

# YUL HR KANG, MD, PHD.

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## EDUCATION & PROFESSIONAL APPOINTMENTS

- 2018 - present Research Associate, Computational & Biological Learning Lab, Engineering Dept., Cambridge U.  
Supervisor: Prof. Máté Lengyel (in collaboration with Prof. Daniel Wolpert at Columbia Univ.)
- 2019 - present 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 optimization, 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](https://doi.org/10.7554/eLife.63721).

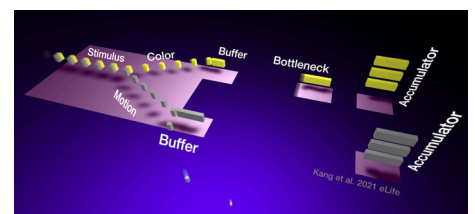
⇒ Impact factor: **8.140**

⇒ 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](https://doi.org/10.1111/1365-2656.13414).

⇒ Impact factor: **5.090**

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

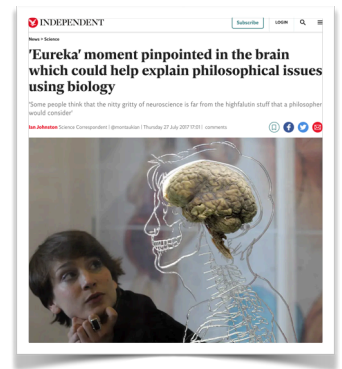
Kang YHR\*, Petzschnr FH\*, Wolpert DM, and Shadlen MN (2017), *Piercing of consciousness as a threshold crossing operation*. *Current Biology* 27 (15). [doi.org/10.1016/j.cub.2017.06.047](https://doi.org/10.1016/j.cub.2017.06.047)

⇒ 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](https://doi.org/10.1101/46080).

⇒ 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, András 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](https://doi.org/10.32470/CCN.2019.1330-0)

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](https://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.comppsy.2008.08.003](https://doi.org/10.1016/j.comppsy.2008.08.003)

## **PUBLICATIONS - IN PREP/UNDER REVISION**

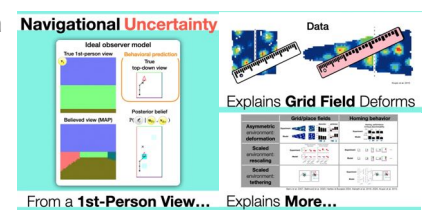
Kang YHR\*@, Wolpert DM, Lengyel M, *Spatial uncertainty provides a unifying account of navigation behavior and grid field deformations* ([Bernstein talk video](#)).

⇒ Selected as a **Contributed Talk at Bernstein Conference** in 2021 (**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 behavior & 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 optimization



Kang YHR\*@, Mahr J\*@, Nagy M, András K, Csibra G†, Lengyel M†, *Eye movements reflect causal inference during episodic memory retrieval*.

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

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 modeling.
- Writing a manuscript for publication together—an unusual success for a Masters project

Kang YHR, *Modeling a decision based on two simultaneous streams of evidence with graded inhibitory interaction*.

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](https://doi.org/10.1101/090217)

## COLLABORATORS

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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 & Birkbeck)	human infant & adult eye movements
György Buzsáki & David Tingley (NYU)	electrophysiology of rodents during navigation
Dora Angelaki (NYU)	electrophysiology of nonhuman primates during navigation

## TRAINEES

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2020 - 2021	Jeroen Olieslagers, Department of Engineering, University of Cambridge
	<ul style="list-style-type: none"><li>• Supervised Masters project</li><li>• Set up &amp; analyzed an online psychophysics experiment on active sensing in spatial navigation</li><li>• Writing an article for publication together, based on the Masters project</li><li>• Started at NYU Neural Science PhD program</li></ul>

## HONORS & AWARDS

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

## SOFTWARE

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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. <ul style="list-style-type: none"><li>• <b>Parametrically interpolates between serial &amp; parallel models of evidence accumulation</b></li><li>• Validated through model/parameter recovery (simulation) &amp; cross-validation (real data)</li><li>• Fit to 40% of experimental conditions and <b>predict unseen conditions (60% of all conditions)</b></li><li>• <a href="https://github.com/yulkang/2D_Decision">https://github.com/yulkang/2D_Decision</a> - accompanies <a href="#">Kang et al. (2021) eLife</a></li></ul>
2019	Constorch: Automatic Transformation-Based Parameter Constraints for PyTorch
	Wrote a library to automatically constrain PyTorch parameters. <ul style="list-style-type: none"><li>• <a href="https://github.com/yulkang/constorch">https://github.com/yulkang/constorch</a></li></ul>
2017	One-Dimensional Drift-Diffusion Models
	Wrote a library to fit choice & reaction time in controlled-duration & reaction time experiments. <ul style="list-style-type: none"><li>• <b>Predict choices with a model fitted only with reaction times/subjective decision times</b></li><li>• Validated through parameter recovery (simulation) &amp; cross-validation (real data)</li><li>• Estimates the posterior distribution of the parameters through MCMC</li><li>• <a href="https://github.com/yulkang/SubjDecTime">https://github.com/yulkang/SubjDecTime</a> - accompanies <a href="#">Kang et al. (2017) Current Biology</a></li></ul>

## INVITED LECTURES

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2018	Samsung Seoul Medical Center, South Korea
2017	Department of Cognitive Sciences, Seoul National University, South Korea

## TEACHING

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- 2020 - present PhD Mentor, Wolfson College, University of Cambridge  
Providing 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 Modeling 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.

## POSTERS & PRESENTATIONS

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- 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 trumps performance optimisation in overt active learning, Annual Meeting of the Cognitive Science Society (CogSci), Montreal, Canada.
- 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**

## VOLUNTEER & EXTRACURRICULAR ACTIVITIES

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- 2019 - present Governing Body Fellow, Wolfson College & University of Cambridge  
Serving as a member to decide on matters of governance of the college & the university.
- 2020 - present Fine Arts Committee, Wolfson College, University of Cambridge  
Serving on the college's committee overseeing matters regarding fine arts, including exhibitions at the college.
- 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. <http://camcrag.org.uk/homeart/>
- 2017 Invited Speaker, Harlem Academy (middle school), New York, NY  
Performed a cognitive experiment (Stroop Effect) together, which led to poster presentations