

# VISUAL ANALYTICS FOR THE MARRIAGE NETWORK IN THE GORYEO DYNASTY, KOREA

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## ABSTRACT

Political marriage has been a historically productive and important matter to maintain or extend social power. This kind of relationship is also found in Korean history. For instance, in the history of the Goryeo dynasty (i.e., AD 918~ 1392 in Korea), the royal families of the Goryeo dynasty used marriage as a political strategy to maintain or extend their power. Qualitative studies have found that royal families used marriage as a means of maintaining political power, but there is still a lack of quantitative research supporting the outcomes of these studies (e.g., Ha, 1968; Jeong, 1984). For this reason, we adopt computational approaches to advance our understanding of the role of political marriage in the Goryeo dynasty, in Korea. In addition, to simulate the change of power by their origin (i.e., region), we made a visualization system to explore the marriage network of royal families. We note two major findings of this current study. First, the marriage strategies of royal families are divided into three types: (1) extra-family marriages, (2) inter-family marriages, and (3) the combination of extra-family marriages and inter-family marriages. The royal family of Goryeo expanded their external relationship through extra-family marriages and reproduced their power through intra-family marriages. Second, the power of the origin is higher in the origin where the king was born in wedlock than in the origin where many marriages were made with the royal family. As a whole, the success of our computational approaches adds to the quantitative evidence for the historical strategies of political marriage in the Goryeo dynasty, in Korea.

## KEYWORDS

visual analytics, network analysis, political marriage, Goryeo dynasty, history of Korea

## 1. INTRODUCTION

Political marriages have historically played a very important role in the ruling elite group to maintain or extend their power (e.g., Rollins & Bahr, 1976). Likewise, in Korean history, political marriage has been a means for the ruling elite group including the royal families of the Goryeo dynasty to form, maintain, and expand their power (e.g., Lee, 1984). In particular, the first king, Taejo, the founder of the Goryeo dynasty (i.e., AD 918~ 1392 in Korea), used political marriage as a means of strengthening royal authority. In addition, political marriage was also an important way for local groups to become the ruling elite group (e.g., Ha, 1968; Jeong, 1984; Kim, 2009). Most of the previous historical studies have been conducted by using qualitative research methods and have found that royal families used marriage as a means of maintaining political power, but there is still a lack of quantitative research supporting the outcomes of these studies. In order to fill the gap between qualitative and quantitative research methods, we aim to analyze the marriage network to see how royal families of the Goryeo dynasty use marriage as a political strategy to maintain or extend their power and how local groups use marriage to grow the ruling elite group. For this aim, we employ three network analysis

algorithms (i.e., degree centrality, closeness centrality, and betweenness centrality) and develop a visualization system to get a better interpretation of the marriage network.

Network analysis method expresses the relationship between information by using nodes and links, and has been widely used in research to express the relationship between people. For instance, Ha et al., (2019) used network visualization to see the change pattern of voting relationship between people in the Joseon dynasty, Korea. In this study, they noted that network visualization could contribute to research easier to compare the relationship between people than other visualization technics. Considering the results of previous studies that network analysis is useful for exploring and understanding the relationship between people, our study investigate the marriage network of royal families in the Goryeo Dynasty through network analysis by developing a visualization system named *DiachronicPowerChanges* (Available at: <http://202.30.16.152/DiachronicPowerChanges/>).

## 2. METHODS

### 2.1 Creating the marriage network data

Historical data on the marriage relationship for the royal family of the Goryeo dynasty is recorded in the Goryeosa (i.e., History of the Goryeo Dynasty), a government-published book of Goryeo dynasty's history, but there was no computerized data that can be used for our research. For this reason, we manually coded the marriage relationship data by examining and exploring the historical records of the Goryeo dynasty, in Korea. Data annotation was progressed by professionals who majored in the history of the Goryeo dynasty, in Korea. The entire process of the annotations is described as follows.

