Yul HR Kang, MD, PhD.

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Education & Professional Appointments

2022 - present — Lecturer (Assistant Prof.), Biological and Experimental Psychology, Queen Mary U. of London

2022 - present — Fellow, Digital Environment Research Institute, QMUL

2018 - 2022 — Research Associate, Computational & Biological Learning Lab, Engineering Dept., Cambridge U.
Supervisor: Prof. Máté Lengyel (in collaboration with Prof. Daniel Wolpert at Columbia Univ.)

2019 - 2022 — Junior Research Fellow, Wolfson College, University of Cambridge
Elected through competition **(< 5% of all Cambridge postdocs)** based on excellence in research; serving as a member of the College and the University's Governing Body.

2012 - 2017 — PhD, Neurobiology & Behavior, Columbia University, New York, NY, USA
Supervisor: Prof. Michael Shadlen
Thesis title: "Inferring Decision Rules from Evidence, Choice, and Reaction Times" (link)

2013 - 2016 — Trainee, Vision Training Grant, National Eye Institute, USA
Chosen as the NEI Vision Training Grant Trainee **(1 student/year in the department)** and received tuition and stipend **(~$152K)**

2008 - 2011 — Head Physician (military duty), Incheon Public Health Centre, South Korea

2002 - 2008 — Medical Doctor, Seoul National University College of Medicine, Seoul, South Korea
Awarded an MD from the top medical school in South Korea.

2003 — Scholarship for short-term overseas studies, Seoul National University (~**$2K**)
: Attended UCLA Summer sessions

2002 - 2004 — Scholarship for tuition, Seoul National University (~**$9K**)

2002 — Case Fellow, Case Inc., South Korea (**~$1K**)

1999 - 2000 — Summer/Winter Schools for International Olympiad in Informatics, South Korea
Chosen through a **national competition (10 students/year in the country)**, trained in algorithms, including dynamic programming, graph theory, and stochastic optimisation, supported by the government to represent the country.

Publications - Published

(@: corresponding author; *†: equal contributions)

Kang YHR*@, Löffler A*, Jeurissen D*, Zylberberg A†, Wolpert DM†, Shadlen MN†@ (2021), *Multiple decisions about one object involve parallel sensory acquisition but time-multiplexed evidence incorporation.* **eLife** 10, e63721.

⟹ Impact factor: **8.140**
⟹ Selected as a **Contributed Talk at Cosyne** in 2021 **(top 4.6% of submissions)**
⟹ **Excellent Poster Award** at Korean Society for Computational Neuroscience

: Developed novel dual-decision tasks & efficient 2D drift-diffusion models, providing quantitative methods to study the dynamics of flexible routing of information between sensory and motor areas.

- Showed that two simultaneous streams of evidence are acquired in parallel, but accumulated sequentially with intermittent switches
- Developed a method to predict 60% of the experimental conditions, trial-by-trial, which disambiguated serial vs. parallel evidence accumulation models
- Developed efficient 2D drift-diffusion models with ~100x lower time complexity & made analyses feasible

Lee DS, Kang YHR, Ruiz-Lambides A, Higham J (2021), *The observed pattern and hidden process of female reproductive trajectories across the lifespan in a nonhuman primate.* **J Animal Ecology** 2021;00:1-14.

⟹ Impact factor: **5.090**

: Contributed a hidden Markov model that explained the effects of senescence (older age) & frailty (short time-to-death) on fertility.

Kang YHR*, Petzschner FH*, Wolpert DM, and Shadlen MN (2017), *Piercing of consciousness as a threshold crossing operation.* **Current Biology** 27 (15). doi.org/10.1016/j.cub.2017.06.047

⟹ Impact factor: **10.834**
⟹ Featured in news outlets including The Independent (link)
⟹ According to Altmetric, "Compared to other publications in the same field, this publication is extremely highly cited and has received approximately
14 times more citations than average"

: Developed novel covert decision-making tasks & cross-validation methods for drift-diffusion models, which provided the first external validation of subjective decision times, which had been considered an impasse in the studies of awareness since Libet *et al.* (1983).

Bakkour A, Palombo DJ, Zylberberg A, Kang YHR, Reid A, Verfaellie M, Shadlen MN, and Shohamy D (2019), *The hippocampus supports deliberation during value-based decisions.* **eLife** 8, e46080.

⟹ Impact factor: **8.140**

: Contributed a perceptual decision-making task, analysis software, and the successful prediction that the hippocampus will be more active during more difficult decisions by engaging in the decision for longer.

Kang YHR*@, Mahr J*@, Nagy M, Andrási K, Csibra G†, Lengyel M† (2019), *Eye movements reflect causal inference during episodic memory retrieval.* Cognitive Computational Neuroscience (CCN). doi.org/10.32470/CCN.2019.1330-0

: Showed that gazes betray subjective uncertainty in causal inference about a false cue during episodic memory retrieval.

