Is Matilda Playing it Safe? Gender in Computational Text Analysis Methods

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Abstract

Numerous studies document the gender gap in published articles in political science journals, observing systematic imbalances in the submission pool which result in a distored publication pattern. In this study we test some pathways that may explain the distorted submission pool: a) playing it safe due to the gender perception gap, and b) as a consequence of the Matilda effect setting a higher bar for methodological knowledge, focusing on papers using Computational Text Analysis methods. Papers using Computational Text Analysis Methods are more likely to be published in journals with a 'masculinized' perception gap. When women are aiming for these journals, they might 'play it safe' by conducting more validation checks than their male colleagues. Moreover, embracing the Matilda effect – i.e. internalizing the systematic under-recognition of female scientists and mis-attribution of, especially methodological skills, to men – women scholars are more likely to indicate that a) there are important training needs in more areas; and b) they themselves need (further) training in computational methods and use these reasons not to publish papers employing these methods. We test these claims using a) a unique content analysis of research articles published in the top 20 journals in communication science, political science, sociology and psychology between 2016 and 2020, identifying all 854 articles that involved some form of quantitative textual analysis; and b) a pre-registered expert survey of all authors of quantitative text analytic research identified via said content analysis, which inquired about researchers' considerations and concerns in the application of computational text analytic strategies.

Keywords: Computational Text Analyses Methods, Gender, Expert Survey

Introduction

The gender gap in the sciences and the social sciences has been debated for decades (Hengel 2017; Huang et al. 2020; Monroe et al. 2008; Welborn and McKenzie 1989). Numerous studies have documented gender disparities in multiple areas of academia. These include publications and citations of both journal articles and books (Young 1995; Teele and Thelen 2017; Samuels and Teele 2021; Ferber and Brün 2011), collaborative projects and co-authorships (Evans and Moulder 2011; König and Ropers 2018), teaching evaluations (MacNell, Driscoll, and Hunt 2015; Mengel, Sauermann, and Zölitz 2018), letters of recommendation (Madera et al. 2019), networking, socialization and mentorship (Barnes and Beaulieu 2017; Alter et al. 2020; Sarkees and Breuning 2010), evaluations of work quality (Knobloch-Westerwick and Glynn 2013), promotion rates (Maliniak et al. 2008; Key and Sumner 2019; Kim and Grofman 2019), status recognition (Alter et al. 2020; Tatalovich and Frendreis 2019), grant awards (Ma et al. 2019; Oliveira et al. 2019) and more. Despite efforts to address these issues and the establishment of dedicated task forces by academic organizations, such gender disparities persist across disciplines (Alter et al. 2020; Dion, Sumner, and Mitchell 2018; Teele and Thelen 2017; Weisshaar 2017). For example, the American Political Science Association's Task Force on Systematic Inequalities in the Discipline published a comprehensive report on January 2022 on the multiple challenges affecting women in the field, discussing many of the above areas of disparity.[1]

Among the various challenges affecting women in the discipline, of particular importance is the gender gap in publication of academic work. Publications are a key element of the profession, serving as both a means to disseminate knowledge and as a metric by which productivity and accomplishments are measured. This metric is then used as a basis for promotion and advancement in the field, making it central for the development of a successful career in academia. Thus, the gender gap in publication of academic work has been the focus of numerous studies over the years, examining a variety of possible explanations for the observed skewed pattern (Breuning et al. 2018; Brown and Samuels 2018; Djupe, Smith, and Sokhey 2019; Hill and Hurley 2022; König and Ropers 2018; Teele and Thelen 2017). Among the various findings in these studies, a common suggestion is that the gender gap in publications can be explained by a distorted submission pool—men publish more papers "simply" because they submit more manuscripts. But why is the submission pool distorted by gender? Some suggest that this

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[1]The full report is available here: https://connect.apsanet.org/sidtaskforce/

is due to skewed employment patterns, women scholars more likely to be employed at teaching-focused institutions (Breuning et al. 2018), or due to other factors like area of study or employed methodology (Hancock, Baum, and Breuning 2013; Key and Sumner 2019). Others suggest a perception gap affecting submissions-some journals are viewed as more "masculinized", resulting in men being more likely to submit their work for consideration at these journals compared to women (Brown et al. 2020). Others still speculate that the gender gap in submissions results from differences in quality standards and self-assessment (Brown et al. 2020; König and Ropers 2018) as well as differences in taught publication strategies through skewed socialization experiences (Brown et al. 2020).

Focusing on the study area of Computational Text Analysis Methods (CTAM), which has grown significantly in the social sciences in recent years, we test two possible pathways that may explain the distort submission pool: a) playing it safe due to the gender perception gap, and b) as a consequence of the Matilda effect setting a higher bar for methodological knowledge. Papers using CTAM are more likely to be published in journals with a 'masculinized' perception gap. When women are aiming for these journals, they might 'play it safe' by conducting more validation checks than their male colleagues. Moreover, embracing the Matilda effect – i.e. internalizing the systematic under-recognition of female scientists and mis-attribution of, especially methodological skills, to men – women scholars are more likely to indicate that a) there are important training needs in more areas; and b) they themselves need (further) training in computational methods and use these reasons not to publish papers employing these methods. In this paper, we are not testing the Matilda effect directly, but we are investigating the consequences in scientific practices due to the long-standing under-recognition of women scholars as well as the active mis-attribution of their skills. We argue that the internalization of this Matilda effect can be observed in wanting more training or time, as this is an observable outcome of other forms of academic socialization that create gender patterns, such as in confidence, risk-taking, and self-valuation. We test these claims using a) a unique content analysis of research articles published in the top 20 journals in communication science, political science, sociology and psychology between 2016 and 2020, identifying all 854 articles that involved some form of quantitative textual analysis; and b) a pre-registered expert survey of all authors of quantitative text analytic research identified via said content analysis, which inquired about researchers' considerations and concerns in

the application of computational text analytic strategies.[2]

