MACQUARIE CENTRE FOR COGNITIVE SCIENCE

(MACCS)

(An Australian Research Council funded Special Research Centre)

ANNUAL REPORT 2001

Max Coltheart
Director
Macquarie Centre for Cognitive Science (MACCS)

Postal Address: Macquarie University
Sydney NSW 2109
Australia

Location: Balaclava Road, North Ryde
Sydney, Australia

Telephone: (02) 9850 9599
Facsimile: (02) 9850 6059

Internet: http://www.maccs.mq.edu.au

Design and Typesetting: Steve Mondy and Suzie Morony, MACCS, and
Tony Dwyer, Centre for Flexible Learning
Macquarie University

Printing: Lighthouse Press, Macquarie University, Sydney
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1 Executive Summary

Output

The Centre's second year was a particularly productive one. Members published one book, 7 book chapters, 42 refereed journal articles and 31 abstracts. They presented 69 conference papers, workshops or other presentations. The first volume in the new book series specifically aimed at publishing the work of the Centre (established after successful negotiations with a leading international publisher, Psychology Press) appeared.

Honours etc

These are listed in section 6; highlights in the year 2001 include the appointment of the Deputy Director, Professor Harrington, to a prestigious Chair in Phonetics at the University of Kiel, the promotions of Dr Nickels and Dr Rastle, Macquarie University's award of the DSc degree to the Director, the election of the Director to fellowship of the Australian Academy of Sciences, the ARC's award of a Federation Fellowship to the Director, Ms Patricia Smith's winning of a University Medal for her honours thesis, and Dr Breen's award of a Vice-Chancellor's Commendation for a PhD thesis of exceptional merit.

Expansion

The Centre has expanded with unforeseen rapidity in its first two years. The initial plan was that there would be 4 postdoctoral researchers; instead, there are currently 14 such researchers (two are half-time). The original plan was to accept 3 PhD students in 2000 and 3 more in 2001: instead, 15 have been accepted since the Centre began operation. These elements of expansion were not funded by the Centre: they occurred because people obtained their own doctoral or postdoctoral fellowship funding having approached the Centre wishing to take up these research positions in the Centre. Hence it is clear that the Centre is highly attractive to researchers in cognitive science.

Grant income

Apart from the Director's award of an ARC Federation Fellowship, Centre members were awarded 24 research grants in 2001, total income from these being in excess of $1 million.
2 Current Staff of MACCS

**Director:**
Professor M Coltheart

**Centre Administrator:**
S Mendes

**Administrative Assistant:**
J Rutkauskas (part-time)

**Systems Administrator:**
C Richardson

**Academic staff members:**
Adjunct Professor M Davies
Adjunct Professor J Harrington
Associate Professor V Coltheart
Dr T Bates
Dr S Kinoshita
Dr C Watson (part-time)

**Research staff members:**
*QEII Fellow:* Dr L Nickels
*MACCS Senior Research Fellow:* Dr A Castles
*International Prize Wellcome Fellow:* Dr S Rossell
*ARC Australian Postdoctoral Fellows:* Dr K Croot, Dr I Harris, Dr R Langdon, Dr K Rastle, Dr M Tabain.
*NH&MRC Clinical Research Fellow:* Dr M Green

**MACCS Postdoctoral Fellows:**
Dr N Breen (half-time), Dr C Davis, Dr S Palethorpe (half-time), Dr C Perry

**Research Officer:** Dr S Mondy

**Research Assistants:** J Cole-Virtue, D Horry, C Windhorst, A Woollams

**Note:** Dr C Clifford was a MACCS Postdoctoral Fellow in 2001 until he resigned this position on July 15th 2001 to take up a Senior Lectureship in the University of Sydney.

**PhD Students:**
*Full-time:* P Dux (APA scholar), Z Evans (APA scholar), I Hepner (RAACE scholar), L Hughes (iMURS scholar), S Kuan (APA scholar), C Lawson (APA scholar), J McGregor (RAACE scholar), R McKay (APA scholar), N Molloy (iMURS scholar), K Metcalf (APA scholar), A Onaka (iMURS scholar), L Petit (iMURS scholar), M Porter (APA scholar), P Smith (APA scholar), J Spencer (RAACE scholar), L Stephenson (RAACE scholar), M Watanabe (iMURS scholar), V Wuthrich (APA scholar)

Note re scholarships: RAACE (“Research Areas and Centres of Excellence”) scholarships, provided by Macquarie University, are financially equivalent to APAs and are available on a competitive basis to research areas identified by the University as areas of excellence; MACCS is one such area. iMURS (“International Macquarie University Research Scholarships”) are equivalent to RAACE scholarships except that they are for students who are not Australian or New Zealand citizens; iMURS scholarships typically provide remission of overseas-student fees.

The MACCS Developmental Cognitive Neuropsychology Research Unit (New Childrens Hospital):

P Joy (Head)
K Bakker
R Brunsdon
J Gracey

External Centre Members:

Professor M Beckman (Ohio State University)
Professor M Corballis (Auckland University)
Professor S Lupker (University of Western Ontario)
Dr A Maguire (Australian National University)
Dr J Ziegler (CNRS, Marseilles)
3 Research Progress

3.1 The Language Project

[Bates, Castles, M Coltheart, Croot, Davis, Harrington, Kinoshita, Lupker, Nickels, Perry, Rastle, Rossell, Tabain, Ziegler; PhD students Brundson, Dufty, Evans, Hart, Levick, McGregor, Molloy, Onaka, Stephenson, Watanabe, Woollams, Wuthrich]

This project seeks to develop a comprehensive theory of the mental processes people use to recognise, understand and produce spoken and written language, and from this theory to generate a computational model of language processing: that is, to express the theory as a computer program that can carry out such language-processing tasks. The project also seeks further understanding of the various highly specific ways in which the ability to understand or to produce spoken or written language can break down after brain injury. Finally, the project also seeks further understanding of how children normally acquire their abilities to understand and to produce spoken and written language, and of the various highly specific ways in which the acquisition of these abilities can be abnormal.

3.1.1 Language comprehension

3.1.1.1 Discourse level

Dufty completed a project on forms of sentence representation used in text comprehension, and submitted his PhD thesis describing this work. He has developed a model according to which representations of the phonological form of the written text and representations of its gist are separately extracted and stored, and recall of the text is achieved by an error-prone mechanism which consults both forms of stored representation. Watanabe and M Coltheart are developing a project on “fillers” – the semantically empty components of spoken discourse such as “um”, “er”, “ah”, “kind of” etc. which are common in speech produced in natural circumstances. What generates these fillers? Do they serve any function? If so, is this just a function for the speaker? Or for the listener? A popular theory is that fillers are generated when the speaker anticipates that the next clause or discourse element which is intended for production may take some time to construct, so that there will be a gap between the end of the current clause and the beginning of the next. This gap needs to be filled since silence will disconcert the listener and may even incorrectly suggest that it is the listener’s
turn to speak. On this theory, fillers assist the speaker’s production but do not contribute to the listener’s comprehension.

Spoken discourse will be recorded under naturalistic circumstances. It will then be presented to listeners in three forms: (a) as it was recorded; (b) with the fillers edited out and replaced by silence; (c) with the fillers edited out and not replaced by silence. Discourse comprehension will be measured in these three conditions; the results will inform us about whether fillers play a role for the listener in comprehension. The experiment will be carried out in both Japanese and English using native speakers and listeners. Fillers are common in spontaneous speech in both languages, but that does not mean that they must serve the same functions in both languages, so cross-language comparisons are worthwhile.

3.1.1.2 Single-word (semantic) level

Work continues on the extremely difficult task of adding a system of semantic representations to the DRC computational model of reading described below. Our theoretical investigations suggest that the semantic-vector representations that Burgess and his colleagues at the University of California (Riverside) have collected by using cooccurrence analyses of large quantities of written text may provide a set of representations of meanings of individual words that could be interfaced to the DRC model. This will be attempted in 2002. Rossell, because of her particular interest in the possible role of impairments of semantic memory in certain symptoms of schizophrenia such as thought disorder and disorganised or impoverished speech, has carried out numerous studies of semantic processing of single words in normal subjects which will provide control data for studies of semantic processing in schizophrenia, but which are also of interest in their own right as far as extending our understanding of single-word comprehension is concerned. This work includes investigations of priming of lexical decision based on the primes and targets being related or unrelated with respect to emotional valence.

3.1.2 Reading

3.1.2.1 Computational modelling

The DRC model

The DRC computational model of visual word recognition and reading aloud is the outcome of a project that has received continuous funding from the ARC since 1990. It is the only existing computational model of reading that offers an account of both visual word recognition and reading aloud. Its ability to explain reading behaviour in each of these domains is superior to that of all other published models. During 2000, a comprehensive
paper exceeding 50,000 words in length that describes the whole DRC project was prepared and submitted to the major journal for theoretical work in psychology, the *Psychological Review*; the paper appeared in the January 2001 issue of that journal. Ziegler, M Coltheart & Perry have produced a DRC model of reading in German, and Perry and Ziegler examined cross-language (German-English) predictions of the DRC model and another computational model of reading (that of Zorzi and colleagues); the DRC model fared better (this work has been accepted for publication in the *Journal of Experimental Psychology: Human Perception and Performance*).

**The SOLAR model**

Davis has been developing the SOLAR model further. One aspect of this work is the analysis of the matching process that enables readers to select the word from their internal lexicon that best matches the input stimulus. This work was reported at the 10th Australian Mathematical Psychology conference in Newcastle in December 2001.

A key feature of the SOLAR model (which distinguishes it from the DRC model) is its capacity to self-organise, that is, to learn its own representations following exposure to an input environment. Another class of models that has the capacity to learn is the class of parallel distributed processing (PDP) models. Supporters of PDP models claim that they offer important insights into the development of reading, as well as developmental dyslexia. In collaboration with Dr Jeffrey Bowers of Bristol University, Davis has been exploring the differences between the SOLAR and PDP models. For example, in addition to their different predictions about adult performance (which derive partly from their different coding schemes; see below), the models lead to different predictions regarding learning (and forgetting) effects, such as the influence of age-of-acquisition on word recognition. This work formed the basis for a research grant submitted to the BBSRC in 2001 (the success of this grant was confirmed in 2002).

Work on masked priming was presented at the international conference on masked priming that was held at MACCS in April 2001, and has been further extended for publication in the book of the conference (edited by Kinoshita and Lupker). This work is important for the way in which it builds a bridge between two different approaches to mathematical modelling of reading phenomena – open-form (iterative) computational modelling and closed-form models – and relates both of these to verbal models of reading. This general approach holds great promise for future modelling.
3.1.2.2 Input coding in the reading system

A major issue for theories of reading is how letter strings are initially encoded prior to being recognised or read aloud. One component of this issue is the question of how the positions of letters in the string are represented: this must be done in some way (otherwise we could not discriminate between anagrams such as ALP, LAP and PAL), but the question is how.

Existing computational models of reading make different proposals about this, and so experiments on how position is encoded by the reading system can help adjudicate between these models. We have developed a method of doing this using a variant of the Stroop task; work using this task in English (M Coltheart and Woollams) and in Italian (M Coltheart, Job and Peresotti) has yielded data that are most easily accommodated by the DRC model. However, a study of English readers using the masked priming technique (M Coltheart & Woollams; presented at the Experimental Psychology Conference, Melbourne, April 2001) has yielded evidence that is inconsistent with the method of position encoding used by the DRC model. Hence we are now developing a version of the DRC model which uses a different input coding scheme, one that we believe will allow this new version of the model to correctly simulate the Coltheart-Woollams results.

Nickels has been investigating this issue by comparing the ability of different coding schemes to explain the pattern of visual errors observed in acquired dyslexia. This has provided further support for the spatial coding scheme advocated by the SOLAR model.

