https://doi.org/10.51408/issi2025_014

Gender Differences in Research Methods: Insights from Chinese Humanities and Social Sciences PhD Dissertations

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Abstract

Research on gender differences has long been a prominent focus in academia. However, prior studies on gender disparities in research method selection have primarily concentrated on specific disciplines, lacking a comprehensive examination across the broader humanities and social sciences. This study addresses this gap by using Chinese humanities and social sciences as a case study, analyzing 63,742 PhD dissertations across 15 fields. After organizing the data and removing duplicates, 36 research methods were identified. A combination of large language models (LLMs) integration and manual retrieval was employed to detect the gender of PhD students and their supervisors. The findings reveal that 17 of the 36 research methods were strongly associated with the author's gender: male authors were more likely to employ summative theoretical construction methods, while female authors showed a preference for real-time data acquisition and analysis methods. Furthermore, significant differences were observed in the diversity of research methods used by supervisors based on gender, with female supervisors demonstrating a greater tendency toward methodological diversity. However, no significant relationship was found between the gender of PhD students and the diversity of research methods used. Dyadic analysis further highlighted that specific gender combinations significantly influenced preferences for particular research methods.

Introduction

In academic research, gender, as a critical variable, has attracted considerable attention due to the differences it generates (Bem, 1993; Eberhardt et al., 2023). Within the humanities and social sciences, gender plays a significant role throughout various stages of research, including project funding, paper publication, and domains such as the labor market, education, and politics. These gender differences are pervasive and have profound impacts (Allum, 2014; Ceci & Williams, 2011; Dolan, 2011). The selection and application of research methods, as a cornerstone of academic research, are also influenced by gender. Evidence indicates a correlation between the author's gender and their choice of research methods (Diaz-Kope et al., 2019; Williams et al., 2018).

However, while the influence of researchers' gender on research method selection has been explored within specific disciplines, there remains a notable gap of research across the entire field of humanities and social sciences (Ashmos Plowman & Smith, 2011; Grant et al., 1987; Nunkoo et al., 2020). Examining gender differences in research method selection within these fields is essential for understanding academic research patterns and promoting the development of academic equity and diversity.

In gender-focused research, direct access to gender information of individuals is often unavailable, necessitating encoding based on names. Two empirically tested methods are widely used for this purpose: manual coding (Rajkó et al., 2023) and computational coding (Sebo, 2021b). While manual coding can be accurate, it is inefficient for large datasets, requiring significant time and resources, and limiting applicability and reliability. The emergence of large language models (LLMs) like ChatGPT provides a new avenue for gender inference, potentially addressing the shortcomings of traditional manual methods (Goyanes et al., 2024). However, existing limitations in LLMs, such as varying performance with different languages and uncommon names (Santamaría & Mihaljević, 2018), highlight the need for integrated approaches to improve gender inference accuracy. Strategies such as majority voting among multiple models and incorporating auxiliary information, such as institutional and disciplinary affiliations, have been proposed to enhance performance.

Given the lack of comprehensive research on gender differences in the selection of research methods among PhD students across the humanities and social sciences, and leveraging the capabilities of LLMs for gender inference, this study utilizes Chinese PhD dissertations as a corpus to explore gender differences in research method selection and their influencing factors. A combination of automated LLM-based inference and manual review was employed to improve the accuracy of gender detection for authors and supervisors. Statistical methods were then applied to analyze the relationship between gender and research method selection. This study aims to address the following research questions:

RQ1: What specific gender differences exist in the selection of research methods among PhD students and their supervisors in the humanities and social sciences?

RQ2: Does the gender of supervisors influence the gender differences in research method selection among PhD students, and if so, how does this influence manifest?

Related Work

In the humanities and social sciences, many scholars have explored gender differences from various angles. Although existing research has revealed gender differences in research topic selection, academic output and academic influence, there is still a lack of comprehensive research on gender differences in research method selection across the entire field. While some achievements have been made, limitations remain, and future research needs to delve deeper to fully understand the impact of gender on academic research method selection.

Gender differences in academia

In the humanities and social sciences, gender differences in academic research are an important topic, and many scholars have explored the manifestations of gender differences in academia from different perspectives. First, in terms of research topic selection tendencies, Kim et al.(2022) found that male and female scholars have distinct preferences in research topic selection. Female scholars tend to choose topics that focus on the rights of vulnerable groups and the coordination of social relationships, while male scholars prefer topics related to macro social structures, political systems, and economic development. Leahey(2006)found that female research projects are broader, spanning multiple subfields, while males tend to focus on fewer subfields, based on cumulative publications and unique keyword descriptors. Additionally, Zhang et al.(2021) pointed out that males focus more on scientific progress, while females pay more attention to social contributions, concluding that papers aimed at scientific progress have higher citation rates, while those aimed at social contributions have higher online reading rates. Second, in terms of gender differences in academic output, Male scholars submit more frequently to high-impact journals, while female scholars, being more cautious and setting higher standards, submit less often(Isabel et al., 2023).Specifically, female graduate students publish on average 8.5% fewer papers than male graduate students(Pezzoni et al., 2016). Among researchers of different age groups, the gender differences in research productivity also vary: among senior researchers, males generally have higher publication and citation counts than females, while among younger researchers, female participation has significantly increased, with publication and citation counts comparable to or even surpassing those of males, especially in high-impact research groups(Van Arensbergen et al., 2012). Finally, in terms of gender differences in the influence of academic achievements, the "Matthew Effect" is evident in academic citations(Dion et al., 2018).Gender bias in citation practices is prevalent in multiple disciplines such as political science and economics(Ferber & Brün, 2011; Maliniak et al., 2013).Jayabalasingham(2020)

found that although the overall average Field-Weighted Citation Impact (FWCI) ratio is close to 1, at the first-author level, males in most countries have a higher average FWCI than females.