Examining authors' gender distribution among the 854 articles using quantitative textual analysis shows a significant gender gap especially in CTAM studies which were authored by 501 male scholars compared to only 209 female scholars. These patterns underlay the importance of an introspective evaluation of what might explain this observed gender gap. Examining the survey data, our findings are slightly optimistic: In social science disciplines where CTAM has become more prevalent, women scholars catch up quickly and we do not see a "play it safe" strategy: Women do not report to conduct much more validation checks when using computational text analyses methods. We do see, however, that in disciplines where CTAM is less of a mainstream method, this strategy is in place. At the same, our findings show various indications of the internalization of the Matilda effect, i.e. the consequences thereof, at play: Women scholars perceive that a lot more effort is required for women to succeed in the profession. This has important downstream consequences for women scholars in their careers: Lower output, out-selecting of grant proposals and team work. To this end, it is important that infrastructure of both training and data acknowledges these gender disparities as well as actively take action, as we see that especially the playing it safe mechanism can be alleviated. This in turn potentially mitigates the influence of the Matilda effect as well.

Gender distortion in the submission pools: A matter of playing it safe?

Numerous studies have examined the gender gap in academic publications, finding both positive and negative associations with various proposed explanations. Breuning et al. (2018), for example, found no supporting evidence for the proposition that women scholars publish less than their male colleagues because of differences in areas of study. Similarly, König and Ropers (2018) did not find support for the proposition that women scholars publish less than their male colleagues because of differences in used research methods, although Teele and Thelen (2017) and Brown and Samuels (2018) did observe such a pattern. Further still, König and Ropers (2018) and Djupe, Smith, and Sokhey (2019) found no evidence that work by women is rejected more frequently than that of men relative to their submission rates, and Breuning et al. (2018), König and Ropers (2018), and Brown and Samuels

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[2]Replication files are available on the corresponding author's Github account

(2018) found no evidence of a gender bias in the editorial process itself. While these explanations can seemingly be ruled out as causes of the gender gap in publications, other explanations do find support. Breuning et al. (2018), for example, found evidence that journal editors exhibit a preference for authors in research-intensive universities, indicating that while some bias exists in the editorial process itself, it is not explicitly gender-based. The most notable finding across these studies is a common suggestion that fundamentally, the gender gap in publications can be explained by a distorted submission pool—that men publish more papers "simply" because they submit more manuscripts (König and Ropers 2018; Brown and Samuels 2018; Breuning et al. 2018).

So what might explain the gender distortion in the submission pools? Few studies offer systematic evidence with which to answer this question, but the literature does offer several speculative explanations. Breuning et al. (2018), for example, speculate that women scholars submit fewer manuscripts for review because they are more likely to be employed at teaching-focused institutions where less value is put on publications. Other studies point to a perception gap affecting submission rates. Brown et al. (2020), for example, argue that some journals, like American Political Science Review, American Journal of Political Science, and Political Analysis are perceived to be "masculinized" with men significantly more likely than women to state that they would submit their manuscripts to these journals. Moreover, men are more likely than women to be optimistic about their chances of successful publication in these journals, a perception that is maintained even when controlling for scholars' methodological approach. Hancock, Baum, and Breuning (2013) (in International Studies) and Key and Sumner (2019) suggest that differences in area of study and/or applied methodology explain the gender gap in submissions, while Djupe, Smith, and Sokhey (2019) find that the gender gap persists within methodological approaches—women who state that their work is primarily quantitative-statistical submit fewer papers for review than their male colleagues. Brown et al. (2020) further speculate that women are also more risk averse than men and are therefore less willing to submit their work to journals with high rejection rates (see Djupe, Smith, and Sokhey (2019) and Key and Sumner (2019) for similar arguments). Djupe, Smith, and Sokhey (2019) also find that male assistant professors "flood" the review process with submissions and receive a higher number of rejections, while König and Ropers (2018), finding a similar pattern, speculate that this may suggest that "male and female authors have different quality standards when submitting their work in the first place..."

(p. 851). Brown et al. (2020) similarly argue in a footnote that "it also could be the case that women scholars are more likely to underestimate the quality of their work and therefore are less likely to submit…" (p. 120, fn 10). Adding to these debates, we propose to look at a different explanation, one that is potentially of large consequences when it comes to employing CTAM.

The Matilda Effect and its Consequences

While it is difficult to determine the root cause of the gender differences in self-perceptions of quality of work and the prospects of successful publication that might lead to a gender submission gap, we suggest that this may be related to the Matthew Effect and its mirror the Matilda Effect. Made famous in the late 1960s by the American sociologist Robert K. Merton, the Matthew Effect refers to the over-recognition of scholars at the top of the scientific profession. This over-recognition is rooted in a cycle wherein those who already have (recognition) gain more of it, while those who have little, will continue to have little. As men have historically been at the top of the scientific profession, the "trickle down" influence of the Matthew Effect can be observed in the gendered patterns discussed above. Thus, while it may indeed be the case that the publication process and its outcomes are not purposefully biased against women scholars, there is nevertheless a systematic gender difference in academic publishing we can trace that is linked to other gendered imbalances in the profession. In particular, co-authored manuscripts are more likely to be published, and the rise in co-authorship is primarily driven by all-male teams (Teele and Thelen 2017). And, even if men and women are equally likely to co-author (Djupe, Smith, and Sokhey 2019), male scholars benefit significantly more from such collaborations in terms of both submissions and publications. Why? Similar to their argument above about differences in publication strategies due to differentiated socialization, Brown et al. (2020, 119) speculate that "something happens to men in their collaborative networks that bolsters their likelihood to submit papers and to resubmit previously rejected papers. Younger male scholars in highly productive collaborative groups may be more likely to receive encouragement for and to develop early habits of frequent article submission. They also may feel more inoculated against the morale-damaging effects of rejection from top-tier journals".