Davis has been further exploring the implications of spatial coding by testing predictions regarding the perceptual similarity of words. Much previous work has considered the similarity of words that differ due to the substitution of a single letter (e.g., TRAIL-TRAIN), and some work has been done on the similarity of words that differ due to the transposition of a pair of adjacent letters (e.g., TRAIL-TRIAL) (Davis has been investigating these TL effects, in collaboration with Professor Sally Andrews of the University of Sydney). However, no published studies have examined the perceptual similarity of words that differ by the addition/deletion of a single letter (e.g., TRAIL-RAIL). According to the coding scheme employed by the SOLAR model, these subset-superset pairs should be relatively confusable, and the effects of this similarity will be observable in tasks like lexical decision and naming; this is true for additions/deletions of either initial or final letters. By contrast, the current coding scheme employed by the DRC model predicts that addition/deletion of a final letter should result in relatively confusable pairs (e.g., SIGH-SIGHT), but that addition/deletion of an initial letter should result in pairs that are not at all perceptually similar (NARROW-ARROW). Experimental work to test these predictions is being conducted in collaboration with Professor Marcus Taft (who has unpublished data supporting the perceptual similarity
for pairs involving initial, medial and final letter insertions). Experiments have recently been conducted at the Centre and at the University of New South Wales to further test subset similarity effects. The successful grant of Bowers (Bristol) and Davis described a planned experiment in which a semantic categorisation task will be employed to examine subset interference (e.g., does the following word refer to an animal? – BEARD).

3.1.2.3 Morphological processes in visual word recognition
Rastle conducted a number of experiments with normal adults investigating how words with more than one morpheme are recognized from print. Experiments suggested a sublexical theory of morphological decomposition, in which stems are separated from affix units on the basis of form, not meaning (e.g., Taft & Forster, 1974). These experiments were written up and have been submitted for publication as a book chapter.

3.1.2.4 Output processes in reading aloud
(See also section 3.1.4 on speech production, below.) Kinoshita, with Lupker and Woollams continued investigation of the role of output process in reading aloud, focussing on the finding that the time to initiate a response to a particular item is affected by the other items presented in the block. The work conducted by Kinoshita and Lupker showed that it is the speed with which the other items are responded to, not the nature of the items, that guide the speed of responding. This finding is interpreted in terms of the notion of a time criterion, which may be viewed as an "optimal" reaction time for a block of trials to which subjects attempt to respond as closely as possible. Part of this work was presented at the Australasian Experimental Psychology Society meeting in Melbourne in April 2001 and the Psychonomic Society meeting in Orlando in November 2001, and also submitted as two journal articles. Kinoshita and Woollams also conducted work investigating the role of output processes in the masked onset priming effect (the effect in which a target word is read aloud faster if it is preceded by a briefly presented prime word that shares its onset with the target word). The data they observed led them to suggest that the disappearance of this effect as a function of other items in the block is also best interpreted in terms of the time criterion framework. This work was presented at the meeting of the European Society of Cognitive Psychology in Edinburgh in September, 2001, and also resulted in a journal article, now in press (Kinoshita & Woollams, in press, Memory and Cognition).

3.1.2.5 Transcranial magnetic stimulation investigations of “temporary lesions” in normal readers
One approach to the investigation of acquired dyslexia involves attempting to induce “virtual” lesions in normal readers by means of transcranial magnetic stimulation (TMS). This
technique involves the application of a brief magnetic pulse to the scalp, which has the effect of altering the local electrical field in the cortical area underneath the point of stimulation. The effects of stimulation are highly localised and have only transient effects (lasting less than a hundred milliseconds). During this very brief period, cognitive functions that depend on the stimulated region may be disrupted. Previous studies have used TMS to simulate neuropsychological disorders such as neglect in normal subjects. As yet, there are no reports of attempts to induce dyslexic symptoms with TMS, though it would clearly be of considerable methodological significance if this were possible. In particular, this technique may overcome some of the difficulties inevitably associated with neuropsychological case studies, such as the diffuse nature of the brain injuries that tend to be observed in acquired dyslexics, the relative scarcity of “pure” cases and the inability to assess reading abilities prior to brain injury. Thus TMS has the potential to (1) greatly increase the availability of neuropsychological evidence, (2) introduce much stronger controls on this evidence (because impaired and unimpaired performance can be directly compared within subjects) and (3) allow more precise localisation of the “lesions” that give rise to functional impairments.

Members of the centre (M Coltheart, Davis) are collaborating with Professors Perminder Sachdev and Simon Gandevia of the University of New South Wales / Prince of Wales Medical Research Institute on a project that will exploit the “virtual lesion” methodology offered by TMS to examine hypotheses concerning the functional and neuroanatomical bases of acquired dyslexia, commencing with the disorder known as attentional dyslexia.

3.1.2.6 Learning to read and developmental dyslexia

Coltheart, together with Jackson (University of Iowa), published a book entitled “Routes to Reading Success and Failure”, which provides a general framework for considering developmental dyslexia and its relation to theories of reading and learning to read.

Bates, Castles and Coltheart were successful in obtaining NH&MRC funding for a project on the genetics of reading. Over the next three years, they will be examining genetic contributions to the acquisition of specific components of the reading system in the course of learning to read. The assessments and genetic analyses will be conducted in collaboration with researchers from the Garvan Institute of Medical Research and the Queensland Institute of Medical Research.

Castles and Coltheart have been collaborating on a review of the relationship between the ability to perceive and manipulate sounds in spoken language, or phonological awareness, and reading acquisition. Although many researchers have argued that phonological awareness is causally linked with reading ability, our re-examination of the evidence suggests this causal
connection may have been overstated. A substantial literature review is currently being prepared for publication and will be submitted by mid-2002.

In a related project, Castles and Kinoshita have been exploring how skilled adult readers perform phonological awareness tasks and, specifically, addressing the question of how heavily people draw on written-word knowledge when performing these tasks. They obtained Macquarie University funding to conduct several experiments on this issue in 2001 and a paper reporting the first set of results is now in press.

Castles and Coltheart have supplemented their ongoing exploration of the ways in which reading can fail to develop normally by exploring the converse situation where reading is particularly advanced for a child of a given age - a phenomenon known as hyperlexia. In 2001, they collaborated with an honours student (Crichton) in conducting a detailed case study of a child of five years old who was reading at the level of a twelve year old. The report of this case study is currently being prepared for publication and a follow-up case study is planned.

Castles and Coltheart are in the process of publishing an on-line reading assessment battery, which will be distributed by Psychological Assessments Australia. The development of this battery is a direct outcome of the research of the centre, as each of the subtests is designed to map directly onto a reading sub-process specified within the DRC model. By being explicitly based on a widely-supported theoretical model of the reading system, we expect that this battery will allow a more accurate and meaningful assessment of a child's reading profile to be obtained than is the case with existing published tests.

Perry and Ziegler implemented software now being used in research on remediation of developmental dyslexia in French.

3.1.3 Spelling

It is intended that the DRC model of reading should become a model of both the perception and the production of print i.e. capable of both reading aloud and spelling to dictation. Much more needs to be known about the cognitive processes involved in spelling before extending the model to spelling can be embarked upon. Perry has worked on both statistical properties of spelling and theoretical properties needed to be understood before such model development, and this work is presented in papers in Applied Psycholinguistics, Quarterly
Journal of Experimental Psychology and the Australian Journal of Psychology. Castles and Coltheart have also been working on the contributions of spelling ability to performance on so-called “phonological awareness” tasks – see section 3.1.2.6.

3.1.4  

**Speech production**

3.1.4.1  The production of prosody

This research is concerned with an analysis of how speakers communicate prosodic changes in English, in particular how articulatory patterns are adjusted at the boundaries between prosodic units and in emphasised words. In 2001, Harrington and Palethorpe designed a corpus to investigate the extent to which there is a cognitive basis to the distinction between primary and secondary word stress. In the dictionary, a word like ‘economic’ is typically marked with secondary stress on the first vowel and primary stress on /O/ of the third syllable. However, this perceived difference may just be a consequence of the fact that when ‘economic’ is spoken in isolation, it necessarily has sentence-accent (it is not possible to produce isolated words in any other way), in which case the /O/ will be aligned with an intonational unit known as a pitch-accent. In order to assess whether the lexical entry is actually marked for the difference between primary and secondary stress, we analysed deaccented contexts in which the contributions from intonation are neutralised. An example is:

It was JOHN who drank the lemon juice

It was JOHN who ate the lemon pie

Here, the nuclear accent falls on JOHN and there is therefore no pitch-accent on any words that follow. The question is: are the traditional primary-secondary (‘lemon juice’) vs. secondary-primary (‘lemon pie’) relationships preserved when there is no contribution from intonation? In 2001, a corpus was constructed and acoustic and kinematic recordings (of tongue, lip and jaw movement) were made from four speakers of Australian English. The current preliminary results show that there are subtle articulatory timing differences between these phrase pairs, which would suggest that the primary-secondary lexical stress relationships are represented in the mental lexicon, independently of the alignment of these words with intonation.

As part of her PhD research, Zoe Evans has analysed the interaction between the production of accent and word frequency in three different dialects of English (Australian, American and
Southern British English). A central aim is to understand whether, when phonemic categories are neutralised, they do so in a categorical or gradient way. The phonemic categories here are syllable-final /t d/ which in American English, and increasingly in Australian English, are neutralised as a flap or tap, so that ‘writer’ and ‘rider’ in General American are largely indistinguishable, except by preceding vowel length. This assumes however a category change, but recent evidence in de Jong (1998, *Journal of Phonetics*) has suggested that the change is gradient (speakers may more or less flap the articulation), and is influenced in part by sentence accent. The goal of this type of investigation is to understand the factors that contribute to these gradient changes. Evans extended the research in de Jong (1998), not only by considering dialect differences, but also by taking into account word-frequency. The specific question she addressed was whether the t/d distinction in the minimal pair ‘toad/tote’ (which was also the pair examined in de Jong) is more likely to be maintained than in ‘node/note’, given that ‘tote’ is a relatively infrequent word. She also examined flapping in words that are highly predictable from context, in order to explore further the relationship between word frequency and flapping. This database of the Australian English speakers is currently being analysed and further data from American and Southern British English speakers will be collected in 2002.

3.1.4.2 Intonation
2001 saw the publication of a paper on rising terminals in Australian English in *Phonetica*, (Fletcher and Harrington, 2001, 58:215–229) and this investigation is being extended by Jeannette McGregor as part of her PhD. The central goal of this research is to contribute to the development of the phonology of intonation, and thereby also to distinguish those processes of intonation which are cognitive and categorical from those which are gradient and continuous. (An example of how intonational categories can change meaning for the same words is in the sentence ‘I don’t publish with anyone’ said with a sharply falling contour on ‘anyone’ and meaning ‘I only write single-authored papers’, as opposed to the same words produced with a fall-rising contour on ‘anyone’ and having the quite different meaning of ‘I do write joint papers but I’m pretty selective in my choice of co-authors’).

McGregor’s current contributions towards these goals have been to explore the extent to which there are intonational category differences between different age groups for the same high-rising categories of Australian English that were analysed in Fletcher and Harrington. She also began an analysis of whether the characteristic high-rising tune in statements of Australian English is a very recent phenomenon that has been progressively introduced in the last thirty years. For this purpose, she extended the MAP-task dialogues (that were originally collected as part of the Australian National Database of Spoken Language project funded at SHLRC) to adolescent speakers of Australian English. Her database currently consists of
sampled speech data and pitch contours and was marked up for intonational categories using the tones-and-break-indices system prosodic transcription.