Research methods in the humanities and social sciences

Research methods encompass the various means, techniques, and approaches used by scholars in the research process to explore and solve research problems scientifically, thereby obtaining reliable knowledge and conclusions(Trochim & Donnelly, 2001).

The classification of research methods in academic papers mainly includes manual classification and computer-automated classification(Chu & Ke, 2017; Eckle-Kohler et al., 2013). Early research primarily used manual classification to systematically sort, compare, and scientifically summarize the research methods used in different disciplines, such as sociology, library and information science, and management information systems, thereby constructing classification systems with universal applicability and disciplinary specificity(Chu & Ke, 2017; Palvia et al., 2003; Peritz, 1983). Manual classification relies on expert knowledge, ensuring high classification accuracy, and is suitable for research tasks requiring high classification accuracy and small data scales. However, manual classification is time-consuming and labor-intensive, and the scale of annotation is difficult to expand. As the number of research literature increases, manual classification struggles to meet the demands of large-scale data processing. With the development of machine learning technologies, computer-automated classification methods have gradually emerged. For example, in the field of Library and Information Science (LIS), Chu(2015) considered data collection and analysis techniques as the two core elements of research methods and classified research methods based on data collection techniques, dividing LIS research methods into 16 categories, including bibliometrics, content analysis, and the Delphi method. Zhang et al.(2021) developed rule-based methods for automatically identifying research methods in this field through content analysis and text mining. Zhang & Tian(2023) used deep learning models to automatically classify research methods in LIS.

Each discipline selects appropriate research methods based on its research characteristics and needs to better solve research problems within the discipline. Research has found that scholars in library and information science now use a greater variety of research methods than before, with content analysis, experiments, and theoretical methods replacing the previously dominant survey and historical research methods(Chu, 2015).

Overview of research on method selection from a gender difference perspective

In academic research, the selection of research methods is one of the key factors influencing research outcomes, and whether gender affects research method selection has long been a topic of interest. Many scholars have explored this issue from different disciplinary perspectives, aiming to reveal the intrinsic relationship between gender and research method selection.

Grant et al. (1987) conducted a stratified random sampling study of 856 articles from 10 sociology journals between 1974 and 1983 and found that, regardless of the article's topic, female authors used qualitative methods more frequently than male authors. However, in articles related to gender topics, both male and female authors used quantitative methods more frequently than in non-gender articles. Dunn & Waller (2000)found males prefer secondary data and quantitative methods, while female authors were more likely to collect data through interviews and publish articles that did not include statistical analysis. Ashmos Plowman & Smith(2011) analyzed articles from four top management journals (1986-2008) and found female authors were significantly more represented in qualitative than non-qualitative research. Diaz-Kope et al.(2019)studied U.S. public affairs PhD programs and found that while males preferred quantitative methods and females leaned toward qualitative ones, females still chose quantitative methods more often. This indicates that the relationship between gender and research methods is not isolated but influenced by multiple external factors. Zhang et al. (2023) analyzed 5,281 articles from three top library and information science journals (1990-2019) and found significant gender differences in research methods. Specifically, female authors used interviews, surveys, and observations more frequently, while male authors preferred bibliometrics and theoretical methods. Thelwall et al. (2019) studied scholarly papers across various disciplines in the United States in 2017 and found that females were more likely to use exploratory and qualitative methods, while males preferred quantitative methods.

In summary, gender differences exist in academic research within the humanities and social sciences. Existing research on gender differences has demonstrated notable findings in areas such as topic selection, academic output, and influence. However, there is still a lack of comprehensive studies on gender differences in research method selection in the whole field. This paper will focus on this issue, construct a theoretical framework, and promote academic fairness and diversity.

Data and Methodology

This paper uses PhD dissertations in the humanities and social sciences field as a corpus and combines LLMs with manual retrieval as the main research methods.

The research framework of this paper is shown in Figure 1. First, journal paper databases and a corpus of over 60,000 PhD dissertations were collected, and gender matching was performed based on the "name + institution" rule. Then, LLMs were used to infer the gender of unmatched names, and the detection results were integrated, with manual retrieval for uncertain names. Finally, the gender information of PhD students and their supervisors was integrated, and correlation analysis was conducted to explore the relationship between gender and research method selection and its influencing factors.

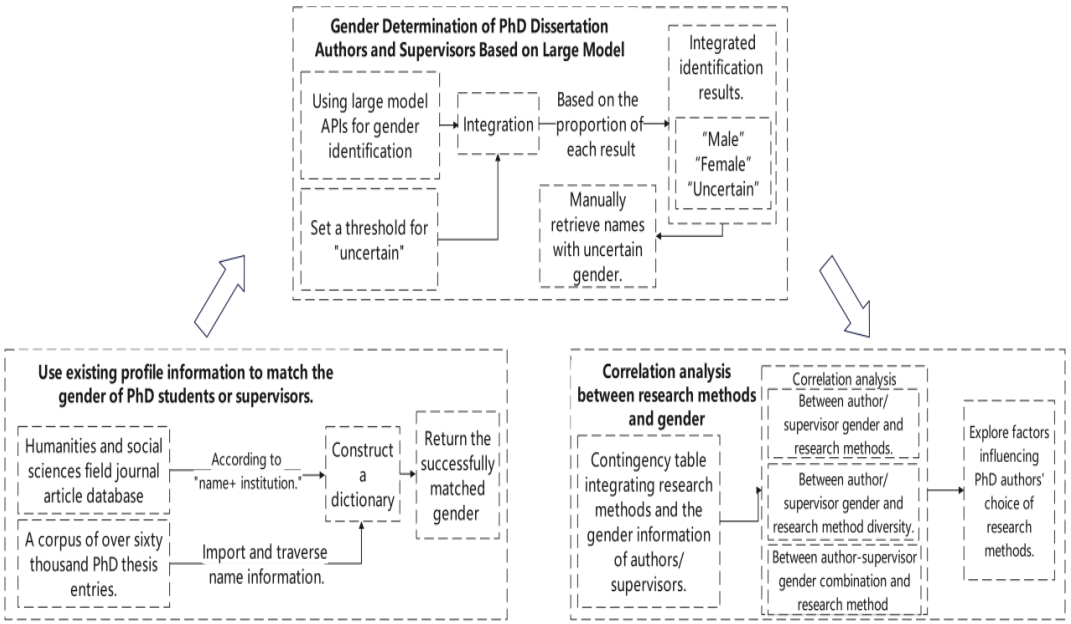

Figure 1. Framework of this study.

