

# Visual Analysis for the Marriage Network in the Goryeo Dynasty, Korea

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AJOU UNIVERSITY

# Outline

Introduction

Data and design tasks

Visualization methods

Evaluation

Conclusion

# Introduction

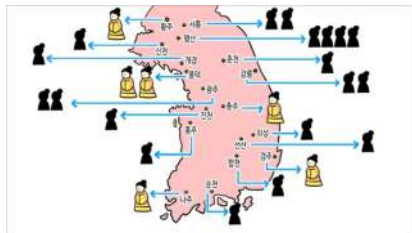
# Political marriages

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).



# Political marriages in Goryeo dynasty

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).



출처: 고학정

# Previous studies on political marriages

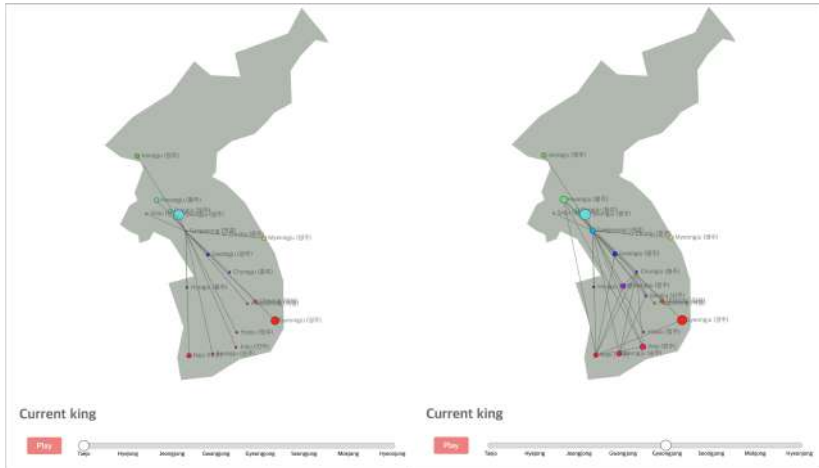
## Studies on political marriages in Goryeo dynasty

- ▶ Ha, 1968
- ▶ Jeong, 1984
- ▶ Kim, 2009

# Problem of political history

Due to the nature of political history, **it is difficult to cover long periods in a single paper**, which shortens the time frame that researchers can focus on with interest (Hong, 1995).

# Simulation with data visualization system





# Time series data (Goryeo dynasty; AD 918–1392)



History big data (time series; AD 918–1392)

**Question:** How did royal families of the Goryeo dynasty use marriage as a political strategy to maintain or extend their power?

# Data and design tasks





# Data processing



King



Queen



great-grandfather  
&  
great-grandmother



grandfathers  
&  
grandmothers



father  
&  
mother



father  
&  
mother



grandfathers  
&  
grandmothers



great-grandfather  
&  
great-grandmother

Additional information: where they were born (i.e., origin), their final grade



including 137 people and 752 relationships

# Data processing

Raw data

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세대, from, from지명, 부명, from_부지명, 조부명, from_조부지명, 조모
1, 태조, 개경, 왕릉, 개경, 의조, 개경, 원창왕후, 개경, 위숙왕후한씨, 개경, ,,
1, 태조, 개경, 왕릉, 개경, 의조, 개경, 원창왕후, 개경, 위숙왕후한씨, 개경, ,,
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2, 대종왕릉, 개경, 태조, 개경, 왕릉, 개경, 위숙왕후한씨, 개경, 신정왕태후황보
3, 성종, 개경, 대종왕릉, 개경, 태조, 개경, 신정왕태후황보씨_태조3, 함주, 선
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2, 혜종, 개경, 태조, 개경, 왕릉, 개경, 위숙왕후한씨, 개경, 장화왕후씨, 태조
2, 혜종, 개경, 태조, 개경, 왕릉, 개경, 위숙왕후한씨, 개경, 장화왕후씨, 태조
  
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Data for Network

Source, Target, weight	Id, Label
태조, 신혜왕후유씨_태조1, 1	태조, 개경
태조, 유천궁, 1	신혜왕후유씨_태조1, 경주
신혜왕후유씨_태조1, 유천궁, 1	유천궁, 경주
태조, 정덕왕후유씨_태조6, 1	정덕왕후유씨_태조6, 경주
태조, 유덕염, 1	유덕염, 경주
정덕왕후유씨_태조6, 유덕염, 1	장화왕후유씨_태조2, 나주
태조, 장화왕후씨_태조2, 1	오다련, 나주
태조, 오다련, 1	오부돈, 나주
태조, 오부돈, 1	연덕교, 나주
태조, 연덕교, 1	신명순성왕태후유씨_태조3, 충주
장화왕후유씨_태조2, 오다련, 1	유금달, 충주
장화왕후유씨_태조2, 오부돈, 1	신정왕태후황보씨_태조4, 함주
장화왕후유씨_태조2, 연덕교, 1	황보지공, 함주
오다련, 오부돈, 1	신성왕태후김씨_태조5, 경주
오다련, 연덕교, 1	김덕엽, 경주