3.1.4.2 Assimilation and phonotactics
Part of the original SRC proposal is concerned with the extent to which phoneme sequences and phonotactic constraints in the lexicon control the types of productions that are possible in continuous speech. The production of spontaneous speech is characterised by numerous elisions, deletions and reductions. The question here is: to what extent are these deviations from citation-form speech controlled by the phonological structure in the mental lexicon? As part of her PhD thesis, Stephenson addressed this issue in 2001 by analysing word blends produced by native Japanese and English speakers using both acoustic and electropalatographic techniques. A word blend was created from two (hypothetical) town names in such a way that there was an assimilation site. For example, ‘randon’ + ‘hawcourt’ result in the blend ‘rangcourt’ and here the question is whether the /n/ assimilates to an /N/ (as in ‘sing’) before the /k/ of ‘court’. The prediction from the phonology of English is that this might be variable (sometimes the consonant does, and sometimes it does not, assimilate) because there are comparable words in the lexicon that can be variably produced in this way (‘sunglasses’ can be produced with a non-assimilated or assimilated /n/). In Japanese by contrast, heterorganic clusters like /nk/, in which the place of articulation of the /n/ differs from the following consonant are phonotactically illegal in the lexicon. Compatibly, Stephenson’s electropalatographic analysis has shown that assimilation is mandatory when the Japanese word blend is created by concatenating /nk/ from two different names of the Japanese towns. The study shows therefore that phonotactics control speech production output and supports the earlier auditory analysis by Cutler & Otake (1998, Int. Conf. of Spoken Language Processing). This research (Stephenson & Harrington) has been accepted for presentation at the forthcoming Laboratory Phonology conference 2002 at the Haskins Laboratories, U.S.A.

3.1.4.3 The syllabary as a component of the speech production system
Little is known about how we derive a motor plan from a string of phonological segments (the output of most models of reading aloud). One possibility is that motor plans for commonly-occurring syllables are stored in a "syllabary" and can be retrieved as wholes, while motor plans for rarely-occurring syllables, or those which exist in no English word even though they are phonotactically legal, have to be computed on-line. If this is true, then we would expect commonly-occurring syllables to be produced not only more quickly than rarely-occurring ones in speech production tasks, but also with greater fluency; commonly-occurring syllables should be of shorter duration and be more extensively coarticulated than rarely-occurring
ones. Croot and Rastle have run an initial experiment to investigate this and their data are currently being analysed.

3.1.4.4 Acquired impairments of spoken word production
Nickels (with Howard, a Visiting Scientist to MACCS) has completed an investigation of effects of word length and syllable complexity on aphasic word repetition; they have submitted a paper on this for publication. Croot has been working on apraxia of speech; she has conducted analyses of articulatory data from picture naming, reading aloud and repetition tasks for one speaker which suggest that phonological content in task stimuli in reading and repetition affects phonological encoding but not articulatory implementation processes in production. Further articulatory analyses for this speaker and data from two other speakers are in progress, in collaboration with S Palethorpe and B Crofts. This work was presented at the Aphasiology Symposium of Australia, Adelaide, September 2001.

Croot has also completed a review of diagnostic criteria for apraxia of speech which suggests the need for description of individual symptoms rather than a syndrome-based approach (i) to permit refinement of cognitive model of processes at the articulatory planning and programming levels of speech production and (ii) to elucidate the nature of disruption in AOS and dysarthric speech disruptions. This work has been submitted for publication and was presented at the Language and Speech meeting at Macquarie University in December 2001.

3.1.4.5 Foreign Accent Syndrome.
Rastle and Croot are collaborating with two MACCS PhD students (Brunsdon and Molloy) in a project which seeks to understand the very rare Foreign Accent Syndrome. Brunsdon took recordings of the speech of a boy who had been involved in a road traffic accident which resulted in a serious head injury. One consequence of this injury was that his speech became impaired, in that he began to talk in a foreign-sounding accent. Croot, Molloy and Rastle are analysing the acoustic properties of his speech in an attempt to (a) characterize his accent in terms of its particular phonetic properties; and (b) understand the locus of the impairment. Their work has led us them to believe that the impairment in this case is one involving the motor programming and motor execution stages of speech production.
3.2 The Visual Cognition Project

[T Bates, V Coltheart, I Harris, S Kuan, S Mondy; new PhD students P Dux, L Hughes, L Petit]

This project seeks an understanding of several recently-discovered and puzzling phenomena observable when people are attempting to perceive, remember and report very briefly presented visual displays. The three most important of these phenomena are Repetition Blindness, Change Blindness, and the Attentional Blink. The project also concerns the implications of these phenomena for our understanding of role of conscious processing in visual perception, and more generally the conscious and unconscious processing of dynamic visual displays.

3.2.1 Repetition Effects with words and nonwords

We have been exploring the units which serve as the long term memory types which are bound to episodic memory representations responsible for successful report or for repetition blindness. Are these lexical units or might they be sub-lexical units? We have conducted a number of experiments which studied the effects of repeating non-lexical verbal items: pronounceable nonwords and pseudohomophones. Repetition of these types of nonwords yields repetition advantage, not repetition blindness. We conducted a further experiment in 2001 in which word and nonword trials were randomly intermixed in order to ascertain whether the different patterns of repetition effects with words and nonwords were due to specific strategies adopted during a task in which all items were nonwords. The results were very similar to those we obtained in previous experiments: repetition blindness occurred for words and repetition advantage occurred for nonwords.

3.2.1.1 Repetition effects with pictorial stimuli

Repetition blindness still occurs when stimuli are line drawings or photographs of familiar objects, animals, etc., rather than words. The conditions generating repetition blindness for non-verbal pictorial stimuli are different from those yielding repetition blindness for verbal materials. For example, semantically related pictures produce repetition blindness while semantically related words do not, and phonological (name) identity fails to generate repetition blindness for pictures while doing so for words. Our recent experiments (V Coltheart and Mondy, 2000) demonstrated that repetition blindness occurs for novel objects and that this effect is view independent (as it is for real objects). We reported these results and
further experiments by an honours student, Jessica Moore, at the Vision Sciences Meeting in Sarasota, USA in May 2001.

We conducted two experiments in which subjects had to count the number of novel objects (2 or 3) shown on each trial in an attempt to assess repetition effects using another response index. This judgment was performed with low accuracy and slow RTs which did not differ for repeated and control trials. In another study using pictures of familiar faces, the counting task was likewise inaccurately performed. In the latter study, an honours student, Cristina Bornhofen, investigated subjects' ability to report briefly presented faces of famous people. Recall of names under RSVP conditions is difficult, but a significant degree of repetition blindness occurred when a face was repeated. Moreover, as with pictures of real and of novel objects, the repetition effect was viewpoint-independent. We are continuing further research on this topic.

3.2.1.2 Indirect indices of repetition effects

We are also studying the characteristics of various forms of repetition blindness and examining effects of repetition in tasks which do not require explicit recall, to investigate the question of whether repetition blindness merely reflects limits on explicit recall. V Coltheart and Langdon (1997, V Coltheart, 1999) demonstrated that a word whose reportability was reduced by repetition blindness produced just as strong a semantic priming effect as a word not subject to repetition blindness. These experiments involved phonological repetition blindness: the critical word pairs were homophones such as WASTE/ WAIST, and we conducted a further experiment with identical word pairs WAIST/WAIST in 2001. We obtained the same pattern of results as we had with homophones: there was no reduction in semantic priming under conditions yielding repetition blindness. The results were presented at Language and Speech conference, (V Coltheart, Langdon and Stephenson, 2001).

3.2.1.3 Investigating conceptual short term memory and short term working memory

Potter (1993, 1999) postulated the existence of conceptual STM, a form of fleeting memory responsible for immediate on-line processing of rapidly presented visual stimuli which can be comprehended and easily retained when the stimuli can be readily parsed and represented in propositional form. We are conducting experiments that examine differences between memory for stimuli shown at high presentation rates (8-10 items/sec) and low presentation rates (1-2 items/sec).

The experiments aim to establish the forms of coding used to register stimuli in memory at such high and low rates. Specifically, we are manipulating various forms of list item
similarity and examining memory for word and picture lists. We examined the effects of visual similarity of line-drawn pictures of objects and the effects of visual feature and phonological similarity for lists of letter names. For pictures of objects, visual similarity did not have significant effects on recall, whereas for letter lists, visual similarity impaired recall for lists presented at a high RSVP rate but not for those shown at the standard STM rate of one item per second. We demonstrated in several experiments that phonological similarity of list items impairs recall at RSVP rates (V Coltheart, 1999; V Coltheart and Langdon, 1998), but noted that Potter (1984) reported failing to find phonological effects in a somewhat different RSVP task in which a mask always followed the last item. In 2001, we therefore examined whether a final mask at the end of the list might reduce or remove the phonological similarity effect. It did not do so despite the fact that the large recency effect for the last item in RSVP list recall was completely abolished by the mask.

We further sought to establish whether semantic relationships are extracted early enough to benefit recall when lists contain thematically or semantically related objects. We observed a significant benefit of semantic relatedness on recall both when lists were presented at 8 pictures per second and at the STM rate of 1 picture per second. The results were presented at the Annual Experimental Psychology Conference (V Coltheart, Mondy and Langdon, 2001). Subsequently, we obtained a similar semantic benefit for recall when list items were the written names of the pictures. More recently, we examined whether the benefit of semantic relatedness still occurred when the names of related pictures were phonologically similar. In one experiment the items were pictures, in the other they were the written names of the pictures. In both experiments, semantically related items were significantly better recalled than were unrelated items. The results will be presented at the joint meeting of the Experimental Psychology Society (UK) and the Belgian Experimental Psychology Society in 2002.

Reviews of the visual cognition research were presented at the Annual Cognitive Neuropsychology and Neuropsychiatry Conference (V Coltheart, 2002) and at a seminar to the Monash University Philosophy Department.

### 3.2.2 Scene processing

Mondy successfully completed his PhD in 2001. His research on the boundary extension phenomenon was presented at the Annual Experimental Psychology Conference (Mondy and V Coltheart). He also conducted several experiments investigating the role of phonological
coding in the detection and identification of changes to objects in scenes. Simons (1996) showed that concurrent articulation by observers viewing objects in simple arrays reduced report of some types of change (e.g., identity changes but not location changes). Mondy's experiments investigated whether other manipulations known to affect short-term memory recall (e.g., phonological similarity of list items) had similar effects on report of change detection. Observers viewed arrays of line-drawn objects that had either phonologically similar or phonologically dissimilar names. Results showed that phonological similarity reduced report of some types of changes but not others. These experiments will be presented at the Annual Experimental Psychology Conference, 2002.

3.2.3 Processing of dynamic visual displays in other species

Of course, the processing of dynamic visual displays is not specific to humans. There is great interest in the way in which nonhuman animals process dynamic visual displays, and the role that perceptual processes have played in the evolution of animal signals. Two centre members (Clifford, Davis) have been exploring these issues in collaboration with researchers from Macquarie University’s Animal Behaviour Laboratory (Evans, Peters) who are studying the processing of dynamic visual displays in Jacky lizards (Amphibolurus muricatus). Clifford was involved in a recently-published project that developed a novel method of computational motion analysis for analysing the aggressive displays of Jacky lizards. Davis is involved in a related project (with Peters and Evans) that aims to use neural network modelling to identify structural variations in dynamic displays and to predict response behavior to novel visual stimuli. This will guide the design of planned behavioural experiments.

3.2.4 The dissociation of identity and location information in visual processing

A central issue in visual cognition concerns the way in which information about an object’s identity is bound to information about its location in the visual field. There is considerable behavioural and neuropsychological evidence suggesting a dissociation between these two types of information: that is, knowing what is not the same as knowing where. Davis has been exploring this dissociation through experiments in which visual stimuli “migrate” to different parts of the visual field. For example, letter migration phenomena are known to occur when multiple words are presented simultaneously for very brief durations (e.g., the display STEP SOUP may be misreported as STOP SOUP). Using this methodology, Davis
has been investigating the factors that affect feature, letter and word “migrations” (an example of the latter would be a subject who reported STEP SOUP as SOUP STEP). This work is also relevant to the language project, because the ability to determine the correct relative position of the letters in a word (and the words in a sentence) is a requisite to skilled reading; this ability is disrupted in some forms of acquired and developmental dyslexia.

The above-mentioned TMS project (M Coltheart, Davis, Gandevia, Sachdev) is also addressing the dissociation of identity and location information issue by targeting a region of the brain (the posterior parietal cortex) that is widely believed to play a key role in spatial attention and localisation. It is expected that magnetic stimulation of this region will increase the frequency of errors in tasks that assess correct localisation of visual stimuli, but that tasks that do not depend on location information will be unaffected.

