

Dr. Andrew James Anderson

UK & Canadian Citizen

Research Assistant Professor
Del Monte Institute for Neuroscience
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High impact research scientist seeking to elucidate how healthy, aging and unhealthy brains represent, process and communicate information using naturalistic tasks and advanced computational models.

10 years' experience decoding brain signals associated with language and memory

Decoding the semantics of **fMRI/EEG** signals elicited in **natural language processing**, **episodic recollection** and **cocktail party attention** tasks using (deep) artificial neural network language models, computer vision and behavioral ratings of sensory/motor/cognitive/affective/social experience.

4 years' experience in brain aging and neurodegeneration in early Alzheimer's

Characterizing **information processing** and **connectivity** in the brains of healthy/unhealthy agers.

3 / 1.5 / 3 years' experience modeling sensory and motor processes

Speech / visual **motion** / insect active **motion camouflage** pursuits (respectively).

Independent thinker and strong team player

Fresh experience **leading research** projects incl. conceptualizing new studies, securing **>\$360K USD** funding, designing and implementing experiments, modeling and analyzing complex data and disseminating outcomes, all undertaken either **personally or by supervision**.

Excellent written and oral communication

- **25+ journal articles** incl **Nature Comms**, **Curr Biol**, **JNeurosci**, **Trans Assoc Comp Ling**.
- 25+ conferences presentations incl. **ACL**, **EMNLP**, **OHBM**, **SfN**.
- Invited talks incl. **Google Deep Mind**, **IBM Watson**, U. Pisa, U. Buffalo, U. Melbourne.
- Media coverage incl. **13WHAM TV** (USA), **Scientific American**, **New Scientist**, **ABC**.

Experienced in computational modeling and analysis

- **Artificial Neural Networks**: Backprop, self-organizing maps, SVM, corr. matrix memories.
- **Regularized Regression**: Cross-validated ridge regression on high-dimensional brain data.
- **Functional Data Analysis**: Modeling, registering and reducing concurrent time series.

Experienced in multimodal signal processing

- **fMRI / EEG** preprocessing, registration and multivariate pattern analysis.
- **Speech Audio** extraction of spectrograms, MFCC, formants, pitch contours
- **Image/video** optic flow extraction and space variant transformation.

Academic / Industry collaboration

- IARPA Knowledge Representation in Neural Systems, Team led by Teledyne Scientific.

MATLAB 15 years
Modeling and analysis
of **fMRI / EEG** / audio /
visual data

C/ C++ 8 years
Object oriented models
of **vision** and **agent-**
based simulations

Python 2 years
Language modeling
using **deep artificial**
neural network toolkits

Java 3 years
Teaching assistant for
Graphical User Interface
design for BSc and MSc
students

OpenGL 2 years
3D graphical simulations
of driving and an agent-
based **computer game**

Operating systems
Windows 20 years
Linux 5 years
Cygwin 3 years
MacOS 7 years

Employment

Research Fellow/Res. Ass't Prof. U. Rochester. USA. 2014/18
Research Fellow. U. Trento. Italy. 2011-2014.
Research Fellow/Programmer. UCL. UK. 2004-2011.

Education

PhD Computer Science. QMUL UK. 2003
MSc Biological Computation. U York UK. 1999
BSc Environmental Protection. U Surrey UK. 1998

Employment Itemized

8/2018-, Research Assistant Professor, Neuroscience, University of Rochester (USA)

Profs Edmund Lalor and Vankee Lin

- Won **\$256,000 USD** funding as PI to initiate research on speech/memory/Alzheimer's disease.
- Revealed brain representations of propositional semantics using deep neural networks (**J Neurosci 2021**).
- Decoded signatures of personal experience in brain activity elicited in imagination (**Nature Comms 2020**).
- Introduced new models/algorithms to explain brain representations of semantics (**J Neurosci 2019a/b**).
- Proposed model-based framework to spot information processing deficits in early Alzheimer's and exposed changes in information processing in healthy aging (**NeuroImage Clin 2019, Scientific Reports, 2021**).

2/2017-8/2018, Research Fellow, Biomedical Engineering, University of Rochester (USA)

Profs Edmund Lalor and Vankee Lin

- Electrophysiologically indexed the semantic processing of narrative speech (**Curr Biol 2018**).
- Revealed brain representations of different grammatical components of sentences (**Cereb Cortex 2018**).
- Identified neural correlates of fatigue in the aging brain (**Cortex 2019, Brain Imag. Behav. 2019, Aging 2019**).
- Named researcher and **co-developer of \$50,000 Schmitt Foundation Award**: "Indexing the dynamic encoding of natural speech at the semantic level". PI Lalor.