# Requirements and design tasks

- ▶ **T.1:** Identify the relationships between individuals and explore the influences of individuals within marriage networks.
- ▶ **T.2:** See and explore the local influences within marriage networks based on their origin/region.
- ▶ **T.3:** Simulate changes in relationships and local influences over time based on the Kings.
- ▶ **T.4:** Analyze the detailed individual information included in the marriage network by origin.



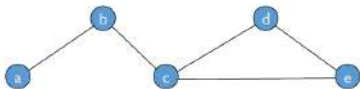
# Visualization methods

# Design tasks

- ▶ **T.1:** Identify the relationships between individuals and explore the influences of individuals within marriage networks.

# Network analysis

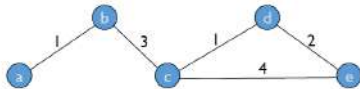
The network analysis method expresses the relationship between pieces of information using nodes and links.



Undirected, binary



Directed, binary



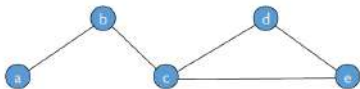
Undirected, Valued



Directed, Valued

# Network analysis

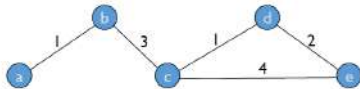
For network analysis, we employed three different algorithms by adapting the functions provided by *networkx* (Barnowski, 2022).



Undirected, binary



Directed, binary



Undirected, Valued

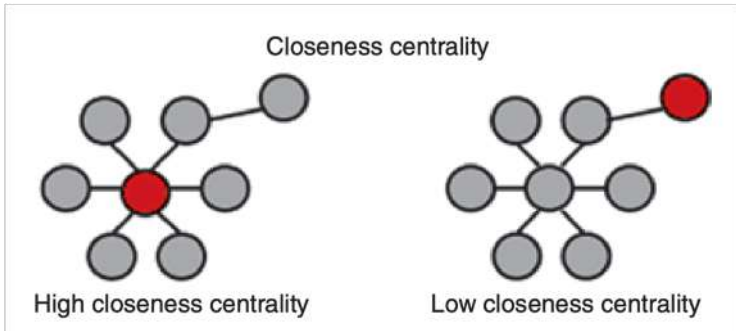


Directed, Valued



## Network analysis: closeness centrality

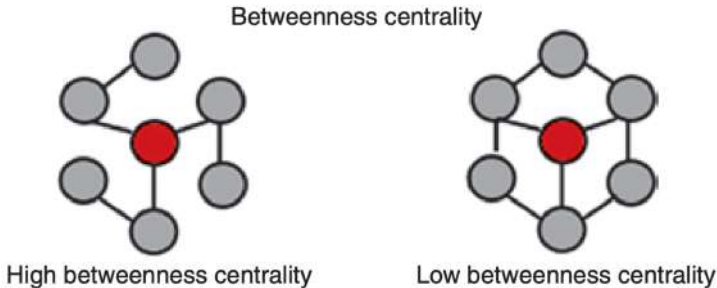
A high degree of closeness centrality means that the target person has a close relationship with all other people on average.



Jacunski & Tatonetti, 2013

## Network analysis: betweenness centrality

A high degree of betweenness centrality indicates that the target person plays a large intermediary role in all people's relationships.



Jacunski & Tatonetti, 2013

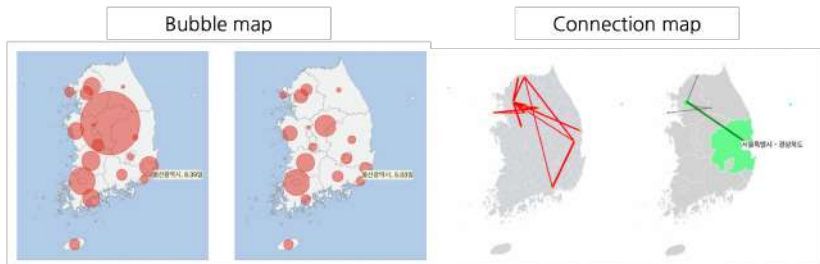
# Design tasks

- ▶ **T.2:** See and explore the local influences within marriage networks based on their origin/region.



