Dr. Cai Wingfield

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Employment and education

2017– Senior Research Associate.
Embodied Cognition Lab, Department of Psychology, Lancaster University.
PI: Louise Connell.

2015–16 Postdoctoral Research Associate.
Centre for Speech Language and the Brain, Department of Psychology, University of Cambridge.
PIs: Lorraine K. Tyler and William Marslen-Wilson.

2013–14 Software Developer.
Symplectic Ltd., London.

2010–13 PhD (Computer science and mathematics).
University of Bath.
Thesis: "Graphical foundations for dialogue games".
Supervisors: A. John Power and Guy McCusker.

2009–10 Research Assistant.
Neurolex group, MRC Cognition and Brain Sciences Unit.
PI: William Marslen-Wilson.

2008–09 Masters of Advanced Study in Pure Mathematics.
University of Cambridge.
Dissertation: "Cartesian closed categories and typed λ-calculi".

2005–08 BSc (Hons.) in Mathematics (1st class).
University of Warwick.
Year 2 dissertation: "Computability theory: Turing machines and other models".
Year 3 dissertation: "Is Structural Realism a rational alternative to Scientific Antirealism?"

Preprints and manuscripts

✳: As first or joint-first author. (By convention, mathematics publications list authors alphabetically.)
☆: Open access/open archive/preprint available.
★: Open data/code available.

<u>Wingfield C</u>, Soltan A, Nimmo-Smith I, Marslen-Wilson WD, Thwaites A (*in preparation*) Tracking cortical entrainment to the Heeger (1988) model of motion perception in the visual field.
✳ (with AT) ★

<u>Wingfield C</u>, Zhang C, Devereux B, Fonteneau E, Thwaites A, Liu X, Woodland P, Marslen-Wilson W, Su L (*under review*) On the similarity of representations in artificial and brain neural networks for speech recognition. Preprint DOI: 10.1101/2022.06.27.497678.
✳ (with CZ) ☆

Journal publications

✳: As first or joint-first author. (By convention, mathematics publications list authors alphabetically.)
☆: Open access/open archive/preprint available.   ★: Open data/code available.

<u>Wingfield C</u>, Connell L (*2022*) Sensorimotor distance: a grounded measure of semantic similarity for 800 million concept pairs. *Behavior Research Methods*. 10.3758/s13428-022-01965-7.
✳ ☆ ★

<u>Wingfield C</u>, Connell L (2022) Understanding the role of linguistic distributional knowledge in cognition. *Language, Cognition and Neuroscience*. 10.1080/23273798.2022.2069278.
✳ (with LC) ☆ ★

Banks B, <u>Wingfield C</u>, Connell L (2021) Linguistic distributional knowledge and sensorimotor grounding both contribute to semantic category production. *Cognitive Science 45*: e13055. 10.1111/cogs.13055.
＊ (with BB and LC) ☆ ★

Thwaites A, <u>Wingfield C</u>, Wieser E, Soltan A, Marslen-Wilson WD, Nimmo-Smith I (2018) Entrainment to the CIECAM02 and CIELAB colour appearance models in the human cortex. *Vision Research* 145:1–10. 10.1016/j.visres.2018.01.011.
☆ ★

<u>Wingfield C</u>, Su L, Liu X, Zhang C, Woodland P, Thwaites A, Fonteneau E, Marslen-Wilson WD (2017) Relating dynamic brain states to dynamic machine states: Human and machine solutions to the speech recognition problem. *PLOS Computational Biology*. 10.1371/journal.pcbi.1005617.
＊ (with LS) ☆ ★

McCusker G, Power AJ, <u>Wingfield C</u> (2015) A graphical foundation for interleaving in game semantics. *Journal of Pure and Applied Algebra* 219(4):1131–1174. 10.1016/j.jpaa.2014.05.040.
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➢ Highest-scoring paper, 2016 Computer Science internal research review, University of Bath.

Nili H, <u>Wingfield C</u>, Su L, Walther A, Kriegeskorte N (2014) A toolbox for representational similarity analysis. *PLOS Computational Biology* 10(4):e1003553. 10.1371/journal.pcbi.1003553 pmcid:PMC3990488.
☆ ★
➢ Cited 600 times as of 2022.

Bozic M, Tyler LK, Su L, <u>Wingfield C</u>, Marslen-Wilson WD (2013) Neurobiological systems for lexical representation and analysis in English. *Journal of Cognitive Neuroscience* 25(10):1678–1691. 10.1162/jocn_a_00420.
➢ Cited 55 times as of 2022.

McCusker G, Power AJ, <u>Wingfield C</u> (2012) A graphical foundation for schedules. *Proceedings of the 28th Conference on the Mathematical Foundations of Programming Semantics (MFPS XXVIII), Electronic Notes in Theoretical Computer Science* 286:273–289. 10.1016/j.entcs.2012.08.018.
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Editorial

☆: Open access/open archive/preprint available.

