Hyejin Youn

CONTACT INFORMATION

Northwestern University
Kellogg School of Management
Evanston, IL 60208, USA

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ACADEMIC POSITIONS

Seoul National University, Seoul, Korea
Associate Professor, Strategy & International Management — 2024 – current

Santa Fe Institute
Emergent Political Economies Advisory Board — 2022 – current
External Faculty — 2021 – current

London Mathematical Laboratory, London, UK
External Fellow — 2017 – current

PAST POSITIONS

Northwestern University, Evanston, IL, USA
Associate Professor, — 2021 – 2024
Management & Organizations, Kellogg School of Management
Core faculty, Northwestern Institute on Complex Systems (NICO)

Northwestern University, Evanston, IL, USA
Assistant Professor, — 2017 – 2021
Management & Organizations, Kellogg School of Management
Core faculty, Northwestern Institute on Complex Systems (NICO)

Santa Fe Institute
Postdoctoral Fellow — 2011 – 2013
Graduate Fellow — 2009 – 2010

Royal Society for Arts, London, UK
RSA Fellow — 2017 – 2023

Harvard University, Cambridge, MA, USA
CID Fellow at John F. Kennedy School of Government — 2017

Massachusetts Institute of Technology, Cambridge, MA, USA
Media Lab Visiting Scientist — 2016 – 2017

University of Oxford, Oxford, UK
Senior Research Fellow at the Mathematical Institute — 2013 – 2016
James Martin Fellow at Oxford Martin School — 2013 – 2016

EDUCATION

Ph. D. Physics, KAIST (Daejeon, South Korea), February 2011
Thesis topic: Quantifying Collective Dynamics and Emergent Behaviors in Complex Systems
Advisor: Hawoong Jeong
M. S. Physics, KAIST (Daejeon, South Korea), February 2006
Exchange program at Royal Institute of Technology, Sweden, 2003–2004
B. S. Physics, KAIST (Daejeon, South Korea), February 2003

RESEARCH INTERESTS

Innovation and technological change
Urban scaling and dynamics (economic diversity, energy consumption, human mobility)
Historical and computational linguistics (language universality, linguistic cognitive space)
Network science & Transportation network (traffic in decentralized system)

GRANT AND CONSULTING

Lead PI "URoL:EN: Towards a unified theory of regulatory functions and networks across biological and social systems"
National Science Foundation, EF-2133863, **$2,200,000** 2021 – 2026

PI, "Understanding Technological Change from the Map of Capabilities."
National Science Foundation SciSIP,
EAGER (USA), No. SMA-1312294, **$152,500** 2013 – 2017

Co-PI, "Understanding Urban Energy Consumption in UK"
REU mentor for Kevin Carlson under the NSF Grant No. 1005075 2011 – 2011

PI, "Quantifying Complex Systems",
National Research Foundation (Korea) **ca. $10,000** 2009 – 2010

PUBLICATIONS

Peer-reviewed

[24] M. Hosseinioun, F. Neffke, L. (LT)Zhang, H. Youn "Nested Skills in Labor Ecosystems: A Hidden Dimension of Human Capital" arXiv:2303.15629 [physics.soc-ph] *conditionally accepted in Nature Human Behaviour*

[23] F. van der Wouden, H. Youn "Impact of geographical distance on acquiring know-how through scientific collaboration" *Research Policy* **52** 2 (2023).

[22] R. Roller, M. Schich, H. Youn, M. Tamm, Editorial for Topical Issue on Cultural Complexity, *Advances in Complex Systems* **25** 2202002 (2022).

[21] L. Wu, A. Kittur, H. Youn, S. Milojevic, E. Leahey, S. M Fiore, Y.Y Ahn "Metrics and mechanisms: Measuring the unmeasurable in the science of science" *Journal of Informetrics* **16** (2) 101290 (2022).

[20] I. Hong, M. R. Frank, I. Rahwan, W. Jung, H. Youn "The universal pathway to innovative urban economies" *Science Advances* **6** (34) eaba4934 (2020).

