

**THE REPRESENTATION OF WOMEN IN STEM IN *QUÉBEC SCIENCE*'S SPACE  
COLUMN: AN ANALYSIS OF DISCOURSE AND INCLUSIVE WRITING**

**JESSICA BLAKENEY**

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Department of Communications  
Faculty of Arts  
University of Ottawa

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**Abstract**

Women in science, technology, engineering, and mathematics (STEM) fields are greatly underrepresented in the Canadian space sector. To better understand their presence in Francophone media from Quebec, this thesis examines the representation of women in STEM in the Space column of the *Québec Science* magazine, as well as how inclusive writing can improve their representation. It considers that STEM identity is strategic and positional, such that discourse can either perpetuate or dismantle hegemony in these fields. The critical paradigm governs a quantitative content analysis and a critical discourse analysis of discourses used to describe female expertise in this column, both before and after the implementation of inclusive writing. Results reveal that symbolically annihilating discourses are lessened in the second corpus with greater inclusion and with gender-neutral writing. It addresses potential impacts on STEM identity and recommends discursive practices in written media that can improve the representation of women in these fields.

*Keywords: inclusive writing, women in STEM, quantitative content analysis, critical discourse analysis, critical theory*

## **Sommaire**

*Les femmes dans les domaines des sciences, de la technologie, de l'ingénierie et des mathématiques (STIM) sont grandement sous-représentées dans le secteur spatial canadien. Pour mieux comprendre leur présence dans la presse écrite au Québec, cette thèse examine la présence des femmes en STIM dans la rubrique Espace du magazine Québec Science, avec une analyse complémentaire de la façon dont l'écriture inclusive peut améliorer leur représentation. Elle considère que l'identité en STIM est stratégique et positionnelle et que le langage peut perpétuer ou démanteler l'hégémonie dans ces domaines. Le paradigme critique régit une analyse quantitative du contenu et une analyse critique du discours décrivant l'expertise féminine dans cette rubrique, avant et après la mise en œuvre de l'écriture inclusive. Les résultats révèlent que les discours symboliquement annihilants sont atténués dans le deuxième corpus grâce à une plus grande inclusion et une écriture non sexiste. Elle aborde les impacts potentiels sur l'identité en STIM et recommande quelles pratiques discursives dans la presse écrite peuvent améliorer la représentation des femmes dans ces domaines.*

*Mots-clés : écriture inclusive, femmes en STIM, analyse quantitative, analyse critique du discours, théorie critique*

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## Chapter 1: Introduction

*... by changing language, we can change our thoughts, and by extension, we can change the world* (Merrigan et al., 2012).

Our lives are deeply engrained in media. In fact, we live in a “mediated public space where media underpin and overarch the experiences and expressions of everyday life” (Deuze, 2011, p. 137). Lifecycles of our knowledge of social reality are but an act of empiricist realism, where reality and texts are continuously compared (Ang, 1985). Media therefore construct part of our experiences of hegemony since they have the “power to represent the world in certain definite ways. And because there are many different and conflicting ways in which the meaning about the world can be constructed, it matters profoundly what and who gets represented, who and what regularly and routinely gets left out” (Miller, 2002, 246). The interest that guides the present research is that of media discourses and their power to maintain or challenge hegemony in processes of covering or uncovering representation. As such, this study views language as a site of ideological struggle. If Michard considers the oppression of women by men as a foundational social relationship of society, which has effects on semantics, and therefore on the usage of language (Armengaud, 2003), then this thesis considers that language can in turn challenge social reality. It focuses on the discourses used to represent women in science, technology, engineering, and mathematics (STEM) fields in written media and seeks to identify processes of “othering,” i.e., the alienation or marginalization of these women.

This research is important to me as I have wanted to study astrophysics for as long as I can remember. The desire to understand the universe led me to study physics. However, I felt that STEM was not for me, a response that is quite common for female undergraduates (Cheryan, Drury, & Vichayapai, 2013). After ultimately losing interest in STEM, I changed fields of study

to communications, which led me to the Master of Arts in Communication (media studies) at the University of Ottawa, after developing a passion for research at the Université de Sherbrooke. This thesis serves in part as an investigation in helping myself and others understand why this pattern is so common amongst young women in STEM (Winnie Chan et al., 2021) and how media—specifically their discourses, engrained in ideology—could be a perpetrator. I have always actively sought after space-related news, specifically in outlets that used plain language to describe remarkable science, which led me to gain an interest in *Québec Science*, a Francophone magazine from Quebec, amongst other written media. This research enables me to add to the critical conversation of the representation women in STEM in written media, while reflecting on how social reality and ideology may be symbolically malleable through discourses.

Written media was selected for this study as it facilitates an analysis of discourse and its ever-subtle manipulations, which may later be expanded to an array of mass media. More specifically, *Québec Science* is at the intersection of a research deficiency since studies on the representation of women in STEM in Francophone media from Quebec are scarce. Moreover, the magazine highly values inclusivity. In fact, the October-November issue of 2022 marked a passage to inclusive writing, which the editor in chief confirms was a research-based decision to encourage mental images of women in scientific roles (Guillemette, 2022b). An analysis of discourses used to describe women in STEM in this magazine, coupled with the examination of how inclusive writing can improve their representation, is at the forefront of this thesis and defines its novelty.

Inclusive writing, which will be later defined in depth, was introduced in the French language and in the ideological space in the early 2000s (Abbou, Arnold, Candea & Marignier, 2018). In Canada, and more particularly in Quebec, it refers to writing that uses gender-neutral

formulations or collective nouns (Office québécois de la langue française, 2020). The goal is to “produce writing that is free of discrimination based on sex, gender, sexual orientation, race, ethnicity, disability or any other identity factor” (Translation Bureau, 2023). It is important to note that in the scope of this research, the analysis is not oriented specifically towards gender identity nor the representation or a plurality of groups, but centres the conversation on what inclusive writing and feminization do for the representation of women in STEM. For instance, while certain inclusive writing techniques may cover female representation, perhaps others could uplift them. While English syntax is less strongly marked by gender, other languages, such as French, Spanish, and even German have a gendered language, showing that these debates go beyond the Francophonie framework (Centre des monuments nationaux, n.d.). Inclusive writing might therefore present additional difficulties that intertwine with discourse pertaining to scientific identity, which makes it a rather interesting and relevant subject of study for this thesis in the context of gender, discourse, STEM, and media.

Considering that role models play an instrumental role in the development of STEM identity<sup>1</sup> in female readership (Starr, 2018), representation through discourse is paramount. Since few people get the opportunity to experience a positive, “real life” encounter with scientists who are enthusiastic about their STEM professions (Ertl, Luttenberger and Paechter, 2017), girls build their knowledge of STEM fields through contextual cues and media, both precursors in

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<sup>1</sup> As will be later elaborated, a science or STEM identity is how someone perceives themselves as a scientist (Hazari, Sonnert, Sadler & Shanahan, 2010). It influences “a wide range of STEM-related outcomes including engagement, interest, learning, motivation, persistence, and commitment” (Steinke, 2017 p. 4).

transmitting STEM identities (Steinke, 2017). However, women have been systematically symbolically annihilated in media, which spans to STEM.

This thesis does not approach the question of representation from a linguistics perspective, but that of a critical theoretical framework. The critical paradigm considers that knowledge of the world, of society, and of gender is mediated and produced through power relations and is distorted, such that reality is “constructed through power relations and shaped over history” (Tracy, 2020, p. 60). By identifying structures that can instigate social change (Merrigan et al., 2012), it seeks to deconstruct “how knowledge is produced, whose knowledge is valued, and how control of such knowledge equates to power in society” (Ryoo & McLaren, 2010, p. 348). More specifically and in the scope of this research, it enables critical discourse analyses to understand how discourses and inclusive writing in Francophone written media construct perceptions of power in STEM through different representations of male and female scientists.

The selected theoretical framework thus designs this research to identify and analyze specific values, or units of language, that characterize women in STEM in Francophone written media. By including aspects of Marxist, feminist, and poststructuralist criticism, this study seeks to identify linguistic processes that can challenge hegemony in STEM through discourse. Meaning is considered to be fluid and fragmented, that is, there are no fixed “truths” (Tracy, 2020). Feminist criticism refocuses these paradigmatic approaches to the inequalities women face, as it seeks to challenge gender-based oppression. Therefore, it examines the intersection comprised of culture, power, and STEM identity through critical theorists, which encompasses postcolonial theorists, feminist theorists, and sociolinguistics.

In this thesis, I argue that language can be an agent of change and that it is a paramount variable in maintaining or challenging the realities of women in STEM, where they are widely underrepresented in Canada, making up less than 25% of the workforce (Canadian Nuclear Safety Commission, 2024). Their research is also significantly underfunded compared to male scientists and researchers (Beaudry, Larivière & Solar-Pelletier, 2016). This disparity in funds diminishes female scientists' presence in research, which extends to their presence in citations in written media (2016). Therefore, their contributions to STEM fields are hindered by biased funding and is reflected in media. Not having a positive presence as role models in written media can discourage young women to pursue careers in STEM fields, since they use media to search for clues of “who belongs in STEM” (Steinke, 2017). In fact, two stereotypes inhabit STEM fields: “STEM stereotypes may be gender-based (e.g., STEM is for men) or trait-based (e.g., STEM is for geniuses)” (Starr, 2018, p. 489). These stereotypes are woven into the language used to describe scientists.

This thesis tackles the gender-based stereotype that STEM is for men. I argue that language can affect semantics and therefore change mental images of scientists, which in turn can spur a positive STEM identity in female readership and ultimately challenge the social realities that inhabit STEM. I claim that the process relies heavily on the perception of female scientists that is built through language. As such, both discourse and inclusive writing must work in symbiosis to uplift women in STEM in written media. If we consider that discourse produces identification, or materializes identity, it therefore produces knowledge through representation; however, positive representation can never *fix* stereotyped representations—the goal is to make stereotypes uninhabitable (Jhally, 1997). The goal is not to directly counter the hegemony that male scientists hold in STEM, but rather uplift women in these fields, which contributes to

making the gender-based stereotype uninhabitable. Therefore, changes in discourse may lead to changes in perceptions towards the STEM community and its actors, since a reader's understanding of how hegemony operates in the scientific community is constructed by the interaction between the subject and the conceptions of reality that they have previously acquired (Perret, 2019). Therefore, perception is key because it is materialized.

Language becomes paramount, as does the critical examination of the discourses that shape scientific identity, which in turn concerns the way that power operates in STEM through media. The examination of the strength of language as an agent of change is prominent. To apply this problematization to Francophone written media in Quebec, what is first needed is to understand how female scientists are currently being portrayed and to expand the findings to a theoretical interpretation of the impacts of these representations on STEM identity.

As such, the following research questions surface: how are women in STEM portrayed in *Québec Science*'s Space column, and how has inclusive writing impacted these representations? Moreover, what impacts could these representations have on female readership's STEM identity?

To answer the research inquiry, the methodological approach orchestrates mixed methods, which includes both quantitative and qualitative analyses. Since the purpose of this research is to examine how women in STEM are represented in the Space column in the *Québec Science* magazine both before and after the implementation of inclusive writing, two corpora are evaluated and compared. The Space column is of particular interest as space has the potential to inspire STEM learning in both children and adults (Sullivan, 2023). Additionally, "observing or studying stars and other astronomical objects" was shown to have a significant and positive effect on STEM identity (Cohen et al., 2021, p. 1126). Space sciences are also understudied in gender and media studies. In fact, most previous studies have considered STEM fields as a

“whole” (i.e., science that is defined as the combination of a variety of fields in which women are underrepresented) and do not consider a specific field, other than a few studies on computer science (Cheryan et al., 2013; Cheryan et al., 2013) and chemistry in textbooks (Good et al., 2010).

Under the discourse umbrella, this research first examines how female scientists are portrayed in the Space column. This includes their representation frequency compared to male scientists, but also how discourse references their expertise, roles, and contributions to specific projects. These analyses will determine if male and female scientists are portrayed with similar or diverging characteristics. Under the inclusive writing umbrella, this research analyzes whether inclusive writing processes alter female scientists’ presence in the Space column, in both quantifiable and qualifiable factors. It examines various techniques of inclusive writing as outlined by Viennot (2018), including the syntactical feminization of professional titles, doublets (i.e., the coordination of both the masculine and feminine nouns), gender-neutral terms, and the generic (i.e., the masculine).

Therefore, critical discourse analysis enables a close examination of the descriptors used to represent female scientists compared to their male counterparts, with a focus on symbolic annihilation and processes of othering, before and after the implementation of inclusive writing. Then, a theoretical analysis, based on existing literature and critical and feminist theories, contextualizes results in the framework of STEM identity and the impact of discursive findings on hegemony in STEM fields. This thesis produces tangible recommendations for media practitioners to better represent women in STEM in Francophone written media through discourse and inclusive writing. It also provides recommendations for future research that should

further the implications of inclusive writing and positive discourse for the benefit of women in STEM.

It is comprised of five chapters, governed by the critical paradigmatic approach. It spans from a thorough literature review of relevant past research, presents the research question, then dives into the methodological approaches and resulting data from the comparative scholarship. The introduction being the first chapter that initiates this research, the following presents the key elements of subsequent chapters.

The second chapter outlines the problematization of this research. It provides a detailed literature review of past studies on the representation of women in STEM in both English written media and Francophone written media from Quebec and the impacts of these portrayals on girls. By highlighting the importance of role models in the formation of STEM identity in girls, it presents discourse as a site of ideological struggle, which can either perpetuate or dismantle hegemony in STEM fields. Inclusive writing as a technique of inclusivity is examined through historical considerations and within the scope of this thesis, as to see how it can impact the representation of female scientists. At the intersection of discourse, inclusive writing, feminism, and STEM, the critical paradigm enables the identification of language structures that can contribute to disrupting power relations in STEM fields through discourse.

The third chapter presents the methodological approach to answer the research inquiry. Mixed methods, comprising both quantitative content analysis and critical discourse analysis, allow to dress a thorough representation of women in STEM in the Space column, both before and after the implementation of inclusive writing, which outline two corpora. The first method examines if women are present in the selected articles and analyzes if inclusive writing hinders or furthers their representation. The second method further investigates *how* these women are

portrayed with an analysis of the discourses used to describe scientific expertise, roles, and contributions to projects. The chapter ends with a presentation of the limits of the research related to potential constraints and scope.

The fourth chapter presents the results and their analysis. Since the methodology produced both quantitative and qualitative data, they are both presented separately. The first part of the chapter focuses on the quantitative data, in which a series of tables present various aspects of the representation of women in STEM in terms of images, cited experts, and several inclusive writing techniques. Results and a partial discussion are presented simultaneously. The second part presents the qualitative results with a series of figures that highlight discourses used to describe female scientists' expertise and contributions to projects compared to their male counterparts. Each corpus is presented separately and with its own partial discussion, followed by a systematic comparative scholarship of both corpora, which yields proposed writing guidelines to optimize the representation of women in STEM in Francophone written media. The chapter ends with a discussion of results and a contextualization of findings to potential impacts on STEM identity, as well as a discussion of broader issues that regulate and constraint language.

The fifth and final chapter presents a summary of the thesis paper and results under the critical paradigm. It provides future research directions that should be undertaken to continue the critical discussion on the representation of women in STEM in Francophone written media and summarizes recommendations for media practitioners.

This thesis compares female and male scientists' representations before and after the implementation of inclusive writing by examining discourse reflecting scientific expertise and inclusive writing techniques. Through a theoretical interpretation of results, it determines the

potential impacts of these representations on female readership through a theoretical analysis, which is expanded to ideology in STEM fields.

## **Chapter 2: Problematization and Literature Review**

Many works and theories have contributed to the formulation of this thesis. An exhaustive review of the literature first maps studies on current representations of women in STEM in both English and Francophone written media and their known impacts on female readership. This first review includes a brief overview of STEM identity formation and the development of self-concept in girls towards the sciences, which spans from contextual cues and mass media. It will be revealed that while more women in STEM are being shown in the media, how they are portrayed is more valuable (Chimba & Kitzinger, 2010), where representation becomes paramount. The importance of discourse (i.e., images and language) compels a deeper look into language, which becomes a site of ideological struggle, an intersectional point of suture, formed by feminist theories, Marxist thinkers, and sociolinguists, all operating under critical theory. Language will be debated as both a means to maintain and challenge hegemony in STEM fields, which is fundamental to the research objectives.

As such, a third part of the literature review examines inclusive writing efforts to make the French language more inclusive and diverse, which could either enhance or decrease the representation of women in STEM in texts. Materialist feminists confront Marxist thinkers on the question of discourse, inclusive writing, and syntactical feminization, and the outcome on the STEM context is debated. The conceptual framework therefore includes aspects of the critical paradigmatic approach with underlying Marxist, feminist, and poststructuralist criticism, as this research seeks to challenge hegemony in STEM through discourse. The validation of this approach guides the research questions, hypotheses, and their operationalization.

## 2.1. Review of the Literature and Key Concepts

Women in STEM fields are widely underrepresented in Canada, making up less than 25% of the workforce (Canadian Nuclear Safety Commission, 2024). Although the gender gap is closing at a lethargic rate, gender biases persist globally and are creating a leaky pipeline between post-secondary education completion and presence in research (UNESCO, 2015). In fact, although women earned 36.4% of all STEM post-secondary degrees in Canada in 2019 (Statistics Canada, 2020), they accounted for only 23.5% STEM-related occupations (Statistics Canada, 2019). The Canadian space sector is also not immune to this underrepresentation: white, military-trained and engineering-trained men predominantly occupy STEM management positions in this field (Ruel, 2019). Moreover, in 2012, women in STEM represented less than 20% of managers across the Canadian space industry (Catalyst, 2013).

The need for greater gender diversity in these fields is monumental as it helps broaden perspectives and tackles research objectives that truly represents society (Nature, 2018) by bringing a variety of experiences to the field (Mendick & Moreau, 2013). Ensuring the prosperity of the sciences instigates the need to understand the root causes of the gender disparity in STEM. What has caused such a significant gender gap in these fields? The gender gap is not a result of biological factors—such as one’s level of intellectual capabilities—but that of social influences, like stereotypes, social status and contextual cues (Ceci, Williams, & Barnett, 2009), which were carved over history.

Studies have shown that if a girl has family that studied and worked in a STEM field and that was supportive of STEM careers, she is more likely to pursue similar career avenues (Ertl et al., 2017). In fact, role models have positive impacts on adolescent girls’ perception towards science (Evans, Whigham and Wang, 1995), but “in the absence of personal experience, news

and entertainment media are common sources of information about scientists and the scientific process” (Mitchell & McKinnon, 2019, p. 177). Since few people get the opportunity to experience a positive, “real life” encounter with scientists who are enthusiastic about their STEM professions (Ertl et al., 2017), girls build their knowledge of STEM fields through contextual cues and media, both precursors in transmitting STEM identities to adolescent girls (Steinke, 2017). As such, in cultural studies, the analysis turns to media as a possible cause for the gender gap in STEM: “The mass media may have a crucial role in either reinforcing or challenging such gender segregation and inequalities” (Chimba & Kitzinger, 2010, p. 609).

While media can help fill this gap by providing role models in movies, televised programs, and written media, it can also propagate stereotypes. Therefore, while showing more women in STEM in the media could seem like a justified approach to help close the gap, *how* they are portrayed holds more value: “Misrepresentation, or lack of representation, can amount to a form of symbolic annihilation” (Chimba & Kitzinger, 2010, p. 609). In fact, these portrayals can either challenge or reinforce the public’s understanding of the scientific community by strengthening gender-normative and patriarchal assumptions (Chesky & Goldstein, 2018). Media representations contribute to forming the image of the “other” (i.e., the female scientist): it is a powerful instrument that carves a space within the public narrative. Media becomes a space that mediates identities, “as they help to constitute narratives of the ‘other’” (Appadurai, 1990, p. 299).