Based on the historical records including Goryeosa (Figure 1), we extracted information about people who have a relationship with the king and the queen within in the marriage network. We further added more people such as great-grandfathers, great-grandmothers, maternal grandfathers, and maternal grandmothers, including the parents of the king and the queen. At the final, we added personal information of each person such as where they were born (i.e., origin), their final grade, etc. The final data include information about royal marriages from 918 to 1031, the family relationship between the king and queen, and the area of their origin (including 137 people and 752 relationships).

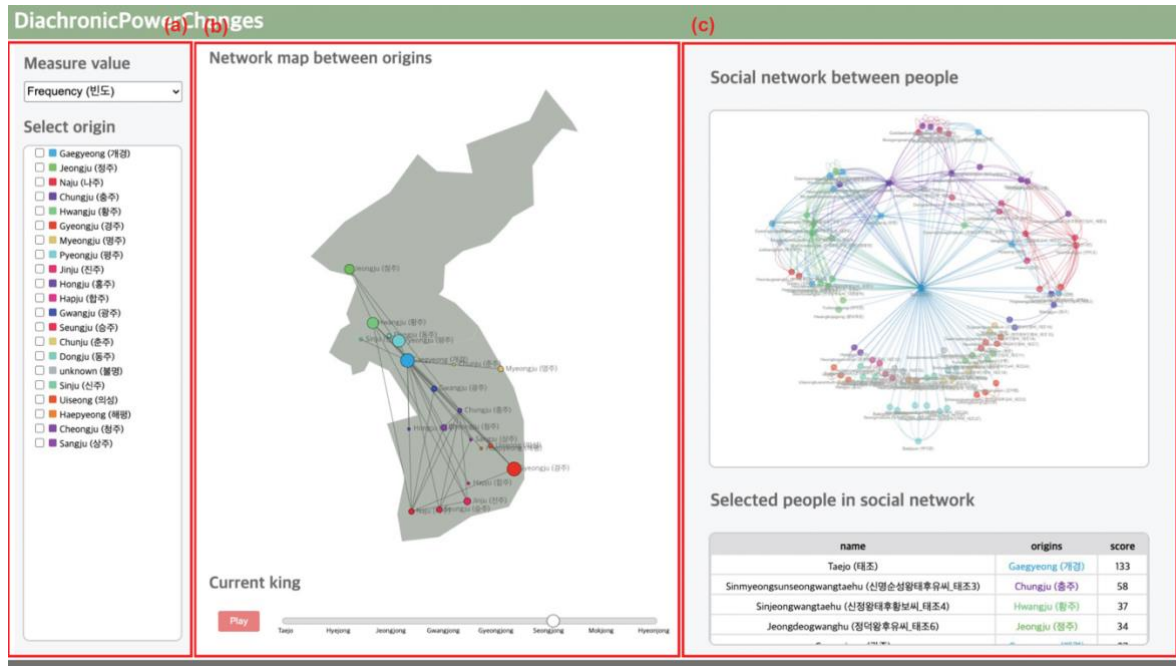
Figure 1. Goryeosa (the historical records of the Goryeo Dynasty; adapted from Kyujanggak. (2023))



## 2.2 Developing the visualization system

For better exploring and understanding of the marriage network, we designed a visualization system with JavaScript, HTML, and CSS environments, using the final data including the marriage relationships between people in the Goryeo dynasty, Korea. For the interface of the system, we created three areas for the exploration of the marriage network: data selection interface, network map between origins, and social network between people and details table of the people.

Figure 2. The overall interface of the visualization system (Available at: <http://202.30.16.152/DiachronicPowerChanges/>)



As shown in Figure 2(b), the network map presents the relationship between origins based on the selected measure values involving different origins (represented as dots and colors). A slider at the bottom of the map allows for changing the kings; the patterns of the network change as the slider moves. Each dot shows the details of the origin (e.g., an index/name of the selected origin, the score according to the selected measure value) once the mouse pointer is located on the dot. For the manipulation of visualization outcomes, Figure 2(a) provides options to select the measure values and checkboxes to highlight interesting origins.