What does it mean that men are more likely than women to collaborate and therefore produce more work for publication? The flip side of this argument is the observation from Brown and Samuels (2018, 329) that "to the extent

that women are less likely to be invited onto a team or form collaborations themselves (perhaps because mentors do not think to encourage them to do so), they are less likely to expand their citation networks, less likely to get cited, and less likely to rise through the ranks…". This, in turn, can be linked we argue, to the mirror of the Matthew Effect—the *Matilda Effect*. Coined by Margaret W. Rossiter in 1993, the Matilda Effect refers to the under-recognition of women in the sciences and the social sciences as well as the the phenomenon that women's work gets attributed to men (Rossiter 1993), which persists across decades. For example, in the early 1990s, Cole and Singer (1991) observed that while there is not much gender difference in achievement levels at the early stages of academic careers, women's careers trajectories are affected more by negative results than those of men. Numerous studies also document gender distortions in citations (Tatalovich and Frendreis 2019; Maliniak, Powers, and Walter 2013; Samuels and Teele 2021; Dion, Sumner, and Mitchell 2018; Ferber and Brün 2011); promotion (Key and Sumner 2019; Kim and Grofman 2019; Maliniak et al. 2008) and visibility on graduate syllabi (Phull, Ciflikli, and Meibauer 2019; Colgan 2016). Tatalovich and Frendreis (2019) further show that while women win more awards today than in the past, they are still unable to match the scholarly recognition men receive for their work.

The focus on and use of computational text analysis has grown significantly in recent years and has taken a prominent place in the study of political texts within the discipline (see for example: Lazer et al. 2020; Salganik 2019). Within computational text analysis, and quantitative research methodology in general, women are particularly underrepresented, studies showing a gender gap across levels in these fields. For example Gatto et al. (2020) found that women, on average, cover significantly fewer methods courses in their graduate training compared to their male colleagues, and that women are more likely than men to complete qualitative methods courses. Barnes (2018) shows that women are less likely to be lecturers in quantitative methods courses. Furthermore, while Gatto et al. (2020) also found that when women do participate in methods training they show similar levels of method employment as their male colleagues, Shannon (2014) and Esarey (2018) found that even when women do use the same methods as men, they are less likely to characterize themselves as methodologists. This echoes findings from Morrow-Jones and Box-Steffensmeier (2014) and Shannon (2014) that women's self-evaluation of math-related qualifications tends to be lower than men's, even when they outperform them. Still further, Teele and Thelen (2017) and Brown and Samuels (2018) show that women are less likely to

publish studies using quantitative and computational methods, Maliniak, Powers, and Walter (2013) making a similar argument in International Relations studies.

Expectatations

Building on the last of these observations and focusing on social science scholarship using computational text analysis methods, we contribute to the debate about possible explanations for a gendered submission gap by proposing two additional explanations: a) playing it safe due to the gender perception gap of journals, and b) In this study we test some pathways that may explain the distorted submission pool: a) playing it safe due to the gender perception gap, and b) as a consequence of the Matilda effect setting a higher bar for methodological knowledge. Papers using CTAM are more likely to be published in journals with a *"masculinized" perception gap*. These are journals that "men are significantly more likely than women to state that they would submit a manuscript and/or be optimistic about their chances of publication" (Brown et al. 2020, 115). Moreover, given that women may tend to also be more risk averse than men (Brown et al. 2020), when women are aiming for these journals, it could be that they "play it safe' ' by conducting more validation checks than their male colleagues. Embracing the idea of the *Matilda effect* – internalizing that a lot more effort is required to women to succeed in academia due to systematic under-recognition and mis-attribution – women scholars are more likely to indicate that a) there are important training needs in more areas; and b) they themselves need (further) training in computational methods and use these reasons to not submit, or submit less work that employs these methods. That is, as women embrace the underlying notion of the Matilda Effect they perceive that they need to work that much harder to prove themselves to be at the same level as men in order to reach at par results. We examine the following hypotheses:

Play it Safe hypothesis (*H1a*): Women scholars are more likely to play it safe and indicate more validation strategies than men scholars.

Play it Safe hypothesis (*H1b*): Women scholars are more likely to play it safe and indicate more challenges as reasons **not** to use CTAM than men scholars.

Matilda effect hypothesis (*H2a*): Women scholars are more likely to indicate a higher number of important training needs than men scholars.

Matilda effect hypothesis (*H2b*): Women scholars are more likely to indicate that they themselves require (further advanced) training than men scholars.