Lee DS and Kang HR (2012), *The categorization of "bad animal" and its relation to animal appearances: a study of 6-year-old children's perceptions.* J Soc, Evol, and Cultural Psy 6 (1), 32. doi.org/10.1037/h0099226

Yoon S, Jun CS, An HY, Kang HR, Jun TY (2009), *Patterns of temperament and character in patients with PTSD and their association with symptom severity.* Comprehensive Psychiatry 50 (3): 226-231. doi.org/10.1016/j.comppsych.2008.08.003

Publications - In Prep/Under Revision

Kang YHR@, Wolpert DM, Lengyel M, *Spatial uncertainty and environmental geometry in navigation* (bioRxiv / Bernstein talk video).

⟹ Selected as a **Contributed Talk** at **Bernstein Conference** in 2021 **(top 3.7% of presentations)**
⟹ Awarded a **Cosyne Presenters Travel Grant** in 2020 **(~3% of submissions)**

: Developed a unifying normative theory that jointly explains well-known homing behaviour & grid field deformations on multiple levels (geometry- / training- / trajectory-dependence).

- Model takes as input the 1st-person view video
- Combined information-theoretic analysis, state-of-the-art robotic navigation algorithm, and large-scale gradient-based optimisation

Olieslagers J*, Kang YHR*@, Wolpert DM†, Lengyel M†, *Active sensing in landmark-based localisation* (Bernstein).

: Supervised an Engineering Masters project that involved online psychophysics & ideal observer modelling.

- Resulted in a manuscript for publication—an unusual success for a Masters project

Kang YHR, *Estimation of time-varying decision thresholds from the choice and reaction times without assumptions on the shape.* bioRxiv. doi.org/10.1101/090217

Funding & Awards

2020	**Cosyne Presenters Travel Grant**, Computational and Cognitive Neuroscience **($1K)**
2019 - 2022	**Junior Research Fellow**, Wolfson College, University of Cambridge **(~£9K)**
2014	**Excellent Poster**, Korean Society for Computational Neuroscience
2013 - 2016	**Trainee**, Vision Training Grant, National Eye Institute, USA **(~$152K)**
2009 & 2010	**Most Welcoming Centre** (among ~20 branches), Incheon Public Health Centre, South Korea
2002 - 2004	**Scholarship for tuition**, Seoul National University, South Korea **(~$9K)**
2002	**Scholarship for overseas studies,** Seoul National University, South Korea **(~$2K)**
2002	**Case Fellow**, Case Inc., South Korea **(~$1K)**
2001	**Grand Prize (1st place)**, Yonsei National Olympiad in Informatics, South Korea
2001	**National Creativity Contest (1st place)**, Minister of Education, South Korea

Invited Seminars

2022	World Wide NeuRise (online): https://www.world-wide.org/seminar/8289/
2022	University of Aberdeen
2018	Samsung Seoul Medical Center, South Korea
2017	MIT Brain & Cognitive Sciences, USA
2017	NYU Neural Science, USA
2017	Champalimaud Centre for the Unknown, Portugal
2017	Department of Cognitive Sciences, Seoul National University, South Korea

Trainees

2020 - 2021 Jeroen Olieslagers, Department of Engineering, University of Cambridge

- Supervised Masters project
- Online psychophysics experiment & ideal observer modelling of active sensing in navigation
- Presented a poster at the Bernstein Conference in 2021 (link)
- Finished the project from planning to writing a manuscript for publication together in 1 year
- Student was admitted to the NYU Neural Science PhD program in 2021

Teaching & Supervision

2023 Module Organiser, Brain and Behaviour, Queen Mary University of London (QMUL)

2022 - current Dissertation Supervisor, Department of Biological & Experimental Psychology, QMUL

2022 - current Tutorial Leader, Introduction to Psychology, QMUL

2022 - current Advisor to Students, Department of Biological & Experimental Psychology, QMUL

2020 - current Engineering Masters Project Co-supervisor, Department of Engineering, University of Cambridge

2020 - 2022 PhD Mentor, Wolfson College, University of Cambridge
Provided pastoral care to new PhD students of the college.

2019 - 2021 Supervisor, Introduction to Neuroscience, University of Cambridge
Supervised engineering Masters students on Bayesian decision-making theories.

2020 Assessor, Engineering Masters Project, University of Cambridge
Assessed an engineering Masters student's term project on computational neuroscience.

2016 Instructor, Quantitative Approaches for Experimental Neuroscientists, Columbia University
Gave a lecture in a graduate course on computational theories of decision making.

2013 - 2014 Founder, Workshops on Modelling Drift-Diffusion Processes, Shadlen Lab, Columbia University
Initiated and led hands-on workshops; taught the theory of the drift-diffusion model of decision-making to graduate students and postdocs, and helped them implement it with MATLAB.

Collaborators

Guifen Chen (QMUL)	electrophysiology of rodents during navigation
Hugo Spiers (UCL)	human navigation on a large-scale mobile game platform
Máté Lengyel (University of Cambridge)	normative models of behaviour & neural representation
Guillaume Hennequin (University of Cambridge)	cortical dynamics
Daniel Wolpert (Columbia University)	human sensorimotor control
Michael Shadlen (Columbia University)	decision-making in human & nonhuman primates
Gergely Csibra (CEU) & Johannes Mahr (Harvard)	human episodic memory
György Buzsáki (NYU) & David Tingley (Harvard)	electrophysiology of rodents during navigation
Dora Angelaki (NYU)	electrophysiology of nonhuman primates during navigation

Software

2021 — Two-Dimensional Drift-Diffusion Models

Wrote a library in MATLAB & Python (PyTorch) to fit choice & reaction time in controlled-duration & reaction time experiments given two simultaneous streams of evidence.

- **Parametrically interpolates between serial & parallel models of evidence accumulation**
- Validated through model/parameter recovery (simulation) & cross-validation (real data)
- Fit to 40% of experimental conditions and **predict unseen conditions (60% of all conditions)**
- https://github.com/yulkang/2D_Decision - accompanies Kang et al. (2021) eLife

2019 — ConsTorch: Automatic Transformation-Based Parameter Constraints for PyTorch

Wrote a library to automatically constrain PyTorch parameters.

- https://github.com/yulkang/constorch

2017 — One-Dimensional Drift-Diffusion Models

Wrote a library to fit choice & reaction time in controlled-duration & reaction time experiments.

- **Predict choices with a model fitted only with reaction times/subjective decision times**
- Validated through parameter recovery (simulation) & cross-validation (real data)
- Estimates the posterior distribution of the parameters through MCMC
- https://github.com/yulkang/SubjDecTime - accompanies Kang et al. (2017) Current Biology

Selected Posters & Presentations

Kang YHR, Wolpert DM, and Lengyel M (2021), Spatial uncertainty provides a unifying account of navigation behavior and grid field deformations, Bernstein Conference in Computational Neuroscience, Online.
***Selected as a Contributed Talk (~3% of all presentations)**

Kang YHR, Wolpert DM, and Lengyel M (2021), An image-computable ideal observer model of navigation explains homing behavior and grid/place field deformation, Computational and Systems Neuroscience Conference (Cosyne), Online.

Kang YHR, Wolpert DM, and Lengyel M (2020), Navigational uncertainty provides a unifying account of human navigational behavior and rodent grid field deformations, Computational and Systems Neuroscience Conference (Cosyne), Denver, CO, USA.
***Cosyne Presenters Travel Grant**

Kang YHR, Wolpert DM, and Lengyel M (2019), Simultaneous Localization And Mapping in People, Computational Vision Summer School (CVSS), Black Forest, Germany. **Acceptance rate: 13.4%**

Kang YHR, Wolpert DM, and Lengyel M (2019), Confirmation bias in active learning, Computational and Systems Neuroscience Conference (Cosyne), Lisbon, Portugal. **Acceptance rate: 35%**

Kang YHR, and Shadlen MN (2014), Making one decision from two simultaneous sources of evidence, The 6th Annual Meeting of Korean Society for Computational Neuroscience, Seoul, South Korea.
***Excellent Poster Award**

Service

2023 — Procurement Lead, Multi-person Eye Tracker, EPSRC Award

2022 - present — Space Committee, Department of Biological and Experimental Psychology, QMUL
Plans allocation of research lab and office spaces.

2022 - present — Research Ethics Committee, Department of Biological and Experimental Psychology, QMUL
Reviews ethics applications.

2020 - 2022 — Fine Arts Committee, Wolfson College, University of Cambridge
Served on the college's committee overseeing matters regarding fine arts, including exhibitions at the college.

2019 - 2022 — Governing Body Fellow, Wolfson College & University of Cambridge
Served as a member to decide on matters of governance of the college & the university.

2018 - 2022 — Host for Visitors, Computational Learning and Memory Group, University of Cambridge
Organised seminars, meetings and other schedules for visitors.

Volunteer & Extracurricular Activities

2021 — Artist, Solo Exhibition "Home, Taken", Wolfson College, University of Cambridge

2019 — Artist, "Home" Art Exhibition, Michaelhouse Centre, Cambridge Convoy Refugee Action Group
Accepted through a competition, exhibited two pieces of painting in a group exhibition to help refugees and homeless people.

2017 — Invited Speaker, Harlem Academy (middle school), New York, NY
Performed a cognitive experiment (Stroop Effect) together, which led to poster presentations