the other hand, the female characters in sci-fi movies are not always gentle and feminine. Another example, as discussed by Allen (2018), is the representations of women in *Black Panther*. By not only supporting but also affecting the leading character, women show their ability to play significant roles in society; despite the women characters' roles as hierarchically secondary to, and in support of, the male lead, these different representations do offer up limited possibilities. Allen (2018) concludes that even though the realistic world we live in is not an ideal world, the different social possibilities offered by sci-fi films open the door for that possibility to become reality. Matthews (2018) and Stevens (2018) also acknowledge that science fiction provides space to explore and expand on the socio-cultural understanding of gender.

Women's Self-assessment and Gender Bias

Movies are part of a wider cultural milieu of institutions, which include educational settings and the workplace. In both the education field and workplaces, many efforts are made to create a more gender-equitable environment. However, Biernat (2003) proposes a "shifting standards model" (p. 1019), which explains that the same language often has different meanings when describing men and women. For instance, when men are evaluated as aggressive, it is usually offered and perceived as a compliment, not a criticism. However, when women are evaluated as aggressive, it is rarely offered or perceived as complimentary but taken as criticizing her gender performance as a woman. Biernat's argument examines the existence of implicit gender stereotypes, which is also supported by Banaji, Hardin, and Rothman (1993). The latter group conducted three studies to show implicit, unconscious, stereotypes in personal

evaluations. The results show that the more participants are exposed to an idea or environment with high stereotypes, the more likely they give an extreme judgement. These results indicate that “a target’s social category determines the influence of previously exposed stereotyped information” (Biernat, p. 272). Biernat (2003) also suggests that these implicit stereotypes reflect two expressions of gender bias on a behavioral level. Either a target’s behavior in a certain category reinforces these stereotypes, or members of negatively stereotyped groups are treated more favorably. Eagly and Carli (2007) also claim that stereotypes, as a social construction, encourage women and men to become people with certain qualities, and thus become embodied as being representative of a certain group.

When it comes to the workplace, these biases also exist behind the curtain. Bowen et al. (2000) find that gender-relevant meanings associated with rating measures can trigger gender biases. Leadership roles, which are defined in relatively masculine terms, favor men as leaders, for example (p. 2210). The qualities that people expect leaders to have overlap with those stereotyped qualities of men (Eagly & Carli, 2007). Accordingly, Eagly and Carli (2007) argue that the bias that defines a woman leader comes from the mismatch between people’s mental associations about women and leaders, and eventually leads to a uniform bias that can prevent women at all ranks from getting promotions (p. 73).

Many researchers have suggested women’s self-assessment would affect women’s career and education choices (see Bowen et al., 2000; Casad et al., 2019; Correl, 2001; Dasgupta & Asgari, 2004; Fouad et al., 2017; Ganley et al., 2018; Jugović, 2017; Powell et al., 2009). Casad et al. (2019) and Jugović (2017) point out that women in STEM majors often exhibit lower self-

assessments than their male counterparts, despite their skill level. Casad et al. (2019) attribute women's low self-assessment to unwelcoming academic environments in STEM majors. Jugović (2017) investigates how low expectancy of success hinders women's self-perception of their ability, which is the strongest predictor of school grades. However, the unwelcoming academic environment, as well as low expectations for success for - and from - women, grows out of the gender stereotypes that contain specific expectations for competence, representing what we think most people believe or accept as true about the categories of men and women.

Gender-linked perception, as a product of cultural and social gender norms which define and police gendered behaviours, acts as an intersection between gender stereotypes and women's self-assessment, which contributes to gender stereotypes and is also an essential reason for the formation of self-assessment. Correll (2001) analyzed 18,000 samples from a national educational longitudinal study of 1988 and the follow-up studies in order to test whether gender norms and ideology would affect personal evaluations and later career choices. Both gender-linked perception and performance feedback affect students' self-assessment. Female students face lower math competence from gender belief levels and rely more on positive performance feedback. Correll (2001) believes that this is because female students lack support due to social expectations of success in math, and that they rely more on local evidence (p. 1974). Regardless of whether gender beliefs are personally endorsed or internalized as other people's expectations, female students often lead themselves to biased negative self-assessments of their math ability.

Because women often internalize existing gender-linked perceptions and norms, they can have a bias in their own evaluation. Furthermore, even if they have not personally internalized

the gender belief, but enter a group that has accepted it, they will face lower ratings, and / or harassment, which may also bring their self-assessment down due to the lower performance feedback. Correll (2001) is concerned that implicit stereotypes and gender beliefs would make students voluntarily enter a particular career field; while this seems voluntary, in fact it is an involuntary process. However, gender belief is not fixed. Dasgupta and Asgari (2004) suggest that self-assessment or gender belief can be influenced and changed. Their social psychology research found that the more women see counter-stereotypical in-group members, the more their automatic gender stereotypes become undermined. At the same time, Dasgupta and Asgari's data also suggests that conscious reflection and subjective interpretation of the counter-stereotypical individuals' success as attainable for those in-group may further contribute to non-conscious stereotype change. This finding also aligns with the subjectivity of the audience's reflection on movies. Thus, showing non-traditional representations in sci-fi movies to female students may lead them to rethink current women's situations and their own position in society and capabilities.

As Correll (2001) asserts, systematic gender bias and women's self-assessments often influence women's education-path choices, making some involuntary choices seem voluntary. Casad et al. (2019) examine the unwelcoming academic environment's function in women's engagement in STEM, and point out that the unwelcoming local environment fosters women's gender stigma-consciousness, which leads to gender-based rejection sensitivity which would predict negative perceptions of the campus' academic environment. The more a negative academic environment exists, the more women students experience stereotype threat, which

leads more women students to have a low self-esteem and a sense of disengagement from STEM domains. Eventually, women students leave the domains occupied by men. Interestingly, Casad et al. (2019) also notice that women are not underrepresented in all STEM sub-majors. If the proportion of women in sub-majors surpasses the proportion of men, women are less likely to feel the disengagement. Ganley et al. (2018) dig more into this phenomenon and propose that students assign different traits to different majors. When these perceived traits are against femininity and are more masculinity-linked, it creates an unwelcoming campus climate to women. This campus climate would contribute to the lower proportion of women in these fields. Therefore, from both the internal level of women's self-assessment and the external level of systematic gender bias and campus climate resulting from it, many women are excluded from certain educational paths.