Data & Measures

Building on a content analysis study of published articles conducted by Baden et al. (2021), we conducted an expert survey, inviting all scholars who had published a scientific article using quantitative text analysis between January 2016 and September 2020 in one of the 20 highest ranked journals in Communications, Political Science, Sociology, and Psychology (for more details, see Baden et al. 2021). Quantitative textual analysis was defined broadly to include any form of processing natural language that identified specific kinds of textual contents with the purpose of classification and quantitative analysis. Using a keyword search on the Web of Science, we identified a total of $7,296$ *potentially* relevant articles out of the $45,437$ published articles, whose abstract suggested any kind of textual content or test analytic procedures.[3] Articles were considered relevant as soon as they used any form of quantitative textual analysis, even if it was used merely in an auxiliary capacity (e.g., a content analysis to identify frames to be used in an experiment; sentiment analyses of open-ended survey responses).[4] This keyword-based screening yielded a total of 854 articles, for which the authors were looked up.[5] This gave us $1,653$ identifiable and working email-addresses. The experts were invited to the questionnaire on March 4th of 2021, and received two reminders, each approximately a week after our last message (respectively on March 11th and March 16th of 2021). This yielded a responses of 433 responses (i.e. response rate of 25%). Of these respondents, 142 were male scholars and 243 were female scholars.[6] This

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[3]As discussed in Appendix A of Baden et al. 2021 on which our survey is built, the following keywords were used: "SO="[Journal]" AND AB=(language* OR text* OR discours* OR coverag* OR speech* OR document* OR fram* NOT framework OR content* OR code* OR coding OR classif* OR "big data" OR "machine learning" OR "dictionary" OR "SML" OR "topic model".

[4]Analyses that relied solely on metadata or pre-existing classification were excluded, as were investigations accessing only formal properties of the sampled texts (e.g., length). We included analyses of multi-modal media (e.g., posters, television) as long as the textual contents were informative toward classification. Purely methodological contributions discussing specific potentials or limitations of available methods were excluded, unless they included applied demonstrations wherein actual textual data were processed.

[5]As Baden et al. 2021 note, those 854 articles show an increase in computational methods – from 35 in 2016 to 79 in 2020 – and the amount of manual content analysis stays the same (around 100 each year).

[6]The two respondents who identified with neither gender are left out of this study. For the full questionnaire see Appendix B in Baden et al. 2021 (https://osf.io/ev85x).

means that women were more likely to respond to the survey – 56% in the sample of the survey, where they are only 39% of the author population. The study has been approved by the Research Ethics Review Committee of the *Vrije Universiteit Amsterdam*, *Hebrew University Jerusalem Isreal*, and *University College Dublin*.

To motivate our claim of a gender gap in CTAM, we coded the first four authors of the 854 articles, leading to 1,844 identifiable names. For these names, we hand-coded the gender of the authors — if pronouns were not given, we assumed gender is equally to sex.[7] We identified the author's gender because either the author was known to us, and we therefore knew their gender or we assumed gender based on the picture and if available references in the author's bio (e.g. his/her). The coding identified 1,133 male scholars and 711 female scholars. Breaking this down by the use of CTAM or manual content analysis methods (MTAM)[8], we see that MTAM are used by respectively 502 and 632 female and male scholars, showing a small gender difference. Among studies using CTAM, however, we find a significant gender disparity, this method being used by respectively 209 and 501 female and male scholars. Furthermore, we compare the likelihood of a male author being the first, second, and third author respectively compared to a female author on that position via an independent T-test. We do this for a) the whole sample of articles; b) the articles that use CTAM; and c) the articles that use MTAM.

Figure 1 shows that men are more likely to be first author in the entire sample. This effect is driven by first authorship in CTAM articles, in which men are significantly more likely to be first authors compared to females — the same pattern holding for second and third author. Figure 1 additionally shows that males are more likely to be first and second author in CTAM articles compared to the sample of articles of both CTAM and MTAM. These findings showcase the existence of a gender gap in CTAM, reinforcing our motivation to examine possible explanations for this observed gender gap.

To survey the field on different aspects of potential 'playing it safe' strategies when it comes to CTAM, we have asked participants to list how many of five pre-defined validation strategies[9] they use, as well as if they use other

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[7]We could not use an automated approach, e.g. like the gender R package, as quite some non-European names would not been assigned, leading to a bias in our sample.

[8]This distinction is based on the data coded by Baden et al. 2021.

[9]The pre-defined validation strategies are: 1) *I check the documentation of the software developer*; 2) *I check whether findings are plausible and interpretable*; 3) *I compare machine-made classifications (i.e. coded outputs) against manually coded/given standards*; 4) *I check whether*
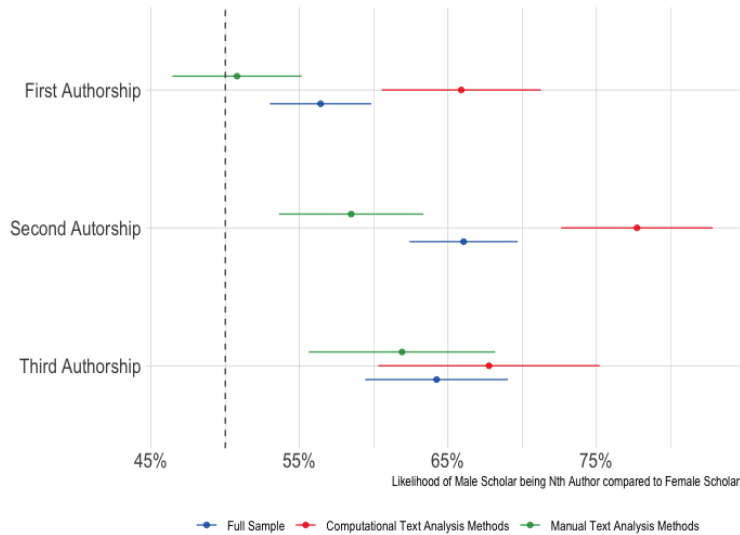
Figure 1: Gender Break-Down of Article Authorship

strategies (open answer possibility).[10] Additionally, we asked participants to what extent 15 pre-defined reasons were a relevant challenge for them in de-ciding to *not* to use CTAM.[11] Answer options where no `challenge`, `minor`