[19] D. Painter, F. van der Wouden, M. Laubichler, H. Youn "Quantifying Simultaneous innovations in Evolutionary Medicine" *Theory in Biosciences* **139** (4), 319-335 (2020).

[18] M. R. Frank et al. "Toward understanding the impact of artificial intelligence on labor" *Proc. Natl. Acad. Sci USA* **116** (14) 6531–6539 (2019).

[17] M. R. Frank, L. Sun, M. Cebrian, H. Youn, I. Rahwan, "Small cities face greater impact from automation", *J. R. Soc. Interface* **15** 20170946 (2018).

[16] T. Bhattacharya et al. "Studying language evolution in the age of Big Data", *Journal of Language Evolution* **3** 94–129 (2018).

[15] M. Lee, H. Barbosa, H. Youn, G. Ghoshal, P. Holme, "Urban socioeconomic patterns revealed through morphology of travel routes", *Nature Communications* **8** 2229 (2017).

[14] X.-M. Cui, C. N. Yoon, H. Youn, S. H. Lee, J. S. Jung, S. K. Han, "Dynamic burstiness of word-occurrence and network modularity in textbook systems", *Physica A: Statistical Mechanics and its Applications* **487**, 103-110 (2017).

[13] P. L.W. Sabloff, S. Thurner, R. Hanel, and H. Youn, "Demographics and Democracy: A Network Analysis of Mongolians' Political Cognition," *Journal of Anthropological Research* **73**, no. 4: 617-646 (2017).

[12] H. Youn, L. Sutton, E. Smith, B. Croft, J. Wilkins, T. Bhattacharya, I. Maddieson, C. Moore "On universal structure of human lexical semantics", *Proc. Natl. Acad. Sci USA* **113** (7) 1766–1771 (2016).

[11] D. Kim, D. Cerigo, H. Jeong, H. Youn, "Technological novelty profile and invention's future impact", *EPJ Data Science* 2016 **5**:8 (2016).

[10] H. Youn, J. Lobo, D. Strumsky, H. Samaniego, G. B. West, L.M.A. Bettencourt "Scaling and universality in urban economic diversification", *J. R. Soc. Interface* **13**:20150937 (2016).

[9] M. Hamilton, J. Lobo, E. Rupley, H. Youn, and G. B. West "The ecological and evolutionary energetics of hunter-gatherer residential mobility", *Evolutionary Anthropology* **25** 124–132 (2016).

[8] H. Youn, J. Lobo, L.M.A. Bettencourt, Debora Strumsky “Invention as a combinatorial process: Evidence from U.S. Patents”, *J. R. Soc. Interface* **12** 20150272 (2015).

[7] E. Arcaute, E. Hatna, P. Ferguson, H. Youn, A. Johansson, and M. Batty, “Constructing cities, deconstructing scaling laws”, *J. R. Soc. Interface* **12** 20140745 (2015).

[6] V. Salnikov, D. Schien, H. Youn, R. Lambiotte, and M. Gastner “The geography and carbon footprint of mobile phone use in Cote d’Ivoire”, *EPJ Data Science* **3** 3 (2014).

[5] L.M.A. Bettencourt, H. Samaniego, H. Youn “Professional diversity and the productivity of cities”, *Scientific Reports* **4** 5393 (2014).

[4] A. Gomez-Lievano, H. Youn, L.M.A. Bettencourt “The Statistics of Urban Scaling and Their Connection to Zipf’s Law” *PLoS ONE* **7(7)** e40393 (2012).

[3] H. Youn, M. T. Gastner, H. Jeong, “Inefficiency in Networks with Multiple Sources and Sinks”, *Complex ‘2009* (USST, Shanghai, China, Feb. 23-25) (2010).

[2] H. Youn, M. T. Gastner, H. Jeong, “The Price of Anarchy in Transportation Networks: Efficiency and Optimality Control”, *Phys. Rev. Lett.* **101** 128701 (2009).