Eagly and Carli (2007) explain the existence of gender discrimination in the workplace through wage and promotion, and argue that men earn more than women. Even after controlling for variables, such as work experience and education level, the gap between men's earnings and women's earnings narrows but does not disappear. In terms of women's career promotion, Eagly and Carli's (2007) results showed that women are promoted more slowly than men. Although the authors acknowledge that women are more popular in feminine-linked jobs, women are also faced with the "glass escalator" that benefits their male counterparts: men are promoted more quickly than women in female-dominated fields, often despite seniority. Besides this, men are more popular in gender-neutral jobs, suggesting that the jobs are not gender-neutral at all.

Students tend to link typical STEM majors such as engineering to high wages (Ganley et al.,

2018), but women in these fields are less likely to get a promotion. Women's difficult promotion path is also reflected in Fouad et al.'s (2017) work. Fouad et al. (2017) examine women's reasons for leaving the engineering field, and report the lack of promotion as a factor that negatively impacted women's retention. Other influences such as occupational values and needs related to comfort, safety, and achievement, predominantly characterized female engineers' attrition decisions. Correll (2001) also noticed that the proportion of women in male-dominated areas from middle school to workplaces has decreased continuously. Women who stay in the field use some strategies to ensure their positions. Powell et al. (2009) find that either women accept the discrimination and work hard to gain a reputation, or they play up their feminine-linked gender traits to gain favors. These strategies echo back to two expressions of gender bias on the behavioral level (Biernat, 2003): if the women play by the rules to gain a reputation, they reinforces the existing stereotypes; if they treat themselves as a member of negatively stereotyped groups, such as women, they are treated more favorably. All these strategies result in women's implicit and explicit devaluing and rejection of femaleness, and in many ways uphold an environment that is hostile to women. However, as I discussed above, sometimes women appear in sci-fi movies as masters of STEM and take on leadership roles, and such representations could disrupt both women's self-perception and the attitude towards women who enter STEM majors. In this way, sci-fi movies with strong female leads could be presented in the classroom as a teaching pedagogy that promotes women's STEM participation.

Movies as A Teaching Pedagogy

Movies, as earlier stated, can affect audiences' ideas, and play a vital role in students'

life. One statistic shows that the average time American students (ages 10-22) spend on TV and movies per week had reached more than eleven hours (Barnett & Kafka, 2007). Watching TV and movies has become a part of our daily life. Much research examines whether using movies in the classroom is helpful, and how movies affect students' learning process.

Icen and Tuncel (2019) conducted a case study to investigate the effect of using movies as a teaching method in 7th grade students' learning process. Teachers played three movies during the social studies classes, then examined the students' acquisition of skills and values. The results show that movies have a significant effect on teaching social phenomena and abstract concepts, such as communication and human relations, and they play an important role in transferring social facts and thoughts into lived meaning and emotions. Movies also provide a productive learning environment and motivate primary school students. Icen and Tuncel's results are in line with other researches'. For example, movies are more memorable compared with hands-on, short-term, memory-based learning (Barnett et al., 2006). Middle school students are not alone in the trend of seeing movies in the classroom. Similar results occurred in research with undergraduates. According to the study conducted by Serpen et al. (2018) with undergraduates majoring in social work, viewing gay-friendly mainstream movies contributed to a reduction in prejudice against the gay community. Therefore, the authors suggest watching these movies as an important component of social work education to enhance the acceptance of diverse sexual orientations.

Previous studies have been conducted to check sci-fi movies' effects on students' understanding of science. Barnett et al. (2006) concern themselves with the idea that plausible

images shown in movies could mislead students into a non-scientific track. Challenges do exist.

When students were shown a single sci-fi movie, some acquired a misunderstanding of scientific concepts (Barnett et al., 2006). However, Barnett et al. also acknowledge that sci-fi movies' special effects raise interest in science and deepen students' understanding of unfamiliar concepts. Other researchers expand this area to both students in science-related and non-scientific courses. For science-related courses, Barnett and Kafka (2007) introduced two episodes from two sci-fi movies to attempt to improve students' capacity for critical thinking about science. The results show that movies can be used to assist in identifying students' perceptions about a topic and foster discussion in class. For non-scientific courses, Laprise and Winrich (2010) organized courses in a business college to promote curiosity and respect for the sciences by encouraging analyses of "science fact" versus "science fiction" portrayed in popular culture. After screening sci-fi movies in classes, they asked students to create written work that offers a critique of movies for scientific accuracy. Students mostly responded positively to the open-response questions, and most students enjoyed watching and critiquing the movies. Therefore, although there are some challenges, introducing sci-fi movies into classrooms can be a useful pedagogical tool for motivating students and developing critical thinking.

Sci-fi movies are also a subject of feminist scholarly analysis. DeRose (2006) offered a course lasting one semester to undergraduate students, using sci-fi literature and film to encourage people to rethink the status and power of women in contemporary culture. During this course, DeRose fostered class discussions to cultivate students' critical thinking and participation in various discussions on power issues, especially the potential of women's non-violent

empowerment, as well as the need for various images representative of "powerful women" in contemporary society and media. In the written assignment at the beginning of the semester, students were asked to come up with their own science fiction stories about women's power and explain the types of definitions of power they used in the stories. In most proposals, the heroines were women in military combat, who could fight side by side with the men, thus reflecting a masculine-linked subjectivity and power associated with women. After some class discussions, many students offered to rewrite their stories. At the end of the semester, the author received 25 science fiction pieces, most of which were non-violent. Both the discussions and the written assignment, as much as the reflection on sci-fi materials they watched and read in class, inspired students to think not only about women's rights, but also about issues related to power and social justice, moving from the starting surface-level of thinking "what if it was different?" to thinking more deeply about "why is this reality?". Therefore, DeRose uses her own experience to show that after learning various feminist theories, viewing science fiction films, and participating in classroom discussions, students discovered a non-violent definition of power.