Dataset

The goal of this paper is to explore the manifestation of gender differences in research method selection and the underlying influencing factors by using LLMs to automatically infer the gender of authors and their supervisors in Chinese humanities and social sciences PhD dissertations. For this purpose, based on the humanities and social sciences subject catalog established by other scholars, this paper systematically collected 63,741 PhD dissertation information from 1989 to 2020 from universities across the country. Each piece of information includes the dissertation title, publication year, author's name, author's primary discipline, author's institution, supervisor's name, and research methods extracted from the dissertation's research methods section. The research methods were recorded according to the classification framework of the humanities and social sciences

field constructed by Zhang & Chu (2024). The number of samples in each discipline is shown in Table 1. After sorting and removing duplicates from the research methods of over 60,000 dissertations, 36 research methods were involved in 63,742 dissertations. The corpus used in this paper has a time span, sample size, and wide coverage of disciplines and regions, which improves the applicability of this research in different time periods and regions and its representativeness in the entire humanities and social sciences field.

Table 1. Primary Disciplines and Sample Sizes in the Chinese Humanities and Social Sciences.

Discipline	*Primary Discipline*	*#Secondary Disciplines*	*#Paper*
Philosophy	Philosophy	9	1998
Economics	Economics	20	11776
Law	Law	10	4305
Political Science	Political Science	9	2927
Sociology	Sociology	5	896
Ethnology	Ethnology	4	634
Marxism	Marxist Theory	6	3289
Educational Science	Educational Science	11	3080
Psychology	Psychology	4	704
Sports Science	Sports Science	5	1973
Literature	Chinese Language and Literature	9	5152
	Foreign language and Literature	9	1133
Journalism and Communication	Journalism and Communication	3	586
Artistic Discipline	Artistic Discipline	8	1305
Historical Science	Historical Science	11	3009
Management	Management Science and Engineering	1	7867
	Business Administration	7	6458
	Agroforestry Economic Management	2	3560
	Public Administration	6	2547
	Library and Information Science and Archival Management	6	542

Methodology

This paper addresses the gender detection of the collected corpus of over 60,000 PhD students and their supervisors, which lacks gender information. Since LLMs alone cannot guarantee high accuracy, gender information is first matched based on "name + institution" rule using existing databases to obtain some reliable gender information. Then, multiple platforms and eight LLMs are used for automatic gender detection and integration, with thresholds set to improve accuracy. Finally, manual retrieval is conducted for names with uncertain gender. At the same time, the correlation between gender and research methodology is analyzed by chi-square test and Mann-Whitney U test in terms of doctoral students, supervisors and their gender combinations to provide support for the subsequent research.

Gender Detection of Thesis Authors and Their Supervisors: This paper collected a corpus of over 60,000 records containing the names of PhD students and their supervisors, but the corpus only includes name information and lacks corresponding gender information, which needs to be supplemented. Since LLMs provide gender probabilities based on extensive data, the detection results have a certain degree of uncertainty. However, the gender obtained by matching the names of dissertation authors and their supervisors based on existing databases is highly reliable. Therefore, this paper first uses existing databases to match the gender of dissertation authors and their supervisors, and considers the gender of the matched part to be correct. The names of PhD students or supervisors that are successfully matched are filtered out from the corpus, and the remaining names are handed over to LLMs for automatic gender detection. This reduces the number of names for which LLMs perform gender detection, indirectly improving the accuracy of the gender detection process. The gender detection steps are as follows:

Step 1. Gender matching of PhD students or supervisors using existing databases

This paper first uses PhD journal paper information databases for various disciplines to match the gender of the 60,000 PhD students and their supervisors in the corpus. The PhD journal paper information databases for various disciplines are formed by researchers screening PhD dissertation information from academic databases, extracting and organizing relevant content such as authors, instructors and titles for subsequent academic research analysis, including author and supervisor profile information, as well as "name-gender" columns for authors and supervisors.

This paper uses Python code to compare and match the PhD journal paper

information databases with the corpus, thereby supplementing the gender information contained in the journal paper information databases into the name-only corpus used in this paper. The matching strategy is based on the rule that "name + institution" coincide simultaneously: first, a nested dictionary {name: {institution: gender}} is created from the journal paper information database; then, the author (supervisor) name information from the corpus is imported, and the return value after traversing the dictionary is the gender of the author(supervisor) at that institution. The matching success criteria is: if and only if the author's name exists and the institution in the corpus is included by the information of the institution in the journal paper, the gender result corresponding to that name will be returned. Ultimately, 10,153 author names were successfully matched, accounting for 15.09% of the total, and 37,516 supervisor names were successfully matched, accounting for 55.76% of the total, as shown in Table 2.

Since this step uses information from journal paper information databases, it is more convincing and credible, and can quickly and accurately obtain gender information for names.

Table 2. Name-Gender Information Matching for Authors and Supervisors.

