Preface

This document is based on replies to a questionnaire sent to all teaching and research staff in the School of Cognitive and Computing Sciences. Now in its fifth edition, it is intended to provide an overview of research interests, to function as a guide for prospective (as well as current) students seeking supervisors, and to act as a general guide to subject areas for use within as well as outside the school. This information is also available on the World-Wide Web at http://www.cogs.susx.ac.uk/cgi-bin/htmlcogsreps?csrp179.

The School of Cognitive and Computing Sciences encompasses faculty in four different subject groups: Computer Science and Artificial Intelligence (CSAI), Linguistics, Philosophy and Psychology. Some of these subject groups, such as Philosophy and Psychology, extend across several schools, and in these cases, only those people who are COGS faculty members have been included.

The editors have exercised relatively little control over the content and structure of replies. People were asked to list any research grants, a maximum of three recent publications and to describe their research interests in 500–1000 words. The letters given after people's names are those which they have chosen to give, and are not necessarily exhaustive.

Entries are included in alphabetical order, and there is a second index which groups names under the subject heading(s) with which members of staff chose to classify their work. These headings are not exhaustive, and are only intended to give an idea of the general area(s) of people's research.

Stephen Eglen
Jason Noble
March 1997

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Index — Listing by subject heading

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Computational Linguistics / Natural Language Processing:

Computer Supported Cooperative Work:

Computer Vision / Image Processing:

Concurrency:

Historical Linguistics:

Richard Coates

Human-Computer Interaction:

Frances Aldrich
Theodoros Arvanitis
Ben du Boulay
Nathan Jeffery
Christopher Morris
Lydia Plowman
Yvonne Rogers
Michael Scaife
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Blay Whitby

Intelligent Tutoring and Expert Systems:

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Sharon Wood

Knowledge Acquisition:

Mike Sharples
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Logic / Theorem Proving:

Chrysafis Hartonas
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Machine Learning:

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Philosophy of Mind / Cognitive Science:

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Planning:

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Programming Language Semantics:

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Psychology — Clinical and Health:

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Psychology — Cognitive:

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Yvonne Rogers
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Psychology — Developmental:

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Software Engineering:

Theodoros Arvanitis
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Theoretical Linguistics:

Lynne Cahill
Richard Coates
Larry Trask
Max Wheeler
Nicola Woods

Virtual Reality:

Yvonne Rogers

Name: F. K. Aldrich BSc MSc DPhil

Subject Group: Psychology

Email address: francesa@cogs.susx.ac.uk

Position: Research Fellow

Recent Publications:

1. Rogers, Y & Aldrich, F. (1996). In search of clickable Dons: learning about HCI through interacting with Norman's CD-ROM. *Sigchi Bulletin*, 28(3), 44–47.

2. Hunkin, N., Parkin, A., Bradley V., Burrows, E., Aldrich, F., Jansari, A., & Burdon-Cooper, C. (1995). Focal retrograde amnesia following closed head injury: A case study and theoretical account. *Neuropsychologia*, 33(4), 509-523.

Research Interests:

Theoretical issues concerned with the facilitation of learning, particularly:

1. the opportunities presented by interactive media

2. the needs of special learner groups (memory-impaired, visually-impaired) Also, the design and use of computer-based memory aids.

My recently-completed DPhil investigated novel methods of computer-based training for people with severe memory impairments. In addition I ran a case study looking at the impact of a computer-based reminding system on the day-to-day life of a severely amnesic man, and was also involved in designing a computer database and interface for the retrieval of people's names in a workplace setting. Prior to my DPhil I had researched ways of improving visually-impaired students' access to study materials, in particular graphically-presented information.

I am now employed as a Research Fellow on a two year grant under the ESRC's Cognitive Engineering Initiative, on a project which aims to use principles from cognitive psychology to inform the design of educational multimedia. The interactivity offered by media such as CD-ROM offers new possibilities for "learning by doing" and we are developing our own software to explore these. The work involves evaluating published multimedia packages, carrying out "lo-fi" prototyping of design ideas with children, contributing to the design of prototype software, and evaluating our own prototypes. At the conclusion of the project we intend to produce a framework which will guide design decisions during the production of interactive learning materials.

Name: Theodoros N. Arvanitis RT DPhil
Subject Group: CSAI
Email address: theoa@cogs.susx.ac.uk
Position: Lecturer in Software Design

Recent Publications:

1. Arvanitis, T. N., & Harrison, P. (1996). Visualising the topography of radiological information systems (RIS). *British Journal of Radiology (Supplement)* 69, 302.

2. Arvanitis, T. N., Papadopoulos, N., Baldock, C., & Watson, D. (1996). Interactive intranet tutoring for medical image processing. Book of Abstracts, *MEDNET 96, European Congress of the Internet in Medicine*, (CSRP 429), 28.

3. Farias, A., & Arvanitis, T. N. (1996). Building software agents for training: a case study on radiotherapy treatment planning. Anjaneyulu, K. S. R., Sasikumar, M. & Ramani, S. (eds.), *Knowledge Based Computer Systems: Research and Applications*, Narosa Publishing, 127–138.

Research Interests:

The main research interests can be identified by the following three areas:

1. Medical Imaging and Visualisation
2. Medical Informatics and the Internet
3. Software and Interactive Systems Design

Medical Imaging and Visualisation: I have research and clinical expertise in the areas of Digital Imaging Modalities such as Computerised Tomography, Digital Subtraction Angiography and Magnetic Resonance Imaging. My previous and current research work is focused on the development of software methods for the automation of processes in Magnetic Resonance Imaging (MRI) and Spectroscopy (MRS) and the solution of crucial problems of these areas. In particular I have studied the problem of respiratory motion artifacts in both MRI and MRS. I am currently working on the issues relating to the intelligent display of clinical information provided by MR. This work is done in collaboration with several clinical and research MR units.

Medical Informatics and the Internet: I have recently developed research work that relates to the uses of the Internet in Medicine. Themes include medical education and access to clinical/health information. In parallel to this, work has been done in the area of electronic health records, with a project on a pacemaker patients database with smartcard access. As a member of the European Committee of Standardization (CEN), Health and Medical Informatics Working Group, I have been interested in medical imaging data standards and health informatics scenarios. Collaborative work is currently undergoing with various clinical sites and the Trafford Centre for Medical Research, University of Sussex.

Software and Interactive Systems Design: In this area I have developed interests in software engineering education and in the development of agent software to support interactive systems. One of the most important projects is the design Interface Agents for Interactive Learning Environments in Medicine, and in particular in the field of Radiotherapy Treatment Planning.

Name: Ed Baines BSc MSc
Subject Group: Psychology
Email address: edb@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications:

1. Baines, E. & Howe, C. J. (1995). Task Effects on the discourse topic manipulation skills of 4, 6 and 9 year olds. In *Proceeding of the Child Language Seminar*, Bristol.

Research Interests:

I am working for Julie Rutkowska on a project focusing on infants' development of reaching and other manipulatory behaviours. This research is concerned with the broader issue of the development and organisation of infant action.

This research links up with my own research interests the first of which focuses on the development and use of hand gestures by infants as early forms of communication and their role in the development of language.

My other main area of interest is in children's developing skill to engage in conversation. More specifically, how children go about engaging in talk focused on topics, how they maintain, organise and plan these topic sequences and how they become more adept at engaging in collaborative discussion.

This research essentially involves a pragmatic approach to the development of language and participation in dialogue but I am particularly interested in the way development is aided and constrained by wider aspects of the ongoing social and physical context as well as children's own cognitive capacities.

Name: Margaret A. Boden MA PhD ScD FBA
Subject Group: Philosophy
Email address: maggieb@cogs.susx.ac.uk
Position: Professor of Philosophy and Psychology

Recent Publications:

1. Boden, M. A. (ed.) (1996). *The Philosophy of Artificial Life*. Oxford University Press.
2. Boden, M. A. (1994). *Piaget*. 2nd edition, expanded. London: Harper Collins.
3. Boden, M. A. (ed.) (1996). *Dimensions of Creativity*. MIT Press.

Research Interests:

Computational approaches in the philosophy of mind and theoretical psychology. Philosophy of AI and A-Life. Especial interest in creativity, purpose, intention, and motivation. History of cognitive science. Also social implications of AI.

Name: G. E. Butterworth BSc MSc DPhil FBPS C.Psychol.
Subject Group: Psychology
Email address: G.Butterworth@sussex.ac.uk
Position: Professor of Psychology

Recent Publications:

1. Butterworth, G. E., & Harris, M. (1994). *Principles of Developmental Psychology.* Psychology Press, Hove.
2. Butterworth, G. E., & Morissette, P. (1996). Onset of pointing and the acquisition of language in infancy. *Journal of Reproductive and Infant Psychology*, 14, 219–231.
3. Franco, F., & Butterworth, G. E. (1996). Pointing and social awareness: declaring and requesting in the second year of life. *Journal of Child Language*, 23, 307–336.

Research Grants Currently Held:

I have just been awarded a collaborative research grant with Dr Michael Siegal of the University of Queensland, Australia. It begins in 1997, Grant Australian Research Council. Culture, cognitive development and children's concepts of astronomy and geography. ($13,340 with Dr M.Siegal, University of Queensland).

Research Interests:

Pointing in babies and how it relates to the development of speech. This is my main research field and although I am "between grants" on this topic at the moment, I intend to continue with research on the precursors of language and the transition to speech in future. Other interests include development of elementary scientific concepts, as in the case of geographical intuitions which I am working on in collaboration with Australian colleagues. I am also interested in the development of prehension in babies and in "aesthetic perception", why babies find some faces beautiful.

Name: Hilary Buxton BSc PhD

Subject Group: CSAI

Email address: hilaryb@cogs.susx.ac.uk

Position: Reader in Computer Science and Artificial Intelligence

Recent Publications:

1. Buxton, H., & Shaogang, G. (1995). Visual surveillance in a dynamic and uncertain world. *Artificial Intelligence*, 78, 431–459.

2. Howell, J., & Buxton, H. (1995). Invariance in radial basis function neural networks in human face classification. *Neural Processing Letters*, 2(3), 26–30.

3. Buxton, H., & Howarth, R. (1996). Visual surveillance monitoring and watching. In Buxton & Cipolla (eds.), *Computer Vision-ECCV'96*, Springer Verlag, 321–334.

Research Grants Currently Held:

- "Behavioural Analysis for Visual Surveillance" EPSRC GR/K08772. 3 years from 1994.

  In the ESPRIT VIEWS project, we developed spatio-temporal reasoning and control techniques for advanced visual surveillance. The reasoning needed to consider higher-level representation of visual motion and trajectory planning for behavioural evaluation and incident detection. In addition, we used Bayesian network belief updating to give consistent interpretations over time and provide selectivity in attentional control. This work is continuing under the new EPSRC project.

  Research fellow: Richard Howarth.

Research Interests:

Computer vision is the main area of my research but I also have interests in parallel processing for vision, distributed visual control formalisms, and in biological models of visual processing which includes neural networks. In addition, I am interested in "hybrid" symbolic and sub-symbolic systems for computer vision applications.

Advanced computer vision for traffic surveillance.

Advanced visual surveillance for traffic scenes requires the combination of artificial intelligence, image understanding and real-time technologies. In the recently completed VIEWS project, we were particularly concerned with work that develops spatio-temporal reasoning (with A. Toal) and perceptual control (with S. Gong). The reasoning needs to consider higher-level representation of visual motion and trajectory planning for behavioural evaluation and incident detection. In addition, we use Bayesian network belief updating to give consistent interpretations over time and provide selectivity in attentional control. This work is continuing under the new EPSRC project on behavioural analysis for visual surveillance (with R. Howarth).

Biological motion analysis.

Biologically plausible models of visual processing require both computational models and close psychophysical testing of human perception as well as considerations from neurophysiology. In the recently completed JCI Cognitive Science/HCI project (with A. Johnston) we were particularly concerned with mathematical models of simple and complex cell functions in the visual pathway and neural network mechanisms for modelling of the human observer. We developed a model that explains the perception of first-order and second-order motion patterns for a wide range of artificially constructed psychophysical stimuli. This work is continuing under the new HCM Network project where parallel processing will be exploited to deal with real image sequences and neural network modelling.

Hybrid vision systems.

A recently completed Image Interpretation Initiative project (with A. Psarrou) was to develop dynamic models of cell behavior for a high-level vision system. The work involved parallel versions of neural networks to perform the main analysis required in a robust and rapid manner after appropriate training. The combination of such "sub-symbolic" techniques with the advantages of traditional "symbolic" knowledge-based techniques to communicate cooperatively with vision system users promises great advances in effective vision applications. This collaboration is continuing with the analysis of temporal patterns using recurrent networks under a joint research fellowship.

Recent doctoral work I have supervised has included: biomedical image interpretation (N. Walker joint ICRF); shape representation for deformable models (C. Davies, SERC); parallel process techniques for 3D model-based vision (M. Usoh, SERC with BP); parallel planning for robot motion (C. Shu, British Council); neural network models for understanding computer vision (A. Psarrou, SERC); agent-based concurrent visual control (J. Linney, SERC III); and spatial reasoning for an advanced vision system (R. Howarth, SERC with Marconi).

New research student projects: face recognition using ANNs (J. Howell, BBSRC with GEC), biomedical analysis using ANNs (M. Sordo, national scholarship), visual attention for robotics (A. Seth, EPSRC) and attentional dynamics (J. Bird, BBSRC with BT).

Name: Lynne Cahill BA MA DPhil
Subject Group: CSAI/Linguistics
Email address: lynneca@cogs.susx.ac.uk
Position: Research Fellow in Computational Linguistics

Recent Publications:

1. Cahill, L. J., & Gazdar, G. (1997). The inflectional phonology of German adjectives, determiners and pronouns. *Linguistics*, 35(2).
2. Cahill, L. J. (1993). Morphonology in the lexicon. *EACL–94*, Utrecht, 87–96.
3. Gaizauskas, R., Evans, R., Cahill, L. J., Walker, J., Richardson, J., & Dixon, A. (1995). POETIC: a system for gathering and disseminating traffic information. *Journal of Natural Language Engineering*, 4.

Research Grants Currently Held:

- "Multilingual Lexical Knowledge Representation", ESRC, 3 years (with Gerald Gazdar).

Research Interests:

My main interest is in (linguistic) morphology and the lexicon, although I have worked in recent years in other areas such as parsing ill-formed input and parsing for information extraction.

For four years I worked on the POETIC project, developing a system which interprets police reports of traffic incidents, builds an internal model of the incident and broadcasts automatically to motorists if necessary. My work on the project involved the Natural Language Understanding front end, and I was responsible for the reimplementation of the entire lexicon and the development of a lexicon structure which permitted relatively easy adaptation. A new lexicon for a different police force sublanguage was developed, and a lexicon for an entirely new domain — commercial joint ventures — was developed, for participation in the Fifth Message Understanding Conference evaluation.

As well as the lexicon work on POETIC, I was responsible for revising the grammar rules, to account for the sometimes ungrammatical and frequently telegrammatic English found in police logs.

My personal research focuses on lower level aspects of lexical representation, more specifically morphology, morphonology and phonology. My doctoral work proposed a formal language for the definition of morphological alternations which was based on phonological concepts, chiefly the syllable. I have since extended this work to cover aspects of phonology proper within the lexicon, and to interface this work to current computational models of the phonology–phonetics interface, which also amke use of the syllable as a fundamental unit. My long term aim is to develop a theory of the lexicon which will enable text-to-speech and *vice versa* by means of a fully integrated lexicon covering (minimally) morphology, phonology and phonetics.

My work has included analyses of fragments of the morphology of a number of languages, including English, German, Arabic, and Sanskrit. All of this lexical work has made use of the lexical representation

language, DATR, developed by Gerald Gazdar and Roger Evans, and I have worked with both on various lexicon work.

I have a great interest in the representation of morphologically subregular forms particularly in English and other Germanic languages, and together with Gerald Gazdar I am currently working on a three-year, ESRC-funded project to develop a tri-lingual lexicon of English, German and Dutch, which uses the relatedness of the three languages to employ information sharing by means of inheritance mechanisms.

As a part of this project, we are investigating how existing large-scale resources (in our case the CELEX lexical database) can be employed to automatically or semi-automatically derive inheritance-based, structured lexicons for use in practical NLP systems.