In this Task, I have examined some previous studies to build the connections between women students' gender-linked perceptions, women in STEM fields, sci-fi movies in the classroom, and women's representations in sci-fi movies. These discussions respond to my research questions that asks how representations of technologically-knowledgeable women in sci-fi movies could shape women students' career-linked self-perceptions. In order to evaluate whether or not women's self-perception could, indeed, be affected by external factors, such as women's representations in sci-fi movies, I carried out surveys and questionnaires that measured

women's embedded gender-linked self-perceptions about careers. The surveys build on the literature review by providing connections between women's self-perception and movies' effects and provide hard data that illustrates the effectiveness of using sci-fi movies in the classroom to affect women's career-linked self-perception.

Chapter Three: Methodology

In Task 2, I explain the methodology, particularly: the consideration of my research design; principles of sample selection and how I chose them; the analysis of the representation of women in the movies I required participants to watch; and the data collection process.

Research Design

Women are still under-represented in STEM majors, or more specifically, in masculine-linked majors, and I explored some of the academic literature that explains the reasons hidden behind this phenomenon. By analyzing the relationship between movies and audiences, women's representations in sci-fi movies, and using movies in the classroom, I built the connection between using sci-fi movies in class and women students' gender-linked perceptions. My portfolio Task also aims to reveal women students' gender-linked career perceptions after watching sci-fi movies. I decided to conduct the present research using both qualitative and quantitative methods (Merriam & Tisdell, 2016). The quantitative method is a timed survey, and the qualitative method is questionnaires regarding career-linked perceptions. Creswell et al. (2003) argue that mixed methods are appealing to researchers who do not give up their exploration even though the information of existing research steps is limited. Taking their lead. I used a quantitative method to test the existence of internalized gender-linked perceptions and then used a qualitative method to further explain the reasons behind the existence of the quantitative data, so as to provide educators with a tool for gender education reform.

According to Creswell and Creswell (2018), surveys provide “a quantitative description of trends, attitudes, and opinions of a population, or test for associations among variables of a

population, by studying a sample of that population” (p. 147). The purpose of the survey I designed for Task 2 aims to test whether women students associate certain careers with a certain gender, and whether watching counter stereotypic women’s representations in sci-fi movies can undermine gender-linked associations.

Since the gender belief about different careers is often embedded in women’s perceptions, I reasoned that a first-reaction survey would help me to find the turnaround in women’s perceptions on career-linked gender distribution. This survey was held twice, the first before participants watched movies with untraditional representations of women leads, and the second after participants had watched the movies. The instruments were two lists with a similar distribution of gender-linked careers. The number of careers traditionally held by women is similar to that traditionally held by men in the two lists. The participants were asked to give a first response whether they think the job is more likely to be done by a woman or a man. Two variables were tested during the survey responses, one was the response time (RT) between the career name and the participants’ identification of its gender link, the other was the number of careers participants linked specifically to men and/or women. Smith and Henry (1996) found that individuals respond sooner when they identify themselves as the in-group example. Thus, in the current research, the RT would be shorter if the participants believed the traits of a career match the traits of their gender. I assumed that these two variables would be helpful in finding the embedded gender-linked perceptions associated with different careers. By comparing these two variables, I expected to be able to find whether there is a change in gender linked attitudes after watching different representations of gender roles in sci-fi movies.

As previously discussed, women students may internalize the gender-linked perception that they are inferior to men, or inappropriate in some fields, because they have learned through gender socialization and norms to link a certain gender with a certain career. However, some studies show that automatic beliefs are not invariable but can be modified by changing the social environment around them (see Dasgupta & Greenwald, 2001; Macrae et al., 1995; Wittenbrink et al., 2001). Dasgupta and Asgari (2004) demonstrate that exposure to counter stereotypic images can disrupt gender stereotypes. My current research situates sci-fi movies as a part of the social context around women students. Hence, to give context to the RT in the first activity, I designed qualitative questionnaires with open-ended questions about the participants' self-perceptions on career-linked path choices, whether these choices have changed as they grew up, and who/what affected this process. After the participants watched the movies, they filled in another questionnaire related to the movies, in order for me to analyze the change of participants' cognition of women's potential professional identity and determine how education can play a role in career-linked perceptions. With the mixed method, I hoped to establish a valid set of data for educators' teaching-based consideration.

Sample/Participants

Considering the time and geographical limitations, and because the initial purpose of this portfolio is to empower women students in higher education regarding their career-linked self-perceptions, I decided to conduct a two-stage response activity with eight to ten current women students at Lakehead University. I placed no restrictions on the academic majors of the participants. Women students of any major could participate. Firstly, as mentioned above, gender

bias is ubiquitous, not just in STEM fields. Implicit gender stereotypes encourage women to conform to the stereotypes of a certain group, thus influencing women's behaviors. In other words, as the work of Eagly and Carli (2007) showed, women in any major will face similar professional challenges in the workplace, not just STEM majors. Secondly, as stated earlier, gender norms may affect a woman's self-perceptions and career-linked educational choices, and my portfolio focuses on providing curriculum developers with data about women students' possible transitions away from traditional gender norms after watching sci-fi movies. Women students in any major can involve themselves in the possible transition process, not just women students in STEM majors. In other words, while women who have chosen STEM majors are important, educators should also focus on women who have not chosen STEM majors to explore the underlying causes of this lack of choice; for example, why they refused to enter STEM majors, and how education affects their choices, so as to explore possible changes in education. The participants were asked to watch three movies between the two response activity surveys and questionnaires: *Aliens* (1986), *Lucy* (2014), and *Arrival* (2016).

Women's Representations in *Aliens* (1986), *Lucy* (2014), and *Arrival* (2016)

In *Aliens* (1986), Ripley, the female protagonist, represents a confluence between two seemingly opposite social roles: an astronaut and a mother. In the traditional structure of a binary conception of gender, these two images represent masculinity and femininity respectively. The concept of an astronaut mother serves to "disrupt the system by which women are seen to make choice between motherhood and other forms of self-realization" (Lovell, 2019, p. 78). As an astronaut, Ripley is an elite professional warrant officer and former commander of a spaceship.