It becomes relevant to ask what identity does a scientist carry? More fundamentally, what is identity? At this point is important define gender, sex, and gender identity, since, as will be later elaborated, scientific identity is tied to gender. The latter “refers to the socially constructed roles, behaviours, expressions and identities of girls, women, boys, men, and gender diverse

people,” whereas sex “refers to a set of biological attributes in humans [...] with physical and physiological features including [...] reproductive/sexual anatomy. Sex is usually categorized as female or male” (Government of Canada, 2023). Since this thesis concerns the representation of women in STEM fields as opposed to their male counterparts, it does not report on gender identity, which “is each person’s internal and individual experience of gender. [...] A person’s gender identity may be the same as or different from their birth-assigned sex” (Ontario Human Rights Commission, 2014).

This study considers that STEM identity is constructed within power relations and discourse: it is both strategic and positional, shaped over history, and is only recognized through the relation to the “other” (Hall, 2011, pp. 3–4). Identity is in relation to the community and built through it, while constantly being transformed, and is in binary opposition with what we are not, since different “social groups and societies use the idea of other groups to define their own character” (Strömberg, 2011, p. 575). It is built “through personal and social negotiations with members of communities who possess a unique collection of characteristics that distinguish them from community outsiders” (Dou & Cian, 2022). As Bhabha carefully defines, “The demand of identification [...] entails the representation of the subject in the differentiating order of otherness” (Bhabha, 1994). This constant need for comparison to define oneself identity could imply that possible underrepresentation and misrepresentation of female scientists in the media are impeding on the already slow shift in gender diversity and inclusivity in STEM, since girls use these images to build their academic self-concept. In fact, identity’s embeddedness in language makes written media a powerful medium for influence as the discourse used to describe scientists can subtly affect cognitive biases through media models tied to gender (Steinke, 2017).

A first step in understanding the impacts of gendered discourse in written media is to map current representations of female scientists in these media.

### **2.1.1. Representations of Women in STEM in English Written Media**

Past studies conducted on English written media have examined the representation of female scientists with a focus on stereotypes and their impacts on girls' STEM identity, performance, and interest in STEM fields under feminist and poststructuralist lenses. These studies used content analysis as well as surveys and experiments to drive results. They unanimously concluded that male scientists are portrayed much more frequently than female scientists. Findings also reveal that female scientists hold exceptional status for accomplishing similar tasks to their male colleagues and are often used to amplify men's voices and research, and therefore were not central to the story (Mendick & Moreau, 2013).

Women in STEM in written media are mostly white, middle-class, able-bodied, and heterosexual (Chesky & Goldstein, 2018). In addition to being "high-achieving women," their appearance and level of attractiveness are often emphasized (Chimba & Kitzinger, 2010; Mitchell & McKinnon, 2019). Placed on a pedestal, they become an unachievable role model and deter girls' interest in the field (Archer, DeWitt, Osborne, Dillon, Willis, & Wong, 2013; Mitchell & McKinnon, 2019). Most studies lack cultural diversity, which presents a significant gap in research: since "whiteness" is a stereotype, experiments only contained Caucasian confederates as to hold constant non-gender factors (Chesky & Goldstein, 2018; Good, Woodzicka, & Wingfield, 2010). As such, these studies do not include intersectionality as prescribed by Crenshaw (2017).

Additionally, female scientists are both female *and* scientists, confirming that media representations hold true to the gendered social construct. Haraway (1989) observed that "the

people known simultaneously as women and as scientists” are “an oxymoronic social subject only beginning to breakdown” (p. 281), or as Laclau would describe, they are subject to marked terms (Laclau, 1990). Not only are women in STEM forced to navigate this oxymoron: the public must also negotiate its own construction of scientific identity at the intersection of sex and patriarchal assumptions.

As such, two striking phenomena emerge from the representation of women in STEM in English written media: first, there is a lack of portrayed engagement with science, meaning that female scientists are shown to support men’s work and are not central to the story (Mendick & Moreau, 2013); second, their appearance is strongly emphasized. These two characteristics are insidious and problematic when we consider that young audiences draw on “discourses that oppose femininity with scientific engagement and make gendered distinctions between doing science and being a scientist” (Mendick & Moreau, 2013, p. 336). Even though these studies concern different types of written media, spanning from press coverage of scientists in newspaper articles, Web search results across popular search engines, website content regarding scientists, and popular magazines like *The New York Times*, representations of female scientists seem consistent throughout. This data suggests that increasing representations of female scientists in the media is not enough to break gender barriers: the portrayed images and the messages they convey hold greater value. The reiteration of these images in media “could be read as expressions of power in society, and, as attempts to change society, or mold society” (Lang, 2013, p. 16), which hinders change, since messages are “connected with the way that power operates in any society” (Jhally, 1997, p. 3).

### 2.1.2. Representations of Women in STEM in Written Media from Quebec

Little to no studies have examined female scientists' representations in Francophone written media in Quebec, although the underrepresentation of women in the media holds true to the overarching narrative. It is, however, relevant to note that there is inequitable funding of research between male and female scientists in this province, in which male researchers received on average \$15,000 more public research funds and double the number of private funds compared to their female colleagues (Beaudry, Larivière & Solar-Pelletier, 2016). This disparity in funds diminishes female scientists' presence in research, which extends to their presence in citations (2016). In turn, this may also reduce female scientists' presence in the media, since their contribution to STEM fields is hindered by biased funding. Girls and women's interest in STEM are also highly influenced by social norms: "Social norms and stereotypes are also responsible for biases, often implicit, which can harm the progress of women and other underrepresented groups in science, by influencing the assessment of their skills or potential" (Eugène, 2019). However, it is not accurate to say that women are simply less represented in professions where they are less present. Regardless of their proportion in various professional spheres, women are always underrepresented (Shine & Sondarjee, 2019).

Other studies on Francophone written media from Quebec examined female representations in the broad context of gender studies, including women in politics and in news outlets. It was found that Francophone written media in both Quebec and France yielded similar representations of women in English written media: women were underrepresented in political, cultural, societal, and sports articles (Benjebria, 2015). The same study showed that experts, witnesses, and cited confederates were majorly male over female. In fact, in the last few years, experts who were granted a space in the media in French magazines in Quebec were mostly male

with a two for one ratio. These experts include politicians, professors, doctors, and government experts, which is particularly alarming when we consider that experts are known to shift political decisions and influence individual behaviour through media (Croteau, 2022).

Similar results were observed in a written community-based media in Quebec, where male political candidates received more than double the exposure of their female counterparts (Théberge-Guyon, Bourassa-Dansereau, & Morin, 2018). A journalist from *La Presse* also studied five major dailies from Quebec, which revealed that only 22% to 27% of cited people were women (Lauzon, 2018). While some fields, like the medical field, may hold parity between genders, there is a leaky, gendered pipeline between employment and exposure in media, revealing structural sexism in the media (Baillargeon & Croteau, 2022). Even though the medical field falls outside of STEM and therefore outside of this research's scope, the guiding principle of underrepresentation is relevant.

It is, however, important to note that even though studies on the representation of women in STEM in Quebec are scarce, female scientists do have a presence on the media scene. For instance, Farah Alibay, aerospace engineer, recently received media coverage as she was part of the team that piloted Perseverance, the robot responsible for exploring Mars (Grenier, 2021). Professor Laurie Rousseau Nepton, Canada's first Indigenous person to obtain a PhD in astrophysics, was also headlined in recent years. The young astronomer from Quebec was featured in podcasts, documentaries, and invited to numerous talks. Her goal is to deconstruct stereotypes, to show that STEM is for everyone (Bouliane, 2023), which is invaluable for the next generation of researchers.

### **2.1.3. Effects of STEM Stereotypes and Counter-Stereotypes in Written Media**

While knowing how female scientists are shown in written media is crucial to establish a basis for this thesis's analysis, knowing how these images impact their audiences can provide valuable insight in knowing what changes should be made in the production of written media, especially concerning choice of discourse. The following section encompasses a synthesis of the research conducted on the impacts of STEM stereotypes and counter-stereotypes on various audiences, with a focus on young women and girls. Previous research has examined through experiments and surveys how stereotypes influence women's and girls' academic performance in STEM fields, how they deter their interest in those fields, and even how stereotypes may feed anxiety towards STEM, all while altering their STEM identity.

Of course, girls may be exposed to stereotypes in social contexts that are external to media. However, while social relations may also play a role in constructing perceptions of gender (Archer et al., 2013), media is a transformative force and may pose a basis for how we understand who STEM is for. It is important to recall that, since social context is devoid of "real life" role models, people mostly only encounter scientists in the media (Ertl et al., 2017). In fact, we live in a "mediated public space where media underpin and overarch the experiences and expressions of everyday life" (Deuze, 2011, p. 137). As such, scientific expertise is associated with the dominantly portrayed gender (Croteau, 2022).

Starr advances that "STEM stereotypes may be gender-based (e.g., STEM is for men) or trait-based (e.g., STEM is for geniuses)" (2018, p. 489). They can be summarized as someone who possesses traits that are "incompatible with the female gender role" (Cheryan, Plaut, Handron & Hudson, 2013, p. 58). The analysis in section 2.1.1. revealed a strong focus on appearance and attractiveness in female scientists. These portrayed characteristics simply

“modernize,” or reiterate traditional gender roles: “It would also seem that although prominent women in SET may no longer be judged for the quality of their baking or their skill with a needle, as they were in the 1920s to the 1980s, they may now be judged on beauty, fashion and sexiness” (Chimba & Kitzinger, 2010, p. 621). As such, stereotypes characterize a scientist who is lacking interpersonal skills, who is technology-oriented, likes videogames, is masculine, white, and highly intelligent (Cheryan, Plaut, et al., 2013). In this analysis, it is also important to examine the opposite of stereotypes, which the literature calls counter-stereotypes. These can simply equate to a female representation in images (Good et al., 2010), or a female scientist who expresses interests outside of STEM, which exclude science fiction and videogames (Cheryan, Plaut, et al., 2013).

Stereotypes negatively impact women’s interest in STEM, since both gender stereotypes and nerd-genius stereotypes negatively contribute to their STEM identity (Starr, 2018, p. 489). For instance, an experiment showed that simply stating that computer science was no longer “dominated by geeks” in a newspaper had a positive impact on female college students’ interest in pursuing a degree in computer science, whereas a variation showing that the field was indeed dominated by a stereotypical, masculine figure deterred their interest (Cheryan, Plaut, et al., 2013). These results show how slight discourse variations impact interest in STEM. Another research showed that a single exposure to a stereotypical or counter-stereotypical computer science role model had a long-lasting effect on undergraduate female students: a short interaction with a counter-stereotypical role model led to an increased interest in computer science, while one with a stereotypical role model decreased their interest in the field (Cheryan, Drury, et al., 2013). Male students’ interest in STEM was not significantly altered, regardless of exposure to

stereotypes or counter-stereotype discourses (Cheryan et al., 2013; Cheryan et al., 2013; Good et al., 2010).

In academics, simply changing an image in a chemistry textbook from a stereotype (male scientist) to a counter-stereotype (female scientist) or neutral stance (mixed male and female) was shown to significantly alter academic performance in female high school students. Counter-stereotypes led to higher comprehension in female students, enhanced their performance on a test, as well as alleviated anxiety levels, while stereotypes had the opposite effect (Good et al., 2010). Again, male students were not significantly affected by these changes. Steele & Aronson (1995) describe this phenomenon as the *stereotype threat*, a “documented phenomenon by which individuals, fearful of confirming a negative stereotype about their group, display decreased performance on a task relevant to the negative stereotype” (as cited in Good et al., 2010, p. 135). Again, the magnitude of slight changes in discourse (which includes images) are prominent.

Having positive role models in written media shows “the potential to spur students’ interest in STEM subjects” (Ertl et al., 2017). These results indicate that “the images that young people get of different fields from the media are crucial as are the ways that these images interact with other aspects of their identity work, including in relation to performances of gender” (Mendick & Moreau, 2013, p. 326). In fact, stereotypes can damage academic self-concept, described as “a person’s self-assessments in academic domains. It is formed through experience and interpretations of one’s environment as it regards feelings of self-confidence, competence, and ability” (Ertl et al., 2017, p. 2).

It is relevant to ask what STEM identity is and how it relates to the gender discrepancy in STEM: “It is important to study STEM identity as a social justice issue since students who develop STEM identities are more likely to persist and secure STEM opportunities” (Cohen et

al., 2021, p. 1127). A STEM or science identity is how someone perceives themselves as a scientist (Hazari, Sonnert, Sadler & Shanahan, 2010). Therefore, a science or STEM identity influences “a wide range of STEM-related outcomes including engagement, interest, learning, motivation, persistence, and commitment” (Steinke, 2017 p. 4), which ties in with academic self-concept. As such, “stereotypes reduce women’s identification with STEM, which can decrease their motivation to enter STEM domains” (Starr, 2018, p. 489).

The superposition of these unities that make up STEM identity is nevertheless constituted within representation (Hall, 2011), and therefore, are “constructed within the play of power and exclusion” (p. 5). Exclusion, because as we recall, groups and individuals use the idea of other groups to shape their own character: “The problem of identity returns as a persistent questioning of the frame, the space of representation, where the image [...] is confronted with its difference, its Other” (Bhabha, 1994, p. 45). When one is confronted with different positions, in this case, when girls are confronted with STEM stereotypes in the media, they go through an “agonistic process of struggling with, resisting, *negotiating* and accommodating the normative or regulative rules with which they confront and regulate themselves” (Bhabha, 1994, p. 14). They are negotiating their STEM identity based on representations and their notion of reality. The latter is further developed in the next section. Identities are fluid since they are “points of temporary attachment to the subject positions which discursive practices construct for us” (Hall, 2011, p. 6). They are constantly shaped and reshaped by discursive practices, as shows the literature through various experiments explained above. This analysis reveals the magnitude of discursive practices to shape a positive STEM identity, that is, to spur women’s interest and performance in STEM fields.

Because of the complex nature of identity and its intricacies, the above definitions are not exhaustive and do not encapsulate all that identity is or can be, but position and define it within the context of this research. Nevertheless, different approaches to defining identity and identification will be examined throughout this literature review through a critical lens, with the objective of completing its portrait through different modes of operation and within the scope of this paper.

From this literature review on current representations of women in STEM in written media and their impacts on female readership, research hints that the gender discrepancy in STEM may be lessened with influential tools such as discourse, and that discourse could challenge hegemony in STEM fields. Further necessary investigation prompts an analysis of these findings while intersecting them with feminism, identity, and language.

#### **2.1.4. At the Intersection of Feminism, Discourse, and Identity**

How is discourse (i.e., language and images) tied to hegemony in STEM fields? A complex relationship exists between discourse and identity, such an intricate point of suture within the patriarchy. As previously stated, some authors posit that identity is constructed within power relations and discourse: it is strategic and positional, shaped over history, and is only recognized through the relation to the “other” (Hall, 2011). As such, media is a space that mediates identities “as they help to constitute narratives of the ‘other’” (Appadurai, 1990, p. 299). It becomes relevant to ask why female scientists in written media are portrayed as described in section 2.1.1.? Why not simply do “better” representation in media? Journalistic practices are to blame, but only in part.

For instance, some women in STEM choose to not interact with media, such as with interviewers for magazines, because they often ask obsolete or sexist questions. These

interviewers emphasize their appearance and level of attractiveness to “sex up” the field (Chimba & Kitzinger, 2010), which make female scientists uncomfortable with the press. This discourages them to accept interviews with such magazines (Mitchell & McKinnon, 2019). Another study has identified that female experts also practise “self-censorship” as they fall victim of the “imposter syndrome” in their fields of expertise (Laurent, 2015). Even female journalists have internalized discriminatory practices, thus diminishing women’s presence in the media (Benjebria, 2015). To summarize, women in STEM in the media remain other because they are underrepresented and misrepresented.

The concept of “othering,” that is, the alienation or marginalization of a group, traverses most feminist theories, under different identifications. Tuchman introduced the concept of symbolic annihilation, a process by which the mass media omit, trivialize, or condemn women, which includes representing them in stereotypical roles (Tuchman, 2000). Journalists are also biased by “empiricist realism,” a process “in which a comparison of the realities ‘in’ and ‘outside’ a text is central” (Ang, 1985, p. 36), which hinders change in STEM fields, because authors produce what they consume and consume what they produce—a hint to Marx’s *Introduction to the Critique of Political Economy* (2014). As such, mass media systematically disseminate symbolic messages that shape the identity of the scientific community and of its actors. But are these renderings of social reality through mass media an “accurate” depiction of women in STEM? How can we redefine their reality through their portrayed identities? The answer reveals the complex nature of the question.

#### **2.1.4.1. Social Reality as Symbolically Malleable**

Reality is a social construction of symbols that make up what we know (Van den Bulck, 1999). However, knowing if our knowledge of the world is true knowledge or not is irrelevant

(Schutz, 1982): “It is the meaning of our experiences and not the ontological structure of the objects which constitutes reality” (p. 348). In fact, “The media are not a monolithic symbolic reality or the only kind of symbolic reality, and many different kinds of interaction are possible among all these realities” (Van den Bulck, 1999, p. 9). As such, knowledge is dependent on the person, or the receiver, and reality is dependent on its constructive participation (Krippendorff, 1993). But meaning does not remain in isolation. It is the superposition of individual constructions of reality through socialisation that make cultural signs “part of the *unity of the verbally constituted consciousness*” (Vološinov, 1973, p. 15).

Nevertheless, while different people can be exposed to a same stimulus, their perceptions of that stimulus may diverge (Kuhn, 1970), since we all have a conceptual world of our own (Jhally, 1997). Together, shared conceptual maps yield meaning, in which the notion of representation gives meaning (Jhally, 1997). Foucault believed that “nothing exists outside language” (Van den Bulck, 1999, p. 5), since discursive practices are the true source of knowledge and power (Merrigan et al., 2012). However, as will later be discussed, Foucault’s approach will be considered to some extent only.

As such, if media mimic multiple realities and inversely, where does scientific identity get translated (or lost in translation) by discourse to favour certain groups? It is a question of negotiation. First, “culture is a way in which we make sense of or give meaning to things of one sort or another” (Jhally, 1997, p. 9). Cultural translation then becomes “a semiotic economy where signs are exchanged for other signs on a basis negotiation rather than equivalence” (Conway, 2020, p. 5). Bhabha theorizes this space of translation:

“a place of hybridity, figuratively speaking, where the construction of a political object that is new, *neither the one nor the other*, properly alienates our political expectations,

and changes, as if must, the very forms of our recognition of the moment of politics.”  
(1994, p. 25)

This analysis hints that social reality is symbolically malleable, and that while discourse may re/produce power relations in STEM, it could also challenge them, to either alienate or uplift women in these fields. The world manifests itself through a reality embedded in the patriarchy. Whether representations are empirically accurate or not, they construct the gendered identity of the scientific community and its actors. Thus far, “girls can be fitted into STEM with little to no disruption to the overall structure of STEM fields, thus maintaining the systematic barriers that exist” (Chesky & Goldstein, 2018, p. 115).

To challenge patriarchy, we need not escape ideology, that is, we must not pursue “an altered epistemological relation to the real, but altered representations” (Hammett, 1997, p. 85). Language becomes paramount, as does the critical examination of the discourses that shape gendered scientific identity, which in turn concerns the way that power operates in society through media. As such, what does language owe to the symbolically annihilated? The examination of its strength as an agent of change is prominent.

