He Said, She Said

A Gendered Exploration of Danish Parliamentary Debates

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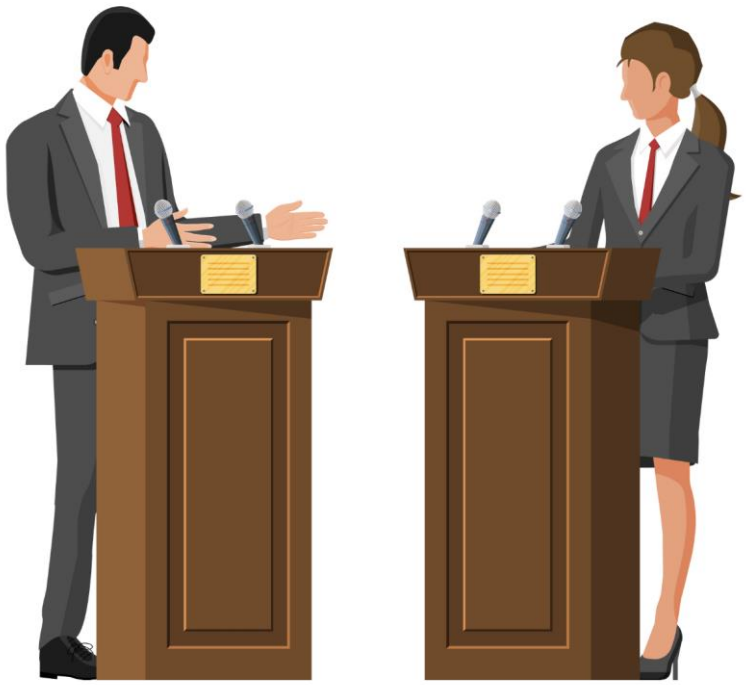

Summary

The objective of this paper was to investigate whether any gender differences exist within the Danish parliament in the domains of linguistic complexity, topics discussed and the sentiment of their statements. Furthermore, it was also investigated whether these gender disparities were between the left and right bloc, as well as the North Atlantic mandates of the Danish parliament. Using previously existing data containing all statements made by MPs in Folketingssalen between 2008-2023, the aforementioned domains were analyzed in which gendered difference was found to exist in all groups in one of the measurements of linguistic complexity, namely Flesch-Kincaid Grade Level Score (FKGL). However, one of these gender differences was only present in the North Atlantic mandates for the measurement of sentence structure complexity measured using mean dependency distance (MDD). Furthermore, an analysis of topics discussed showed that female MPs were significantly more likely to discuss education and social affairs compared to male MPs, who in turn were significantly more likely to discuss topics like economy and labour. This analysis was also carried out on left and right blocs individually, where no significant difference was found between genders in the topic of economy in the left bloc. Labour was not significant in either bloc when looking at them individually; all other results remained roughly the same. In addition, an analysis of sentiment revealed that female MPs were found to be significantly less negative than their in-bloc male counterparts, with the greatest sentiment disparity between genders being seen in the North Atlantic mandates. However, no such gender differences were found for their emotions. Lastly, it was investigated whether the gender proportionality of a topic affected the sentiment of female and male MPs respectively, and here too no significant results were found. In conclusion, the findings of this paper suggest the existence of gendered differences in the Danish parliament within linguistic complexity, topics and sentiment.

keywords: gender, politics, NLP, topic modelling, sentiment analysis, parliamentary debates, language complexity

1. Introduction

1.1 Motivation (FL)

The gender of politicians has been shown to have a substantial impact on the nature of democratic governance and policy outcomes (Annesley et al., 2015; Atchison & Down, 2019; Dziedzic, 2015; Espírito-Santo et al., 2020; Greene & O'brien, 2016; V. Wang, 2013). This paper aims to investigate gender differences in the Danish Parliament using natural language processing, in which it is possible to analyze big amounts of data; in this case, analyzing transcripts of parliamentary debates from 2008 to 2023. In doing so, focusing on gendered tendencies in behavior and language through topic modeling, sentiment analysis, and linguistic complexity analysis. These results will be interpreted through sociological and political theories on gender, aiming to shed light on gendered differences in the Danish Parliament.

While typically regarded as a country with high gender equality, some imbalances do exist within the Danish political system. According to the Global Gender Gap Report 2024 (World Economic Forum, 2024) Denmark is ranked 15th out of 126 countries; when it comes to political empowerment Denmark is ranked 22nd. The rest of the Scandinavian countries, including Finland, Sweden, Norway, and Iceland, are all placed in the top five, indicating that Denmark is behind the Scandinavian countries in an overall gender gap, and even more so when it comes to political empowerment. Historically, the Danish democracy dates back to 1849, and in 1915 women would get the right to vote and get the opportunity to run as a candidate for parliament (*Kvinder i Folketinget*, 2016). The first women were elected to the Danish Parliament in 1918, in which they gained 9.9 percent of the parliamentary seats. It would take a further 6 years before a woman was elected for a ministerial position. In 2011 the first female prime minister was elected (*Kvinder i Folketinget*, 2016). The Danish parliament consists of 179 parliamentary seats, where 4 seats are allocated to the North Atlantic mandates – two from Greenland and two from Faroe Islands. The seats are distributed among 11 parties, where female MPs hold 42 percent of the parliamentary seats, and 33.3 percent of the ministers are female.

Gender representation in politics has a large impact on both policy outcomes and the focus on topics, where more female politicians lead to greater focus on topics like education and welfare (Dziedzic, 2015), equality issues (Annesley et al., 2015; Espírito-Santo et al., 2020; V. Wang,

2013), and renewable energy (Atchison & Down, 2019; Salamon, 2023) increases. Additionally, with an increase of female politicians in parliament, the parties address more diversity in issues in election campaigns, political manifestos become more left-oriented, and the women citizens' policy preferences are better represented (Atchison & Down, 2019; Greene & O'brien, 2016; Salamon, 2023).

1.2 Gender Theory (VM)

In order to investigate gender differences in Danish parliamentary debates, this section first briefly outlines the theoretical framework that provides an overarching approach to interpreting the findings. Specifically, the theories of 'doing gender', 'gender performativity' and 'doing difference' are relevant in this context. *'Doing Gender*' stated by West & Zimmerman (1987) poses a sociological perspective, arguing that gender is not simply a set of traits, a variable or a role, but is constructed through interaction. Continuing, they argue that since society is organized around gender differences, it is unavoidable to "do" gender; a view also shared by the social constructivist theory of "performativity" of Judith Butler (2006). They further suggest that by repeated performance of gendered behavior, the performativity of gender is reinforced, upholding the gendered structure within society. This also means that when one performs gender, they either align or subvert these norms, opening the possibility of alteration within the structure of gender (Butler, 2006, 2009). While these theories focus explicitly on gender, "Doing Difference" (West & Fenstermaker, 1995) incorporates race and class as additional factors that shape how individuals perform their gender – this interaction effect is also commonly referred to as intersectionality (Crenshaw, 1989). In gender performativity, women act within a constrained scope of agency – this scope may be further limited if they simultaneously belong to minority groups in terms of race and class.

Applying this to leadership theory, Eagly & Karau (2002) propose the "role congruity theory" in which they attempt to explain how gender stereotypes affect the behaviour of women in high positions, e.g. female politicians. They argue that women are more profoundly associated with communal characteristics such as concerns about the welfare of others, and are also more likely to be perceived as being affectionate, helpful, nurturant and gentle. Inversely, men are associated with agentic characteristics such as being assertive, ambitious, independent and confident, which are all traits which are congruent with traits of being a successful leader. Therefore, they argue, female politicians experience an incongruity between their feminine traits and being a

leader. According to Eagly and Karau, this leads to 1) women being perceived as being less qualified to obtain a leadership role and 2) women are viewed less favorably when exhibiting (incongruent) leadership traits.

These prejudices therefore affect the behavior of women when obtaining a leadership role. A meta-analysis (Eagly & Johnson, 1990) found that women tend to have a more democratic and participative leadership style compared to men. Furthermore, female leaders receive more negative reactions compared to men when behaving in an assertive and directive manner. However, they receive less negative reactions when complementing their agentic style with communal behavior consistent with their gender role, as long as it doesn't violate the leadership role (Eagly & Karau, 2002b). This creates a narrower margin for maneuver for female leaders, as they both need to behave according to their communal characteristics (but not fully, as this violates expected leadership behavior), while also acting in accordance with the stereotypical behaviour of leadership without violating their expected gender role (Eagly & Karau, 2002b; Morrison et al., 1994). In addition, a meta-analysis examining leadership effectiveness found that there were no differences in the leadership effectiveness between male and female leaders in general (Eagly, A. H. et al., 1995). However, male and female leaders were more effective in leadership roles congruent with their gender roles, i.e. female leaders were more effective in positions dealing with education, government and social service organization and less effective in more traditionally masculine positions, i.e. positions dealing with the military and economy.

1.3 Gender in Politics (FL)

Supporting the role congruity theory, a study (Sapiro, 1983) found that in a 1972 Louis Harris national opinion poll, the respondents reported that women in political offices were primarily suited for working with the aspect of public policy including children and family issues, assisting the poor, and working for peace, whereas men were suited for working with public policy including directing the military, handling business, the economy, domestic rebellion, and foreign relations. These differences are also found in a Scandinavian context, in which female politicians and voters are more concerned with policies regarding welfare, education, environment, and family matters (Dahlerup, 1988; Listhaug, 1985). A study (Heidar & Pedersen, 2006) investigating the gender gap within Nordic Political Parties, in Denmark and Norway, found that in general and across parties, female politicians supported a strong welfare state to a higher degree compared to male politicians. Furthermore, they found that in Denmark there is a greater

gender gap in politicians' attitudes towards European integration, the size of the public sector, and crime prevention than in other policy areas; this gender gap is not to be found among policy areas in Norway. Additionally, they found that the differences between parties are considerably greater than the gender gap within these parties.

Gonzales and Bauer (2020) examined how gender and partisan stereotypes influenced the evaluation of female candidates in the US and how the two stereotypes overlapped with one another. In doing so, respondents described candidates running for Democrats as "caring" and "sensitive", and the candidates running for Republicans as "tough" and "assertive", aligning with research on partisan traits (Hayes, 2005; Winter, 2010), and broader traits related to gender stereotypes (Eagly & Karau, 2002b). Following this, the relationship between partisanship and gender can limit female candidates, since their gender is incongruent with leadership stereotypes. In addition, their findings suggest that it is easier for voters to form an impression of female candidates running for the Democrat Party due to the stereotypical traits of gender and partisanship alignment. In contrast, it is more difficult to form an impression of female candidates running for Republicans due to the incongruence between gender and partisanship stereotypes. These results can have implications for female candidates running for the Republican Party, as they may have difficult time navigating between their gender stereotypes and partisanship. Turning to Scandinavia, a Swedish study (Dahllöf, 2012) explored the automatic classification of speeches by Swedish politicians based on the same personality traits as above; gender, age, and political affiliation. It was possible to predict gender with an overall accuracy rate of 81.2%. Furthermore, when predicting both gender and bloc, the accuracy rate was higher for the right bloc (80.2%) compared to the left bloc (72.7%), both indicating greater gender disparity within the right bloc and also supporting the importance of including bloc as a factor interacting with gender.

All of this suggests that the behavior of politicians is influenced by their gender, making it particularly challenging for women to navigate the intersection of their gender role and their role as politicians – especially for those with a right-oriented political stance. This is supported by studies finding that female candidates who appear feminine are seen as unsuitable for political offices (Bauer, 2015; Ditonto et al., 2014), whereas female candidates with masculine traits are unlikable (Bauer & Carpinella, 2018). This narrow room for maneuver for female politicians is further supported by studies indicating that female politicians must outperform their

male counterparts in order to achieve similar success (Lawless & Pearson, 2008). Furthermore, they are often required to demonstrate levels of non-policy traits including integrity, competence, and leadership to secure an equivalent share of votes (Fulton, 2012), and face greater challenges in being perceived as capable (Cassese & Holman, 2018).

1.4 Gendered Parliamentary Styles (VM)

Specifically narrowing in on parliamentary debates, previous studies have in fact found gendered differences, e.g. female politicians participating less compared to their male colleagues (Ash et al., 2023; Bäck et al., 2014). Female MPs also perform differently rhetorically; for example, some studies suggest that female MPs discuss policies more precisely, more often connecting their personal experiences to arguments and tending to behave in a less adversarial manner (Haselmayer et al., 2022). A study by Hargrave and Blumenau (2020) investigated political style by gender in parliamentary debates between 1997 and 2019 in the United Kingdom. They found that while female MPs use a language that is considerably more emotional, positive, and empathic, male MPs' language is characterized by being more analytical, aggressive, and complex. However, these differences appear to have diminished in later years, as female MPs increasingly convert to more stereotypical male language. Other studies (Childs, 2004; Coates, 2015) have found similar results that male MPs also use a more complex language. In addition, a general tendency seems to appear in the complexity of language in which it differs across party affiliation, meaning cultural conservatives tend to speak in a less complex language compared to cultural liberals. This is found in a study (Schoonvelde et al., 2019), investigating language complexity using FKGL across five European countries including Denmark. The difference does not seem to appear between economic liberals and economic conservatives. A study by Haselmayer et al. (2022) investigated the sentiment of members in the Austrian Parliamentary speeches, in which they found that female politicians tend to be less negative compared to male politicians. This difference decreases when the gender distribution is more balanced within party groups.

Other studies suggest that not only do male and female politicians differ in their use of language, but also in the topics upon which they choose to converse. For example, a study by Blaxill and Beelen (2016) investigated gender in British parliamentary speeches using text mining. Using an algorithm that scores words that characterize different perspectives, they in-

vestigated the words most commonly used for respectively female and male MPs in parliamentary speeches. In doing so they controlled for party bias, ensuring that the results were independent of whether the MP belonged to the Conservative or Labour party. The results showed that female MPs used more words relating to children, education, health, and care, whereas male MPs used more words relating to military, business, foreign policy, and geography. An additional study (Skjeie, 1991) from Norway found that MPs reported that the interest of female politicians included social and welfare policies such as environmental protection, equality policies, disarmament policies, and educational policies. Male politicians were perceived as primarily interested in economic and industrial policies, energy issues, transportation, national security, and foreign affairs. Other studies (Davis, 1997; Krook & O'Brien, 2012) have investigated the allocation of ministries between genders. It was found that female politicians were primarily present in ministries such as health, social welfare, education, family, culture, and consumer affairs. Oppositely, male politicians were primarily present in ministries regarding economic affairs, military defense, employment, equipment, and budget. A paper by Bäck et al. (2014) investigated how gender influenced the number of speeches made in the Swedish Riksdag between 2002 and 2010. They found that female MPs deliver a proportionally smaller share of speeches compared to their male counterparts. This effect is even more profound in policy issues, such as economics, foreign affairs, or defense. Inversely, the difference is less profound in policy issues, such as healthcare, social affairs, and education. These differences in what male and female MPs speak about are also found in a study investigating gender differences in Latin American cabinets (Escobar-Lemmon & Taylor-Robinson, 2009). In summary, all these findings suggest a gendered difference between male and female MPs both in linguistic complexity and their preferred topics.

1.5 Natural Language Processing

1.5.1 NLP in a Political Context (FL)

To gain insight into the workings of legislating bodies, the method of natural language processing (NLP) has been employed in the analysis of parliamentary debates. These analyses include topic modelling – a statistical model which helps classify the semantic structure of large text documents, by clustering semantically related words within a text (Kherwa & Bansal, 2019). Examples of such include Bhatia & Deepak (2018), Nguyen et al. (2013) and Nguyen et al. (2015), which all used this method in a political context. Validation studies suggest that

this method does indeed yield meaningful topics (Quinn et al., 2010). Similarly, van der Zwaan et al. (2016) found equivalent validating results by comparing topics derived from the topic modelling of Dutch parliamentary transcripts with external data, e.g. party manifestos. However, while this study suggests that the topics do validly reflect the content of the text, they could not accurately predict the political standing (left/right) of these parties using the obtained topics.