She is calm, firm, rational and professional. But what we can also see is that her professionalism does not make her popular. She is not trusted by the judge at the hearing about what happened to her first ship, the *Nostromo* (destroyed by her in the film *Alien* in order to kill the xenomorph that attacked her crew), and doubted by the male company representative. Furthermore, all her clothing is masculine or androgynous. Even on earth, she does not wear feminine clothing. Eisenhart and Finkel (1998) believe that this is because, in male-dominated fields, only when a woman acts like a man would her professional contribution be recognized. In *Aliens* (1986), some of the horror of the movie revolves around Ripley's anxiety about being a mother and/or fulfilling a mothering role to the child Newt, the sole survivor of the alien attack on the planet LV-426. While Ripley was drifting in space in the time between *Alien* and *Aliens*, her daughter died on earth; when she got back into space, she saved the orphaned girl Newt, who became her surrogate daughter. In the movie, Ripley is not only a female astronaut, and a former ship commander, but she is also a mother who failed her birth daughter (Lovell, 2019). What is more, the movie ends with a big fight between her and the Alien Queen. She kills the Queen's eggs and banishes the queen to space, showing the complexity of motherhood as both nurturing and potentially violently protective.

In *Lucy* (2014), the titular character obtains psychokinetic abilities by absorbing a nootropic drug through her blood. The drug unlocks her mind, enabling her to access more of her brain capacity - eventually 100%. As her brain develops, Lucy's powers become stronger and stronger, her emotions gradually drain away, and finally she gains all the knowledge of the universe and her body disappears. The story appears to be of a woman gaining power and using

it against her oppressors – she uses it to escape from and destroy the men who forced her to work as a drug mule. However, some scholars disagree with this more positive, empowering reading. Stevens (2018) argues that Lucy's emotional loss is symbolic of her losing her femininity, because emotion is usually regarded as feminine-linked. Matthews (2018) points out that at the end of the movie, Lucy leaves all her knowledge to a male scientist, which means that men who master knowledge can create power again, a regression to "an established patriarchal order of knowledge and power" (p. 26). In addition, Matthews (2018) also argues that the elimination of women's bodies in film, as happens in *Lucy*, represents an annihilation of femininity.

In *Arrival* (2016), the heroine Louise is a linguist who uses mathematical formulae to do her work, and who has gained the ability to see into the future by interpreting an alien language. The movie does not focus too much on the construction of a grand sci-fi scene, like the final showdown between Ripley and the Alien Queen in *Aliens*, but instead highlights how Louise, as a linguist, interprets the alien language using mathematical methods. After gaining the ability to see into the future, Louise sees that her future daughter, Hannah, will die of a disease, but at the end of the movie Louise decides to give birth to her anyway. Most of the plot takes place before Hannah is born using a temporal shift technique. The movie begins with Louise's account of losing her daughter, and it is not until the end of the movie that the audience realizes it has not happened yet. Carruthers (2018) argues that this kind of narrative structure will inspire the audience to think about life and death, and that it also raises crucial questions about pregnant embodiment. For the purposes of my portfolio, it is the pregnant embodiment of a mathematically-based linguist that is useful in disrupting traditional images of women.

In the three movies, sci-fi provides “an imagining space that agitates gendered, raced or classed truths” (Brabazon, 2002, p. 142), whether that be from the representations of the women, or from the story’s text, different interpretations can be obtained from different perspectives: how to interpret these representations depends on the audience. All three characters can be read as both masculine- and feminine-linked. The purpose of using these three movies was to observe how participants would interpret them, and to observe their gender-linked perceptions about careers.

Data Collection

In order to recruit participants for this study, I made a recruitment advertisement and posted it on campus. The participants included eight women students who are currently studying at Lakehead University’s Thunder Bay campus. Five of the participants are graduate students and three of them are undergraduate students. The participants come from various programs: one from Education, two from Social Justice, two from Engineering, one from Nursing, one from Natural Resources Management, and one from Physics. In order to protect the privacy of participants, my correspondence with all participants was via BCC email. All questionnaires were assigned with different title numbers to provide anonymity for all participants. Each participant signed the consent letter prior to participation, with the understanding that a.) they can withdraw at any time, b.) all data will be securely stored and cared for, c.) they will be video recorded during the response activity for analysis, and d.) the final paper will be sent to them by request. There were three participants who requested an electronic edition of the final Portfolio, and it will be sent to them when the Portfolio is completed. The project received Research

Ethics Board approval.

The first response activities were held in two separate groups to accommodate students' schedules, one at the Paterson library's study room and the other in the graduate lounge in the Bora Laskin building. I read the participants a list of careers (see Appendix A) that link to traditionally gendered careers, and had them identify whether, in their view, a man or woman were more likely to do the job. Blue and pink cards were used (perhaps ironically) to link to different gender-linked jobs. If the participant thought a job were more likely to be done by a woman, she held up a pink card. If the participant thought a job were more likely to be done by a man, she held up a blue card. If the participant thought a job was likely done fairly equally by both genders, she held up both the blue card and pink card. Throughout the session, participants were asked to a.) close their eyes to avoid being influenced by other participants and b.) give the first reaction of their gender-linked identification as quickly as possible. Next, the participants filled in a questionnaire related to professional perceptions. The questions in the latter tool aimed at a.) finding participants' previous career-linked options at childhood and their current ones, b.) education's role in their current career-linked options, and c.) the events that affected their career-linked path choices since childhood. Then the participants were asked to watch *Aliens* (1986), *Lucy* (2014), and *Arrival* (2016) on their own time over two weeks.

In the week after they watched the movies, the second response activities were held at the same places as the first response activities in order to maintain the data's stability. I read them a different, but similarly-gender-distributed list of career choices (see Appendix B) to see if there were a difference in response time or attitude change in their gender-linked responses. They

showed cards as quickly as possible to identify their gender linked attitudes with their eyes closed, as before. Then the participants filled in an exit questionnaire about the movies. The questions that were presented examined a.) the character traits valued by participants, b.) the gaps/links they see between themselves and these traits, and c.) the person who affected them the most in their career-linked path choices.