# Bubble & connection map

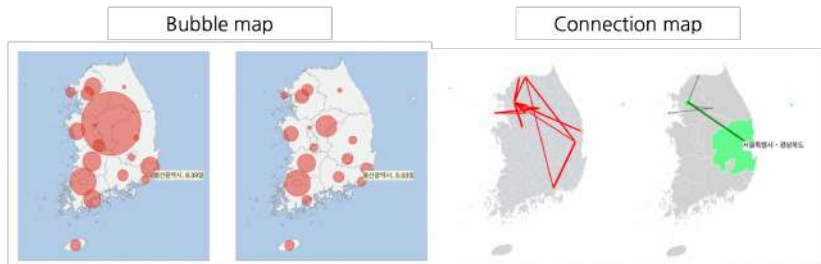
Bubble maps represent location data based on coordinates and visualize regional/place differences by varying the size of bubbles (Ryu Lee, 2021).



Ryu & Lee, 2021

# Bubble & connection map

Additionally, the Connection map technique is used to represent interconnectivity between regions (Ryu Lee, 2021).



Ryu & Lee, 2021



# Design tasks

- ▶ **T.3:** Simulate changes in relationships and local influences over time based on the Kings.

# Slider

Using the Slider technique allows for visualizing data information that changes over time.

## Current king



# Design tasks

- ▶ **T.4:** Analyze the detailed individual information included in the marriage network by origin.

# Table

To provide the details of the people on the social network, we use the table.

## Selected people in social network

name	origins	score
Taejo (태조)	Gaegyeong (개경)	94
Janghwawanghu (장화왕후씨_태조2)	Naju (나주)	25
Yugeungdal (유궁달)	Chungju (충주)	25
Sinmyeongsunseongwangtaehu (신명순성왕태후유씨_태조3)	Chungju (충주)	24
Hyeong (혜종)	Gaegyeong (개경)	74





# Evaluation

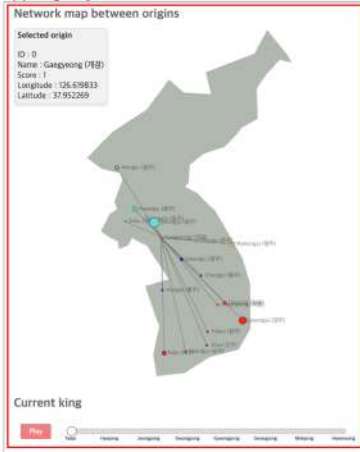
We conducted **two case studies** and **a user study** to assess the functionality of the proposed visualization system (e.g., Hou et al, 2023; Chen et al, 2023).

# Case study 1

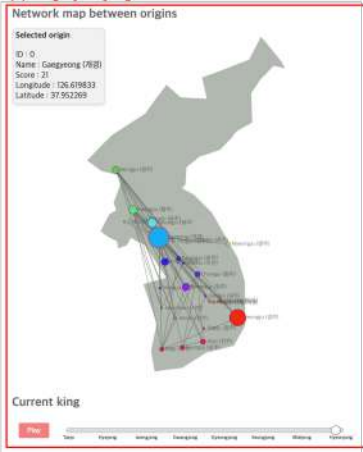
**Question:** How did the royal families of the Goryeo dynasty use marriage as a political strategy to maintain or extend their power?

# Case study 1

(a) King Taejo



(b) King Hyeonjong



## Case study 2

**Question:** Which origin generated the greatest power through the marriage network?

## Case study 2

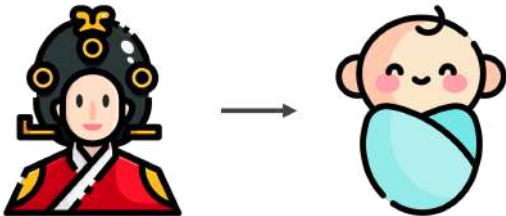
	Frequencies	Degree	Closeness	Betweenness
1st	Gaegyeong(21)	Gaegyeong(3.44)	Gaegyeong(11.34)	Gaegyeong(0.85)
2nd	Gyeongju(16)	Hwangju(0.96)	Gyeongju(7.95)	Jeongju(0.04)
3rd	Pyeongju(9)	Jeongju(0.75)	Pyeongju(4.46)	Hwangju(0.03)
4th	Hwangju(8)	Chungju(0.66)	Hwangju(4.21)	Chungju(0.03)

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

## Case study 2

	Frequencies	Degree	Closeness	Betweenness
1st	Gaegyeong(21)	Gaegyeong(3.44)	Gaegyeong(11.34)	Gaegyeong(0.85)
2nd	Gyeongju(16)	Hwangju(0.96)	Gyeongju(7.95)	Jeongju(0.04)
3rd	Pyeongju(9)	Jeongju(0.75)	Pyeongju(4.46)	Hwangju(0.05)
4th	Hwangju(8)	Chungju(0.66)	Hwangju(4.21)	Chungju(0.03)

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



# User study

We conducted a user study to evaluate the efficiency and usefulness of the developed visualization for analyzing marriage networks, a type of historical data record.