Category	*#Successful Matches*	*Success Rate*
PhD Students	10,153	15.09%
Supervisors	37,516	55.76%

Step 2. Gender Inference and Integration of PhD Dissertation Authors and Supervisors Based on LLMs

Following the above steps of gender matching using the existing databases, the gender information obtained from the matching is filtered out. Then the remaining data without gender information is automatically inferred and integrated based on name information. This study innovatively adopts a LLMs integration approach for author gender detection, because of the particular challenges of Chinese name recognition and the limitations of existing methods. Existing studies have shown (Sebo, 2021a), that Chinese names lack explicit gender markers (e.g., western name suffixes), and the accuracy of traditional methods drops significantly when dealing with rare surnames or polyphonic characters. For example, the international platform Genderize.io recognizes Chinese pinyin with an accuracy of only 73.77% and is unable to deal with the ambiguity of polysyllabic characters. In contrast, LLMs learn the massive Chinese corpus such as ACL conference papers, and is

able to infer names by combining their cultural background and regional characteristics, and reduces the uncertainty rate from 18.7% to 12.5% by the integration strategy(Zhang et al., 2023).

The automatic inference and integration are divided into two steps:

First, suitable tools are selected from numerous automatic gender detection tools. The "name2gender"[1] project in GitHub and the Genderize.io[2] platform were chosen. The "name2gender" project is a model for inferring gender from Chinese names based on LSTM. It utilizes the ccnc.csv and train.csv datasets containing names and corresponding genders. Data reading and preprocessing are handled by functions in the utils.py file. The model definition is in the name2gender.py file, including the Embedding layer, Dropout layer, LSTM layer, fully connected layer, ReLU activation function and Softmax layer. Model training is conducted using PyTorch's optimizer and loss function in finetune.py. Gender prediction for input names is performed in main.py.

For LLMs, priority was given to models provided by leading domestic internet companies. These companies are at the forefront of technological innovation and data processing, including Alibaba, Baidu, and 360. All of these companies are renowned for their strong technical capabilities and extensive industry influence. In addition to industry-leading LLMs, contributions from the academic field were also considered. Consequently, models with academic backgrounds and research foundations, such as Qingyan and ChatGLM, were selected. These models not only have a good reputation in academia but also demonstrate excellent performance in specific field applications. Ultimately, it was decided to use two platforms and eight LLMs, including 360 Brain[3], ERNIE Bot[4], Baichuan[5], Qwen[6], Skywork[7], Qingyan[8], Doubao[9] and ChatGLM[10], for testing. APIs from each platform were invoked, and the previously matched 10,000+ PhD student author "name-gender" information was used as a detection sample, with 5,000 samples randomly selected for inference. The successfully matched "name-gender" results were used as reference answers to compare with the inference results of automatic gender detection tools.

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1 https://github.com/AlphaINF/name2gender.
2 https://genderize.io/our-data.
3 https://api.360.cn/v1/chat/completions.
4 https://aip.baidubce.com/rpc/2.0/ai_custom/v1/wenxinworkshop/chat/completions_pro.
5 https://api.baichuan-ai.com/v1/chat/completions.
6 https://dashscope.aliyuncs.com/compatible-mode/v1.
7 https://github.com/SkyworkAI/Skywork.
8 https://open.bigmodel.cn/api/paas/v4/chat/completions.
9 https://github.com/volcengine/volcengine-python-sdk.
10 https://aip.baidubce.com/rpc/2.0/ai_custom/v1/wenxinworkshop/chat/chatglm2_6b_32k.

The selection of automatic gender detection tools mainly considered two factors: inference accuracy and the manual retrieval proportion. In this research, the manual retrieval proportion is the percentage of names whose gender probabilities output by the model fall below the preset threshold and can't be automatically inference. The performance comparison results are shown in Table 3. After multiple automatic inferences and comparisons with correct gender information, it was found that the Genderize.io platform cannot recognize Chinese characters and is mainly used for recognizing Western names. It resulted in lower accuracy for Chinese names converted to pinyin. The gender inference threshold was set at 70%. After individual inference and integration, a comparison was made between the eight LLMs and the "name2gender" project. It was found that the eight LLMs showed higher accuracy and a lower proportion of manual intervention (the number of names with gender probabilities below 70% was relatively small). Consequently, the eight LLMs were chosen for inference and result integration in automatic gender detection, balancing accuracy and manual intervention.

Table 1. Performance Comparison of Different Automatic Gender Detection Tools.

Platform/Model Name	*Accuracy*	*Proportion of Manual retrieval*
Genderize.io	73.77%	/
Name2gender	88.45%	14.3%
LLMs Integration	86.58%	12.5%

Second, after inferring the automatic gender detection tools, gender inference and integration of PhD dissertation authors and supervisors based on LLMs were conducted.

This study invoked the APIs of the eight LLMs, input the author and supervisor names from the dissertations, and the LLMs began the inference process. The inference results from the eight LLMs are integrated and returned, including the original name data and the gender ("male" or "female") and corresponding probability values inferred by each LLM.

To improve the accuracy of gender inference for PhD dissertation authors and supervisors in the humanities and social sciences, the inference results from the eight LLMs were integrated. In this process, a threshold of 0.7 was set to determine whether the gender is "uncertain". And the following integration strategy was used to determine the final gender inference result: first, the name was input into the

eight LLMs for prediction; then, based on the proportion of uncertain predictions, i.e., the proportion of LLMs predicting "uncertain" to the total number of LLMs, the following steps were taken: (1) if the proportion of uncertain predictions was ≥50%, the gender cannot be determined; (2) if the proportion of uncertain predictions was <50%, the number of predictions for male and female was compared, and if the number of male predictions was greater than female, the gender is determined as male, and vice versa; (3) if the proportions of male and female predictions were both ≤50%, the gender also cannot be determined. This process, by integrating the prediction results of multiple models, aimed to improve the accuracy of gender inference.

After integration, the new results included all the content inferred by the LLMs, as well as the integrated results. The integrated results had three possibilities: "male," "female," and "uncertain," with 1,250 names having an integrated result of "uncertain." This integration method leveraged the advantages of multiple LLMs, reducing single - model misjudgment risks and offering more reliable data for researching gender differences in research method selection.