Name: Catherine Cameron MSc (Clin Psychology)
Subject Group: Psychology
Email address: cathc@cogs.susx.ac.uk
Position: Lecturer in Psychology

Recent Publications:

1. Cameron, C. M. (in press). Information processing approaches to phobias. In Davey, G. C. L. (ed.), *Phobias: A Handbook of Theory, Research & Treatment*. Chichester.
2. Power, M. J., Cameron, C. M., & Dalgleish, T. I. (1996). Emotional priming in clinically depressed subjects. *Journal of Affective Disorders*, 38, 1–11.
3. Dalgleish, T. I., Cameron, C. M., Power, M. J., & Bond, A. (1994). An investigation of the emotional priming paradigm in generalised anxiety. *Cognitive Therapy and Research*.

Research Grants Currently Held:

- Research Development Fund (Sussex University) 1996–97. — Repressive Coping.
- British Council/Accion Integrada Award (1996–97) — Cognitive Markers of Vulnerability to Depression.

Research Interests:

My research covers the following areas:

- Mood effects on cognition and the role of cognition in the emotional disorders Work on Mood and memory has recently highlighted the problems with previous patterns noted such as mood congruence in recall and encoding. It is clear that contextual factors and individual differnces play a major role in mediating mood effects. The theoretical implications of this more complex pattern for cognitive models of psychopathology and in particular depression are an area of ongoing research for myself, bith alone and in conjunction with Spanish colleagues.
- Processing emotional material and its effects in conjunction with personality and coping styles on physical and psychological health. While ruminative thought is clearly implicated in the maintenance of emotional distress, recent research has highlighted that thinking about emotional events can lead to higher levels of emotional and physical well-being. The processes underlying such 'working through' of emotional material and how this differs from unproductive rumination is a research question that I am interested in and one that I have started to study recently.
- Repressive coping is one example of a coping style that relates to the way that individuals process emotional material. Thus, following on from the study of emotional processing, I am also interested in the study of repressive coping. This coping style, which allows an individual to avoid emotional distress, is marked by the individual's avoidance of negative self relevant information. It is interesting both as a coping style in its own right, and also because of what it may tell us about the underlying mechanisms in processing emotional information (see section above).

Name: J. A. Carroll BA MA PhD
Subject Group: CSAI
Email address: johnca@cogs.susx.ac.uk
Position: EPSRC Advanced Fellow

Recent Publications:

1. Briscoe, E., & Carroll, J. (1993). Generalised probabilistic LR parsing of natural language (corpora) with unification-based grammars. *Computational Linguistics*, 19(1), 25–60.
2. Carroll, J. (1994). Relating complexity to practical performance in parsing with wide-coverage unification grammars. *Proceedings of the 32nd Annual Meeting of the Association for Computational Linguistics*, NMSU, Las Cruces, NM, 287–294.
3. Carroll, J., & Briscoe, E. (1996). Apportioning development effort in a probabilistic LR parsing system through evaluation. *Proceedings of the ACL SIGDAT Conference on Empirical Methods in Natural Language Processing*, Philadelphia, PA, 92–100.

Research Grants Currently Held:

- EPSRC Starter Grant: Robust Analysis of Unrestricted English Text, 1996–1997, GR/L02135.
- EU 4th Framework Language Engineering Project: SPARKLE - Shallow PARsing and Knowledge extraction for Language Engineering, 1996–1998, LE-2111.
- EPSRC Research Grant: Analysis of Naturally-occurring English Text with Stochastic Lexicalized Grammars (with David Weir), 1996–1998, GR/K97400.

Research Interests:

Software systems to support the creation of large natural language (NL) grammars and lexicons — in particular:

1. *Grammar development environments* to help grammarians write and maintain wide-coverage NL grammars (a process that has much in common with computer programming).
2. Methodologies for (semi)-automatically extracting syntactic information from machine-readable versions of published dictionaries.
3. Automatic derivation of computational lexicons from corpora, acquiring subcategorisation information, and working towards the collection of selectional preferences, using robust parsers and statistical filtering techniques.

Development of techniques for efficient parsing and ambiguity resolution with linguistically-motivated grammars.

1. Grammar pre-compilation and parsing algorithms for wide-coverage unification-based NL grammars that perform well in practice: worst-case complexity analysis appears not to be a good predictor of practical performance with such grammars.

2. Probabilistic approaches to syntactic disambiguation, using a standard LR parse table construction technique to allow rule application to be differentially conditioned depending on context.

3. Robust analysis of unrestricted English text to produce 'shallow' phrasal analyses of sentences, taking advantage of a linguistic analysis of the use of punctuation and recent advances in lexical tagging technology.

4. Working towards the integration of statistical processing with lexicalist grammar formalisms, using a variant of Lexical Tree-Adjoining Grammar.

Name: Ron Chrisley BS (Stanford) DPhil (Oxon)
Subject Group: Philosophy
Email address: ronc@cogs.susx.ac.uk
Position: Lecturer in Philosophy

Recent Publications:

1. Chrisley, R. (1995). Taking embodiment seriously: non-conceptual content and robotics. In Ford, K., Glymour, C., & Hayes, P. (eds.), *Android Epistemology*. Cambridge: AAAI/MIT Press, 141–166.
2. Chrisley, R. (1994). Why everything doesn't realize every computation. *Minds & Machines*, 4(4), 403–420.
3. Chrisley, R. (1993). Connectionism, cognitive maps, and the development of objectivity. *Artificial Intelligence Review*, 7, 329–354.

Research Interests:

My research focuses on ways of representing the world that are less objective than we usually think adult human cognition is. For example, I am interested in how animals navigate through and represent space, as well as how infants represent their environment before they have the concept of *object*:

- Specifying non-conceptual content:

  On the philosophical side of things, this interest compels me to look for a means of talking precisely about these pre-objective (or *non-conceptual*) representations; how can we specify the non-conceptual contents of the beliefs of animals and infants? Normally, we specify contents by providing sentences in a natural language that have the same content. Thus I might say that the robot believes *that there is a door ahead.* But there are good reasons to believe that this method of specification will not work for non-conceptual contents. One of my goals, then, is to evaluate candidate alternatives to the linguistic specification approach.

- Cognitive map construction in autonomous robots:

  On the scientific side of things, I am looking for an appropriate computational architecture for psychological theories of pre-objective representation. There are several reasons to believe that connectionist (PDP) architectures are more suited to non-conceptual analyses than are classical architectures (Chrisley, 1993). Therefore, I am developing PDP algorithms that permit an autonomous robot to build cognitive maps of its environment so that I can analyse the pre-objective representations it constructs along the way.

Two other interests should be mentioned; I'll express these as sets of questions under consideration:

Foundations of computation: What is computation? Under what conditions can we say that a physical system implements a program? (Chrisley, 1994) To what extent must we make reference to the environment of a computational system when characterizing/explaining it? What are the limitations of formal notions of computation (e.g., Turing machines)?

Artificial life: Is there a unified philosophy behind Alife research? Can Alife research suggest new ways of naturalizing intentionality, ones that do not require the ascription of representations? In what ways does the inclusion of the environment play a crucial role in Alife-inspired theories?

Name: Dave Cliff BSc MA DPhil

Subject Group: CSAI

Email address: davec@cogs.susx.ac.uk

Position: Lecturer in Computer Science and Artificial Intelligence

Recent Publications:

1. Cliff, D., Harvey, I., & Husbands, P. (1993). Explorations in evolutionary robotics. *Adaptive Behaviour* (MIT Press) 2 1:71–108.

2. Miller, G. F., & Cliff, D. (1994). Protean behavior in dynamic games: arguments for the co-evolution of pursuit-evasion tactics. In Cliff, D., Husbands, P., Meyer, J.-A. & Wilson, S. W.(eds.) *From Animals to Animats 3: Proceedings of the Third International Conference on Simulation of Adaptive Behavior (SAB94)*, MIT Press Bradford Books, 411–420.

3. Cliff, D. (1994). AI and A-Life: never mind the blocksworld. In Cohn, A. (ed.) *ECAI94: Proceedings of the 11th European Conference on Artificial Intelligence*, John Wiley and Sons Ltd., 803–808.

Research Interests:

My general interests are in the neural processes underlying the generation of adaptive behaviour. Adaptive behaviour here includes "Intelligent" behaviour. My primary interest is in sensorimotor coordination for situated agents, with a particular focus on parallel distributed processing for visual perception.

In the past, I've published methodological arguments against current common approaches (and their underlying assumptions) in cognitive science and in 'connectionist' computational neuroscience. It is argued that research in both these fields often exhibits an unwarranted focus on human/primate cognitive (intellectual/perceptual) function, frequently with little or no reference to the behavioral, environmental, or evolutionary contexts of the faculties under study. These problems are made worse in connectionist modelling, where widespread biological naivete coupled with an unquestioning acceptance of the thesis that nervous systems are computing devices transforming between intermediate representations, leads to many models of little or no relevance to understanding biological cognitive processes. In particular, modelling perception in isolation from action forces assumptions that are probably untenable.

As a (partial) remedy to these problems, I suggested an approach called "Computational Neuroethology". Neuroethology is a relatively new field in the biological sciences, being the meeting ground for neuroscience and ethology (the study of behaviour). The particular style of computational neuroethology I practice is inspired by Brooks's work in robotics and by Hoyle's work in neuroethology.

This involves an antianthropocentric context. That is, it rejects the established practice in cognitive science and computational neuroscience of studying higher order animals (especially humans) and instead focuses on simpler systems that exhibit adaptive behaviours. These simpler systems are, for a number of good reasons, insects.

The reasons for studying insects rather than primates include: insects are (biologically) extremely successful creatures; there is a high probability that their nervous systems will be understood before more complex systems yield to analysis; and insect-like robots are within the state of the art. However, the

main reason is that the computational neuroethology approach requires a continuous data-path through the synthetic 'neural' network from sensory input to motor output, in order that the semantics of the system are grounded in the environment. Currently available computer power only allows for relatively simple (ie, insect-like) sensory-to-motor networks to be simulated.

The practical application of this work involves 'neural network' simulation for issues arising in *animate vision* with *nonuniform sampling*. Animate vision is a recent paradigm in computer vision. Animate vision systems have dynamic control of the image-capture device (cameras or eyes): animate vision systems are capable of 'looking around'. Besides acknowledging the behavioural contexts of vision, a capability to look around offers a number of computational advantages. These advantages are further supplemented by the fact that animate vision systems can profitably employ spatially variant ("foveal") sampling, where the imaging resolution varies across the image surface. Such sampling is found in many predatory animals (including humans), where the retina has a small localised high-acuity region known as a *fovea*. Foveal vision offers additional computational benefits (the details of which depend on the nature of the nonuniformities) when linked to an animate vision system.

Animate foveal vision is found in insects. The visual behaviour of the male *Syritta pipiens* hoverfly is a good example, being remarkably close (in functional terms) to corresponding behaviour in humans. I've done practical work involving a simulation of an artificial insect, inspired by male *Syritta*, in a complete environment. The simulation was based on prior work in the biology literature, and resulted (amongst other things) in the re-evaluation of the available data. It also demonstrated that sophisticated visually guided behaviours can be generated without reliance on internal representations of the type traditionally employed in the AI literature.

More recently, I've been working with Phil Husbands and Inman Harvey (COGS, Sussex) on using artificial evolution techniques to develop neural-network 'controller' architectures for simple visually guided robots: the visual sensing morphology is under genetic control, and we are working towards the evolution of animate foveal vision systems. This work is in its early stages, but has already been remarkably successful. I am also working with Geoffrey Miller (COGS, Sussex until 1 Jan 95; Psychology, Nottingham thereafter) on the co-evolution of visually guided pursuit-evasion strategies in simulated robots; with Paul Benjamin (Biology, Sussex) on simulating neuronal circuitry underlying feeding behavior in pond snails; and with Stewart Wilson (Rowland Institute, Mass., USA) on extended classifier systems for visually guided autonomous agents. I am also a supervisor to several DPhil students: Seth Bullock (with Phil Husbands) who is working on evolution of signalling and communication mechanisms in autonomous agents; Stephen Dunn (with Paul Benjamin) who is working on simulation studies of the pond-snail nervous system; Giles Mayley, who is developing evolutionary techniques for mobile robots; and Adrian Thompson (with Phil Husbands) who is evolving robot controllers at the gate level, for direct implementation in VLSI silicon.

Name: Richard A. Coates MA PhD FSA
Subject Group: Linguistics
Email address: richardc@cogs.susx.ac.uk
Position: Professor of Linguistics

Recent Publications:

1. Coates, R. (1993). *Hampshire place-names*. Ensign.
2. Coates, R. (1994). Morphophonemics. In Asher, R. E. (ed.), *Encyclopedia of Language and Linguistics*, Pergamon, 2602–2612.
3. Coates, R. (1995). The place-name Owermoigne, Dorset, England. *Indogermanische Forschungen*, 100, 244–51.

Research Interests:

My main interest is in historical linguistics in general and the accountability of synchronic theory construction to the facts of language change. (Hence my attachment, for the latter, to Royal Skousen's *Analogical Modeling of Language* (Kluever 1989)). My work is mainly etymological, and I have a special interest in the origin and history of place and personal names.

Many of my publications deal with Old English, but I have also covered problems in Scots Gaelic, Welsh, French, ancient Scandinavian and some of the older languages of Europe. This kind of work has led me to be interested in the theoretical nature of proper names, and I have recently evolved an approach which is sensitive to the historical notion of *becoming-a-name*, which is problematic if names are merely a set of indicators of unique referents, listed in a kind of mental dictionary or *onomasticon*. How do they get there? In my view, what we are thinking of as names *par excellence* are one end of a typological continuum of referring expressions, distinguished by lack of intensional content. *Becoming-a-name* is therefore the process of losing intensional content; it is a pragmatic notion which, for speakers, on given occasions of use, may refer without commitment to any intensional content the words in a referring expression may have. It is a process internal to the speaker; expressions are more namelike the more frequently a speaker does not commit herself to the sense of the transparent etymology of a referring expression. (If you can't see why I believe all this see the first 10 pages or so of my CSRP 175.) On the basis of this, I can give a principled answer to the old conundrum about whether non-denotational expressions like *the zodiac* are proper names or not, *viz.* "maybe"!

I have been developing interest in morphology, and in semantic aspects of the relationship between related word-forms. For the rest, my work is normal science (in Kuhn's sense) within historical linguistics; I have emphasised here the parts that have most potential contacts with the cognitive sciences.

Name: Graham C. L. Davey BA PhD
Subject Group: Psychology
Email address: grahamda@cogs.susx.ac.uk
Position: Professor of Psychology

Recent Publications:

1. Davey, G. C. L. (1995). Preparedness and phobias: specific evolved associations or a generalized expectancy bias? *Behavioral & Brain Sciences*, 18, 289–297.
2. McDonald, A. S., & Davey, G. C. L. (1996). Psychiatric disorders and accidental injury. *Clinical Psychology Review*, 16, 105–127.
3. Davey G. C. L., Tallis, F., & Capuzzo, N. (1996). Beliefs about the consequences of worrying. *Cognitive Therapy & Research*, 20, 499-518.

Research Grants:

- ESRC (R000235939) An appraisal of evaluative conditioning. £93,474, 1995-8
- The Wellcome Trust (044740/Z/95/Z) UCS rehearsal and the enhancement of phobic responding. £94,856, 1995-8.

Research Interests:

The development of contemporary models of human conditioning and their application to anxiety disorders

This project is concerned with the development of a two-component model of human conditioning which is applicable to an understanding of the aetiology, maintenance and amelioration of anxiety disorders. This model emphasises the role of cognitive factors in predicting the strength and nature of conditioned responding, and has overcome most of the criticisms of aimed at traditional conditional models of anxiety disorders. This model has been successfully applied to a range of clinically-defined anxiety disorders including simple phobias, panic disorder, obsessive-compulsive disorder and post-traumatic stress disorder. This project is currently partly funded by a project grant from the ESRC.

The role of trauma revaluation processes in the aetiology and maintenance of anxiety disorders

The acquisition and maintenance of anxiety disorders are usually associated with either direct experiences of trauma (eg PTSD) or with what the individual believes will be a traumatic outcome (e.g panic disorder). This project is concerned with the cognitive processes that determine an individual's evaluation of these traumas, and the psychological processes which cause the individual to revalue these events. Identification of these factors should shed light on the variables that both precipitate and alleviate anxiety disorders. This project is currently funded by a project grant from the Wellcome Trust.

The role of the disgust emotion in psychological disorders

Very little research has been dedicated to studying the emotion of disgust, even though it is a common emotion and as believed to underlie a number of psychological disorders including animal phobias, obsessive-compulsive reactions, eating disorders, and hypochondrias. This project has been mainly centred on the role of disgust in common animal phobias and has developed a disease-avoidance model of common animal phobias. However, we are currently moving on to develop valid and reliable instruments for the measurement of disgust sensitivity and to broaden the research base to investigate the role of disgust in these other psychological disorders. I am currently involved in cross-cultural collaborations on this research with psychologists from the Netherlands, the USA and Canada, Japan and India.

