

## Curriculum Vitae: (Nicholas) Jeremy Hill, M.A., D.Phil.

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### Education

#### **First degree (Pembroke College, University of Oxford, UK): 1992–1995**

This was a Bachelor + Masters degree in Experimental Psychology at the University of Oxford, UK. I was awarded a First Class honours degree, and the George Humphrey Prize for the year's best research project, in 1995.

#### **Doctoral degree (St. Hugh's College, University of Oxford, UK): 1996–2001**

Supervised by Dr. Bruce Henning at the Experimental Psychology Department, University of Oxford, I first studied motion perception, and then statistics as applied to psychophysical data. I won a Christopher Welch Scholarship from the University, and a Maplethorpe Scholarship from St. Hugh's College. I was awarded the D.Phil. degree for the thesis *Testing Hypotheses About Psychometric Functions* in 2002.

### Employment

#### **Post-doctoral fellow (Max-Planck Institute for Biological Cybernetics, Tübingen, Germany): 2002–2004**

I joined the Department of Empirical Inference for Machine Learning and Perception run by Prof. Bernhard Schölkopf, working in the computational vision and mathematical psychology group of Dr. Felix Wichmann.

#### **Senior Research Scientist (Max-Planck Institute for Biological Cybernetics, Tübingen, Germany): 2004–2010**

Within Prof. Bernhard Schölkopf's Empirical Inference department, I worked mainly on Brain-Computer Interfaces (BCI), leading the BCI group at the institute and managing our collaborations with other departments.

#### **Research Scientist II (Wadsworth Center, Albany NY, USA): November 2010–present**

I am now part of the Laboratory for Neural Injury and Repair headed by Dr. Jonathan Wolpaw. As part of this work, I serve as Project Coordinator for the internationally-renowned BCI2000 project. I work for principal investigator Dr. Gerwin Schalk (see referees section for contact details) although my official employer is Health Research Incorporated, 150 Broadway (Suite 560), Menands, NY 12204-2719, USA.

### Experience in research and research coordination:

My research has involved:

- designing, implementing and running experiments to collect electroencephalographic (EEG) data, at the Max Planck Institute (MPI) and at the Wadsworth Center;
- a collaboration with the Institute for Medical Psychology and Behavioural Neurobiology (IMBPN) of the University of Tübingen, to collect magnetoencephalographic data;
- inventing, developing and testing algorithms for BCI data analysis (including collaborations with the Fraunhofer FIRST in Berlin and Radboud University in Nijmegen);
- visiting paralysed patients in their homes and hospitals to field-test EEG-based BCI systems;
- managing a project involving some 20 members of the MPI and IMBPN in which a completely-locked-in person with ALS received an ECoG implant for the purposes of communication (2007-8), for which I was responsible for planning, implementing and supervising most of the experiments;
- attending deep-brain-stimulation (DBS) surgeries to give the neurosurgery team interoperative feedback on local field potential signals from the sub-thalamic and pedunclopontine nuclei;

### Teaching and supervision

- At Oxford I taught the 8-week course *Sensory Processes and Perception* to several small tutorial groups (size 2–4) of first-year undergraduates at the Department of Experimental Psychology. I received excellent anonymous ratings from the students.
- For the University of Tübingen I was one of three instructors who devised and delivered a week-long practical course entitled *Machine Learning in Neuroscience* to undergraduate students on the *Bioinformatik* (Computation Biology) course.

- I have supervised four summer internship projects at the Max Planck Institute, and three more (including one Bachelor's thesis) at the Wadsworth Center.
- I have supervised three German *Diplom* (Masters) projects, all of which received excellent grades.
- I supervised one Ph.D. student (graduated 2010) and co-supervised another, at the Max Planck Institute.
- I have been a guest lecturer at Radboud University, Nijmegen, on their lecture course *Introduction to Brain-Computer Interfacing* for Bachelor and Masters students.
- I was a lecturer at the 5<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> BCI2000 Workshops, co-organized the 8<sup>th</sup> Workshop, and in July 2013 I will teach again at the 10<sup>th</sup> (see <http://bit.ly/BCI2000-Workshops> )