Another common method of employing NLP is the use of sentiment analysis, wherein the opinion of the speaker is analyzed, often binarily classifying statements as being positive or negative (Abercrombie & Batista-Navarro, 2018; Balahur et al., 2009; Burfoot, 2008). Other methods include a ternary approach, i.e. adding neutral as a classification category (Wilson et al., 2005). Furthermore, some studies attempt to go beyond polarity labels and instead classify statements on their emotional content, e.g. Ma'aly et al. (2024) which analyzed a large amount of YouTube comments pertaining to the 2024 Indonesian general election, classifying these comments as exhibiting either anger, anticipation, disgust, joy, fear, sadness, surprise, or trust. These two approaches, sentiment analysis and topic modelling, can also be combined as seen in Bhatia & Deepak (2018), where they used sentiment analysis of the clustered topics to predict the political stance of the speaker. Furthermore, these methods can also be used to allow for comparison in political environments between countries; for example, a study by Sakamoto & Takikawa (2017) used NLP to make a cross-national comparison between political polarization in the U.S. and Japan by analyzing transcripts from the U.S Congress and the Japanese Diet respectively. As this paper will do, these methods have also been applied to the Danish political landscape (Navarretta & Haltrup Hansen, 2024), showcasing the applicability of such analyses in the political environment we intend to investigate. Lastly, NLP has also been used in a gendered context; Miok et al. (2024) investigated the use of NLP in a joint and comparative analysis of six national parliaments including Bulgarian, Czech, French, Slovene, Spanish, and United Kingdom. In doing so, they made a comparison of linguistic effects based on age, gender, and political affiliation. Furthermore, they investigated the emotions and sentiments of the parliaments. Concerning the prediction of gender, the analysis was made in the original languages of the parliaments. It was possible to predict gender in all of the countries with a mean accuracy of 71%. All in all, this makes NLP and its methods powerful, flexible tools that can investigate not only what is being discussed, but also reveal speakers' attitudes toward it while also being able to investigate potential gender differences.

1.5.2 Linguistic Complexity and Measurements (VM)

For the purposes of this investigation, we opt to analyze linguistic complexity using the Flesch-Kincaid grade score originally developed for education research, however, it has also been widely used in political contexts. For example, it is found that people are less likely to vote for politicians using more complex language as measured using the Flesch-Kincaid score (Reilly & Richey, 2011), that politicians tailor their speeches to the constituents, so when speaking to a demographic with a lower education level, they use less complex language (Lin & Osnabrügge, 2018; Spirling, 2016), and that US inaugural speeches (Siegelman, 1996), US presidential speeches (Lim, 2008), and speeches of Australian politicians (Dalvean, 2017) have become less linguistically complex over time. Several studies (Cann et al., 2014; Coatny, 2015; Kayam, 2018; Pitman, 2012; Y. Wang & Liu, 2018) further illustrate the use of the Flesch-Kincaid grade score in a political context, validating the method usability in investigating the language of politicians. Furthermore, our analysis will also equip mean dependency distance (MDD) as a linguistic marker which is defined as the 'linear distance between two syntactically related words' (Liang et al., 2017), i.e. the amount of words in between these two syntactically related words (see figure 1). This measurement is considered an indicator of syntactic difficulty (H. Liu et al., 2017), and has seen use in various fields (Liu et al., 2022), such as second-language acquisition (Jiang & Ouyang, 2017) and investigating morphology complexity of a language (H. Liu & Xu, 2011). In a more political context, Lei & Wen (2020) analyzed the diachronic evolution of State of the Union addresses for the past 227 years and found that the MDD of these speeches had decreased since its inception. Furthermore, dependency distance has also been used in a gendered context, where Garimella et al. (2019) found gendered syntactic differences. Despite Go & Falenska (2024) failing to replicate these findings, these studies still showcase the applicability of MDD to investigate the effect (or lack thereof) of gender on linguistic complexity.

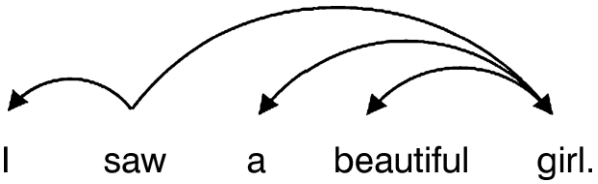

Figure 1, Liu et al. (2017) - Visual Representation of Dependency Distance
e.g. dependency distance between "I" and "beautiful" = 3, as "I" → (1) "saw" → (2) "girl" → (3) "beautiful"

1.6 Thesis Statement

With advancements in NLP, it is now possible to analyze large datasets, yielding promising insights. While previous research has primarily focused on specific aspects of gender differences in parliamentary debates or has been conducted in other countries, this exploratory paper takes a more focused approach, offering a unique perspective on the topic in a Danish context. For this, our paper attempts to answer the following research questions:

How do Danish male and female MPs differ in 1) their linguistic complexity 2) their preferred topics and 3) their sentiment scores?

2. Methods

2.1 Data Cleaning and Normalization (FL)

The initial data structure used in this study was obtained from a previous exam study investigating the use of NLP in Danish parliamentary debates. In this study, Lauritsen & Severin (2024) scraped fifteen years of Danish parliamentary debates (2008-2023) resulting in a dataframe which included 126,021 statements made from 442 MPs, where 190 of these were female and 252 were male. Furthermore, 213 of the MPs belonged to the left bloc and, coincidentally, another 213 belonged to the right bloc. The remaining 16 MPs were the North Atlantic mandates, meaning they represented the interests of countries Faroe Islands or Greenland which are part of the Danish Commonwealth. The distribution, as well as the amount of statements, can be seen in table 1.

Gender and Bloc	# of Statements	# of MPs	Mean # of Statements
Female - Left Bloc	24393	96	254.1
Male - Left Bloc	36751	117	314.1
Female - Right Bloc	19182	87	220.5
Male - Right Bloc	39231	126	311.4
Female - North Atlantic Mandate	776	7	110.9
Male - North Atlantic Mandate	812	9	90.2

Table 1 - Number of Politicians and Statements

Lauritsen and Severin (2024) scraped the transcripts and demographic data about the MPs from the Danish Parliament's website (*Referater*, 2016). For topic modeling, they used BERTopic (Grootendorst, 2022) to automatically cluster statements into 3624 categories, wherein the 364 most frequent topics (which encompassed 80% of all statements) were then manually clustered into 20 topics using clusters from D. H. Hansen et al. (2019). For sentiment analysis, the sentiment classification model XLM-RoBERTa (Conneau et al., 2020) was used from the transformers package (Wolf et al., 2020) in Python (Van Rossum & Drake, 2009) to classify statements as being positive, negative or neutral. For more information about the collection and preprocessing steps of the data used in this paper, the full paper from Lauritsen and Severin (2024) can be found in the link in section 6 (Code Availability).

Although using the same initial dataset which Lauritsen and Severin (2024) use in their paper, their paper had a very different focus, which consisted of very broadly looking at the use of natural language processing in Danish politics - with analyses ranging from sentiment analysis of opposition vs in-government or topic distribution per bloc. It is instead the aim of this paper to conduct a more focused, narrow study; looking specifically at the gender differences in three main areas: linguistic complexity, sentiment score and topic distribution. Furthermore, their paper included no statistical tests or models and focused only on the applicability of NLP in the context of the Danish parliament. Therefore, this paper aims to pivot off of the already-existing dataset and mutate it to better fit our unique research questions which the previous

paper did not investigate. This meant, for example, extracting and analyzing linguistic components, as well as running another more in-depth sentiment analysis, which would be specifically concerned with gender differences. The majority of the analysis was done in R (R Core Team, 2023; Rstudio, 2022), although Python was also used to garner information about linguistic and emotional markers in the data, as will be further elaborated upon in the upcoming sections.

2.2 Measurements of Linguistic Complexity (VM)

In order to compare the linguistic complexity between female and male MPs in both blocs, the Python package textdescriptives (Hansen et al., 2023) was used. This package analyzes texts and scores them on multiple forms of text descriptives. For the analysis of linguistic complexity, it was decided to use the Flesch-Kincaid Grade Level score (FKGL) and the mean dependency distance (MDD) as measurements of linguistic complexity, as these describe both the complexity of words in a sentence and the structural complexity of a sentence respectively.

The FKGL looks at the number of words and syllables in a sentence to determine a number corresponding to the years of education the reader would have had to undergo to easily understand the analyzed text, i.e. a FKGL score of 7 would require seven years of education. The FKGL is calculated by the following formula:

$$FKGL = 0.39 \times \frac{Total\ Words}{Total\ Sentences} + 11.8 \times \frac{Total\ Syllables}{Total\ Words} - 15.59$$

While also a measurement of linguistic complexity, MDD is calculated quite differently – looking at the structure of the sentences rather than the words used. Like previously explained in section §1.5.2, dependency distance can be described as the linear distance between two words which are syntactically related in a sentence (Liang et al., 2017). The formula for deriving the mean dependency distance of a text is as follows:

$$MDD(Text) = \frac{1}{n-s}\sum_{i=1}^{n} |DDi|$$

In this equation, ***n*** is the amount of words in the text, ***DDi*** is the dependency distance of the ***i***-th syntactic link of the sentence and ***s*** represents the total number of sentences in the text (H. Liu et al., 2017). While both FKGL and MDD inform about the complexity of a text, they both have their strengths and weaknesses. For example, sentences using many unique multisyllabic

words like *"The unsympathetic indifference of previously amiable females, the contempt of muscular males, the acceptance of fragments of bread, the simulated ignorance of casual acquaintances"* (Joyce, 1922) has a high FKGL score (13.9) but a relatively average MDD (2.16). Oppositely, for highly recursive sentences, such as *"The dog [that the cat [that the mouse [that the bird [that I fed] chased] frightened] scratched] barked loudly."* will have a low FKGL score of 2.9 and will have a very high MDD score of 5.32.[1] Therefore it was deemed necessary to include both measurements to give a greater insight into which linguistic markers (if any) were different between female and male MPs in the two blocs. These two measurements were extracted using the aforementioned package, which also runs an automatic quality check, wherein 4749 did not pass, resulting in a total of 121,272 observations. Before analysis, outliers were removed, which were defined as any data point that fell more than 1.5 times the inter-quartile range (IQR) below the first quartile or more than 1.5 times the IQR above the third quartile.

3. Analysis

3.1 Linguistic Complexity

3.1.1 Mixed Effects Model - FKGL (FL)

To investigate the difference in linguistic complexity between female and male MPs, using the R package lmerTest (Kuznetsova et al., 2017), two mixed effects models were created; one for the FKGL score and one for the MDD.

The first model was created with the FKGL score as the dependent variable and the interaction of gender and bloc as independent variable. The reasoning for the inclusion of blocs in the model was to see if the effect (if existing) would be more pronounced between political blocs. Lastly, for the random effect, the labeled topic was used. This was to mitigate the fact that some topics may inherently require a higher linguistic complexity. The syntax of the model can be seen below.

[1] Please note that the FKGL and MDD scores cannot be directly compared against each other, i.e, a FKGL score of 5 is not particularly high, but a MDD score of 5 indicates a highly syntactically complex sentence.

FKGL ~ Gender * Bloc + (1 | Topic Discussed)

Compared to female MPs on the left bloc (β = 14.23, SE = 0.05, t = 286, p < 0.001), male MPs on the left bloc had a very slight higher FKGL score (β = 0.07, SE = 0.026, t = 2.47, p = 0.014). Compared to left-oriented female MPs, right-oriented female MPs had a lower FKGL score (β = -0.17, SE = 0.03, t = -5.66, p < 0.001) and this negative relationship was even more profound for the North Atlantic female MPs (β = -0.49, SE = 0.12, t = -4.15, p < 0.001). Furthermore, right-oriented male MPs also appear to have a lower FKGL score than their female equivalents (β = -0.28, SE = 0.04, t = -7.28, p < 0.001), and again, this negative effect is even greater for the male North Atlantic mandates (β = -0.78, SE = 0.15, t = -4.88, p < 0.001). These results are visualized in Figure 2 below.

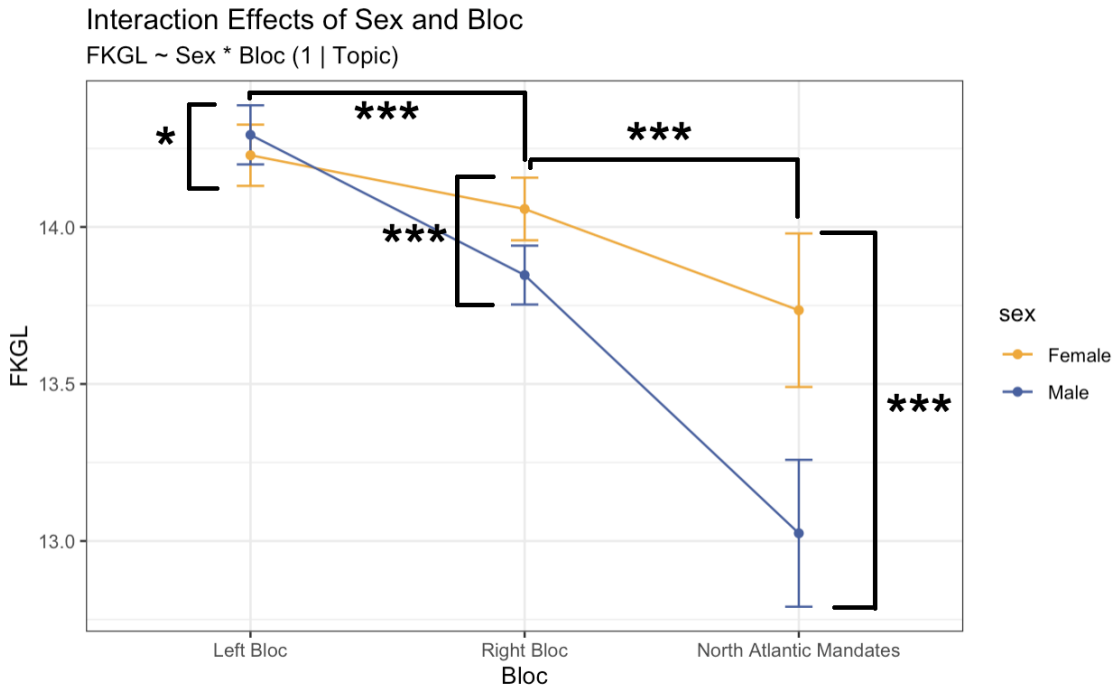

Figure 2 - FKGL By Gender and Bloc; stars indicate statistical significance

3.1.2 Mixed Effects Model - MDD (VM)

Similarly, a mixed effects model was created, this time with MDD as the dependent variable. Like the previous model, the interaction effect of gender and bloc were used as the independent

variables and the discussed topic was included as a random effect. The syntax of the model can be seen below.

MDD ~ Gender * Bloc + (1 | Topic Discussed)

In comparison to female MPs on the left bloc (β = 3.193, SE = 0.054, t = 590.59, p < 0.001), male MPs on the left bloc showed an insignificant, very slightly lower MDD score (β = -0.004, SE = 0.003, t = -1.06, p = 0.291). Right-oriented female MPs had a statistically significant, slightly lower MDD score (β = -0.028, SE = 0.004, t = -7.25, p < 0.001) compared to their left-oriented counterparts, and this negative effect was even greater for North Atlantic female MPs (β = -0.082, SE = 0.015, t = -5.42, p < 0.001). Additionally, right-oriented male MPs also exhibited an insignificant, very slightly lower MDD score than their female counterparts (β = -0.002, SE = 0.005, t = -0,37 p = 0.71). Lastly, male North Atlantic MPs saw a significantly lower MDD compared to the female North Atlantic MPs. (β = -0.066, SE = 0.02, t = -3.28, p = 0.001). These results are illustrated in Figure 3 below.

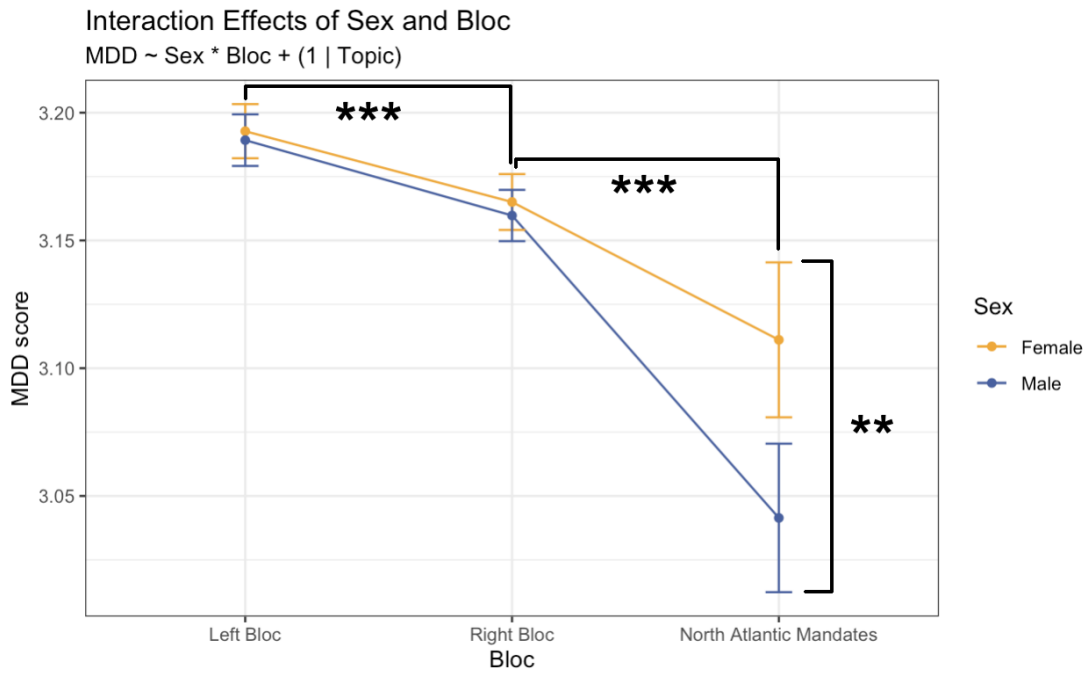

Figure 3 - MDD By Gender and Bloc; stars indicate statistical significance

3.2 Topic Differences By Gender

3.2.1 Descriptive Data - Topics (FL)

In addition to an investigation of differences between genders in linguistic complexity, an analysis of differences in topics, as categorized by Lauritsen and Severin (2024) in their previous paper, was also conducted. Firstly, two descriptive plots were created to (1) give an overall view of topic distribution by gender, as seen in Figure 4a, and (2) the sum difference between genders in topics as seen in Figure 4b. In this latter plot, positive values indicate a proportionally female-dominated topic and, inversely, a negative value indicates a male-dominated topic - meaning this figure essentially zooms in on which topics have the greatest gender disparity.