Third, after the integration of LLMs, the genders corresponding to 5,076 PhD student names and 2,399 supervisor names could not be inferred. Considering the high cost of manual retrieval, the “name2gender” project in GitHub with high accuracy was utilized as an auxiliary tool to reassess the names with undetermined genders post-integration, thereby reducing the burden of manual retrieval. A consistent threshold of 70% was set as the boundary of whether to determine the gender. Following the secondary inference by GitHub, the genders corresponding to 861 author names and 405 supervisor name could not be inferred, so the remaining 1,266 names need manual retrieval.

Step 3. Manual Retrieval of PhD Dissertation Authors and Supervisors with "Uncertain Gender"

For the 1,266 names with "uncertain gender" in the integration results, further manual retrieval was needed to infer their gender. The following steps were taken to integrate the gender inference results from the LLMs.

First, the system filtered out names for which gender could not be inferred from the results obtained in Step 2. Then, the system searched for these filtered names within the corpus to retrieve corresponding name and institution information. Next, the system input the obtained name and institution information into a web browser for online retrieval. The retrieval process prioritized reliable sources, such as Baidu Baike[11] or the official websites of the author's or supervisor's institution, to obtain

[11] https://baike.baidu.com/

detailed information. In this paper, special attention was paid to the supervisors' personal homepage information during the search process. For entries with complete supervisor information, their institutional official websites or academic homepages were manually verified, and gender confirmation was performed through visual clues such as avatar photos. This supplementary verification mechanism enhances the credibility of supervisors' gender labelling, but fails to systematically address gender uncertainty in the PhD student population due to limited information on PhD students' networks. Afterward, the system verified the consistency of the name, gender, and institution information. Once verified, the system annotated the documents by accurately labeling the relevant information within the corpus, thus completing the retrieval process. Despite manual retrieval efforts, 576 names remained without corresponding gender information online. The failure to obtain results primarily occurred for PhD student authors, as individuals with low prominence or those who had left their institution were more difficult to identify. To ensure data accuracy, the system removed these 576 names and their corresponding dissertations from the corpus. These entries accounted for approximately 0.9% of the total number of dissertations, exerting minimal impact on the overall research.

Table 4. Summary of Gender Detection by Different Methods.

Method	*#Detection*	*#Certain Cases*	*#Uncertain Cases*
Gender Matching-Author	63741	9704	54037
Gender Matching-Supervisor	63741	35715	28026
LLMs Intergration-Author	54037	48961	5076
LLMs Intergration-Supervisor	28026	25627	2399
Name2gende-Author	5076	4215	861
Name2gende-Supervisor	2399	1994	405
Manual retrieval -Author	861	372	489
Manual retrieval -Supervisor	405	316	89

Table 4 presents the results of gender detection for each method. In this table, "Detection" indicates the number of name samples assigned to each method for gender identification. "Certain cases" denotes the number of name samples for which gender was successfully detected by each method. "Uncertain cases" represents the number of name samples for which gender could not be determined by each method.

Analysis of the Correlation Between PhD Students and Supervisor Gender and Research Methods: In order to investigate whether there is a correlation between the gender of PhD authors and their supervisors and the research methods they use in their dissertations, this paper analyzes the correlation between the gender of PhD students or their supervisors and the selection of research methods, the diversity of PhD students or their supervisors in terms of gender and the use of research methods, and the gender combination of PhD students and their supervisors and the selection of research methods from three perspectives.

Gender Differences of PhD Students or Supervisors and Research Method Selection: Based on the classification system of research methods in the field of humanities and social sciences, this paper organizes the gender information of PhD authors and their supervisors, and constructs a binary structure that demonstrates the relationship between gender and research methods selection.

In this structure, the gender variable is binary differentiated by 0 and 1, with 0 representing female and 1 representing male; the choice of research method is also represented by 0 and 1, with 0 indicating that a PhD student or supervisor did not use the research method in his/her dissertation, and 1 indicating that he/she did use the method.

In this paper, the chi-square test was used to analyze the relationship between the gender of PhD students or supervisors and the choice of research methods. The chi-square test is a statistical method applied to categorical data, and in this study, it was used to explore the relationship between two categorical variables, namely, the gender of PhD students or supervisors and the choice of research method. The $\chi 2$ value is obtained by dividing the square of the difference between the observed frequency and the expected frequency in each category, by the expected frequency, and then summing the results for all categories, with the specific formula as follows:

$$\chi^2 = \frac{(O_i - E_i)^2}{E_i}$$

Where, O_i denotes the number of theses in which PhD authors or supervisors of a

certain gender used or did not use a particular research method in actual statistics; E_i represents the number of theses that used or did not use a particular research method under the assumption that there is no correlation between the gender of the PhD authors or supervisors and the choice of research method; By calculating the chi-square statistic and comparing the corresponding p-value and significance level, it is possible to determine whether there is a statistical correlation between the gender of PhD authors or supervisors and the choice of research methods.

Analysis of Gender Differences in Research Method Diversity Among PhD Students or Supervisors: Based on the dual structure between supervisor gender and research methods, data were secondary processed. Specifically, for each row of data labeled with supervisor gender, the number of research methods used (marked as 1) was summed to calculate the total number of research methods employed by each supervisor. The same data processing approach was applied to the relationship between PhD authors' gender and the diversity of research methods.

For the significance analysis of the diversity of methods used by supervisors/authors, we use the Mann-Whitney U test. This non-parametric statistical test method is used to compare whether there is a significant difference in the medians of two independent samples, especially applicable to data that do not meet the normal distribution assumption(MacFarland & Yates, 2016).