3.2.5 Visual consciousness

Kuan has been investigating the influence that various states of attention have on a person's conscious experience of visual stimuli. One study focused on people's consciousness for stimuli presented in the unattended periphery, and found that their reports about its features (e.g. location, colour, letters) were generally less accurate and less confident, the further away from the attentional focus the stimuli appeared. The accuracy of their responses also tended to correspond with their confidence in them (i.e. confident responses tended to be correct). There was evidence of a kind of repetition blindness, where identification of the peripheral stimulus was worse when it matched the central stimulus, compared to being a different letter-string.

Another study extended the investigation by also looking at the influence of attentional state on the subject's consciousness of the central stimulus being focused on, and their delayed recall for both central and peripheral stimuli. Preliminary results show that experience of the central stimulus is mainly affected in terms of the presence and timing of its semantic features. Many of the above findings for the peripheral stimulus were replicated. A poster reporting this work has been accepted for presentation at the 'Toward a Science of Consciousness' conference to be held in Tucson in April 2002. Ward, who has a PhD in theoretical physics, is investigating, for his PhD in cognitive science with MACCS, the application of quantum theory and of chaos theory to attempts at explaining the nature of consciousness. The work on consciousness is also relevant to the work on delusional belief which is the major component of the Centre’s Belief Formation Project (see Section 3.3).
3.3 The Belief Formation Project

[Breen, M Coltheart, Green, Davies, Langdon, Maguire, Rossell; PhD students McKay, Metcalf, Porter, Smith; new PhD students Hepner, Lawson, Spencer]

This project concerns much higher-level aspects of cognition than the other two projects. We are investigating the processes by which people formulate, evaluate, and then accept or reject beliefs about the way the world is. Our particular interest is in people who have some form of impairment of these processes. Originally we were just concerned with one kind of belief abnormality, namely delusion. More recently, however, we have extended this work by beginning investigations of hallucination and of confabulation. Our approach throughout is cognitive-neuropsychological: that is, we seek to learn more about normal cognitive processes by studying people in whom these cognitive processes are abnormal. Thus the aim of the Belief Formation Project is to develop a cognitive model of normal belief generation and belief evaluation that, when damaged, can explain a variety of impairments of belief formation.

3.3.1 Delusion

Some people have a disorder which leads them to adopt delusory beliefs. Examples of such delusory beliefs are Capgras Delusion (the delusion that someone emotionally close, typically a spouse, has been replaced by an impostor of identical or similar appearance to the person replaced), Cotard Delusion (people with this delusion believe that they are dead) and Mirrored-self Misidentification (the belief that the person one sees in the mirror is not oneself, but some stranger). We are currently seeking answers to two fundamental questions: how do delusory beliefs of these kinds arise in the first place, and, once they have arisen, why are they not rejected, given that the belief is so bizarre and that the people with whom the deluded person interacts are all urging that the belief is untrue and should be rejected?

3.3.1.1 The two-deficit theory of monothematic delusion

We have developed a theory according to which there are two distinct things that need to be going wrong at different stages within the belief evaluation system in order for a delusion to be present in a person. The first deficit within this “two-deficit model” explains the specific content of a particular delusion (eg. why one person is deluded about his wife being replaced by an impostor and another person is deluded about an alien controlling his actions). The
second deficit explains why a deluded individual uncritically accepts the implausible belief. We have already published a number of papers examining this theory (see publication list). In 2001 we have been working to make this two-deficit account much more explicit, and particularly to develop the argument for the second deficit in some detail. We have also provided two alternative conceptions of the second deficit, corresponding to two different conceptions of the way in which the delusional belief is adopted and maintained. If the delusional belief arises as an explicit explanatory hypothesis that the subject adopts in order to explain an anomaly in experience (as Maher would suggest), then the second deficit is conceived as a failure properly to assess explanatory hypotheses for plausibility. If, on the other hand, the delusional belief arises simply by the subject taking an anomalous perceptual experience as veridical, then the second deficit is conceived as a failure to inhibit a pre-potent doxastic response to perception. Both conceptions of the second deficit face problems. In some work begun since our most recent paper on this subject was accepted for publication, we are considering alternative ways of thinking about the first deficit (conceived by Maher as an anomaly in experience) and of the route from that first deficit to the adoption and maintenance of the delusional belief.

3.3.1.2 Delusional misidentification
Breen has been working on case studies of people with delusions of misidentification, investigating these disorders from a cognitive-neuropsychiatric perspective, with a particular emphasis on whether these patients have underlying face processing deficits; new work has begun with patients who are "half-way" to having a delusion - they describe a very altered experience regarding their spouse and children following neurosurgery, yet remain rational and non-delusional - and will be measuring this objectively using skin conductance recordings when these patients are viewing the faces of their families compared to strangers’ faces. This is collaborative work with Dr P Lovibond (University of New South Wales). In addition, work with prosopagnosic patients continues, since disordered face processing is implicated in some cases of delusional misidentification; this work particularly focuses on the role that facial affect (face expression) plays in the recognition of faces.

3.3.1.3 Styles of belief generation and their relationship to delusion.
Two ideas that may be crucial in understanding the generation of beliefs in general and delusional beliefs in particular are: 1) the idea that delusions result from an extreme externalizing attributional bias (i.e. a tendency to attribute negative events to something awry in the world, most often other people’s harmful intentions, rather than something awry with self – e.g. brain damage/mental illness); and 2) the idea that delusions result from an over-confident jumping to conclusions style of belief generation. This evidence-gathering bias is
typically shown on probability assessment tasks in which subjects are asked to judge the likelihood of one or other event. The interrelationships between theory-of-mind impairments, attributional biases and probabilistic estimation abnormalities are currently under investigation in two studies by Langdon. The first of these is the early psychosis study, mentioned below, and the second of these is a study investigating the interrelationship of these three factors in a group of chronic patients with schizophrenia. Collection of data from a chronic clinical group of 30 patients with schizophrenia was completed in 2001. Throughout 2001, data from 10 healthy controls was also collected; collection of healthy control data will continue into mid-2002.

McKay is also exploring potential influences of attributional biases on belief formation. Bentall and Kinderman have reported that patients with persecutory delusions manifest specific biases of attention, memory and reasoning when compared to normal controls. These biases include biased recall for threatening information, biased attention towards threatening material, and an attributional bias that is characterised by externalising, personalising explanations for negative events. In other words, these patients not only abrogate responsibility for negative events, but tend to blame other people for these events (compared with, say, attributions to chance or fate). If an externalising-personalising attributional style is an essential component of not just persecutory delusions but of paranoid states in general, then one would expect to find such a style associated with paranoia in non-clinical populations as well as in clinical populations. Bentall & Kinderman made no distinction within their normal control group between normals with a suspicious, paranoid style and those without such a style. McKay is therefore investigating the relationship between paranoia and attributional bias in a non-clinical sample. If the same relationship between paranoia and bias is found in a non-clinical group, then the question is raised of what makes the subjects with persecutory delusions (in Bentall & Kinderman’s study) delusional. Is it that they have the biases to a greater extent than the paranoid normals, or is an extra ingredient necessary? To investigate this, McKay is also investigating the relationship between paranoia and attributional bias in individuals with persecutory delusions, and the results with such individuals will be compared with the results from the normal group.

3.3.1.4 Anosognosia and delusion
Some patients with impairments due to neurological damage deny that they are impaired in any way: this is known as anosognosia. A patient with a completely paralysed left arm due to right-hemisphere damage may deny that he cannot move his arm. This counts, of course, as a delusional belief. Cappa, Sterzi, Vallar and Bisiach found that Caloric Vestibular Stimulation
(CVS) (a test of the vestibular system involving cold-water irrigation of the ear canal, used routinely in neurological settings to detect asymmetries of vestibular nerve function) caused temporary remission of the delusional anosognosic belief in patients with left-sided paralysis when it was the left ear which was irrigated, a finding which has been replicated a number of times. It is not certain why CVS has the effect that it does on anosognosia. What is known is that ice-water irrigation of the left ear activates projections to the vestibular cortex in the right parietal lobe as well as to other parts of the right hemisphere. It is therefore possible that the effect of left-sided CVS is to activate a belief evaluation mechanism in the right hemisphere which is otherwise operating imperfectly in these patients because of their right hemisphere brain damage, with this imperfect operation being the cause of their accepting as true the false belief that their left arm is unimpaired. McKay is directly investigating this general idea using CVS with normal subjects. Belief evaluation is assessed by a questionnaire measuring self-deception. Will subjects complete this questionnaire in a more realistic i.e. less self-deceptive way after left CVS compared to no CVS or right CVS?

It is not inconceivable that this work will lead to studies in which left CVS is used with other kinds of deluded patients in order to determine whether delusions other than anosognosia for left-sided paralysis also temporarily remit with such treatment.

3.3.2 Theory of Mind

3.3.2.1 Theory of mind, schizophrenia, and schizotypy

One project completed by Langdon investigated visual perspective-taking in patients with schizophrenia and sought to better specify the nature of the link between theory-of-mind impairments and a latent vulnerability to delusions. Findings from that work (published in 2001 in Cognition and Cognitive Neuropsychiatry) led to the idea that patients with schizophrenia have a much more subtle type of theory-of-mind dysfunction than that seen in autistic individuals. That is, whereas autistic individuals are “blind” to the subjective lives of others, patients with schizophrenia have intact understanding of mental state concepts and spontaneously use those concepts when generating causal explanations for events. The theory-of-mind difficulty for patients with schizophrenia is that these individuals fail to demonstrate an appropriate appreciation of the subjective point of view of other people. In more detail, patients with schizophrenia appear to have difficulty representing their own thoughts about a situation as conditional upon a specific point of view in order to then put aside those thoughts and take on, in imagination, how someone else with a different perspective might view that same situation.
Langdon’s work on this topic in 2001 focussed on a number of themes: 1) to demonstrate that theory-of-mind impairments in patients with schizophrenia are highly selective and not reducible to deficits of general executive reasoning; 2) to provide further evidence that the nature of theory-of-mind impairment seen in patients with schizophrenia is quite different to that seen in autism; 3) to further examine whether theory-of-mind impairments have a primary role to play in the explanation of first-rank symptoms of schizophrenia (in particular, delusions); 4) to investigate the association between theory-of-mind impairments and other factors that have been implicated in delusion-formation in patients with schizophrenia; 5) to investigate the relationship between theory-of-mind functioning and various facets of executive functioning in non-clinical adults, subdivided into a high-schizotypal group and a low-schizotypal group; 6) if theory-of-mind abnormalities do have a primary role to play in the explanation of delusions (first-rank markers of psychotic illness), then performance deficits on theory-of-mind tasks should be present in young people who are actually experiencing their first psychotic breakdown; hence Langdon is collaborating on a study investigating cognitive and functional (i.e. occupational therapy) predictors of function and outcome in sufferers of early psychosis.

3.3.2.2 The role of theory of mind in pragmatic communication

Work reported in the paper by Langdon, Davies and M Coltheart which has just appeared in the journal *Mind and Language* has shown that, whereas autistic individuals have a profound form of theory-of-mind impairment that compromises understanding of both metaphors and verbal irony, theory-of-mind deficits in patients with schizophrenia predict poor appreciation of the mocking attitude of a speaker using verbal irony but are completely unrelated to poor understanding of metaphors. This paper has succeeded in bringing empirical results into an illuminating relationship with the most up-to-date presentations of Sperber and Wilson's Relevance Theory, thus forging a link between cognitive neuropsychiatry and linguistics.

3.3.2.3 Social interaction, face perception and theory of mind in schizophrenia

A primary source of information about the mental states of others is their facial expressions, particularly of emotion. Adequate social interaction depends upon appreciation of the mental states of others, especially their emotional states. It is therefore possible that the inadequacies of social interaction seen in many people with schizophrenia may be associated with an impairment of that ability to infer emotional states from facial expressions. Green is therefore studying the performance of schizophrenic patients and matched normal controls on tasks assessing the ability to interpret facial expressions of emotion. Since, if schizophrenics are impaired in the appreciation of facial expressions of emotion, this may be due to
abnormalities in the way they scan the faces they are looking at, eye movements are being recorded as these face tasks are being performed.