Each response activity took about 10 minutes to complete, and filling out the questionnaire took about 20 minutes. 60 minutes were taken in total to perform all response activities and complete the questionnaires. There was one participant who did not show a gender-linked identification for the job of clinical research associator, and the data analysis is presented in the next chapter as the findings of this research to fulfill Task 3, providing an evidence-based report for educators.

Chapter Four: Results

Data Analysis

Tables 1 and 2, respectively, show the following data in the two response activities: a.) gender-linked identification of each occupation, that is, how many participants think each occupation would usually be undertaken by men or women, or both; b.) the longest (LRT), shortest (SRT), median (MRT), and mean response times given by the participants for each occupation assumed to be a certain gender. Through the comparison of multiple response times in the two activities, the gender attitudes and changing trends in the views of the participants towards a certain occupation was revealed. For example, a shorter response often reflects embedded gender attitudes toward an occupation, while a longer reaction time reflects more thinking time, and less internalized gender stereotypes. Dasgupta and Asgari (2004) used a similar method to illustrate that automatic beliefs related to gender can be modified.

In addition, when multiple participants made the same gender judgment for an occupation, except the longest and shortest response times, the median response time (MRT) was also marked to show other participants' perceptions of the occupation instead of using the mean time. This is because in the calculation of the mean value, the change of any value in the sample will affect the final calculation result. If there is a huge outlier change in one value, the mean value may be invalid. Therefore, to avoid the effect of this difference on the sample, the median time is used in the table. Median time refers to the middle time in the sorted list of times, which can be more descriptive of the data set than the mean time.

Table 1 *Gender-linked identification for 1st response activity*

career name	Male linked				Female linked				Both gender linked			
	NO.	LRT	SRT	MRT	NO.	LRT	SRT	MRT	NO.	LRT	SRT	MRT
IT Supporter	5	3.22"	0.79"	0.99"	0	N/A	N/A	N/A	3	1.88"	0.35"	0.51"
Software Programmer	4	2.93"	1.03"	1.66"	1	0.28"	0.28"	0.28"	3	1.63"	0.28"	0.68"
Senior Controls Engineer	4	2.27"	1.18"	1.53"	0	N/A	N/A	N/A	4	1.52"	0.20"	0.78"
Clinical Research Associate	0	N/A	N/A	N/A	5	2.12"	0.43"	0.73"	2	0.68"	0.36"	0.52"
Crime Scene Investigator	0	N/A	N/A	N/A	1	3.26"	3.26"	3.26"	7	2.24"	0.20"	0.40"
Analytical Chemist	1	2.50"	2.50"	2.50"	2	3.00"	0.98"	1.99"	5	2.30"	0.34"	0.92"
Medicinal Chemist	2	2.45"	1.47"	1.96"	2	2.80"	1.73"	2.76"	5	2.80"	0.52"	0.57"
Science Writer	1	0.54"	0.54"	0.54"	2	2.82"	1.83"	2.33"	5	3.12"	0.47"	0.90"
Surveyor	2	2.43"	2.28"	2.36"	1	1.34"	1.34"	1.34"	5	3.89"	0.35"	0.60"
Pilot	2	2.39"	1.56"	1.98"	1	3.50"	3.50"	3.50"	5	1.28"	0.76"	0.88"

Customer Care Associate	0	N/A	N/A	N/A	4	2.80"	2.12"	1.48"	4	2.43"	0.83"	3.11"
Sales Associate	0	N/A	N/A	N/A	2	1.52"	1.52"	1.52"	6	1.52"	0.60"	0.98"
Cashier	0	N/A	N/A	N/A	1	1.83"	1.83"	1.83"	7	1.48"	0.37"	0.78"
Store Administrator	2	2.43"	2.00"	2.22"	1	0.99"	0.99"	0.99"	5	1.99"	0.74"	1.76"
Customer Service Representative-on-call	0	N/A	N/A	N/A	0	N/A	N/A	N/A	8	4.49"	0.64"	2.26"
Grocery Clerk	0	N/A	N/A	N/A	1	1.91"	1.91"	1.91"	7	3.18"	0.72"	1.88"
Front Desk Host	0	N/A	N/A	N/A	2	1.40"	1.00"	2.20"	6	1.67"	0.30"	0.87"
Office Assistant	0	N/A	N/A	N/A	1	1.40"	1.40"	1.40"	7	2.16"	0.27"	1.41"
Business Development Specialist	1	0.40"	0.40"	0.40"	1	3.09"	3.09"	3.09"	6	1.94"	0.36"	0.64"
Mean reaction time	N/A	2.16"	1.38"	1.61"	N/A	2.13"	1.7"	1.91"	N/A	2.22"	0.46"	1.08"

Note. LRT = longest response time; SRT = shortest response time; MRT = median response time. N = number.

Table 2 *Gender-linked identification for 2nd response activity*

career name	Male linked				Female linked				Both gender linked			
	N	LRT	SRT	MRT	N	LRT	SRT	MRT	N	LRT	SRT	MRT
Market Development Manager	0	N/A	N/A	N/A	0	N/A	N/A	N/A	8	2.65"	0.63"	1.13"
Pet Care Specialist	0	N/A	N/A	N/A	3	1.34"	0.75"	1.20"	5	2.67"	0.24"	0.87"
Post Office Assistant	2	2.08"	0.92"	1.50"	1	1.81"	1.81"	1.81"	5	0.96"	0.40"	0.71"
Curriculum Developer	0	N/A	N/A	N/A	2	0.99"	0.28"	0.64"	6	1.15"	0.51"	0.79"
Education Assistants	0	N/A	N/A	N/A	1	1.36"	1.36"	1.36"	7	1.44"	0.40"	0.66"
Movie Editor	1	2.64"	2.64"	2.64"	0	N/A	N/A	N/A	7	2.66"	0.52"	0.92"
Psychologist	0	N/A	N/A	N/A	2	1.19"	0.92"	1.06"	6	1.84"	0.36"	0.70"
Judge	0	N/A	N/A	N/A	0	N/A	N/A	N/A	8	2.71"	0.68"	0.99"
Photographer	0	N/A	N/A	N/A	0	N/A	N/A	N/A	8	1.92"	0.50"	0.63"
Climate Change Analysts	1	2.68"	2.68"	2.68"	0	N/A	N/A	N/A	7	1.64"	0.20"	0.58"