### Other scientific responsibilities:

- I am Co-Editor (together with Prof. C. S. Nam of North Carolina State University) of a new Taylor & Francis journal entitled *Brain Computer Interfaces* which will begin publishing in 2014 ( <http://bit.ly/BCIJournal> )
- I have reviewed grant applications for scientific grant-awarding organizations based in the Netherlands (NWO) and Saudi Arabia (KAUST).
- I have been a reviewer for journals including *Frontiers in Neuroscience*, *Neuroimage*, *PLoS ONE*, *Attention*, *Perception and Psychophysics*, the *Journal of the Acoustical Society of America*, the *Journal of Neural Engineering*, *IEEE Transactions on Biomedical Engineering*, *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, *Neurocomputing*, *Neural Networks* and the *Journal of Machine Learning Research*, as well as for the machine-learning conferences *NIPS* and *DAGM*, and two books on BCI (MIT Press 2007, OUP 2012).
- I served on the program committee, and as a workshop coordinator, at the 2010 Fourth International Brain-Computer Interface Meeting, Pacific Grove, California. I will co-organize another workshop at the fifth meeting, in June 2013.
- I served on the program committee for the 2009 NIPS workshop *Connectivity Inference in Neuroimaging*.
- From 2003 to 2007 I assisted in the organization of the *Tübingen Perception Conference (TWK)*, constructing and managing the submission system and compiling the proceedings.
- I have regularly taken part in interviewing candidates for post-doc and doctoral-student positions.

### Grant application experience:

- I was responsible for preparing the proposal for the project *B9: Development of Machine-Learning Algorithms for Brain-Computer Interfacing* in the *Sonderforschungsbereich* (SFB) 550 of the German Research Foundation (DFG). Our subproject was awarded 176400 EUR over the full calendar years 2006, 2007 and 2008.
- In 2009 Prof. Peter Desain and I presented a Phase I grant application to the Dutch funding body STW for development of the RE-Phrase communication system. We were successful and Prof. Desain was awarded €25k. Subsequently, I wrote an analysis and research proposal that assisted the company Mind-Affect in their successful extension of this project to a €200k Phase II.
- I successfully applied for two travel grants from the PASCAL network of excellence (to visit Berlin on the short visitor program in 2006, and an extended visit to Nijmegen in 2008).
- Unsuccessful grant applications have also been valuable learning experiences (I was a recognized researcher on a 2003 EPSRC proposal, principal investigator on a 2007 ERC starting grant proposal, and a partner on a 2009 ERC STREP proposal).

### Skills

- **Academic fields:** My degree in experimental psychology, together with my experience of designing, implementing and running experiments in psychophysics laboratory, have given me an appreciation of the methodology of scientific investigation and issues of **experimental design**, as well as a broad body of background knowledge in **neuroscience**. My doctoral and post-doctoral work has also allowed me to acquire and develop skills in **signal processing**, **statistics**, and **machine-learning**.
- **Programming:** I have 18 years' experience of scientific programming, primarily in Matlab, Python and C++, and am proud of my programming skills. I have striven to make reliable tools that other people can use, to advance scientific capabilities by continually raising the stable platform on which we work. Examples include: the Python software suite BCPy2000 as well as substantial contributions to the underlying BCI2000 platform; my `psignifit` package, used for psychometric function-fitting and hypothesis-testing by many psychophysicists worldwide (an index of its use is that Google reports a combined total of over 1500 citations to the two 2001 papers that introduced it, co-written with Felix Wichmann); `sgetools`, a Matlab toolbox I wrote for parallel computing, used by many of my colleagues at the MPI; minor contributions to the widely-used machine-learning toolbox `spider`.
- **Languages:** In addition to my native English, I speak fluent German and am comfortable working in either language. I also speak intermediate French, and very basic Spanish and Dutch. I have very much enjoyed working in multi-national environments, at the Max Planck Institute, at the Wadsworth Center, and in the wider research community.