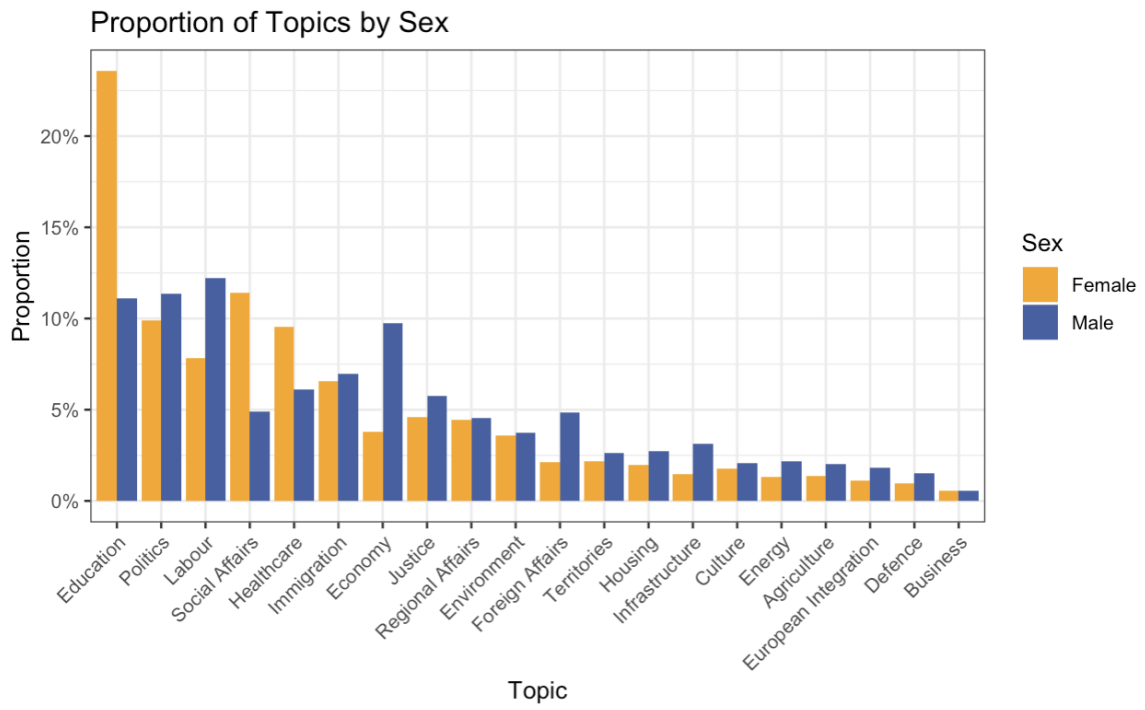

Figure 4a - Proportion of Topics by Gender

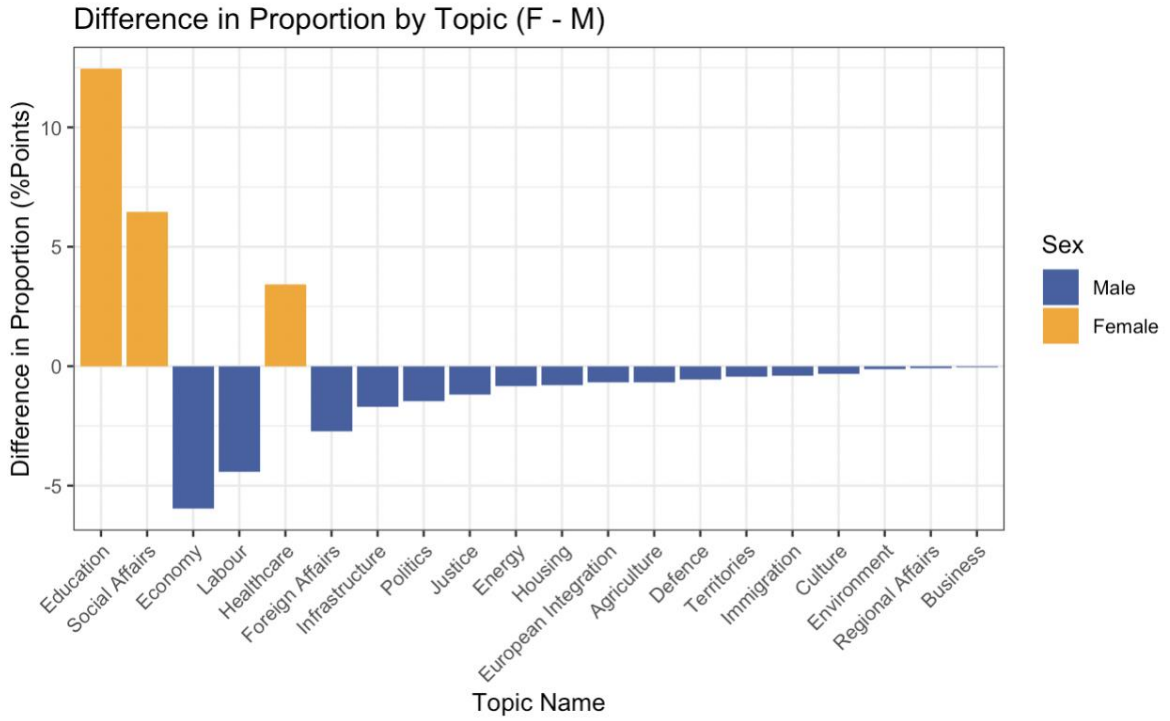

Figure 4b - Difference in Proportion of Topics by Gender (female values subtracted by male values)

Visually inspecting this plot, there seem to be six topics with a noticeable gender difference indicating that female MPs speak more about "Social Affairs", "Healthcare", and "Education", and male MPs speak more about "Labour", "Foreign Affairs", and "Economy". Based on this, an analysis was conducted to determine whether these differences were significantly different. To minimize the probability of erroneously getting a significant result by chance (type I errors), it was decided to include only these six aforementioned topics with the greatest gender differences.

3.2.2 Mixed Effects Model - Topics (VM)

To investigate whether the gender differences in topics discussed as seen in Figure 4a and 4b were indeed significant, a mixed effects model was created. To specifically check proportional differences between groups, the raw data was aggregated where each row indicated the politician ID and how many statements they made for a given topic, e.g. a hypothetical row being ID = 1, Gender = Male, Emotion = Education, Statement Counts (SC) = 50; in other words, MP 1, a male, gave fifty statements that were categorized as being related to the topic of education. There being six topics and 437 MPs making statements within these topics, a total of

2622 observations would be expected – however, not all MPs made statements within all these topics in the given timeframe of our data, resulting in a total of 2181 observations. Before creating and running the mixed effects model, an important pitfall was to be avoided. Due to an unequal proportion between not only the number of male and female MPs ($Female_{Amount}$ = 189, $Male_{Amount}$ = 248), but also male MPs on average making slightly more statements in general (M_{Female} = 28.22, M_{Male} = 29.7), we first had to create a weighting in the variable statement counts (SC) to account for this.

To clarify; this whole weighting process was necessary due to the described structure of the data frame, wherein the value SC was the sum number of statements given within each topic per MP. As our question pertains to whether there exists a gender difference within each topic (by measuring how many statements were made by either gender in all topics), one quickly sees a problem by this approach if either gender is over/underrepresented.

This weighting was achieved by finding the mean number of statements per female MP and dividing it by the mean number of statements per male MP, as seen in the formula below.

$$Male\ Weight\ Multiplier\ = \frac{\#\ of\ Female\ Statements\ /\ \#\ of\ \ Female\ Politicians}{\#\ of\ Male\ Statements\ /\ \#\ of\ Male\ Politicians}$$

This number resulted in a male weight multiplier (MWM) of = 0.901, meaning that a male MP making 50 statements in a given topic would now be counted as having made (50 * 0.901) = 45.1 total statements in that topic. For female MPs, their number of statements would remain the same. Lastly, please note for clarity's sake that while this MWM = 0.901 might suggest that women are only slightly underrepresented in proportion and in average number of statements, however, this effect is way smaller within the six topics analyzed in this section compared to all topics. Taking into account all the statements made for all topics, instead we would get $MWM_{All\ Topics}$ = 0.77[2].

Finally, to investigate whether the gender difference in topics discussed as seen in Figure 4a and 4b was indeed significant, a mixed effects model was created. The (weighted) variable SC,

[2] The vast difference in MWMs is by explained by a lesser gender difference of SC in the six chosen topics - to see a full distribution of # of statements for each topic made by both genders, check Appendix A.

the number of statements made by a MP within a given topic, acted as the dependent variable in our model, with gender being our independent variable. Lastly, MP ID (indicating which MP made the statement) was used as our random effect to take into account that certain MPs might inherently speak more about a singular topic, i.e. Ministers of Finance will assumedly be more prone to make statements regarding economy and finance, regardless of gender[3]. The syntax of the model is as follows:

$$\text{Weighted SC} \sim \text{Gender} * \text{Topic} + (1 \mid \text{MP ID})$$

The summary output of this model does not tell us much as it only compares the SC between the intercept (one particular topic) to other topics, i.e. whether female MPs speak significantly more/less about healthcare than foreign affairs. Although also interesting to some degree[4], we instead employed estimated marginal means (EMMs) using the emmeans package (Lenth et al., 2024) which allows us to do pairwise testing, meaning analyzing the difference in how much female and male MPs discuss each of the topics chosen. The results of this model can be seen in Table 2 below[5] and are also illustrated in Figure 5.

Topic	**Estimate**	**Standard Error (SE)**	**Degrees of Freedom (df)**	**T-ratio**	**P-value**
Economy	-21.31	5.38	2070	-3.963	0.0001
Education	25.50	5.03	2022	5.073	<0.001
Foreign Affairs	-9.50	6.00	2132	-1.585	0.1131
Healthcare	7.51	5.50	2085	1.365	0.1725
Labour	-17.00	5.11	2033	-3.325	0.0009
Social Affairs	14.52	5.20	2043	2.793	0.0053

Table 2 - Gender Proportion of Topics

[3] Although the gender of an MP might determine which minister-post they assume; this will further be discussed in §4.1.2.
[4] For curious minds, the table of this summary output can be seen in the Appendix B.
[5] To account for family-wise errors, a Bonferroni correction was applied to adjust the significance level.

Please note that the estimates were calculated by subtracting the values of male MPs from female MPs, meaning that positive values of estimates reflect a higher proportion of female statements in that topic, whereas, inversely, negative values of estimates reflect a higher proportion of male statements.

Interpreting these results, it appears that female MPs proportionally speak statistically significantly more about education and social affairs. Furthermore, male MPs speak proportionally more about economy and labour. These results are visualized in the Figure 5 below.

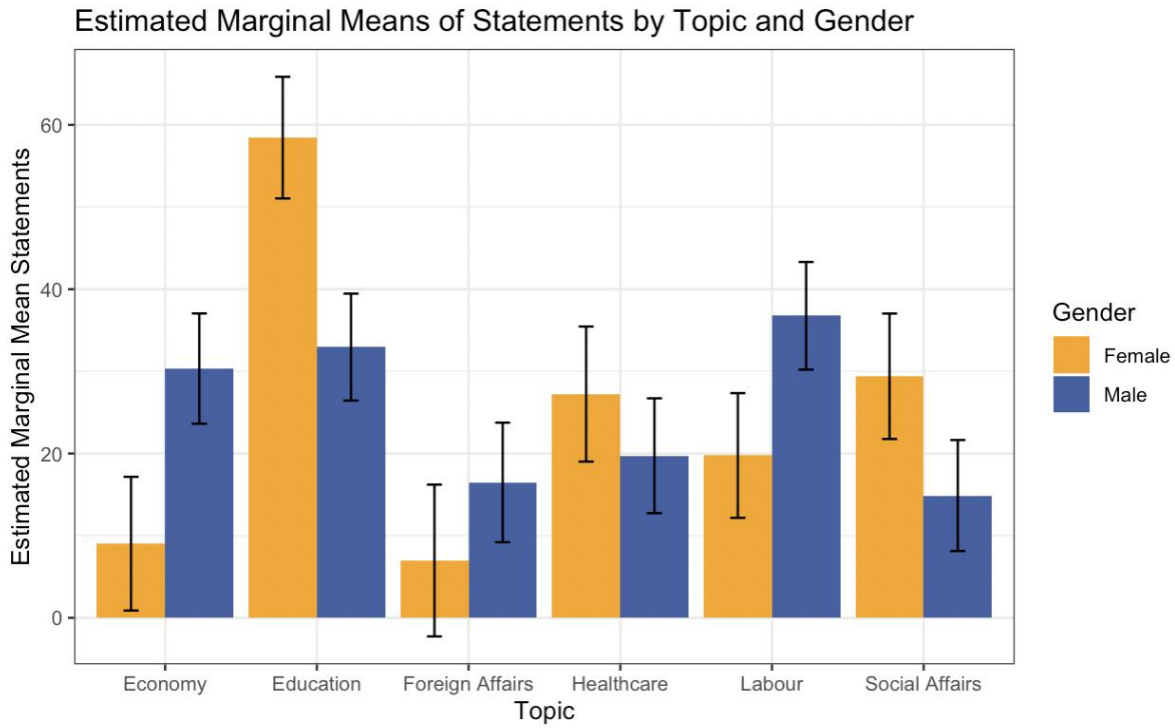

Figure 5 - Estimated Marginal Means of Statements

3.2.3 Topics and Bloc (FL)

While this above model does indeed investigate whether any gendered differences exist across left and right bloc, we were also interested whether these differences would be different between blocs, i.e. one bloc having greater gender disparity compared to the others. For this purpose, the three descriptive figures 6.a - c were created, allowing for a brief overview of the topic distribution by gender per bloc.