Dentists	2	3.20"	0.72"	1.96"	1	1.25"	1.25"	1.25"	5	2.04"	0.65"	0.88"
Economists	2	1.57"	1.43"	1.50"	1	1.24"	1.24"	1.24"	5	2.97"	0.40"	0.88"
Geographers	0	N/A	N/A	N/A	0	N/A	N/A	N/A	8	2.88"	0.48"	0.85"
Political Scientists	1	1.20"	1.20"	1.20"	0	N/A	N/A	N/A	7	1.89"	0.43"	0.72"
Wildlife Biologists	1	0.43"	0.43"	0.43"	2	1.92"	0.96"	1.44"	5	2.00"	0.38"	1.00"
Ship & Boat Captain	4	2.48"	0.80"	1.62"	0	N/A	N/A	N/A	4	1.76"	0.52"	0.66"
Accountant	0	N/A	N/A	N/A	1	1.28"	1.28"	1.28"	7	1.51"	0.36"	0.98"
Audio Engineer	1	1.84"	1.84"	1.84"	0	N/A	N/A	N/A	7	3.16"	0.40"	0.60"
Astronaut	1	1.37"	1.37"	1.37"	0	N/A	N/A	N/A	7	1.06"	0.30"	0.56"
Mean reaction time	N/A	1.58"	1.20"	1.67"	N/A	1.38"	0.88"	0.97"	N/A	2.05"	0.55"	0.80"

Note. LRT = longest response time; SRT = shortest response time; MRT = median response time. N = number.

Embedded Gender-linked Perception on Careers

In both Tables, participants showed some gender-linked perceptions between occupations and specific genders. In the first response activity, half or more of the participants connected the IT Supporter, Software Programmer, and Senior Controls Engineer with men, while Clinical Research Associate and Customer Care Associate were considered more likely for women. Five participants associated a Clinical Research Associate with women and four with Customer Care Associate. In the second response activity, four participants believed that the Ship & Boat Captain should be held by a man, while the Pet Care Specialist received three female-linked votes. One participant felt that her personal experiences had influenced her judgment, stating that if, in her daily life, she sees a certain occupation being performed by a certain gender, she was more inclined to associate that occupation with that gender.

In addition, some of the occupations in Tables 1 and 2 show an inverse gender connection. This reversed gender-linked perception manifests as the perception that participants may connect to women in occupations with strong masculine characteristics; however, participants were less likely to associate men with occupations associated with feminine-linked traits. IT Supporter, Software Programmer, Senior Controls Engineer, and Ship & Boat Captain were all associated with men by half or more of the participants, while the remaining participants identified the three occupations as being linked to both genders. Interestingly, one participant links Software Programmer to women. The Clinical Research Associate and the Customer Care Associate were rated as female-linked careers by half or more of the participants, respectively. Again, the rest of the participants thought both occupations could be performed by both men and women. However, none of the participants linked the two occupations to men. What is noteworthy is that the inverse gender connection diminished after watching movies. Not only did

the number of careers linked to men decrease, but also the number of careers linked to women. No career with more than half the vote was considered to be exclusively female-linked in the second response activity. The career with the most votes, Pet Care Specialist, had only three votes, not more than half.

Table 3 *Changes of Career Choices*

Participant	Current Career Choice	Childhood’s Career Choice
Education student	<ul style="list-style-type: none"> • College program developer/professor on social sciences (Especially community-based courses) • Academic(researcher/prof/writer) (long term...) • Academic guidance counselor for students in college 	<ul style="list-style-type: none"> • Teacher (elementary or high school) • Writer/comedian (performer?) • Archeologist
Social Justice student A	<ul style="list-style-type: none"> • Teach at either the college or first year university level 	<ul style="list-style-type: none"> • Architect
Nursing student	<ul style="list-style-type: none"> • Registered Nurse • Nursing practitioner • Pediatrician (Doctor) 	<ul style="list-style-type: none"> • Chef • Related to medicine • Doctor
Engineering student	<ul style="list-style-type: none"> • Engineer • Salesman • Teacher 	<ul style="list-style-type: none"> • Scientist • Mathematician
Natural Resources Management	<ul style="list-style-type: none"> • Forester • Conservationist • Conservation Officer 	<ul style="list-style-type: none"> • Veterinarian • Paleontologist
Physics student	<ul style="list-style-type: none"> • Researcher • Astrophysicist • Astronomer 	<ul style="list-style-type: none"> • Architect • Special FX artist • Mechanical Engineer
Social Justice student B	<ul style="list-style-type: none"> • Lawyer • FBI agent • Real-estate agent 	<ul style="list-style-type: none"> • Doctor • Pilot • FBI agent
Engineering student	<ul style="list-style-type: none"> • Business part of engineering department either, marine or robotic companies • Air Traffic Controller • Food blogger or chef 	<ul style="list-style-type: none"> • Veterinarian

As shown in Table 3, participants' current career choices were mostly neutral, and did not show a strong feminine-linked tendency. However, their career vision in childhood shows a relatively obvious tendency of gender orientation to male-linked careers. In other words, from childhood to the present, the participants' career choices mostly shifted from male-neutral to neutral. However, even some ostensibly gender-neutral career choices tend to be feminine-linked. For example, one participant expressed her desire to become a human rights lawyer. Human rights lawyers tend to be more feminine-linked than finance or real-estate lawyers. However, the selection of this participant was an exception to the pattern. An engineering student changed her career choice from a feminine-linked veterinarian to masculine-linked engineering work, but even with this exception, the student keeps food blogger or chef as alternate career choices, both unrelated to her STEM major. Almost every participant keeps feminine-linked careers in their current career choices, therefore, gender linked perception was reflected in both response activities and subsequent questionnaires.