Smith is also studying emotion processing in schizophrenia, using a different technique. Patients and controls are shown cartoons and asked to explain the joke in the cartoon. Some jokes require for their interpretation an appreciation of the emotional states of people depicted in the cartoons, some require an appreciation of their beliefs, some both and some neither. This will allow her separately to assess emotional and nonemotional aspects of theory of mind in schizophrenia.

3.3.2.4 Developmental disorders of theory of mind: Williams Syndrome and Autistic Spectrum Disorder

Williams Syndrome is a genetic disorder which gives rise to a specific and interesting configuration of cognitive disorders. Williams children show greatly impaired spatial ability with relatively preserved face processing ability; and they also show an abnormality of social-cognitive behaviour, in that they are excessively and inappropriately sociable, here providing a complete contrast with autistic children and many schizophrenic people, who are characteristically withdrawn and who shun social contact. Since some of the Centre’s work in the Belief Formation project is to do with face processing, and other parts of this work are to do with theory of mind in schizophrenia and autism, research on children with Williams Syndrome will contribute significantly to the Belief Formation project.

Williams Syndrome is rare, and this can be a major obstacle to research. However, contact has been successfully made with the NSW Williams Syndrome Association, a parents’ support group, and with a similar group in South Australia, and these groups have agreed to allow the Centre to carry out research with their children. We believe this is the largest cohort of children with Williams Syndrome available for research anywhere in the world. In 2001 contact was successfully made with the NSW Autism Association. The Autism Association has agreed to allow the Centre to carry out research with their children. Children have been recruited across the association’s numerous schools around Sydney and NSW.

Porter’s PhD research compares people with Williams syndrome, Downs syndrome (to provide mental-age-matched controls), Autism and Asperger’s syndrome. Experiments currently in progress include:

- Face scan-paths and autonomic responses (skin conductance and pupil dilation) to familiar and unfamiliar faces and to a standardised set of facial emotion expressions
(Ekman faces). Skin conductance response to aversive stimuli (vicious dogs) and familiar versus unfamiliar objects.

- Social and emotion processing – expressive and receptive processing
- First and second order theory of mind (verbal and non-verbal tasks)
- Frontal lobe functioning/development
- Visuo-spatial and visual perceptual tasks (in relation to the weak central coherence theory)
- Non-literal speech interpretation

Although these are separate experiments, Porter is interested in the relationship between the results of each experiment for the Williams and Autistic/Asperger’s populations. In particular, the skin conductance responses will be highly relevant to theories of belief formation.

3.3.3 Hallucination

This is being investigated by Rossell, who is focussing on auditory verbal hallucinations (“hearing voices”); she published three papers on this in 2001. Two concerned the neurobiological basis of such hallucinations (in particular whether the corpus callosum or abnormalities of cerebral lateralization are implicated), and the third concerned the view that the basis of such hallucinations is an inability to detect that internal speech is the hallucinator’s own self-generated speech.

3.3.4 Confabulation

Sufferers from anterograde amnesia are those who are unable to lay down permanent memories of experiences they have had since the occurrence of the brain damage that gave rise to the memory disorder. Such patients can retain such information for only a short period of time, so that they may be able to recall accurately what they were doing a few minutes ago but not what they were doing a few hours ago. Some such patients, when asked what they were doing a few hours ago, will simply say: “I don’t remember”. Others, however, will provide an account of what they were doing a few hours ago, but it is a spurious account which is not based on any relevant memories (since there are none available to the patient). This behaviour is known as confabulation, and scientific understanding of it is meagre: there are many unanswered questions. Why do some patients confabulate and not others? Where do
the confabulated accounts come from if they are not coming from retrieved memories? Do the patients actually believe that their confabulations are true? This is being investigated by Metcalf. She has developed a set of measures of confabulatory behaviours and has administered these to a large group of normal control subjects. These measures are now being administered to brain-damaged individuals with anterograde amnesia.

Retrograde amnesia refers to loss of information from memory for events that happened before the brain damage: this is being investigated by Hepner. This phenomenon is interesting in its own right for the contribution it may be able to make to our understanding of the mechanisms of retrieval from long-term memory, but it is also important for confabulation, since patients with retrograded amnesia do not confabulate when unable to recall information that they should be able to recall. What is it about retrograde amnesia that prevents confabulation when in anterograde amnesia confabulation is so common?

Another intriguing memory phenomenon arising in cases of amnesia is the preservation of implicit memories in the absence of explicit memories, shown by many patients with amnesia. If a patient practices some skill for a brief period every day, performance of the skill will steadily improve over the days. But the subject will report never having performed the task prior to the current day. Here implicit memory from previous days is present (as revealed by the steadily improving performance) but explicit memory is absent (as revealed by the patient’s report that he as never performed the task before). Spencer is working on this phenomenon. Its relevance here can be seen by considering what might happen if in these circumstances the amnesic person is asked to explain why he has such an extraordinary level of skill in a task that would need much practice, if he has had no such practice. Will this evoke confabulation in any patients? Will it evoke confabulation in every patient?
3.4 Software Development

3.4.1 The ARC Nonword Database

Rastle, with Harrington and M Coltheart, has completed work on the ARC nonword database, and a paper describing this work has been accepted for publication in the Quarterly Journal of Experimental Psychology. This is a Web-accessible database from which experimenters who wish to use monosyllabic pronounceable nonwords in their research on reading (as many do) can select and analyse their stimulus materials.

3.4.2 The EMU speech database system

This has been developed over a number of years by Harrington and colleagues. All speech researchers at MACCS and many in Australia and worldwide make use of this system. In 2001 its further development was supported by a Macquarie University RIBG grant.

The EMU system is described and can be downloaded from:

http://www.shlrc.mq.edu.au/emu/

The funding under the RIBG grant was used for a part-time programmer. Amongst the outcomes achieved were:

- porting the system to a Macintosh platform (see website)
- integrating the system with a formant and pitch tracker developed at the Institute of Phonetics and Digital Speech Processing, University of Kiel, Germany
- extending the template-editor to allow the template of databases to be changed more easily.

The system forms part of a major research initiative which in 2001 resulted in an edited special edition in the international journal Speech Communication (Bird and Harrington, 2001, 33, 1-176), and a journal paper specifically on EMU in that same edition (Cassidy and Harrington, 2001, 33, 61-67).
3.4.3 Psycholinguistic utilities

During 2001 Davis refined his software utility for obtaining psycholinguistic statistics. This utility is valuable in the construction of stimulus sets and the analysis of psycholinguistic data, and is being used by researchers at a number of institutions, including research centres in the United States, Canada, the United Kingdom and France. The program can be used to obtain information about a broad range of psycholinguistic variables, including word frequency, pronunciation, stress assignment, number of syllables, number of orthographic neighbours, bigram frequency, and subjective familiarity, as well as mean RT and accuracy from lexical decision and naming databases. Davis also wrote a program for calculating orthographic similarity for a variety of orthographic coding schemes. The latest version of these programs can be obtained from his website at: http://www.maccs.mq.edu.au/~colin/.

3.4.4 Modelling software

Perry has completed and tested a program implementing a French version of the DRC model, and also a French version of the Zorzi, Houghton & Butterworth model of reading aloud.

3.4.5 Software for dyslexia remediation work

Perry has been working on the development of game-based dyslexia remediation software for use with English, French and German children.
4 Output

4.1 Publications

4.1.1 Books


4.1.2 Book Chapters


4.1.3  **Journal Articles**


4.1.4 Published Abstracts


4.2 Conference presentations, colloquia and other presentations during 2001


Arnold, D.H., Clifford, C.W.G. & Wenderoth, P. Colour is processed faster than motion. 28th Annual Australian Experimental Psychology Conference, La Trobe University, April 2001.

Bannister, S., McAnally, K., & Castles, A. Auditory stream segregation in dyslexia. 28th Annual Australian Experimental Psychology Conference, La Trobe University, April 2001.

Bates, T.C. Trait agreeableness: Explaining individual differences in personality in terms of input-gating of cognitive modules. 28th Annual Australian Experimental Psychology Conference, La Trobe University, April 2001.


Coltheart, M. Good in bed: Cognitive neuropsychology and developmental disorders of language. Colloquium, Psychology Department, Australian National University, August 2001.


Coltheart, M. Introduction to cognitive neuropsychology. Philosophy Department, Monash University, July 2001.

Coltheart, M. Introduction to developmental cognitive neuropsychology. Philosophy Department, Monash University, July 2001.


Davies, M. Delusions and deficits. Colloquium, Rutgers University, January 2001

Davies, M. People believe the strangest things: Delusions and where they come from. Colloquium, University of Michigan, November 2001.

Davies, M. People believe the strangest things: Delusions and where they come from. Colloquium, Carleton University, November 2001.

Davies, M. People believe the strangest things: Delusions and where they come from. Colloquium, City University of New York, November 2001.


McKay, A, Castles, A., Davis,., & Savage, G. The role of semantic knowledge in the reading of single words. 7th National Conference of the APS College of Clinical Neuropsychologists, Melbourne, October 2001.


Murphy, K., & Coltheart, M. The FIFO principle: Further examination using Stroop, naming and arithmetic verification tasks. 28th Annual Australian Experimental Psychology Conference, La Trobe University, April 2001.

Nickels, L.A. When material is “maternal” and neither is ”relation”: letter-by-letter reading in aphasia. NSW Information Processing Discussion Group, Prince of Wales Hospital, Sydney, March 2001.


Perry, C., & Ziegler, J. A computational investigation of the length effect in reading aloud in German and English. 28th Annual Australian Experimental Psychology Conference, La Trobe University, April 2001.


Tabain, M. Articulation and acoustics of /aC/ sequences at prosodic boundaries. Sydney University, Department of Linguistics, October 2001.


Wenderoth, P., Clifford, C.W.G., & Ma Wyatt, A. A hierarchy of spatial interactions in the processing of contrast defined contours. 28th Annual Australian Experimental Psychology Conference, La Trobe University, April 2001.

Woollams, A., & Kinoshita, S. Interactions between semantics and phonology in the speeded naming task. 28th Annual Australian Experimental Psychology Conference, La Trobe University, April 2001.

4.3 The Macquarie Monographs in Cognitive Science Series

Negotiations with the world's foremost publisher of books on psychology, Psychology Press, led to the signing in 2000 of a contract to establish a new monograph series, The Macquarie Monographs in Cognitive Science, under the general editorship of the Centre's Director. This series will publish books written by or edited by Centre members or generated from conferences supported by the Centre; in the latter case, royalty income for such books will go to the Centre. The first book in the series, Routes to Reading Success and Failure, by Nancy E Jackson and Max Coltheart, was published in 2001. The second volume in the series, Spoken Word Production in Aphasia, edited by Lyndsey Nickels, is currently in press. Three
further volumes in the series will be submitted for publication this year: *Masked Priming: The State of the Art* (edited by Sachiko Kinoshita and Stephen Lupker), *New Directions in Evolutionary Psychology* (edited by Julie Fitness and Kim Sterelny) and *Individual Differences in Theory of Mind: Implications for Typical and Atypical Development* (edited by Betty Repacholi and Virginia Slaughter). Other volumes for this series are currently in various states of planning.
5 Conferences and Seminars

5.1 MACCS Conferences

The original grant application for funding of MACCS included a component for funding conferences at which international experts in fields relevant to MACCS would interact with MACCS personnel and cognitive scientists from elsewhere in Australia. These conferences would be discussion-based and would be relatively small (about 25 participants); attendance would be by invitation only. All MACCS members may attend any of these conferences.