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the classification rules/criteria are valid (e.g., check for meaningful indicators in adictionary); and 5) *I evaluate how well the algorithmic procedures match my concept of interest (e.g., checking adequacy of bag-of-words assumption).*

[10]There are different strategies as to how someone can play it safe. The big difference of CTAM compared to MTAM is the amount of control the researcher has over the process. Where MTAM is determined by the researcher, e.g. by making a codebook, and the validation thereof is formalized by a reliability test (Krippendorff 2013), which is then used in full control of the author to process and analyse texts, the same is not case when CTAM are used. In the case of CTAM, the validation process is less clear for unsupervised methods, the standards are not quite set (Baden et al. 2021), and there is less control by the researcher to fully understand what the algorithm is doing. This makes it possible to fiddle around with alternatives until the measurement is "good enough".

[11]The pre-defined challenges are: 1) *Time/effort required (e.g. technical requirements, ex-perience)*; 2) *Funding required (e.g., for training, fees)*; 3) *Availability of required training in computational methods*; 4) *Limited methodological guidance/documentation of tools*; 5) *Level of instruction and materials higher than needed*; 6) *Level of instruction/materials lower than needed*; 7) *Availability of suitable computational tools for certain languages*; 8) *Comparability of computational tools in different languages*; 9) *Issues concerning measurement validity/limited nuance*; 10) *Loss of manual contact with the material*; 11) *Reviewers'/editors' ' skepticism toward*

`challenge`, `major challenge`. Examining whether there exists a gender gap in the extent of reported challenged, we analyze whether women more than men report major challenges compared to minor challenges controlled for the other variables we use in the study as controls. As Figure 3 shows, female scholars are more likely to report challenges as major compared to male scholars. Additional T-tests confirm this as shown in Figure 4, where even the average scores are statistically significant for the challenges: Time required, Limited methodological guidance/documentation of tools, Level of available instruction/materials higher than needed, Funding required, Availability of suitable computational tools for specific measurement purposes, and Availability of required training. This could be another indication for women scholars either playing it safe or internalizing the Matilda effect.

In the main analyses, we grouped minor and major challenges together and compared them to no challenges reported. To gauge a possible influence of the 'Matilda effect', we asked our experts to list if the field in general needs more training possibilities when it comes to data and open access tools, programming and software skills, theory and concepts, research integrity and ethics, or other training skills – for each option there was the possibility to specify what was needed. Moreover, we also asked respondents if they themselves need more training. In all our analyses, we control for whether or not the respondent uses CTAM themselves, the types of content analyses they use in their work, and their pre-existing knowledge of statistical software. Figure 2 shows the gender break-down in our sample for the dependent variables as well as the control variables. While the descriptive statistics (average and standard deviation) do not show statistically significant gender differences, we do see in the top-right panel that men in our sample are over-represented. Yet where we have roughly the same amount of women scholars using CTAM as not using CTAM (i.e. using quantitative or qualitative manual content analysis), our sample has more men scholars using CTAM than not using CTAM. Moreover, the top-left panel shows that men report fewer challenges for uptaking computational methods than women do.

Is Matilda Playing it Safe?

To test our pre-registered hypotheses, we ran a OLS regression and visualize the results in Figure 5 and 6 with an one-tailed α of `0.05`. Looking at

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computational methods among; 12) *Peers' skepticism toward computational methods*; 13) *I am skeptical toward computational methods myself*; and 14) *Other challenges: (Open ended).*