Through the Mann-Whitney U test, it is possible to compare whether there is a significant difference in the median number of research methods between different gender groups. This method helps reveal the impact of gender on research method diversity, that is, to determine whether a certain gender tends to use more diverse research methods. Similarly, whether the asymptotic significance (two-tailed) p-value is less than 0.05 is used as the basis for determining whether gender is related to research method diversity, and the rank mean is observed to determine which gender of supervisor/PhD student uses more diverse research methods.

Analysis of the Correlation Between "PhD Student -Supervisor" Gender Combinations and Research Method Selection: Building upon the binary structure between the gender of PhD authors or supervisors and research methods, the data originally reflecting only the gender of PhD authors was expanded into a "PhD student - supervisor" gender combination format. This constructed a new binary structure to present the correspondence between the gender combination of “PhD students - supervisors” and the use of research methods. In this paper, the chi-square test is also used to analyze the significance of the relationship between the gender combination and the choice of research methods.

Results

This section will briefly describe the results of the analysis of the relationship between the gender of PhD students and their supervisors and the choice of research methods, and analyze the factors that affect the relationship between the gender of PhD students and their supervisors and the choice of research methods, in addition to drawing conclusions on how the gender factor affects the preference for and diversity of the choice of research methods.

Gender Differences Among PhD Students and Their Supervisors and Research Method Selection

This section answers RQ1. After conducting correlation analysis on the gender and research method selection of authors and supervisors in more than 60,000 PhD dissertations, this paper finds that PhD students or supervisors of different genders tend to choose specific research methods, and the gender of supervisors affects the diversity of research methods in dissertations, while the gender of authors does not have this effect.

Analysis of the Impact of Gender Differences on Research Method Selection: Among the 36 research methods, 17 methods showed strong correlations with author gender, and 15 methods showed strong correlations with supervisor gender. Males showed a clear preference for summative theoretical construction research methods, which may be related to long-standing societal expectations and cultivation of males in logical thinking and abstract construction. In educational and academic environments, males may be more encouraged to analyze problems from a macro, theoretical perspective, which is reflected in their research method selection. They are more adept at integrating existing knowledge systems and constructing systematic theoretical frameworks, so as to promote the deepening and expansion of disciplines at the theoretical level. Females showed a clear preference for real-time data acquisition and analysis methods, reflecting their high attention to actual situations and specific phenomena in the research process. They focus more on collecting first-hand information from the real world and uncovering patterns and trends through rigorous data analysis. This research method helps to bring academic research results that are closer to reality and more practically significant, supplementing and enriching the perspectives and content of academic research. For some new research methods, such as visual analysis and bibliometrics, the correlation with gender is not strong, but in the sample, female supervisors and female authors use them relatively more frequently.

For some research methods, the usage frequency is relatively low, which may not

accurately reflect their actual application. Therefore, to ensure the reliability and persuasiveness of the research results, methods with usage instances below 1,000 were excluded from the correlation analysis. After screening and deleting these methods from the dataset, the correlation results shown in Figure 2 and Figure 3 were obtained.

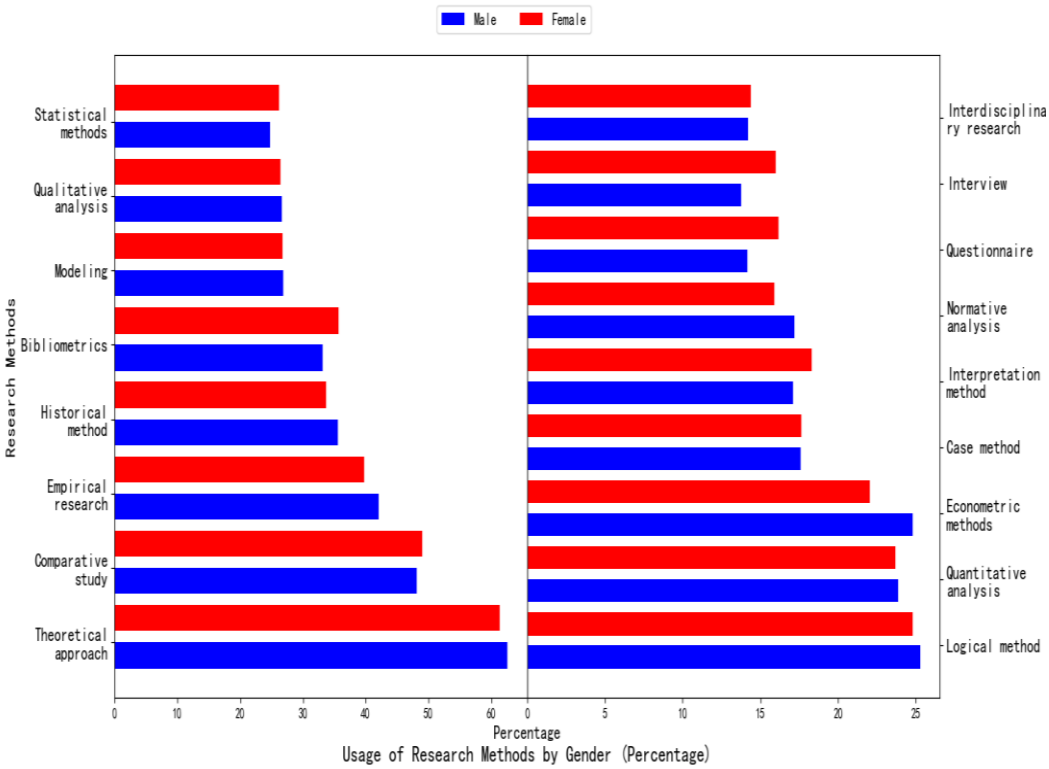

Figure 2. Results for Author Gender and Research Method Selection.