In 2001 four such conferences were organized and took place. The conferences were:

5.1.1 Animal Cognition
[Macquarie University, 5 January 2001, organized by Ken Cheng]

Speakers included Rudiger Wehner (University of Zurich), Jochen Zeil, Mandyam Srinivasan and Shaowu Zhang (Australian National University), and Lesley Rogers and Gisela Kaplan (University of New England)

5.1.2 Masked Priming: the State of the Art
[Macquarie University, 17-18 April 2001, organized by Sachiko Kinoshita]

This conference brought together a small group of Australian and international researchers to discuss what the masked priming paradigm has revealed about the word recognition process. Non-MACCS invited participants were Sally Andrews (University of New South Wales), Jeffrey Bowers (University of Bristol, UK), Marc Brysbaert (University of Ghent, Belgium), Claire Byrne (Monash University), Chris Davis (University of Melbourne), Ram Frost (Hebrew University, Israel), Mike Johnston (University of Melbourne), Jeesun Kim (University of Melbourne), Marielle Lange (University of New South Wales), Michael Masson (University of Victoria, Canada), Meredith McKague (La Trobe University), Manolo Perea (University of Valencia, Spain), Chris Pratt (La Trobe University), Marcus Taft (University of New South Wales), Greg Yelland (Monash University), Kenneth I. Forster (University of Arizona), Stephen J. Lupker (University of Western Ontario, Canada). The proceedings will be published as a book in the Macquarie Monographs in Cognitive Science.
series (see section 4.3). For full details of this conference see:  

5.1.3 **Evolutionary Psychology**

[Australian National University, 2-4 July 2001, organized by Julie Fitness, Macquarie University and Kim Sterelny, Australian National University]

The purpose of this small, invitation-only conference was to bring together a small group of international scholars and Australian cognitive scientists for an interdisciplinary workshop on theoretical issues and current research in the fast growing field of evolutionary psychology. Non-MACCS invited attendees were James Chisholm (University of Western Australia), Garth Fletcher (Canterbury University), Julie Fitness (Macquarie University), Don Gardner (Australian National University), Peter Godfrey-Smith (Stanford University), Russell Gray (University of Auckland), Cecelia Heyes (University College, London), Ben Jeffares (Victoria University of Wellington), Douglas Kenrick (Arizona State University), Victoria McGeer (New York University), Philip Pettit (Australian National University), Ian Ravenscroft (Flinders University), Jeffrey Simpson (Texas A&M University), Dan Sperber
(Centre National de la Recherche Scientifique, Paris), Richard Siegert (Victoria University), Kim Sterelny (Australian National University), and Tom Suddendorf (University of Queensland). The proceedings will be published as a book in the Macquarie Monographs in Cognitive Science series (see section 4.3).

For full details of this conference see: http://www.maccs.mq.edu.au/events/2001/evol_psy/

5.1.4 Theory of Mind and Social Behaviour

[Macquarie University 13-14 July 2001, organized by Betty Repacholi and Virginia Slaughter]

The workshop concerned the question of how the acquisition of, or individual differences in, theory of mind relates to aspects of social functioning. It addressed several related themes: theory of mind and behaviour in evolution, theory of mind and behaviour in special populations, theory of mind and behaviour in development. Non-MACCS invited participants were Janet Astington (University of Toronto), James Blair (University College London), Michael Corballis (University of Auckland), Cheryl Dissanayake (La Trobe University), Philip Gerrans (Adelaide University), Peter Godfrey-Smith (Stanford University), Ben Jeffares (Victoria University of Wellington), Thomas Keenan (University of Canterbury), Stuart Kinner (University of Queensland), Victoria McGeer (New York University), Doris Mellow (Macquarie University), Candida Peterson (University of Queensland), Betty Repacholi (Macquarie University), Jennifer Sanderson (Australian National University), Virginia Slaughter (University of Queensland), Thomas Suddendorf (University of Queensland), and Helen Tager-Flusberg (CRDD, Eunice Kennedy Shriver Center). The proceedings will be published as a book in the Macquarie Monographs in Cognitive Science series (see section 4.3)

For full details of this conference see:
5.2 Other Conferences Supported by MACCS

5.2.1 The 13th Australian Language and Speech Conference

This conference was convened by Dr Anne Castles (MACCS), Dr Linda Cupples (Speech, Hearing and Language Research Centre, Macquarie University), Professor Denis Burnham (Macarthur Auditory Research Centre) and Associate Professor Veronika Coltheart (MACCS), and was hosted by the Macquarie Centre for Cognitive Science (MACCS) and the Speech, Hearing and Language Research Centre at Macquarie University. It was held from Monday December 10 to Tuesday December 11, 2001 at Macquarie University, Sydney. This conference provides a forum for researchers interested in the perception, production and comprehension of spoken and written language. Full details of the conference can be found at

5.2.2 The 1st Australian Conference for Cognitive Neuropsychology and Cognitive Neuropsychiatry

This conference was convened by Dr Lyndsey Nickels (MACCS) and Dr Marina Haywood (Deakin University) and held at Deakin University, Geelong, Victoria from 13 July to 15 July 2001. This inaugural Australian conference for cognitive neuropsychology and cognitive neuropsychiatry brought together researchers from different disciplines including linguistics, psychology, neuropsychology, psychiatry, philosophy and speech pathology to present research that relates neuropsychological or psychiatric impairment to theories of normal cognitive functioning.

5.3 MACCS Seminars in 2001

Informal discussion-based seminars are an integral part of the intellectual life of MACCS, and numerous such seminars were held in 2001, with most speakers coming from outside MACCS. The seminars were as follows:

Friday, 21 December 2001
Title: The neurology of fear and other emotions
Ralph Adolphs, University of Iowa

Wednesday, 12 December 2001
Title: Trying to be fair but failing: How inhibitory deficits lead to unintended prejudice among the elderly
Bill von Hippel, University of New South Wales

Monday, 10 December 2001
Title: Sight unseen: Action without perception in human vision
Mel Goodale, University of Western Ontario

Thursday, 29 November 2001
Title: Categorizing sex and identity from the biological motion of faces
Harold Hill, University College London
Tuesday, 27 November 2001
Title: The role of threat expectancies in obsessive-compulsive disorder
Ross Menzies, School of Behavioural and Community Health Sciences, Sydney University

Tuesday, 20 November 2001
Title: Pragmatics Mini-conference
Robyn Langdon, Skye McDonald, Ingerith Martin & Melanie Porter

Tuesday, 13 November 2001
Title: Strategies of language processing in the left and right cerebral hemispheres
Annukka Lindell, University of Melbourne

Monday, 12 November 2001
Title: TMS as a possible method for exploring how the brain codes letter location
Colin Davis, Macquarie Centre for Cognitive Science, Macquarie University

Thursday, 1 November 2001
Title: Content and Process in Word Meaning
Murray Grossman, Department of Neurology, University of Pennsylvania

Tuesday, 16 October 2001
Title: TASIT: assessing awareness of social inference.
Skye McDonald, School of Psychology, University of New South Wales

Wednesday, 19 September 2001
Title: Discussion of the neurology of dreaming and 'reprocessing' research.
Mike Salzberg, Department of Psychiatry, University of Melbourne

Tuesday, 18 September 2001
Title: Depersonalisation syndrome (with discussion of a current case)
Mike Salzberg, Department of Psychiatry, University of Melbourne
Tuesday, 4 September 2001
Title: When the future disrupts the past: An auditory and visual perceptual deficit associated with language and reading disorders.
Beverly Wright, Audiology and Hearing Sciences Program - Department of Communication Sciences and Disorders, Northwestern University

Tuesday, 14 August 2001
Title: Semantic Effects in RSVP Memory: Picture list recall and Semantic Priming in RB.
Veronika Coltheart, Macquarie Centre for Cognitive Science, Macquarie University

Tuesday, 7 August 2001
Title: Good in Bed: Cognitive Neuropsychology and Developmental Disorders.
Max Coltheart, Macquarie Centre for Cognitive Science, Macquarie University

Tuesday, 24 July 2001
Title: Great Expectations: Top down processes and the conscious perception of things.
Steve Most, Psychology Department, Harvard University

Tuesday, 17 July 2001
Title: Delusions
Andy Young, Department of Psychology, York University

Tuesday, 26 June 2001
Title: Semantic inhibition and repetition priming in aphasic patients and normal people.
David Howard, University of Newcastle (England), Speech Department

Wednesday, 20 June 2001
Title: "Sleights of mind": Delusions and self-deception.
Ryan McKay, Macquarie Centre for Cognitive Science, Macquarie University

Monday, 28 May 2001
Title: Fractioning the supervisory system.
Tim Shallice, Institute for Cognitive Neuropsychiatry, University College, London
Tuesday, 22 May 2001
Title : Strategy effects in naming: evidence for the use of a time criterion.  
Steve Lupker, Macquarie Centre for Cognitive Science, Macquarie University and University of Western Ontario

Wednesday, 16 May 2001
Title : Emotional dysfunction following brain surgery: The functional neuroanatomy of emotion.  
David Andrews, Department of Psychology, University of Melbourne

Tuesday, 24 April 2001
Title : Is binding necessary for consciousness?  
Colin Clifford & Derek Arnold, Macquarie Centre for Cognitive Science, Macquarie University

Thursday, 12 April 2001
Title : A case study of letter-by-letter reading ('pure alexia') - work in progress  
Lyndsey Nickels, Macquarie Centre for Cognitive Science, Macquarie University

Tuesday, 10 April 2001
Title : Theory of mind and story interpretation.  
Patricia Smith, Macquarie Centre for Cognitive Science, Macquarie University

Tuesday, 3 April 2001
Title : Brain characteristics of the mathematically gifted.  
Michael O'Boyle, Morgan Centre for the Study of the Development of High Intellectual Potential, University of Melbourne

Tuesday, 20 March 2001
Title : Task effects in single word production.  
Karen Croot, Macquarie Centre for Cognitive Science, Macquarie University

Tuesday, 27 February 2001
Title : How do textures convey three-dimensional shape?  
Qasim Zaidi, State University of New York
Tuesday, 20 February 2001
Title: Processing & Awareness in Dynamic Vision
Colin Clifford & Derek Arnold, Macquarie Centre for Cognitive Science, Macquarie University

Tuesday, 13 February 2001
Title: Deriving planning models from abstract strategies
Andrew S. Gordon, Department of Computing, Macquarie University

Tuesday, 6 February 2001
Title: Static pictures that move in the mind
Carl Senior, Institute of Psychiatry, London

Tuesday, 30 January 2001
Title: Good God, more stuff about neighbourhood effects
Steve Lupker, Macquarie Centre for Cognitive Science and University of Western Ontario
6 Members' Awards and Recognition During 2001

6.1 Grants Awarded

ARC Discovery project grant (2002): K. Rastle ($24,000)
ARC Discovery project grant (2002-2004): R. Langdon ($60,000)
ARC Australian Postdoctoral Fellowship (2002-2004): I Harris ($204,000)
NH&MRC Project grant (2002-2004): T. Bates, A. Castles & M. Coltheart ($345,000)

Young Scientist Awards: R. Langdon and S. Rossell awarded Young Scientist Awards in partial support of their attendance at the 11th Biennial Winter Workshop on Schizophrenia at Davos, Switzerland, February 2002. ($3000)

NH&MRC Clinical Research Fellowship (2002-2005): M. Green ($219,025)
ARC Federation Fellowship (2002-2006): M. Coltheart ($1,125,000)

Macquarie University Postgraduate Research Fund Grant: S. Kuan: awarded to fund attendance and presentation of her work at the Tucson (Arizona) Conference on Consciousness. ($4000)

Macquarie University Research Grant: M. Coltheart (to support visit to MACCS of Professor H Ellis (Cardiff University) ($3905)

Macquarie University Research Grant: S Kinoshita: Shift in time criterion across tasks. ($2886)

Macquarie University Research Grant: S. Kinoshita & A. Castles: How do people perform phonological awareness tasks? ($2694)

Macquarie University Research Grant: V. Coltheart: Recognition of briefly presented faces: Effects of repetition. ($1920)

Macquarie University Research Grant: V. Coltheart: Implicit change blindness: Memory for changes in visual scenes in the absence of conscious awareness ($7680)

Macquarie University Research Grant: K. Rastle: The perception and production of timing in speaking. ($3000)


Macquarie University Research Grant: K Croot: How do reading and repetition tasks facilitate speech production for people with speech sound production deficits? ($5,760)

Macquarie University Research Grant: L. Nickels: Treatment of Pure Alexia ($2,976)

Macquarie University Research Grant: R. Langdon: Mind-reading and executive function ($3,264)

Macquarie University Research Grant: L. Nickels: An investigation of how words are stored in the language system ($6,468)