Changes of Gender-linked Perception on Careers

The data from this study suggests that gender-linked perception is not unbreakable, as demonstrated in the response activities and the results of the questionnaires. Dasgupta and Asgari (2004) found that exposure to images of counter-stereotypic women leaders undermined women's automatic gender stereotyping. Tables 1 and 2 show a decline in the total number of occupations directly associated with a gender by the participants. At the first response activity, three occupations were identified as male-linked by half or more participants and two were identified as female-linked careers. These numbers all fell to one during the second response activity. In contrast, the number of careers linked to both genders rose in the second response. At the time of the first response activity, 16 occupations were considered by more than half of the

participants to be linked to both genders. That number rose to 19 after the second response activity. Notably, one participant held up a pink card (female linked) first, then a blue one (male linked), when confronted with the occupation of Medical Chemist. Whether more occupations were considered as both-gender-linked in the second response activity or some participants were hesitant about their gender choices on careers, it shows that gender-linked perception is not fixed.

Reaction time (RT) indicates a subconscious gender perspective (Smith & Henry, 1996). When an occupation is automatically associated with a gender by an individual, it reflects their gender perception of the occupation, while a longer RT implies that more thinking is involved in the decision-making process. In the two response activities, the number of occupations considered to be linked to both genders increased, while RT decreased correspondingly (the mean reaction time of median RT dropped from 1.08'' to 0.80'', while the mean reaction time of shortest RT increased slightly from 0.46'' to 0.55''), this demonstrates that participants made choices faster. Interestingly, in both response activities, although fewer participants considered a certain occupation to be a female/male linked job, the mean RT for making a specific connection between a certain occupation and a certain gender also decreased.

As discussed above, audiences are influenced by movies. They may not only accept the intention of the movie creators, but also reflect on the content of the movies (see Hollows, 2000; Melzer, 2006). This kind of personal reflection leads to movies having multiple meanings, and makes watching movies a creative process. After the participants watched the movies, they were asked to answer the following questions: Who was your favorite character from the films you watched and why? Do you feel a particular connection to your favorite character, and why? These questions aimed to analyze women's gender-linked perceptions and the traits they valued.

From the questionnaires, the participants' preferred roles were the heroines of the three movies. However, their use of language reveals a bias towards the characters' masculine-linked characteristics. For example, participants who liked Ripley in *Aliens* (1986) said:

She takes charge of her destiny and doesn't let hard situations stop her from fighting for life ... she always takes the lead role in decision making. (Natural Resources Management student)

She is strong in both a masculine and feminine way. (fights aliens and is motherly)
(Physics student)

Participants who liked Lucy said:

She seemed to fight for herself and run away from bad people when these bad people were trying to harm her. She is cool and has strongest [sic] will power. Also, she became very independent. (Engineering student)

Other participants also found the concept of brain development in *Lucy* (2014) fascinating:

I like her character development, such an interesting concept. The concept at accessing human brain to a certain level made more sense, I liked her character in the movie.
(Social Justice student A)

In the movie, the brain development circumvents Lucy's physical weakness, and gives her the power to control the world around her. Stevens argued that Lucy's brain development demonstrates the mind-body dualism established by Western philosophy. Western philosophy traditionally associates minds with masculinity and bodies with femininity. Hence, with brain development and body vanishment, Lucy shows a subordination to masculinity (Stevens, 2018).

Despite the fact that Louise in *Arrival* (2016) doesn't exhibit physical activities that can be predominantly masculine-linked (compared to, for example, Ripley's fighting), participants

still used masculine language to describe her:

She was independent and followed her principles and heart. (Education student)

She stood her ground with her beliefs despite what everyone said – whether she was wrong or right in the eyes of others. She is very empowering as the skills/power she got entirely because of her own actions and perseverance. (Nursing student)

When the question turned to participants' relationship with the characters, on the one hand, the participants expressed a desire to possess the masculine qualities that their favorite character had in the above descriptions:

Louise... hopefully I have some of those traits. (Education student)

I suppose I didn't realize I use so little of my actual brain power...image if I had more brain usage! (Social Justice student A)

As we're both in a somewhat similar position, it's encouraging to know there are models out there that women could embody as they face real world criticisms. (Nursing student)

When I face a problem that will come, I cannot be brave like her. (Engineering student)

I have overcome challenges after losing people I care about. Ripley is a role model for me. (Physics student)

Once she came to know she was in trouble, she started fighting to save herself, and became very independent. I would also want to be strong and not be too dependent on people. (Engineering student)

On the other hand, feminine-linked traits were also expressed as desirable by the participants:

Louise ...she was smart, thoughtful, and caring of the impact of her actions. She was humble about taking the time and understand the women from a different group's view. (Education student)

Ripley...she always protects and takes care of people who are “weaker”. She makes sure everyone is safe... (Natural Resources Management student)

The simultaneous use of the language for both genders indicates that participants do not establish insurmountable barriers between male and female traits, and many showed their hope to combine traits associated with the two gender. In other words, gender-linked traits showed a tendency of integration in participants’ self-perceptions.

Factors Affecting Gender-linked Perception on Careers

As can be seen from Table 3, the participants’ current career choices are different from those from their childhood when considered from a gender-linked perspective. When asked why, the majority of participants said it was because of their majors. On the one hand, their current majors are different than the career choices they expressed in childhood. Participants reported that their current major prepares them for their future career. That is to say, their current education path choices affect career-linked path choices in the future. When asked who affected their changing career choices from childhood, and how, education emerged as the major theme. Many participants said that education directly affected their self-perceptions and career choices, and that education was not limited to teachers and schools, but also to places outside the school:

I always wanted to be an architect. ... Unfortunately, a MALE high school teacher who I admired said, he didn’t think I had what it took to be an architect. And I was an A+ student with passion! It is probably my biggest regret listening to him ... (Social Justice student A)

I took a summer job in high school that required me to work in nature and that’s when I decided I wanted to be a conservationist. (Natural Resources Management student)

From young child to teen, my teachers and parents probably influenced me the most – i.e.