the variables measuring 'playing it safe' strategies, i.e. reporting number of validation strategies and number of challenges, Figure 5 demonstrates that women scholars do not report more validation strategies than men. However, women that use qualitative methods report to use less validation strategies. This can potentially be explained by the fact that qualitative text analysis involves fewer validation strategies. In the top-left panel of Figure 6, we inspect the gender differences in the type of validation strategies reported. This shows that the only strategy women scholars are statistically significantly less likely to report compared to men scholars is checking the documentation of the software developer. In the Research Software Community, there is a recent uptake on addressing inclusiveness to address this disparity (e.g. see, Gruber and Velden (2023)). Women scholars are more likely to report to use the validation strategies of checking algorithmic procedures and checking against the gold standard. This is only borderline non-significant, most likely due to the small number of women in our sample. For the other playing it safe strategy – i.e. number of challenges reported – Figure 5 shows that women scholars are more likely to report challenges, but this effect is not statistically significant. Breaking down the challenges, shown in the right-hand panel of Figure 6, does demonstrate an interesting gender pattern. Women are more likely to report time/effort, funding, and training needs as well as limited methodological guidance of the tools as a challenge to not using CTAM. Men scholars, however, are more taken back by peers' and editors' skepticism towards the method (as also shown in 3 and 4). This is a mild indication of the consequences of the Matilda Effect's influence at play: Men, more likely to be confident of being recognized for their work, place a higher premium on peer perception while women, taken in by the Matilda Effect, think a lot more effort is required of them to be successful.
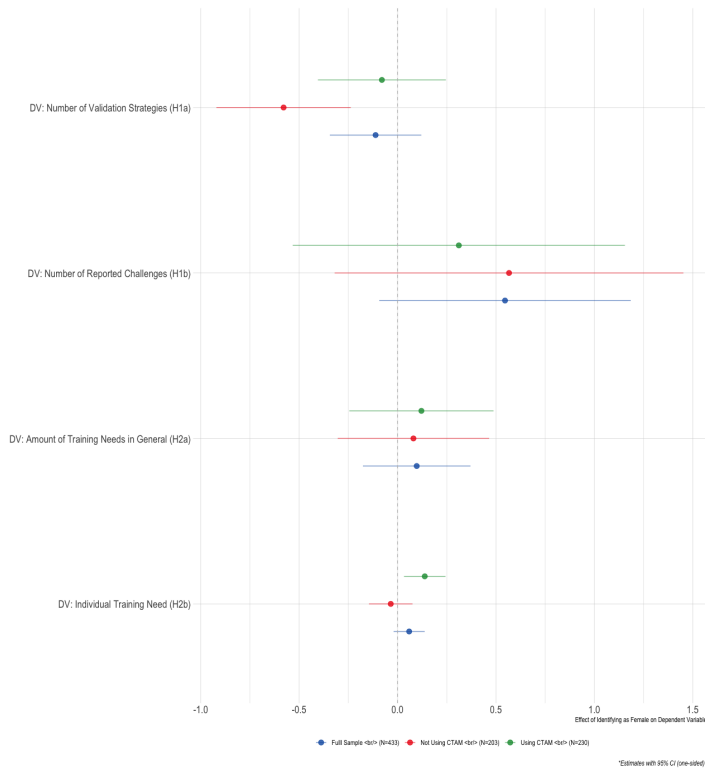
Figure 5: Effect of Being Female on Reported Validation Strategies, Challenges, and Training Needs

Investigating the possible consequences of the Matilda effect further, Figure 5 demonstrates that women scholars are also more likely to report more training needs, but this effect is not statistically significant. Looking at the type of training needs in the bottom-left panel of Figure 6, we see that the insignificance of the aggregated training needs stems from women using CTAM and using manual content analysis reporting opposite needs: Women in CTAM report general needs for training in research integrity and ethics as well as for training in concepts, whereas women not using CTAM report general training needs for programming and software skills as well as for data and open access tools. Importantly, when it comes to individual training needs, women scholars using CTAM do report they need more training compared to men scholars using CTAM. This can serve as an indication of consequences of the Matilda Effect at work, given that research suggest that

women are less likely to be invited on projects (Evans and Moulder 2011; König and Ropers 2018). Using the data of Baden et al. (2021), we see that women are less likely to be first author – 47% of published papers on text analysis have an author with a female first name. An independent `t-test` confirms that this difference is statistically significant. The same holds for second and third authors – they are statistically significant more likely to be male. This could lead to the perception that *if one had more training*, one would be asked to join projects too.
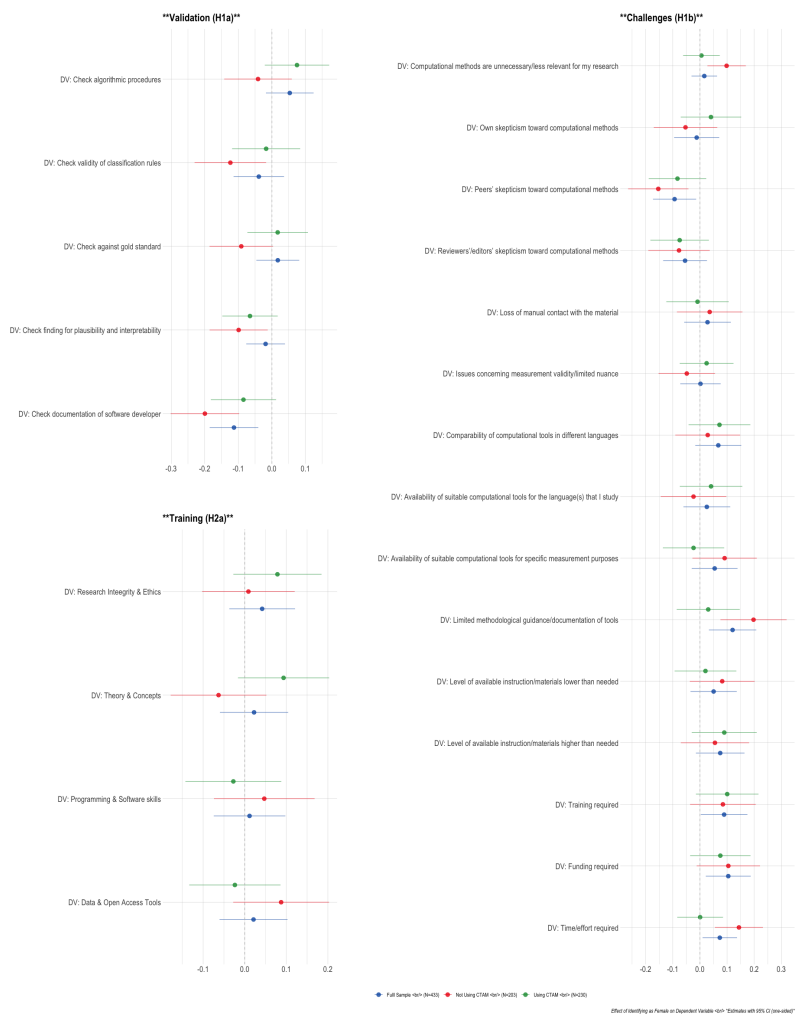
Figure 6: Effect of Being Female on Reported Type of Validation Strategies, Challenges, and Training Needs

In addition to the pre-registered effects, we explored the interaction with discipline and stage of the career of scholars, as demonstrated in Figure 7. The left-hand panel of Figure 7 shows that compared to communication and political science, the other disciplines (grouping sociology, psychology, and economy), where computational methods were less common, we see support for both our playing it safe and Matilda effect hypotheses. This

can be optimistically interpreted: When CTAM is more prevalent in the discipline, women scholars catch up quickly. The right-hand panel of Figure 7 demonstrates that none of the reported results are driven by a particular career stage of scholars.