[1] H. Youn, F. Roth, M. Silver, M.-H. Cloutier, P. Ittzes, and H. Jeong, “Price of Anarchy on Boston Road Network”, *J. Korean Phys. Soc.* (2006). **48** 217

Working Paper (R&R, Under Review, Preprint)

[25] H. Kim, M. J. Hamilton, W-S. Jung, H. Youn, “Deeply nested structure of mythological traditions worldwide” *under review in Science Advances*

[26] J. Chae at al., “Long-term innovative potential of genetic research and its suppression” *reject and resubmit in Nature Communication*

[27] T. Kim, D. Kim, W. Kim, H. Youn “When Jobs Automate: Entrepreneurship as an Alternative Career Path” *submitted to Humanities and Social Sciences Communications*

[28] S. Yang, H. Youn, ‘Geometrics of the Adjacent Possibles: Harvesting Values at the Curvature” *submitted to PNAS* arXiv:2311.16360 [physics.soc-ph].

[29] J Yoon, CP Kempes, VC. Yang, GB West, H. Youn “What makes Individual I’s a Collective We; Coordination mechanisms & costs” arXiv:2306.02113 [physics.soc-ph]

[30] VC Yang, CP Kempes, H Youn, S Redner, GB West, “Scaling and the Universality of Function Diversity Across Human Organizations” arXiv:2208.06487 [physics.soc-ph]

[31] VC Yang, CP Kempes, S Redner, GB West, H. Youn “Unifying regulatory function across complex adaptive systems” *working paper available upon request*.

[32] H. Kim, D. Kim, Y.-H Eom, and H. Youn, “How exploitation and exploration shape the knowledge space” *working paper available upon request*.

[33] J. Park, M. R Frank, L. Sun, H. Youn, “Industrial Topics in Urban Labor System” arXiv:2009.09799 [cs.SI]

[34] L. M. A. Bettencourt, J. Lobo, G. B. West, H. Youn “The Hypothesis of Urban Scaling: formalization, implications, and challenges”, arXiv: 1301.5919 [physics.soc-ph]

[35] J. Lobo et al. Report submitted to the NSF on the Present State and Future of Urban Science, 2020. Available at SSRN: http://dx.doi.org/10.2139/ssrn.3526940

In Preparation

[36] O. Kwon, J. Yoon, H. Youn “A Tale of Two Fortunetellers”

[37] O. Kwon, J. Yoon, L.R. Varshney, H. Youn “Suspense and Surprise in Innovations”

H. Youn et al. “paradigm shift in technological innovation”

H. Youn, P. Kim, S. Son, H. Jeong, “Effective Population Density and Its Applications”,

H. Youn, “Paradox of Taxation”, *in preparation*

Book Chapters

43 Visions for complexity *World Scientific*, Edited by: Stefan Thurner (2017).

EDITORIAL WORK

Associate Editor, **Management Science** 2023 – current
Academic Editor, **PLOS One** 2017 – current
Guest Editor: *Energies*(2019), *Advances in Complex Systems*(2022), *Frontiers in ICT*(2020)

PROFESSIONAL SERVICE

U.S. National Science Foundation (NSF): ad-hoc advisory panel services (2021–2023)

General: Science, PNAS, Nature Communication, Scientific Reports, PLOS One, Journal of the Royal Society Interface
Physics: Physical Review Letter, Physical Review E, Physical A, European Physical Journal B, European Physical Letter, JSTAT
Network Science: Journal of Complex Networks
Social Science: Research Policy, Organization Science, GECON
Computer Science: WWW, ICWSM, Socinfo

Program Committees

Conference on Complex Systems (CCS)	2017–2022
Annual International Conference on Computational Social Science (IC2S2)	2017–2023
International World Wide Web Conference (WWW)	2022–2023
The Program Committee of the 2023 Cultural Data Analytics Conference	2023
Social Informatics (SocInfo)	2017-2019
International School and Conference on Network Science (NetSci-17)	2017-2019
The International AAAI Conference on Web and Social Media (ICWSM)	2015–2017