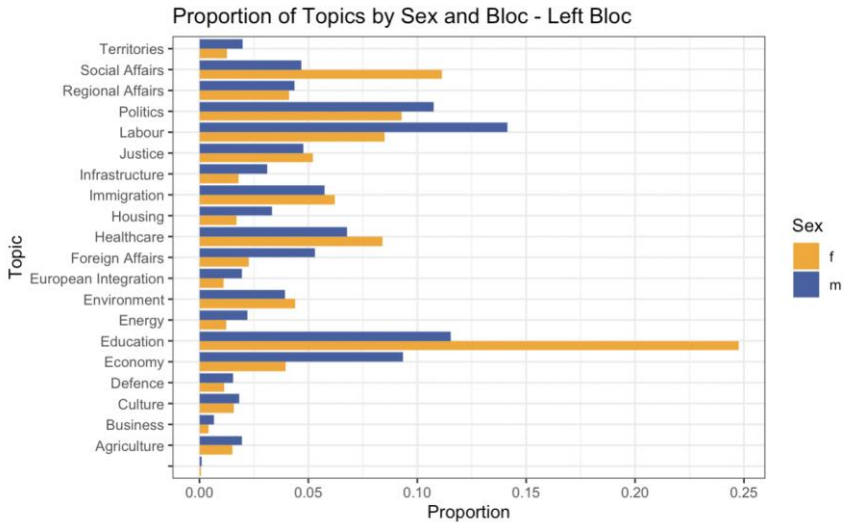

Figure 6a - Left Bloc

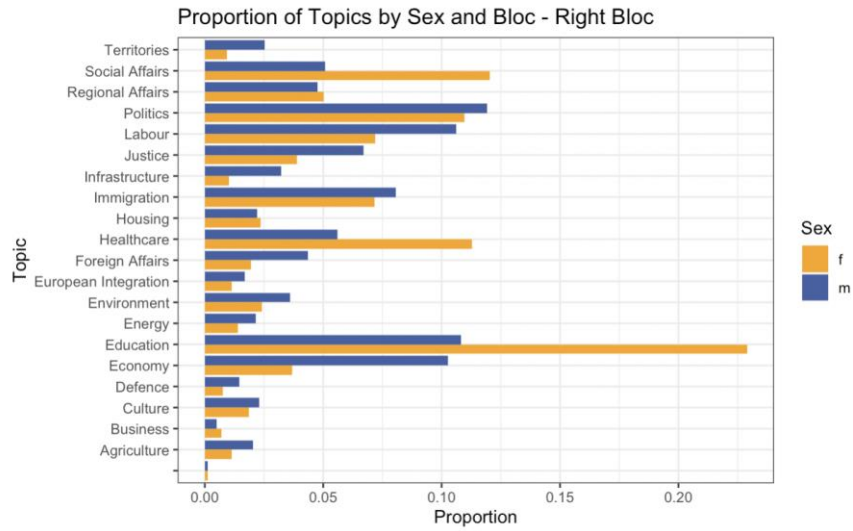

Figure 6b - Right Bloc

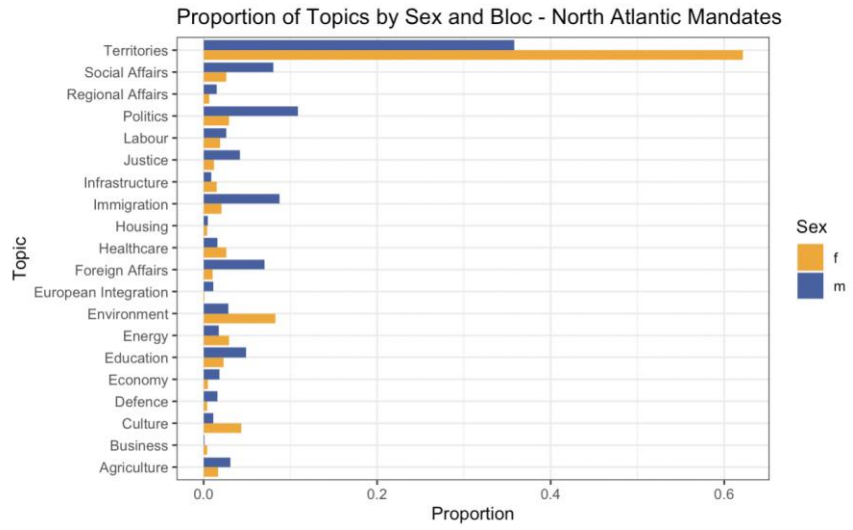

Figure 6c - North Atlantic Mandates

Looking at these figures, North Atlantic mandates appear to have a very different topic distribution compared to the left and right blocs, with a high proportion of their statements focusing on the topic of territories. The differences between the left and right bloc are relatively more subtle - therefore, due to the very differing nature of topic distribution, the North Atlantic mandates were omitted from the data in the model in this section.

To further analyze the topical gender difference per bloc, a mixed effects model was created, wherein our weighted SC variable again acted as our dependent variable. The independent variable was an interaction term between gender and bloc, and MP ID was the random effect. Formally, the model structure looks as follows:

$$\text{Weighted SC} \sim \text{Gender} * \text{Bloc} + (1 \mid \text{MP ID})$$

Like before, the results of this model do not tell us much on its own, therefore the emmeans package was again used to obtain the estimated marginal means to allow for pairwise testing, allowing us to see the gender difference within the two blocs. The results of this model are seen below in Table 3 and are visualized in Figure 7a and 7b.

Topic	**Bloc**	**Estimate**	**Standard Error (SE)**	**DF**	**t-ratio**	**p-value**
Economy	Left	-13.86	7.13	1398	-1.944	0.0521
Economy	Right	-18.13	7.45	1412	-2.434	0.0151
Education	Left	38.50	6.82	1365	5.647	<.0001
Education	Right	27.89	6.89	1365	4.047	<0.0001
Labour	Left	-12.03	6.89	1373	-1.746	0.0810
Labour	Right	-8.87	7.08	13080	-1.253	0.2105
Social Affairs	Left	19.20	6.96	1379	2.758	0.0059
Social Affairs	Right	16.87	7.16	1388	2.355	0.0187

Table 3: Gender Proportion in Topic by Bloc

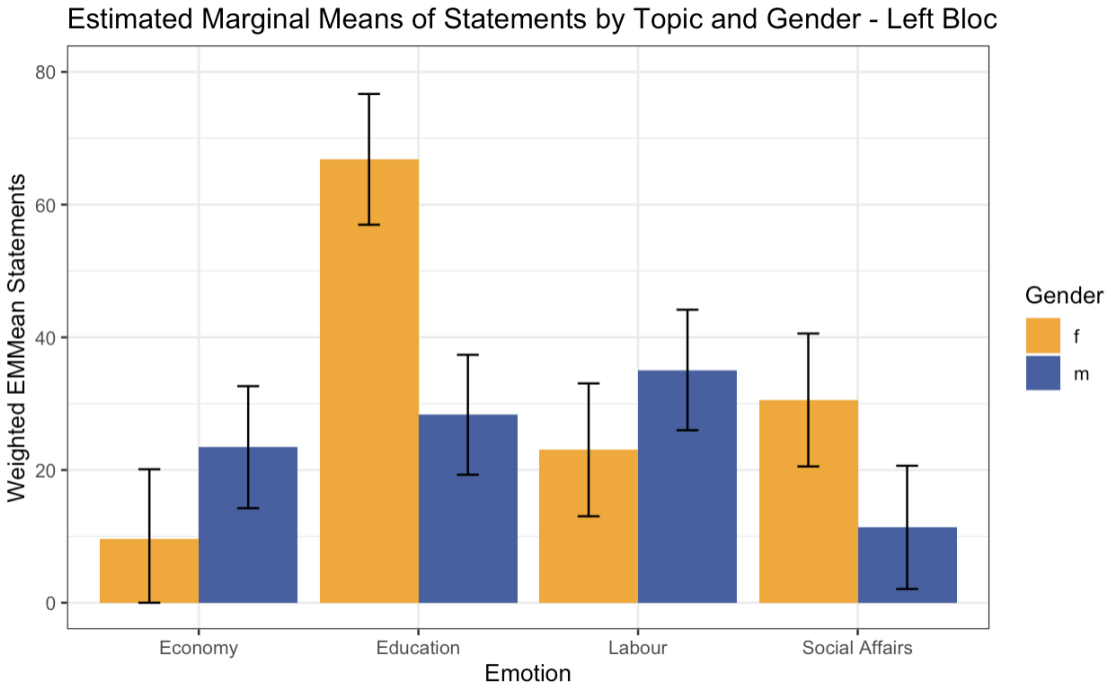

Figure 7a - Left Bloc

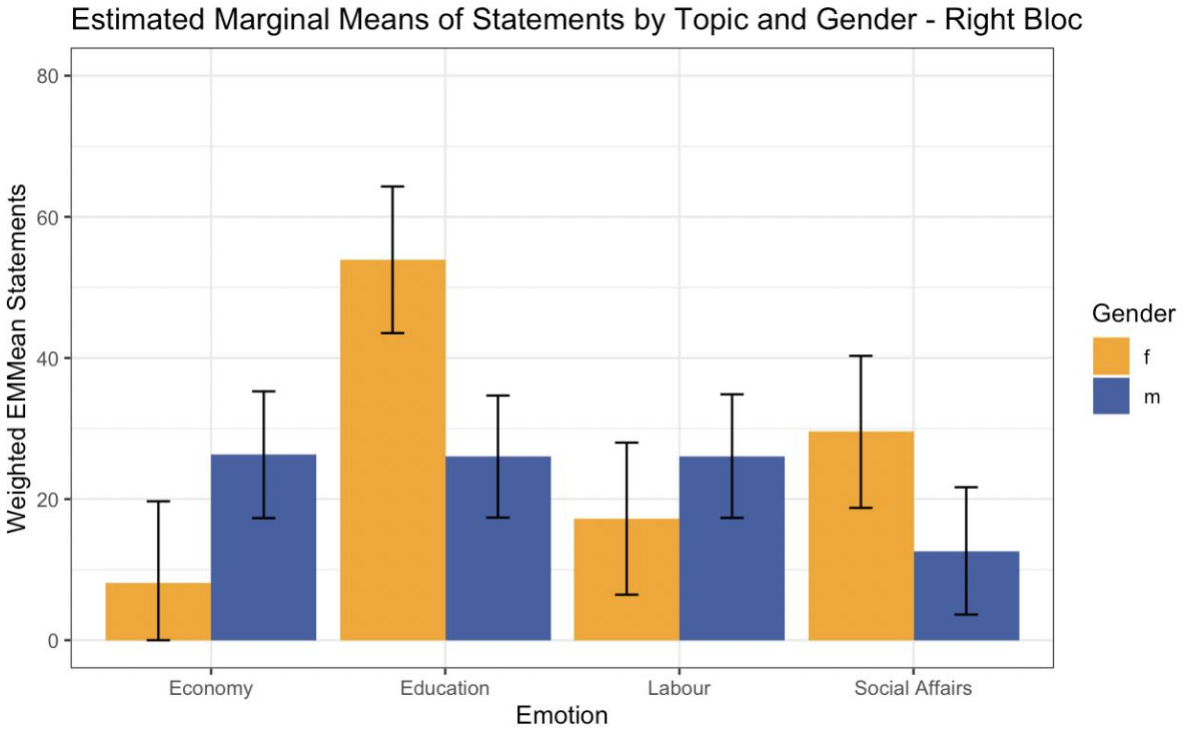

Figure 7b - Right Bloc

These results show that the difference in gender by the topics of education and social affairs are statistically significant in both blocs, where labour does not seem to be significant in either bloc; furthermore, economy only seems to be significant for the right bloc.[6]

3.3 Sentiment Analysis

3.3.1 Ternary Sentiment Scores (VM)

For the first analysis of sentiment in the Danish Parliament, statements had been previously labelled on sentiment in Lauritsen and Severin (2024) using the sentiment classification model XLM-RoBERTa (Conneau et al., 2020) which was used from the transformers package (Wolf et al., 2020). This package labeled each statement as being either positive, neutral or negative in sentiment. To run a statistical model on this data, these values were instead assigned numerical values 1, 0, and -1 respectively. A mixed effects model was created where these numerical sentiment values acted as the dependent variable. An interaction between gender and political bloc acted as our independent variable with politician ID as our random effect to take into account certain individual differences in their sentiment of statements per politician. The structure of this model is then as follows:

$$\text{Sentiment Value} \sim \text{Gender} * \text{Bloc} + (1 \mid \text{ID})$$

Compared to female MPs on the left bloc ($\beta = -0.382$, $SE = 0.050$, $t = -7.52$, $p < 0.001$) male MPs on the left bloc are slightly more negative to a statistically significant degree. ($\beta = -0.0179$, $SE = 0.006$, $t = -2.870$, $p = 0.004$). Female MPs on the right are slightly more positive ($\beta = 0.036$, $SE = 0.007$, $t = 4.967$, $p < 0.001$) than their left-oriented female counterparts. The female North Atlantic mandates appear to be significantly more positive ($\beta = 0.185$, $SE = 0.029$, $t = 6.475$, $p < 0.001$). North Atlantic male mandates also seem more positive, although to a lesser degree than their female counterparts. North Atlantic male MPs are more positive ($\beta = -0.124$[7], $SE = 0.038$, $t = -3.276$, $p = 0.001$). Finally, male MPs on the right bloc are very slightly more negative ($\beta = -0.026$, $SE = 0.009$, $t = -2.937$, $p = 0.003$). These results are visualized in Figure 8 below.

[6] For a full descriptive overview of topic distributions for all parties, see appendix C.

[7] For the sake of clarity, this number is negative as it is relative to the female North Atlantic coefficient. Therefore, NAM males are more negative than NAM females - which are generally much more positive.

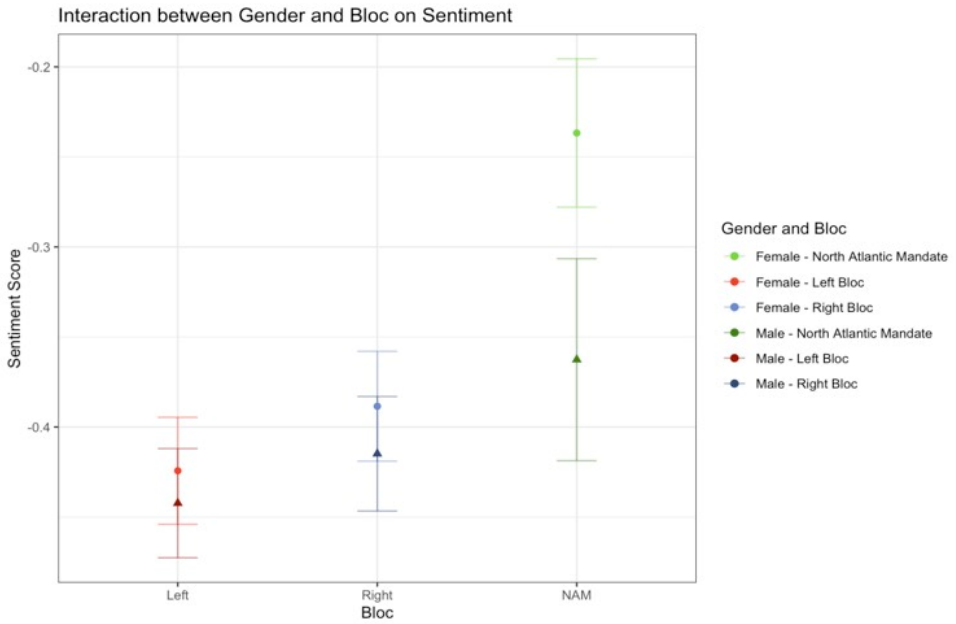

Figure 8 - Sentiment by Bloc and Gender

3.3.2 Sentiment on Gender & Topic (FL)

To further investigate the difference in sentiment of statements between genders, we wanted to investigate whether the sentiment of a statement is influenced by the average gender proportionality for each topic, i.e. do female MPs on average speak more positively/negatively in male-dominated topics like economy? To explore this question, the gender proportionality was calculated for each topic where 1 = indicated that 100% of statements in that topic were from male MPs, and, oppositely, 0 = indicated that 0% of statements were from male MPs. A mixed effects model was created wherein sentiment was our dependent variable and the independent variable was an interaction term between male proportion and gender.

Lastly, the topic label was added as a random effect. This was to take into account that the gender proportion value was repeated in our data frame for every observation - for example, a row might indicate a female gave a negative statement in the topic of Agriculture. The proportion of male statements in this topic is 72% and this number will repeat itself for all statements within that topic. Omitting to add this as a random effect would then result in a very strong (false) correlation, so, to take account for this, this random effect was included in our model. The structure of this model can be seen below:

Sentiment ~ Gender * Male Proportionality in Topic + (1 | Topic)

For female MPs (β = -0.48, SE = 0.1, t = -4.47, p < 0.001), the gender proportionality of a topic had no effect on the sentiment of the statements (β = 0.2, SE = 0.31, t = 0.65, p = 0.52). Similarly for male MPs (β = 0.07, SE = 0.31, t = 0.22, p = 0.83), no effect of gender proportionality on sentiment was found (β = -0.24, SE = 0.62, t = -0.39, p = 0.70). These results are visualized in Figure 9 below.

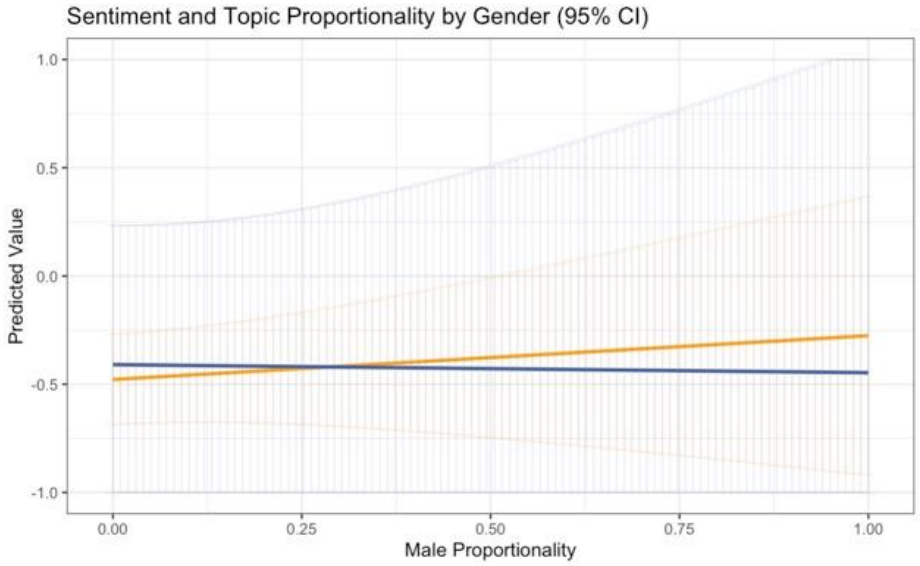

Figure 9: Sentiment and Topic Proportionality by Gender

3.3.3 Emotions by Gender (VM)

For the more in-depth analysis of sentiment analysis going beyond positive, neutral and negative labels, the package second analysis of sentiment, the model alexandrainst/da-emotion-classification-base (*Alexandra Institute*) was used. This model was trained on Danish social media data in collaboration with Danmarks Radio and labels statements as falling into one of eight different categories. These categories are as follows: contempt/disgust, expectation/interest, fear/worry, joy/serenity, surprise/amazement, sadness/sorrow, trust/acceptance and anger/irritation.[8]

A descriptive plot of the proportional distribution by gender of these labels on our data was created. It can be seen below in Figure 10a. Furthermore, in Figure 10b the sum difference in

[8] Manual translations of Danish words: Foragt/Modvilje, Forventning/Interesse, Sorg/Trist, Frygt/Bekymret, Glæde/Sindsro, Overrasket/Målløs, Tillid/Accept, Vrede/Irritation

topics between the two genders can be seen, indicating whether the emotion is typically more prevalent amongst male or female MPs.