6/2014-1/2017, Research Fellow, Brain and Cognitive Sciences, University of Rochester (USA)

Prof Rajeev Raizada

- Won **\$55,000 USD Fellowship** award on "Inference in language and the brain"
- Introduced first model to predict brain activation elicited in sentence comprehension (**Cereb Cortex 2016**)
- Devised new unsupervised model-based brain decoding algorithms (**NeuroImage 2016, JoCN 2016**)

4/2011-4/2014, Research Fellow, Centre for Mind/Brain Sciences, University of Trento (Italy)

Profs Massimo Poesio, Marco Baroni

- Exposed neural correlates of visual and linguistic elements of representation using computer vision/language models (**EMNLP 2013, NeuroImage 2015, TAACL 2017**).
- Decoded brain activation associated with "abstract" concepts using computational models (**JoCN 2014, TAACL 2017**).

2/2006-4/2011, Programming-Tech, Psychology, University College London (UK)

Profs Peter Howell / Gabriella Vigliocco / Marty Sereno

- Designed/implemented GUI toolkits to capture concurrent physiological, MRI and TMS analogue time series.
- Designed/implemented GUI toolkits to statistically model and analyze concurrent motor/acoustic activity in healthy/disordered speech (**JLSHR 2009, J Med. Speech Lang. Pathology 2008**)
- Designed/implemented the Birkbeck/UCL Centre for Neuroimaging website.

3/2005-5/2005, (Part Time) Course author, Queen Mary University of London (UK)

- Author of web-based introductory course on AI entitled "Intelligent Systems" covering history of AI, connectionist AI, symbolic AI, Evolutionary computation.

1/2004-7/2005, Research Fellow, Psychology, University College London (UK)

Prof Alan Johnston

- Implemented C++ computer vision libraries to support optic flow computation, image reconstruction and space variant transformation, suitable for applied driving applications (**Image and Vision Computing, 2006**).

Education

1999-2003 PhD, Computer Science, Queen Mary University of London (UK)

"Sensorimotor neural networks for a predatory stealth behavior camouflaging motion" (with Prof Peter McOwan)

- Demonstrated motion camouflage in dragonflies can be learnt using artificial neural networks trained on real insect flight paths (**Proc R. Soc. Lond. B**)
- Implemented a 3D computer game to demonstrate human susceptibility to motion camouflage (**Proc R. Soc. Lond. B. Supp 1**)

1998-99 MSc (Distinction), Biological Computation, University of York (UK)

Courses: Statistics, Multivariate Statistics, Ecological Modeling, Design of Information Systems, Geographic Information Systems, Image Analysis, Neural Networks.

Dissertation: "Speech Recognition using AURA: A Foundation" (Prof Jim Austin)

1995-1998 BSc (Honors), Environmental Protection, University of Surrey (UK)

Journal Publications

Submitted/In revision:

1. [Anderson AJ](#), Turnbull, A Smallwood J, Lin FV. The multimodal cortical architecture that encodes vivid autobiographical imagery exposed. (Submitted).
2. Turnbull, A Smallwood J, [Anderson AJ](#), Lin FV. Multi-dimensional experience sampling as a means of quantifying aging everyday cognition. (Submitted)

Published:

1. Broderick MP, Zuk N, [Anderson AJ](#), Lalor EC. 2022. More than Words: Neurophysiological Correlates of Semantic Dissimilarity Depend on Comprehension of the Speech Narrative. *European Journal of Neuroscience*.
2. Wu M-H, [Anderson AJ](#), Jacobs R, Raizada RDS. 2022. Word Analogy Relations Predicted from Addition and Subtraction of fMRI activation patterns. *Neurobiology of Language*. 3 (1), 1-17.
3. [Anderson AJ](#), Kiela D, Binder JR, Fernandino L, Humphries CJ, Conant LL, Raizada RDS, Grimm S, Lalor EC. 2021. Deep artificial neural networks reveal a distributed cortical network encoding propositional

sentence-level meaning. *Journal of Neuroscience*. 41 (18) 4100-4119 In [JNeurosci most discussed articles of 04/2021, coverage incl. TV interview on 13WHAM \(USA\)](#)