The right side of the system as in Figure 2(c) provides users social network between people, and a details table of the people. This section is also interlocked with the data selection part so that highlights interesting people by the selected origins. The table at the bottom right side of the system presents the details of the people in the social network. This table provides several people's information such as name, origin, and score according to the selected origin and measure value.

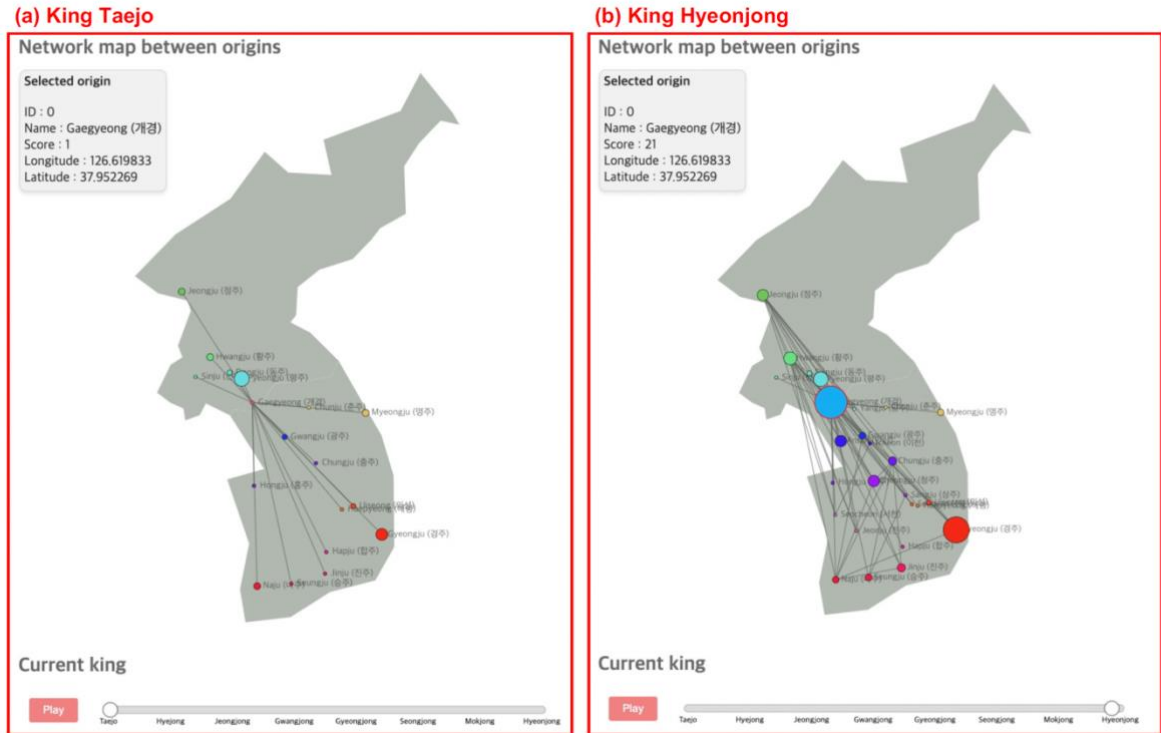
## 3. RESULTS: TWO CASE STUDIES

To assess how our visualization system works, we conducted two case studies.

### 3.1 How royal families of the Goryeo dynasty use marriage as a political strategy to maintain or extend their power?

Our visualization system showed that the royal families of the Goryeo dynasty used marriage as a political strategy to extend or maintain their power as shown in Figure 3. For instance, in Figure 3(a), marriage in the early Goryeo dynasty was a strategy to unify and dominate local power. King Taejo of the early Goryeo dynasty had more marriages with the different origins (i.e., regions) than other kings. On the other hand, the marriage pattern of other kings showed that they used marriage to maintain their power. For example, in Figure 3(b), the period of King Hyeonjong had more marriages with Gaegyeong than other origins. Considering that the Gaegyeong was the central city of royal families, this fact showed us that they had inter-family marriages to maintain their power.