Figure 7: Marginal Effect of Being Female on Reported Validation Strategies, Challenges, and Training Needs

Discussion

This article presents an analysis of recently collected data from a pre-registered expert survey of all authors of quantitative text analytic research identified via a unique content analysis of research articles published in the top 20 journals in communication science, political science, sociology and psychology between 2016 and 2020 (`N = 854 articles`). Using these data, our aim was to understand whether and how using CTAM differs between men and women scholars. According to the existing literature, gender gaps in methods training and applications can have broader consequences for academic careers. Examining authors' gender distribution among the 854 articles using quantitative textual analysis shows a significant gender gap especially in CTAM studies which were authored by 501 male scholars compared to only 209 female scholars. These patterns underlay the importance of an introspective evaluation of what might explain this observed gender gap. Examining the survey data, we find that women are more likely to report as major challenges to use of CTAM time/effort, funding, and training needs and limited methodological guidance while men are more concerned by peers' and editors' skepticism towards the method. Furthermore, and especially when it comes to individual training needs, women scholars using CTAM report they need more training compared to men scholars using CTAM. We argue that these can serve as an indication of the consequences of the Matilda Effect at work and support our assumption for a gender submission gap. It is important to note that we have conducted a very hard test: Women that have published on and are engaged with text analyses methods. This group is a least-likely group for whom gender disparities should occur, since they have supposedly surpassed our assumption regarding a gendered submission gap - they have published work using text analysis (both computational and manual). They have thus also surpassed the expectation of discrimination which already influences women's decision to submit manuscripts or not (König and Ropers 2018) – i.e. these are women that have submitted and went through the review-process are based on a particular self-selected sample. It is therefore remarkable and telling that even in this curated sample, we still find some indications for the fact that women have internalized the Matilda effect and adapted their scientific practices as such. That said, our findings our slightly optimistic: We show that for the "playing it safe" strategy, there are no statistically significant differences between men and women for the whole sample. When we split the sample according to disciplines, we see that in the disciplines where CTAM is more or less

mainstream, the main conclusion holds. In disciplines where this is not the case, women play it safe. This aligns with Hill and Hurley (2022)'s finding that time in the profession is crucial for publication gaps, albeit the fact that men especially benefit from this cohort effect compared to women. Possible, when CTAM is more embedded in the discipline, the gender imbalance is not as apparent anymore. Men traditionally benefit more from collaborations (e.g. see Djupe, Smith, and Sokhey 2019), especially at the early career stage which is arguably crucial in influencing retention in the profession. We do not see that this relationship is rank dependent, while rank is typically something that alleviates the gender difference in the submission process (Brown and Samuels 2018). That is great news, since the early career stage is arguably crucial in influencing retention in the profession.

Looking deeper into how women play it safe, we see that women are more likely to check if what they do computationally is in line with what the program/algorithm says it does. However, they are less likely to check "under the hood" of the used program. In similar vein, the biggest challenges for women not to use CTAM are a) the limited methodological guidance and documentation of the software; and b) the time one has to invest – supposedly – to learn these methods. This ties in with the work on socialization into the profession: "[D]ecisions about where to submit, how often-and whether and where to submit... tend to be shaped by interpersonal contacts and information communicated through social networks, as well as habits acquired through collaborative relationships, which often differ by gender" (Brown et al. 2020, 119). Additionally, this finding about women's biggest challenges collides with the Matilda Effect findings: Women report to be held back by things that seem technical and therefore would cost them a lot of effort.

Our results do indicate the consequences of a Matilda effect at work: Women report that there are in general enough training offered, but that *they* would need more training before up-taking these methods. This could align with (perceived) success they have had publishing papers using CTAM or just attempting to apply these methods. Previous success creates both a sense of accomplishment and achievement that fosters confidence in future success as well as leads to actual success, since more publications result in a more successful career. If men experience this more than women over time (the combined influence of the Matthew and the Matilda effects), and men are at the heart of the networks that socialize yet more men into the same perceptions and attitudes, there perpetuates an environment that is ultimately more supportive of the successful development of men's aca-

demic careers than women's. That is, the under-recognition of women's work results, whether purposefully or not, in the perception that a lot more effort is required for women to succeed in the profession.

Our findings especially underline the persistence of the Matilda Effect in academic work. The under-recognition of women in the sciences and the social sciences (Rossiter 1993), endures across decades. Even if this is mitigate in recent years, where women are more recognized vis-à-vis the past, they are still unable to match the scholarly recognition men receive for their work (Tatalovich and Frendreis 2019). It is therefore of utmost importance that data and training infrastructure projects take gender disparities, especially those coming from long gendered history serious and accommodate alleviation strategies.