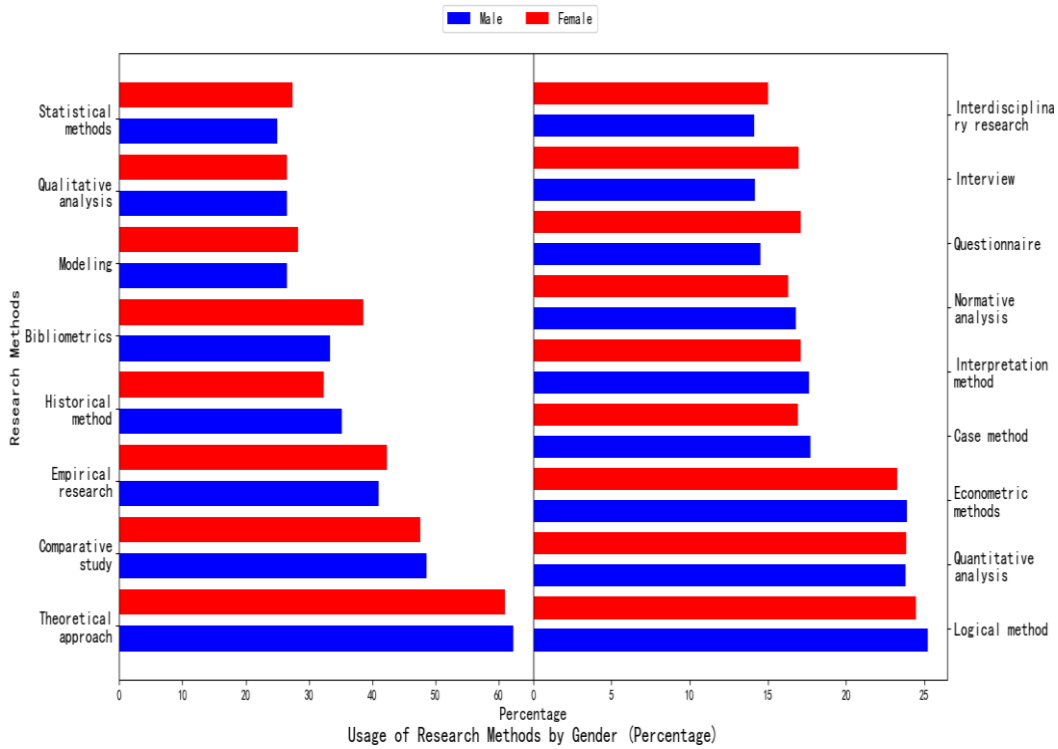

Figure 3. Results for Supervisor Gender and Research Method Selection.

Analysis of Gender and Research Method Diversity: The test results for supervisor gender and research method diversity and PhD student author gender and research method diversity are shown in Table 5. At the 5% significance level, the p-value for supervisor gender and research method diversity is 0.006 (<0.05), indicating a significant difference. Additionally, according to the rank mean values shown in Table 6, female supervisors (coded as 0) tend to use more diverse research methods. The calculated total entropy value for female supervisors is 3.49, slightly higher than that for male supervisors (3.48). This suggests that the distribution of method diversity among female scholars may be more uniform or complex. At the 5% significance level, the asymptotic significance (two-tailed) p-value for author gender and research method diversity is 0.515, greater than 0.05, indicating no significant difference between author gender and the diversity of research methods used. Additionally, as can be seen from the rank mean value in Table 6, the rank mean values of male and female authors are relatively close, further supporting the significant results.

Female supervisors tend to use more diverse research methods, reflecting their stronger inclusiveness and open-mindedness in the academic guidance process. They better recognize the strengths and applications of diverse methods,

encouraging multi-perspective exploration, fostering academic innovation, and enhancing team creativity. In contrast, there is no significant difference in research method diversity among PhD students based on gender, which may mean that at the PhD student stage, gender has not yet had a decisive impact on the exploration of research method diversity. At this stage, PhD students are more influenced by disciplinary norms, the overall guidance style of supervisors, and the needs of the research topic itself, while individual gender factors play a relatively weaker role.

Table 5. Test Results of Gender and Diversity of Research Methods for Supervisors and Authors.

category	*The diversity of methods*			
	Mann - Whitney U	*Wilcoxon W*	*Z*	*Asymptotic Significance (Two - tailed)**
supervisor_sex	246275347.000	1696590500.000	-2.775	0.006
author_sex	462051071.000	1261591137.000	-0.651	0.515

Table 6. Distribution Statistics of Gender and Research Method Diversity.

category	*Distribution Variable*	*The diversity of methods*		
		N	*Rank mean value**	*Sum of ranks*
supervisor_sex	0	9312	32066.41	298602365.00
	1	53857	31501.76	1696590500.00
author_sex	0	23181	31646.68	733601728.00
	1	39988	31549.24	1261591137.00

Analysis of the Influence of Tutors on the Selection of Research Methods for PhD Students

This section answers RQ2. In the field of humanities and social sciences, tutor gender affects gender differences in PhD students' research method selection, either through stable transmission or gender interaction changing preferences.

Through the chi-square test, it was found that at the 5% significance level, 24 out of 36 research methods showed significant associations with gender combinations. For some research methods, the usage frequency is relatively low, which may not accurately reflect their actual application. Therefore, to ensure the reliability and persuasiveness of the research results, methods with usage frequencies below 0.07 were excluded from the correlation analysis. Filtered them out from the dataset, resulting in the correlation results shown in Figure 4. Additionally, in the two-dimensional analysis of "author-supervisor" gender combinations, methods that showed significant associations with gender combinations exhibited strengthened or weakened preferences for certain research methods in the same gender combinations. For example, the selection of theoretical analysis methods is related to gender, with male authors using them more frequently. The frequency of usage in gender combinations ranks as follows: male-male pairs (0.62) > male-female pairs (0.618) > female-male pairs (0.617) > female-female pairs (0.59).