Figure 3. The marriage network between origins (Left: King Taejo; Right: King Hyeonjong)



As a whole, the marriage strategies of royal families can be divided into three types: (1) extra-family marriages, (2) inter-family marriages, and (3) the combination of extra-family marriages and inter-family marriages. The royal family of Goryeo expanded their external relationship through extra-family marriages and reproduced their power through intra-family marriages.

### 3.2 Which origin generates the most power through the marriage network?

For the network analysis algorithms, we used three different algorithms (i.e., degree centrality, closeness centrality, and betweenness centrality) in *Python*, by adapting functions provided by *networkx* (Barnowski, 2022). A high degree centrality value of a person means that the target person has direct relationships with many people, a high degree of closeness centrality means that the target person has a close relationship with all other people on average, and a high degree of betweenness centrality indicates that the target person plays a large intermediary role in all people relationships. We used the three algorithms described above to find important people within the marriage network and applied those scores to the visualization system.

Table 1. Ranking of important origins according to frequencies and network analysis algorithms (used all marriage network data from King Taejo to King Hyeonjong)

	<b>Frequencies</b>	<b>Degree centralities</b>	<b>Closeness centralities</b>	<b>Betweenness centralities</b>
1 <sup>st</sup> origin	Gaegyeong (21)	Gaegyeong (3.438)	Gaegyeong (11.341)	Gaegyeong (0.854)
2 <sup>nd</sup> origin	Gyeongju (16)	Hwangju (0.956)	Gyeongju (7.952)	Jeongju (0.035)
3 <sup>rd</sup> origin	Pyeongju (9)	Jeongju (0.752)	Pyeongju (4.455)	Hwangju (0.033)
4 <sup>th</sup> origin	Hwangju (8)	Chungju (0.664)	Hwangju (4.211)	Chungju (0.026)

Table 1 shows the total sum of the people appearing in the marriage network by each origin (i.e., frequencies) and the total score according to each algorithm calculation method by origin (i.e., degree centralities, closeness centralities, and betweenness centralities). As a result of the analysis, Gyeongju was the origin (i.e., region) with a large number of marriages with the royal family, but Jeongju, Hwangju, and Chungju were the origins that played an important role in the marriage network relationship. For instance, Queen Seonuiwanghu of Jeongju had the highest degree/betweenness centrality score, indicating that Queen Seonuiwanghu played an important role in the marriage network by giving birth to the King Seongjong. This means that the origins where the king was produced through marriage have greater power than the origins which made more marriages with the royal family.

#### 4. CONCLUSION

In this study, we made two major findings. First, marriage in the Goryeo dynasty was an important strategy to maintain or extend power. Furthermore, the marriage strategies of the Goryeo dynasty can be divided into three types: (1) extra-family marriages, (2) inter-family marriages, and (3) the combination of extra-family marriages and inter-family marriages. The royal family of Goryeo expanded their external relationship through extra-family marriages and reproduced their power through intra-family marriages. Second, the power of the origin (i.e., region) is higher in the origin where the king was produced through marriage (i.e., Jeongju) than in the origin where many marriages were made with the royal family (i.e., Gyeongju). For instance, Jeongju became an important origin in the marriage network by producing King Seongjong, although the number of marriages with the royal family was less than other origins.

The findings of this study should be further verified by comparing more historical records with respect to the marriage network of the Goryeo dynasty, which we plan to pursue next. Any future study will also benefit from considering other network algorithms or visualization techniques to better ascertain the advantage of network analysis in this kind of task.

We believe our visualization system will contribute to extending the current understanding of how the marriage network works as a political strategy to maintain or extend royal families' power.

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