Power AJ, <u>Wingfield C</u> (Editors; 2014) Proceedings of the Workshop on Algebra, Coalgebra and Topology WACT 2013. *Electronic Notes in Theoretical Computer Science* 303:1–206. 10.1016/j.entcs.2014.02.001.
☆

Research software

Sensorimotor Distance Calculator (https://www.lancaster.ac.uk/psychology/smdistance; https://github.com/emcoglab/sensorimotor-distance-calculator; 2021). Open-source web app for computing and visualising grounded semantic distances between 800 million pairs of concepts. R/Shiny. Sole developer.

Computational cognitive model of associative activation underlying the category production task (https://github.com/emcoglab/category-production-computational-modelling; 2020). Python. Sole developer.

Framework for training and systematically evaluating a suite of linguistic distributional models to a battery of standard tasks in cognitive psychology (https://github.com/emcoglab/ldm-train-and-evaluate; 2019). Python. Sole developer.

Toolbox for representational similarity analysis in fMRI (https://github.com/rsagroup/rsatoolbox_matlab; 2014). Open-source toolbox, highly used across human cognitive neuroimaging (over 500 citations of associated publication as of 2021). Matlab. Principal developer and contributor.

Smaller research tools and projects. From the Embodied Cognition Lab: https://github.com/emcoglab. By me: https://caiwingfield.net.

Selected talks

Sensorimotor and linguistic distributional knowledge in semantic category production: An empirical study and model. (*Meeting of the Experimental Psychology Society*, University College London, London [virtualised due to Covid-19 pandemic], January 2021).
<small>(Joint presentation with Briony Banks)</small>

What kind of linguistic distributional information best predicts conceptual processing? A systematic cross-task comparison. (Special Session on Methods & Reproducibility, *Embodied and Situated Language Processing Conference*, Lancaster University, August 2018).

Human and machine solutions for speech recognition: challenges with temporally changing models. (Invited speaker. *Representational Similarity Analysis & Advanced Computational Methods Workshop*, MRC Cognition and Brain Sciences Unit, University of Cambridge, May 2018).

Multivariate mapping of speech representations in auditory cortex using machine models. (Invited speaker. Technische Universität Dresden, Dresden, July 2016).

Multivariate mapping of speech representations in auditory cortex using machine models. (Invited speaker. Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig, July 2016).

Understanding human speech recognition: Reverse-engineering the engineering solution using EMEG and RSA. (Invited speaker. *Interdisciplinary Workshop on Neurocomputation: From Brains to Machines*, University of Cambridge, November 2015).

Using machine speech recogniser state to map phonetic speech responses in the human brain. (Invited speaker. *Computing and Information Systems Seminar*, Cardiff Metropolitan University, Cardiff, November 2015).

Using multivariate analysis of fMRI data to investigate lexical representation. (Invited speaker. *Age, Hearing, and Speech Comprehension*, Brandeis University, Boston, MA, July 2014).

Graphical foundations for dialogue games. (*Games for Logic and Programming Languages VIII (GaLoP)*, Queen Mary University London, July 2013).

Graphical foundations for dialogue games. (Invited speaker. *Logic, Reasoning and Computation Seminar*, Laboratoire d'Informatique de Paris Nord, June 2013).

Graphical foundations for dialogue games. (Invited speaker. *Birmingham Theoretical Computer Science Seminar*, Birmingham University, May 2013).

A graphical foundation for schedules. (*Conference on the Mathematical Foundations for Programming Semantics*, University of Bath, June 2012).

Graphical notation schemes. (*Young Researchers in Mathematics*, University of Bristol, April 2012).

Universals and constructions on categories; Tortile tensor categories and other graphical notation schemes. (Lecture series. *Bristol Category Theory Seminars*, University of Bristol, 2011–2012).

A graphical foundation for schedules. (Video-linked. *Mathematical Foundations Seminar*, University of Bath and University of Swansea, March 2012).

Graphical notation for monoidal categories and braided monoidal categories. (Lecture series. *Logic and Semantics Seminars*, University of Bath, 2011).

Cartesian closed categories and simply typed λ-calculi. (*Part III Seminar Series*, University of Cambridge, 2009).

Selected abstracts

<small>❋: As first or joint-first author. (By convention, mathematics publications list authors alphabetically.)</small>

<u>Wingfield C</u>, Connell L. Sensorimotor similarity: A fully grounded and efficient measure of semantic similarity. (2021 *Annual Meeting of the Cognitive Science Society*, Vienna, Austria [virtualised due to Covid-19 pandemic], July 2021).
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Wingfield C, Connell L. Understanding the role of linguistic distributional knowledge in cognition: A systematic comparison of tasks, models and parameters. (*12th Dubrovnik Conference on Cognitive Science*, Dubrovnik, Croatia [virtualised due to Covid-19 pandemic], May 2021).
✻

Banks B, Wingfield C, Connell L. Sensorimotor and Linguistic Distributional Knowledge in Semantic Category Production: An Empirical Study and Model. (*12th Dubrovnik Conference on Cognitive Science*, Dubrovnik, Croatia [virtualised due to Covid-19 pandemic], May 2021).
✻ (with BB)

Banks B, Wingfield C, Connell L. Sensorimotor and linguistic distributional knowledge in semantic category production: An empirical study and model. (*The 26th Architectures and Mechanisms for Language Processing Conference special session on computational models of language processing,* Potsdam, Germany [virtualised due to Covid-19 pandemic], September 2020).
✻ (with BB)

Wingfield C, Connell L. Understanding the role of linguistic distributional knowledge in cognition: A systematic comparison of tasks, models and parameters. (*European Conference for Cognitive Science*, Ruhr-Universität Bochum, September 2019).
➢ Winner of EuroCogSci 2019 "Best Poster" prize.

Banks B, Wingfield C, Connell L. Linguistic distributional information and sensorimotor similarity both contribute to semantic category production. (*41st Annual Meeting of the Cognitive Science Society*, Montréal, July 2019).

Banks B, Wingfield C, Connell L. Linguistic distributional information and sensorimotor similarity both contribute to semantic category production. (*Experimental Psychology Society meeting*, University of Manchester, April 2019).

Thwaites A, Wingfield C, Wieser E, Soltan A, Marslen-Wilson WD, Nimmo-Smith I. Searching for evidence of cortical entrainment to colour appearance models in the adult human brain. (*The Annual Colour Group Colour Vision Meeting*, City University London, January 2019).

Banks B, Wingfield C, Connell L. Linguistic distributional associations predict category member production. (*Embodied and Situated Language Processing Conference*, Lancaster University, August 2018).

Banks B, Wingfield C, Connell L. Linguistic statistical associations predict category member production. (*Psycholinguistics in Flanders*, Ghent University, Belgium, June 2018).

Wingfield C, Su L, Devereux B, Liu X, Zhang C, Woodland P, Fonteneau E, Thwaites A, Marslen-Wilson W. Multi-level representations in speech processing in brain and machine: Evidence from EMEG and RSA. (*Cambridge Language Sciences Symposium*, Cambridge, November 2016).

Wingfield C, Su L, Devereux B, Liu X, Zhang C, Woodland P, Fonteneau E, Thwaites A, Marslen-Wilson W. Multi-level representations in speech processing in brain and machine: Evidence from EMEG and RSA. (*Society for the Neurobiology of Language*, London, August 2016).

Wingfield C, Su L, Liu X, Zhang C, Woodland P, Thwaites A, Fonteneau E, Marslen-Wilson W. Investigating human speech recognition: Reverse-engineering the machine solution with EMEG and RSA. (*Organisation for Human Brain Mapping*, Geneva, June 2016).
(Supported by £600 grant award from Guarantors of Brain charity.)

Wingfield C, Su L, Liu X, Zhang C, Woodland P, Thwaites A, Fonteneau E, Marslen-Wilson W. Investigating human speech recognition: Reverse-engineering the machine solution with EMEG and RSA. (*Cambridge Neuroscience Seminar*, Cambridge, March 2016).

Bozic M, Woolgar A, Fonteneau E, Whiting C, Su L, Wingfield C, Marslen-Wilson W. Modulation of speech processing following item repetition. (*Organisation for Human Brain Mapping*, Beijing, June 2012).

Woolgar A, Bozic M, Fonteneau E, Whiting C, Su L, Wingfield C, Marslen-Wilson W. More repetitions or more items? The effects of repeating stimuli on MVPA for fMRI and E/MEG. (*Organisation for Human Brain Mapping*, Beijing, June 2012).

Su L, Fonteneau E, Wingfield C, Bozic M, Marslen-Wilson W. Dynamic morpholexical processing revealed by time-resolved MVPA. (*British Association for Cognitive Neuroscience Conference and Annual Meeting*, Newcastle, April 2012).

Power AJ, Wingfield C. Graphical notation schemes: a picture is worth a thousand binary tensor words. (*Milner Symposium*, University of Edinburgh, April 2012). ✻ (with AJP)

Su L, Fonteneau E, <u>Wingfield C</u>, Bozic M, Marslen-Wilson W. Searchlight representational similarity analysis for complex morpholexical processes. (*Experimental Psychology Society Meeting*, London, January 2012).

Su L, Fonteneau E, <u>Wingfield C</u>, Marslen-Wilson W. The dynamics of complex morpholexical processes revealed by searchlight representational similarity analysis of MEG/EEG data. (*Neurobiology of Language Conference*, Annapolis, MD, November 2011).

Fonteneau E, Bozic M, Su L, <u>Wingfield C</u>, Marslen-Wilson W. Inflectional and phrasal interactions with lexical processes: an MEG/EEG study. (*Neurobiology of Language Conference*, San Diego, CA, November 2010).

Bozic M, Su L, <u>Wingfield C</u>, Marslen-Wilson W. Characterizing lexical complexity computations in the fronto-temporal language network. (*Society for the Neurobiology of Language*, San Diego, CA, November 2010).

Fonteneau E, Bozic M, Su L, <u>Wingfield C</u>, Billi Randall, Marslen-Wilson W. Spatiotemporal dynamics of morphological processing: an MEG/EEG investigation. (*Society for Neuroscience*, San Diego, November 2010).

Su L, <u>Wingfield C</u>, Bozic M, Fonteneau E, Kriegeskorte N, Marslen-Wilson W. A Multimodal Approach to Representational Similarity Analysis. (*Organisation for Human Brain Mapping*, Barcelona, June 2010).

Bozic M, Su L, <u>Wingfield C</u>, Marslen-Wilson W. Characterizing lexical complexity computations in the fronto-temporal language network. (*Cognitive Neuroscience Society*, Montréal, April 2010).

Grants and awards

2019   Prize for best poster, European Conference for Cognitive Science. €200.

2016   Guarantors of Brain travel grant to Human Brain Mapping conference. £600.

2010–13   PhD scholarship and stipend, University of Bath. £60,000.

Teaching and mentorship

2021–   Departmental mentor for new postdoctoral research associate. Lancaster University Department of Psychology.

2020–21   Co-supervision of two third-year psychology undergraduate (PSYC304) research project students. Lancaster University Department of Psychology. Topic: *Do colour–emotion associations emerge from language experience?*

2013   Course assistant. Advanced programming principles (CM20214). University of Bath Department of Computer Science.

2012   Course assistant. Computer networking (CM50123). University of BathDepartment of Computer Science.

2010–12   Tutor and course assistant. Programming and discrete mathematics (XX10190). University of Bath Department of Computer Science.

Professional activities

Programme Committee member, *SIGNLL Conference on Computational Natural Language Learning (CoNLL)*, Punta Cana, Dominican Republic, November 2021.

Programme Committee member, *SIGNLL Conference on Computational Natural Language Learning (CoNLL)*, fully virtual conference, November 2020.

Invited participant, *PyRSA core development workshop*, September 2020.

Programme Committee member, international *Embodied and Situated Language Processing Conference*, Lancaster University, August 2018.

Workgroup member, PROSPR (Promoting Open Science Practices in Psychology), Lancaster University. The UK's first departmental-level open science advocacy workgroup. Nominee for Outstanding Contribution, 2020 Lancaster University Staff Awards.

Co-organiser, *Representational Similarity Analysis & Advanced Computational Methods Workshop*, MRC Cognition and Brain Sciences Unit, University of Cambridge, May 2018.

Major contributor and core development team member, widely used open-source scientific software github.com/rsagroup/rsatoolbox.

Main organiser, international *Workshop on Algebra, Coalgebra and Topology*, University of Bath, March 2013.

Professional training and development

2022	Accepted to University of Liverpool Prosper Postdoc development programme pilot (second cohort). Successful application made available funding for 10% FTE grant-funded contract extension.
2018	Lancaster Bayesian Methods Workshop, Lancaster University.
2012	Logic and Interaction Winter School, Centre International de Rencontres Mathématiques.
2011	Oregon Programming Languages Summer School, University of Oregon.

Professional membership

Member, Society of Research Software Engineers.

Member, Cognitive Science Society.

Member, Gesellschaft für Kognitionswissenschaft (German society for cognitive sciences).

Voluntary work

2022	Interactive "Beetle Voyage" game development support, Department of Zoology, University of Cambridge.
2020	Internal election systems consultant, XR UK Self-Organising Systems.
2019	Founding member, Lancaster University Climate Emergency working group (LUCE).
2017–2018	Graphic designer, voluntary. Aston-Mansfield youth charity.
2015–2018	Graphic designer, voluntary. Incoming Festival, London and Manchester.

Software proficiency

High:	Python (including Pandas, Numpy); Matlab; Adobe Photoshop; Affinity Suite; Microsoft Excel/Apple Numbers; MacOS.
Moderate:	R (including Tidyverse, Shiny); Unix Shell; Git; LaTeX; C#; JavaScript; HTML/CSS.
Some:	PHP; Lua; Swift; Ink (IF); Unity.