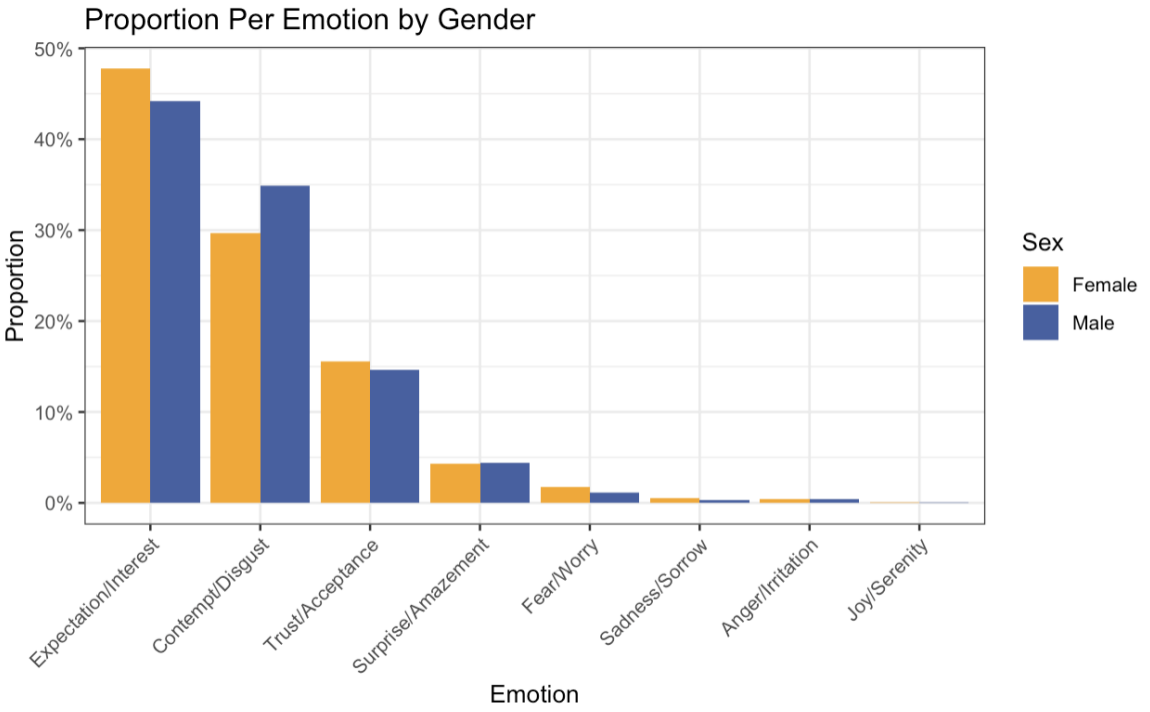

Figure 10a - Proportion of Emotions

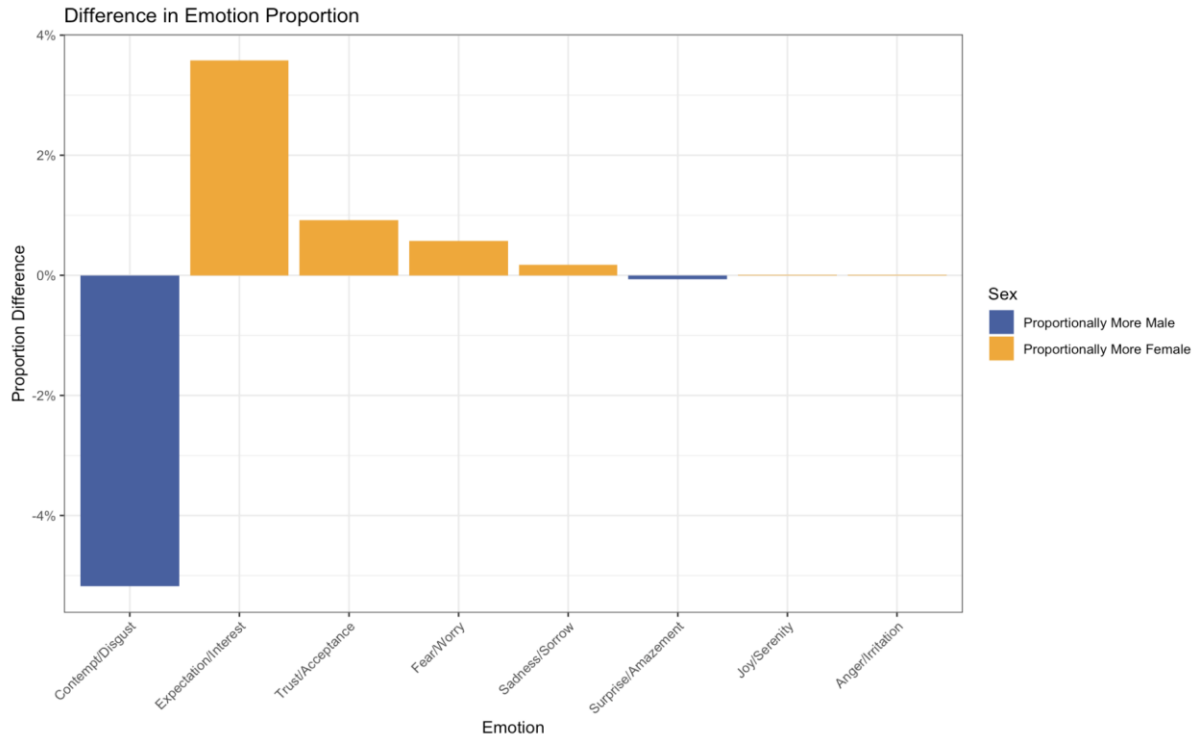

Figure 10b - Proportion Difference in Emotions Between Genders (F - M)

As seen in Figure 10a, the vast majority of statements by both genders were expectation/interest, contempt/disgust, trust/acceptance (~90%). As very few statements were categorized as fear/worry, sadness/Sorrow, anger/irritation, joy/serenity and surprise/amazement, in addition to there being no major difference between genders in these topics, these emotions were omitted in the below analysis.

To investigate whether the proportional differences between genders in their linguistic emotional sentiment were indeed significant ones, a mixed effects model was once again created. To specifically check proportional differences between groups, the raw data was aggregated where each row indicated the politician ID and how many statements they made for a given emotion, e.g. a hypothetical row being ID = 1, Gender = Male, Emotion = Contempt/Disgust, Statements = 20; in other words, Politician 1, a male, gave twenty statements that were categorized as being Contempt/Disgust. Due to the identical data structure of the data in §3.2.2, a similar procedure of taking into account unequal proportions between female and male MPs was taken into account. Using the aforementioned MWM formula on this aggregated emotion dataframe yielded a MWM = 0.76.[9]

Finally, this allowed the creation of the aforementioned mixed effects model, wherein our weighted number of statements was our dependent variable, and our independent variables were the interaction between gender and emotion. Finally, MP ID was added as a random effect to take into account some MPs being more prone to expressing one emotion over the other, compared to other MPs. Formally, the syntax of the model can be seen below:

Weighted # of Statements ~ Gender * Emotion + (1 | MP ID)

As also done for previous models, here too estimated marginal means were employed to allow for pairwise testing. The result of this model indicates no significant difference between females and males in their proportionality of statements labeled as 'Contempt/Disgust' (EST = -11.38, SE = 8.11, $t(763) = -1.403$, p = 0.1609). Similarly, no significant difference was found between genders in Trust/Acceptance (EST = 2.75, SE = 8.13, $t(760) = 0338$, p = 0.7356) and in Expectation/Interest (EST = 9.75, SE = 8.10, $t(767) = 1.203$, p = 0.2295). To summarize

[9] For a full runthrough of the steps of the weighting process and the reasoning for its necessity, please read previous section §3.2.2.

these results, no gender differences were found in any of these three emotion categories. The results are visualized in Figure 11 below.

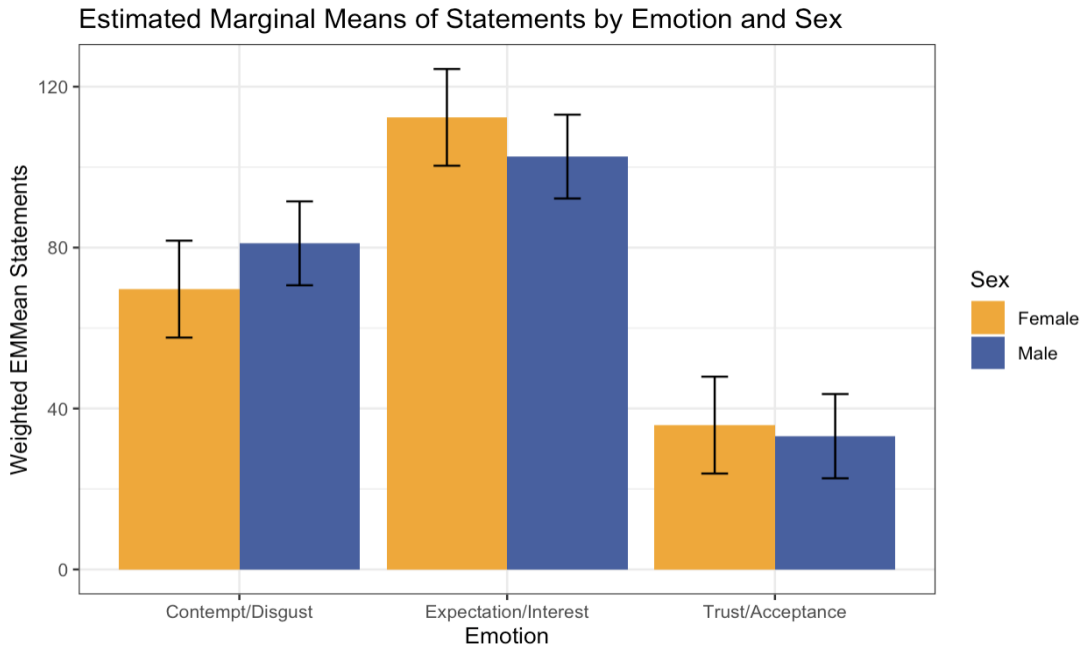

Figure 11 - Estimated Marginal Means of Emotions and Gender

4. Discussion

4.1 Discussion of Results

4.1.1 Linguistic Complexity (FL)

As a general tendency in linguistic complexity, it was found that the left bloc had a higher FKGL score compared to the right bloc. This was also the case for MDD. Exclusively comparing within the domain of political blocs, these results seem congruent with previous literature (Schoonvelde et al., 2019; Tetlock et al., 1984), which also suggests that left-oriented MPs typically use more complex language compared to right-oriented MPs. Furthermore, the results suggest that the North Atlantic MPs have lower FKGL and MDD scores compared to both the right and left bloc. This tendency might be influenced by factors such as bilingualism or differences in educational opportunities compared to Denmark (Körber & Volquardsen, 2020; Markeprand & Stephensen, 2018). In regards to gender differences, male left-oriented MPs seems to have a slightly higher FKGL score compared to female left-oriented MPs, which

aligns with previous literature suggesting that male MPs speak in a more complex language compared to female MPs (Childs, 2004; Coates, 2015; Hargrave & Blumenau, 2022). However, this was not the case for the right bloc and the North Atlantic mandates; here, the female MPs speak in a more complex language compared to their male equivalents - a finding not in accordance with previous literature on the matter (Childs, 2004; Coates, 2015; Hargrave & Blumenau, 2022). This may be due to previous studies having focused on the gender difference in language complexity by looking at entire parliaments (Childs, 2004; Coates, 2015; Hargrave & Blumenau, 2022), not including political blocs. Other studies have also looked at linguistic complexities between blocs (Schoonvelde et al., 2019), while not including gender in the analysis. The results obtained from the analysis in this paper may suggest the existence of an interaction effect between bloc and gender. Explaining this, specifically pertaining to the difference found in the right bloc, previous literature suggest that in a US context, Democrats are described with words aligning with the traits for female gender roles, and the Republicans are described with words aligning with the traits for male gender roles (Gonzales & Bauer, 2020). Therefore, it might be possible that the same tendency is found in a Danish context, meaning that there is an incongruence between being a female and being a right-oriented MP. Building upon the role congruity theory (Eagly & Karau, 2002b), the aforementioned incongruence can create less freedom of act for female right-oriented MPs, in which they have a harder time navigating between their gender role and partisanship stereotype. This might in turn lead to a linguistic compensation in which female MPs try to counterbalance any negative perception of supposed gender and partisan role violations by showcasing competency through language instead. This is supported by previous literature suggesting that female politicians need to outperform their male counterparts in order to be perceived as efficient (Lawless & Pearson, 2008).

Turning towards the North Atlantic mandates, the gender difference in language complexity is the most profound, in which female MPs speak with higher complexity. This may be due to several factors. Firstly, the grouping of North Atlantic mandates distinguishes itself from the other groupings, since North Atlantic mandates includes both left- and right-oriented MPs. Secondly, they are also a minority in them having only four dedicated seats in the Danish parliament. In accordance with the theory of "Doing Difference", the female North Atlantic mandates might experience a difficulty in regards to intersectionality, meaning the way in which their race, class, and gender interact, leading to female MPs potentially experiencing a constrained scope of agency - this scope might be further limited by being a minority in terms of

race and class. It is possible that the female North Atlantic MPs are conforming to the display rules for MPs and in this context through their language. Like right-bloc female MPs, they see an exaggerated version of the linguistic compensation mentioned previously, where a higher linguistic complexity compared to their male equivalents is necessary to balance out violations of stereotypical leadership traits in light of being both female and a minority – ultimately leading to a higher linguistic complexity to showcase competency.

However, it is important to note that these results of the FKGL scores are not fully mirrored in the MDD scores, with no such interaction effect for the left and right blocs. While, like the FKGL scores, the left bloc scored a slightly higher MDD score compared to the right bloc, who in turn scored a higher MDD score compared to North Atlantic mandates, there were no statistically significant gender differences in the major two blocs. Like FKGL scores, female North Atlantic MPs scored vastly higher compared to their male equivalents, which may be explained by the same reasons of intersectionality written above.

These results may at first glance seem conflicting, as FKGL and MDD are both scores of linguistic complexity, and therefore, one might think, should give the same results. However, where FKGL is more a measurement of the complexity of words used in the sentence, MDD is a measurement of the complexity of the sentence structure itself. Therefore, these results seem to suggest that female MPs in all blocs generally have a higher linguistically complex word usage with more polysyllabic words and long sentences, while sentence structure complexity seems to be the same for male and female MPs in the same bloc. These results also align with previous literature (Go & Falenska, 2024), which did not find any gendered difference in MDD. Lastly, as mentioned, both FKGL and MDD scores seemed to follow a similar pattern of left bloc scoring higher than the right bloc, followed by North Atlantic mandates scoring the lowest. This pattern seems to be explainable by 1) right bloc seeming to prioritize efficient, simple communication (Schoonvelde et al., 2019) and 2) the Danish language capabilities of Northern Atlantic may be naturally lower due to it not being their mother tongue (Körber & Volquardsen, 2020).

As a final note, FKGL is meant to be a measurement that correlates with education level; a factor which was not included in this analysis. While data can be found on the educational level of politicians across parties (*Tal og fakta om Folketinget*, 2016), this data does not inform of

the political affiliation nor the gender. To include this factor would then require a manual labeling of all 432 speakers in the time period of this data collection. However, the inclusion of this factor may help understand how these gender differences arise. For example, if FKGL is directly correlated with education level and it happens that female MPs on the right bloc generally have a higher level of education than their male counterparts, then the linguistic differences between genders found in our analysis are not causal, but purely correlational.