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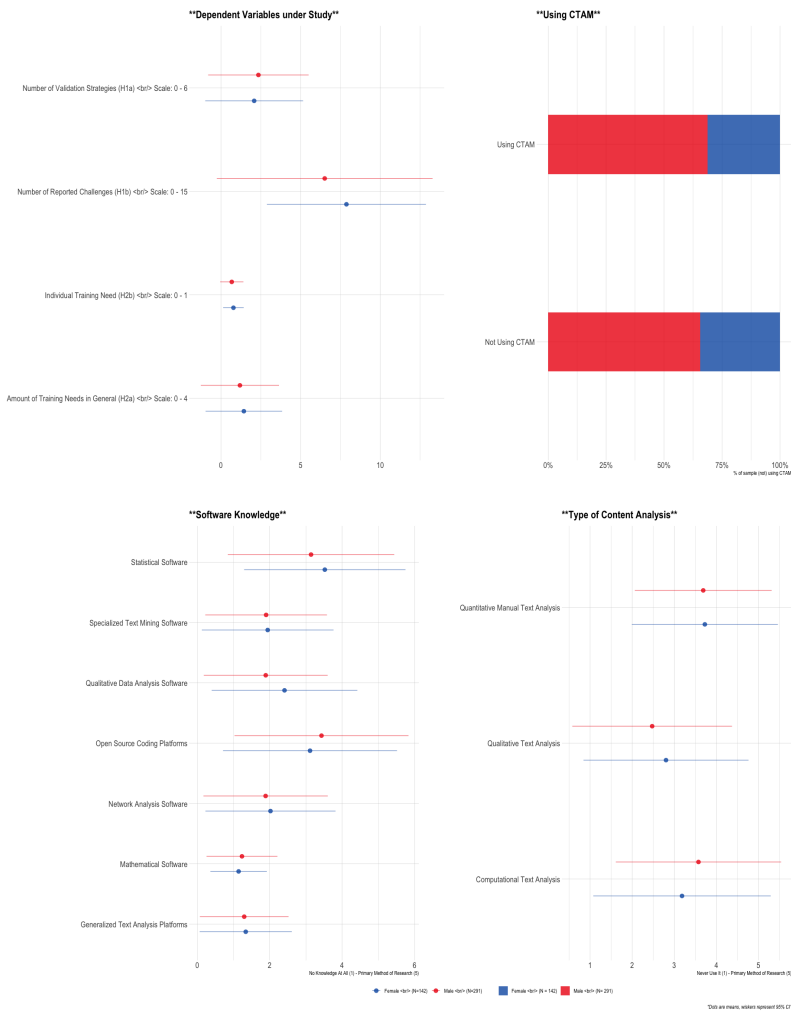
Figure 2: Gender Break-Down in Variables under Study
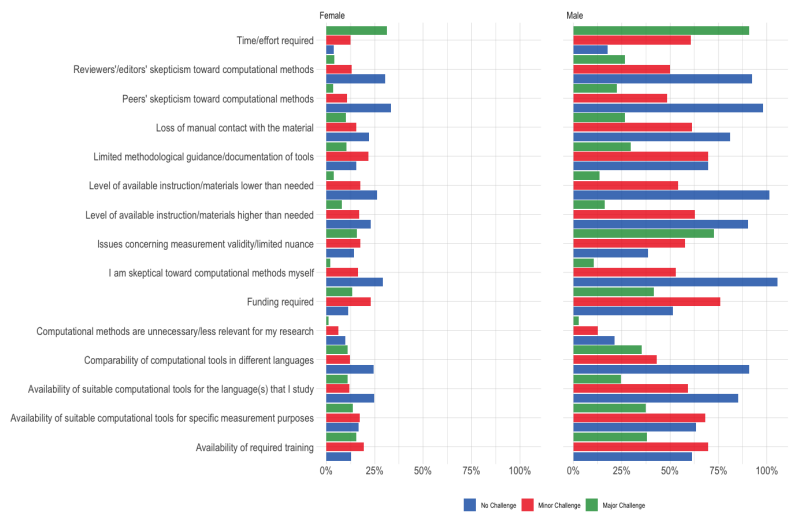
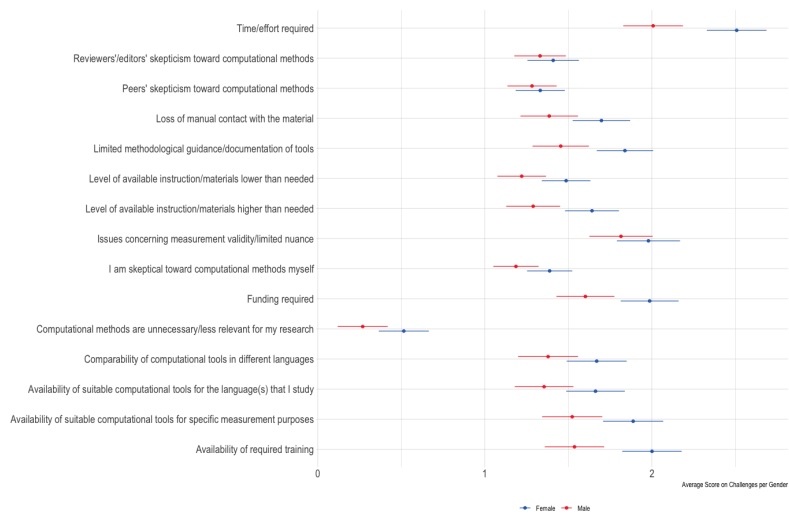Figure 3: Challenges relevant to scholars' decition to not use CTAM

Figure 4: Challenges relevant to scholars' decition to not use CTAM