Dr. Andrew James Anderson

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Profile

Computational neuroscientist using *machine learning* methods and brain imaging to address:

- How does the *human brain* represent the meaning of *natural language*?
- How do neural representations break down in *clinical* conditions and *aging*?

Capability

Research experience

- **Brain and language (2011-):** Modeling and analysis of neuroimaging data associated with linguistic meaning.
- **Neurodegeneration and aging (2017-):** Modeling and analysis of neuroimaging data in clinical/aging populations.
- **Motor speech and disorders (2006-2009):** Modeling and analysis of motor trajectories in fluent and disordered speech.
- **Computational vision (2000-2004):** Modeling and analysis of biological motion perception and motion camouflage.

Data analysis and experimental design

- **Neuroimaging analysis: (8 years):** Multivariate pattern analysis of task-related and resting state fMRI and EEG data.
- **Time series analysis (4 years):** Functional Data Analysis for modeling/registering/reducing concurrent time series.
- **Audio processing (3 years):** Analysis of audio signals and speech (e.g. FFT, MFCC, Formants, Pitch contours).
- **Image processing (3 years):** Image and video processing with a focus on motion estimation and space variant mapping.
- **Neural networks (4 years):** Backpropagation, self-organizing maps, support vector machines, correlational memories.
- **Hypothesis testing (15 years):** Experienced in conceptualization, design and statistical analysis of factorial experiments.

Computer skills and software development

- **MATLAB (10 years):** Computational modeling and analysis of fMRI / EEG / audio / visual / language data.
- **C/Visual C++ (8 years):** Implemented object oriented computational models of vision and motor behavior.
- **Java (3 years):** Teaching assistant for Graphical User Interface Design forBSc and MSc students.
- **OpenGL (2 years):** Implemented 3D graphical simulations of driving and a stealth agent-based "computer game".
- **Operating systems:** Windows (12 years), Linux (5years, some shell scripting), Cygwin (3years), MacOS (2years).
- **PsychToolbox/Cogent (3 years):** Tightly timed stimulus presentation of images, sounds and videos.

Communication

- **Good written communication:** >20 journal publications, 9 refereed conference articles, 2 book chapters.
- **Good oral communication:** Oral seminar and poster presentations at 20-30 international conferences and institutes.
- **Good interpersonal skills:** I routinely work with line managers, project coordinators, researchers, PhD students and interns at all stages of project development including conceptualization, application for funding, data collection, data analysis, written and oral dissemination of results and student/staff supervision.

Academic/industry team work

- **Knowledge Representation in Neural Systems** project, involving teams from Teledyne Scientific company, Medical College of Wisconsin, U. Texas Austin, Teledyne Scientific Company NC, funded by Intelligence Advanced Research Projects Activity (IARPA) via the Air Force Research Laboratory under grant FA8650-14-C-7357 (2014-2015).
- **EU-IST Early Cognitive Vision** project, involving a multidisciplinary team of seven European groups from academia and industry) (2004-2005).

Employment

8/2018-, Research Assistant Professor, University of Rochester (USA)
Neuroscience with Profs Edmund Lalor and Vankee Lin

- Multivariate pattern analysis of natural language EEG/fMRI data in healthy and clinical/aging populations.
- Authorship and assistance in preparation of grant applications for external and internal research funding.
- Assistance in supervision of Post-doctoral associates and PhD, MSc, BSc students.

2/2017-8/2018, Research Fellow, University of Rochester (USA)
Biomedical Engineering with Profs Edmund Lalor and Vankee Lin

- Multivariate pattern analysis of natural language EEG/fMRI data in healthy and clinical/aging populations.
- Assistance in supervision of PhD, MSc, BSc students.

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

- Multivariate pattern analysis of word and sentence-level fMRI data

4/2011-4/2014, Research Fellow University of Trento (Italy)
Centre for Mind/Brain Sciences with Profs Massimo Poesio, Marco Baroni

- Multivariate pattern analysis of word-level fMRI data
- Assistance in supervision of PhD and MSc students.