Institutional Committees

Northwestern Univeristy, Center for Artificial Intelligent Committee	2020 – 2023
Northwestern Univeristy, Data Science Fellows Program Review Committee	2021 – 2022
Northwestern University, MORS Faculty Hiring Search Committee	2021
Northwestern Univeristy, MORS Seminar Series Committee	2020
Northwestern Univeristy, MORS Brown Bag Series Committee	2021 – 2023
Northwestern Univeristy, Kellogg Innovation Speaker Series Committee	2017 – 2021
Northwestern Univeristy, Department Strategy Committee	2019
Northwestern University, Graduate Students, Search Committee	2017 – 2020, 2022
University of Oxford, Postdoc Fellow Search Committee	2015
University of Oxford, Research Fellow Search Committee	2014
University of Oxford, Research Fellow Search Committee	2013

Workshops (Organizer or co-organizer)

Santa Fe Institute Complex Systems Summer School the Santa Fe Institute, NM
organised with David Feldman June 17-18 2024
From Cells to Societies: Regulatory Mechanisms the Santa Fe Institute, NM
organised with V. Yang, G. West, C. Kempes, and S. Redner June 13-15 2023
The Structure of Technology the Santa Fe Institute, NM
organised with J. McNerney and R. Haussmann June 14-16 2022
Frontiers of Physics: Push the Envelope of Statistical Physics
APCTP Headquater, Pohang, Korea
organised with W. Jung, S. Son, J. Jo Dec 12-14, 2016
Building an integrated framework for innovation, organiztions, and society
Caucus session at Academy of Management (AOM), Anaheim, CA, USA
organised with K. Kim Aug 8, 2016
Networks and technology evolution,
Satellite Workshop at NetSci16, Seoul, Korea
organised with J. McNerney, I. Rahwan, and C. Hidalgo May 30, 2016
Technological change,
the satellite meeting at the Conference of Complex System (CCS'15)
Arizona State University, USA
organised with J. Alstott, B. Yan, F. Lafond, G. Triulzi Sep 30, 2015
Theory and practice of innovation: Different perspectives under the same name
University of Oxford, UK
organised with L. Bloom (Oxford) and G. Zanello (Oxford) Feb 27, 2015

TEACHING & ADVISING & FUNDING

Advising & Co-advising

Dawoon Jeong (postdoc), Kellogg, Northwestern	2024 – current
Moh Hosseinioun (postdoc), Kellogg, Northwestern	2023 – current
Seolmin Yang (postdoc), Kellogg, Northwestern	2024 – current
James Holehouse (postdoc), Santa Fe Institute	2022 – current
Seoul Lee (PhD candidate), Kellogg, Northwestern	2022 – current
Shambhobi Bhattacharya (PhD candidate), IEMS, Northwestern	2023 – current
Sari Eisen (Undergrad), Math. Methods in the Social Sciences, Northwestern	2022 – current
Ohyun Kwon (PhD candidate, co-advising), Physics, Postech	2022 – current
Megan Chan (PhD candidate, co-advising), IEMS, Northwestern	2022 – 2024
Jisung Yoon (postdoc), Kellogg, Northwestern (now KDI faculty)	2022 – 2024
Taekyun Kim (postdoc), Northwestern (now postdoc SKEMA Business School)	2022 – 2024
Moh Hosseinioun (PhD candidate, co-advising), MIS, UIC (now at Northwestern)	2019 – 2023
Seolmin Yang (PhD candidate, co-advising), STP, KAIST (now at Northwestern)	2019 – 2023
JiHae Choi (PhD candidate), Kellogg, Northwestern (now at Northwestern)	2022 – 2022
Jaehyuk Park (postdoc), Inforamtion Science, IU Bloomington (now KDI faculty)	2020 – 2021
Daehyun Kim, PhD in BTM, KAIST (now at Max Planck)	2019 – 2022
Frank Van der Wouden, PhD in Economic Geography, UCLA (HKU faculty)	2018 – 2019
Hyunuk Kim, PhD in Industrial & Management Eng., Postech (now BU faculty)	2016 – 2019
Hee Youn Kwon (postdoc), PhD in Systems & Entrepreneurial Engineering, UIUC	2018 – 2019
Inho Hong, PhD in Physics, Postech (now faculty at Chonnam National University)	2016 – 2018
Taehun Kim, Ms in Computer Science, Northwestern University	2019 – 2020
Minjin Lee, PhD in Energy Science, SKKU	2016 – 2017
Alex McCormick, Undergraduate in Physics, University of Oxford	2015 – 2016
Daniel Burkhardt Cerigo, Undergraduate in Physics, University of Oxford	2015 – 2016
Daniel Kim, PhD in Physics, KAIST	2016
Ross Richardson, PhD in Finance, UCL	2016

