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Gender Disparities in Book Circulation at a Chinese University Library (2012–2022)

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Abstract

The study explores the significance of gender differences in higher education, using book circulation data from Nanjing Normal University libraries between 2012 and 2022. It aims to analyze gender disparities and calculate the mathematical characteristics of gender prediction probability using the ANN model. The time-series ARIMA model also forecasts the average number of books that male and female teachers and teacher candidates are expected to borrow and renew in the next three years. The findings indicate that men tend to be more focused and persistent readers despite women having a more extensive network of book borrowing ties. Male graduate students and faculty members demonstrate significantly greater individual variability in book renewals than their female counterparts. Additionally, the maximum value of book renewals for male graduate students and male faculty members is notably higher than that of female graduate students and female faculty members. Book renewal frequency is a crucial factor in ANN gender prediction. On average, male readers incur higher overdue fines than female readers, and the overdue fines for both genders during the COVID-19 pandemic were considerably higher than usual. The actual monthly average renewal rates in 2022 exhibited significant fluctuations across genders and academic statuses, highlighting the limitations of the ARIMA model and other factors influencing renewal rates.

Keywords: Gender, Book borrowing, Teacher, ANN, Time series

1. Introduction

Wu Yan, the director of the Ministry of Higher Education Department, emphasized the remarkable growth of higher education since 1999, which has substantially improved the academic performance of both men and women in higher education (Si, 2022). An essential factor contributing to the enhancement of access to higher education for women from disadvantaged backgrounds and rural areas is the narrowing gender gap. *The Statistical*

Yearbook of Chinese Education indicates that the number of female students in China's higher education institutions has surpassed that of male students since 2009, with more than 50% of college graduates in 2016 being female (Ao & Lin, 2020). Nonetheless, the influence of masculinity in academic leadership persists, with women being relegated to subordinate roles (Brown, 2021). This enduring gender imbalance in academia has led to the reinforcement of gendered perspectives in teaching and research, exemplified by the use of gender-exclusive language (e.g., using "he" implying "he" or "she") (Stout & Dasgupta, 2011).

The access gender gap in higher education, including teacher education, is significantly affected by factors such as family structure, background, and urban-rural economic disparities (Ye & Wang, 2022). It is perceived that there are more female teacher candidates than male teacher candidates enrolled in liberal arts courses. In contrast, male teacher candidates are more predominant in science and engineering courses at Nanjing Normal University (NNU). Furthermore, the borrowing patterns of male and female readers in the library reveal distinct patterns, with female readers exhibiting more active participation in book borrowing activities than their male counterparts. However, this raises questions regarding male diligence in academic pursuits and whether male academic achievement is perceived as separate from book reading. Conversely, female teacher candidates exhibit lower average book borrowing, and renewal rates than male teacher candidates, indicating individual statistical differences. There are also instances where the comparison of averages is reversed. Male readers are subjected to more significant fines for lost and overdue books despite female readers having higher overall numbers of lost and overdue books. The summer vacation months of July and August are considered off-season for library borrowing due to a noticeable drop in the volume of borrowed and returned books. Nonetheless, the average number of books borrowed and returned per person is at its highest throughout the holidays. The presence of these significant differences underscores the crucial need to pinpoint the most gender-specific factors to either validate or question gender stereotypes.

The library book circulation services at NNU were temporarily suspended from 2020 to 2022 due to epidemic prevention and control measures. These lockdown measures prompt the need to reflect on the trends and changes in borrowing habits of male and female readers over the past decade, especially during the COVID-19 epidemic. Furthermore, there is a need to explore the potential implications of COVID-19 on book circulation over the next three years, particularly in understanding whether the gender differences in book borrowing, and renewal among male and female teachers and teacher candidates will increase, narrow, or remain consistent. It is envisaged that this investigation will yield valuable data for gender research, shedding light on the collective and individual advantages and differences in book borrowing between male and female readers across undergraduate, graduate, and faculty demographics, emphasizing the importance of gender-based statistical analysis in studying these differences.

2. Previous Research

Gender differences hold significant relevance in the fields of sociology and psychology. As per Jung (1966), both men and women unconsciously exhibit traits of the opposite sex,

namely anima and animus personalities. Logos, representing male archetypes, embodies reason, independence, and objectivity, whereas Eros, signifying female archetypes, embodies sensibility, dependence, and subjectivity. Research suggests that women tend to display more sensitivity. In contrast, men tend to exhibit more aggression (Alexander et al., 2021) and differences in communication styles, with women leaning towards concrete communication and men towards abstract communication (Joshi et al., 2020). Leisure preferences vary by gender, with women typically displaying a preference for entertainment and men showing a preference for seeking information (Thums et al.,2021). Moreover, men tend to focus on topics related to electronics and business. However, women show lesser interest in these areas but exhibit a strong interest in issues associated with children (Applegate, 2008). Additionally, gender-based differences in evaluating internet sources have been noted, with women displaying more skepticism and men expressing higher confidence in assessing credibility and accuracy (Tibor, 2017). Moreover, research on the influence of peers in higher education highlights that women are more susceptible to peer influence than men (Han & Li, 2009). These findings underscore the divergence in physical attributes and cognitive, expressive, and behavioral patterns between men and women.

Gender stereotypes continue to perpetuate beliefs that men possess greater intelligence and talent than women (Napp & Breda, 2022). Gender disparities in science, technology, engineering, and mathematics (STEM) fields are partially attributed to the hierarchical social structure within these domains, contributing to the underrepresentation of women (Friedmann & Efrat-Treister, 2023). Notably, women outperform men in generating accurate earnings estimates, a result attributed to their ability to rapidly learn through estimation rather than superior information processing or utilization of recent data (Bhagwat et al., 2023). Gender bias is associated with social inequality, family dynamics, educational experiences, and exclusive communication (Kuhn et al., 2023; Martin & Ruble, 2010; Turesky & Warner, 2020). Contrary to focusing solely on gender, factors such as gender roles, the biopsychosocial approach, and organizational culture are considered to provide a more comprehensive explanation for inter- and intra-individual behavioral variances (Hodgetts & Hausmann, 2022).

The subject of gender inequality is examined by various factors, including gender stereotypes (Lewis et al., 2022), challenging work environments (Chatterjee et al., 2020), and cognitive functions influenced by gender, such as long-term memory (Hausmann, 2021). Gender inequality impacts the socialization of students in schools in concealed and ambivalent ways (Gurieva et al., 2022). In China's primary and secondary schools, the proportion of female teachers has surpassed 50% since 2014. The feminization of the teaching workforce is more pronounced in urban areas than rural areas, attributed to the higher concentration of female teachers (Ao & Lin, 2020). Male teachers are predominantly in mathematics, physics, biology, physical education, and information technology. Students' acquisition of gender stereotypes and biases is facilitated by instructional techniques, including gender-based labeling and organization (Farago et al., 2022). Notably, in elementary schools, girls demonstrate significantly higher success rates than boys. However, in secondary schools with better learning environments, no gender differences have been observed (Ye & Wang, 2022).

Moreover, in standardized curricula, girls outperform boys in reading (Hek et al., 2019). The gender composition of a classroom affects students' reading proficiency. A higher proportion of girls attending school benefits boys more than girls. Conversely, girls benefit more from education in settings with higher socioeconomic composition (Hek et al., 2018). Over half of freshmen find mathematics challenging, primarily when taught in the first year at most universities. Both male and female students favor different learning methods for mathematics. Female students have a more favorable perception of learning practices, more vital organizing abilities, and more effective repetition techniques than male students. Female students tend to review their notes, organize critical points, and strive to arrange the material in a way that aids in easy recall (Indrek & Õun, 2020). However, stereotyped text does not significantly impact women's and men's literacy skills (Thums et al., 2020). There is no significant difference in critical thinking ability scores for boys in different subjects. However, critical thinking ability is notably lower for girls in science and engineering compared to girls in the humanities (Wang & Shen, 2022).

Each individual is born into an ongoing narrative of gender disparities that shapes and confines the scope and possibilities of our role identities, personal behaviors, and self-concept. Although none of us can evade gender-based constraints, gender roles have undergone significant transformations in the last decade and continue to evolve. Gender recognition is a current research area in varied fields such as speech analysis, face recognition, fundus photograph identification, and email author discrimination. Human gender identification is crucial in forensics, anthropology, and bio-archaeology. Researchers utilize deep learning algorithms to process images, extract features (Balan et al., 2022), Naive Bayes and decision tree algorithms to obtain a new set of voice data (Altunbey & Erdal, 2023), the Ad boost algorithm for facial feature-based gender intelligence recognition (Wang, 2021), deep learning for gender prediction of Asian fundus photographs (Betzler et al., 2021), and an artificial neural network for improving the accuracy of gender classification (Safara et al., 2020). Optimization techniques address issues related to poor recognition intelligence and gender classification accuracy.

Selecting the gender option on various registration forms is essential information for library users to provide during registration. However, the differences in reading habits among male and female teachers and teacher candidates in a normal university have received minimal research attention. Specifically, there is a lack of retrospective analysis concerning changes in reading behaviors, such as book borrowing and renewing practices before and after the COVID-19 pandemic, as well as gender-based variations in behavioral changes and future behavioral change forecasts. The reading preferences, book selection philosophies, and bibliographic accumulation of teacher candidates significantly impact their values, teaching concepts, and curriculum design. Research on gender-related reading habits is critical for understanding library collection popularity, developing coherent collection policies (Igarashi et al., 2020), exploring borrowing psychology, enhancing reader services, formulating book recommendation guidelines, and identifying trends and patterns of changes in book borrowing, and renewal behaviors of male and female teachers and teacher candidates over time. Gender-related reader research provides new avenues for personalized services in the

post-pandemic era. It can inspire the study of gender in higher education by reading through case studies and justifications.

This study stands out from previous research due to its distinctive NNU background. NNU, renowned as the cradle of higher teacher education in southern China, is dedicated to training diverse teaching professionals. In-depth investigations tailored to the specific context, considering the distinct challenges and cultural influences students encounter, are necessary (Khan et al., 2024). The study stands out in two main ways: first, through its focus on the borrowing behavior of teachers and teacher candidates, and second, utilizing an artificial neural network (ANN) to predict gender based on book renewal and borrowing data and applying ARIMA time series analysis to examine the evolving process and developmental scale of borrowing behavior in the post-pandemic era. The study also forecasts the pattern of book borrowing and renewing for the next three years using the 10-year average and validates the model's accuracy with observation data from 2022. Understanding the statistical features of the data is crucial for accurate interpretation using nonlinear thinking, the Pareto principle, and probability theory. The study focuses on the development trend of gender disparities in book borrowing and renewing during the influence of COVID-19 while examining the mathematical characteristics of probability, accuracy, confidence, and support in the gender statistics indicator.

3. Theoretical Framework

The well-known Buffon needle experiment demonstrates that repeated experiments yield reliable results. Readers constantly visit to check out and return books. If observed over a ten-year or extended period, the average book circulation may stabilize at a particular value. According to Kelly (1994), a vortex and a dune cannot be affected by a small amount of sand or water, respectively. The Law of Large Numbers (LLN) is a frequently occurring law that applies to repeated random events. While big data technologies have opened new research opportunities, social studies have largely embraced them in ways that conform to standard explanatory frameworks. The presence or absence of connections between entities or nodes in a social network determines if a pairwise link exists. This potential causal relationship influences an individual's actions and those of their social contacts (Ogburn et al., 2022). In the social network context, observing numerous independent groups of entities is essential to understanding the causal impacts of an individual's activities on their social contacts. The library management system can effectively track millions of random book circulations, making it an invaluable resource for conducting psychological and behavioral research. One of the critical questions is the meaning of stability in this context. Are there discernible patterns in the circulation of books, and if so, are these patterns intentional or unintentional?

Human empowerment makes machine learning more sophisticated, and various machine learning algorithms progress rapidly and gain popularity. Integrating big data and data mining in social studies presents fundamental methodological challenges that require a review of current explanations and justifications for the relationship between theory, operationalization, and data (Helles & Ørmen, 2020). The use of big data serves two primary purposes: predicting future events and uncovering insights and relationships within large and

multidimensional datasets. However, achieving these objectives comes with challenges in computation and methodology (Almeida et al., 2023). Traditional prediction models face limitations in accounting for complex nonlinear interactions. In contrast, ANN models mimic the human brain's information processing and do not impose restrictions on input or residual distribution. The key advantages of employing an ANN approach include its capability to handle nonlinearity without needing a predefined mathematical model and its minimal effort in evaluating the model's sensitivity to input variables (Abdul Shahid et al., 2023). An ANN comprises input and output layers connected by multiple hidden layers. The input layer nodes represent potential, influential factors affecting network outputs. Conversely, the output layer contains one or more nodes that produce the network output. The hidden layers may consist of numerous processing nodes. Multiple iterations were carried out to minimize errors and improve the accuracy of the analysis (Baig et al., 2023).

Time series prediction is a methodical approach that organizes data chronologically to analyze changes in direction and magnitude and forecast future data points. This analytical framework is essential for understanding temporal dynamics and making informed predictions. Time series analysis provides a comprehensive toolkit for examining time-dependent data, including trend and pattern analysis methodologies and sophisticated modeling techniques. It is an essential resource for scholars, statisticians, and practitioners. Time series analysis has interdisciplinary applications in economics, finance, engineering, and environmental studies, demonstrating its relevance across various fields (Saleti et al., 2024). Among the various models used for time series prediction, the autoregressive integrated moving average model (ARIMA) is notable for its wide application across different domains. The time series data must exhibit stationarity for the ARIMA model to generate reliable forecasts. Stationarity can be assessed visually through graphical analysis or quantitatively through unit root tests to ensure the model's assumptions are met. The challenge in time series prediction often arises from the nonlinear interactions among multiple variables, which can complicate the forecasting process.

An illustrative example of this complexity is observed in the impact of the COVID-19 pandemic on book distribution networks, where unexpected disruptions led to zero values in the data for specific months. This highlights the importance of robust time series analysis methods to accommodate such anomalies. In recent research, scholars have preferred probabilistic approaches to time series prediction, attributed to the solid theoretical foundation of probability theory and its proven efficacy in diverse applications. However, it is essential to recognize that probabilistic interval predictions primarily quantify the coverage of predicted intervals, reflecting the proportion of data points encompassed within these intervals. This focus on coverage may not fully capture the inherent uncertainties in time series data, particularly those related to residuals, which represent a critical aspect of uncertainty (Song et al., 2024). Conventional practice in time series analysis involves the logarithmic transformation of mean values. This technique has been shown to reduce the standard deviation of prediction errors, enhancing forecasts' accuracy (Zhao, 2023). This highlights the continuous evolution of methodologies in time series prediction, driven by the pursuit of greater precision and reliability in forecasting future trends and patterns.

In recent years, there has been an increasing emphasis on employing data mining methods in education. This approach has attracted considerable attention for its capacity to reveal new patterns and trends that can improve our comprehension of student performance and guide educational strategies (Witten et al., 2011; Khairy et al., 2024). This research mainly utilizes ANN and time series data mining to derive valuable insights from extensive datasets.

4. Data & Methods

4.1 Book Borrowing Interests

The dataset comprises borrowing records of graduate students from Grades 2012 to 2018 at NNU library. Typically, master's and doctoral students in China pursue three-year programs, so the borrowing data spans from 2012 to 2021. For instance, the borrowing period for Grade 2012 graduate students ranges from September 2012 to June 2015. To streamline the analysis of the core bibliography, Excel filters out readers and books with circulation times of less than ten per year, owing to the substantial annual book circulation data at NNU. Gephi is employed to visualize book borrowing networks. After converting the Excel data format to a CSV profile, the researcher compares gender-specific waveforms, represented through node ID and label data in Gephi 0.92. The source node includes the reader's registration number with gender-specific information, while the target node uses the property number of the borrowed book. Directed edges signify borrowing relationships, and label weight information indicates the frequency of book checkouts. Furthermore, the layout, nodes' size and color, and labels' size and color are adjusted based on connectivity.

4.2 Gender Prediction

The ANN uses the borrowing and renewal records of 56,767 individuals from 2012 to 2021 as samples and employs SPSS to predict gender. The multilayer perceptron is chosen, with 70% of the samples used as the training set and 30% as the testing set. Gender is the dependent variable, book renewal times are a factor, and book borrowing times are a covariate.

4.3 Month-Average Value Comparison

The dataset for the time series model consists of records detailing the borrowing and renewal of books by undergraduate students, graduate students, and staff at the NNU library over the past ten years (2012–2021). Firstly, calculate the monthly average book circulation values over the last decade, import the data into SPSS, and adjust the period. Secondly, employ the ARIMA model to predict the monthly average book circulation values for the next three years (2022–2024). Thirdly, create gender comparison charts using the observed and projected values for male and female teachers and teacher candidates. Lastly, compare the observed month-average values from January to December 2022 with the projected values.

5. Result

5.1 Core Bibliography

In the past decade, there has been a decline in both the number of borrowers and the volume of books borrowed. Notably, the frequency of book borrowing among female graduates

significantly surpasses that of male graduates. Male graduate students tend to favor books in mathematics, engineering, and physics, while female graduate students prefer books in mass media, novels, philosophy, and psychology. The statistics reveal that the borrowing interest of women includes men, stabilizing at approximately 3%. In contrast, the borrowing interest of men is not as inclusive of women, typically hovering around zero to 6.9% but usually resting at zero. Figure 1 presents the borrowing network of graduate students from Grades 2012 to 2018, with red borders indicating borrowing by female graduate students and blue borders indicating borrowing by male graduate students. This visualization highlights that male students are less prevalent in the borrowing network, suggesting that female networks are notably more extensive. There is less alignment between the borrowing preferences of male graduates and the overall demand for book borrowing in the graduate group. Contrastingly, the borrowing preferences of female graduates are more in sync with the group's market, which is further reflected in the significantly higher number of books borrowed by female graduates than male graduates.

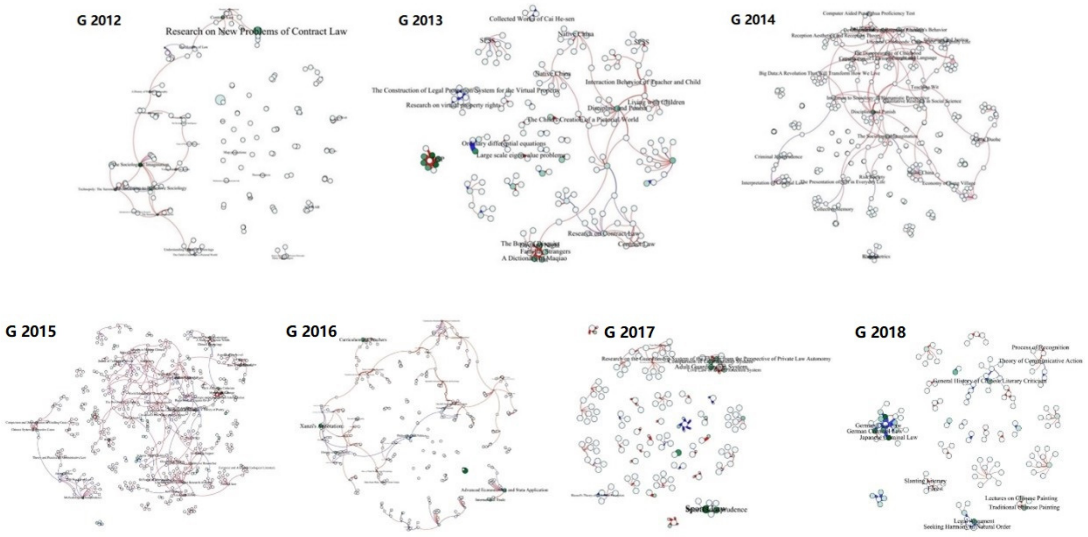


Figure 1. Core book borrowing network in Grades 2012–2018

5.2 Book Borrowing and Renewing

Renewal in book borrowing involves extending the borrowing period after the predefined duration has lapsed. It has been observed that the number of women renewing books surpasses that of men by more than threefold, with women renewing their books over twice as frequently as men. Moreover, the maximum value of book renewal for male graduate students and male staff is notably higher than that of female graduate students and female staff in most months.

The ANN achieved a prediction accuracy of 75.9% in the training set and 75.6% in the testing set. Book renewal times are essential, forming nine dummy variables with book borrowing times to enter the prediction input layer. In Figure 2 (a), the pseudo probability predicted by the model is explained, revealing that the accuracy of the male's prediction is notably low. The ROC curve in Figure 2 (b) illustrates the model's performance, with the area under the

curve (AUC) value of 0.579 (>0.5), indicating that the model is qualified. Figures 2 (c) and (d) depict the prediction model's optimal performance, with a steeper gain line from left to right and a larger AUC representing model performance.

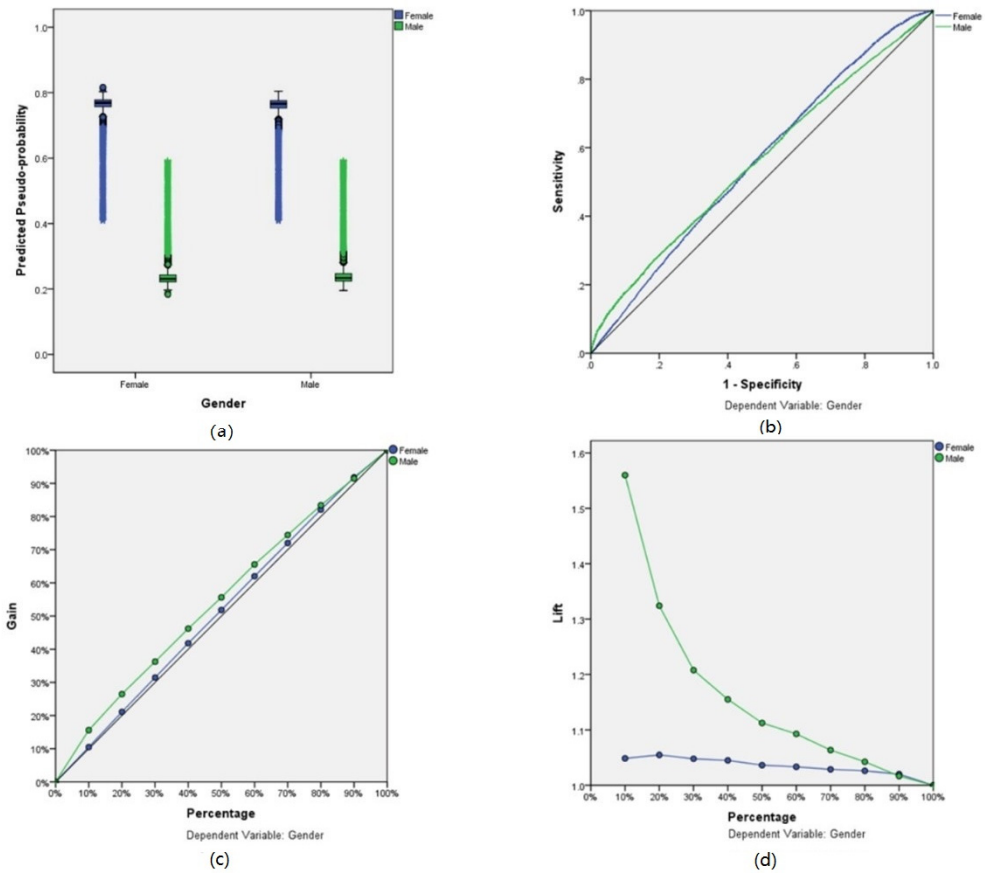
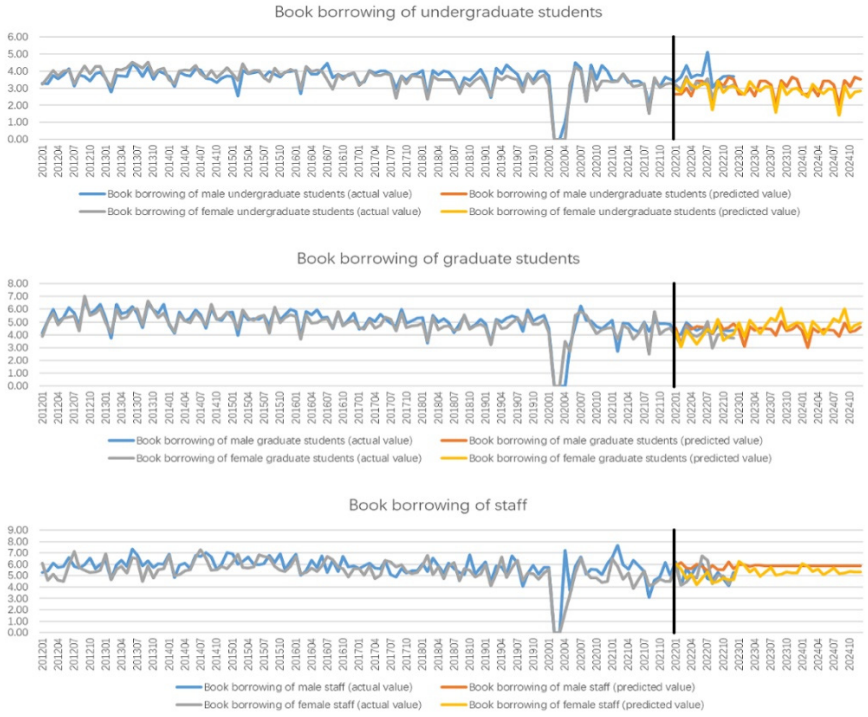


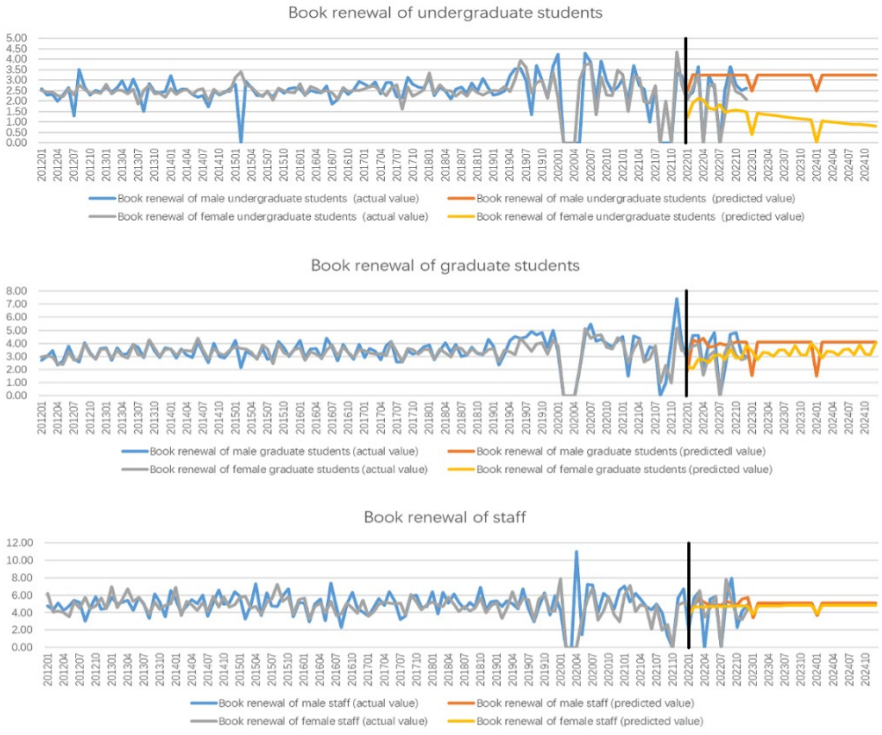
Figure 2. ANN prediction charts

5.3 Month-Average Book Borrowings and Renewals

The comparison of male and female teachers and teacher candidates' book borrowing habits, as illustrated in Figure 3, reveals a disparity in month-average book borrowing between the two genders, particularly significant in book renewing. Notably, the average gap in book borrowing between male and female teachers has widened during the COVID-19 epidemic, with male teachers consistently exhibiting higher borrowing rates. In terms of predicted trends, the ARIMA model indicates that female undergraduate students' average borrowing behavior is rising. In contrast, the variation for male undergraduate students is not statistically significant. Similarly, the average number of books borrowed by male undergraduate students consistently exceeds that of their female counterparts in most months, with the discrepancy growing over time. However, the trend for female graduate students presents a different pattern, as their average number of books borrowed gradually surpasses that of male graduate students (Refer to Figure 3 (a)).



(a)



(b)

Figure 3. Gender comparison of the month-average book borrowing and renewing

Based on the month-average book renewal trends observed over the past decade and projected for the next three years, teachers renew their books more frequently on average than graduate students, while graduate students renew their books more frequently than undergraduate students. Generally, men exhibit a higher frequency of book renewal than women. For male and female teachers and teacher candidates, the peak month-average book renewal rates recorded during COVID-19 were notably higher than usual. The peak month-average book renewal rates were approximately 11 for teachers, around 7.5 for graduate students, and about 4.5 for undergraduate students. The ARIMA model predicts that the average monthly renewal rates for male undergraduate students, graduate students, and teachers will not fluctuate much over the next three years. However, there was a noticeable discrepancy between the predicted and actual values in 2022, particularly among male undergraduate students, whose actual average renewal rate exceeded the prediction by a significant margin. Conversely, it is anticipated that the average renewal rates for female graduate students will increase while those for female undergraduate students are expected to decrease. The average renewal rate for female staff will remain relatively stable over the next three years. Nonetheless, the actual monthly average renewal rates in 2022 displayed substantial fluctuations across gender and academic status, underscoring the limitations of the ARIMA model and other influencing factors on renewal rates (Refer to Figure 3 (b)), such as the adjustment of library closure time, the relaxation of local epidemic control, etc.

5.4 Book Overdue and Lost

The library imposes late fees on patrons who do not return books by the specified deadline or misplace them. An increase in overdue cumulative fines and fines for lost books dampens readers' enthusiasm for borrowing. Borrowing times play a role in mediating cumulative fines and readers' overdue and lost times. Moreover, cumulative fines suppress readers' overdue times (Liu, 2024). This practice aims to safeguard the interests of most readers and promote book circulation. Analysis reveals that female readers have a significantly higher overall number of late books, total overdue times, and total fines for overdue books than male readers. However, female readers have lower per capita overdue times, overdue fines, and each overdue cost compared to male readers. On average, male readers pay higher overdue fines than female readers, and the overdue fines for both sexes during COVID-19 were notably higher than usual. The cost of each late book is increasing for both male and female readers. Over the past ten years, the quartile of male readers has consistently been higher than that of female readers, with the difference between quartiles being more substantial for males than for females, according to the distribution of individual late expenses among readers (refer to Table 1). Likewise, male readers have a higher quartile value than female readers, and the difference between quartiles is more significant for male readers than female readers, following the individual distribution of fines for each lost book (refer to Table 2).

Table 1. Gender comparison of the cost of overdue books (2012 – 2021)

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
N (Males)	Valid	3928.00	3544.00	3619.00	3392.00	3134.00	2699.00	2609.00	2054.00	1150.00	1385.00
	Missing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean		3.10	4.22	3.88	3.60	3.56	3.67	4.28	4.94	5.58	4.90
Std. Error of Mean		0.16	0.26	0.22	0.21	0.23	0.21	0.28	0.50	0.83	0.40
Median		0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.08	1.00	1.27
Mode		0.10	0.10	0.10	0.10	0.20	0.10	0.10	0.10	0.10	0.10
Std. Deviation		9.89	15.70	13.04	12.12	13.15	10.81	14.13	22.63	27.99	14.73
Variance		97.79	246.44	170.04	146.79	173.00	116.86	199.76	511.95	783.19	217.02
Range		169.10	375.90	266.90	305.90	402.00	161.50	275.70	839.90	665.90	334.90
Minimum		0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Maximum		169.20	376.00	267.00	306.00	402.10	161.60	275.80	840.00	666.00	335.00
Percentiles	25	0.40	0.41	0.42	0.40	0.40	0.40	0.42	0.43	0.43	0.50
	50	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.08	1.00	1.27
	75	2.21	2.60	2.47	2.50	2.54	2.60	2.55	3.15	2.90	3.53
N (Females)	Valid	9861.00	8918.00	9273.00	9291.00	8983.00	8116.00	7584.00	6013.00	2985.00	3739.00
	Missing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean		1.97	2.46	2.42	2.19	2.21	2.26	2.47	3.09	3.29	3.86
Std. Error of Mean		0.06	0.11	0.09	0.08	0.07	0.08	0.10	0.12	0.22	0.19
Median		0.70	0.80	0.80	0.70	0.78	0.80	0.84	0.90	1.00	1.00
Mode		0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Std. Deviation		5.61	10.06	8.85	7.26	6.99	7.48	8.54	9.35	11.90	11.42
Variance		31.47	101.13	78.40	52.71	48.89	55.95	72.96	87.48	141.56	130.33
Range		153.90	404.90	369.90	244.90	206.90	337.10	252.40	252.90	324.60	214.67
Minimum		0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Maximum		154.00	405.00	370.00	245.00	207.00	337.20	252.50	253.00	324.70	214.77
Percentiles	25	0.33	0.37	0.38	0.33	0.34	0.35	0.38	0.40	0.40	0.45
	50	0.70	0.80	0.80	0.70	0.78	0.80	0.84	0.90	1.00	1.00
	75	1.64	1.84	1.80	1.64	1.79	1.88	1.94	2.30	2.20	2.75

Table 2. Gender comparison of the cost of lost books (2012–2021)

		Male	Female
N	Valid	225.00	380.00
	Missing	0.00	0.00
Mean		132.49	106.45
Std. Error of Mean		7.41	4.63
Median		115.00	86.00
Mode		180.00	90.00
Std. Deviation		111.09	90.16
Variance		12341.81	8128.51
Range		744.00	580.00
Minimum		1.10	0.75
Maximum		744.00	580.00
Percentiles	25	50.50	39.00
	50	115.00	86.00
	75	180.00	149.00

6. Discussion

6.1 Gender Imbalance

The analysis of book circulation behavior statistics reveals a noticeable gender gap, characterized by a high total and a low average. The number and quality of teacher candidates have increased in China following the implementation of a public funding policy for normal school students (Zhang et al., 2023). Factors such as the likelihood of future employment, job security, and parental expectations influence the decision to enroll in a normal university (Wu et al., 2022). Currently, enrollment in teacher training programs is predominantly female, leading to a significant gender disparity and posing a challenge (Wang & Xie, 2023). This trend is attributed to higher educational expectations among girls compared to boys, with parental influence playing a substantial role (Ye & Wang, 2022). There has been a notable shift in the gender composition of teacher candidates, with a decreasing number of male candidates in both urban and rural areas, resulting in a predominantly female makeup. Scholars emphasize the importance of integrating gender analysis into various policymaking domains, including economic and infrastructural development, to address gender equality (Gloria et al., 2022). It is important to note that gender significantly influences the selection of disciplines and academic institutions, particularly in technical fields or universities. Female candidates tend to prefer humanities majors, while male candidates tend to favor scientific majors, as evidenced by borrowing and learning patterns (Vellamo, 2022). Furthermore, male educators and applicants exhibit lower rates of visiting the library and

engaging in book borrowing activities than their female counterparts. This can be attributed to the comparatively more minor representation in educational institutions, differing reading material requirements, and the less standardized preferences of male graduates in normal universities dominated by females. Statistical analyses also reveal that male readers tend to be more concentrated, consistent, and sustained than female readers, with notable individual differences in male reading behaviors.

6.2 Gender Stereotypes

Studying gender stereotypes requires long-term data collection to understand their stability. Research has shown that gender stereotypes have remained stable, with no significant changes in prescriptive stereotypes (Zehnter et al., 2018). Historical trends continue to influence distinct perceptions of males and females (Haines et al., 2016). For example, boys in kindergarten exhibit less adherence to rules and display tendencies towards increased violence and disruptiveness compared to girls. Additionally, male readers incur higher costs for late payments and lost books. The preference of male students for STEM fields is linked to their perceived superior abilities in logical thinking, mathematics, creativity, and problem-solving. Despite the presence of a robust liberal arts teacher training program, a notable disparity exists, with fewer boys pursuing humanities compared to girls (Perry et al., 2019). Gender continues to significantly impact decision-making regarding specialization and organizational choices in technical departments. Despite improvement, women in academia still lag behind men in prominent positions and hard technology. However, there are observable shifts in disciplinary prototypes. The pace of scientific advancement has accelerated markedly, as evidenced by a significant increase in scientific publications over the past year (Samanta et al., 2022). In science and engineering courses, educators and students predominantly use journals and infrequently borrow professional books when reporting on experiments. The response to library closures due to the COVID-19 pandemic and the increased use of digital services have affected readers' behaviors (Ruthven et al., 2023). In recent years, students from various scientific disciplines have increasingly borrowed literary novels over professional books (Liu, 2023). Over time, male undergraduate students have consistently borrowed more books than their female peers in most months. However, female graduate students have gradually borrowed more books, surpassing their male counterparts. This trend is expected to further elevate the influence of women in academia in China, including a gradual trend towards art design style instruction in technical majors.

6.3 Gender Roles

Gender roles are a set of societal expectations that dictate the behaviors and characteristics considered appropriate for individuals based on their perceived gender. These expectations are heavily influenced by cultural and social systems, shaping distinct behavioral patterns in men and women. The concept of gender-typed skills, encompassing work-related duties, skills, and knowledge domains categorized as either feminine or masculine, plays a significant role in the occupational divide between the sexes, reinforcing entrenched and unequal dynamics between women and men (Hsiung, 2022). Within the realm of pre-service

education, gender roles have a substantial impact on the perceptions of workplace culture and benefits among undergraduate and graduate students (Turesky & Warner, 2020). The division of labor between genders is also evident in career choices, with men showing greater interest in electronics and computation. At the same time, women are predominant in nursing, education, and the media. Male students often prefer subjects such as math, engineering, and physics, while female students tend to favor disciplines related to philosophy, psychology, fiction, and media. Female undergraduate students may not always feel strongly inclined toward physics (Bottomley et al., 2023). Moreover, there has been a noticeable shift among female undergraduate students in their aspirations to assume leadership roles compared to their male counterparts in recent years (Powell & Butterfield, 2022). These factors significantly influence male and female students' reading habits and academic experiences, leading to disparities in reading perseverance, stability, openness to novelty, and the formation of individual worldviews, life perspectives, and values.

6.4 Gender Prediction

Gender is a significant determinant of reader characteristics and a primary influencer of group preferences, needs, and behavior. Similar to how B-scan ultrasonography can predict fetal sex, an algorithmic model is employed to analyze data on borrowed and renewed books to discern reading patterns. Enhanced decision-making can be achieved through computer simulations of the human brain, where different algorithmic models prioritize influential factors to yield optimal results in the ANN model. Algorithm validation enables us to pinpoint the most crucial factors. Regression is utilized in time series prediction, leveraging historical data to analyze trends in book borrowing, and renewal while accounting for random fluctuations caused by unintentional factors. For instance, Safara et al. (2020) amalgamated various approaches and utilized a large sample size to elucidate this method further. When choosing features for a labeled dataset, it is vital to consider supervised feature selection techniques that consider the target variable. On the other hand, unsupervised feature selection techniques can be helpful for datasets without labels or when the target variable is absent. It is crucial for machine learning users to carefully determine which feature selection technique is best suited for their model. In machine learning, there are two main types of variables: numerical variables, which have continuous values like floats and integers, and categorical variables, which include nominal, ordinal, and Boolean values (Khairy et al., 2024). As we better understand the data and variables, selecting the appropriate statistical measure for feature selection becomes more accessible. Initially, it is essential to identify the input and output variables type to choose the suitable featured algorithm.

7. Limitations

The study at hand delves into a comprehensive analysis of the borrowing patterns of male and female readers, both individually and in groups. It also explores the impact of sudden public events on book circulation and the cyclical nature of changes in borrowing and renewing books. However, one limitation of the study is its failure to investigate softer aspects such as the learning environment, reader personality, emotions, and spiritual communication. While data mining provides valuable insights, it is crucial to complement it with expert analysis to

ensure effectiveness and informed decision-making. Before applying this mined knowledge to real-world issues, it needs to be made more actionable. This study emphasizes the need to understand the inherent diversity of men and women across different contexts. Further research should aim to identify patterns and rules within the extensive book circulation data that reflect the diverse cultural attributes of men and women. This will help refine the oversimplified notion that male and female borrowers inherently exhibit distinct digitization behaviors.

8. Conclusion

One crucial factor to consider when examining social classification is gender, as mentioned by Glazier et al. in 2020. The concept of gender essentialism, which asserts that men and women are inherently different due to their unique biological essences, has been widely recognized (Şahin & Yalcinkaya, 2021). In the 1990s, gender-related issues such as equal opportunities, resource allocation, gender segregation, organizational imbalance, and cultural discrimination were significant concerns (Jacobs, 1996). However, in recent decades, fertility rates have decreased, the balance between work and family life has improved, and the norms for parenthood have evolved for both men and women (Preisner et al., 2020). Gender studies aim to understand how collaboration between men and women can develop in a changing social environment, its impact on teacher preparation, the enhancement of school organizational culture, and the increase in public awareness (Hosseini & Sharifzad, 2021). Although big data offers new opportunities for organizations, its adoption is still in the early stages of introduction, and its determinants remain unclear in many sectors (Baig et al., 2023). Over the past few years, evolutionary algorithms have been successfully utilized in various optimization problems, mimicking the evolutionary process to solve various mathematical problems (Bandyopadhyay et al., 2021). Furthermore, machine learning algorithms for gender categorization suggest improving the algorithm and application preconditions, opening up new avenues for problem-solving, academic research, and exploring innovative directions in social research (Zakaria et al., 2015).

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Informed Consent

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Data Availability Statement

The data that support the findings of this study are available on request.

Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

References

Abdul Shahid, M. D., Mohd Hashim, M. H., Mohd Fadzil, N., Ahmad Rushdi, M. H., Al-Fakih, A., & Muda, M. F. (2023). A bibliometric analysis on the relevancies of artificial neural networks (ANN) techniques in offshore engineering. *Cogent Engineering, 10*(1). https://doi.org/10.1080/23311916.2023.2241729

Alexander, G. M., John, K., Hammond, T., & Lahey, J. (2021). Living up to a name: Gender role behavior varies with forename gender typicality. *Frontiers in Psychology*, *11*, 604848. https://doi.org/10.3389/fpsyg.2020.604848

Almeida, A., Brás, S., Sargento, S., & Pinto, F. C. (2023). Time series big data: a survey on data stream frameworks, analysis and algorithms. *Journal of Big Data, 10*(83). https://doi.org/10.1186/s40537-023-00760-1

Altunbey, O. F., & Erdal, O. (2023). A new approach for gender detection from voice data: Feature selection with optimization methods. *Journal of the Faculty of Engineering and Architecture of Gazi University*, *38*(2), 1179-1192. https://doi.org/10.17341/gazimmfd.938294

Ao, J. M., & Lin, L. (2020). On present situation, causes and countermeasures of "feminization" phenomenon of primary and secondary school teachers. *Journal of Research on Education for Ethnic Minorities*, *31(2)*, 54-62.

Applegate, R. (2008). Gender differences in the use of a public library. *Public Library Quarterly*, *27*(1), 19-31. https://doi.org/10.1080/01616840802122468

Baig, M. I., Yadegaridehkordi, E., Shuib, L., & Sallehuddin, H. (2023). Identifying determinants of big data adoption in the higher education sector using a multi-analytical SEM-ANN approach. *Education and Information Technologies, 28,* 16457-16484. https://doi.org/10.1007/s10639-023-11875-6

Balan, H., Alrasheedi, A. F., Askar, S. S., & Abouhawwash, M. (2022). An intelligent human age and gender forecasting framework using deep learning algorithms. *Applied Artificial Intelligence*, *36*(1), 2073724. https://doi.org/10.1080/08839514.2022.2073724

Bandyopadhyay, A., Begum, L., & Grossman, P. J. (2021). Gender differences in the stability of risk attitudes. *Journal of Risk and Uncertainty*, *63(2)*, 169-201. https://doi.org/10.1007/s11166-021-09361-w

Betzler, B. K., Yang, H. H. S., Thakur, S., Yu, M., Quek, T. C., … & Wong, T. Y. (2021). Gender prediction for a multiethnic population via deep learning across different retinal fundus photograph fields: Retrospective cross-sectional study, *JMIR Medical Informatics*, *9(8)*, e25165. https://doi.org/10.2196/25165

Bhagwat, V., Shirley, S. E., & Stark, J. R. (2023). Gender, learning, and earnings estimate accuracy. *Journal of Financial Markets*, *62*, 100756. https://doi.org/10.1016/j.finmar.2022.100756

Bottomley, E., Kohnle, A., Mavor, K. I., Miles, P. J., & Wild, V. (2023). The relationship between gender and academic performance in undergraduate physics students: The role of physics identity, perceived recognition, and self-efficacy, *European Journal of Physics*, *44*(2), 025701. https://doi.org/10.1088/1361-6404/aca29e

Brown, L. M. (2022). Gendered artificial intelligence in libraries: Opportunities to deconstruct sexism and gender binarism. *Journal of Library Administration*, *62*(1), 19-30. https://doi.org/10.1080/01930826.2021.2006979

Chatterjee, P., Warner, L. N., Basil, M. C., Christopher, M., Manning, K., Fisher, H. N., … & Yialamas, M. A. (2021). "Make the implicit explicit": Measuring perceptions of gender bias and creating a gender bias curriculum for internal medicine residents. *Advances in Medical Education and Practice*, *12*, 49-52. https://doi.org/10.2147/AMEP.S292166

Farago, F., Martin, C. L., Granger, K. L., Santos, C. E., & Miller, C. F. (2022). Teachers' gender-role attitudes and gendered classroom practices. *Sex Roles*, *87*(9-10), 471-486. https://doi.org/10.1007/s11199-022-01331-z

Friedmann, E., & Efrat-Treister, D. (2023). Gender bias in stem hiring: implicit in-group gender favoritism among men managers. *Gender & Society*, *37*(1), 32-64. https://doi.org/10.1177/08912432221137910

Glazier, J. J., Gülgöz, S., & Olson, K. R. (2020). Gender encoding in gender diverse and gender conforming children. *Child Development*, *91*(6), 1877-1885. https://doi.org/10.1111/cdev.13399

Gloria, A. G., Daniel, B. A. J., & Mar, S. V. M. D. (2022). Infrastructure and subjective well-being from a gender perspective. *Administrative Sciences*, *12*(1), 32. https://doi.org/10.3390/admsci12010032

Gurieva, S. D., Kazantseva, T. V., Mararitsa, L. V., & Gundelakh, O. E. (2022). Social perceptions of gender differences and the subjective significance of the gender inequality issue. *Psychology in Russia: State of the Art*, *15*(2), 65-82. https://doi.org/10.11621/pir.2022.0205

Haines, E. L., Deaux, K., & Lofaro, N. (2016). The times they are a-changing … or are they not? A comparison of gender stereotypes, 1983–2014. *Psychology of Women Quarterly*, *40*(3), 353-363. https://doi.org/10.1177/0361684316634081

Han, L., & Li, T. (2009). The gender difference of peer influence in higher education. *Economics of Education Review*, *28*(1), 129-134. https://doi.org/10.1016/j.econedurev.2007.12.002

Hausmann, M. (2021). Sex/gender differences in brain activity–It's time for a biopsychosocial approach to cognitive neuroscience. *Cognitive Neuroscience*, *12*(3-4), 178-179. https://doi.org/10.1080/17588928.2020.1853087

Hek, M. V., Buchmann, C., & Kraaykamp, G. (2019). Educational systems and gender differences in reading: A comparative multilevel analysis. *European Sociological Review*,

35(2), 169-186. https://doi.org/10.1093/esr/jcy054

Hek, M. V., Kraaykamp, G., & Pelzer, B. (2018). Do schools affect girls' and boys' reading performance differently? A multilevel study on the gendered effects of school resources and school practices. *School Effectiveness and School Improvement*, *29*(1), 1-21. https://doi.org/10.1080/09243453.2017.1382540

Helles, R., & Ørmen, J. (2020). Big data and explanation: Reflections on the uses of big data in media and communication research. *European Journal of Communication, 35*(3), 290-300. https://doi.org/10.1177/0267323120922088

Hodgetts, S., & Hausmann, M. (2022). Sex/gender differences in brain lateralisation and connectivity. *Current Topics in Behavioral Neurosciences*, *62*, 71-99. https://doi.org/10.1007/7854_2022_303

Hosseini, M., & Sharifzad, S. (2021). Gender disparity in publication records: a qualitative study of women researchers in computing and engineering. *Research integrity and peer review*, *6*(1), 15. https://doi.org/10.1186/s41073-021-00117-3

Hsiung, C. (2022). Gender-typed skill co-occurrence and occupational sex segregation: The case of professional occupations in the United States, 2011–2015. *Gender & Society*, *36*(4), 469-497. https://doi.org/10.1177/08912432221102148

Igarashi, T., Koizumi, M., & Widdersheim, M. (2020). Capturing citizens' information needs through analysis of public library circulation data. *Libri: International Journal of Libraries & Information Services*, *70*(2), 127-141. https://doi.org/10.1515/libri-2018-0137

Indrek, K., & Õun, K. (2020). Gender differences favouring females in learning strategies in mathematics. *Problems of Education in the 21st Century*, *78*(4), 595-611.

Jacobs, J. A. (1996). Gender inequality and higher education. *Annual Review of Sociology*, *22*(1), 153. https://doi.org/10.1146/annurev.soc.22.1.153

Joshi, P. D., Wakslak, C. J., Appel, G., & Huang, L. (2020). Gender differences in communicative abstraction. *Journal of Personality and Social Psychology: Attitudes and Social Cognition*, *118*(3), 417-435. https://doi.org/10.1037/pspa0000177

Jung, C. G. (1966). *Spirit in Man, Art, and Literature*. Princeton University Press.

Kelly, K. (2009). *Out of control: The new biology of machines, social systems, and the economic world*. Hachette UK: Perseus Books.

Khairy, D., Alharbi, N., Amasha, M. A., Areed, M. F., Alkhalaf, S., & Abougalala, R. A. (2024). Prediction of student exam performance using data mining classification algorithms. *Education and Information Technologies*. https://doi.org/10.1007/s10639-024-12619-w

Khan, M., Perwez, S. K., Gaddam, R. P., Aiswarya, R., Abrar Basha, M., Malas, A., & Ahmad, F. (2024). Mind matters: Exploring the intersection of psychological factors and cognitive abilities of university students by using ANN model. *Neuropsychiatric Disease and Treatment, 20,* 137-148. https://doi.org/10.2147/NDT.S436975

Kuhn, A., Schneider, U., & Schwabe, A. (2023). Digital reading and gender inequality in higher education. *Higher Education Research & Development*, *42*(1), 141-155. https://doi.org/10.1080/07294360.2021.2019201

Lewis, M., Borkenhagen, M. C., Converse, E., Lupyan, G., & Seidenberg, M. S. (2022). What might books be teaching young children about gender?. *Psychological Science*, *33*(1), 33-47. https://doi.org/10.1177/09567976211024643

Liu, J. X. (2023). A normal university's disciplinary instruction: A close look at book lending. *Creative Education*, *14*(8), 1637-1668. https://doi.org/10.4236/ce.2023.148106

Liu, J. X. (2024). The challenge of procrastination: gaining insights from overdue books in university libraries. *Medical & Clinical Research*, *9*(8), 1-19. https://doi.org/10.33140/MCR.09.08.01

Martin, C. L., & Ruble, D. N. (2010). Patterns of gender development. *Annual Review of Psychology*, *61*, 353-381. https://doi.org/10.1146/annurev.psych.093008.100511

Napp, C., & Breda, T. (2022). The stereotype that girls lack talent: *A worldwide investigation. Science Advances*, *8*(10). https://doi.org/10.1126/sciadv.abm3689

Ogburn, E. L., Sofrygin, O., Díaz, I., & van der Laan, M. J. (2022). Causal Inference for Social Network Data. *Journal of the American Statistical Association*. https://doi.org/10.1080/01621459.2022.2131557

Perry, D. G., Pauletti, R. E., & Cooper, P. J. (2019). Gender identity in childhood: A review of the literature. *International Journal of Behavioral Development*, *43*(4), 289-304. https://doi.org/10.1177/0165025418811129

Powell, G. N., & Butterfield, D. A. (2022). Aspirations to top management over five decades: a shifting role of gender?. *Gender in Management*, *37*(8), 953-968. https://doi.org/10.1108/GM-10-2021-0330/full/html

Preisner, K., Neuberger, F., Bertogg, A., & Schaub, J. M. (2020). Closing the happiness gap: the decline of gendered parenthood norms and the increase in parental life satisfaction. *Gender & Society*, *34*(1), 31-55. https://doi.org/10.1177/0891243219869365

Ruthven, I., Robinson, E., & McMenemy, D. (2023). The value of digital and physical library services in UK public libraries and why they are not interchangeable. *Journal of Librarianship and Information Science,* *55*(4), 1143-1154. https://doi.org/10.1177/09610006221127027

Safara, F., Mohammed, A. S., Potrus, M. Y., Ali, S., Tho, Q. T., Souri, A., … & Hosseinzadeh, M. (2020). An author gender detection method using whale optimization algorithm and artificial neural network. *IEEE Access*, *8*, 48428-48437. https://doi.org/10.1109/ACCESS.2020.2973509

Şahin, O., & Yalcinkaya, N. S. (2021). The gendered brain: implications of exposure to neuroscience research for gender essentialist beliefs. *Sex Roles*, *84*(9-10), 522-535.

https://doi.org/10.1007/s11199-020-01181-7

Saleti, S., Panchumarthi, L. Y., Kallam, Y. R., Parchuri, L., & Jitte, S. (2024). Enhancing Forecasting Accuracy with a Moving Average-Integrated Hybrid ARIMA-LSTM Model. *SN Computer Science, 5,* 704. https://doi.org/10.1007/s42979-024-03060-4

Samanta, S., Rautaray, B., & Swain, D. K. (2022). Intellectual structure and pattern of publication in the International Journal of Innovation Science: a bibliometric study. *International Journal of Innovation Science*, *15*(2), 279-301. https://doi.org/10.1108/IJIS-06-2021-0103/full/html

Si, W. (2022). Higher education expansion and gender norms: Evidence from China. *Journal of Population Economics*, *35*(4), 1821-1858. https://doi.org/10.1007/s00148-022-00888-z

Song, M., Wang, R., & Li, Y. (2024). Hybrid time series interval prediction by granular neural network and ARIMA. *Granular Computing, 9,* 3. https://doi.org/10.1007/s41066-023-00422-w

Stout, J. G., & Dasgupta, N. (2011). When he doesn't mean you: Gender-exclusive language as ostracism. *Personality and Social Psychology Bulletin*, *37*(6), 757-769. https://doi.org/10.1177/0146167211406434

Thums, K., Artelt, C., & Wolter, I. (2021). Reading for entertainment or information reception? Gender differences in reading preferences and their impact on text-type-specific reading competences in adult readers. *European Journal of Psychology of Education*, *36*(2), 339-357. https://doi.org/10.1007/s10212-020-00486-1

Thums, K., Gnambs, T., & Wolter, I. (2020). The impact of gender-stereotypical text contents on reading competence in women and men. *Zeitschrift für Erziehungswissenschaft*, *23*(6), 1283-1301. https://doi.org/10.1007/s11618-020-00980-8

Tibor, K. (2017). Gender and information literacy: Evaluation of gender differences in a student survey of information sources. *Library Review*, *27*(3), 479-480.

Turesky, M., & Warner, M. E. (2020). Gender dynamics in the planning workplace. *The Importance of Women in Management*, *86*(2), 157-170. https://doi.org/10.1080/01944363.2019.1691041

Vellamo, T. (2022). Gendered identities in a university merger–female academics' identifications in technical fields. *European Journal of Engineering Education*, *48*(2), 267-283. https://doi.org/10.1080/03043797.2022.2117590

Wang, J. (2021). Research on facial feature-based gender intelligent recognition based on the Adaboost algorithm. *International Journal of Biometrics*, *13*(1), 40-50. https://doi.org/10.1504/ijbm.2021.112217

Wang, W. Y., & Xie, D. S. (2023). Who are studying in normal majors in universities? *Journal of South China Normal University (Social Science Edition)*, *1*, 38-47.

Wang, Y., & Shen, H. (2022). A study on the gender differences of value–Added in critical

thinking capacity of Chinese undergraduates. *Chongqing Higher Education Research*, *10*(2), 60–74.

Witten, I. H., Frank, E., & Hall, M. A. (2011). *Data mining practical machine learning tools and techniques* (3rd ed.). Morgan Kaufmann.

Wu, Q. X., Lin, Y. J., & Gong, H. Y. (2022). Why choose a major in education: An empirical study based on the college major choices of county high school graduates. *China Higher Education Research*, *352*(12), 51-58.

Ye, J. T., & Wang, L. K. (2022). Gender differences in access to education opportunities in key universities. *Social Science of Beijing*, *233*(9), 106-115.

Zakaria, N. K., Jailani, R., & Tahir, N. M. (2015). Application of ANN in gait features of children for gender classification. *Procedia Computer Science*, *76*, 235-242. https://doi.org/10.1016/j.procs.2015.12.348

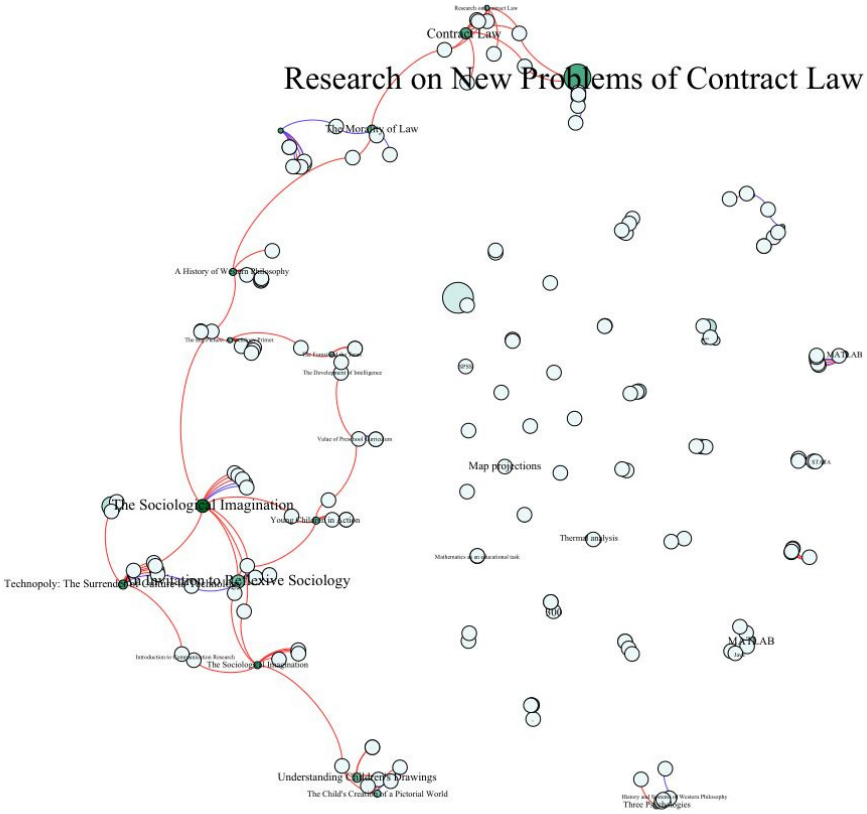
Zehnter, M. K., Olsen, J., & Kirchler, E. (2018). Obituaries of female and male leaders from 1974 to 2016 suggest change in descriptive but stability of prescriptive gender stereotypes. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.02286

Zhang, X. L., Shi, Y., Zheng, Q., Ye, X. Y., & Wang, N. (2023). An empirical study on students' academic performance of public funded pre-service teacher programs: based on the administrative data of a top-ranked normal university in China. *Journal of Educational Studies, 19*(1), 165-181.

Zhao, B. (2023). Smart library access flow prediction method oriented to big data and embedded web system. *International Journal of System Assurance Engineering and Management*. https://doi.org/10.1007/s13198-023-02144-3

Supplementary files

Figure 1



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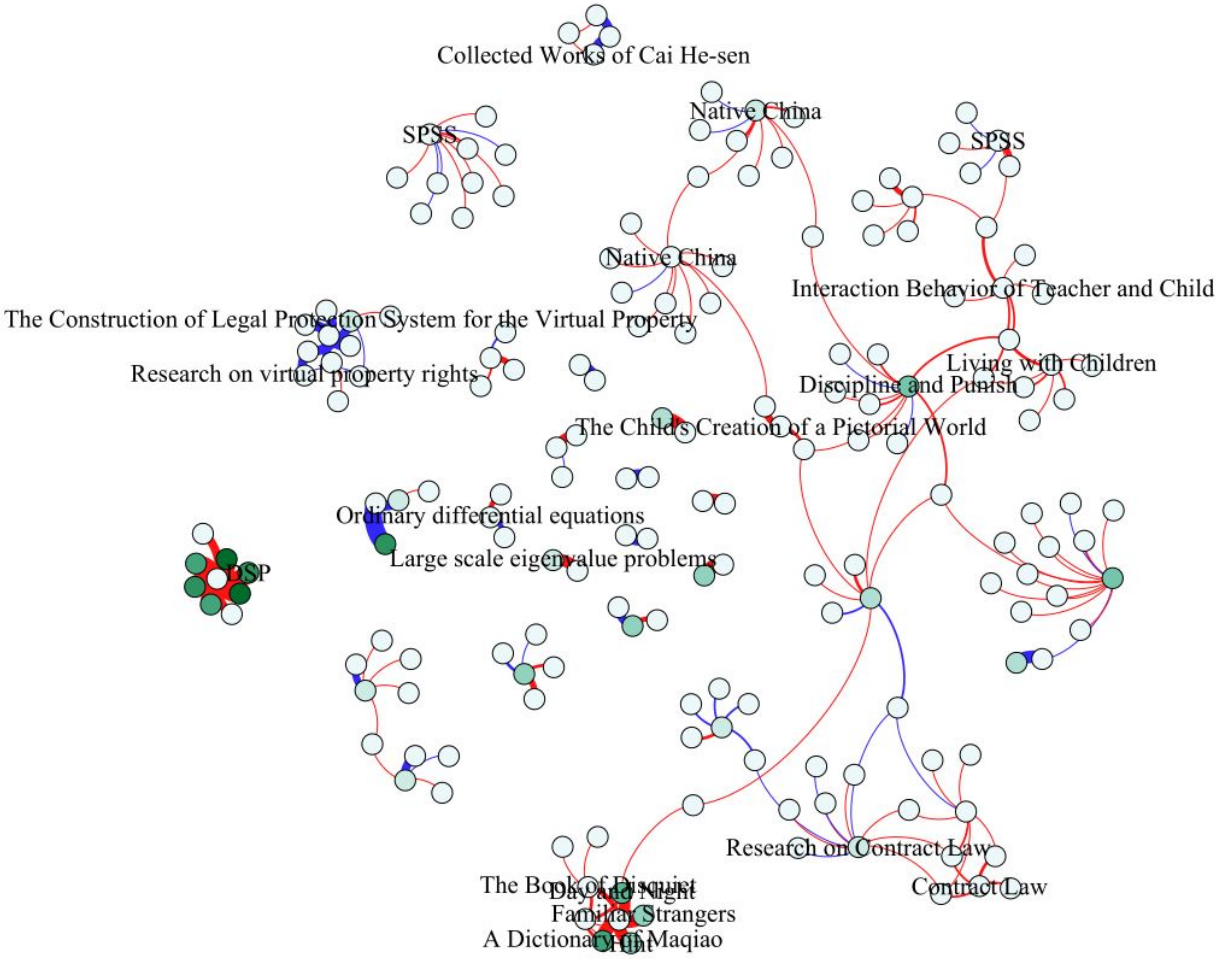
Collected Works of Cai He-sen
Native China
SPSS
SPSS
Native China
Interaction Behavior of Teacher and Child
The Construction of Legal Protection System for the Virtual Property
Research on virtual property rights
Living with Children
Discipline and Punish
The Child's Creation of a Pictorial World
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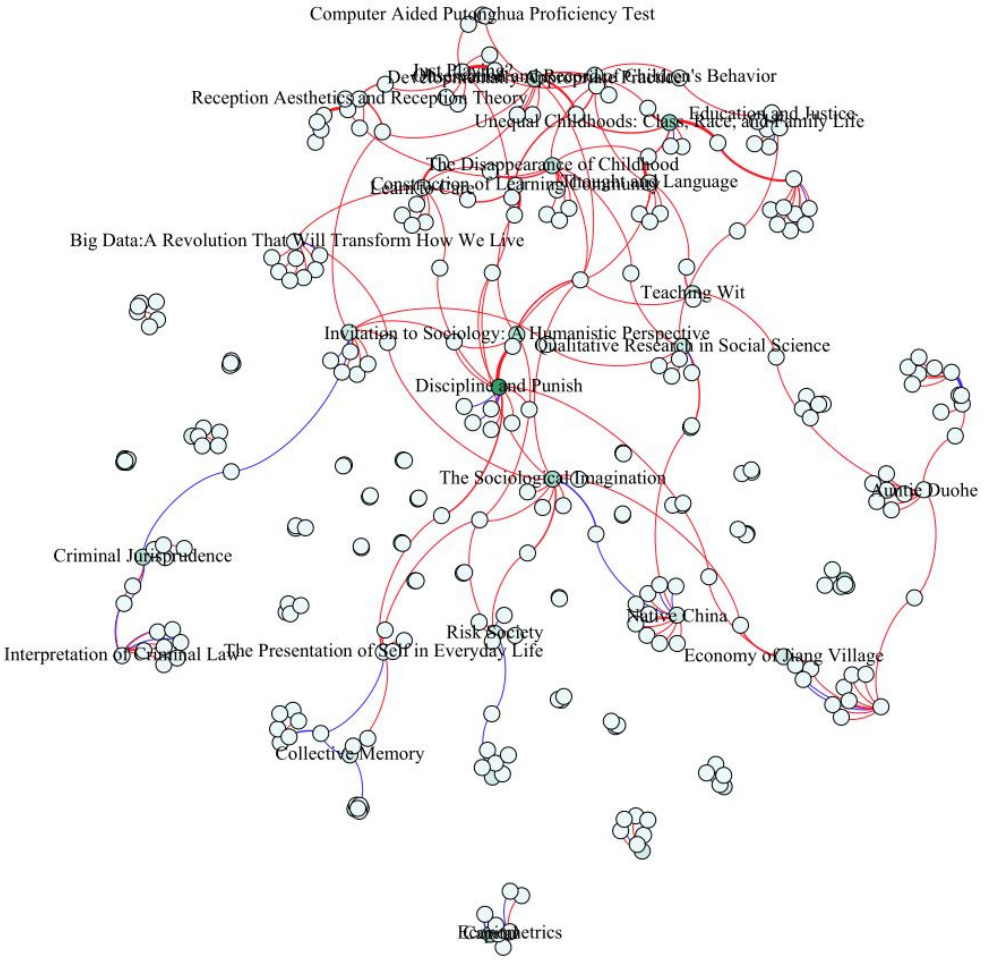
Contract Law
Familiar Strangers
Maqiao

Grade 2013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Education and Justice
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The Disappearance of Childhood
Big Data:A Revolution That Will Transform How We Live
Teaching Wit
Invitation to Sociology: A Humanistic Perspective
Qualitative Research in Social Science
Discipline and Punish
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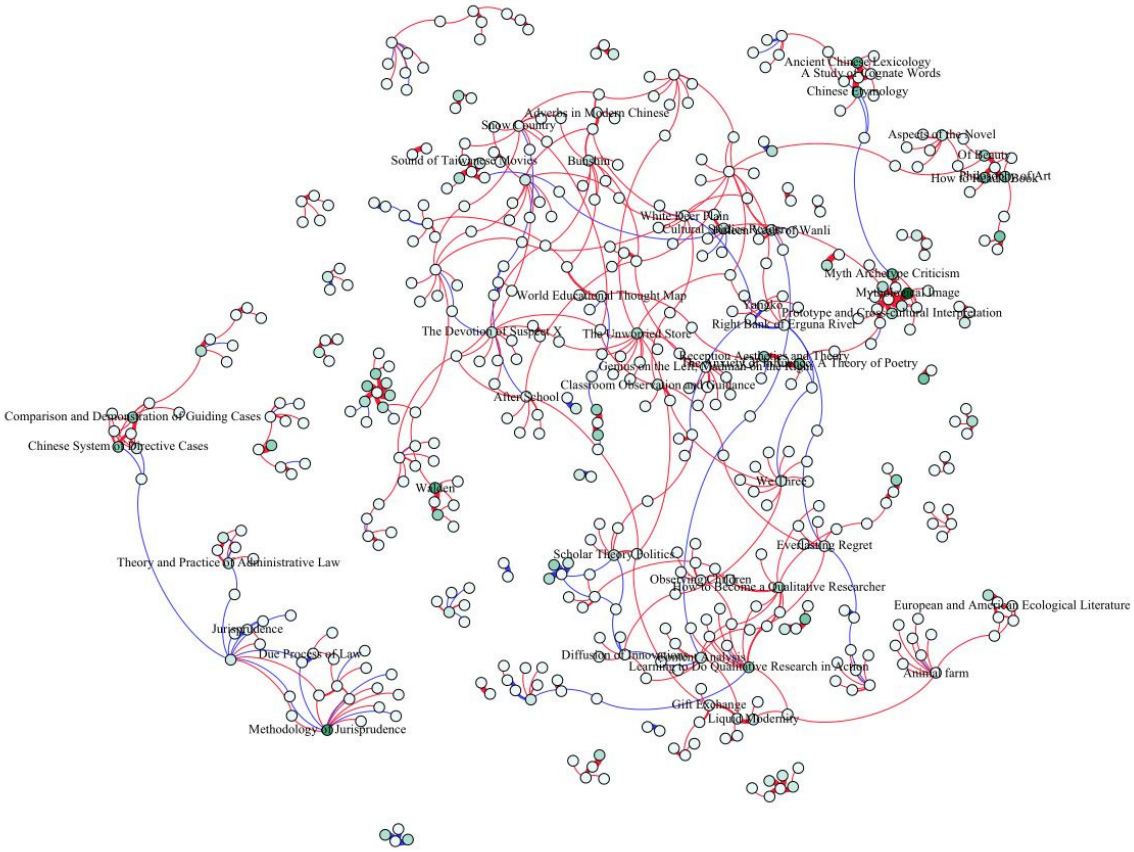
Economy of Diang Village
Collective Memory

Grade 2014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World Educational Thought Map
Right Bank at Erguna River
The Devotion of Suspect X
The Unwomed Store
Reception Aesthetics and Theory
Classroom Observation and Guidance
After School
Comparison and Demonstration of Guiding Cases
Chinese System of Directive Cases
We Three
Everlasting Regret
Scholar Theory Politics
Theory and Practice of Administrative Law
How to Become a Qualitative Researcher
European and American Ecological Literature
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Due Process of Law
Learning to Do Qualitative Research in Action
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Gift Exchange
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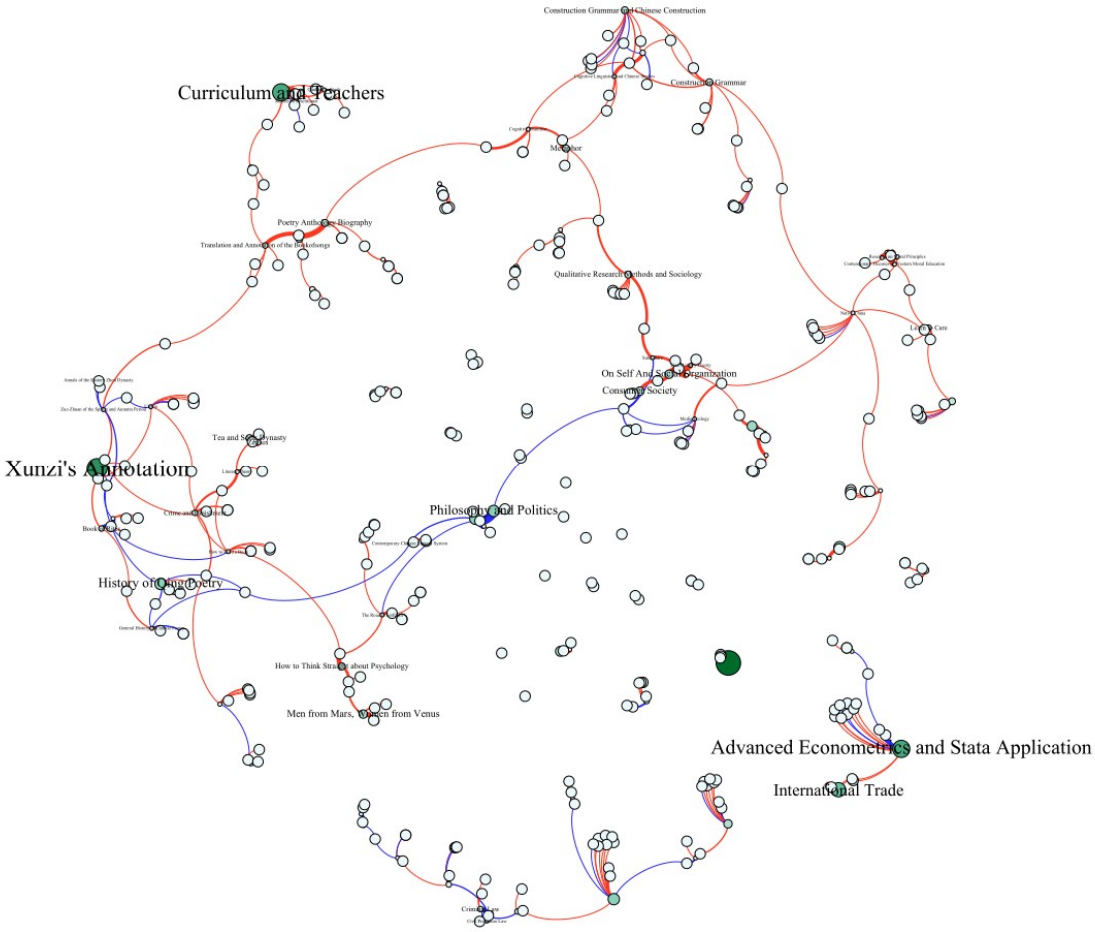
Methodology of Jurisprudence

Grade 2015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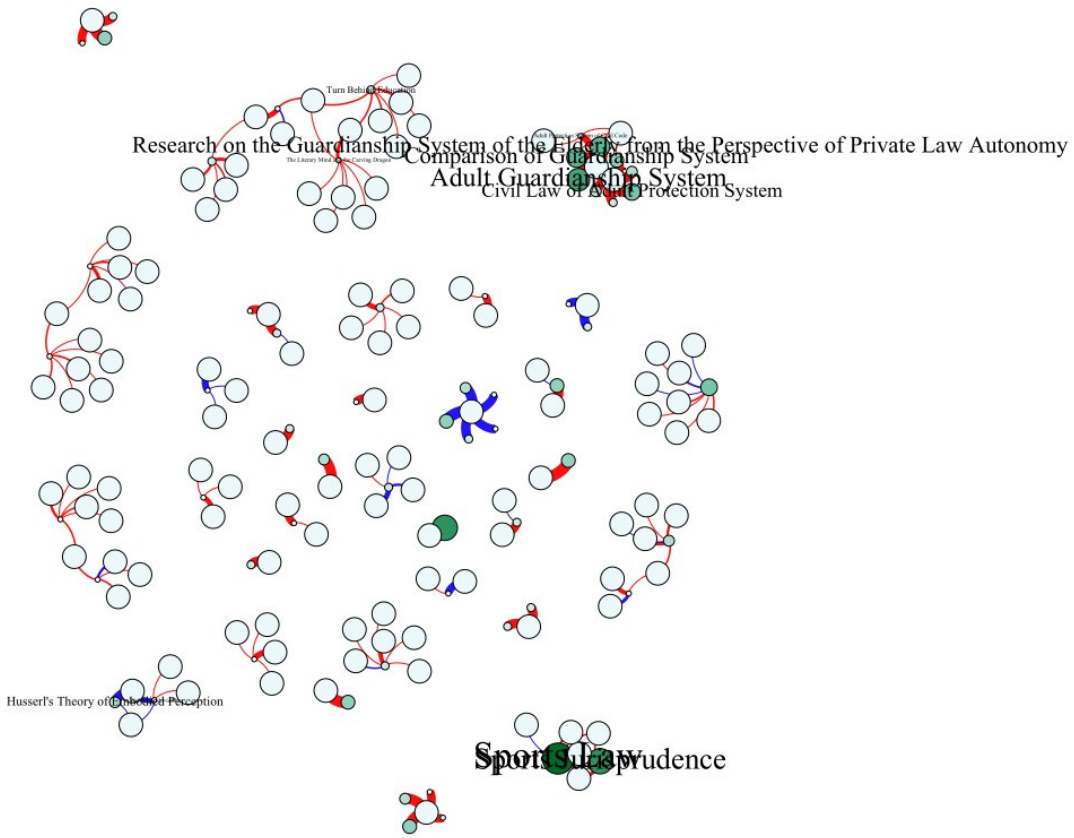
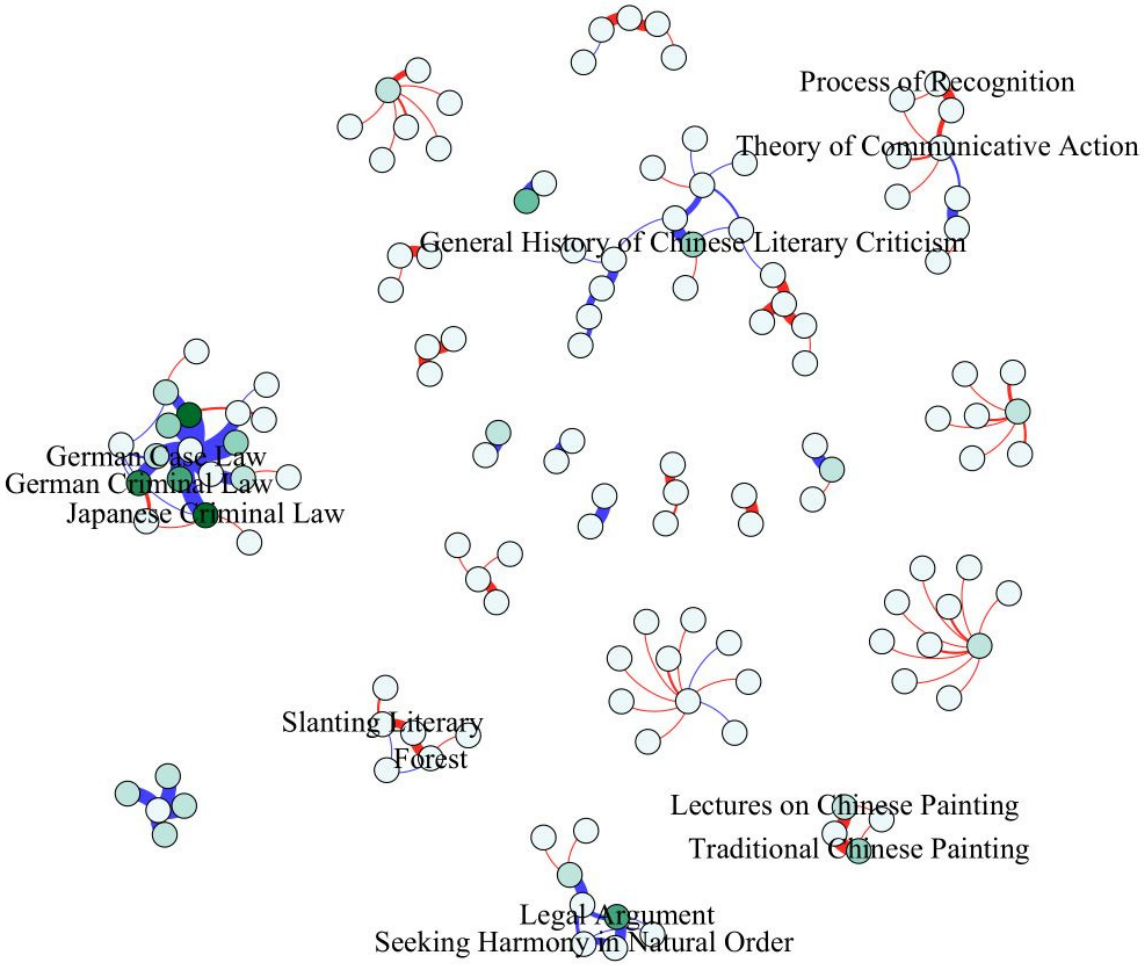
Xunzi's Annotations
Philosophy and Politics
History of Tang Poetry
Advanced Econometrics and Stata Application
International Trade
Qualitative Research Methods and Sociology
Consumer Society
How to Think Straight about Psychology
Men from Mars, Women from Venus

Grade 2016


Research on the Guardianship System of the Elderly from the Perspective of Private Law Autonomy
Comparison of Guardianship System
Adult Guardianship System
Civil Law of Adult Protection System
Husserl's Theory of Embodied Perception
Sports Law
Sports Jurisprudence

Grade 2017



Grade 2018