#### **2.1.4.2. Discourse: Does it Challenge or Maintain Hegemony?**

Hall believed that we share conceptual maps, based on how we, as individuals and as groups, classify the world. As humans, we “learn or internalize the shared maps of meaning with other people in your culture” (Jhally, 1997, p. 10). But how malleable is our understanding of these conceptual maps, or systems of representations? He posits that language is a tool that transforms culture into a social fact, or a social process, because it externalizes representation.

Discourse and reality intersect when we consider that “nothing *meaningful* exists outside of discourse” (p. 12). This interpretation of reality, which is a complex one, is an important basis for this thesis, without being as extreme as Foucault’s view, which denies material existence since it is outside of language. As such, language, or discourse, in the theoretical framework of this thesis, is defined as sign systems, which include images, symbols, written text, etc., which yield meaning within social reality. Therefore, STEM identity exists within language and is materialized through socialization. In this system, the subject is discursively constructed, that is, the materialization of identity is “strongly grounded in a performative theory of language” (Hall, 2011, p. 14). In fact, social identity is “consisted of ‘inputs’ into this self-identity” (Watson, 2008). These inputs were socially constructed, and manifested, in discourses via interactions with others.” (p. 6)

The underrepresentation and the misrepresentation of women in STEM in the media continuously translate a discourse that affirms a reality of female scientists, which is in binary opposition with the gendered construction of STEM identity, which has been discursively constructed through power relations and over history. That is why their faulty depictions and the use of stereotypes are so insidious on their audiences: “If we are concerned about the proliferation of images in our culture, it is because they constantly construct us, through our fantasy relationship to the image, in a way which implicates us in the meaning” (Jhally, 1997, p. 17).

It becomes clear that discourse can maintain power relations in STEM fields. After all, although the overarching representations in section 2.1.1. were pulled from various written media, a copious discourse was used to depict female scientists. The analysis reveals the insidious nature of these mis- and underrepresentation of women on STEM, especially when one

considers that “hegemony requires iteration and alterity to be effective” (Bhabha, 1994, p. 29), which is what is currently happening in most written media pertaining to scientific research (and in most media when we consider general gender studies). As put by Butler in *Bodies that matter: on the discursive limits of “sex”*, the reiterative power of discourse produces “the phenomena that it regulates and constrains” (1993, p. 2).

If this is true for the maintenance of hegemony, can the same principle be applied to language that *challenges* hegemony? Can positive representations through discourse “have the potential to destabilize norms and binaries to serve as empowering figures”? (Cocca, 2020, p. 1) If we consider that discourse produces identification, or materializes identity, it therefore produces knowledge through representation; however, positive representation can never *fix* stereotyped representations—the goal is to make stereotypes uninhabitable (Jhally, 1997). Under a discursive approach, identification is a construction in which the process is always *in process*, thus never completed: it “is constructed on the back of a recognition of some common origin or shared characteristics with another person or group, or with an ideal, and with the natural closure of solidarity and allegiance established on this foundation” (Hall, 2011, p. 2). Therefore, identification is constricted by ideology.

V. N. Vološinov, in *Marxism and the Philosophy of Language*, recognized language as a site of ideological tension and conflict: it does not only express existing or pre-existing thoughts, but rather dynamic and socially constructed systems. In fact, is it not a passive medium but an active force that shapes and reflects the social and cultural context in which it operates. He emphasized the role of social context and power relations in the production and interpretation of discourse, where power relations are negotiated and may be opposed (Vološinov, 1973). He demonstrated that “material conditions always impinge on our subjective experience of language,

so much so that language is a material fact that exists outside of speakers' individual psyches" (Conway, 2020, p. 34). Bhabha (1994) examined how this new space is created through language:

"The linguistic difference that informs any cultural performance is dramatized in the common semiotic account of the disjuncture between the subject of a proposition (*énoncé*) and the subject of enunciation, which is not representation in the statement but which is the acknowledgment of its discursive embeddedness and address, its cultural positionality, its reference to a present time and a specific space." (p. 36)

According to Vološinov, units of speech, that is, sentence structures and linguistic choices, can significantly impact perceptions of the symbolically annihilated: "The word has the capacity to register all the transitory, delicate, momentary phases of social change" (Vološinov, 1973, p. 19). While discourse can marginalize or stigmatize women in STEM in written media and influence how they are perceived by the broader society, these groups, through media, can also engage in linguistic strategies to resist such marginalization and assert their own identities and perspectives. After all, "the true meaning of it will depend on what meaning people make of it; and the meanings that they make of it depends on how it is represented" (Jhally, 1997, p. 7). In fact, "the existence of the sign is nothing but the materialization of that communication" (Vološinov, 1973, p. 13). Anything that contributes to the creation of meaning can shape perceptions.

As such, how can we utilize discourse to inform of a counter-hegemonic positionality in STEM fields in the media? If we recall, Hall posited that stereotypes must be made inhabitable in order to change perceptions of a group. As such, discourse manipulations may lead to changes in perceptions towards the STEM community and its actors (i.e., to change the female scientist's

narrative), even though hegemony and stereotypes have been formed over history, since language is located outside of an individual's psyche and identity is materialized through language.

In written media, subtle discourse manipulations, such as reframing sentence structures to uplift the symbolically annihilated, or even including inclusive dialogue around female expertise and contribution in STEM stories, may be key to shifting perceptions. Therefore, how can we utilize a change in linguistic processes in scientific discourses written for the public? As an effort to bring “together a variety of ways to better represent the diversity of people being talked about in a text” (Guillemette, 2022b), some Francophone written media, like *Québec Science*, has introduced inclusive writing to their journalistic practices. This change instigates multiple questions. Does representing more diverse groups diminish women's presence in texts, or does it uplift them along with the symbolically annihilated? Could inclusive writing be a gateway towards changing the narrative for women in STEM in media? It becomes relevant to ask what inclusive writing, which includes syntactical feminization, brings to women in texts, a question that guides part of this thesis.

### **2.1.5. Feminization and Inclusive Writing in Francophone Media**

The present section serves as an introduction to understanding how feminization and inclusive writing impact the representation of female scientists in Francophone written media. As will later be elaborated, the main objective is to determine how female scientists are portrayed in the magazine *Québec Science* under critical theory. A second, complementary objective is to examine if the representation of female scientists has shifted since *Québec Science* has implemented inclusive writing, and if it has influenced other discourses pertaining to scientific identity. It is important to note that the analysis is not oriented specifically towards gender identity nor the representation of a plurality of groups but centres the conversation on what

inclusive writing and feminization do for the representation of women in STEM in Francophone written media. As such, it is necessary to first bring context to this linguistic process from a feminist linguistics perspective, including its definition in Quebec, which regroups syntactical feminization and gender-neutral writing. This analysis will enable the completion of the interpretations of results, expanding this research to a broader societal context and considering future implications.

### **2.1.5.1. Context and Definitions: Feminization and Inclusive Writing in Quebec**

In recent years, different tactics have been put in motion to counter gender biases in various professional contexts to foster principles of diversity, equity, and inclusion (EDI). One characteristic of the EDI paradigm is that it emphasizes “the multiplicity and intersectionality of markers (gender and gender identity, social class, language, ethnicity, racialization, disability, sexual orientation)” (Mc Andrew, 2023). Inclusive writing was introduced to the French language and in the ideological space in the early 2000s (Abbou et al., 2018). In Canada, and more particularly in Quebec<sup>2</sup>, inclusive writing refers to writing that uses gender-neutral formulations or collective nouns (Office québécois de la langue française, 2020). The goal is to “produce writing that is free of discrimination based on sex, gender, sexual orientation, race, ethnicity, disability or any other identity factor” (Translation Bureau, 2023).

The term “inclusive writing” encapsulates various methods to accomplish gender-neutral language, including syntactical feminization. These are two principal methods to promote gender equality in the French language but target different aspects of the issue. Inclusive writing moves

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<sup>2</sup> In French-speaking Europe (mostly in France), inclusive writing aims to balance representations of men and women in texts through various linguistic processes, including feminization (Centre des monuments nationaux, n.d.). Its political aim is towards combating “the stereotypes which slow down progress towards more real equality” (Légifrance, 2017).

away from the systematic use of the generic masculine (e.g., *les chercheurs*) to prioritize neutral formulations (e.g., *le personnel de recherche*) (Office québécois de la langue française, 2021), which include nouns, adjectives and pronouns that are the same under feminine or masculine forms (Guillemette, 2022b). Syntactical feminization, on the other hand, was introduced in Quebec in the '70s. In 1969, the appearance of radical feminism intended to get to the root of the system that oppressed women, by attacking patriarchy and calling into question the entire social order (Dumont, 2024). According to Julie Abbou, feminist language practices shook hegemonic relationships in language, and with them, the traditional conceptions of the masculine and the feminine (Université Paris Cité, 2022). Towards the end of the 1970s, various public bodies, associations and workplaces expressed the need for feminine names to designate all professions and the women who occupy them, following the principle that grammatical gender is a function of sex in designating animate beings, particularly humans (Guilloton & Vachon-L'Heureux, 2022).

Inclusive writing now encapsulates syntactical feminization as part of its processes. It was hoped that the feminization of texts would enable to ensure the full visibility of women by matching the expression to the intended discourse aim (Vachon-L'Heureux, 1992, p. 142). Using the feminine form to replace sexist expressions (i.e., generic expressions) with non-sexist expressions (i.e., gender-neutral expressions) and circumlocutions includes replacing titles that were traditionally masculine, which now emphasizes the specific recognition of women (Gouvernement du Canada, 2009). For example, using *mathématicienne* or *professeure* instead of *mathématicien* or *professeur* aims to make the presence of women in these professions visible. As such, this linguistic process could be invaluable to help improve female scientists' representation in written media. In fact, a study has shown that the feminization of professional

titles increases the degree of self-confidence amongst 13–14 years old students regarding their ability to succeed in the academic requirements needed to practise such profession (Chatard-Pannetier et al., 2005), which hints to STEM identity and performance, which were previously defined. Viennot (2018) also recognized other techniques of inclusive writing in addition to the syntactical feminization of professional titles, such as the proximity agreement and double flexions (doublets) (Kamblé-Bagal & Tatossian, 2022), which will be subject to examination in this study.

Presently, an outdated heteronormative grammar rule from the 17th century states that male nouns represent both men and women, which only serves male representations (Guillemette, 2022b). This generalization hides identities and may harm attempts of inclusivity. With incomplete information about the group they are reading about, readers might imagine a scientist that fits the status quo (Guillemette, 2022b), which perpetuates hegemony in STEM fields, as seen in the first part of this literature review. However, as will later be elaborated, feminism drawing on a materialist epistemology posits that emphasizing women in texts with syntactical feminization is an issue, since women were recognized in texts as a sex, but not as humans as are men. Some representations of female scientists in the media can thus be emphasized or masked by language, in addition to existing difficulties with misrepresentation by harmful discourse that symbolically annihilates them, since, as previously argued, discourse can both embody and conceal actors in the scientific community.

#### **2.1.5.2. Inclusive Writing, Feminization, and Other Discourses: Considerations for Women in STEM**

The use of inclusive writing coupled with the recognition that discourse enables or disarms hegemony (see section 2.1.4.2.) may help challenge previous assumptions towards the

scientific community. However, it becomes relevant to ask whether this change is sufficient. A deeper dive into the interpretation of this linguistic manipulation is needed to identify its implications pertaining to the representation of women in STEM in written media, as is the consideration of French materialist feminism, which posits that inclusive writing and feminization perpetuate othering by separating both genders linguistically.

If using strategic linguistic processes can change the representation of female scientists' representations in texts, or increase their presence through syntactic feminization, can the latter also increase Othering? Monique Wittig, a French author, philosopher, and feminist theorist, advances that gender is the linguistic index of opposition between the sexes. As such, there would only be one gender: the feminine. The masculine is not a gender, because it is the reference by default. Language thus contains the general (masculine) and the feminine (or the mark of the feminine) (Wittig, 1992).

Therefore, inclusive writing may both perpetuate this opposition with the use of doublets (i.e., a mark of gender with syntactical feminization) or eliminate othering with gender-neutral terms (epicene words), two linguistic processes that are part of inclusive writing. In fact, gender-neutral writing eliminates the branding of gender and, with it, the syntactic differentiation that distinguishes the sexes. The impact of this choice would go beyond the linguistic level alone since, according to Wittig, both female and male actors would face the same subjectivity (a general subjectivity rather than a particular one based on gender) and the same representational capacity (universal rather than specific) (Bourque, 2022).

Claire Michard, sociolinguist and materialist feminist, also situated her work on the basis that gender is constructed socially and within power relations, which in turn have cognitive ideological effects, shaped by the semantic usage of language (Michard, 2002). She also

highlights that, while the notion of men conveys “humanity,” the notion of women conveys “sex”: this semantic structure reveals the ideological basis of meaning (Armengaud, 2003). In the context of critical studies and within the scope of this research, Laclau also identifies “female scientist” as a “marked term,” in contrast to the “unmarked” term of “scientist” (Laclau, 1990, p. 33) (i.e., we will never read “male scientist.”). It is clear to say that, in the present analysis’s scope, “if we want our language to produce more than the illusion of inclusion, what we really need to change is not our vocabulary, but our ingrained and largely unconscious habit of treating men as the prototypical humans” (debuk, 2018).

According to Michard, the usage of language is to fundamentally express the mental effects of social gender relations (Armengaud, 2003). Where her research diverges from that of Marx is that it provided materialist analyzes of the social relationship constructing gender as classes, and not as individuals (Armengaud, 2003). As such, within the context of inclusive writing, the separation of the two genders (or, of the feminine from the generic) with the syntactical feminization of professions would perpetuate the marginalization of women, since they are seen as individuals and not as being part of a larger group (Michard & Ribéry, 2008). This explanation contrasts that of Vološinov (1973) as previously described, in which units of speech can voice the symbolically annihilated, which spans to women in STEM. Further investigation on inclusive writing as a means for social change is necessary to identify its real-life impacts on audiences’ perception of gender in STEM.

Since French is a gendered language, inclusive writing may present additional difficulties that intertwine with discourse pertaining to scientific identity, which makes it a rather interesting and relevant subject of study for this thesis in the context of women, discourse, STEM and media. While English syntax is less strongly marked by gender, other languages, such as Spanish

and even German, are gendered languages, showing that these debates go beyond the Francophonie framework (Centre des monuments nationaux, n.d.). As such, what can inclusive writing and feminization bring to women in STEM in Francophone written media? If inclusive writing, through the use of gender-neutral words and syntactical feminization, could uncover female representation in scientific news, efforts may be in vain if other discourses on scientific/professional identity perpetuate misrepresentations, since “the understanding of any sign, whether inner or outer, occurs inextricably tied in with the *situation in which the sign is implemented*” (Vološinov, 1973, p. 37). In fact, inclusive writing and feminization are not the only power at play. These linguistic processes could be meaningless if other discourses remain symbolically annihilating, since “the meaning of a word is determined entirely by its context.” (Vološinov, 1973, p. 79).

As previously stated, *how* female scientists are portrayed is more valuable than simply increasing their representation (Chimba & Kitzinger, 2010), which evidently applies to discourse: “To properly account for the image of women disseminated by media, it is necessary, beyond the analysis of visibility, to look at the very content of the journalistic discourse which mentions women” (Bamberger, 2012, p. 41). One could ask whether inclusive writing and discourse pertaining to scientific identity are equally important with regard to their impact on perceptions of women in STEM.

### **2.1.5.3. Inclusive Writing VS. Francophone Written media in Quebec**

In the context of this thesis, what is important is not a historical essay of the evolution of inclusive writing, but rather to examine which institutions and media in Quebec have implemented it thus far and what resistances it has encountered. Historically, syntactical feminization was introduced by a feminist movement, which later encouraged public bodies,

associations and workplaces to express the need for feminine names to designate all professions and the women who occupy them (Guilloton & Vachon-L'Heureux, 2022). Modifying gender linguistics is modifying the identity of a nation, by language and by gender (Université Paris Cité, 2022).

However, today, inclusive writing is rather a top-down political approach in which Canadian federal governments, academic institutions, and other actors implement inclusive writing in policy (Moreau, 2023). To contextualize, top-down implementation is when a policy decision is carried out: “The starting point is the authoritative decision; as the name implies, centrally located actors are seen as most relevant to producing the desired effects.” (Matland, 1995, p. 146). According to Mazmanian and Sabatier (1983), three variables determine the probability of a successful implementation, such as the “tractability of the problem” the “ability of statute to structure implementation,” and the “nonstatutory variables affecting implementation” (as cited in Matland, 1995, p. 146). The first is related to the problem’s complexity, such as the scope of change and behavioural diversity; statutory variables structure the implementation, which include coordination amongst institutions; and non-statutory variables concern variables related to the context (e.g., social context) (Touati et al., 2007). In this specific case, it is rather ideological institutions of the government, through academic bodies and dictionaries, that implement inclusive writing, since its success heavily relies on social context (Université Paris Cité, 2022).

Francophone written media, however, is reluctant to implementing it as part of its journalistic practices (Caillou, 2023), which is related to the scope and implications of the change in a top-down political approach. As we will see, the coordination amongst these outlets varies significantly. Most media outlets from Quebec are concerned that inclusive writing may

interfere with a clear and understandable French language for all readers. For example, Radio-Canada has struggled to propose simple directives and guidelines regarding inclusive writing. Above all, they prioritize their duty of reporting with accuracy and applying the principles and values of the *Normes et pratiques journalistiques* (NPJ), with which inclusive writing may interfere by making the text heavier with doublets or truncated terms (Julien & Grandmont, 2023). Their working group, comprised of journalists and French language specialists, took more than a year to propose simple, clear, and coherent guidelines for a progressive and voluntary use of inclusive writing (Caillou, 2023). While no mandatory policy has been implemented, gender-neutral writing is recommended as of 2023.

At *Métro* newspaper, on the other hand, inclusive writing is not mandatory, but encouraged since December 2021, to better represent society. They mostly use gender-neutral writing or truncated formulations because it is easy and simpler (Caillou, 2023). Other outlets from the province of Quebec, such as *Le Devoir* and *La Presse*, also recognize the balancing act between the importance of the clarity of information and the necessity of inclusivity: while some writers have started using truncation for ease of use, most media reiterate that all must adhere to grammatical conformity before passing policies (Caillou, 2023). Of course, these media conform to the feminization of professional titles as an exception to inclusive writing. Indeed, it seems as though the usage of inclusive writing is still “up in the air,” that is, institutions other than the *Office québécois de la langue française*, are attempting to invent a new grammar that fits their linguistic needs through their own writing guides, instead of using a unified approach (Moreau, 2023).

While these media outlets are prudent with their adaptation to demands of inclusivity, *Québec Science* is the only Francophone written media to have adopted an inclusive writing

policy as of their October-November 2022 issue (Caillou, 2023), which seemingly adheres to the recommendations of the *Office québécois de la langue française*. In fact, the magazine announced that it will prioritize the lightest form of inclusive writing, that is, favouring epicene terms (e.g., *les spécialistes, les médecins*, etc.). Doublets, that is, the representation of both the feminine and masculine form of a word (e.g., *les mathématiciens et les mathématiciennes*) will be used sparingly (Guillemette, 2022b). The magazine also references *Inclusivement: Guide d'écriture pour toutes et tous*, an inclusive writing guide written by the Université de Montréal. In turn, the guide defines epicene terms as a process that ensures equal representation between women and men, and inclusive writing, which seeks to avoid any discrimination in the writings (Université de Montréal, 2019). The guide follows the principles of inclusive writing as defined by the *Office québécois de la langue française* and the Translation Bureau, thus positioning it in the Quebec ecosystem.