4.1.2 Topic modelling (VM)

The results of topic modelling suggest that female MPs speak significantly more about education and social affairs, and male MPs speak significantly more about economy and labour. In the Swedish parliament they found that female MPs speak more about healthcare, social affairs, and education, and male MPs speak more about economy, foreign affairs, and defense (Bäck et al., 2014). These results follow a general tendency across the world of female MPs speaking more about welfare and social-oriented topics and male MPs speaking more about economics, foreign affairs and labour with results. These tendencies are found in the US (Sapiro, 1983), the UK (Blaxill & Beelen, 2016), Latin American countries (Escobar-Lemmon & Taylor-Robinson, 2009), and Scandinavia (Bäck et al., 2014; Dahlerup, 1988; Heidar & Pedersen, 2006; Listhaug, 1985; Skjeie, 1991). The results further align with the role congruity theory (Eagly & Karau, 2002b), and the broader theories of gender performativity (Butler, 2006, 2009), which suggest that the preconceived expectations of the gender of an individual will affect their behaviour; specifically in this case, meaning female politicians will end up discussing topics related to e.g. the care of others and male politicians will discuss more analytical matters.

In addition, the topic differences were also investigated individually on the left and right blocs individually, which found that healthcare and social affairs were indeed discussed more by female MPs. However, the difference in economy was only significant in the right bloc, which implicates a greater gender disparity in topics in the right bloc. These results seem to be in line with previous studies, e.g. Dahllöf (2012) which had a higher gender prediction accuracy on the right line; indicating again a bigger gender disparity in this bloc. Furthermore, these results align with the previous literature suggesting an incongruence between being a woman and being a right-oriented politician (Gonzales & Bauer, 2020). Interestingly, labour was not significant in either bloc individually. This curious result could have arisen from the fact that the North Atlantic mandates were included in the gender-only analysis and their values may have

skewed the results to make the topic of labour statistically significant. However, further inspection revealed that the North Atlantic mandates were only responsible for 35 out of 12865 statements within this topic making this explanation unlikely. More probable is the idea that the gender difference in this topic is so subtle that it requires the combined observation of both blocs to be statistically significant.

An important factor to consider in the interpretation of the results obtained in the analysis of topics is the allocation of ministries and spokesperson roles. It is previously found that female MPs were primarily allocated to ministries such as health, social welfare, education, family, culture, and consumer affairs, whereas male MPs were primarily allocated ministries of economics, defense, employment, equipment, and budget (Davis, 1997; Krook & O'Brien, 2012). Furthermore, previous literature suggests that female MPs in Scandinavia are more concerned with policies regarding welfare, education, environment and family matters (Dahlerup, 1988; Listhaug, 1985). Female leaders are also more effective in leadership roles defined in less masculine terms (Eagly, A. H. et al., 1995). The allocation of ministerial posts in the government and spokesperson roles within each party can thereby be a possible co-explanation of the disparity between genders in the aforementioned topics. Although this is not included in the analysis, Appendix D, shows the count of male and female ministers within the different topics from 2008-2023, in which there is a general tendency that female MPs are more often given ministerial positions concerning culture, education, and social affairs, and male MPs are more often given ministerial positions concerning defence, economy, foreign affairs, and infrastructure. Although there are some dissimilarities, the allocation of ministerial positions somewhat aligns with the gendered topics, thus the allocation of ministerial posts and spokesperson roles can act as a contributing factor to the results obtained in this paper. This is interesting in regards to causal factors for these gendered disparities; e.g. do female MPs speak proportionally more about education due to them simply being more allocated to these ministerial and speakership positions? If so, why are they allocated in this manner - are they simply performing their expected gender roles? Do sitting governments tactically choose an MP in a chosen ministerial post congruent with their gender as these are seen as being more effective and performing better (Eagly, A. H. et al., 1995)? Or do men and women simply prefer different political topics – and if so, why? While the ministerial positions could therefore be an interesting factor to include in future models, it is still hard to draw any causal conclusions. Despite this, our results do

suggest a clear gendered difference which may indicate the existence of different display rules for genders.

4.1.3 Sentiment Analysis (FL)

The results of the analysis of sentiment by bloc and gender suggest that female MPs are generally less negative compared to their male counterparts. However, this difference was quite subtle for the left and right blocs with a sum difference between genders of ~0.02 for both blocs. Interestingly, this difference was almost identical between these two blocs indicating a lack of any interaction effect between bloc and gender within these blocs. Furthermore, the difference between the left and right blocs was also small with the lowest mean value of -0.44 for left-oriented MPs and highest mean value of -0.39 for right-oriented females. Taking into consideration that the scale goes between 1 and -1, this modest variation of 0.05, albeit statistically significant and existing, seems to only indicate a subtle difference between these two blocs and between genders within the bloc.

However, for the North Atlantic mandates, the story was quite different; not only were they less negative in general, the difference between genders was also exaggerated - a pattern also seen in the analysis of linguistic complexity. This meant that female North Atlantic mandates were by far the least negative. Now, how do these results compare to previous literature on the matter and how might one explain and interpret these results? The matter of female MPs generally being less negative is consistent with previous studies (Hargrave & Blumenau, 2022; Haselmayer et al., 2022), which found similar results in their analysis of the Austrian parliament. Furthermore, studies suggest that there exists a reduced room for maneuver for female behavior in politics (Eagly & Karau, 2002b), which can lead to politicians exhibiting less negative traits. In regards to the explanation as to why North Atlantic mandates are less negative, similar to how there exists the reduced room of behaviour for female politicians, the same concept of intersectionality also applies to being a minority in terms of race and/or class which can further restrict this room for maneuver (Eagly & Karau, 2002b; West & Fenstermaker, 1995; West & Zimmerman, 1987), again leading to less negative statements. This point is further demonstrated by the fact that female North Atlantic MPs, who are constrained by both the reduced room of maneuver from both being a minority and female, exhibit the least negative behaviour in terms of language.

As a further part of this analysis, it was examined whether the sentiment of a statement was influenced by the gender proportionality for each topic. The sentiment of male MPs was not influenced by topics being either more female- or male-dominated. The sentiment of female MPs had a slight increase in more male-dominated topics. However, this was not found significant, thus not supporting the idea of reduced room for maneuver for female MPs in more male-dominated areas (Eagly & Karau, 2002b). It is possible that the limited results are due to female MPs conforming to more typical male-behavior similar to the results found by (Hargrave & Blumenau, 2022). However, to make any causal claims would require a more in-depth analysis; opening up the avenue for future studies on this matter, a diachronic investigation whether this effect (or rather, lack thereof) has always been non-existent, or whether this effect has simply ebbed out with time as seen in the aforementioned study.

Lastly, it was investigated whether male and female MPs showcased different emotions in their statements. However, no such differences were found. Although female MPs showed a slightly higher preference for more positive emotions such as expectation/interest and trust/acceptance compared to males, who showed a higher preference for contempt/disgust, this difference was not statistically significant. These results do not align with previous sentiment analysis studies on the matter (Haselmayer et al., 2022); however, the emotions used in this package are different to the ternary sentiment used in their study. Beside not getting results in regards to gender differences, it comes with some interesting aspects in regards to the use of sentiment analysis in parliament debates. While the majority of statements was labelled as negative in the ternary analysis, the emotion model labelled the majority of the statement as expectation/interest. Although this model may seem to enhance the understanding of emotional content beyond the simplicity of ternary sentiment analysis, it does not actually accomplish this. The majority of the statement was labelled one out of three emotions, thus this model possessed similar limitations as the ternary sentiment package. This leads to a general questioning of the applicability of sentiment analysis in Danish parliament debates - a point which will be further elaborated on in the Limitations section.

4.2 Limitations

4.2.1 Constraints of Sentiment Analysis (VM)

While sentiment analysis can be a powerful tool in giving an insight into the emotional valence of speakers, there exists linguistic hurdles that this tool may struggle to overcome which may negatively impact the accuracy and reliability of the analysis. For example, as Onyimadu et al. (2014) states, the presence of complexity-increasing factors such as the presence of sarcasm, interjections, irony and digression from the topic, can make the application of standard sentiment analysis difficult or lead to misleading results. Using a recent example from the opening debate of Folketinget in 2024, the party spokesperson of far left-wing Enhedslisten[10] gave the following quote: "Has the government then been a concrete success? The answer is a clear yes. The government has been a huge success, for example, for the heirs of the Danish billionaire dynasties. [...] That must be called a success. And, as a little extra gift, the upper elite has also received a tailor-made discount on flying in private jets – a huge success."[11] (*Pelle Dragsted*, 2024). While this statement is a verbal, sarcastic jab at the sitting government, these sorts of statements would by most sentiment detection models be classified as being positive. Although one must assume that the majority of recorded statements in our dataframe are not such examples of sarcasm, these sorts of verbalities are difficult to account for. Furthermore, like some previous studies, a ternary approach of sentiment analysis was used in this paper. While this procedure allows for a non-polarized (neutral) score, these labels are still a (considerable) simplification of the statement made. As Bukhari et al. (2014) state in their paper, statements like "I don't like X" are less intense than saying "I hate X" - but these types of statements are still equally classified as being negative and this nuance is lost in the ternary classification. Therefore, a similar future study might benefit from further subdivisions of sentiment, i.e. using categories such as mildly negative, negative, extremely negative and so on; or even using a continuous scale.

An attempt was made in this paper to go beyond simple polarity scores using the extended sentiment analysis, wherein each category was classified as belonging to six emotions. How-

[10] Party name in English: 'Red-Green Alliance'
[11] Manually translated from Danish

ever, the majority of statements (~90%) ended up being classified as either Expectation/Interest, Contempt/Disgust or Trust/Acceptance, leading to almost a ternary classification nonetheless. The predominance of these categorizations may arise from the fact that certain rules of conduct exist in the Danish parliament, which say that meetings must be held in peace and order, and that all members are required to speak nicely to one another. These guidelines are generally upheld, as a failure to comply will lead to an interruption by the chairperson *(Rules for Language and Conduct in Danish Parliament)*. Therefore, the results found in both the ternary sentiment and emotion analysis are surely affected by these rules, which effectively prohibit or limit any major extremely emotionally charged statements, which can be seen in the extremely low percentages of statements being classified in the more polar emotion categories such as joy/serenity and anger/irritation. (~2%).

4.2.2 Categorization of Political Parties (FL)

In this paper, political parties were divided into three simple categories, namely left bloc, right bloc or a North Atlantic mandate. While this approach allowed for a greater ease of comparison, there are also several downsides to this approach. Firstly, the obvious one being that the political range of values between parties within the same political bloc can be quite large, where parties such as Socialdemokratiet[12] (moderate left bloc) and Venstre[13] (moderate right bloc) may be more politically aligned than, for example, Socialdemokratiet and Enhedslisten (far-left bloc), and these two moderate parties are even in the sitting government as of present date, despite being from two different political blocs. Secondly, in a sort of continuation to the previous point, political parties are often also not classified on only a one-dimension plane (from liberal/left to conservative/right), but can also be further described along two axes; distributional and value/identity politics (Slothuus et al., 2010). For example, the Danish party Dansk Folkeparti has a fiscally moderately liberal distributional politics, with a focus on elder care and a strong healthcare system (*The Best Healthcare System, Dansk Folkeparti*), while also having a conservative view on identity politics, e.g. being strong opponents of immigration from regions such as the Middle East and Africa (*Strict Immigration Politics, Dansk Folkeparti*). This is not just an exception to a rule though, with several Danish parties not aligning neatly along a one-dimensional left-right line. However, these nuances in policy are lost by the

[12] The Social Democratic Party
[13] The Liberal Party

ternary grouping of left, right and North Atlantic mandates used in this paper. For example, Schoonvelde et al (2019) found no difference in linguistic complexity between economic liberals and economic conservatives, despite finding cultural conservatives having a lower FKGL score than cultural liberals.

Although it was considered to create other groupings based on the degree of liberalism/conservatism of both distributional and identity politics, this was ultimately decided against. Firstly, this simpler categorization lead to more efficient and easily comprehensible analysis as including more and more groups would lead to many more outputs as, each political grouping added would lead to two more outputs (male and female for each group); increasing the complexity and also the risk of getting type 1 errors. Secondly, and more importantly, the main objective of this paper was ultimately to look at politics through a *gendered* lens. This means that while political parties were included in our analyses, it was mainly to see how (potential) gender differences would change between blocs and whether any interaction between gender and bloc would exist; in other words, the exploration of gender was the primary focus and political affiliation was an interesting variable to include in this exploration of gender differences. However, future studies may benefit from the inclusion of a complex grouping of political groups which may yield different results, even through a gendered lens. This assumption is supported by the results of the North Atlantic mandates group found in this paper, whose results differed greatly from the left and right blocs in all parts of the analysis; in sentiment analysis, linguistic complexity and topic distribution. Furthermore, the gender differences in these categories were often amplified compared to the other two blocs. While it's important to note that 1) these mandates do not obviously derive from a single political party and 2) are a quite unique part of the Danish parliament due to, amongst other things, their nature of being elected by non-mainland Denmark citizens. Lastly, only 16 North Atlantic MPs made statements within the observed time period, with just 9 male MPs and 7 female MPs. This low sample size (especially compared to the other two blocs) inherently gives more uncertainty and variability of the observations, leading to these results being taken with a higher level of skepticism. However, the results of this grouping might still suggest that more ideological-focused political categorizations can lead to interesting results and perhaps even shed light on in-group gendered differences, such as the amplified differences seen within the North Atlantic mandates.

5. Conclusion

This paper aimed to investigate gender differences in the Danish parliament pertaining to differences in linguistic complexity, discussed topics, and general sentiment. It was found that left-oriented MPs on average have a slightly higher linguistic complexity compared to their right bloc counterparts, who then had a higher complexity compared to North Atlantic mandates. For FKGL, an interaction effect occurred in which male left-oriented MPs scored higher than their female equivalents; a pattern not seen in the other two groups. However, this was not the case for MDD, indicating that while word usage and sentence length (FKGL) could see an interaction effect between gender and political bloc, this was not the case for sentence structure complexity (MDD).

Furthermore, in alignment with previous studies, it was found that female MPs spoke significantly more about education and social affairs, while male MPs spoke significantly more about economy and labour. These differences were almost the same between left and right blocs; however, the gendered difference in economy in the right bloc was not statistically significant. Interestingly too, labour was also not significant when looking at the blocs individually although it was significant when looking at the combined left and right blocs.

Lastly, a sentiment analysis was carried out using both positive, neutral and negative labels, as well as a second analysis that attempted to classify the emotions of the speakers' statements. It was found that the left bloc MPs were slightly more negative compared to the right bloc MPs, who in turn, were more negative than North Atlantic mandates. For all groups, a gendered difference was found in which male politicians were significantly more negative than their in-bloc female counterparts. However, no gendered differences were found in the emotional content of their statements. Lastly, it was also investigated whether the gender dominance of a given topic would impact the sentiment of that topic, i.e. did a proportionally female topic like education affect how positive or negative female and male MPs spoke about that topic? The results of this analysis showed no significant effect.

The majority of these results seem to align with previous studies and the sociological theories of West & Fenstermaker (1995) "Doing Difference", as well as Eagly & Karau's (2002) role congruity theory, which state that female politicians suffer from an incongruity between the

perceived traits of being a woman and a successful leader; therefore female MPs may be more inclined linguistically compensate for this, speaking in a more complex manner. Furthermore, this might also be what causes female MPs to speak less negatively than their male equivalents. In addition, an interaction between gender and bloc seem to appear especially in the ternary sentiment and linguistic complexity analysis, in which a general tendency appears in which the difference between male and female MPs are lowest on the left bloc, followed by the right bloc, and most profound within the North Atlantic mandates. This tendency supports the importance of including blocs as a factor in the analysis as this incorporates additional layers of nuances in the understanding of the gendered differences in the Danish Parliament.

In conclusion, the findings of these analyses suggest a gender difference within linguistic complexity, topics discussed and the sentiment of the statements of MPs. For future studies, it would be interesting to investigate how these differences may change within different political groups in a more in-depth manner than purely a left/right/North Atlantic split.