Evaluating cognitive vs. biological models of preparedness phenomena

It is well known that the distribution of fears and phobias is uneven, and this uneven distribution has traditionally been attributed to the biological prewiring of associative dispositions (biological preparedness). However, the aim of this project has been to investigate alternative interpretations which allude to the role of generalised cognitive biases in determining preparedness phenomena. This project is at the stage of developing a cognitive-judgmental model of preparedness phenomena which obviates the need to postulate phylogenetically-based associative predispositions. This project is partly funded by a project grant from the ESRC.

Pathological worrying as exacerbated problem-solving

Worry is now a cardinal diagnostic feature of generalised anxiety disorder and a feature of a range of other anxiety disorders, and this project is investigating these cognitive and situational factors which contribute to pathological or chronic worrying. In particular, it is concerned with developing a model of chronic worrying which centres on the role of dispositional factors which thwart attempts to find acceptable solutions to stressful life problems. In addition, collaborative research is being carried out with clinical psychologists based in London on the development of a worrying inventory it is hoped will have discriminative diagnostic value.

Name: Benedict du Boulay BSc PGCE PhD

Subject Group: CSAI

Email address: bend@cogs.susx.ac.uk

Position: Professor of Artificial Intelligence
Dean, School of Cognitive and Computing Sciences

Recent Publications:

1. Lemut, E., du Boulay, J. B. H., & Dettori, G. (eds.) (1993). *Cognitive Models and Intelligent Environments for Learning Programming*, NATO ASI Series (Series F: Computer and Systems Sciences), Vol. 111, Springer-Verlag.

2. Teather, B. A., Sharples, M., Jeffery, N., Teather, D., du Boulay, B., Direne, A. I., & du Boulay, G. H. (1994). Statistical modelling and structured image description for intelligent tutoring in MR imaging of the head. *Rivista di Neuroradiologia*, 7, 29–35.

3. del Soldato, T., & du Boulay, B. (1996). Implementation of motivational tactics in tutoring systems. *Journal of Artificial Intelligence in Education*, 6(4), 337–378.

Research Grants Currently Held:

ESRC Cognitive Engineering Programme. "A Cognitive Engineering Approach to the Design of of Computer-Based Training in Radiology". Two years, about 90K (co-applicant with Dr M. Sharples, Prof. D. Teather (De Montfort), Prof. G. du Boulay (Institute of Neurology, London).

Research Interests:

My main research interest lies in the application of A.I. techniques in education. For some time I have been interested in the problems faced by novices in learning to program. At first this interest focused on Logo but more recently I have looked at Pascal and at Prolog. Some of this work has been empirical and involved studying novices' mistakes both in terms of their pre-conceived misconceptions of programming as well as in terms of their particular misunderstandings of more general aspects of the activity. These include a wide range of difficulties ranging from the pragmatics of dealing with computers through to failures to comprehend underlying mechanisms made available in the programming language. My work with Josie Taylor and others carefully unpicked a wide range of Prolog difficulties. Some of these centred on students' misunderstandings of the underlying Prolog machine but others were at a higher level and were concerned with interference effects between students existing knowledge (e.g. natural language, other programming languages, logic etc) and their new knowledge of Prolog.

The work has also developed toward systems that try to help novices automatically by anticipating the kinds of mistakes that they might make and offering advice as well as towards the design of systems that might reduce errors. This includes the issue of providing tools to help the novice design programs which bridge the long gap between the statement of the problem in English and actual (Pascal) code as well as the design of program trace tools for Prolog. Together with Mark Elsom-Cook I produced a system that could conduct a limited range of checks of a student's Pascal program using chart parsing techniques. Together with Christo Dichev I produced a tracer for Prolog that put more emphasis on

tracing the changing pattern of variable instantiation and data values than is usual. Against the fashion this is a textual rather than a graphical tracer.

Recent work concentrated on novices learning Prolog and specifically the design of tracing tools to help them. Chris Taylor, Mukesh Patel and I ran experiments to look at differences in user performance between textual and graphical tracers and showed that the textual tracers did as well as the graphical. We also designed a tracer notation, TTT, which combines the best of both worlds.

I have also worked in the area of Intelligent Tutoring Systems, producing (with Bill Imlah) a system for French that influenced a line of development at Exeter under Yazdani and others. I worked with Mike Sharples to produce the underlying knowledge representation for a tutor to teach Radiology and with Darina Dicheva produced a tutor for a logical game based on attribute blocks. This latter improved on Brown and Burton's original by being able to provide more accessible reasons for the choices made by the underlying domain expert.

The ITS work with Mike Sharples is proceeding through a partnership with Professor Derek Teather and others at De Montfort University and Professor George du Boulay at the Institute of Neurology in London. We have produced a prototype tutor for MR images of the brain that exploits a large annotated database of images. The tutor aims both to teach a specialised image description language as well as teach differential diagnosis for confusable pairs of diseases. Currently this work is supported by a grant from the ESRC Cognitive Engineering Programme and emplys an RF at Sussex, Nathan Jeffery.

My recent research students have worked in similar fields to the above. Teresa del Soldato produced a prototype tutor for Prolog debugging that adjusts its interaction with the student to take account of motivational issues in a principled manner. Maria Virvou has designed an active help system for Unix based on plausible assumptions about user-goals. Roger Noble explored the role that program examples play in the learning of programming. Alison Petrie-Brown developed a formal theory of dialogue and applyed it to certain classes of educational dialogue. Haider Ramadhan developed a discovery environment for elementary programming concepts and tested it successfully on small cohorts of students. Sadhana Puntambekar investigated the application of ITS techniques to teaching metacognitive strategies. She built a tutor and a browser and conducted an empirical evaluation looking to see differential effects between good and poor learners.

Currently Rosemary Luckin is investigating the application of Vygotski's notion of a Zone of Proximal development to ITS design. Jorge Ramirez-Uresti is investigating the role and utility of learning companion systems.

Name: Steve Easterbrook BSc PhD

Subject Group: CSAI

Email address: steveea@cogs.susx.ac.uk

Position: Lecturer in Computer Science and Artificial Intelligence

Recent Publications:

1. Easterbrook, S. M., & Nuseibeh, B. A. (1996). Using viewpoints for inconsistency management. *Software Engineering Journal*, 11(1).

2. Easterbrook, S. M., & Callahan, J. (1997). Formal methods for V&V of partial specifications: an experience report. *Proceedings, Third IEEE International Symposium on Requirements Engineering (RE'97)*, Annapolis, Maryland.

3. Easterbrook, S. M., & Callahan, J. (1996). Independent validation of specifications: a coordination headache. *Proceedings, IEEE Fifth Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE'96) – Workshop on Requirements Engineering in and for Networked Enterprises*, Stanford, 232–237.

Research Interests:

My main research interest is the development and representation of shared understanding in the design process. My research is primarily concerned with the software design process, but other types of design provide useful points of comparison. Most design processes are team activities, and differences in the conceptual models between different members of a design team can reveal interesting facets of the design process. Furthermore, mismatches between the designers' understanding and that of the other stakeholders (users, procurers, managers, etc) explain many of the difficulties that arise when introducing the 'finished' product into an organisation.

To a certain extent a shared understanding is established through the production of key documents during the software process, which define the task through a series of publicly examinable specifications. However, misunderstandings, breakdowns of co-ordination, and conflicts still occur in the software process. Part of the problem is dealing with the sheer amount of information involved, and the changeability of that information.

I am particularly interested in the use of abstractions. These help the software team to cope, but also introduce new problems. An abstraction represents a particular perspective, suppressing detail that is irrelevant to that perspective. Any representation of the abstraction will fail to capture the assumptions, and indeed the full perspective surrounding the abstraction, making it difficult to understand and evaluate the abstraction at a later point. As abstractions pass through the different sub-groups of an organisation they are interpreted in terms of that particular community's set of meanings, which frequently do not map onto other groups' sets of meanings. Consequently, as the design progresses through the organisation, it is subjected to differing analyses and interpretations, resulting in 'ontological drift'. These problems greatly reduce the utility of repositories of design documents.

Many of the problems described above can be tackled through a process of collaborative domain modelling. I regard domain modelling as an exercise in externalising conceptual models of the domain used

by participants in the design process. By externalising these models, participants share them with one another, and develop an understanding of each other's perspectives. This provides a basis for communication between disparate communities, while reducing the chance of misunderstandings. It also allows the design team to coordinate their activities.

Name: G. J. M. Gazdar BA MA PhD FBA
Subject Group: CSAI
Email address: geraldg@cogs.susx.ac.uk
Position: Professor of Computational Linguistics

Recent Publications:

1. Evans, R. & Gazdar, G. (1996). DATR: A language for lexical knowledge representation. *Computational Linguistics*, 22(2), 167–216.
2. Gazdar, G. (1996). Paradigm merger in natural language processing. In Milner, R., & Wand, I. (eds.), *Computing Tomorrow: Future Research Directions in Computer Science*, Cambridge: Cambridge University Press, 88–109.
3. Cahill, L. J., & Gazdar, G. (1997). The inflectional phonology of German adjectives, determiners and pronouns. To appear in *Linguistics* 35(2).

Research Grants Currently Held:

- ESRC Research Grant: Multi-Lingual Lexical Knowledge Representation (with Lynne Cahill), 1995–1997, R000235724

Research Interests:

Theoretical issues in lexical knowledge representation, especially those connected with:

1. the automatic acquisition of lexical entries from relevant data;
2. the integration of probabilistic information into inheritance lexicons;
3. the design of multi-lingual lexicons for related languages;
4. the representation of polysemy, metonymy and collocation;
5. Zipf's Law.

Continuation of development work on DATR (in collaboration with Roger Evans and others). DATR is a widely used declarative language for representing a restricted class of inheritance networks, permitting both multiple and default inheritance. The principal area of application is the representation of lexical entries for natural language processing. The goal of the DATR enterprise has been the design of a simple language that (a) has the necessary expressive power to encode the lexical entries presupposed by work in the unification grammar tradition, (b) can express all the evident generalizations about such entries, (c) has an explicit theory of inference, (d) has an explicit declarative semantics, and (e) can be implemented in a way that makes it useful for practical NLP systems.

Name: Dale W. Griffin BA MA PhD
Subject Group: Psychology
Email address: daleg@cogs.susx.ac.uk
Position: Senior Lecturer in Psychology

Recent Publications:

1. Griffin, D. W., & Varey, C. A. (1996). Towards a consensus on overconfidence. *Organizational Behavior and Human Decision Processes*, 65, 227–231.
2. Griffin, D. W., & Buehler, R. (1993). The role of construal processes in conformity and dissent. *Journal of Personality and Social Psychology*, 65, 657–669.
3. Griffin, D. W., & Tversky, A. (1992). The weighing of evidence and the determinants of confidence. *Cognitive Psychology*, 24, 411–435.

Research Grants Currently Held:

- "Judgments in Couples", Research Development Fund, University of Sussex.

Research Interests:

My research interests fall in and between the two broad areas of social cognition and judgement and decision making (JDM). Social cognition research focuses on the cognitive processes by which people organize and make sense of their social world. JDM research focuses on the rules by which people make predictions, choices and evaluations. The particular concern that underlies my work in both social cognition and JDM is my interest in how much awareness people have of the processes and rules that control their social judgments. I am especially interested in using implicit or "unconscious" measures of cognition to trace the processes involved in social judgments.

In one area of my current research, I am examining the basis of confidence or certainty judgements and contrasting the importance of controlled reasoning processes with the importance of unconscious or automatic inferential processes. What are the cues by which people "know" that they are certain about an answer or a prediction? How much deliberative planning goes into a prediction and how much of the conscious cognition involved is merely a justification of the results of a process to which the person has no access? I find these questions to be fascinating and vital to our understanding of the human mind.

Name: C. Hartonas PhD
Subject Group: CSAI
Email address: hartonas@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications:

1. Hartonas, C. (in press). Semantics for finite delay. *Theoretical Computer Science*.
2. Hartonas, C. (in press). A fixpoint aproach to finite delay and fairness. *Theoretical Computer Science*.
3. Hartonas, C. (in press). Pretopology semantics for bimodal intuitionistic linear logic. *Logic Journal of the IGPL*, 5(1).

Research Interests:

Fairness in concurrent computation, finite delay notions, denotational semantics for delay calculi.

Duality theory for lattice-ordered structures, applications in logic and in denotational semantics.

Foundational calculi in CS (operational and denotational semantics), higher-order formalisms, combinations of functional and concurrent calculi.

Name: Inman Harvey BA Cert.Soc.Anth. MA (Cambridge) MSc DPhil (Sussex)
Subject Group: CSAI
Email address: inmanh@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications

1. Harvey, I., & Thompson, A. (1996). Through the labyrinth evolution finds a way: A silicon ridge. *Proceedings of The First International Conference on Evolvable Systems: From Biology to Hardware (ICES96)*, Springer-Verlag.

2. Harvey, I., Husbands, P., Cliff, D., Thompson, A., & Jakobi, N. (in press). Evolutionary robotics: the Sussex approach. *Robotics and Autonomous Systems*.

3. Harvey, I., & Stone, J. (1996). Unicycling helps your French: spontaneous recovery of associations by learning unrelated tasks. *Neural Computation*, 8(4), 697–704.

Research Interests:

From October 1996, as well as my COGS connection I am Research Fellow in Evolutionary Robotics at the newly founded Centre for Computational Neuroscience and Robotics, a joint venture between COGS and BIOLS (the School of Biological Sciences). This brings together roboticists, artificial evolutionists, biologists plus a number of robots and ants in the same lab.

My D.Phil. thesis is on 'The Artificial Evolution of Adaptive Behaviour'. Ongoing research as a research fellow in the Evolutionary and Adaptive Systems Group allows the theoretical ideas worked out in my thesis to be put to practice in the real world.

Some people are in AI and Cognitive Science because they want to learn more, perhaps through computer simulation, about how humans and other animals act intelligently and adaptively (scientists and psychologists). Some are interested in making useful tools for humans (e.g. HCI). Others see intelligent behaviour as based on principles divorced from any particular agent and its world (these are philosophically confused). A fourth group — the one to which I subscribe — is basically interested in engineering or building artificial agents, and is eager to borrow any useful ideas that biologists, psychologists, and computer scientists can provide.

I see the design of increasingly complex systems, such as particular cognitive systems for artificial agents — 'brains' for robots, if you like — as ultimately beyond human capabilities. The ideas I want to borrow are from natural Darwinian evolution, the process which produced humans and animals; using a population, with selection, reproduction, mutation and recombination. I have been developing genetic algorithms (GAs) so as to work with genotypes (strings of characters analogous to DNA) of arbitrary length, which specify the architecture of a robot 'brain'; in this way artificial evolution can work from simpler structures towards arbitrarily complex ones. Analogies are drawn from population genetics; although artificial evolution has certain advantages over natural evolution; for instance, mutation rates, and the selective pressures acting on a population, can be manipulated at will.

The conclusions of my own version of GAs — SAGA, or Species Adaptation Genetic Algorithms — are that in practice one will be working with a genetically converged population, a 'species' of robots.

Selective forces should be much higher than standard GAs, maintained by rank or tournament selection. Mutation rates should also be relatively high, at a balance between too high which means the population loses its current local hill in the fitness landscape and drifts anywhere, and too low which means not enough exploration is done towards potentially higher hills.

SAGA has initially been used in the context of evolutionary robotics, but is more widely applicable in any domain where incremental evolution is a possibility. More recently Adrian Thompson in COGS has been using some aspects of SAGA in his Evolvable Hardware research; this currently looks like the most promising area for artificial evolution to reach serious real-world applications in the short or medium term.

When applying artificial evolution to the design of control systems or 'nervous systems' of robots, a decision has to be made on the class of primitives that this design process will work with. On philosophical and practical grounds, classical AI systems can be rejected; most connectionist, or artificial neural network, paradigms can similarly be dismissed as being stuck in the computational, information processing, input / output view of cognition which I reject. The perspective I favour, along with a small but rapidly growing number of people within the field, is that of considering cognitive systems as dynamical systems coupled (through sensors and motor actuators) with the environment (which is also a dynamical system). With this view, which is compatible with the ideas of Maturana and Varela among others, sensory inputs act as a 'perturbation' on the dynamics of the nervous system and hence influence, without directly specifying, motor outputs; these motor outputs themselves influencing sensory inputs.

Following through from this, the class of primitives for artificial evolution to work with should be such as to generate dynamical systems, operating in real time. One simple such class is that of recurrent dynamic networks, using real-valued time delays on the links between nodes in the network.