During an interview with *Le Devoir*, *Québec Science*'s editor in chief described their initiative as a means to better represent women in texts. In fact, our brains picture masculine subjects when presented with sentences where the masculine (i.e., the generic) is prominent, and she judges that it is important that their readers also imagine women in their texts (Caillou, 2023). Interestingly, a study has shown that people associate the generic with the masculine more than they do with the feminine. Even if the generic is meant to represent both the feminine and masculine, through mental processes, readers associate it most often with the masculine sex (Gygax, Gabriel, Sarrasin, Oakhill & Garnham, 2008). Another study measuring neural activity of participants reading various sentences revealed that the issue is rather semantic than syntactic, meaning that the masculine form, in its neutral form, is never really neutral, since it creates the mental image of the masculine sex (Misersky, Majid & Snijders, 2019).

Syntactical feminization of professional titles also influences mental images. Participants who were exposed to doublets were three times more likely to picture a female professional in that position compared to those exposed to the generic (Brauer, 2008). In another study, when children (Vervecken, Hannover & Wolter, 2013) and teenagers (Vervecken, Gygax, Gabriel, Guillod & Hannover, 2015) were exposed to a job description that is traditionally masculine (e.g., physicist) that is written in the generic, they consider that men will be more successful than women in these careers. However, these negative effects were diminished when the same jobs descriptions were written with gender-neutral terms. These results could possibly be applied to the construction of STEM identity for these groups.

Therefore, inclusive writing could be a gateway to increasing female representation in texts through feminization of professional titles and the use of doublets, and by diminishing male representation with gender-neutral terms. But even though *Québec Science*'s decision to implement inclusive writing relies on scientific studies, does gender neutrality automatically yield mental images of female scientists? The analysis of this decision on the impact of the representation of female scientists in *Québec Science* is prominent.

Under a critical theory scope, it is relevant to ask whether gender-neutral writing impedes or uplifts the representation of women in STEM. In fact, if groups or individuals use the characteristics of other groups to define their own character as defined by Bhabha (1994), Appadurai (1990), and Hall (2011), how can inclusive writing redefine characters in the absence of binary opposition? Or if alterity is lessened, are stereotypes as well? Would girls and women feel less threatened by gender-neutral scientific groups rather than the generic (i.e., they would be freed from the stereotype threat)? This reflection will help guide results and the discussion. As

such, the following section addresses the issue by presenting the conceptual framework of the research, in which concepts and theoretical approaches are further defined.

## **2.2. Conceptual Framework**

The critical paradigm governs this thesis paper. Its ontology supposes that the nature of reality is “constructed through power relations and shaped over history” (Tracy, 2020, p. 60). Its epistemology shows that knowledge of the world, of society and of gender is mediated and produced through power relations and is distorted (Tracy, 2020). As such, the goal of the critical paradigm is to identify structures to instigate social change (Merrigan et al., 2012), and to deconstruct “how knowledge is produced, whose knowledge is valued, and how control of such knowledge equates to power in society” (Ryoo & McLaren, 2010, p. 348). The object of this research is to analyze and identify reproducible linguistic processes that can improve the representation of women in STEM in Francophone written media, thus contributing to the disruption of power relations in STEM fields through discourse. By identifying how specific values, or units of language, characterize women in STEM in the *Québec Science* magazine, it also seeks to identify the strengths and limitations of discourse and inclusive writing, to help further social change in STEM fields.

To understand how discourse could be contributing to a potential shift in power relations (or lack thereof) within the science community, the study will address these questions through critical theory and with Marxist, feminist, and poststructuralist criticism, since it seeks to challenge power relations in STEM through discourse. Marxist criticism helps understand “how ideologies reinforce false consciousness that can be used to maintain power in the hands of those in control” (Ryoo & McLaren, 2010, p. 349). Poststructuralism challenges the notion of fixed “truths” and emphasizes the idea that meaning is fluid and fragmented (Tracy, 2020), which

applies to language and social reality. Feminism refocuses these paradigmatic approaches to the inequalities women face, as it seeks to challenge gender-based oppression. If Michard considers the oppression of women by men as a foundational social relationship of society, which has effects on semantics, and therefore on the usage of language (Armengaud, 2003), then this thesis considers that language can in turn challenge the social reality of women in STEM fields, and beyond.

The critical paradigm designs this research to “identify the ways that power is constructed and distributed in society” (Merrigan et al., 2012, p. 44). More specifically, it enables critical discourse analyses to understand how discourses and inclusive writing in Francophone written media construct perceptions of power in STEM through different representations of male and female scientists. As such, the properties that will be studied are that of the discourses used to represent female scientists compared to their male counterparts, with a focus on STEM identity, as well as how inclusive writing affects the representation of these women. This study will determine how inclusive writing can either benefit or hinder female representations in Francophone written media. Since “*Words are always filled with content and meaning drawn from behavior or ideology*” (Vološinov, 1973, p. 70), it will be interesting to see if minor changes enable varying representations of the sexes, and in turn how these portrayals can influence perceptions of scientists, since the discourse used to describe them can subtly affect cognitive biases towards the scientific community (Steinke, 2017).

As shown in the literature review, past studies have focused on gender representations in STEM and their effects in English written media. In Francophone media, they have focused on the representation of women in non-STEM roles, such as politicians, professors, doctors, and government experts. As such, there is a research gap with regards to the representation of women

in STEM in Francophone media in Quebec. *Québec Science*, a magazine that offers a privileged link between the research community and the public (*À propos*, 2018) is at the intersection of this research deficiency. This magazine addresses questions relating to science and technology and takes a scientific look at major current issues in a way that speaks to the general public (Guillemette, 2022a). It is the first and only written media of the province to have solely adopted inclusive writing as of their October-November issue of 2022 (Guillemette, 2022b), making it an ideal medium for this study, since the magazine values inclusivity, but also recognizes that discourses may have been hiding multiple identities (Guillemette, 2022a).

Before diving into the research questions, a few additional definitions are needed. Diversity is defined as the representation of people of various social and ethnic groups and identities present in the research ecosystem, where they can express their points of view, including underrepresented groups, such as women (FRQ, 2023). The focus on women as an underrepresented group in STEM fields is retained, where they warrant a space in media to express their research and points of view in the STEM ecosystem. Inclusion is defined as providing equal representation between members of various groups and identities, where they are valued, respected and supported, including underrepresented groups in the research community (FRQ, 2023). The focus of this study includes finding discourses that avoid gender-normative and patriarchal assumptions (Chesky & Goldstein, 2018) and ceasing to symbolically annihilate women specifically, as defined by Tuchman (2000). As such, in the framework of this thesis, the definitions of diversity and inclusivity are tailored to women in STEM, a field in which they are a minority, making up less than 25% of the Canadian STEM workforce (Canadian Nuclear Safety Commission, 2024).

These concepts will help interpret results and identify potential disparities between the ways female scientists are portrayed in the Space column of the *Québec Science* magazine compared to their male counterparts, both before and after the implementation of inclusive writing. The study's take on inclusive writing and feminization follows Quebec's definition as summarized in section 2.1.6. It focuses on *Québec Science's* own definition, also outlined in the same section, but also reflects on authoritarianism and illusions of inclusion through policy (see Chapter 4).

Considering that subtle changes in discourse may affect the perception of women in STEM, this study also aims to investigate, through the results and theoretical interpretation, how the perceptions of women in STEM fields are negotiated in the temporary space that is created when one reads a science article written for the general public. In fact, according to Vološinov, an “utterance is constructed between two socially organized persons and, in the absence of a real addressee, an addressee is presupposed in the representative of the social group to which the speaker belongs” (Vološinov, 1973, p. 3). As such, while we use our knowledge of the world through existing symbols, or role models, the individual can manipulate social signs through the regulation of social relations (Vološinov, 1973). As argued by Laclau, “the constitution of a social identity is an act of power” (Laclau, 1990, p. 33).

Within the interpretation of results, this research seeks to understand how the representation of women in STEM through language manipulations can cause different negotiations of the perception of women in STEM through this new “space of negotiations.” While this space can hold the negotiation of the concept of self and of STEM identity, the objective is to understand how subtle changes in discourse (i.e., through inclusive writing and professional/identity discourse) influence the broader interpretation of hegemony in STEM fields

in a crafted media space that temporarily holds varying or similar social realities/identities of women in STEM. As argued by Piller (2012), “we do not have culture but [...] we construct culture discursively” (p. 5). Since “messages work in complex ways, and that they are always connected with the way that power operates in any society, together at the same time” (Jhally, 1997, p. 3), this specific research objective may seem challenging, but it is important to remember that writing is a linguistic mechanism that can be quantitatively measured; therefore, its effects can be expanded to a qualitative interpretation.

### **2.3. Research Questions and Hypotheses**

Multiple questions were posed in the literature review. If we map the literature in all its aspects, we find an intersection comprised of discourse and its role of power, the formation of STEM identity, inclusive writing, and Francophone written media. It is relevant to ask in which ways discourse reflecting identity (i.e., professional attributes) and inclusive writing in Francophone written media contribute to the gender disparity in STEM. Does one linguistic process weight more against the other? Are inclusive writing and other discourses mutually exclusive? Can they truly instigate changes in perceptions towards women in STEM?

The question of scientific identity portrayed through media “is a matter of considerable political significance, and is only likely to be advanced when both the necessity and the ‘impossibility’ of identities, and the suturing of the psychic and the discursive in their constitution, are fully and unambiguously acknowledged” (Hall, 2011, p. 16). In the temporary space that holds the confrontation, or the agreement, of language and the social reality of gender in STEM, the negotiation of identity that yields a conclusive perception of gender may challenge and break hegemonic cycles. Reality and knowledge of identity are built through perceptions (Benjebria, 2015). As such, the understanding of how hegemony operates in the scientific

community is constructed by the interaction between the subject and the conceptions of reality that they have previously acquired (Perret, 2019), which is built under ideology. Therefore, perception is key because it is materialized.

As such, the following research questions surface: how are women in STEM portrayed in *Québec Science's* Space column, and how has inclusive writing impacted these representations? Hypotheses rely on discursive processes and known impacts of female representation in STEM on women and girls.

Based on previous research, it is hypothesized that male and female scientists will be portrayed in asymmetrical ways, where male scientists outnumber female scientists. Moreover, it is predicted that male scientists will be shown as having more expertise than their female counterparts. With regards to inclusive writing, it is conjectured that, if doublets are mainly used, female representation will increase, and therefore have a perceived greater place in the STEM narrative, *only if* other discourses include them in the narrative through positive portrayals of professional identity. In fact, while one study stated that simply increasing female representation in discourse (images) was sufficient to have positive impacts (Good et al., 2010), others have shown that increasing female representation alone is not sufficient to instigate change: the way in which female scientists are portrayed holds greater value (Cheryan et al., 2013; Cheryan et al., 2013; Chimba & Kitzinger, 2010; Mitchell & McKinnon, 2019). This hypothesis does not rely on the basis that doublets further the marginalization of women by separating both male and female counterparts, and therefore does not consider materialist feminism, since it draws on previous studies that have shown that positive discourse, although separating both genders, and role models, have a positive effect on the perception of girls and women towards STEM (Ertl et

al., 2017; González-Pérez et al., 2020) and yields positive mental images of women (Brauer, 2008).

It is also hypothesized that, if gender-neutral writing is used, male representations will be reduced. However, this result may not be as beneficial to female scientists as the other processes, since gender-neutral terms may still be associated to the dominant group (i.e., male scientists) (Guillemette, 2022a). However, gender neutrality does yield a greater perception of success in traditionally masculine jobs for both genders compared to the generic (Vervecken et al., 2013; Vervecken et al., 2015). The outcome of this linguistic process will be further discussed in Chapter 4, in relation to scientific identity built through relations to the other. However, if other discourses surrounding professional identity are positive and inclusive, perhaps it will offset underrepresentation and still have positive effects on the representation of female scientists.

The general hypothesis pertaining to the main research question is that inclusive writing could have positive effects on the perception of women in STEM in Francophone written media, only if other discourses surrounding gender are uplifting and not symbolically annihilating. Since the value of words heavily relies on context (Vološinov, 1973), both inclusive writing and discourse pertaining to scientific identity should work in symbiosis to shift perceptions of women in STEM fields. As such, building on previous research about the representation of women in STEM in the media and their effects on girls and women, this study seeks to expand the research to Francophone written media. Through its strong focus on language, it seeks to find ways to challenge perceptions of women in STEM through inclusive writing and discourse, an effort that could be expanded to other journalistic practices in Francophone written media outside of STEM. After all, “critical scholars believe that by changing our language we can changes [*sic*] our thoughts, and by extension we can change the world” (Merrigan et al., 2012, p. 44).

### Chapter 3: Methodology

This research's purpose is to examine how women in STEM are represented in the Space column in the *Québec Science* magazine with a focus on discourses on scientific identity and inclusive writing by examining male and female representations and processes of othering. To accomplish the inquiry, multiple steps in research, which include mixed methods, are required. The general strategy is outlined by both quantitative and qualitative data.

The first objective is to understand how female scientists are portrayed in the Space column compared to their male counterparts. Then, their representations from both before and after the implementation of inclusive writing will be compared. These steps in research include the critical analysis of the discourse that reflects scientific and professional identity, which spans to roles and contributions, and the use of inclusive writing. As such, it will be possible to see if changes in language have truly occurred since the implementation of inclusive writing in *Québec Science*, as it is useful to study media processes and its effects (Croucher & Cronn-Mills, 2019). The critical discourse analysis of scientists will focus on efforts in diversity, inclusiveness, and processes of othering in visual and textual data while remaining under Marxist and feminist criticism.

While data collection and research instruments will establish how female scientists are portrayed in the Space column of *Québec Science* and if their representation has changed with the implementation of inclusive writing, a theoretical analysis, based on existing literature and the critical framework, will guide results and provide a theoretical interpretation of the impacts of female readership in the realm of social reality and STEM identity. This approach prioritizes an intersectional interpretation of results while reflecting on symbolic annihilation in written media. This chapter outlines the justification for the approach, presents a summary of the

methods used including coding frameworks, and concludes with a presentation of the limits of the research.

### **3.1. Research Strategy and Relevancy**

Knowing how female scientists are portrayed in the Francophone magazine both before and after the implementation of inclusive writing enables the examination of possible shifts in discourse. This step is fundamental in understanding how inclusive writing may un/cover female representations and possibly perpetuate othering. Statistical quantitative content analysis and critical discourse analysis will focus on discourse as a driver for change. As outlined by Bamberger, to properly examine the dissemination of women in the media, “it is necessary, beyond the analysis of visibility, to look at the very content of the journalistic discourse which mentions women” (Bamberger, 2012, p. 41). As such, these two empirical methods allow to paint a complete portrait of female representations in the Space column and provide a strong basis for a comparison of both corpora, before and after the implementation of inclusive writing.

The comparison will examine the feminization of professional titles, doublets, gender-neutral writing, the generic, and all other potential shifts in other discourses. While the feminization of professions and using doublets may enhance the visibility of women in STEM, gender-neutral writing could also hide gender depending on the chosen stylistic processes of writing. In fact, if gender-neutral writing is prioritized, then there is no increase in female representations, but male representations will not be emphasized as per the generic form. On the other hand, if doublets are dominant, then greater visibility is given to female scientists. However, the way female scientists are qualified, in addition to their quantitative representation, is utmost important, since discourse can either challenge or reinforce the public’s understanding of the scientific community (Chesky & Goldstein, 2018).

As previously stated, *Québec Science*'s October-November issue of 2022 marked a shift towards the implementation of inclusive writing. The comparative study of both before and after the shift towards inclusive writing will benefit from two types of data. First, a quantitative analysis of visual and textual data will address the frequency at which male and female scientists are represented in the text and in images, which will determine whether representations of male and female scientists are diverse. Second, a critical discourse analysis of textual data will address the discourses used to describe both male and female scientists, which in turn will determine whether these representations are inclusive. This investigation is relevant in identifying processes of othering or alienation of female scientists and how they have evolved since the magazine adopted inclusive writing. In fact, increasing female representation may be in vain if they are not portrayed adequately, that is, if they are symbolically annihilated, as defined by Tuchman (2000).

### **3.1.1. Content Analysis—Quantitative Data**

Quantitative content analyses “report the percentage or number of times a particular category occurs in the sample” (Croucher & Cronn-Mills, 2019, p. 182); in this particular case, it will report how many times male and female scientists are included in the text and in images. As such, the unit of analysis is the number of occurrences for both genders. This includes occurrences with scientists' names, the labelling of their expertise (including the feminization of professional titles), appearances in quotes, and inclusive writing techniques. These datasets provide a basis for a comparative scholarship before and after the implementation of inclusive writing, which will be to determine whether inclusive writing significantly alters the representation of women in STEM. Descriptive claims will conclude whether the representation of female scientists is altered by inclusive writing.

### 3.1.2. Discourse Analysis—Qualitative Data

A summative qualitative discourse analysis (DA) of textual data will closely examine discourses used to describe both male and female scientists. This investigation is relevant in identifying processes of othering/alienation and how they may have evolved since the magazine adopted inclusive writing. The qualitative mode of inquiry is appropriate to answer the research question since, under the critical paradigm, it is coupled with considerations of power and class (Tracy, 2020); it therefore supposes that reality is socially constructed and seeks pluralism, beyond numerical indices (Yilmaz, 2013, p. 314). As such, when reading an article, discourse helps the reader understand who belongs in the space sciences by using both visual and textual cues (Ceci et al., 2009). DA focuses “on language-use and on language as a means of social action” and is a relevant method to “shed light on core characteristics of the issue at hand” (Olbertz-Siitonen, 2018, p. 192), making it valuable to answer the problematic. Precisely, it studies “social situations and processes in their natural settings in order to reveal in descriptive terms the meanings that people attach to their experiences of the world” (Yilmaz, 2013, p. 312). As such, the collected data will inform how hegemony operates in STEM through indices of both male and female scientists’ roles and contributions to projects.

Under the critical paradigm, this research relies on the description and critical reflection of hegemony portrayed through language (Merrigan et al., 2012). The collection of this qualitative data will allow for descriptive claims, which provides a “framework for understanding power inequalities and instigating social change” (p. 52). As such, DA can explain a more complex phenomenon compared to quantitative analysis as qualitative data helps understand “how social experience is created and given meaning” (Yilmaz, 2013, p. 312). For example, this method will allow to examine if male scientists are portrayed with greater expertise

than their female counterparts through descriptive terms relating to their scientific/professional identity.

Qualifiers thus gain relevance over quantifiers, since the “summative approach uses the count to demonstrate repetition and intensity of certain word(s) in the data, then goes one more step by including latent analysis as part of the process. Latent analysis involves the interpretation of underlying meaning” (Croucher & Cronn-Mills, 2019, p. 163). The summative qualitative discourse analysis provides a more complex understanding of how different terms are used, and therefore provides a richer, more insightful understanding of the data, since the analysis considers contextual knowledge (Hsieh & Shannon, 2005). Findings on discursive practices can improve understanding of how gender inequalities and hegemony are tied to discourse (Olbertz-Siitonen, 2018) in STEM fields.

While qualitative and quantitative content analyses and discourse analysis allow for descriptive claims, they do not address causality nor can they predict the impacts of these images on their audiences (Croucher & Cronn-Mills, 2019). As such, the data will be interpreted under a theoretical framework, which includes both Marxist and feminist paradigms. The following section presents a summary of the methods and procedures used for the collection of both quantitative and qualitative data, while specifying the sample for both approaches and the research instruments used.