6. Code Availability (VM)

In accordance with the principles of open science, the data and code used for this paper, as well as a link to the previous exam paper whose foundation this paper is built upon, can be found in the link below.

https://github.com/VilliamJ/bachelor_cogsci

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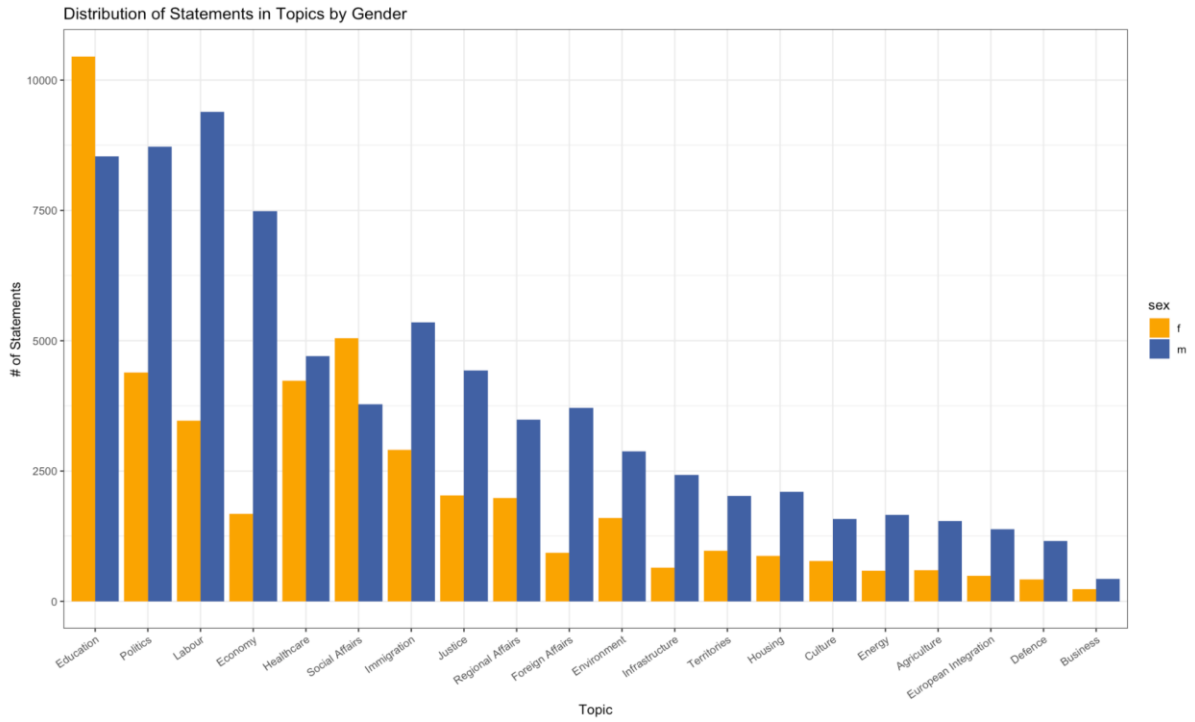
8. Appendix

Appendix A: full distribution of # of statements for each topic made by both genders

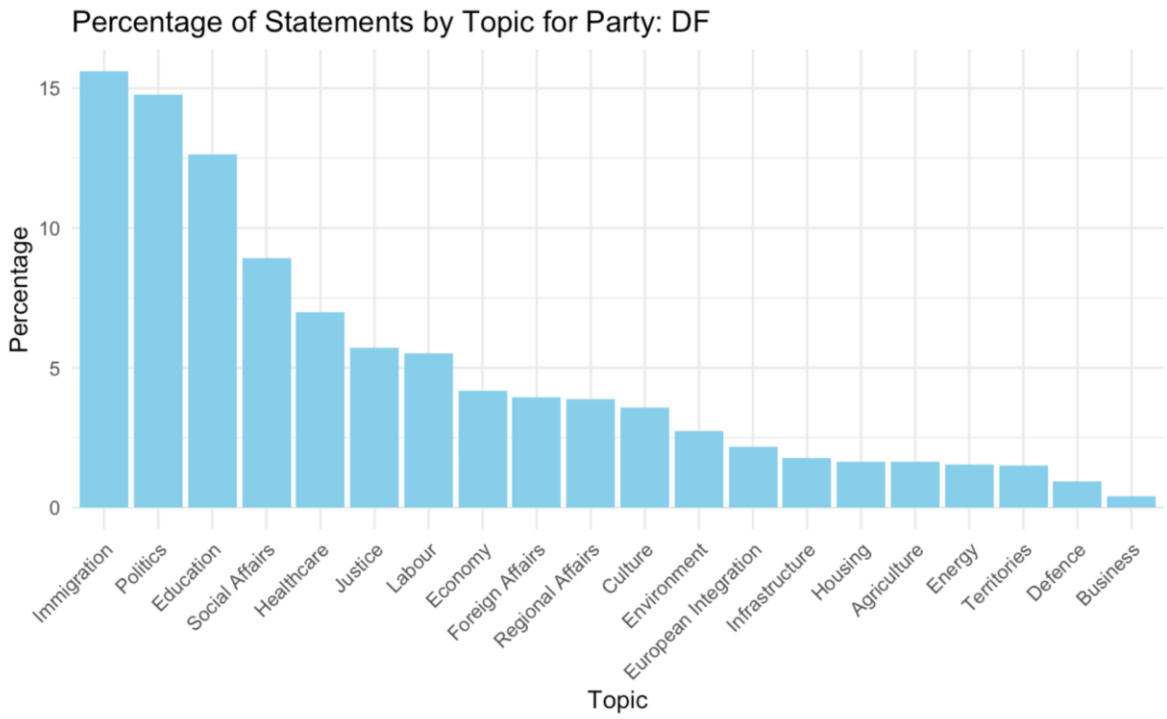


Appendix B: the table of this summary output Weighted SC ~ Gender * Topic + (1 | MP ID)

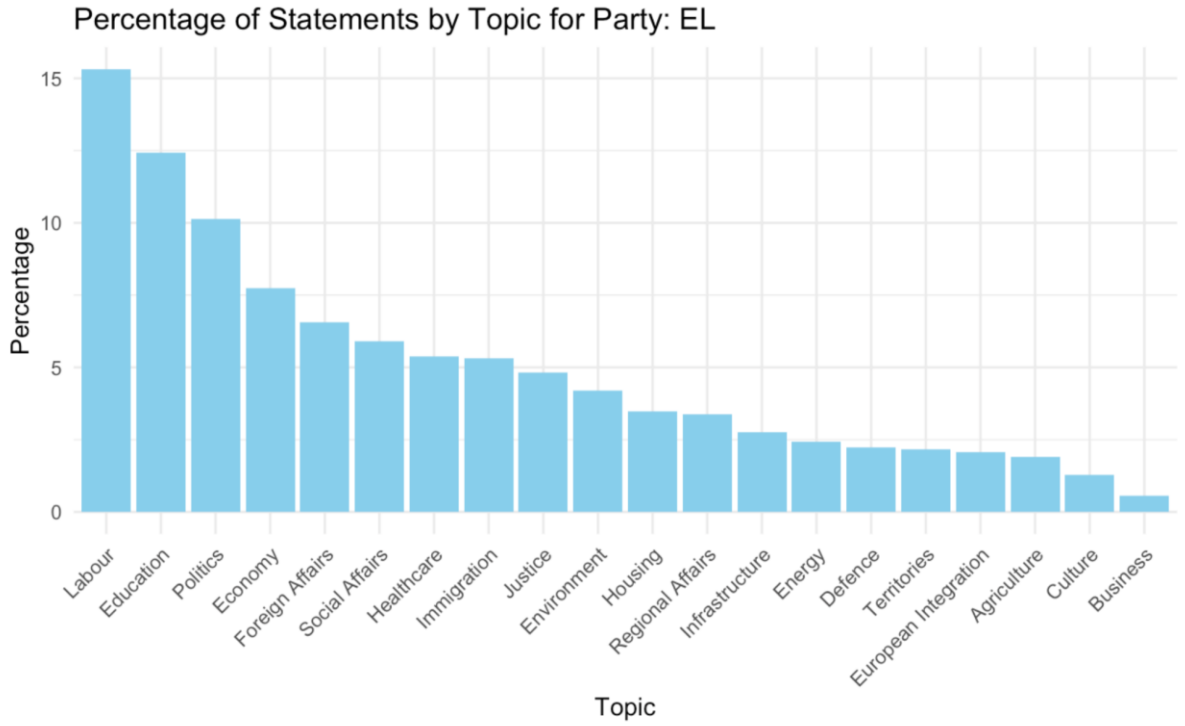
```
Formula: weighted_statements ~ sex * Topic_name + (1 | ID)
   Data: topic_counts

REML criterion at convergence: 23150.2

Scaled residuals:
    Min      1Q  Median      3Q     Max
-1.4355 -0.4037 -0.1773  0.0542 11.1268

Random effects:
 Groups   Name        Variance Std.Dev.
 ID       (Intercept)  358.6   18.94
 Residual             2182.7   46.72
Number of obs: 2181, groups:  ID, 437

Fixed effects:
                               Estimate Std. Error       df t value             Pr(>|t|)
(Intercept)                       9.023      4.149 2089.987   2.175             0.029765 *
sexm                             21.313      5.377 2075.901   3.964      0.0000763289884 ***
Topic_nameEducation              49.420      5.255 1840.598   9.405 < 0.0000000000000002 ***
Topic_nameForeign Affairs        -2.048      5.948 1888.741  -0.344             0.730627
Topic_nameHealthcare             18.212      5.534 1833.058   3.291             0.001019 **
Topic_nameLabour                 10.735      5.315 1833.554   2.020             0.043526 *
Topic_nameSocial Affairs         20.376      5.324 1825.998   3.827             0.000134 ***
sexm:Topic_nameEducation        -46.808      6.883 1829.365  -6.800      0.0000000000141 ***
sexm:Topic_nameForeign Affairs  -11.809      7.604 1869.831  -1.553             0.120574
sexm:Topic_nameHealthcare       -28.822      7.211 1828.997  -3.997      0.0000667212865 ***
sexm:Topic_nameLabour            -4.316      6.937 1823.571  -0.622             0.533906
sexm:Topic_nameSocial Affairs   -35.828      6.991 1819.062  -5.125      0.0000003288170 ***
---
```

Appendix C: Topic distribution by bloc

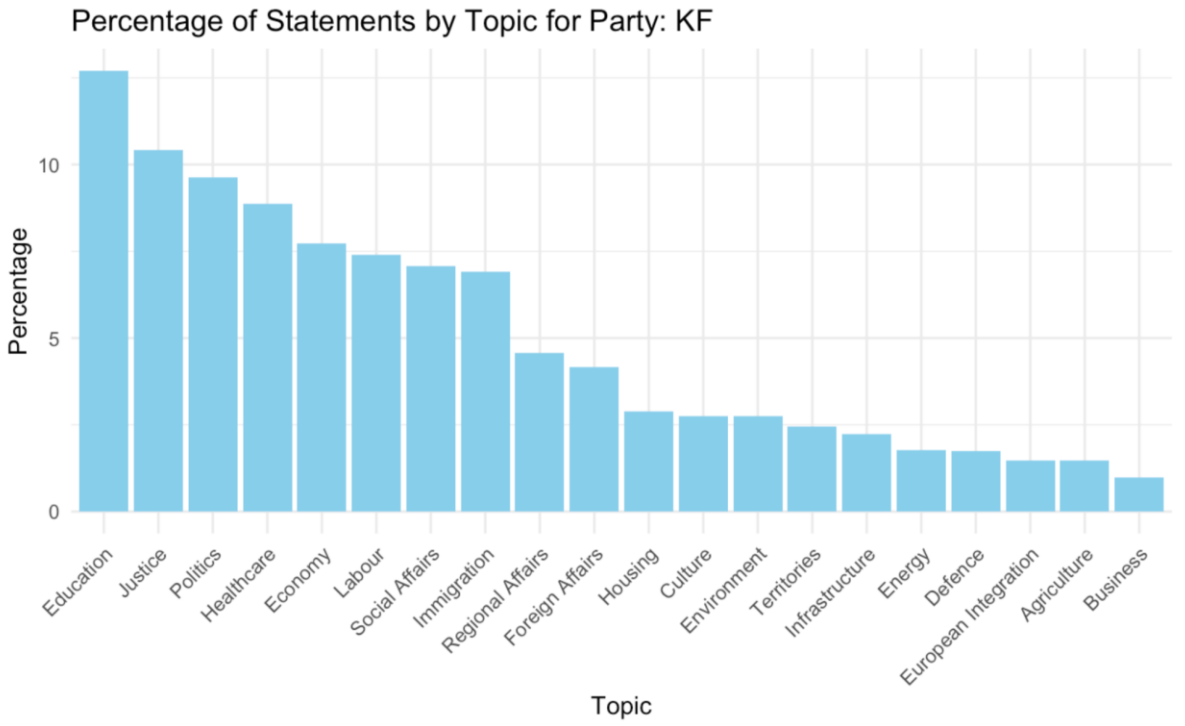
Danmarksdemokraterne (Denmark Democrats)



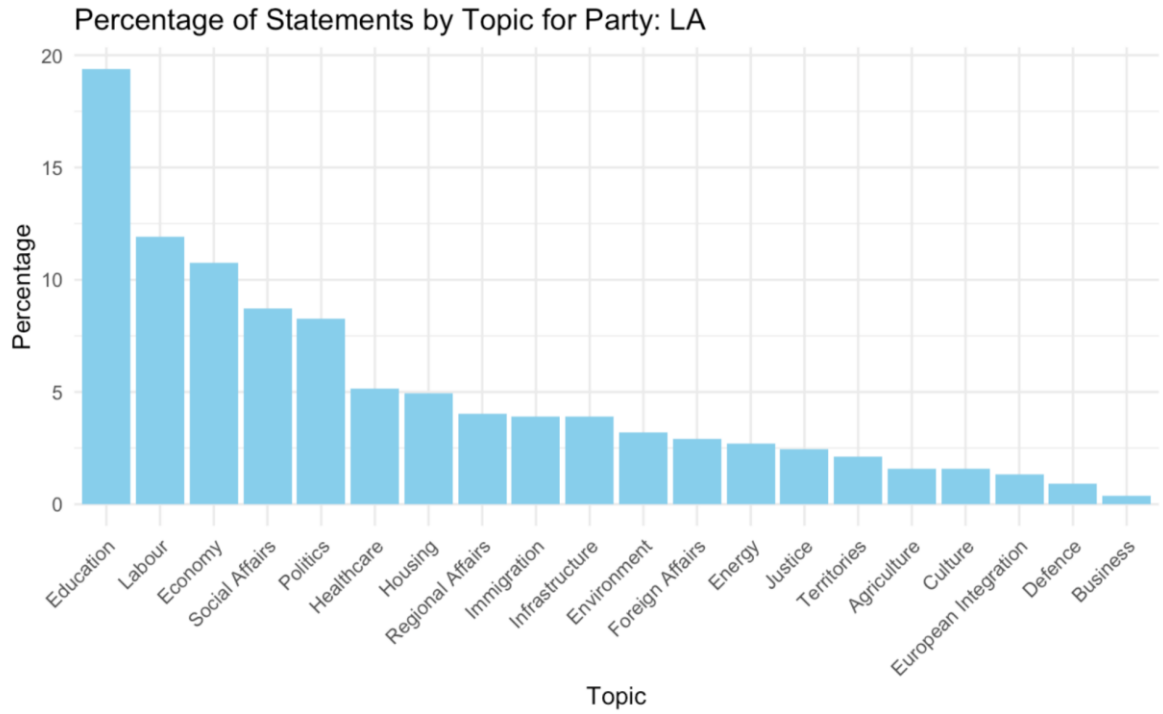
Enhedslisten (The Red-Green Unity List)



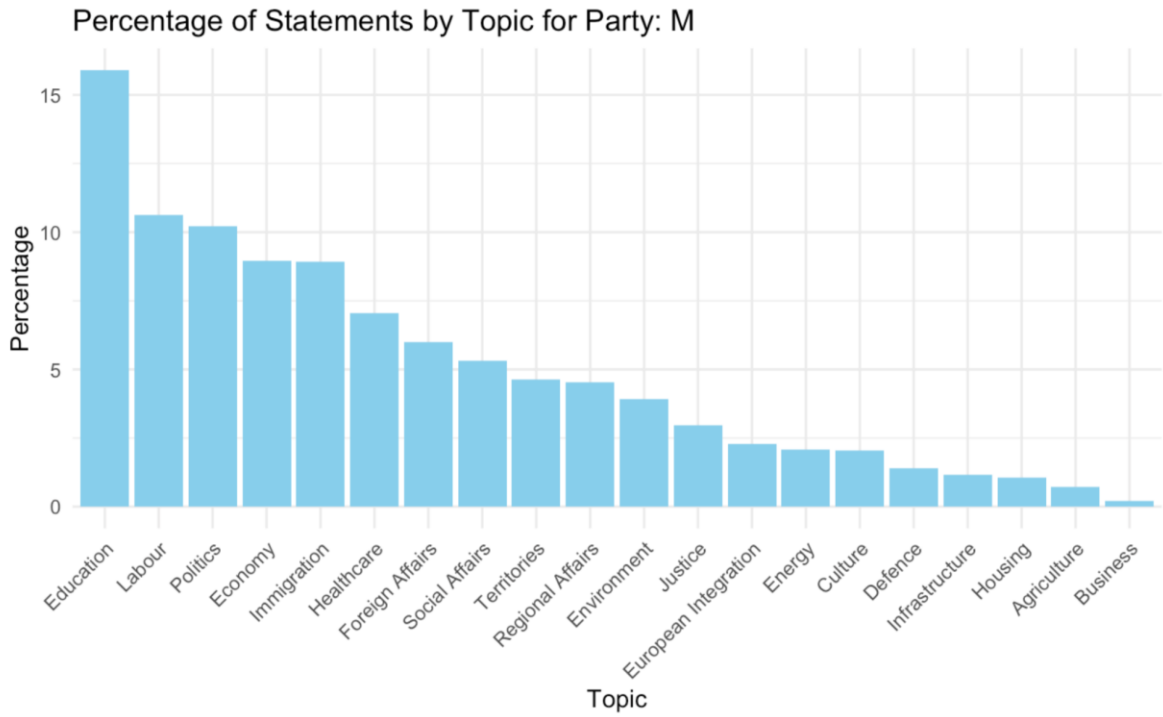
Konservative Folkeparti (Conservative People's Party)



