

# Byunghwee Lee

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**Office** | School of Data Science  
University of Virginia, Charlottesville, VA, USA  
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**Research interests** Computational Social Science, Cultural Analytics, Human Behavior,  
Belief Dynamics, Digital Art history

**Professional Experience** **School of Data Science, University of Virginia** Charlottesville, VA, USA  
Postdoctoral research associate Aug. 2025 – Current  
(Advisor: Yong-Yeol Ahn)

**Luddy School of Informatics, Computing, and Engineering, Indiana University Bloomington** Bloomington, IN, USA  
Postdoctoral researcher at Center for Complex Networks and Systems Research Mar. 2023 - Aug. 2025  
(Co-Advisors: Jisun An, Haewoon Kwak, and Yong-Yeol Ahn)

**Institute of Basic Science, Sungkyunkwan University** South Korea  
Senior researcher (PI: Boem Jun Kim) Sep. 2022 – Feb. 2023

**National Science Museum** Daejeon, South Korea  
Researcher/Curator at Exhibition Policy Division Jun. 2021 – Sep. 2022  
- Participated in the online science museum project  
- Contributed to the advancement of museum data management system

**Natural Science Research Institute, Korea Advanced Institute of Science and Technology** Daejeon, South Korea  
Post-doctoral researcher (PI: Hawoong Jeong) Mar. 2021 – Jun. 2021

**Education** **Korea Advanced Institute of Science and Technology** South Korea  
- PhD in Physics (Adviser: Hawoong Jeong) Mar. 2013 – Feb. 2021  
Thesis: *Art and Complexity in the Era of Big Data* (2021)  
- BS in Physics Feb. 2009 – Feb. 2013

**Professional License** **National Certificate on Museum and Art Gallery Curator (level 3)**  
Ministry of Culture, Sports and Tourism, South Korea Oct. 2022

**Honors and scholarships** Best poster presentation, Korean Physical Society Meeting July 2020  
Best oral presentation, Korean Physical Society Meeting Apr. 2019  
Best oral presentation, Korea Academy of Complexity Studies Nov. 2017  
Best oral presentation, Korea Academy of Complexity Studies Nov. 2015

Best poster award, Conference on Complex Systems (AZ, USA)	Oct. 2015
Best oral presentation, Korea Academy of Complexity Studies	Nov. 2014
Best oral presentation, Korea Academy of Complexity Studies	Nov. 2013
Best poster award, STATPHYS25 satellite meeting Computational Methods for Bio and Complex Systems	July 2013

## Selected Publications

### **A semantic embedding space based on large language models for modelling human beliefs**

Byunghwee Lee, Rachith Aiyappa, Yong-Yeol Ahn, Haewoon Kwak, and Jisun An.

*Nature Human Behaviour* (2025).

<https://doi.org/10.1038/s41562-025-02228-z>

- Highlighted by *Phys.org* (<https://phys.org/news/2025-06-llms-delve-online-debates-human.html>)

### **Dissecting landscape art history using information theory**

Byunghwee Lee, Min Kyung Seo, Daniel Kim, In-Seob Shin, Maximilian Schich, Hawoong Jeong, Seung Kee Han.

*Proc. Natl. Acad. Sci. U.S.A. (PNAS)* 117.43 (2020): 26580-26590.

<https://doi.org/10.1073/pnas.2011927117>

- Featured as *research highlight* on *In this Issue* section in PNAS

- Introduced with a commentary paper in PNAS

(<https://doi.org/10.1073/pnas.201865211>)

- Highlighted by diverse media including Forbes, Cosmos, Science Daily, and introduced in Nature Index Research Highlights

## All Publications

### **(Submitted) Combined influence of artwork and artist features in predicting user generated art valuation**

Seunghwan Kim, Soomin Lee, Byunghwee Lee<sup>\*</sup>, Wonjae Lee<sup>\*</sup>.

<sup>\*</sup>Co-corresponding authors

### **(Submitted) Context-aware multimodal AI reveals hidden pathways in five centuries of art evolution**

Jin Kim, Byunghwee Lee, Taekho You, Jinhyuk Yun.

arXiv preprint arXiv:2503.13531

### **Network analysis reveals news press landscape and asymmetric user polarization**

Byunghwee Lee, Hyo-sun Ryu, Jae Kook Lee, Hawoong Jeong, Beom Jun Kim

*Physica A: Statistical Mechanics and its Applications* (2025).