### **3.2. Summary of Methods and Procedures Used**

As previously argued, the research strategy encapsulates two empirical methods to answer the research question and its sub-questions, while operating under the critical paradigm. Quantitative content analysis and qualitative discourse analysis allow to draw a portrait of the representation of women in STEM through discourse, while closely examining the use of

inclusive writing and discourse reflecting scientific and professional identity. These methods operationalize the research question by examining existing data and studying them under a comparative scholarship. Results will produce evident conclusions on the representation of female scientists in the Space column and identify any potential shifts brought by inclusive writing, which will inform next steps in research and in policy. In fact, results will enable a debate on whether the desire to be more inclusive through inclusive writing really does have the potential of changing the reality of women in STEM in written media, or if it is only for show, an “illusion of inclusion,” to increase readership who value inclusivity. The modes of operation of the two methods, along with the sample selection, are detailed in the following section.

### **3.2.1. Samples and Coding Frameworks**

Both the content analysis (quantitative) and discourse analysis (qualitative) share the same samples to allow for a consistent and complete analysis. After all, the first objective is to examine the representation of women in STEM in the Space column, to then compare datasets before and after the implementation of inclusive writing; they should therefore concern the same articles from these periods. As previously mentioned, the Space column is of particular interest as space has the potential to inspire STEM learning in both children and adults (Sullivan, 2023). Space sciences are also understudied in gender and media studies. In fact, most studies have considered STEM fields as a “whole” (i.e., science that is defined as the combination of a variety of fields in which women are underrepresented) and do not consider a specific field of study.

*Québec Science’s Espace* [Space] column saw its first article in February 2011. Articles were scarce in this column during its first years—only three articles in 2011, then four in 2012. Leading up to 2018, most articles touched on historical space news, summarized research, or addressed more general research happening within research teams in universities in Quebec.

Later, 2018 was this column's biggest year, as the magazine published 49 articles. With the inauguration of SpaceX's Falcon Heavy rocket, the launch of three new NASA missions, a renewed interest in dark matter and supernovas, and other diverse research projects in astronomy from Canada, Europe, and the United States (*Espace Archives — Québec Science*, 2018), 2018 was a significant year in space, providing rich content for the column and was an excellent basis for the dissemination of scientific identities through their research. The column remained relevant in the years following 2018, with an average publication rate of 20 articles per year. The implementation of inclusive writing in the column occurred during the October-November issue of 2022 (Guillemette, 2022b), which is continued today.

Since one of the research objectives is to identify and compare shifts in discourse before and after the implementation of inclusive writing in this column, a clear sample selection is drawn. It is also important to take into account the COVID-19 pandemic, which became a public health emergency of international concern in early 2020 (World Health Organization, 2021). Choosing 2018 for the analysis is further justified because it does not coincide with this global event. As such, the first corpus is a selection of articles from the first half of 2018, from January 1<sup>st</sup> to June 30, 2018. The second corpus contains all articles from October 2022 to February 2024, which yields two samples that are similar in size. The upper limit of the second sample was determined by this thesis' timeline of completion. The articles from these corpora include news on scientific discoveries and progress, and scientist spotlights based on their space missions.

Both these samples underwent quantitative content analysis and qualitative discourse analysis. Then, both datasets were examined and compared. Coding articles from these samples yields relevant data as the dissemination of male and female scientific expertise was abundant

during this period and may present important variations, moreover with the use of inclusive writing. This rich sample draws a dependable portrait of the representation of female scientists and allows for an analysis of shifts in discourse. Since both quantitative and qualitative data were collected from this sample, they both benefited from different coding methods, which were orchestrated with the NVivo software.

As will be reflected in the following section, coding guides were guided by categories highlighted by Mucchielli. First, the units of meaning are distributed in categories in an exhaustive manner. The categories are distinct, meaning that the same element does not belong to two categories at once and in the same relation. They are also objective and can be understood by multiple coders. Finally, they are relevant and related to the objectives of the analysis (Mucchielli, 2006).

### **3.2.1.1. Coding Guide for Quantitative Content Analysis**

The collected quantitative data addresses the frequency at which female and male scientists are portrayed in the text and in images. This data helps determine whether representations of scientists in the Space column of *Québec Science* are diverse, and if the implementation of inclusive writing yields more or fewer female representations. The quantitative data was compiled through the NVivo software, which facilitated data analysis with code creation.

First, visual data was grouped with respect to the type of image (see Appendix I). Four categories emerged through inductive content analysis, which were crafted based on the literature. The categories are images relating to science (such as laboratory equipment or research centres, astronomy pictures, or artistic interpretations of astronomy); images of male scientists; images of female scientists; or images combining both sexes. The number of times

each category occurred in the sample was compiled under a class titled “Images” and with respect to the four categories.

Second, the number of times a male or female scientist was mentioned by name or was quoted was compiled. In the instance where a scientist was quoted more than once in an article, it was counted as only one representation. However, if the same person appeared across multiple articles, the representation was compiled once per article. “Male representation” and “female representation” became two additional codes.

The method becomes interesting when adding inclusive writing to the equation. Four linguistic processes were expected (i.e., the syntactical feminization of professional titles, gender-neutral writing [which can turn into generic “masculine” depending on its attached pronoun], doublets, and the generic [masculine form]); therefore, the codes were established under a deductive content analysis (Croucher & Cronn-Mills, 2019). To complete the compilation of female and male representations, “female expertise – feminization” and “male expertise – generic” became two additional codes, to better examine how syntactical feminization furthers female representation. Then, under an inclusive writing scope, three main techniques were coded, such as “gender-neutral,” “doublets,” and “generic masc. form,” which allowed to keep track of inclusive writing occurrences per technique. The coding grid is available in Appendix II.

### **3.2.1.2. Coding Guide for Qualitative Discourse Analysis**

Discourse analysis is invaluable as it unveils subtle differences between the description of male and female scientists. This method is paramount in determining whether representations are inclusive and to identify processes of othering or alienation of female scientists and uses a

systemic approach to sorting the data. Discourse analysis is data-driven, which means that the coding frame is inductive and the process may adjust as the analysis progresses (Schreier, 2014).

To first provide a comparative basis between the representation of female and male scientists, a coding structure of descriptors was developed and adapted during the process of analysis, and then compiled to identify repetition and intensity of certain words, making it a summative approach to qualitative content analysis (Hsieh & Shannon, 2005). “Descriptors,” as I name them, include any discourse that qualifies scientific or professional identity, which provides details relative to their field, such as titles, related skills, and roles and contributions to projects. These can include prestigious titles such as expert, scientist, astronomer, professor, etc.; and titles that do not convey as much expertise, such as contributor. The compiled descriptors per gender representation function to describe or identify the quoted scientists, which can reveal a more complex phenomena (such as processes of othering) compared to quantitative data. If a scientist is qualified by multiple characteristics, for example, expert, professor, director, etc., each new occurrence was compiled throughout a same article. These descriptors were programmed as child codes in NVivo for both “male representation” and “female representation” parent codes. Two coding grids were developed for this collection of data. The first relates to expertise (see Appendix III); the second relates to roles and contributions, with an added analysis of action verbs (see Appendix IV).

Moreover, since this research’s second objective is to compare female and male scientists’ representations before and after the implementation of inclusive writing, two cases were established in NVivo to answer the research inquiry: articles written in 2018 [“before iw”] and articles written after the October 2022 issue [“after iw”]. As such, each unit of analysis was coded to a case, which allows for an intersectional interpretation of the data, thus directly

addressing the comparative aspect of the research inquiry. The collection of both quantitative and qualitative data allows for a well-rounded portrait of discourse and inclusive writing.

Interpretations will be based on the results, previous research, and on contextual knowledge.

### **3.3. Limits of the Research**

This research utilizes strong methodology to answer the research question, which helps understand how women in STEM are represented in Francophone written media, but remains a steppingstone for future research. In fact, while it helps understand how inclusive writing transforms (or does not change) the representation of female scientists in Francophone written media, specifically in *Québec Science*'s Space column, this scope only concerns one magazine and one of its columns. The scope of the research, limiting it to the space sciences in Francophone media, allows for a systematic understanding of the way journalistic practices in this magazine portray women in STEM in the space sector, and how inclusive writing can impact representations for *Québec Science*'s female readership.

To further this research, an online survey could help determine whether general discourse surrounding scientific expertise or inclusive writing practices weight more against the other in shaping positive perceptions towards women in STEM fields. Interviews could be used to better understand the space of negotiation that is created when participants read articles. Future research should also compare this study to other Francophone written media in Quebec that report on STEM and space news, to get a broader understanding of the phenomenon. Due the thesis' time limitations, the scope was not expanded to this comparison, nor did it pursue the survey or interviews. Nevertheless, the present research streamlines our understanding of how women in STEM are portrayed in Francophone written media, which defines its novelty, and addresses the impacts of inclusive writing and discourse tied to scientific expertise on the

perceptions of women in STEM. It provides a strong basis for future research on discourse, inclusive writing, and the representation of the sexes in STEM.

## **Chapter 4: Results and Discussion**

This thesis aims to compare female and male scientists' representations both before and after the implementation of inclusive writing, while examining other discourses reflecting scientific identity. This chapter presents and examines the collected data under a critical scope. Since both quantitative and qualitative data were collected, they are both presented separately but analyzed intricately and under the theoretical framework. As such, this final chapter, preceding the conclusion, explains and interprets the results and ties them in with the research questions. An analysis of the relevancy of the hypothesis and of the chosen methods further enlighten the obtained results. While partial discussions are led throughout the examination of results, a more comprehensive discussion expands the findings to larger outcomes for the representation of women in Francophone written media and their impacts on female readership closes the chapter.

### **4.1. Quantitative Representation of Male and Female Scientists**

As outlined in the methods chapter, two corpora were selected, and each underwent quantitative and qualitative analyses. The first corpus concerns articles that were published before the implementation of inclusive writing while avoiding the COVID-19 crisis. The selected articles from the Space column range from January 2018 to June 2018 and cover a variety of scientific news, from the inauguration of SpaceX's Falcon Heavy rocket, new NASA missions, a renewed interest in dark matter and supernovas, and other diverse research projects in astronomy. The second corpus is defined by the commencement of inclusive writing in October 2022 to February 2024, which yields similar sample size and scientific news, in addition to new space missions. The articles were first collected into two separate MS Word documents to define each corpus. They were then imported into the NVivo software. This first section examines quantitative results under critical theory and in parallel with previous literature.

#### 4.1.1. Male and Female Scientists in Visual Data

First, all images were identified and coded to one of four categories, as outlined in Chapter 3. This data collection functions to identify the gender representation frequency of male and female scientists in visual data. The following table presents the proportion of each type of image, in which male and female representations are of main interest.

**Table 1: Male and Female Presence in Images**

Percentage of each image by image type	Before inclusive writing (January 2018 to June 2018)	After inclusive writing (October 2022 to February 2024)
Male representation in images	7.3%	6.7%
Female representation in images	2.4%	4.4%
Both male and female in a same image	4.9%	2.2%
No humans (scientific picture)	85.4%	86.7%

In both corpora, most images are scientific in nature, portraying either pictures of astronomy, observatories, technological hardware, or artists' interpretations of the cosmos, showing that *Québec Science* values the dissemination of science and technology over profiles in science, which is in line with their mission statement (*À propos*, 2018). As hypothesized, male and female scientists are represented in asymmetrical ways. The 2018 sample reveals that male

scientists are three times more present in images than their female counterparts, which corresponds to previous literature. Female scientists are also twice as present in images taken with male colleagues than they are alone in an image. The sample taken after inclusive writing slightly increases female representation in images. While there is a slight increase in individual photos, there is a decrease in images containing both male and female scientists and a slight increase in pictures of scientific nature.

The lack of female scientists in images compared to male scientists increases the gender-based stereotype that STEM is for men. It is, however, important to note that this sample yields a limited analysis. Given the importance allocated to scientific news, it is easy to understand why the majority of images relate to science. This neutrality could inspire those reading the article to be curious about the cosmos, as opposed to associating research with gender-based images. By recentralizing the focus on the text, content analyses and discourse analyses gain relevance in both their quantitative and qualitative aspects.

#### **4.1.2. Male and Female Scientists in Textual Data**

Before analyzing *how* female scientists are portrayed in this column with qualitative data, we must first know *if* they are portrayed and how frequently with quantitative data. A first step in this analysis is to collect the frequency at which male and female scientists are cited or mentioned in the text by name. As previously mentioned, only one occurrence by article was counted. If a scientist was mentioned in multiple articles, each occurrence was compiled throughout. As such, it is possible to establish the percentage of female scientists in proportion to their male counterparts. The collected data was assembled in the following table:

**Table 2: Cited Scientists per Gender**

Percentage of cited or mentioned scientists per gender	Before inclusive writing (January 2018 to June 2018)	After inclusive writing (October 2022 to February 2024)
Cited or mentioned male scientists	88.1%	74.1%
Cited or mentioned female scientists	11.9%	25.9%

It was hypothesized that male scientists would hold a greater place across all articles and that female scientists would be underrepresented. The analysis of gender representation frequency per mention of a scientist's name in textual data reveals that male scientists hold a greater place than their female colleagues. Before the implementation of inclusive writing, the gender gap is significant. For every nine cited or mentioned male scientist, approximately only one female scientist is cited or mentioned (11.9%). This number is particularly low if we consider that 29% of workers in the Canadian space sector are women (STEM or other positions) (Canadian Space Agency, 2023) and less than a quarter of women work in STEM in Canada (Canadian Nuclear Safety Commission, 2024). In the second corpus, the proportion of cited female scientists approximately doubled, bringing the number of female representations much closer to the actual presence of female scientists in the Canadian STEM workforce. However, they are still greatly outnumbered by their male counterparts with an approximate ratio of seven-to-three.

Previous studies on Francophone written media from Quebec have shown that women were underrepresented in political, cultural, societal, and sports articles with a two for one ratio (Benjebria, 2015), and again a two for one ratio in politics in written community-based media in Quebec (Théberge-Guyon et al., 2018). Therefore, the representation of female scientists in *Québec Science* is lower than other outlets in the province. However, women in STEM are not the same subject matter as politicians, doctors, and government experts, but can still be identified as experts. Thus, the narrative of the underrepresentation of female expert holds true, confirming the hypothesis that male scientists would outnumber their female counterparts.

Based on the literature, two factors could explain the gender disparity in the Space column. First, since there is a gap between male and female scientists in the Canadian STEM workforce, they are less present in research teams, and therefore they do not occupy the roles sought after for interviews in light of articles. As previously examined, in Quebec, female researchers are victims of biased funding for their research projects (Beaudry et al., 2016), which also affects their presence in research, spanning to their place in media. Female scientists could also be underrepresented in these results since they are less likely to accept interviews with journalists (Mitchell & McKinnon, 2019). Under an empiricism realist examination, that is, the analysis of realities in and outside the text (Ang, 1985), the rendering of the quantitative representation of women in STEM in this column are a “true” depiction of reality, most likely because of these factors.

Under a critical lens, the underrepresentation of cited female scientists could symbolize who STEM is for and how hegemony in STEM is maintained. Male scientists uphold the prototype status, or the role model, furthering the gender-based stereotypes that STEM is for men, which can negatively contribute to the STEM identity of female readership (Starr, 2018).

Although female representation nearly tripled in the corpus after inclusive writing was implemented, we can only establish correlation and not a cause to effect relationship between these factors. It is also important to note that the samples are four years apart and other factors could have contributed to this increase, including greater awareness to gender equity in STEM.

Scientists are not only portrayed by name in these articles: inclusive writing techniques further their representation. For example, the syntactical feminization of professional titles offers a different way in making texts more inclusive, which is subsequently examined. It is important to note that professional titles that are naturally gender-neutral were not counted in the following analysis (e.g., *astronome*), since Table 4 addresses them and the categories must be distinct, as outlined by Mucchielli (2006). For male representations, the generic form that has a corresponding feminized form was compiled, and for female representations, the syntactical feminization of a title was counted. All professional titles are linked to an expert’s name, which were quantitatively examined in Table 2.

**Table 3: Female Representation by Syntactical Feminization of Titles**

Percentage of professional titles per gender	Before inclusive writing (January 2018 to June 2018)	After inclusive writing (October 2022 to February 2024)
Male scientists (masculine or “generic” titles)	80%	76.2%
Female scientists (feminization of titles)	20%	23.8%

The feminization of titles allows to further the quantitative representation of women in the column. In fact, while the analysis of cited or mentioned scientists by name revealed a poor quantitative portrayal of female scientists, the use of syntactical feminization further carries female scientists in the texts. Based on the results in Table 2, it was expected to see fewer feminized professional titles in both corpora since there were significantly fewer female representations than male representations, and have slightly more feminized professional titles in the second corpus, since female representation also slightly increased. Examples of compiled titles include *professeur* or *professeure*, *physicien* or *physicienne*, etc. In the second corpus, two feminized titles occurred from the use of doublets to represent a group, which is analyzed in section 4.1.3. The specific titles and portrayed expertise will be further analyzed under a qualitative scope in section 4.2. to reveal a more complex phenomenon of inclusion based on the value of various professional titles.

As seen in the literature review, materialist feminists suggest that the separation of the feminine from the generic with the syntactical feminization of professions would perpetuate the marginalization or the othering of women in STEM (Michard & Ribéry, 2008). However, under the critical scope, this linguistic technique still increases their representation and may favorize a better visibility of this minority group by voicing their righteous space in texts through their professional accomplishments. As Vološinov posits, “the existence of the sign is nothing but the materialization of that communication” (1973, p. 13). As such, extending the representation of female scientists with feminized titles beyond the basic appellation of their names contributes to the creation of meaning that can shape perceptions, thus materializing the message that women do in fact hold a space in STEM fields. He would argue that, since syntactical feminization was instigated by radical feminists (Dumont, 2024), they are engaging in linguistic strategies to resist

marginalization in STEM and assert their own identities and perspectives. These results show that female scientists assert their own scientific identity in discursive practices through their professional accomplishments.

As Hall explained, “the true meaning of it will depend on what meaning people make of it; and the meanings that they make of it depends on how it is represented” (Jhally, 1997, p. 7). Therefore, it is essential to ask, when a female reader sees the feminization of a title, is their reflex to stigmatize that female scientist, or are they simply satisfied with seeing a female in STEM having the opportunity to voice the space they hold in STEM fields? Future research should examine these implications.

Other inclusive writing methods must also be considered as they can also materialize scientific identity through its various techniques of portraying scientists, which could either benefit or hinder female scientists. Three techniques were analyzed and examined in the following section.

#### **4.1.3. Un/covering Male and Female Representations with Inclusive Writing**

The following table presents the results obtained from the quantitative analysis of three inclusive writing techniques to represent scientific groups or professionals: gender-neutral formulations, generic formulations (the masculine form), and doublets (the coordination of the masculine and feminine forms), followed by their individual analyses.

**Table 4: Inclusive Writing Occurrences per Technique**

Percentage of inclusive writing occurrence per technique	Before inclusive writing (January 2018 to June 2018)	After inclusive writing (October 2022 to February 2024)
Doublets (coordination of masculine and feminine terms)	0%	3.5%
Generic formulations (masculine)	64.3%	29.3%
Gender-neutral formulations	35.7%	67.2%

### Doublets

In the first corpus, doublets were absent. After the implementation of inclusive writing, only two individual occurrences were noted, or 3.5%, when referencing scientists. While this number is low compared to the other writing methods, the result was expected, since *Québec Science* announced that it would use this technique sparingly and prioritize gender-neutral terms (Guillemette, 2022b). It is, however, interesting to note that these two occurrences clearly represent both male and female scientists, without referring to a specific expert. *Les chercheurs et chercheuses* was used in both occurrences. As such, in these instances, this group of experts is materialized as being diverse. By expressing both genders, it holds a space for female scientists. Previous research has shown that the syntactical feminization of professional titles influences mental images, where readers exposed to doublets are three times more likely to picture a female

professional in that position compared to those exposed to the generic (Brauer, 2008). An additional instance of doublets was noted, but concerned visitors of an observatory (i.e., *les visiteurs et visiteuses*). While this occurrence does not relate to scientists, it still holds a space for both men and women with regards to who can be interested in visiting the observatory and meeting with scientists.