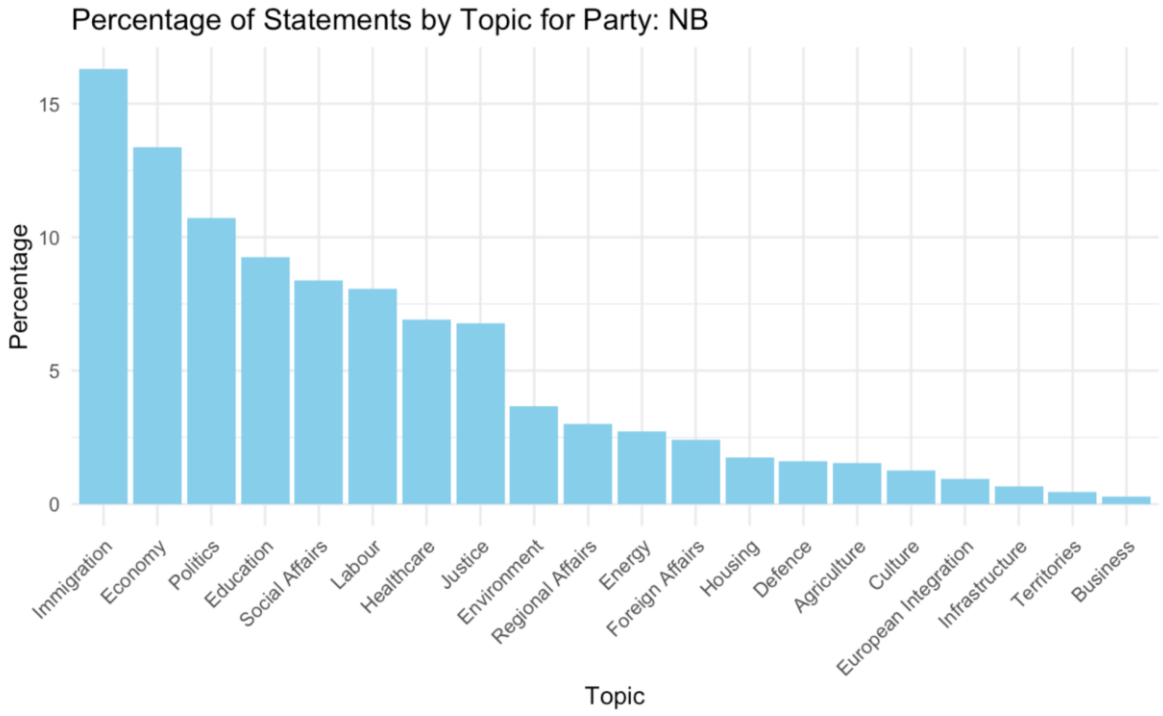
Liberal Alliance (Liberal Alliance)



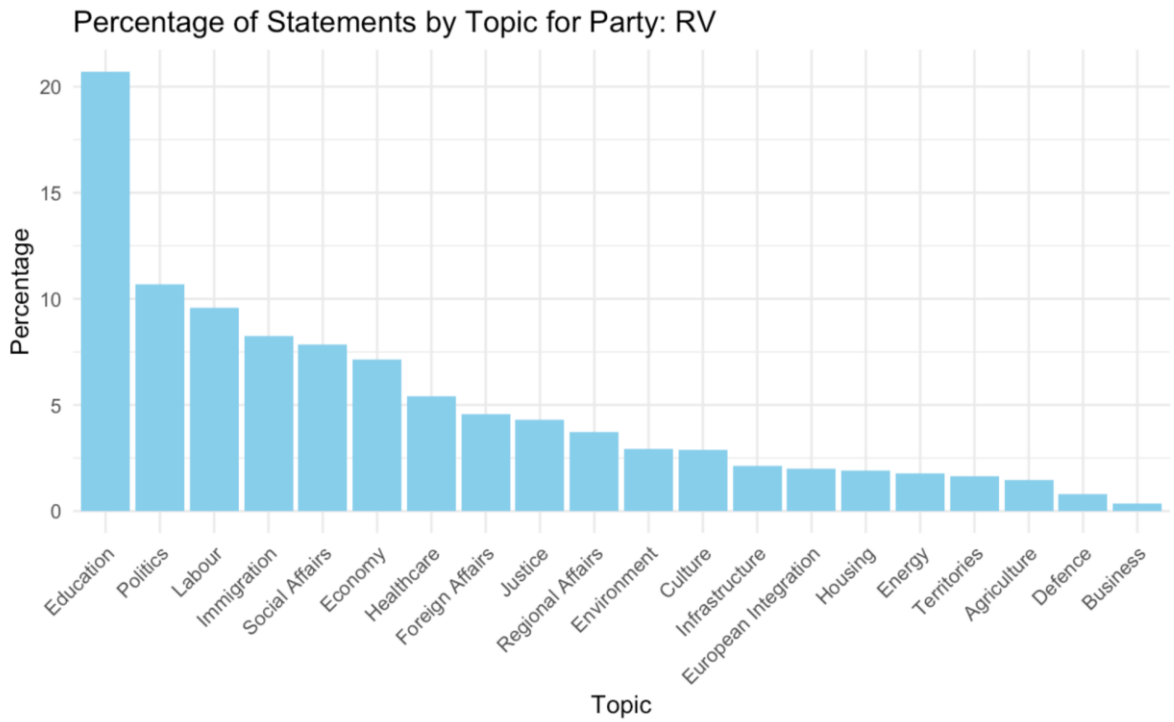
Moderaterne (The Moderates)



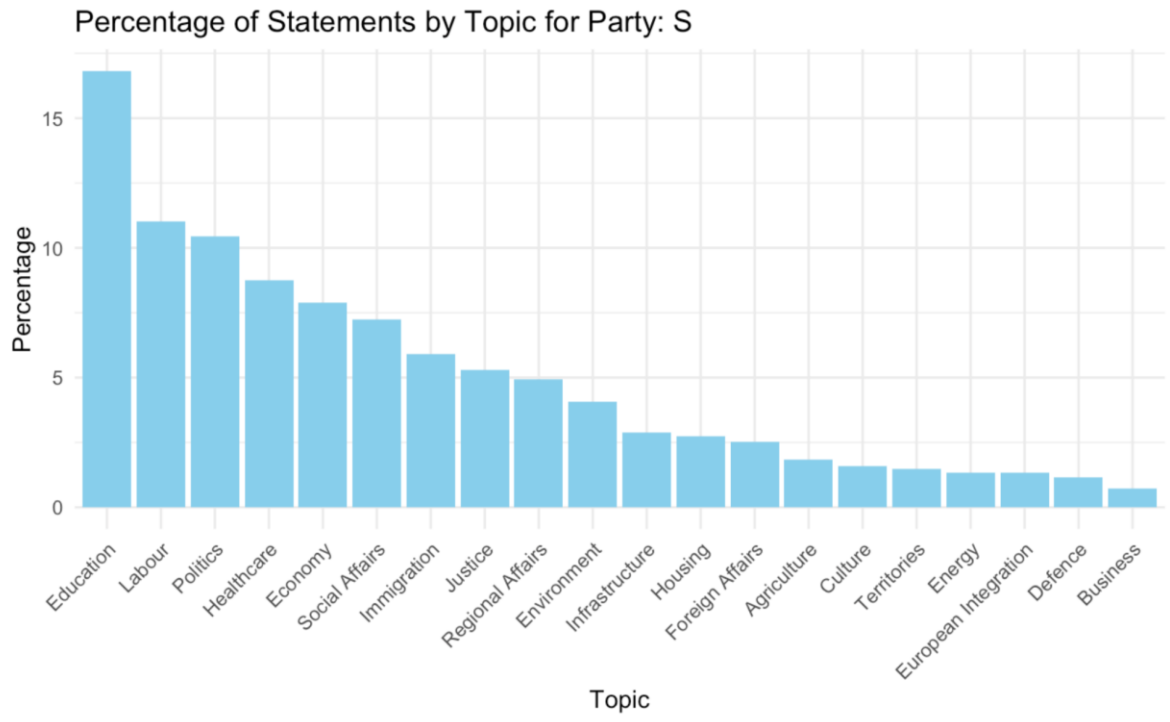
Nye Borgerlige (New Right)



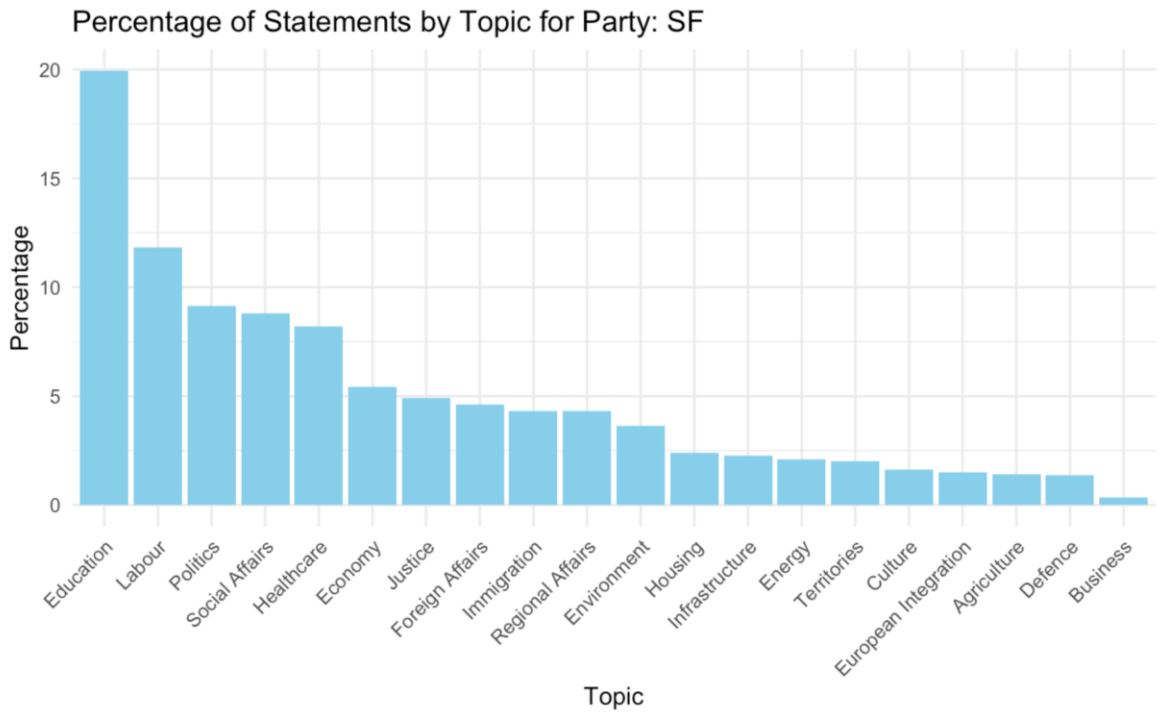
Radikale Venstre (Danish Social Liberal Party)



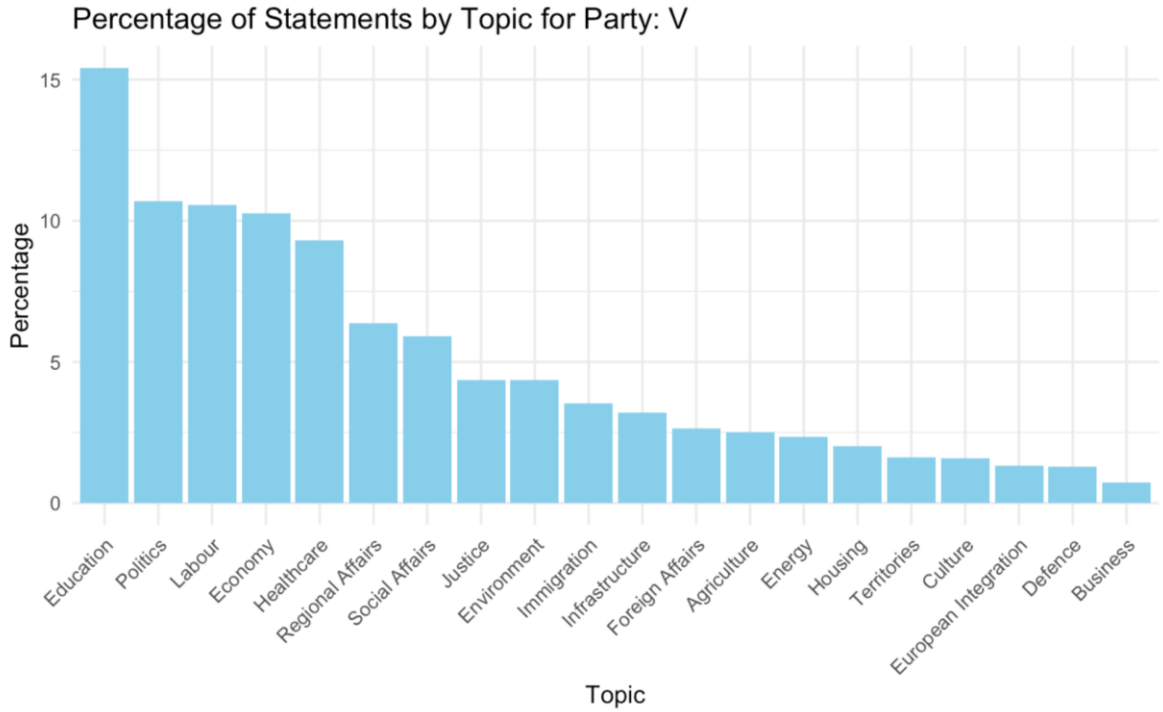
Socialdemokratiet (The Social Democratic Party)



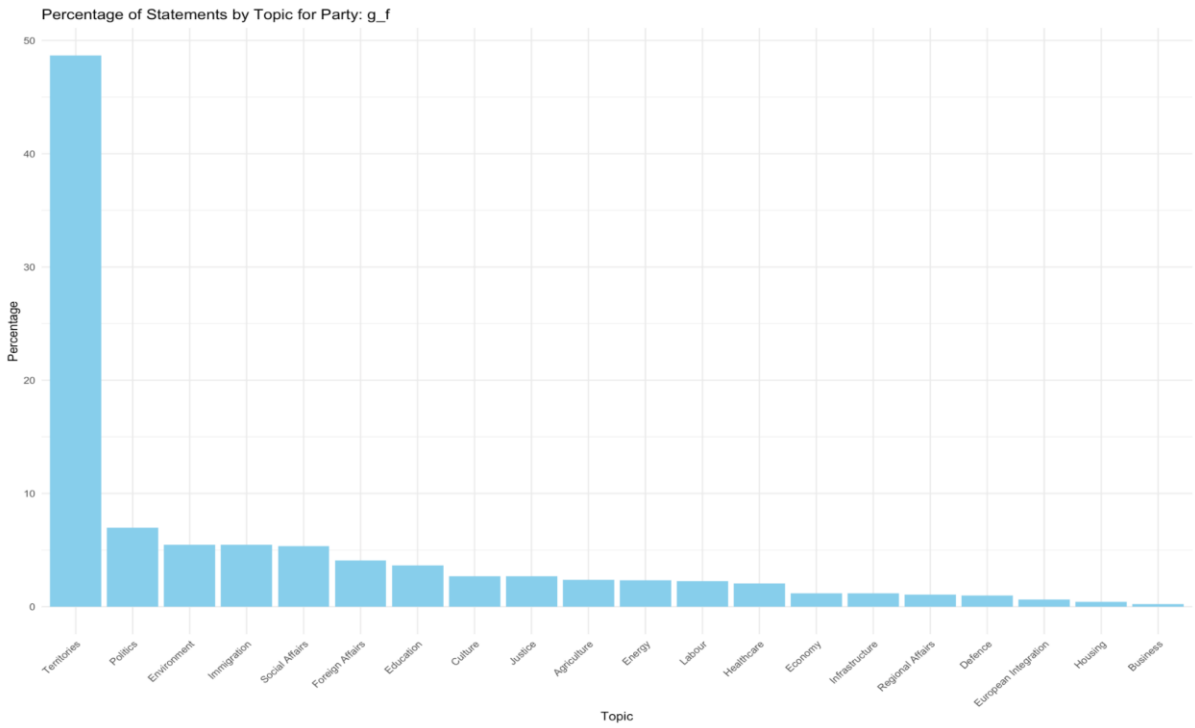
Socialistisk Folkeparti (Socialist People's Party)



Venstre (The Liberal Party)



De Nordatlantiske Mandater (Greenland and the Faroe Islands)



Appendix D: Distribution of ministers by gender and topic