<https://doi.org/10.1016/j.physa.2025.130842>

### **Investigating the diversity and stylization of contemporary user generated visual arts in the complexity entropy plane**

Seunghwan Kim, Byunghwee Lee (co-first author), Wonjae Lee.  
*Scientific Reports* (2025).  
<https://doi.org/10.1038/s41598-025-04448-9>

**A semantic embedding space based on large language models for modelling human beliefs**

Byunghwee Lee, Rachith Aiyappa, Yong-Yeol Ahn, Haewoon Kwak, and Jisun An.  
*Nature Human Behaviour* (2025).  
<https://doi.org/10.1038/s41562-025-02228-z>

**Uncovering Hidden Dependency in Weighted Networks via Information Entropy**

Mi Jin Lee, Eun Lee, Byunghwee Lee, Hawoong Jeong, Deok-Sun Lee, Sang Hoon Lee.  
*Physical Review Research* 3.4 (2021): 043136.

**Integrated Infodemic Surveillance System: The case of COVID-19 in South Korea**

Gil-sung Park, Jintae Bae, Byung Yeon Yun, Jong Hun Lee, Byunghwee Lee, Eun Kyong Shin  
*Studies in Health Technology and Informatics* (2021).

**Dissecting landscape art history using information theory**

Byunghwee Lee, Min Kyung Seo, Daniel Kim, In-Seob Shin, Maximilian Schich, Hawoong Jeong, Seung Kee Han.  
*Proc. Natl. Acad. Sci. U.S.A. (PNAS)* 117.43 (2020): 26580-26590.

**Multi-Label Classification of Historical Documents by Using Hierarchical Attention Networks**

Dong-kyum Kim, Byunghwee Lee (co-first), Daniel Kim, Hawoong Jeong.  
*Journal of the Korean Physical Society* 76.5:368-377 (2020).

**Social influence of 2015 MERS outbreak on twitter: Diversity of online discourse over time and social groups**

Byunghwee Lee, Hawoong Jeong.  
*Journal of Social Research*, vol.21, no.1, pp.35-62 (2020).

**On-line (TweetNet) and Off-line (EpiNet): The Distinctive Structures of the Infectious**

Byunghwee Lee, Hawoong Jeong, Eun Kyong Shin.  
*Explainable AI in Healthcare and Medicine*, pp. 187-194 Springer, Cham. (2020).

**Heterogeneity in chromatic distance in images and characterization of massive painting data set**

Byunghwee Lee, Daniel Kim, Seung Hye Sun, Hawoong Jeong, Juyong Park  
*PLoS One* (9) e0204430 (2018).

**Information-theoretic analysis of color interaction in artistic paintings**

Min Kyung Seo, Byunghwee Lee , In-Seob Shin, Hawoong Jeong, Seung Kee Han  
*New Physics: Sae Mulli* 68(6), 693-699 (2018).

**N-gram web service and stylometric analysis of Korean historical documents**

Byunghwee Lee , Daniel Kim, Dongwoo Kim, Hawoong Jeong  
*New Physics: Sae Mulli* 66 (4), 502-510 (2016).  
- Selected as the cover image and research highlights.

In preparation

**(In preparation) Arts, Music, Fashion, and Beyond: Can LLMs Infer Your Political Leaning from Casual Talk?**

Byunghwee Lee, Sangyeon Kim, Filippo Menczer, Yong-Yeol Ahn, Haewoon Kwak, Jisun An.

Book chapters  
/Articles

**Math reveals the evolution of composition in paintings**

Byunghwee Lee, Hawoong Jeong  
*The Science Breaker*, Dec. 29. 2021.

**물리학의 눈으로 본 미술사 - 교양이 전공이 된다면? (Art history seen through the eyes of physics)**

Byunghwee Lee  
*APCTP Crossroad Webzine*, Apr. 2021.

**네트워크 과학으로 살펴보는 사회적 거리두기와 접촉자 추적의 원리 (Principles of social distancing and contact tracking through network science)**

Byunghwee Lee, Hawoong Jeong  
한국 생물공학회 소식지 *BTNews* (Newsletter of the Korean Society of Biotechnology), Apr. 2021.

**전염의 복잡계 과학적론 접근 (Complex science approaches to the contagion phenomena)**

Byunghwee Lee, Hawoong Jeong.  
전염의 상상력 (Imagination of contagion), pp.101-137. 2017.

Teaching experience

**Teaching assistant, Department of Physics (KAIST)**

Nonlinear dynamics

Fall 2015

Thermal Physics

Spring 2015

College Physics  
General Physics

Spring 2014  
Spring 2013

### Referee works

*EPJ Data Science, ICWSM, PLoS One, PhD Symposium of The Web Conference, Advances in Complex Systems, Humanities and Social Science Communications, New Physics: Sae Mulli*

### Skills

#### Programming

Proficient in: Python

Familiar with: Matlab, R, Java, HTML, CSS, d3.js, Processing, PyTorch, Keras, Scikit-Learn, Parallel processing, Network visualization tools (Gephi, NetworkX), OpenAI API, Hugging Face, LaTeX, Git, Linux/Unix, Adobe Illustrator, Final Cut Pro.