In the work of the Evolutionary Robotics Group, we are pioneering this methodology for developing control systems for real robots, and in particular for navigation using (low-resolution) vision; a field where conventional approaches have had no serious successes. We co-evolve simultaneously both the 'brain' structure and the visual morphology. We have built an 'evolution machine', which allows thousands of experiments in visual navigation to be carried out on a miniature robot using real vision; the robot can be tested automatically on a given task, evaluated, and then repositioned with a new 'brain' for the next trial. With this equipment we have successfully evolved control systems for simple navigational tasks, and recognition of simple objects.

This means that our approach has to be *highly* interdisciplinary. We have to work with assembly language and higher level program languages, with single-board computers and frame-grabbers for a miniature CCD, and with mechanical engineering problems on our 'evolution machine'. We use notions from population genetics, the evolution of early RNA molecules, morphogenesis, genetic algorithms, neurobiology, neuroethology, neural networks, insect vision, active vision, and dynamical systems theory. Last but not least, our work must be properly philosophically grounded. It's fun.

Name: Matthew Hennessy BSc MA PhD
Subject Group: CSAI
Email address: matthewh@cogs.susx.ac.uk
Position: Professor of Computer Science

Recent Publications:

1. Hennessy, M., & Lin, H. (1996). Proof systems for message-passing processes. *Formal Aspects of Computer Science*, 8, 379–407.
2. Hennessy, M., & Liu, X. (1995). A modal logic for message passing processes, *Acta Informatica*, 32, 375–393.
3. Hennessy, M., & Lin, H. (1995). Symbolic bisimulations. *Theoretical Computer Science*, 138, 353–389.

Research Grants Currently Held:

- Symbolic Verification Systems
  Three year EU funded project to develop and support research collaboration between COGS, The Institute of Software of the Chinese Academy of Sciences in Beijing and the Ecole Normale Superieure in Paris.
- Foundations for the Integration of Concurrent Distributed and Functional Programming
  EPSRC funded three year research grant with two Research Fellows.
- EXPRESS: Expressiveness of Languages for Concurrency
  EU supported research network between COGS and seven other European research institutes.

Research Interests:

Formal semantics and related verification methodologies for specification and programming languages, with particular emphasis on concurrency.

My research centers on the development of a sound mathematical understanding of computational processes in general and more particularly of the languages used to describe these computational objects. This mathematical understanding is typically expressed as a formal semantic model and properties of the the computational objects under scrutiny may then be elucidated by investigation of this underlying model.

The models may be *behaviour* based in the sense that they express semantics in operational terms; a computational process is characterised intensionally in terms of the set of possible *internal states* it can involve to and criteria for determining under what circumstances it can move from one state to another. These models also provide a behavioural basis for comparing processes, for deciding when two processes are essentially the same from the point of view of any potential user. Denotational models provide a more abstract view of semantics. Here a model consists of some collection of abstract mathematical entities

such as functions over some data space and a meaning is associated with a process in a manner completely independent of its behaviour, typically in terms of its structure.

Most of my recent research has centered around the development, investigation and use of such models for a variety of languages for describing distributed processes. Denotational models have been used for many years for sequential processes but as of yet this approach has had only very limited success for concurrent or distributed processes. One of the main reasons seems to be that there is no clear consensus on the *essential nature* of such processes, which is not surprising in view of their pervasiveness in computer science. Instead a rich and varied behavioural theory of concurrent processes has evolved. Much of this has centered around *process algebras*, a family of rather abstract algebraic description languages for communicating processes. Current research involves the investigation of *higher order* distributed systems, where complicated data such as functional abstractions, processes, or so-called *applets* can be exchanged between independent systems, often residing at independent locations.

These mathematical theories have been used as the basis of various verification tools which are under continual development. One, the *Concurrency Workbench*, is behaviour based in that a process is proved to have a certain property by examining the state space of the process. More recently a more abstract tool, PAM (Process Algebra Manipulator), has been developed in conjunction with Dr. Huimin Lin. This is based on equational rewriting of process descriptions but one may also prove statements about processes using induction.

Name: Graham Hole BSc PhD
Subject Group: Psychology
Email address: grahamh@cogs.susx.ac.uk
Position: Lecturer in Psychology

Recent Publications:

1. Hole, G. J., Tyrrell, L., & Langham, M. (1996). Some factors affecting motorcyclists' conspicuity. *Ergonomics*, 39(7), 946–965.
2. Hole, G. J. (1996). Decay and interference effects in visuo-spatial short-term memory. *Perception*, 24, 1059–1073.
3. Hole, G. J., & Tyrrell, L. (1995). The influence of perceptual 'set' on the detection of motorcyclists using daytime headlights. *Ergonomics*, 38(7), 1326–1341.

Research Interests:

My main research interests are in two different areas of visual perception. I'm interested in face recognition in children and adults, and in particular, I'm interested in age-perception (work I've been doing in collaboration with Pat George). I'm also interested in perceptual aspects of driving, in particular the factors affecting motorcyclists' conspicuity to other road-users (work done in conjunction with Martin Langham).

Name: Richard Howarth BSc PhD
Subject Group: CSAI
Email address: richardh@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications:

1. Howarth, R. J., & Buxton, H. (1993). Selective attention in dynamic vision. *Proceedings of the Thirteenth IJCAI Conference*, 1579–1584.
2. Howarth, R. J. (1995). Interpreting a dynamic and uncertain world: high-level vision. *Artificial Intelligence Review*, 9(1), 37–63.
3. Howarth, R. J., & Buxton, H. (1996). Visual surveillance monitoring and watching. *Proceedings of the Fourth European Conference on Computer Vision*, Springer-Verlag, Vol. 2, 321–334.

Research Interests:

Most of my research interests are related to computer vision, although I'm mainly interested in how to use the results from computer vision, for example, the recognition of an object in a scene, to build a conceptual description of each object's behaviour in the scene. This is part of something we can call "high-level vision" which combines AI techniques with the perceptual processing. Current work has used the movement of road-traffic at a roundabout which simplifies some of the visual processing because most of the moving scene objects have rigid bodies. This includes modelling the environment using spatial representation and reasoning, often using analogical models to index prior knowledge, as well as reasoning about the changes that take place over time. In addition to the behaviour of the various moving objects in the scene, it is also useful to consider the behaviour of the observer watching the scene. This "active vision" approach broadens my field of interest further to include the consideration of things like how these various behaviours might be learnt, how the visual task of the observer can affect interpretation, how the visual tasks are situated in the dynamic environment, and how this top-down control affects system design.

Name: Phil Husbands BSc MSc PhD
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Email address: philh@cogs.susx.ac.uk
Position: Lecturer in Artificial Intelligence

Recent Publications:

1. Husbands, P., Harvey, I., & Cliff, D. (1995). Circle in the round: state space attractors for evolved visually guided robots. *Robotics and Autonomous Systems*, 15(1–2), 83–106.

2. McIlhagga, M., Husbands, P., & Ives, R. (1996). A comparison of search techniques on a wing-box optimisation problem. In Voigt, H., Ebeling, W., Rechenberg, I., & Schwefel, H.-P. (eds.), *Proceedings of PPSN IV*, Springer Verlag, LNCS Vol. 1141, 614–623.

3. Harvey, I., Husbands, P., & Cliff, D. (1994). Seeing the light: artificial evolution, real vision. In Cliff, D., Husbands, P., Meyer, J.-A., & Wilson, S. (eds.), *Proc. 3rd Int. Conf. on Simulation of Adaptive Behavior*, MIT Press, 392–401.

Research Grants Currently Held:

- Genetic Algorithms in Manufacturing Engineering, EPSRC, 3 years.
- Evolution of Control Architectures for Visually guided Autonomous Agents, EPSRC, 3 years.
- Genetic Synthesis of a neural network for a six leg robot, EC, 2 years.
- Coevolutionary techniques for communication networks design, Nortel, 2 years.

Research Interests:

A central theme in most of my research is genetic algorithms. My primary interests at the moment are robotics, specifically the development of techniques for the artificial evolution of control systems for autonomous mobile robots; and the development of large distributed highly parallel coevolutionary genetic algorithms for hard open-ended optimisation problems.

The robotics research is being carried out jointly with I. Harvey, F. Gruau, A. Thompson N. Jakobi and a group of DPhil students. We argue that the hand design of control systems for mobile robots intended to act in uncertain complex noisy domains becomes intractable as the complexity of required robot behaviour increases. It appears that such control systems, or artificial nervous systems, necessarily involve many emergent interactions between many sub-systems coupled in complex ways. Traditional engineering design methodologies have nothing of any consequence to say when faced with that kind of problem. Hence we are developing a methodology in which control systems, based on continuous recurrent neural networks with rich dynamics, are incrementally evolved to generate more and more complex behaviours. We are investigating the concurrent evolution of control networks and sensors (primarily visual) using both simulations and a variety of real-world robots. This research opens up many avenues of investigation: how best to encode networks; the departures from standard GA practices necessary to accomplish

open-ended artificial evolution; how best to evaluate robot behaviours; determining the most appropriate basic building blocks for artificial evolution to work with; evolution of ultra-robustness (we are investigating this with respect to space missions with Matra Marconi Space), integration of evolutionary processes and life-time learning to name but a few.

These topics form part of a wider interest in adaptive systems. In particular how systems, both natural and artificial, adapt to their environments and in how cognition can be viewed in terms of this adaptation, particularly from an evolutionary perspective. A number of these issues are being investigated in the new Sussex Centre for Computational Neuroscience and Robotics (CCNR), a joint venture involving the Schools of Cognitive and Computing Sciences and Biological Sciences, with a mission to exploit the synergy between neuroscience and new-wave AI. I am joint coordinator of the Centre along with Prof. M. O'Shea of BIOLS. CCNR research of particular interest to me includes: evolutionary robotics, hardware evolution, modelling the action of diffusable modulators in invertebrate nervous systems, investigating hypotheses about navigation behaviour generating mechanisms in ants and bees using visually guided robots.

I have been working with Genetic Algorithms for more than a decade and retain a strong interest in their application to industrial problems. I have applied them to a number of difficult real world problems on which deterministic methods have previously had very little success. These include production plan optimisation, scheduling, non-linear systems identification, component shape optimisation, and automatic test pattern generation for digital circuits. The production plan optimisation and scheduling work has led to a model which allows the solution to a highly generalised job-shop scheduling problem to emerge from the parallel and cooperative optimisation of the process plans whose interactions can be described in terms of the overall schedule. This is achieved via an 'ecosystem' model of co-evolving organisms using shared resources. The model has been implemented on a transputer-based parallel machine and is highly distributed, involving local interactions only. There are many possible extensions to this work. A generalisation of the 'ecosystem' model and a study of the emergent dynamics of co-evolution are two projects that are particularly worthwhile. The work is currently being extended by applying it to open-ended multi-criteria design optimisation problems. I have a keen interest in the development of more sophisticated encodings than are generally used in GA work, this in turn calls for a mathematical analysis which will be far more sophisticated than the standard one available. With M. McIlhagga I have worked on a variety of scheduling and component design optimisation problems. This work has had a strong comparative component and we have been able to show that out GA-based methods perform much better than most commonly used techniques. We recently started collaborative work with Nortel on the use of evolutionary techniques (particularly coevolutionary methods) in telecommunitaction network design and management. Companies that have been collaborated in various aspects of the research outlined above include: Rolls Royce, British Aerospace, Logica Cambridge, Nortel, Schlumberger, Mandelli, Spatial Technology, Stressle, Matra Marconi Space, British Telecom.

Name: N. P. Jeffery BSc (Hons) PhD
Subject Group: CSAI
Email address: nathanj@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications:

1. Jeffery, N., Teather, B., Teather, D., Sharples, M., du Boulay, B., & du Boulay, G. H. (1997). Computer based radiological training and education. In Blackledge, J. (ed.), *Image Processing: Mathematical Methods and Applications*, Oxford University Press, ISBN 0-19-851197-3.

2. Jeffery, N., du Boulay, G. H., Teather, B., & Teather, D. (1997). Expert-novice differences in the interpretation of MR-imaging of the brain. Paper accepted for presentation at *BIR conference, Radiology UK*, 21st May 1997.

3. Jeffery, N., Teather, B., Teather, D., Sharples, M., du Boulay, B., & du Boulay, G. H. (1995). MEDIATE — A magnetic resonance tutor. *Proceedings of the Computers in Teaching in Medicine Conference*, Bristol.

Research Interests:

Current research activities include improving the training of radiologists by applying an analysis of working practices, learning methods, professional development, training techniques and the process of medical image description to the design of a computer-based training system for Magnetic Resonance Imaging of the head. The research also addresses the generic problem of how to design software situated in the workplace to support the training of busy professionals.

More generally, I have an interest in providing methods for indexing and retrieval of images from large image databases via a cognitively informed graphical representation of visual concepts. Also, roviding Intelligent Tutoring of visual concepts via computer based training thus allowing access to a fully indexed archive of images based around a representation designed to support the Roscherian (prototypical) notion of concept representation and operationalising the notions of similarity and typicality of instances within a particular concept to support exemplar based learning paradigms.

Name: Alan Jeffrey BSc DPhil
Subject Group: CSAI
Email address: alanje@cogs.susx.ac.uk
Position: Lecturer in Computer Science

Recent Publications:

1. Aceto, L., & Jeffrey, A. (1995). A complete axiomatization of timed bisimulation for a class of timed regular behaviours. *Theoretical Computer Science*, 152(2): 251–268.
2. Jeffrey, A. (1994). A fully abstract semantics for concurrent graph reduction. In *Proc. LICS 94*.
3. Jeffrey, A. (1993). A chemical abstract machine for graph reduction. In *Proc. MFPS 93*, Springer-Verlag LNCS 802.

Research Interests:

I am employed on SERC project GR/H 16537 to investigate formal models of concurrent systems. In particular, I am investigating links between theories of concurrency and functional programming. This includes concurrent models of graph reduction, type theories for concurrent languages, and the interaction between the semantics of data and the semantics of concurrent processes.

I am task leader of the Processes and Datatypes task of the CONCUR2 Esprit Basic Research Action.

I have an active interest in electronic typesetting, especially Lamport's LaTeX document markup language. I am a member of the LaTeX3 project team, and one of the authors of LaTeX 2ε.

Name: Bruce F. Katz BA PhD
Subject Group: CSAI
Email address: brucek@cogs.susx.ac.uk
Position: Lecturer in Artificial Intelligence

Recent Publications:

1. Katz, B. (1993). Musical pleasure through the unification of melodic sequences. *Proceedings of the Fifteenth Annual Conference of the Cognitive Science Society*, Boulder.
2. Katz, B. (1993). A neural resolution of the incongruity-resolution and incongruity theories of humour. *Connection Science*, 5, 59–76.
3. B. Katz (in press). An ear for melody. *Connection Science.*

Research interests:

My research centers on neurally-inspired models of cognition. One area that I have explored extensively in the recent past has been the use of such models in modelling learning. In particular, I have shown how two seemingly disparate forms of learning, Explanation-Based Learning, and Similarity-Based Learning can be unified within the connectionist framework. This unification has yielded interesting emergent properties, such as cognitively plausible results for the reversal learning task.

Currently, however, my work is focussed on what I call last chapter topics; i.e., those areas which tend to be placed toward the end of Cognitive Science books but which I believe are central in understanding what it means to be human. These topics include, among other things, emotion, consciousness, and aesthetic preference. It is the last of these items that I am most actively pursuing, as an end in itself, and with a view toward ultimately producing a greater understanding of the first two items.

My work is based on the fact that high-level, explicit goals are inadequate as explanations of human motivation. When extended to higher aims, such as music, art, etc., these rules are neither dynamic nor fine-grained enough to capture the vagaries of human aesthetic preference. Goals are replaced in my theory by tendencies to act such that internal harmony is maintained. Harmony is measured by a hedonic function, such that well-distributed states of activation are deemed to be pleasurable, and localized activation states are repellent. In this theory, pain does not result in the narrowing of attention, pain *is* the narrowing of attention.

The theory has been applied successfully to explain the following: the nature of humour, including its tendentious aspects; the psychological basis for the laws of harmony; the thematic form of melody; the beauty of nature and natural forms; and, preference for prototypes. My current research centers on two areas. First, I am attempting to extend the theory to human sexual response. Next, I am trying to show that the continuum ranging from bank managers and insurance salesman to court jesters and ax murderers can be explained by a neuro-sociobiological account consistent with the proposed theory.