## Publications and Invited Talks

The following lists comprise peer-reviewed full-length articles accepted/published in journals, books and conference proceedings. These can also be browsed on my Google Scholar Citations profile: <http://bit.ly/Hill-Scholar>

A small sample of my invited talks is also available to be viewed online, at [http://videlectures.net/jeremy\\_hill](http://videlectures.net/jeremy_hill)

### Papers in Neurotechnology / Brain-Computer Interfacing

- [1] **N. J. Hill**, A. Moinuddin, A.-K. Häuser, S. Kienzle, and G. Schalk. Communication and control by listening: Toward optimal design of a two-class auditory streaming brain-computer interface. *Frontiers in Neuroscience*, 6:181, **2012**.
- [2] J. Farquhar and **N. J. Hill**. Interactions between pre-processing and classification methods for event-related-potential classification. *Neuroinformatics*, 11(2):175–192.
- [3] **N. J. Hill**, D. Gupta, P. Brunner, A. Gündüz, M. A. Adamo, A. Ritaccio, and G. Schalk. Recording human electrocorticographic (ECoG) signals for neuroscientific research and real-time functional cortical mapping. *Journal of Visualized Experiments*, 64:e3993, **2012**.
- [4] X. Pei, **J. Hill**, and G. Schalk. Silent communication. *IEEE Spectrum*, 3(1):43–46, **2012**.
- [5] **N. J. Hill** and B. Schölkopf. An online brain-computer interface based on shifting attention to concurrent streams of auditory stimuli. *Journal of Neural Engineering*, 9(2):026011, February **2012**.
- [6] **J Hill**, P Brunner, and T Vaughan. Interface design challenge for brain-computer interaction. *Lecture Notes in Computer Science*, 6780/2011:500–506, **2011**.
- [7] A Ramos Murguialday, **J Hill**, M Bensch, S Martens, S Halder, F Nijboer, B Schölkopf, N Birbaumer, and A Gharabaghi. Transition from the locked in to the completely locked-in state: a physiological analysis. *Clinical Neurophysiology*, 122(5):925–33, May **2011**.
- [8] M Gomez Rodriguez, J Peters, **J Hill**, B Schölkopf, A Gharabaghi, and M Grosse-Wentrup. Closing the sensorimotor loop: Haptic feedback helps decoding of arm movement imagery. *Journal of Neural Engineering*, 8:036005, 2 **2011**.
- [9] S. M.M. Martens, J. Mooij, **N. J. Hill**, J. Farquhar, and B. Schoelkopf. A graphical model framework for decoding in the visual ERP-based BCI speller. *Neural Computation*, 182:160–182, **2011**.
- [10] M. Grosse Wentrup, B. Schölkopf, and **N. J. Hill**. Causal influence of gamma oscillations on the sensorimotor rhythm. *NeuroImage*, 56:837–42, 05 **2011**.
- [11] W. Haselager, R. Vlek, **J. Hill**, and F. Nijboer. A note on ethical aspects of BCI. *Neural Networks*, 22:1352–1357, 07 **2009**.
- [12] S. M. M. Martens, **N. J. Hill**, J. Farquhar, and B. Schölkopf. Overlap and refractory effects in a brain-computer interface speller based on the visual P300 event-related potential. *Journal of Neural Engineering*, 6(2:026003):1–9, 04 **2009**.
- [13] **J. Hill**, J. Farquhar, S. M. M. Martens, F. Biessmann, and B. Schölkopf. Effects of stimulus type and of error-correcting code design on BCI speller performance. *Advances in Neural Information Processing Systems*, 21:665–672, 06 **2009**.
- [14] T. Hinterberger, G. Widmann, T. N. Lal, **J. Hill**, M. Tangermann, W. Rosenstiel, B. Schölkopf, C. E. Elger, and N. Birbaumer. Voluntary brain regulation and communication with ECoG-signals. *Epilepsy and Behavior*, 13(2):300–306, 08 **2008**.