The results of the two-dimensional analysis show that, to some extent, in a specific academic atmosphere or when the research team has formed a tradition of research method selection, the academic inheritance between supervisors and PhD students of the same gender is relatively stable. However, the combination of supervisors and PhD students of different genders reflects the influence of gender interaction on the choice of research methods. PhD students of different genders may collide with their supervisors and experience a different atmosphere of academic exchanges, thus changing the preference of research methods, which is a phenomenon that provides rich research materials and certain inspiration for an in-depth understanding of the relationship between gender combinations in academic research.

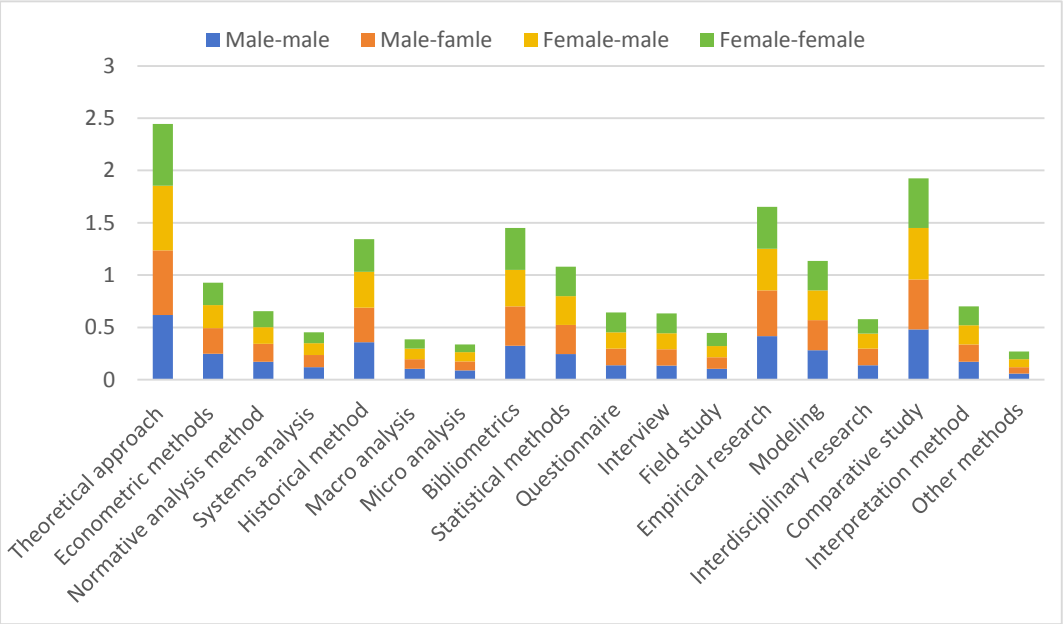

Figure 4. Correlation Results between "Author-Supervisor" Gender Combinations and Research Method Selection.

Discussion

Research Implications

Theoretical Implications: This study has shown the impact of gender factors on the selection of academic research methods, providing a new perspective on how gender shapes academic research directions and methods. The study found that there are preference differences in research method selection among researchers of different genders. The difference may be related to gender roles in the socialization process, cognitive style differences, and gender stereotypes in academic environments. This paper also postulates that the diversity of research methods is influenced by the gender of the supervisor. Supervisor gender determines not only the composition but also the research culture and, as such, impacts research method adoption or diversity. These findings provide new theoretical dimensions to prior research on gender, emphasize the inclusion of gender factors in academic research, and provide a theoretical basis for future gender difference research.

Practical Implications: Based on academic research and educational practice, this paper emphasizes the existence of gender differences and puts forward some suggestions. In academic research, supervisors should recognize the impact of gender differences in choosing research methods. Supervisors should encourage researchers to adopt diverse research methods to promote academic innovation and enrich knowledge production. In education, the educational institution should

provide training and guidance to help students and researchers realize the existence of gender bias and encourage them to adopt a more fair and inclusive perspective in choosing research methods. It helps students and researchers be more aware of gender biases and develop a more impartial and inclusive approach when choosing research methods. This paper also puts forward that academic publishing units need to pay attention to the issue of gender bias in the review and editing process to ensure fairness and objectivity in the results of the research.

Research Limitations

Although this paper conducts a study of gender differences in the choice of research methods and the factors influencing them among PhD students in the whole field of humanities and social sciences, there are some limitations. First, the corpus, spanning from 1989 to 2000, may not fully capture contemporary research methodologies and trends. Second, while the study enhances the precision of gender detection through LLMs processing and manual retrieval, it cannot entirely eliminate discrepancies between automatically inferred gender and actual gender, leaving room for further improvement in the accuracy of research outcomes. Fourth, the study does not fully unpack the cultural mechanisms underpinning observed gender disparities. Additionally, generalisability is constrained by China's unique sociocultural and academic ecosystems. Institutional norms and cultural values likely interact to shape gendered method preferences. Future research should incorporate cross-regional comparisons, subdisciplinary analyses, and individual variables to explore cultural moderating effects.

Conclusion and Future Research Directions

This study focuses on gender differences in research method selection among PhD students and their supervisors in the Chinese humanities and social sciences. In terms of research method usage tendencies, among the various research methods examined, some showed significant gender correlations. Males more commonly using theoretical construction methods and females more prominent in data collection and analysis methods. Regarding research method diversity, there are significant gender differences at the supervisor level. Female supervisors using more diverse research methods, with more complex and uniform method distributions than male supervisors. However, among PhD students, gender factors did not significantly affect research method diversity. In further dyadic analysis, a considerable number of research methods showed significant selection preference differences under different gender combinations, with some methods significantly increasing or decreasing in usage frequency under specific gender combinations However, this study has limitations in data coverage, the accuracy of gender

detection, and the analysis of factors influencing gender differences in research method selection. Future research can comprehensively explore the influencing factors behind these differences from multiple perspectives such as research topics, the number of PhD students supervised by supervisors, and institutional levels.

Acknowledgments

This paper was supported by the National Natural Science Foundation of China (Grant No.72074113).

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