# User study

- ▶ The study involved a sample of 40 individuals who were humanities students with background knowledge of history.
- ▶ Data were collected for 7 d, from March 20 to March 26, 2023.
- ▶ The study used a questionnaire with Likert 5-point scale questions.

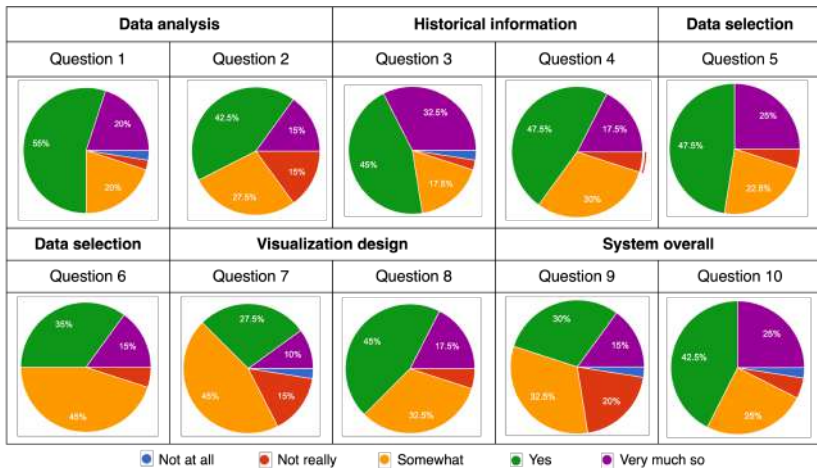
# User study

Number	Question
Q1	Patterns of data that change over time (dynasty) can be identified.
Q2	Data Patterns that change depending on the network centrality calculation method can be identified.
Q3	The political marriage strategies of the Goryeo royal family can be understood.
Q4	Important figures in the marriage network of the Goryeo royal family can be identified.
Q5	Only desired specific data can be selected.
Q6	Desired network centrality calculation method can be selected.
Q7	The information presented in the visualization can be understood without separate explanations of the visualization system.
Q8	Desired regional information can be distinguished without separate explanations of the visualization system.
Q9	The operation of the system can be understood without separate explanations.
Q10	The system operates smoothly.

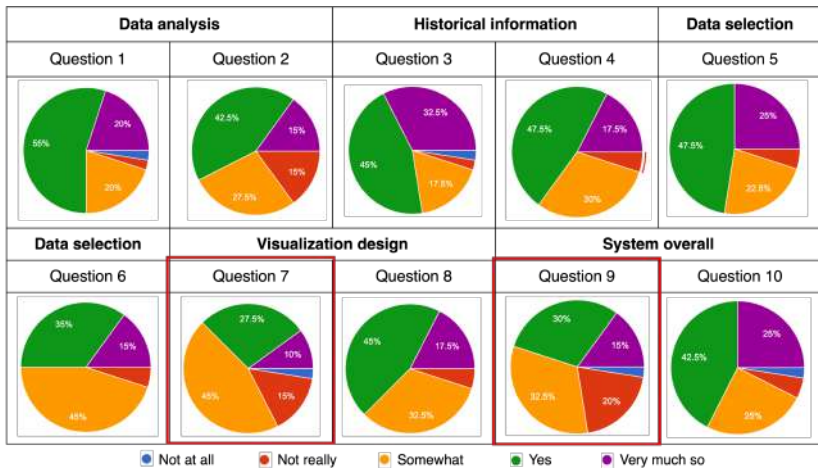
# User study

	Number	Question
Data analysis	Q1	Patterns of data that change over time (dynasty) can be identified.
	Q2	Data Patterns that change depending on the network centrality calculation method can be identified.
Historical information	Q3	The political marriage strategies of the Goryeo royal family can be understood.
	Q4	Important figures in the marriage network of the Goryeo royal family can be identified.
Data selection	Q5	Only desired specific data can be selected.
	Q6	Desired network centrality calculation method can be selected.
Visualization design	Q7	The information presented in the visualization can be understood without separate explanations of the visualization system.
	Q8	Desired regional information can be distinguished without separate explanations of the visualization system.
System overall	Q9	The operation of the system can be understood without separate explanations.
	Q10	The system operates smoothly.

# User study



# User study



# Conclusion

# Conclusion

- ▶ Marriage was an important strategy for maintaining or extending power during the Goryeo dynasty.
- ▶ The power of a region was higher when the king was produced through a single marriage (Jeongju) than when multiple marriages were pursued with the royal family (Gyeongju).
- ▶ The proposed visualization can be useful for historians to analyze historical records.

Thank you.