- [15] **N. J. Hill**, T. N. Lal, M. Tangermann, T. Hinterberger, G. Widman, C. E. Elger, B. Schölkopf, and N. Birbaumer. *Classifying Event-Related Desynchronization in EEG, ECoG and MEG signals*, pages 235–260. Toward Brain-Computer Interfacing. MIT Press, Cambridge, MA, USA, 09 **2007**.
- [16] T. Hinterberger, F. Nijboer, A. Kübler, T. Matuz, A. Furdea, U. Mochty, M. Jordan, T. N. Lal, **J. Hill**, J. Mellinger, M. Bensch, M. Tangermann, G. Widman, C. E. Elger, W. Rosenstiel, B. Schölkopf, and N. Birbaumer. *Brain-Computer Interfaces for Communication in Paralysis: A Clinical Experimental Approach*, pages 43–64. Neural Information Processing. MIT Press, Cambridge, MA, USA, 09 **2007**.
- [17] R. Tomioka, **N. J. Hill**, B. Blankertz, and K. Aihara. Adapting spatial filter methods for nonstationary BCIs. In **2006 Workshop on Information-Based Induction Sciences**, pages 65–70, 11 **2006**.
- [18] J. Farquhar, **N. J. Hill**, T. N. Lal, and B. Schölkopf. Regularised CSP for sensor selection in BCI. In **3rd International Brain-Computer Interface Workshop and Training Course 2006**, pages 14–15, Graz, Austria, 09 **2006**. Verlag der Technischen Universität Graz.
- [19] **N. J. Hill**, J. Farquhar, T. N. Lal, and B. Schölkopf. Time-dependent demixing of task-relevant eeg signals. In **3rd International Brain-Computer Interface Workshop and Training Course 2006**, pages 20–21, Graz, Austria, 09 **2006**. Verlag der Technischen Universität Graz.
- [20] J. Farquhar, **N. J. Hill**, and B. Schölkopf. Optimizing spatial filters for BCI: Margin- and evidence-maximization approaches. *Challenging Brain-Computer Interfaces: MAIA Workshop 2006*, page 1, 11 **2006**.
- [21] **N. J. Hill**, T. N. Lal, M. Schröder, T. Hinterberger, B. Wilhelm, F. Nijboer, U. Mochty, G. Widman, C. E. Elger, B. Schölkopf, A. Kübler, and N. Birbaumer. Classifying EEG and ECoG signals without subject training for fast BCI implementation: Comparison of non-paralysed and completely paralysed subjects. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 14(2):183–186, 06 **2006**.
- [22] M. Schröder, T. N. Lal, T. Hinterberger, M. Bogdan, **J. Hill**, N. Birbaumer, W. Rosenstiel, and B. Schölkopf. Robust eeg channel selection across subjects for brain computer interfaces. *EURASIP Journal on Applied Signal Processing*, **2005**(19, Special Issue: Trends in Brain Computer Interfaces):3103–3112, **2005**.
- [23] **N. J. Hill**, T. N. Lal, K. Bierig, N. Birbaumer, and B. Schölkopf. An auditory paradigm for brain-computer interfaces. *Advances in Neural Information Processing Systems*, 17:569–576, **2005**.
- [24] T. N. Lal, M. Schröder, **J. Hill**, H. Preissl, T. Hinterberger, J. Mellinger, M. Bogdan, W. Rosenstiel, T. Hofmann, N. Birbaumer, and B. Schölkopf. A brain computer interface with online feedback based on magnetoencephalography. In S. Wrobel De Raedt, L., editor, *ICML Bonn*, pages 465 – 472, **2005**.
- [25] T. N. Lal, T. Hinterberger, G. Widman, M. Schröder, **J. Hill**, W. Rosenstiel, C. E. Elger, B. Schölkopf, and N. Birbaumer. Methods towards invasive human brain computer interfaces. *Advances in Neural Information Processing Systems*, 17:737–744, **2005**.