Macquarie University/DETYA Research Infrastructure Block Grant (RIBG): Infrastructure support for MACCS. ($91,153)
Macquarie Graduate School of Management Scholarship (Macquarie Centre for Professional Development): S. Mendes ($6000)
NSW Institute of Psychiatry Training Fellowship: M Porter ($20,104)
Northern Sydney Health Research Development Grant: L. Nickels (with C. Taylor, K. Makin and M. Moses): The facilitation of word production in aphasia ($39,350)
Specialist Support Grant (Macquarie Centre for Professional Development): C. Richardson ($300)

6.2 Appointments and Promotions

J. Harrington appointed to the Reader Panel of the ARC's Expert Advisory Committee in the Social, Behavioural & Economic Sciences
M. Coltheart appointed a member of the ARC's Expert Advisory Committee in the Social, Behavioural & Economic Sciences [1 Mar 2001 – 31 December 2002].
V. Coltheart and M. Coltheart appointed Initial International Fellows of the American Psychological Society.
J. Harrington appointed Professor and Chair, Institute of Phonetics, University of Kiel, Germany from Jan 1 2002.
J. Harrington appointed Adjunct Professor at Macquarie University (from 1 Jan 2002).
M. Coltheart elected to the Council of Macquarie University for the term 2002-2004.
M. Coltheart appointed by the Australian Academy of Science to the National Committee for Psychology until April 2004.
L. Nickels promoted to Level C on the academic scale, Macquarie University
K. Rastle promoted to Level B on the academic scale, Macquarie University

6.3 Editorial

M. Coltheart re-appointed to the Editorial Board, Psychonomic Bulletin & Reviews
K. Rastle appointed to the Editorial Board of Language and Cognitive Processes.
M. Coltheart appointed to the Editorial Board of Cortex.
J. Harrington appointed Associate Editor of the Journal of Phonetics.
A. Castles appointed to the Editorial Board of the journal Scientific Studies of Reading
M. Coltheart appointed to the Editorial Board of Neuropsychologia
S. Kinoshita appointed Associate Editor of the Australian Journal of Psychology

6.4 Honours

N. Breen awarded the Vice-Chancellors' Commendation for a PhD thesis of exceptional merit.
P. Smith awarded a University Medal for her Honours work at Central Queensland University in 2000
M. Coltheart elected Fellow of the Australian Academy of Science
M. Coltheart awarded the degree of DSc by Macquarie University
7 Progress and Achievements in Independent Funding

The Centre being only two years old, it is too soon to be very specific about plans for its funding after its nine-year term has expired. However, as is indicated in Section 6.1, in the year 2001 members of the Centre attracted more than $1 million in competitive grant funding from internal and external sources. All nineteen of the Centre's full-time PhD students are now funded from sources outside the Centre grant. The Centre currently has 12 full-time and two half-time postdoctoral fellows. As part of the eventual independent funding of the Centre, it is intended that ultimately all the postdoctoral fellows in the Centre will have their own independent funding. Good progress has already been made towards that aim: eight of the full-time fellows are now funded from sources outside the Centre grant.

8 Progress in the Education and Training Programs

The ambit of MACCS is research and research training in cognitive science. An essential component of the activity of the Centre is therefore the provision of a high-quality research environment and high-quality supervision for PhD students. Since the Centre has been operating for only two years, it is too soon to be looking at outcome measures such as PhD completions. However, it may be noted that all MACCS full-time PhD students have dedicated accommodation with their own desks and their own networked computers, as well as full access to all MACCS facilities, and that PhD students have flocked to the Centre since it opened two years ago (see Section 9.2). All nineteen of the current PhD students in the Centre have APA scholarships or else equivalent scholarships (RAACEs or iMURS) obtained competitively within the University. It may also be noted that three students who were part-way through their PhDs when they joined MACCS on 1st January 2000 have since submitted their PhD theses (Langdon, Breen, Mondy) and all three were highly praised by their examiners. Two received a Vice-Chancellor's commendation for a thesis of exceptional merit and the third was awarded the degree without being required to make any amendments at all to the thesis. Five current students (Dufty, Woollams, Kuan, Joy, Brunsdon) will submit their PhD theses this year.
9 Expansion of the Centre

At the end of its second year, the Centre is far larger than had been anticipated at its inception. Including part-time personnel, there are now more than 50 people working in the Centre. This unforeseen expansion has occurred for four reasons.

9.1 Attractiveness to postdoctoral researchers

The original Centre application requested salaries for 4 full-time postdoctoral fellows. However, there are now 12 full-time and 2 half-time postdoctoral fellows in the Centre. This has happened because the Centre rapidly became known as an extremely attractive research environment for cognitive scientists, and began to receive many enquiries from applicants for postdoctoral fellowships who wished to hold these fellowships in the Centre. As a result, there are now 5 APD fellows, one NH&MRC Clinical Research Fellow, one International Prize Wellcome Fellow and one QEII Fellow pursuing their research projects in the Centre. None requires a salary from the Centre’s funds, but all are carrying out research related to one or the other of the Centre’s three research projects and making major contributions to the Centre’s research programme.

9.2 Attractiveness to doctoral researchers

The Centre has proven similarly attractive to doctoral researchers (PhD students). The number of PhD students working in the Centre has grown enormously since the Centre’s inception: there are now in the Centre 19 full-time PhD students (every one supported by an APA scholarship or equivalent) and 7 part-time PhD students. There is a regrettable tendency in Australia for undergraduates to be reluctant to widen their horizons by moving to a new department for their doctoral work, but this is not true of MACCS PhD students; of the 19 full-time PhD students only 6 are Macquarie graduates. Of the remainder, 5 are from overseas (2 from the UK, 2 from Japan, 1 from Switzerland) and the others are from the University of Newcastle, the Australian National University, the University of New South Wales, Griffith University, the University of Sydney, the University of Central Queensland, and the University of Western Australia.
9.3 The MACCS Developmental Cognitive Neuropsychology Research Unit at the New Children’s Hospital

This hospital had an extremely active neuropsychology department of four clinical neuropsychologists all interested in research, and with a case load that included many people with important and interesting cognitive deficits of direct relevance to the Centre’s work. Because clinical loads are typically so heavy that it is very difficult to combine clinical work with research, the four members of this department were unable to exploit their unique research environment. The Centre has addressed this problem by providing an annual sum of approximately $40,000 which gives these people enough assistance that adequate amounts of research time is now available to them. This arrangement has been formalised by the recognition of a Developmental Cognitive Neuropsychology Research Unit at the hospital; this is an outpost of the Centre and members of that Unit collaborate closely with members of the Centre. This research initiative is flourishing, as can be seen from the Unit’s Progress Report (Appendix A1).

9.4 University Support

This expansion of MACCS has only been possible because of generous support from the University. Thus has taken two forms. The first concerns the RAACE/iMURS scheme, a competitive scheme internal to the University by which designated areas of research excellence may nominate outstanding potential students for PhD scholarships, including scholarships for overseas students which pay their very large overseas student fees. The quality of students wishing to undertake PhDs in MACCS is so high that MACCS has been very successful in this highly competitive scheme: of its 19 full-time PhD students, 4 are funded by RAACEs and 5 by iMURS.

An even more significant source of support from the University has been space. The initial provision of space by the University for MACCS was an area of 240 m². Not long after the inception of the Centre on January 1 2000, that area became completely occupied and there was a serious need for additional space, particularly for the rapidly increasing number of PhD students. A large (70 m²) communal room for PhD students was provided by the University: all students have their own desks and desktop computers in that room, which is also furnished with bookcases, filing cabinets, reading chairs, etc., and is immediately adjacent to a kitchen for making coffee etc; a pleasant working environment has been established here.
The influx of postdoctoral fellows in 2001 caused a separate difficulty with space. Postdoctoral Fellows need individual offices, and none were available. A number of these Fellows have had to work initially in shared offices. The University responded to this difficulty by providing the Centre with an additional area of about 120 m² which is currently being converted from teaching rooms to office space, and will yield the Centre 11 additional offices; this building work is scheduled to be completed on 12th April 2002. When these offices are available, the Centre will have all the space required by its rapid expansion.

10 Visitors and Other External Contacts and Collaborations

10.1 Visitors during 2001

- Professor Stephen Lupker (University of Western Ontario) 10 January - 30 June
- Dr Jo Ziegler (CNRS, Marseilles) 22 January – 12 February
- Professor Ken Forster (University of Arizona) 1 April - 11 May
- Professor David Howard (University of Newcastle upon Tyne) 8 June - 13 July, 30 July – 24 August
- Leigh Harrington (Victoria University of Wellington) 27 June – 13 July
- Dr Skye McDonald (University of New South Wales) 1 July - 31 December
- Professor Andrew Young (University of York) 16 August - 20 August

Research described in section 3 involves active current collaborations with Dr D Besner and M Roberts (University of Waterloo), Dr M Davis and Professor W Marslen-Wilson (Cambridge University), Dr M Zorzi (University of Milan), Dr P Lovibond (University of New South Wales) and Professor K Paap (University of New Mexico). There is also active ongoing collaborative work with all of the Centre’s external members. Research described in section 3 also involves active current collaborations with Dr J Bowers (University of Bristol), Professor M Taft (University of New South Wales), Professor S Andrews (University of Sydney), Professor Simon Gandevia and Professor Perminder Sachdev.
11 Web Site and Mailing Lists

The Centre has its own extensive web site at http://www.maccs.mq.edu.au At that site, the page http://www.maccs.mq.edu.au/mailman/listinfo provides a number of public mailing lists dealing with different aspects of cognitive science; anyone in the world interested in email discussions of topics in cognitive science can subscribe to and then contribute to any of these mailing lists.

12 Expenditure Reports

This statement is at Appendix A2. All core funding for 2001 has been expended, with additional requirements having been met by University contributions.

13 Management Arrangements

During 2000, Professor Gordon Stanley, Chairman of the Board of Studies of NSW, and Professor Jim Piper, a former SRC Director and Professor of Physics at Macquarie University, accepted invitations to join the Centre’s Advisory Board. No problems have arisen that have required a full meeting of the Board, but individual members of the Board, particularly Professors Clark, Ward, Young, Stanley and Piper, and the Deputy Vice Chancellor (Research) at Macquarie University, are frequently consulted for advice about Centre affairs.

14 Revised Core Activity Statement

The Annual Report for 2000 described some slight extensions to the core research activities of the Centre. There have been no further extensions since then, so that the description of the Centre’s research activities given in that report remains accurate.
15 Activity Plan for the Next Twelve Months

Apart from the slight expansions of the Centre’s core research activities noted in Section 14 above, our plan for 2002 is exactly as described in the original Centre grant application, apart from one major change. The Director having been awarded a Federation Fellowship, his administrative duties in the Centre will be taken over by a new appointment to the Centre, an Administrative Director whose position will be funded by the University as part of its support of the Federation Fellowship. Professor Coltheart will continue to work in the Centre and will assume the title of Scientific Director.

16 Appendices

A1: Annual Report of the MACCS Development Cognitive Neuropsychology Research Unit


ANNUAL REPORT 2001

Preamble

2001 has seen a number of changes within the Developmental Cognitive Neuropsychology Research Unit, with staff changes and temporary absences. Research work within the unit has continued to cover a diverse range of areas from cognitive neuropsychological focus on reading, spelling and visual processing disorders to group neuropsychological research in a range of acquired and developmental disorders of childhood.

Progress report (detailed statement appended)

Postgraduate position

At the beginning of 2001 Sara Coombes resigned from the postgraduate position to take up the maternity locum position in Rehabilitation Department made available by Kath Bakker's absence. There was then a short break before the position was refilled with Jacinta Gracey taking up the position on 17 April 2001. Jacinta came to the position after completing her D. Psych in Clinical Neuropsychology at the University of Melbourne.