Being practical and getting a 'good' job... (Education student)

Parents were similarly cited along with teachers as influencers:

My parents because they won't force me to do something which they would want me to be. They have always been supportive in my choice of career path. They would guide me if the choices I am making were right or wrong. (Engineering student)

Definitely my mom. What I learned and observed from growing up, she was a constant factor in it... (Nursing student)

Except for the obvious factors related to education, the participant also mentioned the culture around her, and how culture affected her choice:

...whether I saw myself in those jobs. So many actions/ writing/comedy jobs. I didn't ever "see" myself in those roles because it was mostly men... (Education student)

That is to say, whether from the positive side or the negative side, directly or indirectly, education affects personal gender-linked self-perception in some way, thus affecting educational path choices, and then affecting career-linked path choices in the future.

Chapter Five: Conclusion & Discussion

There are some limitations to the research I conducted for this portfolio. One of the most limiting aspects of this research was the relatively small sample size and the fact that I only chose students from one university. Second, due to the time and venue constraints, I could not organize participants to watch these movies at the same time in a certain place, but let them use their spare time to watch them over the course of two weeks. This brings uncertainty to the data of the second response activity. I have no way of knowing whether they were influenced by the movies or some other uncontrolled external influence during that time.

Despite these limitations, however, the purpose of my portfolio is to examine whether watching sci-fi movies can change the gender-linked self-perceptions about careers among women students in higher education. I hope that this portfolio will inspire educators, especially teaching staff on the front line, to rethink the curriculum, teaching methods, and the existing academic climate at school. Eventually, they can encourage more women students to disrupt internalized gender beliefs and provide an inspiration for educational practice and research. This study provides a tool for educators that they might use to think about how to deconstruct internalized and deep-rooted gender beliefs and contribute to a more equitable education system. As Dasgupta and Asgari (2004) point out, and the response activities in this portfolio suggest, women's gender-linked perceptions are not fixed. After watching sci-fi movies, participants were more likely to think of careers as linked to both genders, rather than linked to one gender. When describing the traits that participants appreciate, and the connection between them, participants tended to mix masculine- and feminine-linked traits, describing a framework that allows for gender multiplicity, rather than reinforcing the socially constructed division between masculinity and femininity. In addition, in the follow-up questionnaires, education clearly played an

important role directly or indirectly in the formation of gender-linked perceptions. In conclusion, the data supports the idea that gender-linked self-perceptions about careers can be changed by watching specific sci-fi movies.

Discussion

This portfolio provides a report that supports the possibility of designing a curriculum using sci-fi movies as a feminist teaching pedagogy to undermine existing deep-rooted gender beliefs, thereby encouraging female students to participate in traditionally masculine fields (including but not limited to STEM areas). Like I discussed above in the second chapter, DeRose (2006) introduced sci-fi movies in an undergraduate class and received good results. However, in my study, most of the participants mentioned that their educational path choices were formed when they were teenagers. Therefore, the question of how to intervene in the gender self-perception of women students through corresponding curriculum needs to be addressed during the teen years. It requires more educational research and teaching practice. The method used in this portfolio can be utilized to create a unit plan in classrooms to foster discussions about women students' gendered self-perceptions. Further, another thing to consider is the sustainability of the curriculum. Dasgupta and Asgari (2004) indicate that more sustained exposure produces more stable changes, therefore further exploration into how to design and offer the curriculum continuously is required.

In addition to the formal curriculum discussed above that could be introduced, there is also the consideration of the hidden curriculum, or the academic climate and social atmosphere that affects the formation of women's gender-linked self-perceptions. In the feedback from participants, the effects of the hidden curriculum bubble to the surface. Some of the participants would argue that even though no one pushed them to make a particular career decision, they

were affected by the climate around them. For example, an education student expressed clearly that she is affected by the existing gender proportion in some careers. She did not follow her childhood dream jobs because she did not see herself in these jobs simply because the people who do her dream jobs are mostly men. This climate discouraged many participants from joining a masculine-linked field. Hence, this portfolio shows the potential of using sci-fi movies to expose hidden curriculum and provides the possibility of how to bring gender socialization into the discussion. For example, the discussions between me and participants after watching the movies showed that the participants were ready to dig more into gender climate around them. They came to realize how the atmosphere around them affects them. Giroux and Penna (1979) argue that hidden curriculum involves the transmission of certain norms, beliefs and values, which can take place outside the classroom in a campus or social environment. As Parson and Ozaki (2018) point out, STEM institutions outside the classroom promote a masculine-linked climate that discourages women from joining. Casad et al. (2019) suggest that the social climate of the university should be neutral, because a prominent display of male imagery can signal to women that they do not belong. Universities tend to display the prominent figures' portraits on the wall but if these portraits are mostly older white men, women and other racialized peoples might feel excluded. In future studies, therefore, it would be useful to investigate how to change the hidden curriculum in order to create a more inclusive and welcoming environment that encourages gender equity.

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Appendix A

List of career names at first response activity:

IT Supporter, Software Programmer, Senior Controls Engineer, Clinical Research Associate, Crime Scene Investigator, Analytical Chemist, Medicinal Chemist, Science Writer, Surveyor, Pilot, Customer Care Associate, Sales Associate, Cashier, Store Administrator, Customer Service Representative-on-call, Grocery Clerk, Front Desk Host, Office Assistant, and Business Development Specialist

Entry questionnaire:

- What three careers could you see yourself doing after graduation?
- How does your education prepare you for these careers?
- What career(s) (up to three) do you remember wanting to pursue when you were a child (e.g.: firefighting, paleontologist)? Are they different from your current career path? If yes, why?

Appendix B

List of career names at second response activity:

Market Development Manager, Pet Care Specialist, Post Office Assistant, Curriculum Developer, Education Assistants, Movie Editor, Psychologist, Judge, Photographer, Climate Change Analysts, Dentists, Economists, Geographers, Political Scientists, Wildlife Biologists, Ship & Boat Captain, Accountant, Audio Engineer, and Astronaut.

Exit questionnaire:

- Who was your favorite character from the films you watched, and why?
- Do you feel a particular connection to your favorite character (named above), and why?
- If your current career path is different from what you wanted to do as a child, who was the most important influence in changing your career path, and why?