Name: Bill R. Keller BSc MA DPhil
Subject Group: CSAI
Email address: billk@cogs.susx.ac.uk
Position: Lecturer in Artificial Intelligence

Recent Publications:

1. Keller, B. (1996). An evaluation semantics for DATR theories. In *Proceedings of COLING96*, 646–651.
2. Keller, B. (1995). DATR theories and DATR models. In *Proceedings of the 33rd Annual Meeting of the Association for Computational Linguistics*, 55–62.
3. Keller, B., & Weir, D. (1995). A tractable extension of linear indexed grammars. In *Proceedings of the 7th Conference of the European Chapter of the Association for Computational Linguistics*, 75–82.

Research Interests:

My major area of research is natural language and computational linguistics, a topic which has interested me since my undergraduate days. Early work concerned logical theories of natural language semantics as well as parsing with Generalized Phrase Structure Grammar. Recent and current research interests include the following:

- **Semantics of DATR:**

  DATR is a knowledge representation language developed by Gerald Gazdar and Roger Evans that has particular application to natural language lexicons. There are around a dozen implementation of DATR in existence. DATR is probably the most widely used language for specifying natural language lexicons in the NLP community. I have developed a denotational semantics for the full DATR language (Keller 1995) as well as an alternative, operational semantics, which axiomatises the evaluation of DATR expressions is given in (Keller, 1996). Current work will show the equivalence of these two semantics.

- **Grammatical Inference using Genetic Algorithms:**

  In recent work with Rudi Lutz I have developed an approach to the induction of stochastic context-free grammars using a genetic algorithm. The problem addressed in this work is that of inferring a suitable grammar for a given language from a stochastic sample or corpus of the sentences in that language. Practical techniques for grammatical induction have application to current work in NLP and speech recognition, as well as wider application to syntactic pattern recognition. A first report can be found in Keller and Lutz (1996) "Learning Stochastic Context-Free Grammars from Corpora Using a Genetic Algorithm", CSRP 444.

  A spin-off of this work has been the introduction of a new cross-over operator that appears to outperform standard operators on a range of function-optimisation problems. A report summarising the results of experiments comparing various cross-over operators is currently in preparation.

- **Tractable Unification-Based Grammar Formalisms:**

  The constraint- and unification-based grammar formalisms developed in computational linguistics tend to be very powerful mathematically (as powerful as general-purpose programming languages). In work with David Weir I have developed a formalism that is more powerful than Linear Indexed Grammar (LIG), but which can also be processed in polynomial time using techniques that are similar to those developed for LIG by Vijay-Shanker and Weir. The formalism, referred to as 'partially linear PATR' manipulates feature structures rather than stacks (see Keller and Weir, 1995)

- **Feature Logics:**

  A number of researchers in computational linguistics have investigated the properties of logical languages (so-called *feature logics* for expressing constraints on linguistic objects. In previous work I have studied a variant of one of these logics — Regular Rounds-Kasper logic — which incorporates the device of *functional uncertainty* due to Kaplan and Zaenen. For full details, see: Keller (1994) "Feature Logics, Infinitary Descriptions and Grammar", CSLI Lecture Notes No.44.

Name: Martin P. Langham BA
Subject Group: Psychology
Email address: martinl@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications:

1. Hole, G. J., Tyrrell, L., & Langham, M. (1996). Some factors affecting motorcyclists' conspicuity. *Ergonomics*, 39(7), 946–965.

Research Interests:

Motorcycle accidents tend to involve other road users who often claim not to have seen them in time to avoid a collision. The tradition explanation for such accidents is that the motorcyclist is relatively inconspicuous compared with other road users. Therefore the way to reduced motorcycle accidents is to make them more conspicuous. However, database studies and those accidents involving highly conspicuous police motorcycles tend to question if this hypothesis is the only explanation available. My research is funded by the universities own research development fund. My aim is to offer alternative explanations for these accidents from models of human visual search and selective attention. My current work involves the examination of how a drivers search skills change with experienced.

The current project is to examine how a traffic police officers change the way they search for vehicles at junctions during their training. Measurements are made during simple detection tasks. The recording of driver eyemovemnts and questionnaires assessing the change in hazard perception are the basis of the study. Preliminary results indicated that the experienced driver uses a series of heuristics when driving, these developing because of training and exposure to the road environment. These heuristics appear to be able to deal with frequently experienced road situations but may fail in circumstances that are uncommon to the driver. Therefore accidents which involving the less frequent motorcyclist indicates where there maybe a failure of short hand rules for driving. So far these short hand heuristics do not appear to be so prevalent in the new or inexperienced driver.

Name: Rudi Lutz BSc MSc PhD
Subject Group: CSAI
Email address: rudil@cogs.susx.ac.uk
Position: Lecturer in Artificial Intelligence

Recent Publications:

1. Keller, W., & Lutz, R. K. (1996). Learning stochastic context-free grammars from corpora using a genetic algorithm. *CSRP-444*, U. of Sussex. Accepted for presentation at ICANNGA-97.
2. Keller, W., & Lutz, R. K. (1996). A new crossover operator for rapid function optimisation using a genetic algorithm. *CSRP-446*, U. of Sussex.
3. Lutz, R. K. (1996). Flowgraph parsing. In Bunt, H., & Tomita, M. (eds.) *Recent Advances in Parsing Technology*, Kluwer Academic Publishers, 359-383.

Research Interests:

Generally speaking, my main research interest is in the area of Genetic Algorithms. Currently, the specific topic I am working on is on the application of Genetic Algorithms to the problem of the inductive inference of a stochastic context free grammar for a language from a corpus of examples of sentences in that language. This work is joint research with Bill Keller, and we have had some success so far in learning grammars for some rather simple "toy" languages e.g. 2 and 3 symbol palindromes. Our ultimate aim would be to take one of the rather large corpora of natural language that now exist and try to learn a grammar for (say) English. However, our current techniques have severe scaling problems, and we are currently working on trying to address these.

A spin-off from this work has been the development of a new crossover operator (which we call *randomised and/or crossover*) which seems remarkably successful at performing function optimisation across a fairly wide range of problems. I intend to continue investigating this crossover operator (and variants) with the aim of achieving still better performance at function optimisation tasks.

Name: D. F. McCarthy BSc MSc
Subject Group: CSAI
Email address: dianam@cogs.susx.ac.uk
Position: Research Fellow

Research Interests:

My main research interest is the automatic acquisition of lexical information. I am specifically interested in acquisition of verbal argument structure and preferences, and also relationships at the syntax-lexical semantics interface.

I am currently working with John Carroll on the EU funded project SPARKLE (Shallow PARsing and Knowledge extraction for Language Engineering). The starting point for my work uses the shallow parses and subcategorization frames produced by my colleagues. My work concerns modelling semantic type and acquisition of selectional preferences for the lexicon.

In order to provide a lexical semantic representation for argument heads I am looking into use of man-made resources such as WordNet. Alternatively, I am considering class hierarchies that can be derived automatically using distributional evidence. In order to perform automatic semantic tagging of the argument heads any word sense ambiguity must be resolved. To avoid the overhead of substantial manual tagging I am researching unsupervised methods of word-sense disambiguation.

Selectional preference acquisition proceeds using the training set of shallow parses with semantically tagged argument heads. One of the representations of selectional preferences currently being considered is that of a ”tree cut” through the semantic class hierarchy so that any classes on the cut are not related as descendants of one another. These nodes are associated with scores which represent their degree of association with the target verb. The Minimum Description Length principle is seen as a useful strategy of obtaining selectional preferences which form a compact model whilst being representative of the training data.

A further goal of my work involves recognition of the participation of verbs in rules of diathesis alternation. The aim is to do this using evidence of the verb's subcategorization frames and the preferences for arguments in the corresponding slots of the alternating frames.

Name: C. A. Morris BA MBA MSc MSc
Subject Group: CSAI
Email address: chrismor@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications:

1. The Brunswick System: A Town Architectural Record. IT Journal, International Systems Research Institute 1996 RMG Publishing. ISSN 1364-7598.

Research Interests:

My interest lies in the development of systems that could assist, or perhaps mimic, the work of designers and material specifiers working in the building materials supply and construction industries. In particular, I am interested in the use of hypermedia to locate and incorporate objects into designs as is currently being undertaken using catalogues containing thousands of such materials as produced by numerous suppliers. As an example, one answer might be to show design precedents showing the use of such materials in-situ, perhaps allowing the designer to browse around inside office blocks or other constructions. Finding objects in this way might call for new ways of searching and browsing through semi-formal data structures with hybrid search tools.

Having located an objects of interest, or at least something close, it has to be incorporated into a part-completed, still fluid design. Design is an iterative process, with each new object added forcing a reappraisal of much that has already been incorporated into the design. Here I am particularly interested in ways in which the design itself might be modelled, how the objects might interact with each other and their environment as their attributes and hence their identities develop and how the designer might view, interpret and control such a process.

For design precedents to be displayed economical forms of hypermedia construction are needed. Here I am working with the Regency Town House Museum in Hove with the support of the Department of National Heritage to produce hypermedia templates that will speed up this process, allowing presentations of collections of objects in traditional ways or using newer methods such as virtual walkthroughs of completed buildings or landscapes.

Name: Nicolas Nicolov BSc MSc

Subject Group: Linguistics

Email address: nicolas@cogs.susx.ac.uk

Position: Research Fellow

Recent Publications:

1. Nicolov, N., Mellish, C., & Ritchie, G. (1996). Approximate generation from non-hierarchical representations. *Proceedings of the 8th International Workshop on Natural Language Generation*, Herstmonceux Castle, UK, 13-15 June, 31–40.

2. Gardella, N., Mellish, C., & Nicolov, N. (1996). A nearest-neighbour algorithm for Catalan stress assignment. *Proceedings of the 2nd International Conference on Mathematical Linguistics (ICML'96)*.

3. Nicolov, N., Mellish, C., & Ritchie, G. (1995). Sentence generation from conceptual graphs. *Conceptual Structures: Applications, Implementation and Theory (LNAI 954)*, Berlin: Springer, 74–88.

Research Interests:

My main research interests are in Natural Language Generation and Robust Natural Language Processing (both theoretical and applied aspects).

On the generation side, I am interested in architectures, generation algorithms and input representations. In work with Chris Mellish and Graeme Ritchie I have built a large surface generation system—PROTECTOR which does not assume hierarchical nature of the input representation and allows for approximate matches between the input semantics and the conveyed semantics. PROTECTOR's input is a conceptual graph. The system employs a new grammar formalism—D-Tree Grammar (DTG) which is similar to Lexicalized Tree-Adjoining Grammar. DTGs have a larger domain of locality than other grammars and the initial grammatical structures can be seen as a kind of pre-compilation of some the generation tasks. PROTECTOR also uses a specialised generation algorithm which looks first for a skeletal structure which could be further expanded and employs (on-line) memoing techniques (chart generation).

In work with Chris Mellish and Nevena Gromova I have looked at applying classification-based techniques for surface realisation in Russian. The result of the work was the GENERUS system.

On the parsing side, as part of a new project with David Weir and John Carroll we are investigating techniques for analysis of naturally occurring English texts using stochastic lexicalized grammars. We are using D-Tree Grammars and encode the initial structures in a non-monotonic inheritance framework (DATR) thus capturing generalisations and achieving a compact and better maintainable grammar. We are investigating different techniques for parsing with D-Tree Grammars and intend to use frequency information to speed up parsing and to impose preferences over ambiguous structures. Ultimately we aim to develop a robust wide-coverage parsing system. Given my interests in generation I am also interested in bidirectionality issues and in particular whether the grammar used in the parsing project can be used for generation.

In a project with Narcís Bassols and Chris Mellish I have also looked at the problem of assigning stress patterns to Catalan words. Unlike most systems which are rule-based, we have investigated a nearest-neighbour algorithm which computes a similarity measure between an input word and words from a training set. The words of the training set that are closest to the input word suggest the stress pattern for it. The main methodology is similar to that employed by case-based reasononing (CBR) systems.

I am also interested in:

- conceptual graphs and how they can be used to represent natural language semantics; also their use in applied systems;
- grammar formalisms and representations;
- multilingual aspects of NLP (in particular Slavic languages);
- frameworks, programming languages, tools and teaching aids for computational linguistics and integrated NLP applications.

Name: Andy Ormsby BSc PhD
Subject Group: CSAI
Email address: andyo@cogs.susx.ac.uk
Position: Lecturer in Software Systems

Recent Publications:

1. Nakata, K., & Ormsby, A. (1996). Principles of model reuse: a case study in the electromechanical domain. *Sixth European-Japanese Seminar on Information Modelling and Knowledge Bases*, Copenhagen, May.

2. Olivier, P., Ormsby, A., & Nakata, K. Occupancy array-based kinematic reasoning. *International Workshop on Qualitative Reasoning About Physical Systems*, Amsterdam, The Netherlands.

3. Nakata, K., Lee, M., Ormsby, A., & Olivier, P. (1995). Modelling electromechanical systems from multiple perspectives. *Tenth International Conference on Applications of Artificial Intelligence in Engineering*, Italy.

Research Grants Currently Held:

- EPSRC Multimedia and Network Applications Programme £170,729 "Lowband" (with Ian Wakeman)

Research Interests:

I have a long standing interest in object-oriented systems and the wide applicability of object-oriented modelling approaches has been a recurrent theme in my work, originally as a result of my involvement in a research project which developed object-oriented development methods to promote software reuse.

The majority of work in software reuse has tended to concentrate on two main themes: technical issues in software reuse, such as software tools, programming languages, libraries and component technologies and non-technical issues including the organisational and managerial structures which assist in facilitating reuse.

In contrast with these two areas, the cognitive issues relating to software reuse have received relatively little attention. This is surprising, as the claims made for many of the technological solutions are frequently made in psychological terms: for example, that object-oriented design is somehow "natural", or that object-oriented programs are "easier" to understand. These claims are often made with little or no support other than intuition. One of my current interests is in looking for accounts of the cognitive processes which underlie software reuse, and the ways in which such accounts could inform the software development process.

On a more technical note, object-oriented approaches are also useful in the description and implementation of communication protocols, and in collaboration with Ian Wakeman, I am working on the design of application specific protocols for the delivery of multimedia content over variable bandwidth networks.

Name: D. Pavlovic BA BSc MSc PhD
Subject Group: CSAI
Email address: duskop@cogs.susx.ac.uk
Position: Lecturer in Computer Science

Recent Publications:

1. Pavlovic, D. (1995). A categorical setting for the 4-colour theorem. *J. Pure Appl. Algebra*, 102, 75–88.

2. Pavlovic, D. (1995). Convenient categories of processes and simulations I: modulo strong bisimilarity. In D. H. Pitt et al., (eds.), *Category Theory and Computer Science '95*, Lect. Notes in Comp. Science 953, 3–24.

3. Pavlovic, D. (1996). Chu I: cofree equivalences, dualities and $*$-autonomous categories. *Math. Structures in Comp. Sci.* 6, 25pp.

Research Interests:

The main topic of my research is the broad area of the semantics of programming, especially its logical aspects. The applied research methods mostly combine various pieces from the categorical toolkit. My direct goal is reducing various computational paradigms to a common structural and conceptual denominator. The papers currently in preparation (with collaborators) align *computational monads* with *action calculi* on one side and *interaction categories* on the other. The results will bring the recent, somewhat mysterious, game theoretical models closer to the main body of semantics.

Name: D. Peerbhoy
Subject Group: Psychology
Email address: dawnp@cogs.susx.ac.uk
Position: Research Fellow

Research Grants Currently Held:

- (Held with Professor Graham Davey). Wellcome Trust research grant, The role of rumination and rehearsal in the enhancement of phobic responding.

Research Interests:

Previous research has found that a prevalent feature of anxiety disorders is that individuals tend to experience repetitive and uncontrollable ruminations about the consequences of the source of their anxiety, and this can often lead to the disorder being maintained and intensified (Marks, 1987, Mathews, 1990). Focusing on and constantly rehearsing critical features of a problem or an aversive outcome of a phobic encounter can be seen across a number of clinical disorders, for example people suffering from panic disorder tend to focus in on their bodily sensations and repeatedly ruminate about the possible catastrophic consequences of bodily sensations. Similarly simple phobia's are also associated with cognitiions which represent potentially negative or threatening consequences of the phobic stimulus (Lovibond & Rapee. 1993; Mcnally & Lauro, 1992) and these consequences are frequently imagined and rehearsed in periods between encounters with the phobic stimulus (Marks, 1987).

Rumination and repetitive rehearsal of features of the anxiety sufferer's problem have recieve little attention and therefore, the present research funded by the Wellcome Trust is designed to increase out knowlede of the effects of rumination and the repetitive rehearsal of threatening oucomes on phobic responding. The repetitive processing of stimuli may be theoretically important because rehearsal of different features of the disorder may have quite specific effects of the maintenance and exacerbation of the disorder.