Research

The unit has continued to work on large research projects as well as smaller cognitive neuropsychological case studies. Two projects for 2001 have focused on investigation of visual processing disorders in childhood. Pam Joy and Ruth Brunsdon have submitted their paper, a case study of visual agnosia and prosopagnosia to Developmental Neuropsychology. Pam Joy has also been involved as a co-investigator in a second case study of visual agnosia in childhood in conjunction with Suzanne Benson, The Children's Hospital at Westmead (CHW) and Max Coltheart, Macquarie Centre for Cognitive Science (MACCS). This paper has also been submitted for publication to Cognitive Neuropsychology.
Kath Bakker and Pam Joy have been involved in a research project on memory outcome for children following epilepsy surgery in conjunction with Sunny Lah, Sydney Children's Hospital (SCH). This article has been submitted to *Epilepsia*. An additional paper is due for submission in early 2002. Tim Hannan is planning to submit a paper completed during 2001 on the psychosocial sequelae of traumatic brain injury in childhood to *Brain Impairment*.

Involvement in larger group studies has continued for 2001 with a number of successful grant applications. Kath Bakker has been successful in attracting a grant for $102,000 to conduct a multi-centre study into the use of stimulant medication in children with attention deficits secondary to acquired brain injuries. The project is awaiting final ethics approvals and is expected to commence in February 2002. Pam Joy has also been successful in attracting funding of $3,957 through the CHW Small Grants Fund to continue research into the neuropsychological outcome of children of mothers with phenylketonuria. The project is currently in the recruitment and testing stage.

Testing has been completed in Pam Joy's research into Turner syndrome, with the focus now on thesis preparation. Pam has also been involved with a study investigating the use of magnetic resonance spectroscopy in acquired brain injury. Data collection has been completed for stage one of this project. Kath Bakker is continuing her review of neuropsychological outcome following anoxic brain injuries in childhood. This was temporarily suspended through 2001, whilst Kath was on maternity leave, and is now intended for submission for publication in 2002. Other large group studies on outcome in low grade tumour and measurement of post-traumatic amnesia in acquired brain injury are continuing in the development stage.

In addition to group studies, case study work is continuing. Ruth Brunsdon has completed two case studies focusing on treatment of developmental surface dysgraphia and the treatment of developmental prosopagnosia as part of her PhD, supervised by Max Coltheart and Lyndsey Nickels (MACCS). Both treatment programmes have had extremely successful outcomes, with the prosopagnosia treatment study representing the first known successful treatment program for childhood prosopagnosia. The dysgraphia treatment study also represents a valuable addition to the very limited number of treatment studies in the literature. Both treatment programmes will be prepared for publication in 2002. Ruth is also working on a treatment programme for topographical disorientation, which is in the pre-treatment assessment stage.
The unit has been represented by members and associates at conferences at a national level throughout 2001. Pam Joy, Ruth Brunsdon, Tim Hannan and Suzanne Benson presented a symposium on the application of cognitive neuropsychological models and methods to childhood disorders at the Australian Conference for Cognitive Neuropsychology and Neuropsychiatry in July 2001. Pam Joy along with Max Coltheart (MACCS) also presented a poster on gender differences in the mental rotation test at the national conference of the Australian Psychological Society's College of Clinical Neuropsychologists in October. Pam was also involved in a second poster presentation at that conference on the investigation of neuronal integrity in severe traumatic brain injury using proton magnetic resonance spectroscopy, in association with Arthur Shores, Macquarie University, and others.

**Staffing 2001**

A number of staff changes occurred in the past year with Kathleen Bakker commencing maternity leave on 19 March 2001 and returning to her position on 23 October 2001. Ruth Brunsdon also commenced maternity leave on 11 September 2001 and is due to return on 13 February 2002. Additionally, Tim Hannan resigned from the unit in October 2001.

**Financial Report (Detailed statement appended)**

*Previous Balance*

The net balance at 31 December 2000 of $10,493.67 was brought forward.

*Income*

Two further project grant instalments totalling $41,033.00 were received from MACCS. Funding of $3,957.00 for a research project, Neuropsychological and behavioural outcomes of offspring from maternal Phenylketonuria, was received from the Children’s Hospital at Westmead Small Grants scheme. There was a total of $1,015.90 interest on investment earnings.

*Expenditure*

The primary outgoings were for salary and associated on-costs. There was a substantial increase in salaries flowing from a new Psychologist’s Award for Public Health Psychologists. This award included an initial salary increase to $39,000 from 1 December 2001 followed by further increases of 3% in January 2002. This led to higher than expected salary costs for the year, however, interest earnings covered these. Other expenditure included materials for conference presentations and postage. An incorrect debit for conference...
expenses and associated cost of a bank draft were made and will be adjusted in the January report.

**Balance**

The net balance at 31 December 2001 was $14,919.98. Projected income from interest through to February 2002 is $169.31. Projected expenditure for the same period includes $7,466.93 for salaries and associated costs (based on the new salary rate of $41,170.00) and $3,084.80 for research materials. This will give a projected balance of $5,435.25 at 28 February 2002.

**Budget for March, 2002 to February, 2003**

<table>
<thead>
<tr>
<th>Level 2 Psychologist’s scale</th>
<th></th>
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<tbody>
<tr>
<td>March – December 2002</td>
<td>34,308.33</td>
</tr>
<tr>
<td>January – February, 2003</td>
<td>7,136.13</td>
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<tr>
<td>15% on costs</td>
<td>6,216.67</td>
</tr>
<tr>
<td>Goods and Services</td>
<td>300.00</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>$ 47,961.13</strong></td>
</tr>
</tbody>
</table>

To be paid in instalments:

- **$23,980.63** (due March 1, 2002)
- **$23,980.50** (due September 1, 2002)

The current salary for the new post-graduate position is $41,170.00 with a further 4% increase payable from January 2003. This is included in the proposed costing for 2002-03. The budget for goods and services is conservatively estimated at $300.00

**Proposals for 2002**

Our proposal for the unit in 2002 would be to broaden the unit, through utilising these additional hours and the vacant position to draw on the wider neuropsychological resources within the Children's Hospital at Westmead. It is envisaged that hours would be allocated on a project basis. For example they may be taken in blocks to enable completion of specific tasks, such as project development, completion of specific papers and submission of grant applications. Excluding the staff already directly involved within the unit there are 3
additional clinical neuropsychologists working within the hospital. Providing these individuals with associate membership of the unit and allocating blocks of days on a needs basis for specific projects would, we envisage, increase the ability of the unit to meet its outcome measures and increase the expertise and level of scholarship within the unit.

**Outcome Measures**

The proposed outcome measures for 2001 as set out in the Annual report for 2000 were 2 papers submitted for publication and 3 conference presentations as well actively seeking research grants. The unit has succeeded in meeting its commitments with 3 papers submitted and 3 conference presentations in 2001 as well as success in attracting 2 grants to the value $102,000 and $3,957.

We would expect to continue this level of research throughout 2002, with a number of papers in preparation for submission, a number of studies in progress and ongoing project development.

**PROGRESS REPORT**

**Publications**

*Accepted*

Brunsdon, R. K., Hannan T. J., Coltheart, M. & Nickels, L. Treatment of Lexical Processing in Mixed Dyslexia: A Case Study *Neuropsychological Rehabilitation*

Brunsdon, R. K., Hannan T. J., Coltheart, M. & Nickels, L. Successful treatment of sublexical reading deficits in a child with dyslexia of the mixed type. *Neuropsychological Rehabilitation*

*Submitted*


Benson, S., Joy, P. & Coltheart, M. Do you see what I see? A case study of visual agnosia in childhood. Submitted to *Cognitive Neuropsychology* *January 2002*

*Due for submission early 2002*

Hannan, T. Psychosocial sequelae of traumatic brain injury in childhood: A cognitive-behavioural formulation To be submitted to *Brain Impairment*, *February 2002*

*In preparation*

Bakker, K. Neuropsychological sequelae of paediatric anoxic brain injury: A review.

Brunsdon, R., Nickels, L., & Coltheart, M. Developmental Prosopagnosia: A Case Study in Rehabilitation


**Professional Activities**

**Conference Presentations**

*Australian Conference for Cognitive Neuropsychology & Neuropsychiatry, Deakin University, July 2001*

**Symposium**


*Conference of the APS College of Clinical Neuropsychologists, Melbourne, October 2001*

**Posters**

Joy, P. & Coltheart, M. Gender differences in children's performance on the mental rotation test: upside down or back to front?

**Grants**


**Projects in Progress**

Sex chromosomes and brain organisation in Turner syndrome. Joy, P., Rae, C., & Coltheart, M. Progress: Data collection completed

Post concussional syndrome – A MRS & neuropsychological study. Shores, A., Joy, P., Hannan, T. & Parry, L. Progress: Stage 1 data collection completed; Analysis in progress


Treatment of topographical disorientation in a 6 year old child. Brunsdon, R. Progress: Pretreatment assessments completed


Neuropsychological outcome following low grade glioma. Brunsdon, R., Joy, P. & Kellie, S. Progress: Preparation and development of project


MACQUARIE UNIVERSITY

STATEMENT OF INCOME AND EXPENDITURE

*For the Period 1 January 2001 to 31 December 2001*

<table>
<thead>
<tr>
<th></th>
<th>Reported to date</th>
<th>Current report</th>
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<tbody>
<tr>
<td><strong>INCOME</strong></td>
<td></td>
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</tr>
<tr>
<td>Grant Received</td>
<td>863,343.00</td>
<td>727,004.00</td>
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<tr>
<td><strong>Total Income</strong></td>
<td>863,343.00</td>
<td>727,004.00</td>
</tr>
<tr>
<td><strong>EXPENDITURE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries</td>
<td>374,303.78</td>
<td>563,231.57</td>
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<td>Travel</td>
<td>63,855.15</td>
<td>102,306.44</td>
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<tr>
<td>Equipment</td>
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<td>57,032.21</td>
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<tr>
<td>Materials/consumables</td>
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<td>103,727.57</td>
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<td>Other expenses</td>
<td>40,030.00</td>
<td>30,210.66</td>
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<td><strong>Total Expenditure</strong></td>
<td>733,838.55</td>
<td>856,508.45</td>
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<tr>
<td><strong>Surplus / (Deficit) for reporting period</strong></td>
<td>(129,504.45)</td>
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<tr>
<td><strong>Surplus/(Deficit) from Previous Period</strong></td>
<td>129,504.45</td>
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<td><strong>Uncommitted / (Overcommitted) Balance</strong></td>
<td>129,504.45</td>
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</table>

I certify that the expenditure itemised above has been incurred solely for the purpose of this project. I also certify that the salary rates paid to persons employed on this project are in accord with the rates applicable to persons of similar status and responsibility employed by the University.

G R Tongue
Acting Assistant Chief Finance Officer
20 March 2002

RESEARCH CENTRES SCHEMES: FINANCIAL STATEMENT

Please complete the following information on the Centre's 2001 financial activities and return, with the Annual Report to:

The Scheme Manager
Research Centres Scheme
Australian Research Council
GPO Box 9880
CANBERRA ACT 2601

CENTRE NAME: Macquarie Centre for Cognitive Science (MACCS)

INSTITUTION: MACQUARIE UNIVERSITY

INCOME

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
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<tr>
<td>ARC Centre Grant</td>
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<tr>
<td>Other ARC programs</td>
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<tr>
<td>Other Commonwealth Government Funds</td>
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<tr>
<td>State Government Funds</td>
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<tr>
<td>Local Government Funds</td>
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<tr>
<td>Industry/Private Funds</td>
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<tr>
<td>Contracts/Consultancies</td>
<td>2,659</td>
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<td>Host Institution Support</td>
<td>214,964</td>
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<tr>
<td>Other Income Sources/Interest</td>
<td>24,159</td>
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</table>

**TOTAL INCOME** 1,393,767

EXPENDITURE OF RESEARCH CENTRE'S GRANT FUNDS

<table>
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<th>Item</th>
<th>Amount</th>
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<td>Salaries</td>
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<td>Equipment</td>
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<td>Accommodation</td>
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<td>Travel</td>
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<td>Consumables</td>
<td>103,728</td>
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<tr>
<td>Other Expenditure</td>
<td>30,211</td>
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</tbody>
</table>

**TOTAL EXPENDITURE** 856,508

Carryover amount (ARC Centre Grant only): NIL

Acting Assistant Chief Finance Officer