Through Engineering Control to Attention and Consciousness

JG Taylor
Department of Mathematics, King's College, Strand, London WC2R2LS, UK.
Email:john.g.taylor@kcl.ac.uk

Abstract

The control aspect of attention will be emphasised by employing the language of engineering control to create a model of attention control in the brain. Various aspects of this, especially experimental support from brain imaging and single cell data, and simulations of various sensory and motor paradigms, will be described; the manner in which emotions enter to bias attention control will also be touched on. The CODAM model of consciousness will then be developed, and its use in explaining the nature of the inner (or pre-reflective) self will then be described. An explanation of the attentional blink will be then be developed, and the talk will close with implications for mental diseases such as schizophrenia, as well as a brief description of the relation of CODAM to other approaches..

Schematic Description

Section 1 *Introduction* : The modern tools of brain imaging and computational neuroscience; the problems of attention and consciousness; philosophical problems of qualia and the pre-reflective self; evidence from mental disieases (schizophrenia, autism Ad, PD).
Section 2 *The Nature of Attention:* Psychological data; fMRI and single cell data; MEG data; spatial v object attention in vision; endogenous v exogenous attention; involvement of emotions; conclusion on attention control and overall architecture.
Section 3 *Engineering Control Approach to Sensory-Motor Attention:* Forward, inverse and error modules, success in application to motor control; evidence for similar modules in attention control; structure of the overall model; application to simulation of various paradigms: Posner, conjunction search, sensorimotor tasks.
Section 4 *From Attention to Consciousness;* Attention necessary but not sufficient for consciousness: blindsight, masked stimulus can draw attention but not into awareness for normals; inattentional blindness, attentional blink
Section 5 *The CODAM Model for Consciousness:* What must be added to attention control to support consciousness: buffers or working memory sites for content; as in motor control; add further corollary discharge buffer of attention control signal (for which there is now very good evidence) to obtain more efficient speed up – add AB simulation results in presence of masking; evidence for existence of corollary discharge signal in N2/P2 complex; explanation of 'ownership' granted by corollary discharge signal; explanation of 'immunity to error'; a function for consciousness as speed-up of attention movement.
Section 6 *Implications of CODAM for Humanity:* Nature of philosophical problems of Nagel 'What is like to be'/Chalmers 'hard problem'/ Wittgenstein-Shoemaker 'Immunity'; bringing back the notion of 'self'; relation to pre-reflective self of Western phenomenology; relation to 'pure consciousness' in meditation and of mystics across all religions; free will and the difference between ownership and agency of thoughts; implications for understanding of animal consciousness).

Section 7 *Relation to Other Consciousness Approaches* Machine consciousness; 40 Hz; proto-consciousness of Damasio; relaxation models; Western cognitive science 'content only' models
Section 8 *Conclusions*

References

[1] Taylor JG(2000) Attentional Movement: The Control Basis for Consciousness. Neuroscience Abstracts 26:2231, #839.3; ibid (2000) The Central Representation: The Where, How and What of Consciousness. Pp 117-148 in The Emergence of Mind, ed KE White. Milan: Fondazione Carlo Erba.

[2] Taylor JG & Rogers M (2002) A Neural Control Model of the Movement of Attention. Neural Networks 15:309-326; Fragopanagos N & Taylor JG. (2003) Attention and Motor Response (submitted); Fragopanagos N & Taylor JG (2004) Modelling the Emotional Attentional Blink (submitted to IJCNN04).

[3] Taylor JG (2002) Paying Attention to Consciousness. Trends in Cognitive Sciences 6:206-210 (http://journals.bmn.com/journals/list/latest?jcode=tics); ibid (2002) From Matter to Mind. Journal of Consciousness Studies 9:3-22; Taylor JG (2003) Paying Attention to Consciousness, Progress of Neurobiology 41:305-335

Biosketch & CV

JG Taylor received degrees from the Universities of London, and Cambridge. He then held a number of research posts in the UK, USA and France: Member of the Institute for Advanced Study, Princeton, Professor of Physics at Rutgers University, NJ, USA, Senior lecturer at the Mathematical Institute, Oxford, Reader in Physics at Queen Mary College, Professor of Physics at Southampton University and Professor of Mathematics at King's College London, and Director of the Centre for Neural Networks.

He is a Fellow of the Cambridge Philosophical Society and a member of the Society for Neuroscience, the European Editor-in-Chief of the journal *Neural Networks* and, during 1995, President of the International Neural Network Society. He was President of the European Neural Network Society in 1993, and Director of the EC Networks of Excellence in Neural Networks NEuronet (which he established) during 1994). He has been a Consultant in Neural Networks to several companies, and is presently Research Director for ECONOSTAT, working on time series prediction in the financial markets (bonds and equities). He is also the Research Director of the Start-Up company Lobal Technologies, creating brain-based Language understanding system LAD (Language Acquisition Device).

He has published over 500 scientific papers, is the author of 12 books, and has edited numerous others. Particular titles of interest are *Artificial Neural networks* (ed, North-Holland,1992), *The Promise of Neural Networks* (Springer,1993), *Mathematica*l *Approaches to Neural Networks* (ed, Elsevier,1994) and *Neural Networks* (ed, A Waller,1995). He has recently published a book on the Mind/Body problem from a Neural Network viewpoint for MIT Press in 1999 (*The Race for Consciousness*)..He is presently writing 'Discovering the Ghost in the Machine'.

His research interests span the whole range of neural networks, including financial and industrial applications, as well as being especially concerned with higher cognitive processes, including consciousness. He has had funded research projects

from the European Community (on Attentional Agents, and on Emotional Recognition), and from EPSRC in the UK on language and neural networks. Earlier projects involved work in Pattern Recognition, Hard Optimisation, Novel Neural Networks and Learning Rules, Time Series Prediction, the development of Rule Formation in the Frontal Lobes, and the creation of Adaptive Intelligent Agents for communication networks, as well as in natural language propcessing and attention modelling.
New projects are on further modelling of attention (UK: EPSRC), its applications to information processing (EC: GNOSYS, to be finalised), and the interaction of emotion and attention (BBSRC: UK, in collaboration with Oxford, Birkbeck & Bangor).

Contact Information

Professor JG Taylor
Department of Mathematics, King's College, Strand, London WC2R2LS, UK
http://www.mth.kcl.ac.uk/staff/jg_taylor.html