By conducting such research it is hoped that our understanding of rumination across anxiety disorders and other clinical disorders will be increased and will therefore be beneficial to the development of more effective treatment packages.

Name: Lydia Plowman BA PhD
Subject Group: CSAI
Email address: lydiap@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications:

1. Plowman, L. (forthcoming). Designing interactive media for schools: a review based on contextual observation. *Information Design Journal*, 8(3).
2. Plowman, L. (1996). Narrative, linearity and interactivity: making sense of interactive multimedia. *British Journal of Educational Technology*, 27(2), 92–105.
3. Plowman, L. (1995). The interfunctionality of talk and text. *Journal of Computer Supported Cooperative Work*, 3(3/4), 229-246.

Research Grants Currently Held:

- ESRC Cognitive Engineering Programme, 3 years from Oct.1995. 'Narrative construction and the comprehension of interactive multimedia.'

Research Interests:

I am interested in the role of the computer in mediating how people think and interact and how this impacts on teaching and learning processes. This has been central to my research into computer support for collaborative writing, the process of requirements capture for complex electronic technology in industry, and computers in education. Parallel with this, I am interested in how research methods - particularly the use of ethnographc methods - can access useful and illuminating data which can be used to inform human-centred design of computer systems. This entails observing, describing, identifying and analysing existing communication, coordination, and collaboration processes in the workplace and the classroom. In addition, I am developing methods for capturing and analysing on-screen and off-screen events for users of interactive multimedia and using this information to provide guidelines for designers of multimedia products and teachers who want to integrate these materials into the curriculum.

My current research is concerned with the role of narrative in the design of educational multimedia and how it can provide a more coherent and motivating framework. This has led to an interest in the concept of 'multimedia literacy' and the extent to which traditional literacies interact with and inform the specific skills needed for understanding or 'reading' multimedia. I favour sociocultural approaches to analysis which emphasise the relationships between the cultural (narrative), the social (the classroom context), and the cognitive (children thinking and learning).

Name: Murali Ramachandran
Subject Group: Philosophy
Email address: muralir@cogs.susx.ac.uk
Position: Lecturer in Philosophy

Recent Publications:

1. Ramachandran, M. (1993). A Strawsonian objection to Russell's theory of descriptions. *Analysis*, 53(4), 209–212.
2. Ramachandran, M. (1993). Restricted rigidity—the deeper problem. *Mind*, 102, 157–158.
3. Ramachandran, M. (1994). Methodological reflections on two Kripkean strategies. *Procedings of the Aristotelian Society*, 67–68.

Research Interests:

My area of research is philosophical logic—in particular the theory of reference. I am currently working on Russell's theory of descriptions and also on Lewis's theory of causation.

Name: James Riely
Subject Group: CSAI
Email address: jamesri@cogs.susx.ac.uk
Position: Research Fellow

Recent Publications:

1. Riely, J., Purushothoman Iyer, S. & Prins, J. (1995). Vectorizing nested-parallel programs. In *Massively Parallel Programming Models*, IEEE Press.

2. Cleaveland, R. & Riely, J. (1994). Testing-based abstractions for value-passing systems. In Jonsson, B. & Parrow, J. (eds.), *CONCUR '94: Concurrency Theory*, Springer-Verlag.

3. Goldberg, A., Mills, P., Nyland, L., Prins, J., Reif, J. & Riely, J. (1994). Specification and development of parallel algorithms with the Proteus system. In Blelloch, G.E., Chandy, K.M. & Jagannathan, S. (eds.), *Specification of Parallel Algorithms*, AMS Press.

Research Interests:

Parallel and distributed systems: specification and verification, programming notations and their semantics, prototyping and refinement methodologies, compilation techniques; message-passing and shared-object paradigms. Formal methods. Logic.

Name: Yvonne Rogers BA (Wales) MSc (London) PhD (Wales)
Subject Group: CSAI
Email address: yvonner@cogs.susx.ac.uk
Position: Lecturer in Computer Science and Artificial Intelligence

Recent Publications:

1. Rogers, Y & Aldrich, F. (1996). In search of clickable Dons: learning about HCI through interacting with Norman's CD-ROM. *Sigchi Bulletin*, 28(3), 44–47.
2. Scaife, M. & Rogers, Y. (1996). External cognition: how do graphical representations work? *International Journal of Human-Computer Studies*, 45, 185–213.
3. Plowman, L. Rogers, Y. & Ramage, M. (1995). What are workplace studies for? In *Proceedings of the 4th European Conference on Computer-Supported Cooperative Work (ECSCW'95)*, 309–324, Kluwer Academic Publishers, Dordrecht.

Research Grants Currently Held:

- (with M. Scaife) "Explaining External Cognition for Designing and Engineering Interactivity (eco-i)." *ESRC Cognitive Engineering Initiative Grant* (2 years, started November 1995, £128,100).
- (with M. Scaife) "Cooperative Technologies for Complex Work Settings (COTCOS)." *EU Training and Mobility Network (TMR) Grant* (3 years, started October 1996, £177,000).

Research Interests:

My current research interests are in (i) external cognition and interactivity, and (ii) distributed cognition and computer supported collaborative activities. In both areas, I am developing theoretical accounts to explain the phenomena whilst also applying the findings to the design of interactive information and computer systems to support collaborative work, respectively. For the first line of research, I am working in collaboration with Mike Scaife (Psychology) on an ESRC funded project (see http://www.cogs.susx.ac.uk/users/mattd) to determine how graphical representations work. In particular, we are developing a theory of the cognitive processing that accounts for how people interact with different kinds of external representations, be they diagrams, animations, multimedia or virtual reality (Scaife and Rogers, 1996). Using our theoretically-based framework, we are also designing and evaluating interactive information for innovative technologies (e.g. CD-ROMs, the Web). In particular, we have begun developing a suite of prototypes of interactive 'spaces' for various educational domains (e.g. ecology), ranging in complexity and representational formats (e.g. 2D abstract worlds vs 3D environments) to determine how different external representations can facilitate the learning of complex domains.

The second line of research uses alternative theoretical frameworks (e.g. distributed cognition) to explain and design for collaborative activities in various work settings. I have recently been awarded (with Mike Scaife) an EU Training and Mobility Grant (TMR) for 3 years to work on a project, called "Cooperative Technologies for Complex Work Settings (COTCOS)". Last year I was on sabbatical at Apple Computers Inc. (USA), where I worked on a project designing future technologies for collaborative settings. I have

also carried out a number of field studies in engineering, publishing and travel companies, focussing on how networking technologies and groupware applications are being deployed and used. A central theoretical and applied concern is how the various interdependent activities are coordinated and how they might be better supported.

Other research interests include: the role of mental models, practical reasoning and understanding in everyday activities, computer mediated communication and learning.

Name: Julie Rutkowska BA MSc DPhil
Subject Group: Psychology
Email address: julier@cogs.susx.ac.uk
Position: Lecturer in Psychology

Recent Publications:

1. Rutkowska, J.C. (1995). Can development be designed? What we may learn from the Cog project. In Moran, F., Moreno, A., Chacon, P. & Merelo, J.J. (eds.), *Advances in Artificial Life: Proceedings of the Third European Conference on Artificial Life*, 383-395. LNAI/LNCS Series Number 696. Berlin: Springer-Verlag.

2. Rutkowska, J.C. (1994). Scaling up sensorimotor systems: constraints from human infancy. *Adaptive Behavior*, 2, 349–373.

3. Rutkowska, J.C. (1993). *The Computational Infant: Looking for Developmental Cognitive Science.* Hemel Hempstead: Harvester Wheatsheaf.

Research Interests:

My theoretical and empirical research interests lie in developmental cognitive science. They are concerned with trying to understand the nature of human abilities by looking at their origins, in particular with seeing what mutual benefits may be gained by bringing together computational work from artificial intelligence with study of the human infant, an especially relevant naturally intelligent system that is designed to function and develop in our physical and social environment.

On the theoretical side, my research has concentrated on developing the view that infant abilities (and also those of adults) are best understood in terms of action, and on exploring how computational concepts might help to clarify the organization and operation of action systems and the pragmatic knowledge that they support. This approach diverges from the new nativism that features in many current cognitive accounts of infancy, which attribute concepts and (evocational) representations to ever younger infants, and from ecological psychology, whose commitment to direct realism is incompatible with a truly mutual and co-relative perspective on the relationship between subject and environment in knowing activity.

This work has involved looking at a range of issues revolving around the notions of 'perception', 'action' and 'representation', such as: What mappings exist between computational models of low-level vision and early infant vision? What kind of functional organization underlies perception's role in action? What implications does viewing the infant as a situated agent have for the nature and role of behaviour; issues of representation and meaning; and mechanisms of adaptive change? Development is often viewed as a transition from sensorimotor to conceptual and representational mechanisms, but my analysis has focussed on the way that perceptual-behavioural action shares properties of functioning (e.g. representation through selective correspondence with the world) and of change (e.g. successful functioning in a domain preceding explicit representation of how and why behaviour 'works') with other naturalistic representational systems.

My empirical research is concerned with trying to clarify reciprocal constraints between physical-motor and cognitive mechanisms, looking at the construction of everyday voluntary activities such as visually

tracking or manipulating objects. One line of study is on infants' changing perceptual and behavioural discrimination of objects in the period leading up to the development of mature reaching (around 5 months in normal infants). This looks at issues such as the extent to which young infants have an appreciation of body-scaled (e.g. 'graspable') size; whether there is evidence of preadapted goal-directed organisation of reach-grasp-retrieve-manipulate sequences; and the way a range of behaviours that first occur due to the 'serendipitous' meshing between physical-motor properties of the infant and object properties appear to come under voluntary control.

A current focus is on how this work links with recent advances in behaviour-based robotics that are contributing to the new field of artificial life and to our understanding of adaptive behaviour that enables intelligent systems to cope with changing and uncertain environments. This recent direction is inspired by the abilities of insects and other creatures low down the evolutionary scale, and my interest is in seeing what happens when the results of following a bottom-up evolutionary direction are compared with those of following a bottom-up developmental one. So far, a number of interesting convergences have been highlighted between behaviour-based robotics' notions of adaptive organization through 'emergent functionality' of independent sensorimotor coordinations interacting with the environment and the organization of early infant abilities. A key issue for such situated systems is just how far they can go in accounting for more complex behaviours. Analysis of infants' construction and restructuring of activity suggests ways in which they could be scaled up farther than many think, to encompass the kinds of phenomena (e.g. anticipation) for which a qualitative shift to conceptual abilities is often deemed essential.

Name: Geoffrey Sampson MA PhD (Cantab.) MA (Yale) MA (Oxon.) MBCS
Subject Group: CSAI
Email address: geoffs@cogs.susx.ac.uk
Position: Reader in Computer Science and Artificial Intelligence

Recent Publications:

1. Sampson, G. R. (1995). *English for the Computer: The SUSANNE Corpus and Analytic Scheme*. Oxford: Clarendon Press.
2. Sampson, G. R. (1996). *Evolutionary Language Understanding*. Cassell.
3. Sampson, G. R. (forthcoming). *Educating Eve*. Cassell.

Research Grants Currently Held:

- "Analytic Standards for Spoken Grammatical Performance", ESRC, 1996-99, #213688.

Research Interests:

I am interested in developing techniques and resources enabling computers to deal successfully with natural language in all the quirky, unpredictable diversity and complexity found in real-life speech and writing. This means that much of my work revolves round large machine-readable fair samples or *corpora* of English, such as the British National Corpus, the Brown Corpus of American English, and the London-Lund Speech Corpus.

One area I have been working on is probabilistic parsing. Real-life language is too "messy" for orthodox, compiler-like parsers to deal with it without falling over, so we have developed techniques which measure the relative plausibility of any way of drawing a parse-tree over an input string by reference to the frequencies (in correctly-parsed language) of the various local configurations within the parse-tree, and seek the most plausible tree in terms of this measure. The concept of a formal grammar for a natural language falls away; instead of a sharp difference between "legal" and "illegal" analyses, we have a gradient from high-valued to low-valued analyses. My particular contribution to this paradigm has been the use of stochastic optimization as a search technique: since the logical space of possible labelled tree analyses is too vast to consider case by case, we "evolve" an analysis towards the optimum by a Darwinian process of random mutation with a bias towards retention of fitter alternatives.

Analysing authentic language automatically presupposes that we know what the "target" analysis should be which an automatic parser tries to achieve. In reality there is no consensus here; many phenomena which are salient in real-life language are never discussed at all in the literature of grammatical analysis. (Consider for instance the grammar of punctuation marks, or of names and addresses, or of editing phenomena in extempore speech.) A second area of my research has to do with developing a "Linnaean taxonomy" for English, that is a public, rigorously-defined set of categories and analytical conventions which will offer a standard analysis for anything that occurs in writing or speech, facilitating the interchange of data between different sites involved in English-language computation and permitting the definition of generally-accepted benchmarks for assessing the achievements of individual NLP systems.

Returning to the concept of stochastic optimization: this is by its nature a processing-intensive technique, so practical applications of it in the NLP field will need to exploit the speed advantage offered by parallel-processing technology. A third recent research undertaking has been the implementation and testing (on a transputer array) of an algorithm for parallel optimization of tree-structured analyses. (The algorithm is general, and has potential applications outside the natural language area, in view of the ubiquity of tree-shaped data structures in information technology.)

Apart from these recent research concerns, over the years I have also made contributions to theoretical linguistics (for instance I have published arguments against the widely-held belief that language gives us evidence favouring a nativist view of human cognitive mechanisms as genetically predetermined), and to libertarian political / economic thought.

Name: Michael Scaife DPhil
Subject Group: Psychology
Email address: mikesc@cogs.susx.ac.uk
Position: Lecturer in Psychology

Recent Publications:

1. Scaife, M. & Van Duuren, M. (1995). Do computers have brains? What children believe about intelligent artefacts. *British Journal of Developmental Psychology*, 13, 365–376.
2. Scaife, M. & Rogers, Y. (1996). External cognition: how do graphical representations work? *International Journal of Human-Computer Studies*, 45, 185–213.
3. Rogers, Y. & Scaife, M. (in press). How can interactive multimedia facilitate learning? In *Proceedings of First International Workshop on Intelligence and Multimodality in Multimedia Interfaces*.

Research Grants Currently Held:

- 1995-1997 ESRC Cognitive Engineering Programme into: Explaining External Cognition for Designing and Engineering Interactivity (ECO-i). £140000 (with Y. Rogers)
- 1996-1998 EU TMR Network Grant for Cooperative Technologies in Complex Work Settings (COTCOS) ECU 221,000 (with Y. Rogers)

Research Interests:

One major interest is an analysis of the cognitive basis of external representations, focussing on graphical and diagrammatic forms. The research involves developing a theoretical account of external representation, particularly in relation to the potential of multimedia for new representational types. One project, funded by the ESRC Cognitive Engineering Programme, is to build software multimedia prototypes to test some of the ideas for dynamic linking of representations. Another project, funded by the EU, is about coordination of representations using technologies for collaborative work. A second research interest is investigating the mental models children and adults have of ecosystems. This research is cross-cultural—with collaborators in several countries—and feeds in to the multimedia project, where ecological understanding is the chosen domain.

Name: Mike Sharples BSc PhD

Subject Group: CSAI

Email address: mike@cogs.susx.ac.uk

Position: Senior Lecturer in Artificial Intelligence

Recent Publications:

1. Sharples, M. & Bruce, B. C. (1996). Collaborative writing and technological change: implications for writing practice and system design. *Computer Supported Collaborative Work Journal*, 3(3-4), 225–228.

2. Sharples, M. & van der Geest, T. (eds.) (1996). *The New Writing Environment: Writers at Work in a World of Technology* London: Springer-Verlag.

3. Sharples, M., du Boulay, B., Teather, D., Teather, B. A., Jeffery, N. & du Boulay, G. H. (1995). Computer-based training and professional practice. In *Proceedings of the World Conference on Artificial Intelligence and Education (AI-ED '95)*, Washington DC, 429-436.

Research Interests:

I have two main areas of research interest: interactive learning environments (ILE) and computers and writing. The link between the two is in applying findings from the cognitive and social sciences to inform the design of software to support the acquisition and performance of complex skills.

My work in ILE has concentrated on the development of a knowledge representation formalism and teaching strategies for systems to tutor about medical images. A project with De Montfort University and the Institute of Neurology is bringing together cognitively informed system design, statistical modelling and medical image description, in developing a system to train radiologists in Magnetic Resonance (MR) imaging. I am grant holder for an ESRC project entitled "A Cognitive Engineering Approach to the Design on Computer-Based Training in Radiology".