Lecture

Social Dynamics Network Analysis, Kellogg School of Management at Northwestern	2018-2024
The Oxford Summer School in Economic Networks, Oxford, UK	2024
The Santa Fe Institute Complex Systems Summer School, Santa Fe, NM	2019-2024
The Summer Institute in Computational Social Science (SICSS), KAIST	2022
CIFS Research Boot Camp on Innovation and Entrepreneurship, KAIST	2019-2022
The New England Complex Systems Institute Winter School, Cambridge, MA	2019-2021
Guest lecture: MIT (2016), KAIST (2016), Oxford (2015), UNM (2013)	2016–2017

Tutoring

Network Analysis of UK Patent Data (MSc), University of Oxford	2016
Physics and Urban Scaling (Undergraduates), University of Oxford	2014

Teaching Assistant

Statistical Mechanics, KAIST (best teaching award in the department)	2005
Thermodynamics, KAIST	2005
General Physics II, KAIST	2004
General Physics I, KAIST	2004

OTHER HONORS & AWARDS

Northwestern Summer Grant (#OUR-SUMMER-18163)	2023
Bridge Grant for Young Researchers of the Complex Systems Society	2021
Northwestern Faculty Recognition List	2020
Northwestern the Provost Faculty Mentoring Program	2020
Northwestern Kellogg Certificate of Impact	2019
London Mathematical Laboratory Fellowship	2017-2020
Royal Society for Arts Fellowship	2017-2020
NSF SciSIP award	2013-2016
D4D (Data for Development) Challenge from Orange (Mobile phone data in Ivory Coast)	2012
Congress Fellowship of XVI International Congress on Mathematical Physics	2009
The Best prize of CYRAM Social Network Analysis competition	2008
Springer Prize for the Best Presentation at APPC10 (The 10th Asia Pacific Physics Conference)	2007
Distinguished Teaching Award, Dept. of Physics	2007
The Best Student of the Year 2001, Dept. of Physics	2001

MEDIA

The Guardian "The big idea: What's the secret of innovation" Jan 9, 2023
NBC News "Manufacturers embrace robots, the perfect pandemic worker" Apr 8, 2021
Business Insider "The pandemic could accelerate job automation — here's how the change would impact cities, the labor force, and inequality" Apr 13, 2021
WIRED "Robots will take jobs from men, the young, and minorities" Jan 24, 2019
Bloomberg "Self-driving cars might kill auto insurance as we know it" Feb 19, 2019
New Scientist "Automation will have a bigger impact on jobs in smaller cities," May 15 2017
Nature "Languages have common structure," *Nature* **530**, 133, 2016
The Economist:
"The process of invention: Now and then," April 25, 2015
"Queuing conundrums," September 13, 2008
Nature Physics "Innovation Slowdown," Mark Buchanan, **11**, 2, 2015
Kellogg Insight
"10 years from now," Dec, 2023
"The Pandemic Could Accelerate Job Automation—and Inequality," March, 2022
"Could a Small City Become the Next Silicon Valley? It's Unlikely," Sep, 2020
"How Will Automation Affect Different U.S. Cities?," Apr, 2018
MIT Technology Review:
"In these small cities, AI advances could be costly," Oct 23, 2017
"Data Mining 200 Years of Patent Office Records To Reveal The Nature of Invention," June 16, 2014
Forbes "The hidden universal rule that helps govern the way businesses grow in a city, " Feb 10, 2016
Smart Planet "How will our cities grow?" July 27, 2011
NEXT CITY: Science of Cities "When it comes to making money, Big Data reveals cities have a pattern" Jan 29, 2016
National Geographic "Do languages 'think' alike?" Feb, 2016
QUARTZ "Scientists say the ways humans describe nature transcends culture and geography" Feb 2016
Scientific American "Detours by Design" January, 2009
CIO "The coming IT job apocalypse: Rise of the machines" May 28, 2019
Others: Gizmodo, Phys.org, News and Tribune, Ars technica, SpringerOpen, National Geography, Mathematical Institute at the University of Oxford, News in Santa Fe Institute, Highlights in PNAS, Next City.

KEYNOTE, COLLOQUIUM, INVITED, PANEL

Computational Social Science, University of Chicago	Feb, 2024
Organizational Behavior Seminar, Stanford GSB	Nov, 2023
TIE Seminar, MIT Sloan, MA	Nov, 2023
Theoretical Organizational Models (TOM) Summer School, HBS, MA	Aug, 2023
Santa Fe Institute Complex Systems Summer School, NM	June, 2023
ANN-SONIC-NICO 10th International Workshop on Network Theory, Kellogg	May, 2023
Strategy Seminar, Seoul National University, Korea	April, 2023
Complex Network Seminar, Indiana Bloomington, IN	April, 2023
DINS Seminar Series, Pittsburgh, PA	Mar, 2023
GrowthLab Seminar, Harvard, MA	Mar, 2023
Complexity Speaer Series, Northeastern, MA	Mar, 2023
The Psychology of Collectives, SPSP Annual Convention, Atlanta	Mar, 2023

2022 (invited & keynote)

Computational Social Science Seminar, Yale, CT	Nov, 2022
MORS Colloquium, Haas, UC Berkeley, CA	April, 2022
Modelling an Evolving Economy, Digital Catapult, London, UK	Oct 7, 2022

2021 (invited & keynote)

Social Computing at IEEE WIC ACM; Conference on Complex Systems (keynote), Lyon, France; Artificial Intelligence and the Future of Lawyering and Law Firms, Northwestern;

2020 (invited & keynote)

MIT Media Lab; Korea Academy of Complexity Studies; NSF workshop on Future of Work (panel); AI Institute at Northwestern University; University of Chicago

2019 (invited & keynote)

Federal University of Parana - UFPR, Brazil; The Conference on Complex Systems 2019 (invited), Sngapore; Satellite meeting of CCS2019 (invited), Singapore; Santa Fe Institute ACtioN, San Francisco, CA; Johns Hopkins University; NetSci 2019 (keynote), University of Vermont; The Future of work, Microsoft Faculty Summit 2019, Redmond, WA; Academy of Management (invited), Boston; CIFS workshop, KAIST; INET, University of Southern California

2018 (invited & keynote)

Royal Statistical Society, London; Salesforce, San Francisco; International Conference on Artificial Life (keynote), Tokyo, Japan; Engineering Sciences & Applied Mathematics, Northwestern University; Civil & Environmental Engineering, Northwestern University; Northwestern Institute on Complex Systems, Northwestern University; Industrial Engineering & Management Science, Northwestern University; Universite de Lorraine, France; Santa Fe Institute, NM;

2017 (invited & keynote)

Conference on Complex Systems (invited); MIT; Northeastern University; Santa Fe Institute; Updating the Production Function for the Algorithmic Economy, Menlo Park, CA; KAIST; 2017 KDD Workshop on Datadriven Discovery (keynote); Indiana University Bloomington

2016 (invited &keynote)

Cities as complex systems symposium (VW-Foundation), Germany; Postech; Korea Land & Housing Institute; Complexity Science HUB, Vienna;

2015 (invited & keynote)

Merck KGaA, Darmstadt, Germany; Urban Innovation Centre, UK; University of Cambridge; The Future of Fund Management, UK

2014 (invited & keynote)

Seoul National University; UCL; Kavli Royal Society International Centre, UK; the Ettore Majorana Centre, Erice, Italy; Harvard University; the Museum of London, UK