2/2006-4/2011, Programmer, University College London (UK)
Psychology with Profs Peter Howell / Gabriella Vigliocco / Marty Sereno

- Design/implementation of GUI toolkits to record/analyze analogue time series monitoring timing of concurrent behavioral responses, MRI pulses, and TMS signals.
- Design/implementation of GUI toolkits to support statistical models of concurrent motor/acoustic activity in healthy/disordered speech.
- Design/implementation of 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, University College London (UK)
Psychology with Prof Alan Johnston

- Implementation of C++ computer vision libraries to support optic flow computation, image reconstruction and space variant transformation for applied driving applications.

Education

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

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

Resulting in two publications in the Proceedings of the Royal Society, coverage in the New Scientist and 3 invited talks.

- Demonstrated motion camouflage in dragonflies can be learnt using neural networks trained on real insect flight paths.
- Implemented a 3D computer game to demonstrate human susceptibility to motion camouflage.

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

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

Final Project "Speech Recognition using AURA: A Foundation" (with Prof Jim Austin, York)

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

Journal publications

In review:

Anderson, A.J., McDermott, K., Rooks, B., Heffner, K., Dodell-Feder D., Lin, F. Decoding individual identity from brain activity elicited imagining weddings, funerals and other experiences. Review @ Nature Human Behaviour.

Published:

Anderson, A. J., Binder, J. R. Fernandino, L., Humphries, C. J., Conant, L. L. Raizada, R. D. S., Lin, F, Lalor E. C. (In press). An integrated neural decoder of linguistic and experiential meaning. *Journal of Neuroscience*. **(Due for SfN press release)**

Broderick, M.P., **Anderson, A.J.**, Lalor, E.C. 2019. Top down influence of semantic context on the early auditory encoding of speech. *Journal of Neuroscience*. doi: 10.1523/JNEUROSCI.0584-19.2019

Anderson, A. J., Ren, P. Baran, T. M. Zhang, Z. Lin, F. 2019. Insula and putamen-centered functional connectivity networks reflect healthy agers' subjective experience of cognitive fatigue across multiple tasks. *Cortex.* doi:10.1016/j.cortex.2019.07.019

Anderson, A. J., 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

Baran, T., Zhang, Z., **Anderson, A.J.**, 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

Ren, P., **Anderson, A.J.**, McDermott, K., Baran, T., Lin, F. 2019. Cortical-Striatal Network and Cognitive Fatigue in Old Age. *Aging.* 11(8):2312-2326

Anderson A. J., Broderick M. P., Lalor, E.C. 2018. Neuroscience: Great expectations at the speech-language interface. *Current Biology*. 28 (24), R1396-R1398

Anderson, A. J., Lalor E. C., Lin, F, Binder, J.R., Fernandino, L., Humphries, CJ. Conant, L.L. Raizada, R. D. S., 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

Broderick M. P., **Anderson A. J.**, Di Liberto, G. M., Crosse, M., Lalor, E. C. 2018. Electrophysiological correlates of semantic dissimilarity reflect the comprehension of natural narrative speech. *Current Biology.* 28, (5), 803–809. **(Media incl. Times)**

Anderson, A. J., 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.

Anderson, A. J., Binder, J., R., Fernandino, L., Humphries, C. J., Conant, L. L., Aguilar, M, Wang, X., Doko, D., Raizada, R. D. S. 2016. Predicting neural activity patterns associated with sentences using a neurobiologically motivated model of semantic representation. *Cerebral Cortex*. doi: 10.1093/cercor/bhw240 **(Media incl. NSF frontpage, Scientific American)**.

Zinszer, B. D., **Anderson, A. J.,** Kang, O., Wheatley, T., Raizada, R.D.S. 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

Anderson, A. J., Zinszer, B. D., Raizada, R.D.S. 2016. Representational similarity encoding for fMRI: pattern-based synthesis to predict brain activity using stimulus-model-similarities. *NeuroImage. 128, 44-53.*

Anderson, A. J., 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.

Anderson, A. J., 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.

Gu, Y., Fabio Celli, F., Steinberger, J., **Anderson, A. J.**, Poesio, M., Strapparava, C., Murphy, B. 2014. Using Brain Data for sentiment analysis. *Journal for Language Technology and Computational Linguistics* 29(1) 79-94.