My research in computers and writing has covered children's development of writing abilities, the provision of computer-based tools for learning the skills of creative writing, the development of a Writer's Assistant, and the development of a model of the cognitive and social processes of collaborative writing. The Writer's Assistant, funded by a grant from British Telecom, is a computer-based writing environment founded on an explicit model of the writing process. Its aim is to support the writer throughout the writing process, from the generation and capture of ideas to production of prose, providing a single environment for all stages of document production. I have carried out consultancies for companies developing new writing software, most recently advising on the design of Houghton Mifflin's CommonSpace writing environment.

I was grant holder of project to develop a cognitive model for computer support of collaborative writing, funded by the Joint Research Councils' Cognitive Science/HCI Initiative. We carried out detailed case studies to investigate the social processes of collaboration and the cognitive processes involved in writing.

I was the academic partner in a Teaching Company Scheme to develop hypermedia and multimedia in the Poplog computing environment, and I received a grant to set up a Macintosh-based Multimedia Teaching

Centre. One aim is to develop low-cost multimedia packages to support teaching and learning in the University.

I am grant holder of the CORECT project, funded by the DTI/EPSRC Computer Supported Cooperative Work initiative. Involving Racal, Intelligent Applications, and Edinburgh University it is developing a computer system to support the collaborative design of electronic test equipment.

Name: Yoshindo Suzuki MsA PhD
Subject Group: CSAI
Email address: yoshindo@cogs.susx.ac.uk
Position: Lecturer in Computer Science

Recent Publications:

1. Suzuki, Y. (1991). Coding systems and recursive manifolds. Report No. 10/91, CS Division, University of Sussex.
2. Suzuki, Y. (1985). The transfer principle. *Brit. J. Philo. Sci.*, 36, 61–66.

Research Interests:

1. Geometry of computation studies geometric aspects of computation, hence the study of objects which are similar to differential manifolds. As a typical example:

   > If a group is finitely presentable, then the solvability of the word problems for it does not depend on a specific word problem.

2. Computational Information Theory has a different name: Kolmogoroff complexity.

Name: Chris Thornton BA MSc DPhil
Subject Group: CSAI
Email address: christ@cogs.susx.ac.uk
Position: Lecturer in Artificial Intelligence

Recent publications:

1. Thornton, C. (1992). *Techniques in Computational Learning: An Introduction*. London: Chapman & Hall.
2. Thornton, C. & du Boulay, B. (1992). *Artificial Intelligence Through Search*. Intellect Press.
3. Clark, A. & Thornton, C. (1993). Trading spaces: computation, representation and the limits of learning. Cognitive Science Research Paper 291, University of Sussex, Brighton.

Research interests:

I am interested in learning and behaviour acquisition. I have carried out various empirical studies comparing symbolic acquisition methods (ID3 etc.) with connectionist methods (backpropagation etc.) and evolutionary methods. I have also developed a task analysis of the complexity of the acquisition task. This makes a theoretical distinction between statistical (low-complexity) and relational (high-complexity) acquisition tasks and shows how the development of internal recoding-structures can lead to weak representations of implicit properties of the environment. I am currently working on a new acquisition method for unsupervised, constructive learning. This method, which can be implemented using either neural or symbolic processes, has been used to successfully acquire a form of path-emulation behaviour.

Name: Stephanie Thornton BA PhD
Subject Group: Psychology
Email address: thorn@cogs.susx.ac.uk
Position: Lecturer in Psychology

Recent Publications:

1. Thornton, S. (1995). *Children Solving Problems*, Harvard University Press.
2. Thornton, S. & Thornton, D. (1996). Empathy and the recognition of abuse. *Legal and Criminological Psychology*, 1, 147–153.
3. Thornton, S. (1996). Developmental change in the use of relevant recall as a basis for judgments. *British Journal of Psychology*, 87, 417–429.

Research Grants Currently Held:

- "Becoming a responsible pedestrian," Department of Transport, 2 years.

Research Interests:

Research interests include: the origins of beliefs and behavioural strategies, and the processes which foster or hinder change in beliefs or strategies, in a range of contexts including: children's discovery of new strategies in problem-solving; conceptual understanding and the adoption of appropriate road safety behaviour in children and adults; how representations of the situation impact on openness / hostility to changing one's practices, in normal and deviant adult populations.

Name: Larry Trask PhD
Subject Group: Linguistics
Email address: larryt@cogs.susx.ac.uk
Position: Lecturer in Linguistics

Recent Publications:

1. Trask, L. (1995). *A Dictionary of Phonetics and Phonology*. Routledge.
2. Trask, L. (1996). *Historical Linguistics*. Edward Arnold.
3. Trask, L. (1996). *The History of Basque*. Routledge.

Research Interests:

I'm interested in Basque language, particularly in its history and prehistory, and my major book on this topic will be out in November 1996. I also work on other aspects of the language, chiefly morphology and syntax.

I'm also interested in theoretical and descriptive syntax, including context-free grammars, typology and universals, and diachronic syntax, with particular interests in ergativity, non-configurationality and diachronic syntax.

I have an abiding interest in linguistic terminology; I have published two dictionaries of linguistic terminology, and I have a third in press.

I also work in historical linguistics, and I've recently published a textbook of this subject.

Finally, I have an interest in educational linguistics; I am a member, and was until recently the secretary, of the Committee for Linguistics in Education (CLIE), an organization which concerns itself with the teaching of linguistics and related topics in schools and universities.

Name: Carol A. Varey BA MA PhD
Subject Group: Psychology
Email address: carolv@cogs.susx.ac.uk
Position: Lecturer in Psychology

Recent Publications:

1. Varey, C. A. & Griffin, D. W. (1996). Towards a consensus on overconfidence. *Organizational Behavior and Human Decision Processes*, 65, 227–231.

2. Snell, J., Gibbs, B. J. & Varey, C. A. (1995). Intuitive hedonics: consumer beliefs about the dynamics of liking. *Journal of Consumer Psychology*, 4, 33–60.

3. Varey, C. A. & Kahneman, D. (1992). Experiences extended across time: evaluation of moments and episodes. *Journal of Behavioral Decision Making*, 5, 169–185.

Research Interests:

My research is concentrated within two broad areas of cognitive psychology: attention, and judgement and decision making. I am also pursuing some intriguing links between these two areas.

In attention, my main focus is on intentional control, its failures, and what they can tell us about humans as information processors. A number of effects in the literature, including the well-known Stroop effect and congruence effects in classification tasks, suggest that people routinely perform many more operations than they intend; these multiple, simultaneous operations have effects on the efficiency and sometimes on the product of the intended process; in many of these situations, people are completely unaware of performing multiple computations. In normal processing, multiple operations are often useful, even if not specifically intended, and it may be more effortful to inhibit common processes than to undertake them. I am particularly interested in exploring the limits of our control over cognitive processes, and in determining what factors govern the unnecessary processes that are evoked. I believe that an understanding of these "mental contamination" effects will provide a deeper, more unified, understanding of many important but disparate experimental findings. It should also provide constraints for the ways we model human information processing.

In judgment, I am also exploring the effects of unintended and irrelevant information, in particular the processes underlying "anchoring" effects. In addition, I am also interested in judgments of utility, particularly for temporally-extended outcomes, and in the effects of stimulus context on judgments. Finally, I am interested in how satisfaction with choices and outcomes is affected by the alternatives that were not chosen.

Name: Ian Wakeman MA (Cantab) MS (Stanford) PhD (London)
Subject Group: CSAI
Email address: ianw@cogs.susx.ac.uk
Position: Lecturer in Computer Science

Recent Publications:

1. Handley, M., Wakeman, I., & Crowcroft, J. (1995). The conference control channel protocol (cccp): a scalable base for building conference control applications. *Sigcomm95*, August.
2. Wakeman, I., Bolot, J., Turletti, T., & Crowcroft, J. (1994). Multicast congestion control in the distribution of variable bit rate video in the internet. *Sigcomm94*, London, August.
3. Wakeman, I., & Crowcroft, J. (1994). A combined admission and congestion control scheme for variable bit rate video. *Journal of Distributed Systems Engineering*, vol 1, pp 242-256.

Research Grants Currently Held:

- EPSRC funded Lowband project (GR/L06072) of duration two years.

Research Interests:

I am interested in anything to do with connecting machines and people together over a network, ranging from protocol design for congestion aware video transmission, through to the design of a distributed object system for adaptive media objects, and the policy and security issues surrounding the use of wide area multicast. Currently, I am interested in discovering just how far the combination of intelligent terminals and adaptive people can be used in the design of application specific protocols, such as in the design of wide area conference tools.

Name: Des Watson MA PhD
Subject Group: CSAI
Email address: desw@cogs.susx.ac.uk
Position: Senior Lecturer in Software Systems

Recent Publications:

1. Watson, D. J. (1989). *High-Level Languages and Their Compilers*, Addison-Wesley.

2. Tate, R., Watson, D. J. & Eglen, S. (1995). Using wavelets for classifying human *in vivo* magnetic resonance spectra. In Antoniadis, A. & Oppenheim, G. (eds.), *Wavelets and Statistics*, 377–383. Volume 103 of *Lecture Notes in Statistics*. Springer-Verlag.

3. Tate, R., Watson, D. J., Eglen, S., Arvanitis, T. N., Thomas, E. L. & Bell, J. D. (1996). Automated feature extraction for the classification of human *in vivo* ^{13}C NMR spectra using statistical pattern recognition and wavelets. *Magnetic Resonance in Medicine*, 35, 834–840.

Research Interests:

My major interest is in the design of code generators for high-level language compilers. Current work is primarily connected with techniques for the specification and design of software for the generation of code generators and peephole optimizers. The aim of this work is to enable the rapid and largely automated development of high-quality code generators and optimizers from target machine and intermediate code descriptions. These techniques should be applicable to a wide range of target machine architectures. Major issues involved in this work concern the methods used for the specification of target machine architectures and instruction sets and also the automated production of a mapping from a formally-specified intermediate code to target machine instructions.

A related project concerns techniques for the automated detection of parallelism during code generation. The aim of this work is to develop compilers which generate code which executes efficiently and makes good use of the multiple processors in parallel architectures. A great deal of work has already been done by many research groups in the detection of parallelism in Fortran programs at the source code level, but it it now time to look for more general solutions. A promising approach to the detection of code sections which can potentially be executed in parallel seems to be program analysis at the intermediate code level. The great advantage of this approach is that the detection of potential parallelism can occur almost independently of the source language and of the target architecture. However, deciding whether to schedule code sections for parallel execution depends on the overheads associated with parallelism on the target architecture.

Underlying this work is the study of intermediate language design. Many high-level language implementations are carried out via some form of intermediate language. To what extent can these intermediate languages be designed so that they are as general-purpose (in terms of source language and target hardware) as possible? Is it still possible to generate efficient target code from them? To what extent is it possible to automate the production of code generators from these intermediate languages? What about architectures such as parallel processors or digital signal processors?

Several current collaborative research projects concern the design of high-level language compilers for small processors designed for embedded applications. One aspect receiving particular attention concerns the implementation of object-oriented languages for embedded systems. The generation of highly optimized code is essential to this project.

Another current research interest is in nuclear magnetic resonance imaging and spectroscopy. Collaborative research is underway in several aspects of clinical NMR. One aspect of this research concerns the automated noise removal and analysis of NMR spectra. A more recent aspect of this work is to develop automated techniques for the removal of imaging artifacts. These artifacts may be caused by any of a large number of phenomena such as patient movement, magnetic field instability or inhomogeneity and so on. In the past, the effect of image artifacts has been reduced by concentrating on making modifications to the hardware aspects of the imaging system. But it appears that software techniques can also be used effectively for this purpose, so that the effect of hardware-related imperfections in the image can be minimized.

Another related project concerns the development of software tools for the automated analysis and visualization of clinical NMR spectra data.

Name: David J. Weir BSc MSc PhD
Subject Group: CSAI
Email address: davidw@cogs.susx.ac.uk
Position: Lecturer in Computer Science and Artificial Intelligence

Recent publications:

1. Rambow, O., Vijay-Shanker, K. & Weir, D. (1995). D-tree grammars. In *Proceedings of the 33rd Annual Meeting of the Association of Computational Linguistics*, 151–158.

2. Evans, R., Gazdar, G. & Weir, D. (1995). Encoding lexicalized tree adjoining grammars with a nonmonotonic inheritance hierarchy. In *Proceedings of the 33rd Annual Meeting of the Association of Computational Linguistics*, 77–84.

3. Vijay-Shanker, K., Weir, D. & Rambow, O. (1995). Parsing D-tree grammars. In *International Workshop on Parsing Technologies*, 252–259.

Research Grants Currently Held:

Principal Investigator: David Weir
Co-investigator: John Carroll
Source: EPSRC
Title: Analysis of Naturally-Occurring English Text using Stochastic Lexicalized Grammars
Amount: £225,840
Duration: 3 years
Start date: 1 October 1996

Research interests:

- In work with Owen Rambow and K. Vijay-Shanker I have developed a new grammar formalism called D-Tree grammars (DTG), which is an extension of Tree Adjoining Grammar. It is motivated by the desire to have a lexicalized grammar for which the derivation itself is linguistically meaningful, and not just the derived structure. The two combination operations of the formalism map uniformly to the linguistic operations of complementation and modification.

- In an EPSRC-funded 3 year project that began in October 1996 John Carroll, Nicolas Nicolov and I plan to build a a robust wide-coverage parsing system capable of accurate analysis of naturally-occurring English text to the logical-form level. We will exploit three recent developments in natural language processing research: statistical techniques involving online corpora; inheritance hierarchies for imposing structure on NLP data; and lexicalized grammars. We hope to demonstrate are that (1) lexicalized grammars can make effective use of the kind of frequency information that can be (automatically) extracted from corpora, and (2) inheritance allows the necessarily large amounts of detailed grammatical information to be abstracted into a smaller set of general principles and exceptions, thus facilitating system development and maintenance.

The three core modules of the system will be the word database, the tree database, and the parser. When using lexicalized grammar formalisms such as Lexicalized Tree Adjoining Grammar (LTAG), syntactic information (traditionally held in the grammar and encoded as a set of rules or productions) is considered to be part of the lexicon. Thus, we use the term word database to refer to that component of the lexicon that associates each lexical item with a set consisting of information specifying possible part-of-speech, syntactic environments (complement patterns) and simple selectional restrictions (such as subject/verb, verb/object, verb/prepositional object), each with associated probabilities. We use the term tree database to refer to the set of tree structures that correspond to the various syntactic environments referred to in the word database. In the completed system, both the word and tree databases will be encoded as nonmonotonic inheritance hierarchies.

- In work with Roger Evans and Gerald Gazdar I have been investigating the use of DATR, a widely used formal language for lexical knowledge representation, to encode a Lexicalized Tree Adjoining Grammar (LTAG) lexicon as an inheritance hierarchy with internal lexical rules. Such an encoding eliminates the considerable redundancy otherwise associated with an LTAG lexicon.

- In work with K. Vijay-Shanker I have developed a framework for parsing Linear Indexed Grammars (LIG) and Tree Adjoining Grammars (TAG) in polynomial time by exploiting constraints which make possible the extensive use of structure-sharing. We have also studied parsing of TAG with particular emphasis on the use of shared forests to represent all the parse trees deriving a well-formed string. In we show that there are two distinct ways of representing the parse forest one of which involves the use of LIG and the other the use of CFG. We present a general framework for studying tag parsing within which it can be seen that the schemes using LIG and CFG to represent parses underly most of the existing TAG parsing algorithms.

  In collaboration with K. Vijay-Shanker and Owen Rambow, I have extended this work to build a polynomial time Earley-style parser for D-Tree Grammars. In this work the role of Linear Indexed Grammars was replaced by a variant called Linear Prioritized Multiset Grammars which manipulate multisets rather than stacks.

- Combinatory Categorial Grammars, Head Grammars, Linear Indexed Grammars and Tree Adjoining Grammars were known to generate a larger class of languages than Context-Free Grammars. These formalisms were developed independently and appear superficially to be quite different from one another. In work with K. Vijay-Shanker I have shown that all of these formalisms generate exactly the same class of string languages. I have defined a hierarchy arising from a comparison of context-free languages (CFL) with this larger class of languages. The hierarchy extends the step from CFL to this larger class to give an infinite progression of classes where the relationship of each class to its neighbours resembles the relationship between the first two members of the progression. This work considers variants of nondeterministic one-way S-automata and context-free S-grammars where S is a storage type.

Name: Max W. Wheeler MA DPhil

Subject Group: Linguistics

Email address: maxw@cogs.susx.ac.uk

Position: Reader in Linguistics

Recent Publications:

1. Wheeler, M. W. (1995). 'Politeness', sociolinguistic theory and language change. *Folia Linguistica Historica*, 15, 149–174.