While the trace number of doublets in the sample limits the analysis, it is important to note that the second corpus is not a selection of articles but concerns the totality of articles written since *Québec Science* implemented inclusive writing, until February 2024. Therefore, the sample is complete and shows that doublets do not have a great incidence on the representation of female scientists in this column, even though they increase mental images of female scientists.

### **Generic Formulations**

Before the implementation of inclusive writing, generic formulations accounted for two thirds of all scientific group designations (64.3%). This data also includes pronouns that define the gender of gender-neutral terms. For example, *les scientifiques...* followed by the pronoun *ils* defines the group as being generic (masculine) as opposed to gender-neutral. These numbers are particularly insidious for the representation of female scientists. Even though the generic is meant to represent “humanity,” previous studies have shown that readers associate the generic with the masculine more than they do with the feminine (Gygax et al., 2008), which in turn defines the identity of scientists as masculine and furthers gender-based stereotypes, which is known to hinder STEM identity in female readership (Starr, 2018).

In fact, as previously revealed, even when children (Vervecken et al., 2013) and teenagers (Vervecken et al., 2015) are exposed to job descriptions that are traditionally masculine (which is

applicable to STEM) and where the generic is used, they attribute higher success to the masculine sex rather than the feminine. As such, the neutral form is never truly neutral since it creates mental images of the masculine sex (Misersky et al., 2019). Coupled with the lack of female representation as outlined in Table 2, these linguistic choices extend hegemony in STEM by symbolizing that STEM is for male scientists. In the second corpus, however, generic formulations drop to only one third of all group designations, which would reduce mental images of the masculine sex. Most generic formulations were replaced with gender-neutral formulations, in which the implications are further analyzed.

### **Gender-neutral Formulations**

In the first corpus, gender-neutral formulations approximately represented one third (35.7%) of scientific group designations even without an announced dedication to inclusive writing from the magazine. These occurrences could be attributed to the fact that most scientific titles in the space sector are already gender neutral. In the articles, these appeared as *les scientifiques*, *les astronomes*, *les astronautes*, *les spécialistes*, and *les cosmologistes*. It is relevant to note that 87.9% of gender-neutral terms have occurred in the text written by journalists, and 12.1% of gender-neutral terms have occurred in quotations by interviewees, that is, cited experts.

After the implementation of inclusive writing, gender-neutral formulations nearly doubled, going from 35.7% to 67.2% of all representations of scientific groups or professionals. This result was expected given that *Québec Science* publicized their intent to prioritize gender-neutral terms (Guillemette, 2022b). In this subsample, 84.6% of gender-neutral terms have occurred in the bulk of the text written by journalists, and 15.4% of gender-neutral terms have occurred in quotations by interviewees. It is, however, not clear if this jump towards neutrality in

quotations comes directly from the cited experts, or are corrections made by the journalists. Either way, it increases the gender neutrality in the overall articles.

While using gender-neutral terms does not directly increase the representation of female scientists, it does limit that of male scientists through the generic (masculine terms), which helps reduce the gender-based stereotype that STEM is for men. In the studies conducted by Vervecken et al. (2013; 2015), the effects on the perception of success in traditionally masculine roles were diminished towards the masculine sex and also attributed to the feminine sex. As such, in conjunction with previous literature, this inclusive writing process could be extrapolated to be considered as a counter-stereotype. Previous research has shown that counter-stereotypical role models lead to an increased interest in STEM fields for women (Cheryan, Drury, et al., 2013), in part because it reduces the stereotype threat (Good et al., 2010).

If “stereotypes reduce women’s identification with STEM, which can decrease their motivation to enter STEM domains” (Starr, 2018, p. 489), counter-stereotypes can have the opposite effect (Cheryan et al., 2013; Cheryan et al., 2013; Good et al., 2010). Therefore, these results show that even though the representation of female scientists has not significantly increased in the second corpus (see Table 2), gender-neutral writing could still be contributing to a positive interpretation of whom STEM is for since STEM identity is constituted within representation and “constructed within the play of power and exclusion” (Hall, 2011, p. 5). In fact, since female readership “use the idea of other groups to define their own character” (Strömberg, 2011, p. 575), perhaps decentralizing the focus from male scientists and refocussing it on gender-neutrality increases STEM identity in female readership. As explained by Bhabha, “the problem of identity returns as a persistent questioning of the frame, the space of representation, where the image [...] is confronted with its difference, its Other” (Bhabha, 1994,

p. 45). Therefore, if the confrontation, or alterity, is lessened, perhaps the negotiation of a STEM identity encounters less struggle and resistance, since it does not need to accommodate the normative rule that STEM is for the masculine sex.

#### **4.1.4. Summary of Quantitative Results**

The analysis of the quantitative results answers part of the research question. It confirms the hypothesis that female scientists are underrepresented in images and in the text compared to their male counterparts, both before and after the implementation of inclusive writing, showing that representations are not diverse. While these results may represent the current state of the Canadian space sector, greater representation in Francophone media is needed to instigate social change in STEM overall. Inclusive writing had minimal impact on the representation of female scientists through the techniques of syntactical feminization and doublets. However, the increase of gender-neutral terms helps neutralize male representations, thus leaving space for mental images of female scientists. Content analysis is only one of two empirical methods used to answer the research question. A deeper dive into *how* female scientists are characterized is needed to understand how they are portrayed in all aspects. As previously mentioned, while the analysis of gender-neutral formulations seems promising, these inclusive writing techniques may be in vain if other discourses used to describe female scientists are symbolically annihilating, which calls for critical discourse analysis.

#### **4.2. Roles, Contributions, and Expertise of Female Scientists Compared to Male Scientists**

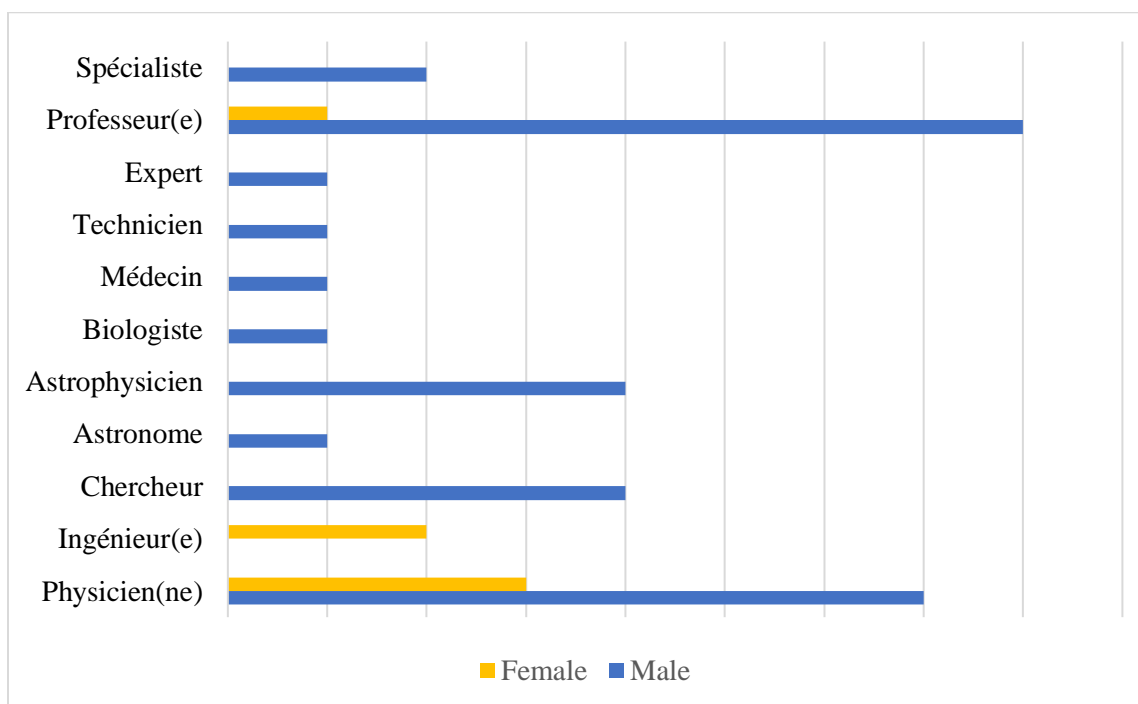
Both aspects of the research questions are not fully addressed until we consider critical discourse analysis. While the quantitative results from the content analysis revealed that female scientists are underrepresented in the Space column in both corpora, it does not address the way they are qualified with discourse, which in turn addresses inclusivity. As such, two more steps in

research were necessary. First, a critical discourse analysis of descriptors of both corpora reveals how this group is portrayed qualitatively compared to their male counterparts. Then, both analyses are compared to reveal any discrepancies between the data. To accomplish the inquiry, the results and their analysis were divided in two parts, corresponding to both corpora, to provide a rich analysis of findings. Then, a comparative scholarship of both samples draws on descriptive claims and previous literature to answer the research question. Chapter 4 ends with a discussion of results under a critical scope and contextualizes them.

#### **4.2.1. Analysis of First Corpus: Before Inclusive Writing**

During the process of analysis, a coding framework was inductively developed to allow the collection of descriptors in both corpora. These descriptors function to portray cited scientists' expertise by providing details relative to their field, such as their skills, STEM backgrounds or certifications, and their specific role or contributions to projects. The following chart compiles the main descriptors pertaining to scientific or professional job titles, including titles that are gender-neutral or that can be feminized (e.g., *astronome* is gender-neutral, but still related to an expertise, while *mathématicien* can be syntactically feminized). In all instances, the data in the following figures are presented in French since *Québec Science*'s content is in French.

**Figure 1: Descriptors: Expertise by Gender (First Corpus)**

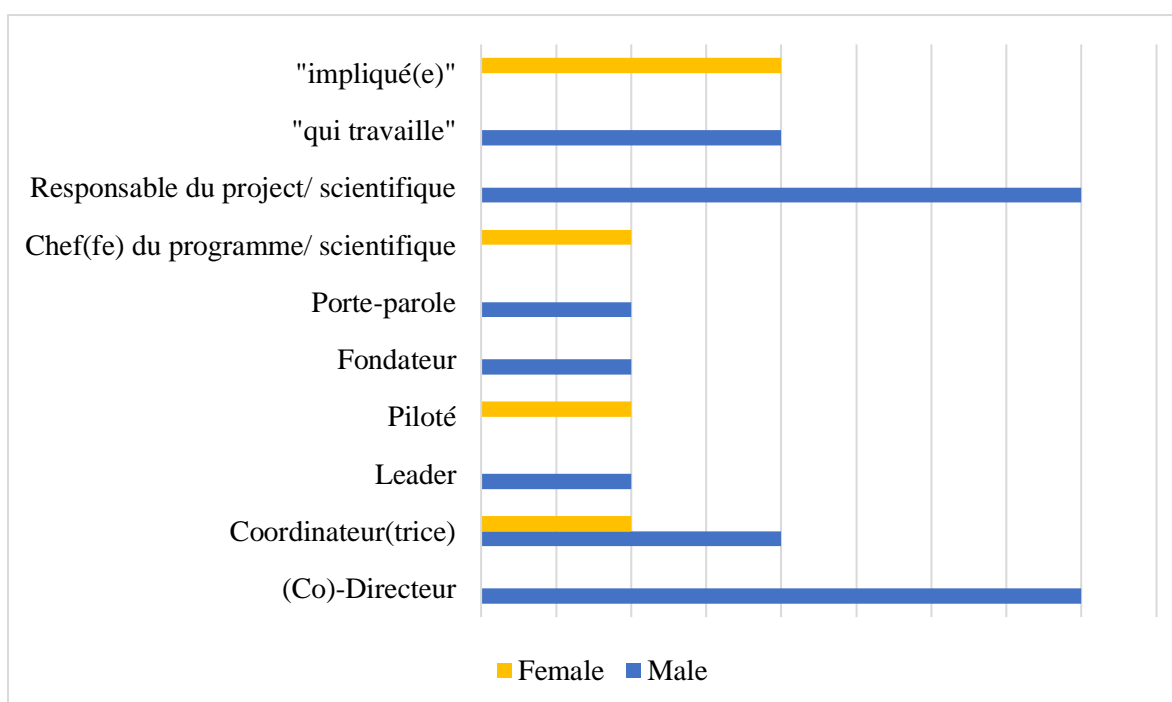


In the first corpus, eight professional titles were identified, such as *professeur*, *technicien*, *médecin*, *biologiste*, *astrophysicien*, *astronome*, *ingénieur*, and *physicien*, as well as titles that relate to a more generalized expertise, such as *spécialiste*, *expert*, and *chercheur*. The results clearly indicate that male scientists are portrayed with an array of scientific titles or expertise, while the representation of female scientists is limited to three professional titles: *professeure*, *ingénieure*, and *physicienne*, the latter being the most frequent. It is important to remember that the analysis in section 4.1, female scientists were mostly absent in the first corpus; therefore, their representation in professional titles is also limited. However, is it relevant to note that these results indicate that male scientists are shown with greater dimension, that is, they are associated with an array or roles (8 versus 3 compared to women). As such, this data shows that male scientists occupy more spaces in STEM than female scientists do, which could be damaging when we consider that ideology is tied to discourse (Vološinov, 1973). The descriptors used to

describe female scientists can be interpreted as discourse that is symbolically annihilating, since women are underrepresented in limited roles while men are represented in a wider range of roles (Tuchman, 2000).

To better understand how female scientists are included in the articles, the main descriptors used to describe the specific role or contribution of male and female scientists in a project or study was also examined. This data is particularly relevant when we consider that young audiences draw on “discourses that oppose femininity with scientific engagement and make gendered distinctions between doing science and being a scientist” (Mendick & Moreau, 2013, p. 336). Therefore, if female scientists are presented as physicists while other discourses dismiss their engagement within a project, then the overall discourse is symbolically annihilating and continues to maintain the status quo in STEM. The following figure presents these descriptors:

**Figure 2: Descriptors: Roles and Contributions by Gender (First Corpus)**



In this inductive discourse analysis, seven administrative titles describe the roles and contributions of scientists. These include *co-directeur* or *directeur*, *coordinateur* or *coordinatrice*, *leader*, *fondateur*, *porte-parole*, *cheffe du programme* or *cheffe scientifique*, *responsable du projet* or *responsable scientifique*. It was also relevant to identify other descriptors that are not considered administrative nor professional titles but that still situate the scientist within the project with action verbs, such as *a piloté*, *impliqué* and *qui travaille*.

Generally, the discourse surrounding both genders seems well rounded, painting the picture that both male and female scientists occupy a variety of roles or have both diversely contributed to projects. However, when comparing the spaces male scientists occupy where female scientists are absent, a gap becomes evident. The data shows that, compared to female scientists, male scientists are more likely to be associated with higher positions, such as director or co-director, as well as *responsable du projet* [project manager] or *responsable scientifique* [scientific manager]. This specific characteristic is further discussed in section 4.3. The discourse surrounding male scientists also showcases their role within a team or project more often than women. In fact, female scientists were often quoted with a professional title, but mostly out of context with their specific role or contribution within a team or project. This dissociation is also present in previous literature (Chesky & Goldstein, 2018). The analysis also reveals that when a male scientist is quoted, their role or contribution to a project directly follows their name, tying them to a context and allowing them to occupy a space outside of the articles. Female scientists, however, presented with having a punctual expertise following their name, and their role or contribution to a project is only mentioned later in the article or is absent.

The other descriptors that situate scientists within the project (such as *a piloté*, *impliqué* and *qui travaille*) also vary per gender. For instance, male scientists “worked” on projects,

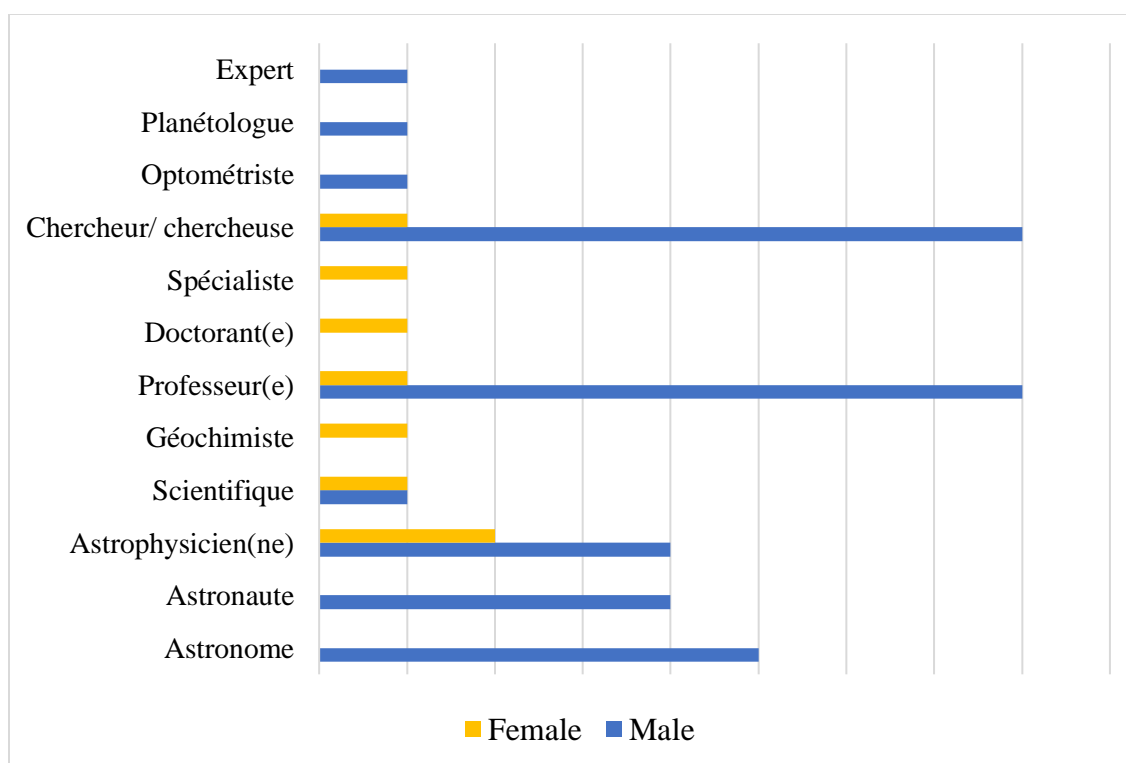
whereas female scientists were “involved” in projects. Does “being involved” in a project carry the same weight as “working on a project”? Not quite. While the first descriptor seems like a more abstract concept, the second is more action oriented. Paired with the lack of representation of female scientists, these discourses support the social constructions that not only do male scientists uphold STEM fields, they are also more involved in them. These representations could prompt gender biases that affect female readership’s perceptions of “who belongs in STEM” (Steinke, 2017). One identified strength in other discourses is that female scientists were also described as having piloted a project, which is action oriented. However, its singular occurrence does not outweigh other discourses and lack of portrayal.

The examination of the discourse used to describe female scientists in this first corpus confirms the hypothesis that male scientists would be portrayed with having greater expertise than their female counterparts, which correspond to previous literature. While these results do not refer to inclusive writing practices, it is concluding to note that, in the first corpus, these descriptors were coupled with a lack of representation of female scientists, where the generic (the masculine) was dominant, which greatly disadvantages female scientists in this column, especially when we consider that “hegemony requires iteration and alterity to be effective” (Bhabha, 1994, p. 29). A lack of positive role models negatively impacts female readership since “these images interact with other aspects of their identity work, including in relation to performances of gender” (Mendick & Moreau, 2013). It confirms the gender-based stereotype that STEM is for men (Starr, 2018, p. 489). The same analysis was repeated for the second corpus, that is, articles that followed the implementation of inclusive writing in the *Québec Science* magazine.