4. Broderick MP, Di Liberto GM, **Anderson AJ**, Rofes A, Lalor EC. 2021. Dissociable electrophysiological measures of natural language processing reveal differences in speech comprehension strategy for younger and older adults. *Scientific Reports*. 11:4963. **Covered in Psychology Today**
5. **Anderson AJ**, McDermott K, Rooks B, Heffner KL, Dodell-Feder D, Lin, FV. 2020. Decoding individual identity from brain activity elicited in imagining common experiences. *Nature Communications*. DOI: 10.1038/s41467-020-19630-y **Covered in 16 News outlets**
6. **Anderson AJ**, Ren P, Baran TM, Zhang Z, Lin, F. 2019. Insula and putamen-centered functional connectivity networks reflect healthy agers' subjective experience of cognitive fatigue across multiple tasks. *Cortex*. (119), 428-440.
7. Broderick MP, **Anderson AJ**, Lalor EC. 2019. Semantic context enhances the early auditory encoding of natural speech. *Journal of Neuroscience*. 39 (38), 7564-7575.
8. **Anderson AJ**, Binder JR, Fernandino L, Humphries CJ, Conant LL, Raizada RDS, Lin F, Lalor EC. 2019. An integrated neural decoder of linguistic and experiential meaning. *Journal of Neuroscience* 39 (45) 8969-8987. **SfN press release**
9. **Anderson AJ**, Lin F. 2019. How pattern information analyses of semantic brain activity elicited in language comprehension could contribute to early identification of Alzheimer's disease. *NeuroImage Clinical*. doi: 10.1016/j.nicl.2019.101788
10. Baran T, Zhang Z, **Anderson AJ**, McDermott K, Lin F. 2019. Brain structural connectomes indicate shared neural circuitry involved in subjective experience of cognitive and physical fatigue. *Brain imaging and behavior*. doi:10.1007/s11682-019-00201-9
11. Ren P, **Anderson AJ**, McDermott K, Baran T, Lin F. 2019. Cortical-Striatal Network and Cognitive Fatigue in Old Age. *Aging*. 11(8):2312-2326
12. **Anderson AJ**, Broderick MP, Lalor EC. 2018. Neuroscience: Great expectations at the speech-language interface. *Current Biology*. 28 (24), R1396-R1398
13. **Anderson AJ**, Lalor EC, Lin F, Binder JR, Fernandino L, Humphries CJ, Conant LL, Raizada RDS, Grimm S, Wang X. 2018. Multiple regions of a cortical network commonly encode the meaning of words in multiple grammatical positions of read sentences. *Cerebral Cortex*. doi: 10.1093/bhy110
14. Broderick MP, **Anderson AJ**, Di Liberto GM, Crosse M, Lalor EC. 2018. Electrophysiological correlates of semantic dissimilarity reflect the comprehension of natural narrative speech. *Current Biology*. 28, (5), 803-809. **Media coverage incl. Times**
15. **Anderson AJ**, Kiela D, Clark S, Poesio M. 2017. Visually grounded and textual semantic models differentially decode brain activity associated with concrete and abstract nouns. *Transactions of the Association for Computational Linguistics*. 5, 17-30.

16. **Anderson AJ**, Binder JR, Fernandino L, Humphries CJ, Conant LL, Aguilar M, Wang X, Doko D, Raizada RDS. 2016. Predicting neural activity patterns associated with sentences using a neurobiologically motivated model of semantic representation. *Cerebral Cortex*. doi: 10.1093/cercor/bhw240 **Media coverage incl. NSF frontpage, Scientific American**
17. Zinszer BD, **Anderson AJ**, Kang O, Wheatley T, Raizada RDS. 2016. Semantic structural alignment of neural representational spaces enables translation between English and Chinese words. *Journal of Cognitive Neuroscience*. doi:10.1162/jocn_a_01000
18. **Anderson AJ**, Zinszer BD, Raizada RDS. 2016. Representational similarity encoding for fMRI: pattern-based synthesis to predict brain activity using stimulus-model-similarities. *NeuroImage*. 128, 44-53.
19. **Anderson AJ**, Bruni E, Lopopolo A, Poesio M, Baroni M. 2015. Reading visually embodied meaning from the brain: visually grounded computational models decode visual-object mental imagery induced by written text. *NeuroImage*. 120, 309-322.
20. **Anderson AJ**, Murphy B, Poesio M. 2014. Discriminating taxonomic categories and domains in mental simulations of concepts of varying concreteness. *Journal of Cognitive Neuroscience*. (3) 658-681.
21. Gu Y, Celli, F, Steinberger J, Anderson AJ, Poesio M, Strapparava C, Murphy B. 2014. Using Brain Data for sentiment analysis. *Journal for Language Technology and Computational Linguistics* 29(1) 79-94.
22. Howell P, **Anderson AJ**, Bartrip J, Bailey E. 2009. Comparison of acoustic and kinematic approaches to measuring utterance-level speech variability. *Journal of Speech, Language and Hearing Research*. 52, 1088-1096.
23. **Anderson A**, Lowit A, Howell P. 2008. Temporal and spatial variability in speakers with Parkinson's Disease and Friedreich's ataxia. *Journal of Medical Speech Language Pathology*, 16, 173-180.
24. Tan S, Dale J, **Anderson AJ**, Johnston, A. 2006. Inverse perspective mapping and optic flow: a calibration method and quantitative analysis. *Image and Vision Computing*, 24(2) 153-165.
25. **Anderson AJ**, McOwan PW. 2003. Humans deceived by predatory stealth strategy camouflaging motion. *Proc. R. Soc. Lond. B* Suppl. 1 S18-S20. **(Media incl. New Scientist, 28th June 2003, ABC Australia)**.
26. **Anderson AJ**, McOwan PW. 2003. Model of a predatory stealth behaviour camouflaging motion. *Proc. R. Soc. Lond. B* 270, 489-495.

Book Chapters

- Howell P, **Anderson AJ**, Lowit A. 2011. Variability and Coordination Indices and their Applicability to Motor Speech Disorders. In A Lowit & RD Kent (Eds). **Assessment of motor speech disorders**. 269 - 284. Plural Publishing Group.
- Howell P, **Anderson A**, Lucero J. 2010. Motor timing and fluency. In B Maasen & PHHM van Lieshout (Eds.). **Speech Motor Control: New Developments in Basic and Applied Research**. Oxford: Oxford University Press.

Peer Reviewed Conference Articles

- **Anderson AJ**, McDermott K, Rooks B, Heffner KL, Dodell-Feder D, Lin, FV. 2020. Decoding Identity from Brain Activity elicited during the Recollection of Personal Experiences. **Organization for Human Brain Mapping**. Montreal.
- **Anderson AJ**, Binder JR, Fernandino L, Humphries CJ, Conant LL, Erk K, Raizada RDS. 2016. Decoding Neural Activity Patterns Associated with Sentences by Combining Experiential Attribute and Text-Based Semantic Models. 1st Workshop on Representation Learning for NLP. **ACL 2016**, Berlin, Aug 2016.
- Zinszer BD, **Anderson AJ**, Kang O, Wheatley T, Raizada RDS. 2015. You say potato, I say tudou: How speakers of different languages can share the same concept. Proceedings of the 37th Annual **Conference of the Cognitive Science Society**.
- **Anderson AJ**, Bruni E, Bordignon U, Poesio M, Baroni M. 2013. Of words, eyes and brains: Correlating image-based distributional semantic models with neural representations of concepts. Proceedings of **EMNLP 2013** (Conference on Empirical Methods in Natural Language Processing), East Stroudsburg PA: ACL. 1960-1970. (Runner up for best paper award).
- **Anderson AJ**, Tao Y, Murphy B, Poesio M. 2012. On Discriminating fMRI Representations of Abstract WordNet Taxonomic Categories. Proceedings of the 3rd Workshop on Cognitive Aspects of the Lexicon (CogALex-III), 21–32, **COLING 2012**, Mumbai, December 2012.
- Vinson D, **Anderson A**, Ratoff W, Bahrami B, Vigliocco G. 2011. Slow to anger: Emergence of emotionally loaded words and faces from binocular suppression. Proceedings of **Conference of the Cognitive Science Society**, 3155.
- **Anderson AJ**, Johnston A, Tan S. 2004. How cortical magnification could benefit depth, surface slant and self-motion estimation. **Early Cognitive Vision Workshop**, Skye, Scotland. 1-6.
- **Anderson AJ**, McOwan PW. 2003. Motion camouflage team tactics. Tech. report no. 393, University of Hertfordshire.
- **Anderson AJ**, McOwan PW. 2002. 3D simulation of a sensorimotor stealth strategy for camouflaging motion. **International Conference on Neural Information Processing**, Singapore, 1805-1810.
- **Anderson AJ**, McOwan PW. 2002. Towards an autonomous motion camouflage control system, **International Joint Conference on Neural Networks**, WCCI, Hawaii, 2006-2011.

Grant Applications Under Consideration

- R01 NIH NICHD "Fine-tuning the electrophysiology of natural, continuous speech comprehension". PI EC Lalor, **Cols AJ Anderson**, A White (3rd revision, 3M USD requested).
- R21 NIH NICHD "Mapping language production in the speaking brain". **PI AJ Anderson**, Cols EC Lalor, D Dodell-Feder. (418,880 USD requested)
- R21 NIH NICHD "What will they say? Brain-based assessment of the sociolinguistic grounding of interpersonal relationships." **PI AJ Anderson**, Cols EC Lalor, D Dodell-Feder. (418,880 USD requested)

Current Research Funding (Competitive Awards)

- Pilot: **\$50,000**, Del Monte Institute Pilot Award. What will they say? Interpersonal brain models of natural language in social relationships. **PI AJ Anderson**, Co-I EC Lalor, D Dodell-Feder.
- Pilot: **\$50,000**, Schmitt Foundation Award: "Predicting semantics in the perspective-taking brains of romantic couples: How perspective-taking ability contributes to relationship strength" **PI AJ Anderson**, MPI D Dodell-Feder.

Past Research Awards

- 2021, **\$30,000**, Pilot via NIH U24 Scheme: "Predicting the emotional impact of a pandemic from brain activation elicited in recollecting experiences". **PI AJ Anderson**, MPI F Lin.
- 2020, **\$76,861**, NIH CTSA: "Using neural correlates of story comprehension to reveal mild cognitive impairment in early Alzheimer's". **PI AJ Anderson**, MPI FV Lin.
- 2019, **\$50,000**, Schmitt Foundation Award: "Mapping semantic information flow in the brain during natural speech production". **PI AJ Anderson**, MPI EC Lalor, Co-I D Dodell-Feder.
- 2017, **\$50,000**, Schmitt Foundation Award. "Indexing the dynamic encoding of natural speech at the semantic level". PI Lalor. **Named researcher AJ Anderson**.
- 2015, **\$55,000**, Fellowship award: U. Rochester Center for Language Sciences. "Inference in language and the brain" **Named researcher AJ Anderson**.
- 2010, **£7,394**, UCL Grad School.
- 2009, **£10,500**, Wellcome Trust, Value in People.
- 2005, **£12,971**, Wellcome Trust, Value in People.

Invited Talks

- 2019 University of Melbourne (Australia).
- 2016 University of Pisa (Italy).
- 2016 IBM Watson NY (USA).
- 2016 University of Buffalo NY (USA).
- 2016 Google Deep Mind London (UK).
- 2005 SMI's 9th Conf. Signature Management: The pursuit of stealth. The Hatton, London (UK).
- 2004 SMI's 8th Conf. Signature Management: The pursuit of stealth. The Hatton, London (UK).
- 2004 University of Sunderland (UK).

Teaching (Research)

- Co-supervised 3 PhD graduates.
- Co-supervising 2 PhD students.
- Co-supervised of >20 MSc/BSc student projects.
- Field biology instructor: Two-week ecology field course to Swedish desert island Götiska Sandön (1998).

Teaching

- **Guest Lecture:** Swarthmore College (2021) Final year undergraduate – using language models to explain brain activity.
- **Guest Lecture:** Univ. Trento winter school Multivoxel pattern analysis of fMRI word representations (2012).
- **Guest Lectures:** QMUL Advanced MSc Neural Networks course (2002) – Backpropagation / Simulated Annealing / Evolutionary Computation.
- **Course design:** Open Distance Learning Unit, QMUL, Invited author, Intelligent Systems open learning course (2005), (history of AI, connectionist AI, symbolic AI and Evolutionary computation).
- **Teaching assistant:** UCL BSc/MSc Psychological Experimentation and MATLAB (2010-2011).
- **Teaching assistant:** QMUL: BSc/MSc Intro to Programming and Graphical User Interfaces, both using Java (2000-2003).

Referees

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