2. Wheeler, M. W. (1996). La primera persona del present d'indicatiu, pot haver-hi me's a dir-ne? [The first person singular present indicative: can there be more to say?] In *Estudis de lingüística i filologia oferts a Antoni M. Badia i Margarit*. Barcelona: Publicacions de l'Abadia de Montserrat, 2, 411–425.

3. Wheeler, M. W. & Dols, N. (1996). El consonantisme final del mallorquí i el 'llicenciament d'obertures' [Majorcan word-final consonants and 'onset licensing']. *Caplletra*, 19, 51–63.

Research Interests:

My general field is that of Romance linguistics. My major interest is in Catalan language. I have published on the phonology of the contemporary language and on the historical development of verbal inflection in the various dialects. I am currently working, in collaboration, on a reference grammar of Catalan (in English), due out in 1997.

I am interested in sociolinguistic theory, especially as it relates to our understanding of language change.

I also work in the area of Natural Morphology, looking to refine the theory, in particular with respect to its predictions and explanations of historical change in inflectional morphology.

Name: Blay Whitby BA MA MSc
Subject Group: CSAI
Email address: blayw@cogs.susx.ac.uk
Position: Tutorial Fellow in Computer Science and Artificial Intelligence

Recent Publications:

1. Whitby, B. (1996). *Reflections on Artificial Intelligence*. Intellect Books.
2. Whitby, B. (1996). The Turing test: AI's biggest blind alley? In Clark, A. & Millikan, R. G. (eds.) *Machines and Thought*, 53–62. Oxford University Press.
3. Whitby, B. (1996). Multiple knowledge representations: maps and aeronautical navigation. In Peterson, D. (ed.) *Forms of Representation*, 67–78. Intellect Books.

Research Interests:

The social and ethical implications of computing and AI form the core of my research interests. I'm keen to encourage people in computing and AI to take a more professional and responsible attitude to their work and/or research. This includes taking an active interest in the public perception of AI. Partly to this end, I am presently editor of the quarterly journal of the Society for Artificial Intelligence and the Simulation of Behaviour (AISB).

I am also involved with applications of human-centered technology (HCT). This is partly as a consequence of the research interests described above. HCT is an area which poses many apparently novel ethical questions such as: "how are we to respond to virtual crimes?" I am also concerned to contribute to the development of applications in this area which provide opportunities to employ AI and other new technologies such as VR and multimedia in socially beneficial ways.

Name: Peter Williams MA MSc DPhil
Subject Group: CSAI
Email address: peterw@cogs.susx.ac.uk
Position: Lecturer in Computer Science

Recent Publications:

1. Williams, P. M. (1993). Aeromagnetic compensation using neural networks. *Neural Computing & Applications*, 1(3), 207–214.
2. Williams, P. M. (1995). Bayesian regularization and pruning using a Laplace prior. *Neural Computation*, 7(1), 117–143.
3. Williams, P. M. (1996). Using neural networks to model conditional multivariate densities. *Neural Computation*, 8(4), 843–854.

Research Interests:

Neural networks can be used for general engineering purposes as well as for modelling human cognitive and perceptual abilities. Research is currently focussed on theoretical issues relating to (i) general regularisation and pruning techniques (ii) accuracy, validation and reliability of neural network models (iii) data pre-processing techniques such as discrete polynomial and wavelet transforms. Specific application areas include mineral exploration and remote sensing, and applications to prediction in the capital markets.

Name: Sharon Wood BA DPhil
Subject Group: CSAI
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Position: Lecturer in Computer Science and Artificial Intelligence

Recent Publications:

1. Wood, S. (1993). *Planning and Decision Making in Dynamic Domains*. Chichester: Ellis Horwood.

2. Wood, S. (1990). A model of classroom processes: towards the formalisation of experienced teachers' professional knowledge. In Goodyear, P. (ed.) *Teaching Knowledge and Intelligent Tutoring*, Norwood, NJ: Ablex Publishing Corporation, pp.295–313.

3. Wood, S. (1988). The trainee teacher support system: an expert system for advising trainee teachers on their classroom practice. *Expert Systems*, 5(4), pp.282–289.

Research Interests:

My first interest is in the area of applying traditional planning techniques to rapidly changing, uncertain multi-agent environments. My work has involved the specification and development of an agent architecture for addressing the requirements of planning and acting in such an environment — one of a driver. Rapidly changing environments, of which the driving domain is a good example, pose additional problems to those dealt with by existing planning systems. One of the main problems is that of uncertainty — one cannot assume that the changes which are to take place in the world and of which one must take account in one's planning are known about beforehand — in a real-time rapidly changing environment, such as that one confronts when driving down a busy road, this is simply not the case. This has implications both for how we reason about the world and for how we generate appropriate plan solutions.

I have developed a planning system, called Autodrive, which simulates the generation and execution of a driver's plan to reach a destination safely, taking account of other road users and obeying traffic signs and signals, in a simulated microworld. The behaviour of each vehicle in the microworld is generated by clones of the processes governing the behaviour of the driver. The problem confronting a driver emphasises the need to apprehend information about the world and to use this information in order to predict just how and when the world will change. When reasoning thus about the behaviour of other individuals, this would seem to require some ability to recognise the intentions of those individuals and to anticipate how they will interact with the changing world in order to realise their goals. The problem of plan specification would then be resolved by reasoning about this anticipated world.

The Autodrive system incorporates components additional to a traditional planning system architecture which enable the system to interact with a simulated rapidly changing environment. The architecture is based upon a re-appraisal of a planner's representational needs for interacting with such an environment and includes components for recognising the intentions of other drivers and hypothesising their future behaviour through a process of 'dynamic world modelling'. An initially abstract plan is progressively refined until a sequence of actions are identified which satisfy the multiple goals of the driver. The selection of appropriate goals is made through a process of 'dynamic goal creation'. Plan generation

and execution is interleaved in a cyclic process, progressively directing the behaviour of the driver as he undertakes his journey. generated by clones of the processes governing the behaviour of the driver.

More recently my research interests have concerned the role of attention in apprehending task relevant information and techniques for supporting this in autonomous agents.

My second interest is in the application of Expert Systems techniques to the social domain of classroom teaching practice. I have developed an expert system, the Trainee Teacher Support System (TTSS), which advises trainee teachers upon their classroom teaching practice. The main purpose of an initial feasibility study was to investigate the application of Expert Systems technology and artificial intelligence techniques, to the formalisation of theory within an area of the social sciences. The 'domain' or area of application chosen was that of the school based tutor who is advisor to trainee teachers on their lesson practice. The role of the 'teacher-tutor' (the expert) is particular to the operation of the Sussex PostGraduate Certificate of Education (PGCE) course. He or she is a teacher based in the appropriate department at the school where the trainee is receiving their teaching practice, who is responsible for guiding and advising the trainee and for their eventual assessment in the classroom in awarding the PGCE.

There are two main threads to this work. Firstly the development of a particular class of Expert System that captures within its knowledge base expertise which is the product of an area within the social sciences. Secondly the formalisation of knowledge of experienced teachers regarding lesson practice as yet unaccounted for by mainstream educational theory.

Preliminary investigations into the nature of the experienced teacher's knowledge about classrooms identified some of the discriminations teachers make in responding to a trainee's problem. These discriminations are made possible by appeal to their knowledge about classroom processes. By recourse to their appreciation of these processes, tutors are able to infer the possible antecedents to the events trainees describe. Without this, their sole response in giving advice would be to the superficial characteristics of a situation as it presents itself, without being able to direct attention towards those factors which contributed to the problem arising in the first place.

Experienced teachers possess knowledge that enables them to ascertain which processes are of paramount influence in a given situation. This combines a range of abilities. These include assessing which events in the classroom carry implications for the outcome of the lesson and are critical in teachers' decision making, and the ability to make valid inferences about the processes underlying the current situation, as well as reasoning about how that situation may have come about and evaluating those factors which have most likely brought that situation about. Reasoning about how a situation came about requires an understanding of the causality of events on processes and interactions between processes — the teacher's 'deep' knowledge. It was especially knowledge about classroom processes that we wished to articulate in developing the knowledge base of the TTSS.

Through analysis of the data collected we were able to outline a model of classroom processes and a specification for the computational implementation of a prototype advisory system which included a formal description of the mechanics of internal reasoning that would enable advice to be provided based on some deep understanding of classroom process. Work has since continued on the implementation of this prototype.

Name: Nicola J. Woods BA (Roehampton) MPhil DPhil (Oxon)
Subject Group: Linguistics
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Position: Lecturer in Linguistics

Recent Publications:

1. Woods, N. J. (1997). The formation and development of New Zealand English: interaction of gender-related variation and linguistic change. *Journal of Sociolinguistics*, 1(1), 95–125.

Research Interests:

Sociolinguistic analysis with particular reference to the explanation of dialect formation. My current research is concerned with examining the origins and development of New Zealand English, and particularly with explaining the sound changes which have occurred in this variety. As well as charting the influence of internal principles which govern linguistic change, this involves the study of external social factors on change, and specifically the linguistic processes which result as a consequence of interaction between speakers of different dialects. Bringing together internal and external approaches allows insights into why languages change, how they change and the reasons that certain changes occur at particular points (and not others) in the history of a language.

Other research interests include gender-related variation in language, and particularly the investigation of the differences between male and female speakers in terms of the sound patterns and discourse strategies which characterise their speech. My doctoral study involved the investigation of language use at the non-segmental (specifically intonational) level, and I maintain an interest in this aspect of language use.

Name: David Young MA PhD
Subject Group: CSAI
Email address: davidy@cogs.susx.ac.uk
Position: Lecturer in Artificial Intelligence

Recent Publications:

1. Tunley, H. & Young, D. (1994). First-order optic flow from log-polar sampled images. In Eklundh, J-O. (ed.), *Computer Vision — ECCV '94: Third European Conference on Computer Vision*, Stockholm, Sweden, May 2–6, 1994: Proceedings, Vol. 1. Berlin: Springer, 132–137.

2. Lee, D. N., Young, D. S., & Rewt, D. (1992). How do somersaulters land on their feet? *J. Experimental Psychology: Human Perception and Performance*, 18:1195–1202.

3. Young, D. S. (1990). Quantitative ecological optics. In Jorrand, P. and Sgurev, V. (eds.) *Artificial Intelligence IV: Methodology, Systems, Applications*, 423–431, Amsterdam: North-Holland.

Research Interests:

Most of my research is in the field of computer vision, but I have interests in biological vision and in visuo-motor skills. I am also interested in the application of simulated neural networks to problems in vision.

Analysis of first-order optic flow

I have recently developed the theory of first-order optic flow (dilation, shear and rotation) to clarify the kinds of information that might be available from it for the control of action. This is relevant both to robotics and to understanding visuo-motor skills in humans and animals.

Structure from motion

I am interested in the general structure-from-motion problem and have done some work on quantifying the stability of the equations.

Representing images for computer vision

Non-standard image representations might offer significant advantages over the usual uniform raster-scan representation used in computer vision. In particular, foveal representations, where the resolution varies across the image, are inspired by biological vision and fit in well with the current active vision paradigm. One particular scheme, log-polar sampling, has some extremely useful properties, and I have worked on how these might be exploited in shape recognition. More recently, together with Dr Hilary Tunley, I have shown how log-polar properties can be exploited for the efficient estimation of first-order optic flow. I am also studying how the observed distributions of the receptive fields of neurons in the early stages of human vision might be explained in information-processing terms.

Human visuo-motor skills

I am studying the strategies humans use to control actions such as intercepting a moving object, running over uneven ground, or deciding when to cross the road, that involve precise timing. I am currently involved in collaboration with Professor D.N. Lee of the Department of Psychology, Edinburgh University, aimed at understanding visual information pickup and motor skills in such time-to-contact problems. My contribution to this work lies largely in computer modelling of the low-level visual processes that supply the timing information necessary for rapid control of action. The central assumption is that vision for the control of rapid actions depends less on the construction of an explicit 3-D model of the environment than it does on the pickup of the values of a few rapidly updated variables, such as τ, the estimated time to nearest approach of an object. It may be that sufficiently good information can be obtained directly from functions of the optic flow, using relatively straightforward mechanisms.

Artificial neural networks

I am interested in the use of artificial neural networks in low-level vision, in particular in the pick-up and analysis of optic flow information. I have also worked on the use of neural networks in the removal of noise from image sequences, using standard neural net architectures. I am interested in use and training of recurrent neural networks.

Software tools for computer vision

I have developed a suite of vision software for use under the POPLOG Artificial Intelligence computing environment. I have also developed methods to assist with using numerical tools such as the NAG Fortran library under POPLOG.

Computer vision for traffic monitoring

Current information systems for the control of traffic could be improved greatly by the introduction of computer vision techniques, allowing rich information to be collected by cheap sensors. I have recently completed a project to develop methods for building geometrical models of road junctions, using the dynamic information from a single camera's view of vehicle movements. This was carried out in collaboration with Prof. D. C. Hogg of the Department of Computer Studies at Leeds University.

Name: Nicola Yuill DPhil AFBPsS

Subject Group: Psychology

Email address: nicolay@cogs.susx.ac.uk

Position: Lecturer in Psychology

Recent Publications:

1. Yuill, N., Perner, J., Pearson, A., Peerbhoy, D. & van den Ende, J. (1996). Children's changing understanding of wicked desires: from objective to subjective and moral. *British Journal of Developmental Psychology*, 14, 457–475.

2. Yuill, N. (in press). *English Children as Personality Theorists: Accounts of the Modifiability, Development and Origin of Traits*. General, Genetic and Social Psychology Monographs.

3. Yuill, N. (1997). Children's understanding of traits. In Hala, S. (ed.) *The Development of Social Cognition*. Studies in Developmental Psychology, UCL Press.

Research Grants Currently Held:

- 1995-8: £22,500 ESRC studentship for Robin Banerjee.
- 1996: £2697 for EHE project "Information Search Skills", producing information search and note-taking booklet and workshop for use on first-year courses.
- 1995-2000: Adviser on five-year ESRC-funded grant of £175,000 to Dr J Oakhill and Prof. P. Bryant on the development of reading comprehension.

Research Interests:

My main research interests fall into two related categories: social cognitive development (how children's thinking about the social world and people's minds changes with development) and children's reading comprehension.

Social Cognitive Development: My main interest is in children's understanding of motivational states, in particular traits and desires. For example, in one project (with Josef Perner, and Anna Pearson) I have been looking at the developing understanding of the concept of a personality disposition. The research involves analysis of adults' use of such terms (e.g. are they perceived as real causes or just empirical summaries of action?), and empirical study of children's explanations of individual differences and the time course of traits. The theoretical basis is derived from recent work in children's 'theory of mind' and has links with work on understanding intention, volition, emotion and belief. I am also interested in the way children's understanding of desire changes, from desire as an intrinsic objective feature of events or situations to desire as a subjective, idiosyncratic property of individuals. This change affects children's conceptions of motivation (e.g. whether they think getting a reward for an activity makes people less interested in the activity), of manipulative and competitive intents and moral judgements. I am involved in two projects addressing the implications of these cognitive developmental changes. One, with Jenny Lyon, looks at self-regulation of desires and behavioural control in impulsive children. This work is

linked to DPhil research by Eleni Kallis. The other project, linked to DPhil work by Robin Banerjee on the origins of self-presentation, addresses children's understanding of self-consciousness and how this relates to their understanding of 'impression-management'. Recent work suggests that the behavioural manifestations of shyness change developmentally: young children show fearful shyness while only older children show evidence of self-consciousness. We are investigating whether conceptions of shyness change in concert with this behavioural change. A linked project by Paula Cooper is investigating social cognition in deaf children.

My other main research interest is children's text comprehension. This work arises from previous work with Jane Oakhill (Experimental Psychology, Sussex), investigating a specific group of 7–8 year old children: those who are proficient at decoding words, but fail to understand what they read. Our studies examined their difficulties in memory, inferential skills (e.g. on-line pronoun assignment) and comprehension monitoring (e.g. noticing textual anomalies). A recent grant has enabled us to develop and test a training programme designed to address the particular problems that poor comprehenders have in being aware of linguistic inferences. The programme involves the use of riddles and jokes to develop inferential skills. I am now interested in the broader implications of how riddles may contribute to children's awareness of language and their ability to monitor their own comprehension. This forms part of a more general concern with the development of self-regulation of behaviour, in children and in university students. With colleagues in Experimental Psychology, I am also investigating the role of working memory in learning to read, and in particular, how processing limitations influence comprehension skill.