## Other Papers (Psychophysics, Statistics, Machine-Learning)

- [1] H Shin, **N. J. Hill**, A. M. Lisewski, and J.-S. Park. Graph sharpening. *Expert Systems with Applications*, 37(12):7870–7879, **2010**.
- [2] T. Curnow, D. A. Cowie, G. B. Henning, and **N. J. Hill**. Some observations on the masking effects of Mach bands. *Journal of the Optical Society of America A*, 24(10):3233–3241, **2007**.
- [3] A. M. Zalewski, G. B. Henning, and **N. J. Hill**. Cue combination and the effect of horizontal disparity and perspective on stereoacuity. *Spatial Vision*, 20(1):107–138, **2007**.
- [4] H. Shin, **N. J. Hill**, and G. Rättsch. Graph-based semi-supervised learning with sharper edges. In J. Fürnkranz, T. Scheffer, and M. Spiliopoulou, editors, *17th European Conference on Machine Learning (ECML)*, pages 401–412, Berlin, Germany, 09 **2006**. Springer.
- [5] T. Kammer, K. Puls, H. Strasburger, **N. J. Hill**, and F. A. Wichmann. TMS in the visual system: I. the psychophysics of visual suppression. *Experimental Brain Research*, 160:118–128, **2005**.
- [6] G. B. Henning, K. T. Hoddinott, Z. J. Wilson-Smith, and **N. J. Hill**. Masking effect produced by mach bands on the detection of narrow bars of random polarity. *Journal of the Optical Society of America*, 21(8):1379–1387, August **2004**.
- [7] F. A. Wichmann and **N. J. Hill**. The psychometric function: II. bootstrap-based confidence intervals and sampling. *Perception and Psychophysics*, 63 (8):1314–1329, **2001**.
- [8] F. A. Wichmann and **N. J. Hill**. The psychometric function: I. fitting, sampling and goodness-of-fit. *Perception and Psychophysics*, 63 (8):1293–1313, **2001**.
- [9] G. B. Henning, R. W. Millar, and **N. J. Hill**. Detection of incremental and decremental bars at different locations across mach bands and related stimuli. *Journal of the Optical Society of America A*, 17 (7):1147–1159, **2000**.

## Invited Talks and Lectures

- [1] N. J. Hill and D. Gupta. Current trends in research and development of brain-computer interfaces. *Invited tandem talk at Fortis Hospital, Chandigarh, India.*, 8th Jan 2013.
- [2] N. J. Hill. Brain-computer interfaces. *Invited talk at the workshop “Triggers and Treatments for Autism” at the David Axelrod Institute, Albany, NY, supported by the School of Public Health (Wadsworth Center/SUNY Albany) and the Autism Research Institute.*, 12th September 2012.
- [3] N. J. Hill. Brain-computer interface research and development at the wadsworth center. *Invited talk at the Brain-Computer Interface Workshop and Hands-On Seminar organized by gtec Medical Engineering GmbH, Old Dominion University, Norfolk, VA, USA.*, 18th May 2012.
- [4] N. J. Hill. Listening to your brain listening: Brain-computer interfacing based on auditory evoked potentials in EEG. *Invited talk on course EHS-790 “Seminars in Environmental Health Sciences” at the School of Public Health (Wadsworth Center/SUNY Albany)*, 11th October 2011.
- [5] N. J. Hill. Machine-learning methods for decoding intentional brain states. *Invited talk at the plenary symposium “Non-Invasive Brain Computer Interfaces: Current Developments and Applications”, BIOMAG 2010*, 30th March 2010.
- [6] N. J. Hill. Machine learning for brain-computer interfaces. *Invited talk at the mini-symposium, “Assistive Machine Learning for People with Disabilities” at NIPS 2009, Vancouver*, 10th Dec 2009.
- [7] N. J. Hill. Event-related potentials in brain-computer interfacing. *Invited lecture on the bachelor & masters course “Introduction to Brain-Computer Interfacing”, Radboud University Nijmegen*, 15th Oct 2009.
- [8] N. J. Hill. BCI2000 and Python. *Invited lecture at the 5th International BCI2000 Workshop, Albany Medical College*, 1st Oct 2009 (Repeated at the 7th and 8th workshops, 2010 and 2011).
- [9] N. J. Hill. Challenges in brain-computer interface development: Induction, measurement, decoding, integration. *Invited keynote talk at the launch of BrainGain, the Dutch BCI research consortium, Nijmegen*, 30th Nov 2007.
- [10] N. J. Hill. Thinking out loud: Research and development of brain-computer interfaces. *Invited keynote talk at the Max Planck Society’s PhDNet Workshop, Frankfurt.*, 27th July 2007.
- [11] N. J. Hill and C. Raths. New BCI approaches: Selective attention to auditory and tactile stimulus streams. *Invited talk at the PASCAL Workshop on Methods of Data Analysis in Computational Neuroscience and Brain Computer Interfaces, TU Berlin.*, 28th June 2007.
- [12] N. J. Hill and J. Farquhar. New margin- and evidence-based approaches for EEG signal classification. *Invited talk at the FaSor Jahressymposium 2007, Fraunhofer FIRS, Berlin*, 1st Feb 2007.