Howell, P., **Anderson, A. J.**, 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.

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.

Tan, S., Dale, J., **Anderson, A. J.** Johnston, A. 2006. Inverse perspective mapping and optic flow: a calibration method and quantitative analysis. *Image and Vision Computing*, 24(2) 153-165.

Anderson, A. J. McOwan, P. W. 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)**.

Anderson, A. J. McOwan, P. W. 2003. Model of a predatory stealth behaviour camouflaging motion. *Proc. R. Soc. Lond. B* 270, 489-495.

Book chapters

Howell, P., **Anderson, A. J.**, Lowit, A. 2011. Variability and Coordination Indices and their Applicability to Motor Speech Disorders. In A. Lowit & R.D. 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 & P. H. H. M. van Lieshout (Eds.). *Speech Motor Control: New Developments in Basic and Applied Research*. Oxford: Oxford University Press.

Peer reviewed conference articles

Anderson, A. J., Binder, J., R., Fernandino, L., Humphries, C. J., Conant, L. L., Erk, K., Raizada, R. D. S. 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, B. D., **Anderson, A. J.,** Kang, O., Wheatley, T., Raizada, R.D.S. 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, A. J., 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, A. J., 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 Cognitive Science*, 3155.

Anderson, A. J., 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, A. J. McOwan, P.W. 2003. Motion camouflage team tactics. Tech. report no. 393, University of Hertfordshire.

Anderson, A. J. McOwan, P. W. 2002. 3D simulation of a sensorimotor stealth strategy for camouflaging motion. *International Conference on Neural Information Processing*, *Singapore*, 1805-1810.

Anderson, A. J. McOwan, P. W. 2002. Towards an autonomous motion camouflage control system, *International Joint Conference on Neural Networks*, *WCCI*, *Hawaii*, 2006-2011.

Grant applications and awards

Submitted:

- NIA R21 #12815223 "Using neural correlates of story comprehension to estimate cognitive impairment and blood amyloid in early Alzheimer's disease". **Author and MPI AJ Anderson**, MPI F Lin. Co-Is EC Lalor, T Baran.
- NIA R21 #12809314 *"Is aging-associated cognitive fatigue an early behavioral symptom of preclinical Alzheimer's disease?"* Author and PI F Lin, **MPI AJ Anderson**, MPI T Baran.

Awarded:

- 2019, **$50,000**, University of Rochester Schmitt Program on Integrative Neuroscience Award: "*Mapping semantic information flow in the brain during natural speech production*". **Author and PI AJ Anderson**, MPI EC Lalor, Co-I D Dodell-Feder.
- 2017, **$50,000**, University of Rochester Schmitt Program on Integrative Neuroscience Award. "*Indexing the dynamic encoding of natural speech at the semantic level*". PI Lalor. **Named researcher AJ Anderson**.
- 2015, **$55,000**, University of Rochester Center for Language Sciences internal award. "*Inference in language and the brain*" PI Raizada. **Named researcher AJ Anderson**.
- 2003-04, Member of Emergent In Vivo In Silico (EIVIS) Research Cluster for Novel Computation, (PI Prof. S. Stepney. EPSRC app. "*ODISSIAC, Openness, Diversity, Interaction, Structure, Scale: A bio-inspired approach to computation*".
- 2010, **£7,394,** UCL Grad School.
- 2009, **£10,500,** Wellcome Trust, Value in People.
- 2005, **£12,971**, Wellcome Trust, Value in People.

Prizes:

- 2013, Best paper runner up, Empirical Methods in Natural Language Processing.

Mentoring

- Assisted in PhD supervision of 3 students and co-supervision of 10-15 MSc/BSc student projects.
- Field biology instructor: Two-week ecology field course to Swedish desert island Götska Sandon (1998).

Teaching

- **Lecturer:** Univ. Trento winter school Multivoxel pattern analysis of fMRI word representations (2012).
- **Lecturer:** QMUL Co-lecturer on Advanced MSc Neural Networks course (2002).
- **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).

Invited talks

- 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)

References available on request