



# THE NEWSLETTER

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## FROM THE DIRECTOR.....

First, as many of you know from participating last year, we have hired two new faculty in the Hill Program for Social Cognition and Decision Making: Holly Arrow, Psychology, and Larry Sugiyama, Anthropology. In addition to Bertram Malle, Psychology, we now have all three Institute faculty positions filled. We also added two new Institute members this summer from our continuing faculty: Doris Payne, Linguistics, and William Harbaugh, Economics. We will also have several visitors this year: Nahoko Hayashi, Political Science, sponsored by John Orbell, Leigh Tesfatsion, Economics, sponsored by John Orbell, and Anke Heidrich, Psychology, sponsored by Mike Posner. (We are trying to publish in the newsletter a brief biography of each new member and visitor.) Welcome to all of you.

This Fall we open the doors on the Institute's new Hill Lab for Social Cognition and Decision Making. It is located in a suite of rooms in 170-179 Straub. This space will be available for laboratory use for group studies by all members of the Institute and their graduate students. If you would like more information on its use, contact Bertram Malle at 6-0475. As part of the Hill Lab we will be purchasing video equipment and a computer system for general Institute use.

This year we have a full schedule of activities in the Institute. Tom Givón, John Orbell and Larry Sugiyama are sponsoring a graduate seminar this Fall on evolution, behavior and culture. It meets from 2 to 5 Wednesdays in 104 Gilbert. Russ Tomlin, Linguistics, is coordinating the colloquium series which is held on Mondays at 3:30. The dates and speakers will be published in the newsletter every quarter. Vonda Evans, our secretary will also send out weekly announcements via email and paper. Russ still has a some slots available and is at 6-3909 or 6-3278, email: [tomlin@oregon.uoregon.edu](mailto:tomlin@oregon.uoregon.edu). Mark Johnson is planning a two day conference in early April entitled, "Embodied Mind and the Renewal of Philosophy." This will feature several prominent speakers from the philosophy and cognitive science community, as well as local talent. The Attneave Lecture committee headed by Steve Keele has invited Dan Kahneman to speak. That lecture will be Friday, April 11. Our regular Poster Party is scheduled for Monday, June 2. Please encourage your graduate students to plan ahead to participate in this exciting annual event.

We now have almost thirty faculty members from

eight different departments in the Institute. I would like to encourage all of you to *actively* participate by serving on a committee, giving a talk, inviting a speaker, organizing a workshop, etc. We have several special interest groups which occasionally meet. These are Cognitive Neuroscience (Mike Posner), Social Cognition and Decision Making (Bertram Malle, John Orbell, Tom Givón), and Language Culture and Cognition (Russ Tomlin, Dare Baldwin). Each group has a small budget of \$2,000 which can be spent to invite speakers or sponsor other activities. I would also like to encourage you to submit proposals for workshops or symposia on cutting edge research topics which would bring together outside speakers with members of the University community. Finally, I am going to be instituting a Research Initiation program to award a small amount of money competitively to two or three research proposals. The purpose of the award is to encourage cognitive science and decision making research with a priority given to cross-disciplinary proposals written by at least two Institute members. I will send out more information on this program later in the Fall quarter.

I would also like to invite students to participate whenever possible in the Institute. You are welcome at all events, including the special interest groups. In the past, graduate students have organized seminars, created and maintained our WEB site, and nominated guest lecturers. I want to increase student involvement in the Institute and encourage both faculty and students to recruit students into our activities. In particular, I would like to hear from graduate students about what the Institute can do for them.

Our Executive Board members are Marjorie Taylor, Psychology, Mark Johnson, Philosophy, Russ Tomlin, Linguistics, and Bertram Malle, Psychology. Our Institute secretary is Vonda Evans, located in the Institute office in the basement of Straub Hall. Please contact any of them or myself if you have questions about the Institute, want to contribute, or have new and exciting ideas. Finally, a useful service was instituted last spring so that email can be sent to all Institute members by using the address: "[icds@psych.uoregon.edu](mailto:icds@psych.uoregon.edu)".

Enjoy this year at the Institute.

**Sarah Douglas**  
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## COGNITIVE NEUROSCIENCE ENTERS 8TH YEAR

Michael Posner

In January we will enter the last of eight years of support that the James S. McDonnell Foundation and Pew Memorial Trusts have given to our Cognitive Neuroscience Program. During that time the original seven faculty members, Keele, Marrocco, Posner, Stevens, Takahashi, Tucker, and Woollacott, have been joined by Sereno, Neville and Anderson.

Eight years ago we proposed to use our skills in cognitive studies and to develop high density electrical recording of humans and cellular recordings in monkeys and owls to trace attention from synapse to pathology. I think the dissertations of Matt Davidson, Bruce McCandliss, Petr Janata and Jerry Russell best illustrate how far we have come. Petr Janata's dissertation combines cellular recording from the inferior colliculus of the barn owl with high density event related potential recordings in humans to show how context influences collicular cells and how these may build up to expectations for musical notes that can bias cortical responses. Matt Davidson's builds upon much research directed by Richard Marocco showing how transmitter activity at the synaptic level can be related to the cognitive operation of alerting and orienting. Davidson is exploring the firing rates of parietal cells thought to be central to these operations. Bruce McCandliss studies how learning influences brain circuitry in visual word processing both when undergraduates learn a new language (developed by T. Givón) and in children acquiring literacy for the first time. None of these studies would have been possible eight years ago. The careful work of Marrocco and Takahashi on animal models, and the development of high density recording by Tucker were necessary to carry out this work and many other projects currently underway here. Kent Stevens and Margaret Sereno provided the modelling skills that have helped Jerry Russell to design BRAIN (Bayesian Reentrant Analysis and Inference Network), a very interesting and detailed model of early vision.

In the process of these studies eight students have graduated with certificates in cognitive neuroscience and we have about twenty more currently in process. Our project has also attracted many postdoctoral people not only from the U.S. but also France, Ireland, UK, Spain, Japan, Italy, Germany, India and Russia. For example, Yalchin Abdullaev has completed two years here and accepted an Assistant Professor position at the University of Louisville School of Medicine. At the recent International Congress, he reported on his studies tracing the circuitry of semantic processing of words using high density electrical recordings from the scalp in relation to PET and depth recording studies.

One of the major trends of our research has been to move toward brain plasticity. This includes many forms of learning being carried out by Anderson, Keele, McCandliss and others. In addition, with the recruitment of Helen Neville and the collaboration of Dare Baldwin and Mary Rothbart, we have underway studies of development in infants and young children using high density electrical recording and many types of cognitive tasks. Marjorie Woollacott has also studied infants and young children, but has examined changes toward the end of life as well.

While the McDonnell and Pew Foundations will be phasing out their direct support of Centers, we expect that our Center will continue to study how the attention system develops and is expressed in many forms of human skill with individual grants and group grants from NSF, NIMH, McDonnell, Human Frontiers, ONR and other sources.

## INTERDISCIPLINARY SEMINAR

**"The Evolution of Mind, Culture and Communication"**

**Fall, 1996**

**sponsored by**

**Institute of Cognitive and Decision Sciences**

### CO-TEACHERS:

**Larry Sugiyama (Anthropology)**

**John Orbell (Political Science)**

**Emilia Martins (Biology)**

**Tom Givón (Linguistics)**

**TIME: WEDNESDAY 2-5pm**

**PLACE: Humanities Center Conference Room, PLC**

The study of the evolution of culture and culturally-mediated behavior and cognition has been, historically, a neglected step-sister to the study of physical and neurological evolution. The reasons for this curious neglect are varied and complex. They go back to the Wallace-Darwin split, and further back to the traditional philosophical and religious reluctance to examine the human mind, soul and rational intelligence from the same adaptive perspective from which evolutionary biologists examine the human body and brain. Part of the lingering reluctance is no doubt due to well-known simplistic abuses and plain bad science, in the naive-Darwinian study of human culture, behavior and intelligence. Part of the neglect is also due to the inherent difficulty of studying the evolution of the "soft" components of the organism, where evidence is hard to come by, and where unbridled speculation has often been substituted for sound methodological thinking.

Be all these reasons as they may, the topic is too important for us to continue to ignore. Such continued neglect would be tantamount to the admission that the physical hardware of human behavior — the neurology — has

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## Interdisciplinary Seminar

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somehow evolved in total independence of the software that runs it—the behavioral and cognitive capacities of the organism. In terms of plain evolutionary thinking this sounds so unlikely, that only the most died-in-the-wool Cartesian dualist (or the devoutly religious) could take such a proposition seriously as a scientific research program.

What we would like to do in this seminar is put all possible questions, and the facts relevant to them, out in the open, on the table. We would like to begin by surveying some of the fundamentals of evolutionary-adaptive thinking, and then move on to some of the core questions: the rise of human cognition and culturally-mediated behavior, the evolution of social behavior and cooperation, and the rise of social communication and ultimately human language. Contributions from the four co-teachers in their areas of expertise may alternate with visits from invited speakers. There will be a reading packet, and a term paper will be required for grade. The course is currently listed in the Fall catalog as LINGUISTICS 607, but 600-level credit in anthropology, political science or biology can be arranged. For further information please contact John Orbell, Emilia Martins or Tom Givón (Larry Sugiyama will be late this quarter).

## TWO INTRODUCTORY fMRI PROGRAMS SPONSORED BY THE MGH-NMR CENTER

- 1) 4-Day Intensive Visiting Fellowship Program
- 2) 1-Day Lecture-Only Workshop Preceding Annual CNS Meeting

This notice to Cognitive Neuroscience Society members concerns two different programs for an introduction to functional magnetic resonance imaging (fMRI) based research.

The longer, more intense program, is a 4-day workshop held three times per year at the MGH-NMR Center in Charlestown, Massachusetts. Participants attend lectures, have ample time for informal discussion with the lecturers, attend a “demonstration” fMRI experiment, design a group fMRI experiment, implement, execute, and analyze the data from that experiment. Registration fee is \$1000, or \$600 for graduate students.

The next such program is scheduled for October 16-19, 1997. The program is limited to 23 people. There are still openings for this session. For detailed information regarding registration, accommodation, etc., consult the web page at: <http://www.nmr.mgh.harvard.edu/fmrivfp> and/or send e-mail to: [fMRIVFP@nmr.mgh.harvard.edu](mailto:fMRIVFP@nmr.mgh.harvard.edu)

The second program is a one-day, lecture-only, workshop that will be held in the Westin hotel on the Saturday (March 22, 1997) immediately preceding the annual meeting of the CNS (March 23-25, 1997) in the same hotel. This one-day workshop on the fundamentals of fMRI would be a repeat of the first day of the “fMRI2Day” program (“Tutorial Lectures on FMRI”) held in Boston in June, 1996, in conjunction with the Second International Conference on Mapping the Human Brain.

In contrast to the fMRI Workshop held in San Francisco in 1995 (which gave a broad introduction to the technology and its applications, covering a wide range of issues from fundamentals to research results), the proposed workshop for 1997 would be focused on the basics of fMRI—underlying physical and biophysical principles, conducting experiments, data analysis, experimental design, and comparing data across brains. It would be taught primarily by the staff of the MGH-NMR Center.

Registration fees for this workshop would be the same as for the June, 1996 meeting: \$75 for students, \$100 in advance, and \$150 at the door. Registration will be limited to approximately 200 people. Registration via e-mail is recommended at: [fMRI4CNS@nmr.mgh.harvard.edu](mailto:fMRI4CNS@nmr.mgh.harvard.edu)

Information on the previous June, 1996, program is available at: <http://www.nmr.mgh.harvard.edu/HBM96/2day/2day.html> Information specific to the CNS 1-day program will be presented on a future web page, some time in October, at: <http://www.nmr.mgh.harvard.edu/fmrivfp/fMRI4CNS>. For further information please contact the following:

Robert Savoy, Ph.D.  
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Room 2301  
Building 149, 13-th Street  
MGH-NMR Center  
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## 8TH ANNUAL SUMMER INSTITUTE IN COGNITIVE NEUROSCIENCE

Gregory J. DiGirolamo

From July 1 to July 14, the James S. McDonnell Foundation & Pew Charitable Trusts sponsored the 8th annual Summer Institute in Cognitive Neuroscience at Dartmouth College in Hanover, New Hampshire under the auspice of Dr. Michael Gazzaniga. The Summer Institute in Cognitive Neuroscience is a two-week international training course (with each week focusing on a single topic) for graduate students, post-doctoral fellows, and faculty. The 1996 Summer Institute focused on Memory and Frontal Lobe function, and was attended by Michael Anderson, Antonella Pavese, Brian Rakitin, and myself.

Leading experts in cognitive psychology, neuroanatomy & neurophysiology, neuropsychology, and computational modeling presented the latest research and techniques for studying memory and frontal lobe function. The methodologies varied from simple choice reaction time to the latest neuroimaging techniques; from animal maze learning to patient work; from developmental disorders to neural network modeling, from ethology to evolution. Besides lectures and presentations, lab sessions were held which taught us how to test neuropsychological patients, how to design neuroimaging experiments, how to read magnetic resonance images (MRI) and computerized axial tomography (CAT) scans to determine locations of brain damage, how to build neural network models, and how to dissect human brains.

**Read these words:** SEW, THREAD, SOUP, POINT, CAN, DARN, SHARP, STITCH, THIMBLE, ALPHABET

The first week on memory was led by Dr. Daniel Schacter from Harvard University. Dr. Schacter organized an impressive collection of researchers whose areas of expertise ranged from work on the neurochemical basis of memory (long-term potentiation[LTP], perhaps, the cellular basis of memory) by Dr. Gary Lynch from the University of California at Irvine, to neuroimaging work on hemispheric specialization in memory by Dr. Endel Tulving from the University of Toronto. We heard about food storage in birds and the relation of storing strategies to hippocampus size (hippocampal structures are crucial for storing new memories) from Dr. David Sherry from the University of Western Ontario, and neural network modeling of hippocampus function from Dr. Michael Hasselmo of Harvard University. My favorite memory talk was given by Dr. Schacter on the neuroimaging of illusory memories. Without looking back, was the word "NEEDLE" in the list that you read at the start of this paragraph? If

you remembered "Needle", you've just experienced an illusory memory. Illusory memories are memories for words that subjects report having seen in the study list though the words were not actually presented (though they are semantically related). Surprisingly, the same areas of the brain are active during an illusory memory as a real memory; with the exception that real memories activate the cortical areas involved in the sensory processing of the studied words (e.g., auditory areas if the words were heard, and visual areas if the words were seen).

The second week on frontal lobe function was led by Dr. Robert Knight from the University of California at Davis. Dr. Knight brought together researchers who studied monkey and human frontal lobe functions. We heard a talk by Dr. Patricia Goldman-Rakic from Yale University on single-cell recordings in monkey prefrontal cortex and how depletion of dopamine in these areas would cause a monkey to forget where a recently hidden food reward was located. Dr. John Jonides from the University of Michigan presented neuroimaging data which demonstrated that working memory used the same neural areas regardless of the sensory input. We also heard talks by Antonio Damasio from Iowa University, and Bob Knight and Bob Rafal from the University of California at Davis, on the effects of frontal lobe damage in humans. Most importantly for me, we saw videos of real people suffering from frontal lobe damage...an illuminating experience which made the abstract notion of frontal damage intensely human. Dr. Leah Krubitzer gave a spirited talk on the evolution of frontal lobes in marsupials and mammals. The week ended with an interesting talk by Dr. Terrence Sejnowski (I now know how to properly pronounce his name) from the Salk Institute on a neural model of frontal lobe function.

Besides classes and labs, the Institute provided an excellent opportunity to meet many people working in Cognitive Neuroscience and exchange ideas. Nightly scopa (an Italian card game) tournaments were held in which the exchange of ideas quickly (and appropriately) degenerated into the exchange of drink and humor. As the Institute coincided with the July 4th holiday, a barbecue was also held. Though the weather did not cooperate, a good time was still had. Swimming, volleyball, and canoeing were other activities which filled our days. Finally, a tongue-in-cheek debate occurred each week (ask Mike Anderson to do his William James impression) in which no one was spared from our biting humor. It was a fun, interesting, and intense two weeks.



## INSTITUTE GAINS NEW MEMBERS

Our newest additions to the Institute are Holly Arrow, Psychology Department, Doris Payne, Linguistics Department and William Harbaugh, of the Economics Department. Following are biographies written by each of these members describing their areas of interest and a little background. Welcome to all!

### Holly Arrow

I am delighted to join the Social Cognition and Decision Making branch of the Institute.

My main research focus is studying small groups whose membership changes over time, both as a consequence of internal dynamics and in response to changes in the group's environment. While working toward a Ph.D. in social and organizational psychology at the University of Illinois, Urbana-Champaign, I collaborated with my advisor, Joseph McGrath, and other colleagues on several studies of group development and performance in face-to-face and computer-mediated groups. My focus on membership issues also includes the study of how demographic diversity in group composition affects group identity and group performance, especially on creative tasks.

My questions about cognition in groups draw on the concept of schemas in the social cognition literature. How do people in groups import, adopt, adapt, and invent new group schemas for predicting the behavior of other members and interpreting events in the world outside the group? How do members of a group construct a coherent narrative out of their multiple perspectives? And how does this process differ for groups whose composition is more or less homogeneous?

My dissertation addressed some of these questions by looking at the emergence of norms in newly formed groups, and at the stability of those norms as the groups added members. From the new member perspective, I was interested in how the socialization process differed for male and female newcomers who arrived either singly or in pairs. I found that female newcomers perceived the culture of their groups more accurately than male newcomers, and female newcomers in formerly all-male groups judged themselves to be fitting in better than did male newcomers joining formerly all-female groups.

One area of group decision-making that particularly interests me is membership decisions: the decision to add, substitute, expel, or reassign members of a group. In some cases, these changes ensure continuity in a group. In other cases, membership change is a strategy for altering group behavior. John Orbell of Political Science, visiting

institute postdoc Nahoko Hayashi, Ph.D. student Ruth Bennett and I are planning a study that draws on small group theory and game theory to understand the choices about membership that both prospective and established group members make.

The concepts of membership and group take on a different meaning in cyberspace. What does it mean to be a member of a group that "meets" in a non-physical social space that is jointly constructed via the text-based communication of its membership? The way people who meet in a virtual space adjust their behavior and adapt the technology to their needs provides insight into the social grammar of group life that has developed through both biological and cultural evolution. Although my primary affiliation is with the Social Cognition group of the institute (note how careful I am to clarify membership issues), my thinking about these issues has already been enriched by conversing with members of the Culture, Cognition, and Language branch.

I moved to Oregon in August with my three-legged cat Osha and my husband Bruce Holland Rogers, who spends his time creating text-based virtual social systems known as novels. We all feel at home here. Eugene reminds us of Boulder, Colorado, where Bruce and I met while teaching writing, and from whence we moved to scenically challenged Central Illinois. Bicycling to campus along the Willamette, I once again start each day with gratitude at living amidst great natural beauty.

### Doris Payne

My professional academic career began, I suppose, when I was about 8 or 9 years old. I spent part of my growing-up time in Tanzania (then Tanganyika), East Africa, where my parents (and grandfather before them) had been involved in language work on Sukuma. Sukuma is a Bantu language, related to Swahili. I remember distinctly standing beside the table while my mother explained to me how in Sukuma, the form of a noun, its modifiers, and the verb all change in wonderful alliteration together, as the kind of item the noun referred to changes. I remember being impressed with what a neat way this was for a language to work! Many, many years later I learned that the phenomenon in question is linguistically referred to as "noun classification", and that linguists and cognitive psychologists had come to think there was something pretty interesting about it too! However, at that point, I wasn't really into research on anything other than tree climbing and game playing.

My linguistic research life began in earnest with two-plus years in Peru (where I discovered that a lot of languages all over the world have "noun classes"), and has continued with field work on languages of South America (Venezuela, Brazil, etc.), North America, a bit of Austronesian, and most recently has extended to Nilotic

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## New Members

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languages of — yes — East Africa. A primary focus of my work on all these languages has been on understanding their word, sentence, and discourse structures, both structurally and in terms of functional communication. For the most part, languages I have worked on have been chosen because their speakers either normally begin sentences with the verb (rather than with the subject), or the order of verb, subject and object in the sentence is determined by various “discourse” properties (thus, to an English speaker, the order of words within the sentence may appear to be “free”). Some of the results of this work include grammars that I have co-authored with Tom Payne on Yagua (Peruvian Amazonia) and Panare (Venezuelan).

One of my most recent projects is focused on understanding how languages can express “possession” without putting an overt possessive marker like “my” or “your” into the sentence. For example, a Maasai speaker can literally say “The goat fates me” to mean “My goat is fat”, or “The man took me the child” to mean either “My husband took the child” or “The man took my child.” In English one can say “She hit me in the right front fender,” and it is clear that it must be “my fender” that got hit. It turns out that, like noun classification, this kind of phenomenon is also very widely found around the world.

One reason that this way of expressing possession is of interest to cognitive linguists and syntacticians is because the number of referents in the sentence is often at odds with the number of referents many linguists have believed the verb in that sentence should be able to take. This then has implications for what kinds of information speakers “store” about different verbs, for theories of syntax, and for theories of how listeners process the meaning of sen-

tences upon hearing the component words. (In the coming year, the Department of Linguistics hopes to host an international conference focusing on this topic.)

Another long-term project that I am very excited about involves collaboration with native Maasai speakers and the Maasai Cultural Center of Kenya on a dictionary of the Maasai language. This project of course involves tremendous research into all aspects of the Maasai language, culture, and world-view. The end-products of the research will be not only a better understanding of the language and culture, but also practical materials of use to the Maasai in passing on knowledge of their culture to future generations.

### Bill Harbaugh

I was born in Connecticut, grew up in Virginia, and ran away to Montana when I turned 18. I have graduate degrees in agricultural economics and economics. My wife Pamela is a graphic designer and we have two children.

One current research interest is explaining why people do good deeds, such as vote and give money to charity. Existing economic models account for such behavior either by arguing that people care about the results of their actions, or by hypothesizing that they somehow get utility from the actions themselves. My research suggests that many aspects of peoples behavior are best explained by models where people care about how others perceive their deeds. Voting provides one example. About a quarter of those not voting in presidential elections will lie and claim that they did. I show that this can be an equilibrium in a model where citizens have heterogenous tastes for praise, (obtained by claiming to have voted) and distastes for lying.

Charity is another example. Charities publicize the donations made to them, usually by setting brackets for different categories of donation amounts and then report-

ing the names of the donors that fall into each category. Donations tend to clump up at the minimum level needed to enter a certain category. These facts, as well as behaviors such as tithing, can be explained with a model where people derive some benefit from having the charity report how much they gave.

I am also interested in the origin of tastes and preferences. Economists typically accept these as given. Since virtually any behavior can be described as the rational result of some taste, the value of the assumption of rational behavior is very much weakened. I believe that by showing that tastes have a rational basis this value can be restored. Currently I am working on a paper that shows that prospect theory preferences toward risk can be rational in an evolutionary environment. Related research includes the formation of tastes and the development of rational economic behavior in children.

## DISSERTATIONS

### Electrophysiological Studies of Auditory Contexts Petr Janata

Memories of previous sensory input and accumulated knowledge of how the sensory environment behaves are capable of shaping our perceptions of incoming sensory information. Similarly, moment-to-moment sensory input is capable of reshaping stored representations, especially when the recent information doesn't match our expectations. In this dissertation, I studied neural correlates of perceptual and cognitive processes in the auditory system to (a) understand how harmonic sounds are represented by populations of neurons in the auditory midbrain and how these representations are influenced by the contexts in which the sounds appear and (b) find

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## Dissertations

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neurophysiological correlates of the representations of harmonic sounds are activated to generate expectations, or mental images, of specific physical information.

To address the first issue, neural representations of incoming auditory information were studied by recording the responses of neurons in the central nucleus of the barn owl's inferior colliculus (ICc) to harmonic sounds. While consisting of multiple frequencies, a harmonic sound is perceived as having a single pitch corresponding to its fundamental frequency, even when the fundamental frequency is physically absent. Recordings of single neurons and populations of neurons showed that the ICc neurons encode the fundamental frequencies of harmonic sounds and combinations of harmonic sounds in their temporal pattern of firing. Additional experiments showed that the neural representation of a harmonic sound depended on the context in which the sound occurred. If a particular sound was embedded in a rapidly repeating sequence of different sounds, the neural response was altered relative to the response observed when the sound was played in isolation or when it formed the stream of rapidly repeating sounds.

The second topic was approached by recording the brain electrical activity at the scalps of musicians as they listened to simple eight note melodies and imagined portions of these melodies. The patterns of evoked brain activity were very similar for heard and imagined musical events, suggesting that the act of imagining a specific musical event activates auditory cortex. Additionally, the results implicate auditory cortex as a site at which external and internal representations of pitch are compared.

## Mechanisms of Memory for Musical Attributes

**Daniel Levitin**

Seven experiments were conducted to investigate the underlying mental codes and mechanisms of memory for musical attributes, in particular, musical pitch and musical tempo.

Experiment 1 establishes that absolute pitch is a continuum of abilities present in the general population, and that long-term memory retains sensory details of prior experiences. It also reveals a dissociation between labeling ability and recognition memory for tones in normal subjects: normal subjects without labeling ability are able to remember the absolute pitch of tones far better than had been previously thought. Experiments 2 and 3 generalize this finding to musical tempo. Experiments 4, 5 and 6 (a) further support the notion that AP is a continuum of abilities, and (b) find that people with absolute pitch do not have categorical perception, as has been previously claimed. Experiment 7 explores the issue of whether focal tones exhibit the type of perceptual magnet effect that focal vowel sounds do in spoken language, and concludes that they do not. Experiment 8 finds a moderate dissociation between labeling ability and recognition memory for tone in possessors of absolute pitch. This finding shows that AP possessors with near perfect labeling and production abilities may still make large errors in tone recall. Experiment 1 showed that people without absolute pitch may have near perfect memory for pitch. These two results show a double dissociation between absolute pitch as conventionally defined and the ability to remember pitch in a musical context.

## Reentrance and Recurrence in Early Vision: Perception, