Investigating the Relationships between Scholars and Politicians in Ancient China: Taking the Yuanyou Era as an Example

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Abstract

The Song Dynasty was a decisive period of transformation in ancient China, during which relationships between scholars and politicians are thought to have become closer and closer, and this change is considered part of the “Tang–Song transition.” In the Song Dynasty, the Yuanyou 元祐 era (1086–94) was a critical and complex period with regard to its political environment. The major purpose of this paper is to investigate the relationships between scholars and politicians during this period. The connections between figures collected from the CBDB (China Biographical Database) include both literary relations and political relations. Two scholars have a literary relation when both of them write to a common third figure, and a political relation between two politicians is demonstrated through such connections as political support associations, recommendation sponsorship, and oppositional political affiliations. In the present study, two matrices are respectively constructed according to literary and political relations among figures and a Poisson-Gamma factorization model is adopted to obtain the key factors of the matrices. According to calculated results and literary history, the scholars can be clearly classified into three groups. We identified two groups of the politicians with this method, while we found other politicians to have steered a course between them. Furthermore, the figures engaged in common literary pursuits are more likely to share common political goals. As a result, the observation that scholars and politicians are related closely in the Yuanyou era confirms that this period must have featured literati politics.

1. Introduction

The research described in this paper studies the relationships between scholars and politicians in the Yuanyou era. The Song dynasty is considered a decisive period in the development of literati politics, and the Yuanyou era is especially important in Northern

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Song (960-1127) politics. In a typical literati politics environment, scholars are active in politics and politicians are interested in writing to others (this may happen in a literary or a nonliterary way, but only the former way is related to literati politics, and thus to the main focus of the study). Therefore, investigating the relationships between the two groups of people may throw light on future studies.

For the sake of studying the relationships between scholars and politicians of the Yuanyou era, we proposed the following research question: for Yuanyou era figures, are those who are engaged in common literary pursuits more likely to share political goals?

In order to answer this question, we investigate literary relations among scholars and political relations among politicians. Here, “literary relation” is defined as “two scholars interacting with each other literarily,” while “political relation” is defined as “two politicians interacting with each other politically.” Further explanations of the concepts will be given in section 3 by listing all of the subrelations of the two kinds of relations. Since scholars interact with each other in the field of writing because of their common literary pursuit, while politicians interact with each other in the field of politics because they are sharing certain political goals, the question can be answered by studying the correlations among those figures.

We construct correlation matrices based on data collected from the CBDB (China Biographical Database) (2017). Afterwards, we apply dimensionality reduction, and explain the results using the features extracted. We explain the factors generated as literary pursuits and political goals respectively. We analyze and compare the scholars and politicians who are notable regarding certain factors and create a visualization of the results of dimensionality reduction. Finally, we establish two social network graphs for scholars and politicians, respectively, in order to visualize the relations among them more intuitively. The results are briefly discussed and compared with those from dimensionality reduction.

In section 2, we present the motivation of the research, discussing literati politics in the Song dynasty. We introduce the methods in section 3, which describes our methodology of data collection and data analysis. We present the evaluation in section 4, which displays and discusses the results of dimensionality reduction of both literary and political matrices and their comparisons. In addition, we show and briefly discuss the results of social network graphs. Finally, we present our conclusions in section 5.

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1 CBDB is a freely accessible relational database with biographical information about approximately 370,000 individuals as of April 2017, primarily from seventh-through nineteenth-century China: see https://projects.iq.harvard.edu/cbdb.
2. Literati Politics in the Song Dynasty

“Literati politics” was a distinct feature of ancient Chinese government, which became a typical autocratic monarchy government in the Ming and Qing dynasties. For instance, in a case study on the literati of Huizhou during 1200–1550, literati were the most important actors on the stage of politics (Du 2012). However, it was in the Song Dynasty that the growth in the importance of literati on imperial politics accelerated notably, a trend which the academic world considers part of the “Tang–Song transition.”

The concept of the “Tang–Song transition” was proposed by Naitō Konan, who argued that “the fall of the T’ang Dynasty was the collapse of aristocratic government in China, and the rise of monarchical autonomy and populism” (Fogel 1984, 170). Based on this theory, the Song dynasty was considered a period when the “semi-hereditary professional bureaucracy” was being replaced by the “local elite gentry families” (Luo 2005, 107). This enabled the establishment and development of literati politics.

Literati had ubiquitous influence on imperial politics during the Song Dynasty. *Daoxue* 道学, as an ideology of literati, became official during the Southern Song (1127–1279) as it adapted to the culture of examination (De Weerdt 1998). *Guanzhong* 关中 was considered a bond among “the monarch, the court, the local officials, the *shi*, and the common people” (Ong 2005, 57). Other scholars have also noted the importance of literati in the Song government in their study on the “Ancestors’ Family Instruction” (*zu zong jia fa* 祖宗家法), arguing that they were playing the role of guarantors in helping to standardize the rules (Deng and Lamouroux 2005, 97).

Moreover, in the Northern Song, cultural interactions among the literati were

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2 Termed *lixue* 理学 (English: Neo-Confucianism) in the Northern Song. The ideology is seen as a reaction to the ideas of Buddhism and religious Daoism, as well as a renaissance of traditional Confucian ideas. The Neo-Confucians tried to borrow Daoist and Buddhist terminology and concepts into their ideology (Huang 1998). *Daoxue* or *lixue* was thought to have been first developed by Zhou Dunyi 周敦颐 (1017–1073) in the Northern Song; it became the dominant ideology from the twelfth century onwards.

3 A school of *daoxue* led by Zhang Zai 张载 (1020–1077), who “was looked upon in later periods as the co-founder of the *daoxue* movement” (Ong 2005, 30). Since members of it “were mostly active in the region called Guanzhong 关中 in present-day Shaanxi 陕西,” which was abbreviated as *guan* 关, “the school was referred to in later periods as *Guanxue* 关学, which literally means the Guanzhong school of *daoxue*” (Ong 2005, 30).

4 According to Hucker (1985), *shi* means “elite,” and is “a broad generic reference to the group dominant in government, which also was the paramount group in society.” The concept “gradually transformed” from “a warrior caste . . . into a non-hereditary, ill-defined class of bureaucrats among whom litterateurs were most highly esteemed” (p. 421, item 5200).
connected with politics as a result of the development of literati politics. For example, a number of prominent scholar-officials during the eleventh century, including Fan Zhongyan, Ouyang Xiu, Su Shi, and many others, promoted Yan Zhenqing’s calligraphic style for ideological reasons (McNair 1998). The unprecedented frequency of cultural interactions among the literati made the issue of their involvement in politics extremely important. Inn-wall writing in the Song Dynasty implies “communication, collaboration, and community” of the literati, and such connections may have strongly influenced their political relations (Cong 2005).

In addition, in the Song Dynasty, literati wrote prefaces and postfaces to each other, and the phenomenon was so common that “writings are disseminated because of the prefaces” (wen yi xu chuan 文以序传). The Song dynasty witnessed a fundamental change in the value, function, and significance of the prefaces and postfaces compared with their predecessors. As a result, the prefaces and postfaces gradually took on a political function, especially when written for collected works of political memorials.

These phenomena shed light on Song politics. Culture and politics seem to have developed a close connection through interactions between scholars and politicians, and sometimes among the scholar-officials (those who were simultaneously both scholars and politicians).

We have chosen scholars and politicians who were active in Yuanyou era as examples for the study. The Yuanyou era was especially important in the Northern Song: it was a critical period in the transformation from ordinary party conflict to disastrous political persecution, because politicians were exercising moral judgements towards each other in the party conflicts during that time (Xiao 1998). In the Yuanyou era, there was conflict not only between the reformers and the antireformers, but also among the antireformers. It was an important and complex period and thus is fertile ground for research.

Therefore, we try to verify the supposition that scholars and politicians were closely related to each other during the period. In order to study the literary relations among the scholars, we used methods from the field of informetrics. There are two important methods available for studying the relationships between two documents: bibliographic coupling and co-citation. Two documents are bibliographically coupled if they reference a common third item, and their bibliographic coupling strength is the number of references they have in common (Kessler 1963). In contrast, the co-citation frequency is defined as the frequency with which two documents are cited together (Small 1973).

For the purpose of studying literary relations among the literati, the concept of bibliographic coupling can be converted into “two figures writing to a common third figure,” while the concept of co-citation can be converted into “two figures being written
to by a common third figure.” For our research, we chose to use bibliographic coupling rather than co-citation based on the following analysis: two figures writing to a common third figure imply that they share approval of the same person, and thus demonstrating their close relationships. However, two figures receiving a piece of writing from a common third figure may result from their reputations, and that “common third figure” may not even be contemporary with them, since he or she may just write prefaces or postfaces for their works.

3. Methods

In order to generate a list of figures who were active in the Yuanyou era (1086–94), we queried the CBDB (2017) for all of the figures who were born in or before 1080 and died in or after 1086. By selecting people who died in or after 1086, we excluded those who died before the Yuanyou era. And by setting the birth year at 1080 or earlier, we eliminated those who were too young to be active or were not yet born in the era. Any person selected must have been at least 15 years old in 1094 (the last year of the Yuanyou era). Since the age of 15 is called “an age of aspiring to learn” (zhi xue zhi nian 志学之年) in Chinese culture and is considered a landmark in a person’s life, being at least 15 can be considered a minimum age for expressing oneself in the fields of literature and politics.

After generating the list, we collect the literary relations among them. Referencing the concept “writing association” in CBDB (2017), we generate a list of all specific relations belonging to the category in the database, including writing commemorative texts, epitaphs, prefaces/postfaces, ritual texts, biographical texts, explanatory texts, mottos, correspondences, and occasional texts. (All of the associations recorded in the CBDB are directly based on original historical materials, and they are gathered manually since the significant difference between ancient and modern Chinese makes it unrealistic to generate the data from the original contents automatically.) Then we search for all the data in which figures are contained by the Yuanyou-era figure list, while relation types are contained by the literary relation list. When generating the literary relation list, since we focus on two figures writing to a common third figure instead of receiving writings from a common third figure, only the relations in which Yuanyou-era figures are people who write rather than receive a piece of writing are chosen.

Our approach to collecting initial data for political relations is similar to that for

5 Confucius, Analects 2.4.
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...literary relations, except that it focuses on direct relations among Yuanyou era figures, rather than their relations with a common third figure. Political relations are divided into three types: explicit positive relations, implicit positive relations, and negative relations. Explicit positive relations include supportive political associations, recommendation and sponsorship, and some connections via office; implicit positive relations include most connections via office (since they frequently but not necessarily result in close relationships), and negative relations include oppositional political associations.

At the data collection stage, we collected 4,810 records of literary relations, involving 110 Yuanyou-era figures who composed a piece of writing in the relationship, and 2,235 figures who received a piece of writing. We collected 590 records of political relations among Yuanyou era figures, with 148 figures involved in total.

We then used the data to construct the correlation matrices. The correlation matrix based on literary relations is similar to a bibliographic coupling matrix, and whenever Yuanyou-era figures \( i \) and \( j \) have literary relations with a common third figure (although this figure may not be among Yuanyou-era figures), the value of \( (i, j) \) in the correlation matrix will be increased by 1. Another correlation matrix is based on political relations. The value of \( (i, j) \) is a sum of three parameters: the number of explicit positive relations between figure \( i \) and \( j \) multiplied by 2, the number of implicit positive relations between figures \( i \) and \( j \) multiplied by 1, and the number of negative relations between figures \( i \) and \( j \) multiplied by -1.

Then both of the matrices are subjected to dimensionality reduction. Dimensionality reduction is the process of reducing the number of variables by obtaining a set of principal variables called factors (Roweis and Saul 2000), which describe correlations among the original variables. Since both of the matrices are relatively sparse and the data are all count data, we use a Poisson-Gamma factorization model for dimensionality reduction. The core idea of constructing the model is to place a gamma process prior to a Poisson factor analysis, and which creates a “hierarchical structure useful for sharing statistical strength between different groups of data” (Zhou et al. 2012). The mathematical formula is as follow:

\[
X_{pi} = \Sigma_{k=1}^{K} x_{pik} \times x_{pik} \sim Pois(\varphi_{pk} \theta_{kl}) \quad (1)
\]

The parameters proposed in formula (1) are explained as follows:

\[
\varphi_{k} \sim Dir(a_{\varphi}, \ldots, a_{\varphi}) \quad (2)
\]

\[
\theta_{kl} \sim Gamma(r_{k} \frac{p_{k}}{1-p_{k}}) \quad (3)
\]

\[
r_{k} \sim Gamma(c_{0}r_{0}, \frac{1}{c_{0}}) \quad (4)
\]

\[
p_{k} \sim Beta(c_{e}, c(1 - e)) \quad (5)
\]

We generate twelve factors from each matrix. It is necessary to mention that, when factor analysis is used to analyze a co-citation matrix or a bibliographic coupling matrix, the key factors are usually explained as academic groups focusing on a certain topic. Contemporary scholars citing other scholars’ work imply that the topics of their papers are related to the papers they cite, and thus a record of co-citation or bibliographic coupling reveals that two scholars are working on the same topic. In contrast, Yuanyou-era figures who write to a common third figure do not show they are both concerned about
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the same academic topic. Nevertheless, Yuanyou-era figures who write to a common third figure still imply the potential existence of a particular literary pursuit. Those who have literary relations with many people in common are likely to be engaged in common literary pursuits with them. Similarly, those who tend to aid each other politically primarily seem to be sharing some political goals. The supposition can be also reinforced by the fact that a certain figure may have different literary pursuits and share different political goals with different groups of people, which matches the mathematical concept of the factors.

Therefore, although the exact meaning of the key factors still needs further exploration, figures who have a common factor can be explained as being engaged in common literary pursuits or sharing certain political goals. The factors generated will first be discussed separately and then be compared.

4 Evaluation
4.1 Literary relations
Dimensionality reduction performed on the literary matrix (the correlation matrix of writings) reduces the dimension of the matrix to twelve variables. Based on general regulations of dimensionality reduction, these twelve variables can be considered as the twelve key factors of the matrix. We use mean squared error (MSE) as the estimator to measure the difference between the estimated value and what is estimated. The difference occurs because of randomness or because the estimator does not account for information, and thus the value of the MSE is positively related to the error (Lehmann and Casella 1998). After continuous iteration, the MSE becomes smaller and smaller; we iterate the algorithm 400 times, and report the MSE of the dimensionality reduction on the literary matrix as follows:

<table>
<thead>
<tr>
<th>Number of Iterations</th>
<th>Mean Squared Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.3228</td>
</tr>
<tr>
<td>2</td>
<td>0.8583</td>
</tr>
<tr>
<td>3</td>
<td>0.7000</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>400</td>
<td>0.2876</td>
</tr>
</tbody>
</table>

The goal of dimensionality reduction is to describe original variables mathematically in terms of a lower number of unobserved factors. Each factor is generated for the purpose of reconstructing the data, and contains unequal information about the original matrix. All of the factors are mathematically explanatory to some extent, but some of them should be disregarded as being historically meaningless. Although the first five extracted factors
explain the highest variances, since they act as accumulations of many variables, certain features of the matrix are neglected, which makes these factors historically meaningless. Conversely, variances explained by the last three extracted factors are too low, which leads to too small an amount of information contained, making these factors also historically meaningless. Therefore, we choose the four factors which rank from sixth to ninth out of the twelve factors. For each factor, we pick the ten figures who have the highest values, in order to find those who are engaged in common literary pursuits. The factor matrix is excerpted in table 2:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Su Shi 苏轼; Huang Tingjian 黄庭坚; Fan Chunren 范纯仁; Sima Guan 司马光; Wang Anshi 王安石; Fan Zuyu 范祖禹; Su Zhe 苏辙; Su Song 苏颂; Zhang Lei 张耒; Cheng Yi 程颐.</td>
</tr>
<tr>
<td>7</td>
<td>Su Shi 苏轼; Huang Tingjian 黄庭坚; Bi Zhongyou 毕仲游; Chao Yuezhi 晁说之; Zhang Lei 张耒; Shi Huihong 释惠洪; Chen Shidao 陈师道; Su Zhe 苏辙; Mi Fu 米芾; Su Guo 苏过.</td>
</tr>
<tr>
<td>8</td>
<td>Yang Shi 杨时; Han Wei 韩维; Luo Congyan 罗从彦; Ye Mengde 叶梦得; Chen Guan 陈瓘; Li Guang 李光; Cheng Yi 程颐; You Zuo 游酢; Su Shi 苏轼; Hu Anguo 胡安国.</td>
</tr>
<tr>
<td>9</td>
<td>Han Wei 韩维; Liu Yan 刘弇; Zheng Xia 郑侠; Zhang Lei 张耒; Sun Jue 孙觉; Lv Huiqing 吕惠卿; Zeng Zhao 曾肇; Cheng Shimeng 程师孟; Cai Bian 蔡卞; Su Zhe 苏辙.</td>
</tr>
</tbody>
</table>

Dimensionality reduction on literary relations shows some interesting findings, and figures having the highest values in some of the factors listed above can be explained as being “engaged in common literary interests.”

Scholars who have the highest values in both factors 6 and 7 include Su Shi 苏轼 (1037–1101), Huang Tingjian 黄庭坚 (1045–1105), Zhang Lei 张耒 (1054–1114), and Su Zhe 苏辙 (1039–1112), while Bi Zhongyou 毕仲游 (1047–1121), Chao Yuezhi 晁说之 (1059–1129), Shi Huihong 释惠洪 (1071–1128), Chen Shidao 陈师道 (1053–1102), Mi Fu 米芾 (1051–1107), and Su Guo 苏过 (1072–1123)—scholars who are all family members or students/close friends of Su Shi—have the highest values in factor 7. Thus these two factors can be explained as representing the literary interest of Su Shi, and
in particular, factor 7 can be directly explained as *shuxue* 蜀学⁶.

Scholars who have the highest values in factor 8 include Yang Shi 杨时 (1053–1135), You Zuo 游酢 (1053–1123), Luo Congyan 罗从彦 (1072–1135), and Cheng Yi 程颐 (1033–1107), the former two being Cheng Yi’s students who were honored as his four best students (程门四先生). Furthermore, Luo Congyan is the student of Yang Shi. Therefore, factor 8 can be explained as *luoxue* 洛学⁷ to some extent.

Finally, scholars who have the highest values in factor 9 include Liu Yan 刘弇 (1048–1102), Lv Huiqing 吕惠卿 (1032–1111), Zeng Zhao 曾肇 (1047–1107), and Cai Bian 蔡卞 (1048–1117). Factor 9 cannot be definitively attributed to a specific literary interest. However, those who have a high value in this factor do have some shared characteristics, as we will discuss in chapter 4.3.

Admittedly, not all figures having the highest values in certain factors are as explanatory as the figures noted above. For one thing, this is because calculated results are naturally different from historical reality. No matter how similar they are, there is still tension between them. For another, although most literary relations should be attributed to the scholars’ engagement in common literary pursuits, there are still some literary relations detected because of other reasons (for example, they write to a common third figure because the three of them are family members). However, since the above-mentioned observations are far more significant than random occurrences, it is reasonable to draw historical conclusions from them.

In figure 1 we visualize the result of dimensionality reduction of the literary matrix using factors 7, 8, and 9. The figure below can be divided into three sections, with section A representing *shuxue*, section B representing *luoxue*, and section C, which is hard to name but will also be discussed in section 4.3.

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⁶ A school led by Su Shi, it was name after his hometown Sichuan 四川, which was called shu 蜀 in ancient China.

⁷ A school led by Cheng Yi and Cheng Hao 程顥 (1032–1085), it was named after their hometown Luoyang 洛阳, which was abbreviated as luo 洛.
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Figure 1. Visualization of the results of dimensionality reduction on the literary matrix

4.2 Political relations

The political matrix (correlation matrix of politics) is also reduced to twelve factors, which are explained as “political goals.” We again iterate the algorithm 400 times, and the MSE of the dimensionality reduction on the political matrix is shown in table 3:

Table 3. The Mean Squared Error of the Dimensionality Reduction on the Political Matrix

<table>
<thead>
<tr>
<th>Number of Iterations</th>
<th>Mean Squared Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.3056</td>
</tr>
<tr>
<td>2</td>
<td>3.4259</td>
</tr>
<tr>
<td>3</td>
<td>2.4214</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>400</td>
<td>0.4669</td>
</tr>
</tbody>
</table>

Similarly, we choose the four factors which rank from sixth to ninth out of the twelve factors, and pick the ten figures who have the highest values:

Table 4. Figures with the Highest Values in the Literary Matrix after Dimensionality Reduction

<table>
<thead>
<tr>
<th>Factor</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Sun Yong 孙永; Fan Chunren 范纯仁; Cheng Yi 程颐; Li Pu 李朴; Lv Yihao 吕颐浩; Li Qingchen 李清臣; Sima Guang 司马光; Su Song 苏颂; Wife of Zhao Shu 高氏(赵曙妻); Cheng Xiang 程珦.</td>
</tr>
<tr>
<td>7</td>
<td>Fan Zuyu 范祖禹; Su Shi 苏轼; Zhao Lingshi 赵令时; Chao Yuezhi 晁说之; He Zhu 贺铸; Zheng Mu 郑穆; Sima Kang 司马康; You Zuo 游酢;</td>
</tr>
</tbody>
</table>
Unlike “literary interest,” “political goals” are difficult to name. Therefore, we will simply analyze what those who share certain factors have in common. The main findings from the factor matrix of politics are as follows:

a. Politicians who have the highest value in factor 9 are mostly reformers, including Zhang Dun (1035–1105), Cai You (1077–1126), Zhang Shangying (1043–1121), and Zeng Bu (1036–1107), who are all listed by Liang Tao (1034–1097) as “confederates of Wang Anshi 王安石 (1021–1086)” according to Continuation of Comprehensive Mirror in Aid of Governance (Xu zhi tong jian 续资治通鉴) (1992, vol. 81) by Bi Yuan 毕沅 (1730–1797), while Yang Wei 杨畏 also attaches to Wang Anshi, Zhang Dun, and Cai Jing 蔡京 (1047–1126).

b. Politicians who have the highest value in factors 6, 7, and 8 are mostly anti-reformers. Among them, factor 6 is shared by Cheng Yi, Sima Guang 司马光 (1019–1086) and Wife of Zhao Shu 高氏(赵曙妻) (1032–1097), who are all typical anti-reformers; Wife of Zhao Shu is the queen who was the regent in Yuanyou era and abolished all of the new laws by Wang Anshi. Factor 7 is shared by Fan Zuyu 范祖禹 (1041–1098) and Su Shi, who are relatively mild anti-reformers, and factor 8 is shared by Cheng Yi and Guangting 朱光庭 (1034–1097), who are leaders of luodang 洛党.8

In figure 2 we visualize the result of dimensionality reduction of the political matrix with factors 6, 8, and 9. Figure 2 can be divided into two sections, with section A representing reformers and section B representing anti-reformers. Moreover, different sects of anti-reformers are also separated (for example, the members of shudang 蜀党9 are relatively separated from those of luodang. We did not visualize some of the figures in case the captions should cover each other. However, the result is fairly clear. Su Shi, Lv Tao, and Kong Wenzhong are all close to where Peng Ruli 彭汝砺 (1041–1095) is located in the figure below, which is quite far from where Cheng Yi is located).

8 A political group in the Yuanyou era led by Cheng Yi and Cheng Hao, abbreviated as luo 洛, always disputed with shudang 蜀党, another political group led by Su Shi, even though both of the political groups were antireformers.

9 A political group in Yuanyou era led by Su Shi, the members of which include Su Shi, Su Zhe, Lv Tao 呂陶 (1028–1104), Kong Wenzhong 孔文仲 (1038–1088), and others.
4.3 Comparison

The value of factors is especially important for quantitative analysis, and it rather difficult to explain the exact meaning of those values, since they are generated mathematically rather than historically. Therefore, at the comparison stage we try to describe the results qualitatively instead of arbitrarily introducing a quantitative indicator.

From the results of the dimensionality reduction on the literary matrix, we find an interesting characteristic common to the scholars sharing factor 9. Lv Huiqing, Zeng Zhao, and Cai Bian are all reformers and are listed as “confederates of Wang Anshi,” while Liu Yan is friendly to the reformers. Moreover, scholars who are attributed to section C in the visualized graph (fig. 1) are also mostly reformers. Therefore, it is no exaggeration to say that the results imply the existence of a certain literary interest shared by reformers and their friends, thus preliminarily showing a close relationship between literary pursuit and political opinions.

Moreover, in synthesizing the results presented in sections 4.1 and 4.2 we find that scholars who are engaged in common literary pursuits (who shared common factors after dimensionality reduction on the literary matrix) are likely to be both reformers or both antireformers, while most pairs of politicians who share political goals (who shared common factors after dimensionality reduction on the political matrix) are also both reformers or both antireformers. In addition, among the antireformers, scholars who are followers of shuxue are separated from those of luoxue in figure 1, just as politicians who are members of shudang are separated from those of luodang in figure 2.

Finally, we establish two social network graphs in order to verify the above conclusions. The social networks are constructed based on the data in the two matrices respectively, and are divided into various communities by the Louvain modularity algorithm, which outperforms many similar methods (Blondel et al. 2008). Besides, since the social network graph of scholars is much more complex, the size of the nodes in it is positively related to their degrees, thus highlighting the influential figures.
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Figure 3. Social network graph of scholars

Figure 4. Social network graph of politicians

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In figure 3, four communities are detected, and three of them contain at least ten figures. The purple community can be explained as a “core group” of scholars, of whom most are followers of *shuxue*. The orange one contains mostly followers of *luoxue* while the green one contains mostly reformers and their friends. And in figure 4, seven communities are detected. In the left half of the graph, the four communities (purple, blue, coral, and cyan) are mostly reformers, while in the right half of the graph, the three communities (green, orange, and black) are mostly anti-reformers. Specifically, members of *shudang* are mostly in the orange community, and members of *luodang* are mostly in the green one.

The findings above strongly reinforce the results of dimensionality reduction. The communities detected in the two social network graphs clearly overlap with each other. More intuitively, the position of a scholar in the social network of scholars (fig. 3) reflects his or her political view on the reform to a certain degree: most of those who appear in the right part are reformers, and those appearing in the left part are antireformers.

In conclusion, the results of dimensionality reduction indicate the connection between the literary relations and political relations among Yuanyou era figures. Those who are engaged in common literary pursuits usually share political goals with each other.

**5 Conclusion**

The final result of the evaluation is clear: although scholars and politicians have distinct characteristics, they have overt connections in Yuanyou era. Those who are engaged in common literary pursuits are more likely to help each other politically, making the Yuanyou era a period when culture and politics are highly related to each other.

Unlike previous research on the ancient history of China, our research has mainly used digitized historical materials instead of paper-based ones. The data in the CBDB (2017) provide most of our source material, supplemented by historical records of ancient China. We use methods from the field of informetrics, and add dimensionality reduction realized by statistical algorithms. Therefore, our research methodology is new.

However, the research is still preliminary and improvement is needed. Although the results seem meaningful, their reliability still needs to be verified. Moreover, the method of choosing factors ranking from sixth to ninth lacks validation. These problems need to be addressed in further studies. Our research methodology can be adapted for research on other historical periods and even different themes in the future. For instance, correlations between economic and political relationships could be examined.

The relationships between scholars and politicians became closer and closer in medieval China, and literati politics became more and more overt. As a result, China gradually transformed into a typical autocratic monarchy government governed by literati during the Ming-Qing dynasties. The Song Dynasty was a decisive period of transformation, and our research may serve as a preliminary evidence.

It is important to point out that our choice of the Yuanyou era as an object of study is just an example. The model we developed in the course of the research can be adapted for any historical period in and beyond Song Dynasty, to study the relationships between scholars and politicians by analyzing their similar literary pursuits and common political goals, thus acting
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as a tool for observing the implicit tendencies of ancient Chinese politics.

Our research provides a different approach to studying history that draws on scientific methods. We sincerely hope that our methodology can be adapted for further research on history, and that this preliminary research may inspire more and better work in the digital humanities. We firmly believe that the humanities and sciences can help each other forward.

References


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