#### Languages

Korean (fluent), English (advanced)

### Conference presentations

(Oral) **Byunghwee Lee**, Sangyeon Kim, Filippo Menczer, Yong-Yeol Ahn, Haewoon Kwak, Jisun An *Can LLMs infer political affiliation from non-political discourse?* The International Conference on Computational Social Science (IC2S2) 2025, Norrköping, Sweden, July 21-24, 2025.

(Plenary talk) **Byunghwee Lee**, Rachith Aiyappa, Yong-Yeol Ahn, Haewoon Kwak, and Jisun An. *Neural embedding of beliefs reveals the role of relative dissonance in human decision-making*, The International Conference on Computational Social Science (IC2S2) 2024, Philadelphia, PA, USA, July 17-20, 2024.

(Poster) Taekho You (presenter), Jin Kim, **Byunghwee Lee**, Jinhyuk Yun. *Understanding the Creativity through Evolution of Western Painting Art Using the Stable Diffusion Model* The International Conference on Computational Social Science (IC2S2) 2024, Philadelphia, PA, USA, July 17-20, 2024.

(Poster) **Byunghwee Lee**, Min Kyung Seo, Daniel Kim, In-seob Shin, Maximilian Schich, Hawoong Jeong, Seung Kee Han *Information-theoretic dissection of painting reveals the evolution of composition of landscape painting and super communities of painters and style periods*, NetSci 2020, Rome, Italy (Virtual), Sep. 17-25, 2020.

(Poster) **Byunghwee Lee**, Min Kyung Seo, Daniel Kim, In-seob Shin, Maximilian Schich, Hawoong Jeong, Seung Kee Han *Revealing the evolution of composition of landscape painting through the lens of information theory*, Korean Physical Society Meeting, Korea (Virtual), Jul. 13-15, 2020.

(Oral) **Byunghwee Lee**, Daniel Kim, Dongwoo Kim, Hawoong Jeong *Information-theoretic dissection of landscape paintings reveals conceptual overlap in art histography*, 제 20차 통계물리 워크숍. 변산, Korea, Oct. 21-23, 2019.

(Poster) **Byunghwee Lee**, Min Kyung Seo, Daniel Kim, In-seob Shin, Hawoong Jeong, Seung Kee Han *Information-theoretic analysis of composition in painting and the composition-similarity network of painters*, NetSci2019, University of Vermont, Burlington, USA, May. 27-31, 2019.

(Oral) **Byunghwee Lee**, Daniel Kim, Dongwoo Kim, Hawoong Jeong *Large-scale information theoretic analysis of composition in painting*, 2019 Korean Physical Society Meeting, Korea Daejeon Convention Center, Daejeon, Korea, Apr. 24-26, 2019.

(Oral) **Byunghwee Lee**, Daniel Kim, Hawoong Jeong *Inferring Posthumous Fame from Social Network Location Using a Half Millennium Historical Documents*, 2017 Conference of Korean Society of Complex Systems (한국복잡계학회 가을 컨퍼런스), Sookmyung Women's University,

(Oral) **Byunghwee Lee**, Daniel Kim, Hawoong Jeong *역사기록물에서의 인물 등장 패턴과 명성*, 경제사회물리연구회, KAIST, Daejeon, Nov. 17-18, 2017.

(Oral) **Byunghwee Lee**, Daniel Kim, Hawoong Jeong *Inferring Posthumous Fame from Social Network Location Using a Half Millennium Historical Documents*, The 19th Workshop for Statistical Physics, 서울대학교병원 인재원, 문경, Korea, Oct. 28-30. 2017

(Oral) **Byunghwee Lee**, Daniel Kim, Hawoong Jeong *Analysis of Spatio-temporal Pattern of Historical Cities in the Annals of the Joseon Dynasty*, Workshop on Special Topics in Statistical Physics & Complex Systems (SPnCS). Chosun University, Gwangju, Korea, Dec. 22, 2016.

(Oral) **Byunghwee Lee**, Kibum Kim, Daniel Kim, Beom Jun Kim, Hawoong Jeong *Understanding the spatiotemporal patterns of geographic places in large-scale historical documents: The Annals of the Joseon Dynasty* 2016 Korean Physical Society Fall Meeting. Kimdaejung Convention Center, Gwangju, Korea, Oct. 19-21, 2016.

(Oral) **Byunghwee Lee**, Daniel Kim, Hawoong Jeong, Seunghye Sun, Juyong Park *Quantitative analysis on contrast effect in the evolution of paintings* STAT-PHYS 26. Centre de Congres, Lyon, France Jul. 18-22, 2016.

(Oral) **Byunghwee Lee**, Daniel Kim, Hawoong Jeong, Seunghye Sun, Juyong Park *Quantitative analysis of color contrast in the evolution of painting* NetSci2016. The K hotel, Seoul, Korea, May. 30-June. 3, 2016.

(Oral)**Byunghwee Lee**, Daniel Kim, Dongwoo Kim, Hawoong Jeong 양식 측정학을 이용한 한국 역사 기록물 분석과 N-gram 웹 서비스, 2016 Korean Physical Society Meeting (Spring). Daejeon Convention Center, Daejeon, Korea, Apr. 20-22, 2016.

(Oral)**Byunghwee Lee**, Daniel Kim, Hawoong Jeong, Juyong Park 미술사에 나타난 색채 대비 효과의 변화와 과정 2015 Conference of Korean Society of Complex Systems (Sungkyunkwan University international hall, Seoul, Nov. 28, 2015

(Oral)**Byunghwee Lee**, Daniel Kim, Hang-Hyun Jo, Hawoong Jeong *Quantitative analysis of history of Joseon using half-millennium chronological historical data and its visualization* 한국물리학회 2015년 가을 학술논문발표회 및 임시총회 Hwabaek International Convention Center, Gyeongju, Korea, October 21-23, 2015.

(Poster)**Byunghwee Lee**, Daniel Kim, Hang-Hyun Jo, Hawoong Jeong *Understanding Motives of Historical Events through a Half Millennium Chronicle, The Annals of the Joseon Dynasty* Conferences on Complex Systems in 2015. Tempe, Arizona, Doubletree by Hilton, USA, September 28 - October 2, 2015.

(Oral) **Byunghwee Lee**, Daniel Kim, Hang-Hyun Jo, Hawoong Jeong *Understanding Motives of Historical Events through a Half Millennium Chronicle, The Annals of the Joseon Dynasty* 제 18차 통계물리 워크숍. Chonbuk National University, Jeonju, Korea, August 20-22, 2015.

(Oral) **Byunghwee Lee**, Daniel Kim, Kihong Chung, Hawoong Jeong, 조선왕조실록에 나타난 조선 사회 연결망 구조의 특성과 변화, 2014 한국복잡계학회 학술대회 Ewha Womans University, Seoul, November 29, 2014.

(Oral) **Byunghwee Lee**, Daniel Kim, Kihong Chung, Hawoong Jeong, Social Network Analysis on the annals of Joseon Dynasty, 2014 Workshop on Special Topics in Statistical Physics and Complex Systems, Marine Bio Research Center of Chosun University, Wando-gun, Jeollanam-do, Korea, October 10-11, 2014.

(Oral) **Byunghwee Lee**, Daniel Kim, Kihong Chung, and Hawoong Jeong, 조선왕조실록에 대한 통계적 분석 및 네트워크 연구, 한국사회사학회 제167회 9월 월례발표회, Dept. of Sociology, Seoul National Univ. Korea, September 13 2014.

(Poster) **Byunghwee Lee**, Daniel Kim, Kihong Chung, and Hawoong Jeong, Stylometry and Network Analysis on the Annals of the Joseon Dynasty, 2014년 봄학술논문발표회 및 제90회 정기총회, Daejeon Convention Center, Daejeon, Korea, April 23-25, 2014.

(Oral) **Byung-hwee Lee**, Daniel Kim, Hawoong Jeong, *조선왕조실록에 대한 통계적 분석 및 네트워크 연구*, 제 8 회 복잡계 컨퍼런스, 가천대학교, Sungnam, Korea, Nov. 16, 2013.

(Oral) **Byung-hwee Lee**, Daniel Kim, Hawoong Jeong, *Exploring the Trend of Society by Big Data*, 17th Statistical Physics Workshop, Chungmu Marina Resort, Tongyeong, Korea, Oct. 31-Nov. 3, 2013.

(Poster) **Byung-hwee Lee**, Daniel Kim, Hawoong Jeong, *Web Search Trend Based Social Network Construction*, 2013 Fall KPS, Changwon Convention Center, Changwon, Korea, Oct. 30-31, 2013.

(Poster) Daniel Kim, **Byung-hwee Lee**, Hawoong Jeong, *Quantitative Analysis of the Annals of the Joseon Dynasty*, STATPHYS 25, Seoul National University, Seoul, Korea, July 22-26, 2013.

(Poster) Daniel Kim, **Byung-hwee Lee**, Hawoong Jeong, *Quantitative Analysis of the Annals of the Joseon Dynasty*, STATPHYS25 satellite meeting: 'Computational Methods for Bio and Complex Systems', KIAS, Seoul, Korea, July 18-21, 2013.

Invited talks &  
Seminars

**A semantic embedding space based on large language models for modelling human beliefs**, The Max Planck Institute for Security and Privacy (MPI-SP) DSLAB Weekly Seminar, Aug. 6, 2025.

**A semantic embedding space based on large language models for modelling human beliefs**, KDI School, Jun. 13, 2025.

**A semantic embedding space based on large language models for modelling human beliefs**, Soongsil University, Jun. 02, 2025.