#### 4.2.2. Analysis of Second Corpus: Implementation of Inclusive Writing

To complete the analysis and answer the research questions, the same steps in research were repeated for the second corpus, that is, once inclusive writing was implemented. While these discourses are again not directly tied to inclusive writing, their analysis is paramount since “the meaning of a word is determined entirely by its context.” (Vološinov, 1973, p. 79), that is, the inclusive writing efforts analyzed in section 4.1 might be meaningless if other discourses are symbolically annihilating. Again, these descriptors were collected regardless of if they are gender-neutral or can be feminized. The following figure presents the descriptors used to qualify male and female scientists:

**Figure 3: Descriptors: Expertise by Gender (Second Corpus)**



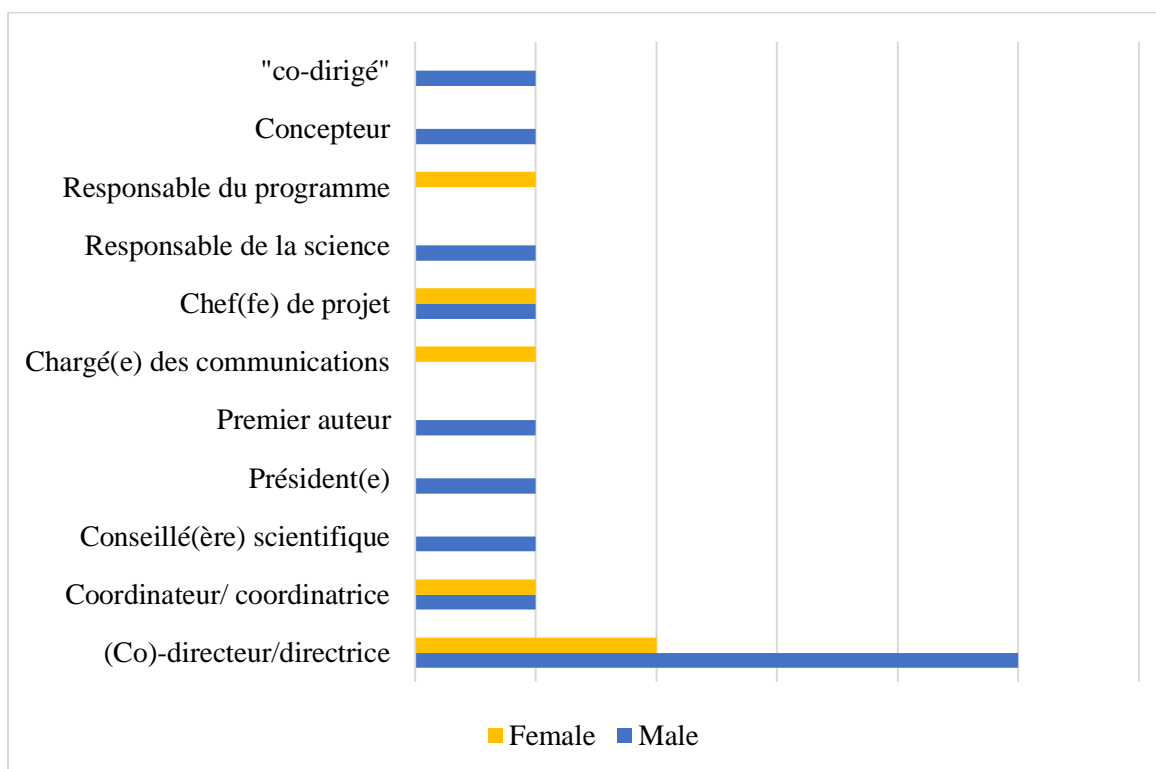
In this second corpus, which comprises articles from October 2022 to February 2024, seven professional titles were identified, such as *planétologue*, *optométriste*, *professeur*,

*géochimiste, astrophysicien, astronaute, astronome*, as well as five titles that relate to a more generalized expertise, such as *expert, chercheur, spécialiste, doctorant, and scientifique*. In this sample, male scientists are portrayed with six out of seven professional titles and three out of four titles relating to a generalized expertise. Female scientists are portrayed with three out of seven professional titles and four out of five more generalized expertise. While both male and female scientists were portrayed with an array of scientific titles or expertise, female scientists are still a minority in this column. In fact, male scientists were most often portrayed as researchers, professors, astrophysicists, astronauts, and astronomers, while the only professional title that most often described female scientists was astrophysicist. These results again confirm the hypothesis male scientists would be portrayed with greater expertise than their female counterparts and that male scientists have more dimension.

The articles in this corpus reported on space travel and research in astronomy, which is why there are many occurrences of the titles astronaut and astronomer. Since the spotlight is currently on our Canadian astronaut and fighter pilot Jeremy Hansen, it is easy to understand why female scientists are absent under this professional title. The article being about our Canadian astronaut, other crew members, including the American astronaut Christina Koch, a female flight engineer who already flew to the International Space Station (NASA, 2024), were not central to the story. As such, it is easy to understand how context also affects the representation of female scientists. While the implementation of inclusive writing had no incidence on these individual scientific titles, female scientists have more dimension in this second corpus, that is, they are represented in a wider variety of roles. These implications are further discussed in section 4.3.

As performed in the previous corpus, it is necessary to analyze how female scientists are included in the articles through their portrayed roles and contributions with the analysis of these specific descriptors. The following figure presents the results for this second corpus:

**Figure 4: Descriptors: Roles and Contributions by Gender (Second Corpus)**



An inductive discourse analysis was again conducted for this second corpus. It revealed eight administrative titles that describe the roles or contributions of scientists to a given research project. They include *co-directeur* or *directeur*, *coordinateur*, *conseillé scientifique*, *président*, *premier auteur*, *chargé des communications*, *chef de projet*, *responsable de la science*, *responsable du programme*, and *concepteur*. It was also relevant to identify other descriptors that are not considered administrative nor professional titles but that still situate the scientist within the project. In this sample, only *qui a co-dirigé* was identified.

Generally, the discourse surrounding both genders seems well rounded, painting the picture that both male and female scientists occupy a variety of roles or have both diversely contributed to projects. The comparison of these results with the first corpus will be shortly introduced. In this corpus, female scientists were portrayed as being at the forefront of projects (program or project manager), including the title of director. They were also more strongly tied to their expertise in relation to the project context, i.e., their expertise and related institute or research group was promptly named, which better puts them and their work in context within the article. As such, although the representation of female scientists is still scarce in this corpus, it does give them more dimension than previously observed.

If we recall the analysis of inclusive writing, the second corpus relied heavily on gender-neutral terms to characterize scientists. While the benefits of this approach were discussed in section 4.1.3., other language used to describe scientists, including their roles and contributions to projects, has improved, but remains limited. Increasing gender-neutral terms to designate scientific groups is perhaps not enough to contribute to the representation of women in STEM, since other discourses do not necessarily uplift them. Therefore, general discourse must be more inclusive to work together with inclusive writing. This result is further analyzed in section 4.3. The only other descriptor that situates scientists within the project was *qui a co-dirigé*, which was attributed to a male scientist. Therefore, while the analysis is limited, this occurrence still concords with the general result that male scientists are portrayed with more complex roles or have made more diverse contributions to projects than female scientist.

Now that the qualitative aspect of both corpora has been examined, the following section compares them to reveal any changes or discrepancies between samples, which then leads to a discussion of results under a critical lens while reflecting on empiricist realism.

### 4.2.3. Comparative Scholarship of Both Corpora

In section 4.1., the quantitative analysis of male and female scientists revealed that female scientists are underrepresented in the Space column, both before and after the implementation of inclusive writing. It also revealed that gender-neutral formulations mask the presence of male scientists, which could help with mental images of scientists. Section 4.2. does not address inclusive writing, but rather examines the discourses used to describe these scientists, from professional titles to discourses that characterize roles and contributions in projects. The comparison of both corpora reveals some changes in the way female scientists are portrayed.

#### Professional Titles

In both corpora, male scientists were most frequently cited as professors and researchers. In the first corpus, they were also mostly cited as astrophysicists and physicists, which shifted to astronaut, astronomer, and astrophysicist in the second corpus. Nevertheless, they were the sex that was portrayed in a greater diversity of roles. Female scientists, on the other hand, were only cited with three professional titles in the first corpus, with physicist being the most frequent. In the second corpus, their expertise is expanded to seven roles, giving them more dimension as researchers. While their representation nearly doubled in the second corpus (see section 4.1.2.), the variety of roles that they occupy was also diversified, which marks a positive change in discourses.

The discourse surrounding male scientists showcases their role within a team or project more often than women. In fact, in the first corpus, female scientists were often quoted with a professional title, but mostly out of context with their specific role or contribution within a team or project. The analysis reveals that when a male scientist is quoted, their role or contribution to a project directly follows their name, tying them to a context and allowing them to occupy a

space outside of the articles. Female scientists, however, were presented as having a punctual expertise following their name, and their role or contribution to a project was mentioned later in the article or was simply omitted.

For example, in the first corpus, they were often cited with a vague expertise: *la physicienne Québécoise* (Corniou, 2018a) or *ingénieure Québécoise* (Labrecque, 2018). One instance of *professeure émérite de physique à l'Université de Californie à Los Angeles* (Corniou, 2018b) was noted. Nonetheless, the way female scientists were quoted has positively evolved in the second corpus, where female scientists had more than one facet: journalists reported on their expertise, their professional title, and their place of work. A representative example is *Sarah Rugheimer; spécialiste des biosignatures et professeure au Département de physique et d'astronomie de l'Université de York, à Toronto* (Bourquin, 2023). Therefore, although women in STEM are still underrepresented overall, the discourse surrounding their expertise has shifted positively in the second corpus by portraying them in a greater variety of roles and by contextualizing them in the real world.

### **Roles and Contributions**

The discourse used to describe the roles and contributions of female scientists has also positively shifted when comparing both corpora. In fact, in the first corpus, there were only two instances of a leadership role (i.e., *cheffe du programme* and *piloté*), and female scientists made abstract contributions to projects. All other instances of leadership roles were used to describe male scientists. In the second corpus, female scientists are shown in more leadership roles, which includes director. The latter was only reserved for male scientists in the first corpus.

As such, the overall results show that, compared to female scientists, male scientists are more likely to be associated with higher positions, such as director or co-director, as well as *responsable du projet* [project manager] or *responsable scientifique* [scientific manager]. This specific characteristic is further discussed in section 4.3. These subtle differences in discourse reveal that male scientists hold higher administrative positions. However, this disparity is not only reserved to the sciences. In Canada, “Women continue to be underrepresented in leadership and decision-making positions, accounting for one in four senior managers in Canada, or about one in five corporate board directors, while they represented almost one in two workers” (Richards & Longpré-Verret, 2021). However, this gap is more significant in STEM fields, as only one in four people employed in STEM in Canada are women (Canadian Nuclear Safety Commission, 2024). Therefore, it can be difficult to portray female scientists in leadership roles if their presence in these positions is scarce.

### **4.3. Discussion**

Sections 4.1. and 4.2. presented and examined the results of the research inquiry. While some explanations and interpretations about these results were given throughout the analysis, some topics should be further evaluated under critical theory to fully answer the research question and its hypotheses. In this final section, a discussion on the results is reiterated but also expanded to understand how the representation of female scientists in this column can impact female readership’s relation to STEM, including STEM identity, for both general discourse and inclusive writing.

#### **4.3.1. The Representation of Female Scientists Through Discourse**

The findings in this study show that the representations of female scientists in the Space column of the *Québec Science* magazine both before and after the implementation of inclusive

writing are not diverse, as they are underrepresented. It was hypothesized that male and female scientists would be portrayed in asymmetrical ways, where male scientists would outnumber female scientists and be shown as having more expertise than their female counterparts. Results show that the representation discrepancy between male and female scientists was greater than anticipated, considering that female representations in this column are lower than their presence in STEM jobs in Canada. It is fair to conclude that female scientists are symbolically annihilated in this column, that is, they are “other,” since they are underrepresented in limited roles while men are represented in a wider range of roles (Tuchman, 2000). However, this gap is slightly lessened in the second corpus, where female scientists are portrayed in greater roles and are contextualized in the real world. Nevertheless, their overall underrepresentation continue to define the scientific community and its actors, thus maintaining the gender-based stereotype that STEM is for men (Starr, 2018).

Given the values portrayed by *Québec Science* and their recent efforts in making the magazine more inclusive and diverse, these results are most likely systemic and reflect the reality of female scientists in the STEM workforce (i.e., they are underrepresented and their research is underfunded). Expert availability and presence in leadership roles are factors that journalists do not control. Authors also face inevitable gender biases, which are embedded within a patriarchal ideology. A previous study conducted by Mendick and Moreau (2013) revealed how some authors manifested a disconnection between their knowledge of gender representation issues in STEM and applying diverse and inclusive language in their work. Consequently, they reproduced dominant gender discourses, exiling considerations of the potential impacts of these representations, which impedes on social change. The reality of female scientists is transposed to written media, which in turn impacts female readership.

*Québec Science* authors, however, improved discourses in the second corpus, which uplifts women in STEM through the descriptors used to identify their expertise, roles, and contributions, even though they remain underrepresented. Multiple factors could explain this slight increase in representation in the second corpus. These articles were published after COVID-19, a global event that increased the number of women as cited experts in media (mostly as public health officers) and brought awareness to the contribution of women to the sciences (notably, health care and public care) (Taboada, 2020), which could have set the tone for future STEM-related news articles. The Government of Canada has also increased efforts in recent years to promote STEM professions through mentorship programs, but also through action plans that help identify barriers in workplaces (Shared Services Canada, 2021).

#### **4.3.2. Inclusive Writing to Improve Mental Images of Scientists**

Although the way female scientists are portrayed in the second column was improved as inclusive writing was introduced, these two factors are most likely independent or were influenced by the above factors. It is important to remember that four years separate both corpora; therefore, discourses surrounding female expertise could have naturally shifted towards more frequent or positive portrayals. It was hypothesized that female representation would increase if doublets were predominantly used, and male representations would decrease if gender-neutral writing is used; in both cases, these techniques would have a positive impact on the perceived place of women in the STEM narrative *only if* other discourses concerning their expertise and roles and contributions are uplifting.

In the second corpus, only three instances of doublets were identified; therefore, this specific data set is insignificant to draw full conclusions. It can be noted that in these instances, female scientists did get exposure with the feminization of their professional title compared to

when the generic masculine was used. Results become relevant with the examination of gender-neutral terms. In the second corpus, most scientific group designations referred to gender-neutral terms instead of the generic (i.e., the masculine). In a subtle way, through mental processes, this linguistic manipulation indirectly helps the representation of female scientists since people associate the generic with the masculine more than they do with the feminine (Gygax et al., 2008; Misersky et al., 2019), whereas gender-neutrality yields a space for both genders compared to the generic (Vervecken et al., 2013; Vervecken et al., 2015).

Since gender-neutral terms were coupled with a more intricate representation of female scientists in the second corpus, it can be said that inclusive writing facilitated a positive perception of women in STEM in this column. While these results successfully answer the research question, it is highly pertinent to expand the analysis to a discussion on the construction of STEM identity of female readership and to reflect on the principle of spaces of negotiation in the critical scope.

#### **4.3.3. Theoretical Interpretation and Contextualization of Results**

In response to the critical inquiry, it is relevant to examine how these messages impact female readership. Female audiences constantly compare themselves to media representations and search for clues to confirm whether they belong in a certain community and if they would be successful there (Cheryan, Plaut, et al., 2013). Carefully crafted discourse has the potential to disrupt the status quo in STEM and contribute to carving a positive space within the public narrative (Chesky & Goldstein, 2018). As audiences are not homogenous and STEM identities are dynamic, their conceptualization is ever-changing. Therefore, gender representations should also be diverse and inclusive to propose a variety of role models for female readership (Steinke, 2017), since “data show clearly that young people negotiate and take up positions in relation to

dominant pre-existing meanings [...] and make gendered distinctions between doing science and being a scientist” (Mendick & Moreau, 2013, p. 336). This continuous interplay has built hegemony in STEM fields over history and defines female scientists’ identity because it is constantly measured against the way male scientists are portrayed (i.e., they are in binary opposition).

As such, a theoretical interpretation of the impacts that these results could have on the perception of women in STEM, and how these perceptions are negotiated in the temporary space that is created when one reads a such scientific news, follows. Since an “utterance is constructed between two socially organized persons and, in the absence of a real addressee, an addressee is presupposed in the representative of the social group to which the speaker belongs” (1973, p. 3), the portrayal of female scientists in written media becomes the representative of that social group in STEM, beyond the article that is being read, and become symbols that regulate our interpretation of hegemony in STEM fields, since culture is constructed discursively (Piller, 2012).

When reading an article, the reader has preconceptions of a group, situated in their own individual psyche, that are either confronted or in agreement with the material conditions portrayed in the text (i.e., discourse). As argued in the literature review, scientific identity “is only likely to be advanced when both the necessity and the ‘impossibility’ of identities, and the suturing of the psychic and the discursive in their constitution, are fully and unambiguously acknowledged” (Hall, 2011, p. 16). Since our negotiation of hegemony in the scientific community is constructed by the interaction between the subject and the conceptions of reality that we have previously acquired (Perret, 2019), it yields a conclusive perception of the scientific community.

In the first corpus of this study, female scientists were underrepresented and were not portrayed as having much dimension, whereas male scientists held the dominant narrative. Furthermore, in terms of inclusive writing techniques, the generic (the masculine) was predominantly used. These representations of male and female scientists are most likely in agreement with what readers would expect in a scientific magazine because these portrayals follow hegemony. Since they are in agreement, there is less chance of confrontation between the individual's psyche and the material world, and the internal space of negotiations remains unaltered. As such, perception is materialized in such way that contributes to maintaining hegemony, since reality and knowledge of identity are built through perceptions (Benjebria, 2015). The result is further materialized when it is translated to STEM identity, as it is hindered by the gender-based stereotype that STEM is for men (Starr, 2018).

In addition to the underrepresentation of female scientists in the first corpus, a lack of portrayed engagement further normalizes the status quo and haltering discussions surrounding the implementation of programs tailored to girls and women in STEM, which in turn influences budgets for these activities and limits their impacts. As such, not seeing female scientists' direct involvement within research projects or research teams in this sample contributes to shaping public opinion towards their roles in science (Chesky & Goldstein, 2018). In fact, "what we know of society depends on how things are represented to us and that knowledge in turn informs what we do and what policies we are prepared to accept" (Miller, 2002, 246). Additionally, this lack of portrayed engagement place female scientists in the margins instead of being truly included in the text, which feeds into dominant discourses where they remain "other." While this first corpus fed into dominant discourses, the second enabled a slight shift in the representation of female scientists.

The second corpus, while still underrepresenting female scientists in a quantitative matter, portrayed female scientists in a more equitable way on the qualitative front. In fact, through a positive shift in descriptors, their roles and contributions to projects tie them more closely to the STEM narrative: they are not only scientists but also “do” science. This increased scientific engagement compared to the first corpus lessens the gap between male and female scientists, but only momentarily.

When reading an article in the second corpus, seeing female scientists express their viewpoint, share their expertise on a project as well as hold leadership roles such as project directors may cause a confrontation<sup>3</sup> in the reader’s temporary space of negotiation, since it is rather rare to see women in STEM hold such space in media (see sections 2.1.1. and 2.1.1.). As such, the preconceptions towards this group based on a reality that the reader has previously acquired might be in contradiction, or in confrontation, with what is seen in the text, because these positive portrayals make gender-based stereotypes uninhabitable. This negotiation of whom belongs in STEM may prompt a positive STEM identity in female readership since they encounter positive role models that oppose a preconceived social reality. These processes help challenge and break hegemonic cycles, because, as previously analyzed, perception can be materialized. This space of negotiation is, however, momentary, since women in STEM are still underrepresented in the column. Even though a more positive space is carved for female scientist in this corpus, more representation is needed, since a shift in power relations require repetition to be effective (Bhabha, 1994, p. 29).

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<sup>3</sup> Here, the word *confrontation* does not necessarily have a negative connotation.

A similar analysis can be done for the increased gender-neutral terms to designate scientific groups in the second corpus. According to Bhabha, two things are needed to maintain an effective hegemony: iteration and alterity (1994, p. 29). Since gender neutrality in texts yields more positive mental images of women (Vervecken et al., 2013; Vervecken et al., 2015) compared to the generic, which is mostly associated to the masculine sex (Misersky et al., 2019), alterity is lessened with this inclusive writing technique, which in turn could contribute to making stereotypes inhabitable. By decreasing this state of otherness, female readership may not be as constraint by binary opposition, since identification “is constructed on the back of a recognition of some common origin or shared characteristics with another person or group” (Hall, 2011, p. 2). Female readers are exposed to more equitable symbols and positive role models, which could lead to a successful negotiation of a positive STEM identity, since their knowledge of whom STEM is for would be constructed through more equitable representations.

This analysis yields some necessary representational techniques to make stereotypes inhabitable for women in STEM in written media. First, women in STEM should be more frequently portrayed in quotes and in the feminization of their professional titles. Second, an increased and positive portrayal of their roles and contributions to scientific projects as women in STEM and in leadership roles should be emphasized. Finally, group designations of scientists should benefit from both doublets (e.g., *les physiciens et les physiciennes*) and gender-neutral terms (e.g., *les scientifiques*) above the generic.

#### **4.3.3.1. Inclusive Writing: Organic Evolution or Authoritarianism?**

As is identity, language is fluid and ever-changing. Since they are so closely tied together, and since language is a powerful tool that can instigate or hinder social change, it is relevant to ask who gets to decide what new writing policies, including that of inclusive writing, should be

implemented in written media. This final contextualization closes the chapter, followed by a short summary of findings.

While *Québec Science*'s decision to implement inclusive writing is research-based, the magazine still follows guidelines established by the *Office Québécois de la langue française* (Guillemette, 2022b). As carefully described by Vološinov, “the word has the capacity to register all the transitory, delicate, momentary phases of social change” (Vološinov, 1973, p. 19). The French language is currently in a transitory period where inclusive writing is not mandatory but strongly recommended. Hegemony can only be challenged by discourse if marginalized groups engage in linguistic strategies to resist such marginalization and assert their own identities and perspectives. Today, inclusive writing is a top-down political process, where it is imposed rather than its usage being spread freely within linguistic communities. Therefore, inclusive writing might be a different hegemony manifesting itself through language, rather than an agent of change supported and advanced by the symbolically annihilated.

If we recall, it is ideological institutions of the government, through academic bodies and dictionaries, that implement inclusive writing, since its success heavily relies on social context (Université Paris Cité, 2022). Three variables determine the probability of a successful top-down implementation—which is, by definition, authoritative (Matland, 1995, p. 146)—one of which is the ability to structure implementation, which include coordination amongst institutions (Mazmanian and Sabatier, 1983). Since written media is a vessel for discourse and representation, it is best left in the hands of linguistic communities and through public consultation to find ways to truly represent everyone in texts. Inclusive writing must “produce more than the illusion of inclusion” (debuk, 2018), and not be implemented just to “look good.”

Nevertheless, aside from the political debates that regulate and constraint the French language, a main takeaway from this aspect of the research is that gender-neutral terms and the syntactical feminization of professional titles do have a desired effect of increasing mental images of women in texts, which is particularly relevant to STEM fields. If anything that contributes to the creation of meaning can shape perceptions, and if perceptions can by extension shape social reality (see sections 2.1.4.1. and 2.1.4.2.), then inclusive writing can positively impact the representation of women in STEM in written media, since alterity is lessened. While *Québec Science*'s representation of women in STEM did slightly improve between both corpora, inclusive writing also played an additional part in changing mental images of the scientific community. The magazine is aware that linguistic codes can evolve, which is why it will remain flexible in its usage. The editor in chief based her decision to implement inclusive writing not by following the masses but by following research-based evidence which states that inclusive writing can improve mental images of people being talked about in a text (Guillemette, 2022b). Therefore, its implementation seems authentic rather than a tactic to supplement the magazine's image.

Overall, the methodology allowed to dress a portrait of how female scientists are represented in the Space column of *Québec Science*. The collection of quantitative and qualitative data produced descriptive claims for these representations, both before and after the implementation of inclusive writing. While these results cannot be extrapolated to all written media in Quebec, they do contribute to a novel understanding of how female scientists are portrayed in Francophone written media, which is data that is currently lacking. The proposed steps are reproducible for future research entailing other written media or can serve as a basis for future analyses.

The obtained results of how *Québec Science* represents women in STEM in the Space column and the theoretical interpretation of the impact on female readership are summarized below. As such, each corpus is broken down to its representation of female scientists and potential impacts on STEM identity and hegemony based on either the agreement or confrontation between the preconceptions of women in STEM and the material conditions the reader is subject to.

### **First Corpus – Main Findings and Impacts**

In the first corpus, discourse and inclusive writing represent women in STEM as follows:

- Compared to male scientists, they are underrepresented as cited experts and in images.
- Their roles, contributions to projects, and expertise are minimally described nor contextualized.
- They do not have as much dimension as their male counterparts.
- The feminization of professional titles slightly furthered their presence in the text.
- The generic was the dominant technique to describe groups of experts.

Theoretical interpretation of impacts:

- These representations symbolically annihilate women in STEM.
- The representations are likely in agreement with the preconceptions that readers have about scientists.
- There is little to no confrontation between the reader's psyche and the material conditions, and the negotiation of a STEM identity is unsuccessful.
- The perceptions of the scientific community are materialized in such way that the interpretation of hegemony in STEM contributes to maintaining it.

## **Second Corpus – Main Findings and Impacts**

In the second corpus, discourse and inclusive writing represent women in STEM as follows:

- They are still underrepresented as cited experts and in images (only a slight improvement was noted).
- They are portrayed in more diverse roles, including leadership positions.
- Their expertise is more intricate, action-based, and contextualized in the real world.
- The feminization of professional titles slightly furthered their presence in the text.
- Gender-neutral terms was the dominant technique to describe groups of experts.

Theoretical interpretation of impacts:

- Improved discourse facilitates a positive perception of women in STEM in this column.
- Alterity is lessened with gender neutrality.
- There is confrontation between the individual's psyche and the material conditions, and the chances of a successful negotiation of a STEM identity increase.
- The perceptions of the scientific community are materialized in such way that the interpretation of hegemony in STEM is challenged.

## Chapter 5: Conclusion

This research has presented a new facet of how female scientists are portrayed in written media. The multidisciplinary approach intersected inclusive writing with discourse under quantitative and qualitative analyses and provided a strong and detailed assessment of the representation of women in STEM in *Québec Science*. The comparison of two corpora, one occurring before the implementation of inclusive writing and the other, after it was implemented, offered an original look on the study of the representation of this group. As such, not only were representations through discourse studied: the potential impact that inclusive writing could have on these portrayals was fundamental. The originality of this research stems from the fact that Francophone written media has not yet been studied for its representations of women in STEM, and even less from an inclusive writing perspective—even though it is a topical issue—and was conducted under a critical paradigm, which is relevant in identifying processes of othering through discourse.

By focusing on articles from the Space column, the research further found its originality and relevancy. The question of representation is paramount for female readership, as positive role models and counter-stereotypes have the potential to spur STEM identity (Cheryan et al., 2013; Cheryan et al., 2013; Good et al., 2010; Starr, 2018). In turn, someone who develops STEM identity is “more likely to persist and secure STEM opportunities” (Cohen et al., 2021, p. 1127). The reiteration of positive representations of female scientists could contribute to normalizing and encouraging discussions surrounding the implementation of programs tailored to girls and women in STEM, which in turn could influence budgets for these activities. Carving a diverse and inclusive space within the Francophone narrative may advance awareness and challenge the current hegemonic nature of STEM (Chesky & Goldstein, 2018).

The goal to study the representation of women in STEM in Francophone media instigated the following research questions: how are women in STEM portrayed in *Québec Science's* Space column, and has inclusive writing impacted these representations? Related hypotheses guided the research question and relied on both previous literature and discursive processes. It was first hypothesized that male scientists would outnumber female scientists in a quantitative capacity and would be portrayed as having greater expertise than their female counterparts in a qualitative capacity. With regards to the role of inclusive writing and the representation of female scientists, it was conjectured that outcomes would rely on specific inclusive writing techniques. If doublets were mainly used, representation would increase, and therefore female scientists would have a perceived greater place in the STEM narrative, *only if* the process is coupled with positive portrayals of professional identity. If gender-neutral writing was mainly used, then male representation would be reduced, in which gender neutrality produces greater perception of success for both genders compared to the generic (Vervecken et al., 2013; Vervecken et al., 2015). This process could be beneficial for women in STEM *only if* the process is coupled with positive portrayals of STEM expertise. Therefore, inclusive writing would only benefit female representation as a dependant variable of positive discourse.

The critical paradigm governed the research. Through its considerations that the nature of reality is “constructed through power relations and shaped over history” (Tracy, 2020, p. 60), it designed this research to identify structures in discourse that can instigate social change within STEM fields (Merrigan et al., 2012). Through Marxist, feminist, and poststructuralist criticism, it examined the intersection comprised of culture, power, and STEM identity through critical theorists, which encompass postcolonial theorists, feminist theorists, and sociolinguistics.

To accomplish the research inquiry, empirical data were collected through statistical quantitative content analysis and inductive critical discourse analysis, the latter's coding guide being shaped by emerging results. These methods allowed to collect complex and complete data, including the frequency at which male and female scientists were included in texts and in images; how inclusive writing, including the syntactical feminization of professional titles, gender-neutral terms, and doublets allowed to extend female representations; and how both genders were portrayed through descriptors relating to expertise, roles, and contributions. The comparison of both corpora (before and after the implementation of inclusive writing) allowed to determine if shifts in discourses occurred.

Results rely on descriptive claims. They showed that female scientists were underrepresented overall compared to their male counterparts. They were cited and mentioned significantly less frequently than male scientists. In the first corpus, female scientists had less dimension than male scientists, that is, they were less present in a variety of roles and their expertise was limited to a few professional titles (i.e., they were symbolically annihilated). Their specific contribution to projects was also limited and vague compared to male scientists, which occupied various roles and contributed diversely to projects. The representation of women was improved overall in the second corpus, where they were represented in a wider variety of roles and were better situated in the STEM narrative, since more information was given about their expertise and place of business. In terms of inclusive writing, while the syntactical feminization of professional titles slightly furthered their representation, the increased usage of gender-neutral terms to designate scientific groups outnumbered the generic (i.e., the masculine) in the second corpus, which might help improve mental images of these groups by enabling mental images of female scientists in these roles. Both the underrepresentation and misrepresentation of female

scientists in this column confirm the hypotheses. Research results are highly relevant as they help propose clear writing guidelines in Francophone written media to optimize the representation of female scientists.

It is important to note that this research only concerned the representation of female scientists in one magazine in the Quebec media ecosystem, and that the impacts of various discourses on female readership were theorized based on theory and previous literature. It conjectured how discursive practices shape hegemony in STEM fields through the negotiation of STEM identity under the realm of social reality. Since quantitative content analysis and critical discourse analysis can only establish correlation (Croucher & Cronn-Mills, 2019), the research should be furthered by examining the perceptions of female scientists based on varying discursive practices to gain insight on the space of negotiations that regulates these perceptions. In other words, results indicated that gender neutrality was much more frequent in the second corpus, and that the discourse used to describe female expertise and their roles and contributions to projects had also improved by being more diverse and action based. While these elements should work in symbiosis to improve the representation of female scientists, it is relevant to know which linguistic process influences perceptions the most.

Therefore, future research should conduct cross-sectional surveys to examine the impacts of these linguistic variations on female readership. Surveys help understand complex social issues, including behaviours and opinions that are experienced across diverse populations (Scharrer & Ramasubramanian, 2021) and can be defined as “a social scientific method for gathering quantifiable information about a specific group of people by asking the group members questions about their individual attitudes, values, beliefs, behaviors, knowledge, and perceptions” (Wrench, Thomas-Maddox & Richmond, 2018, p. 214). Remaining under the

critical paradigm, this method “seeks to make people aware of how specific values shape reality” (Merrigan et al., 2012, p. 38) and determine which symbolic messages are retained by participants. The data should be collected with Likert scaling, since it is “the best predictor of behavior” (Tittle & Hill, 1967, p. 210). Data collected through surveys is valuable since it will reflect “real-life” perceptions of participants after being exposed to varying discourse, which is particularly useful to see whether inclusive writing or discourses describing expertise and roles and contributions play an equal part in shaping perceptions of women in STEM. Making the survey anonymous to protect the participants’ identity would also help counter social desirability bias, which can be common with Likert scaling (Kreitchmann et al., 2010). Focus groups are also an invaluable socially situated method to address power and the imposition of meaning with regards to relational aspects of self (Wilkinson, 1998). They could provide additional insight on the dynamic negotiation of meaning when one reads an article.

Using positive discourse to promote the “awe” factor of space exploration and related STEM fields could also be a positive entry point to developing a positive STEM identity. Space has the potential to inspire STEM learning in both children and adults (Sullivan, 2023), and “observing or studying stars and other astronomical objects” was shown to have a significant and positive effect on STEM identity (Cohen et al., 2021, p. 1126). For instance, Dr. Melanie Ratnam, President of The Society for Canadian Women in Science and Technology and mentor, promotes STEM as being a field that is powerful, beautiful and a force for good (Women and Gender Equality Canada, 2024).

Understanding the role of discourse and inclusive writing as tools that can lessen the gender gap in STEM fields will not only impact scientific innovation: it could play an instrumental role in seeing how future written media production could address gender-based

issues in STEM. After all, “the true meaning of it will depend on what meaning people make of it; and the meanings that they make of it depends on how it is represented” (Jhally, 1997, p. 7). Since anything that contributes to the creation of meaning can shape perceptions, it is necessary to measure which linguistic process most positively influences perceptions towards female scientists. Based on results, future discussions and debates should be held to determine how policy is instigated and through which bodies.

In summary, to improve both the representation of women in STEM in francophone written media and the mental images of female scientists, media practitioners should improve their overall discourse and use specific inclusive writing techniques, listed below as recommendations. They should:

- Be more diverse, that is, increase the number of times female experts are cited or talked about in the text to propose a variety of role models for female readership.
- Highlight the roles, contributions, and expertise of women in STEM and contextualize them in the real world.
- Continue using the feminization of professional titles.
- Describe groups of scientists with doublets and gender-neutral terms.
- Limit or eliminate the generic (the “masculine”).

To further these results, future research should:

- Use surveys to determine the impacts of linguistic variations (discourse vs inclusive writing) to understand if they play equal parts in shaping perceptions of women in STEM.

- Carry out a focus group to gain insight into the dynamic negotiation of a STEM identity against varying material conditions.

Since mass media systematically disseminate symbolic messages that shape the identity of the scientific community and its actors, all efforts centred on breaking away from gender-normative and patriarchal discourse help undo systematic barriers. It is important that Francophone media not only provide the illusion of inclusion, but centralize their efforts in making stereotypes inhabitable for women in STEM, which *Québec Science* seems to be leading through research-based efforts. Greater visibility and positive portrayals that emphasize the roles and contributions of women in the scientific community would help recognize, celebrate, and encourage the diversity and inclusivity that is significantly needed for women in STEM fields, not only across Canada, but across the globe, to inspire research that truly represents everyone.

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### Appendix I

#### Quantitative Coding Grid for Male and Female Scientist Occurrences in Texts and in Images

		Before inclusive writing (January 2018 to June 2018)	After inclusive writing (October 2022 to February 2024)
		Quantity	
Male and Female Presence in Images	Male representation in images	3	3
	Female representation in images	1	2
	Both male and female in a same image	2	1
	No humans (scientific picture)	35	39
Cited Scientists per Gender	Cited or mentioned male scientists	52	40
	Cited or mentioned female scientists	7	14

## Appendix II

### Deductive Quantitative Coding Grid for Inclusive Writing Processes

		Before inclusive writing (January 2018 to June 2018)	After inclusive writing (October 2022 to February 2024)
		Quantity	
Representation by Syntactical Feminization of Titles	Male scientists (masculine or “generic” titles)	<i>32</i>	<i>32</i>
	Female scientists (feminization of titles)	<i>8</i>	<i>10</i>
Inclusive Writing Occurrences per Technique	Doublets (coordination of masculine and feminine terms)	<i>0</i>	<i>2</i>
	Generic formulations (masculine)	<i>45</i>	<i>17</i>
	Gender-neutral formulations	<i>25</i>	<i>39</i>

### Appendix III

#### Inductive Qualitative Coding Grid for Discourse Relating to Expertise

Descriptors	Before inclusive writing (January 2018 to June 2018)		After inclusive writing (October 2022 to February 2024)	
	Male	Female	Male	Female
<i>Astronome</i>	1	0	5	0
<i>Astronaute</i>	0	0	4	0
<i>Astrophysicien(ne)</i>	4	0	4	2
<i>Planétologue</i>	0	0	1	0
<i>Physicien(ne)</i>	7	3	0	0
<i>Ingénieur(e)</i>	0	2	0	0
<i>Géochimiste</i>	0	0	0	1
<i>Biologiste</i>	1	0	0	0
<i>Médecin</i>	1	0	0	0
<i>Optométriste</i>	0	0	1	0
<i>Scientifique</i>	0	0	1	1
<i>Chercheur/chercheuse</i>	4	0	8	1
<i>Expert(e)</i>	1	0	1	0
<i>Spécialiste</i>	2	0	0	1
<i>Technicien(ne)</i>	1	0	0	0
<i>Professeur(e)</i>	8	1	8	1
<i>Doctorant(e)</i>	0	0	0	1

### Appendix IV

#### Inductive Qualitative Coding Grid for Discourse Related to Roles and Contributions

Descriptors	Before inclusive writing (January 2018 to June 2018)		After inclusive writing (October 2022 to February 2024)	
	Male	Female	Male	Female
<i>(Co)-directeur/directrice</i>	4	0	5	2
<i>Coordinateur/coordinatrice</i>	2	1	1	1
<i>Leader</i>	1	0	0	0
<i>Conseillé(ère) scientifique</i>	0	0	1	0
<i>Président(e)</i>	0	0	1	0
<i>Fondateur/fondatrice</i>	1	0	0	0
<i>Porte-parole</i>	1	0	0	0
<i>Premier auteur/première autrice</i>	0	0	1	0
<i>Chargé(e) des communications</i>	0	0	0	1
<i>Chef(fe) de projet</i>	0	0	1	1
<i>Chef(fe) du programme/scientifique</i>	0	1	0	0
<i>Responsable de la science/scientifique</i>	4	0	1	0

<i>Responsable du programme</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>1</i>
<i>Concepteur/conceptrice</i>	<i>0</i>	<i>0</i>	<i>1</i>	<i>0</i>
<b>Action verbs/adjectives</b>				
<i>qui travaille</i>	<i>2</i>	<i>0</i>	<i>0</i>	<i>0</i>
<i>impliqué(e)</i>	<i>0</i>	<i>2</i>	<i>0</i>	<i>0</i>
<i>co-dirigé</i>	<i>0</i>	<i>0</i>	<i>1</i>	<i>0</i>
<i>piloté</i>	<i>0</i>	<i>1</i>	<i>0</i>	<i>0</i>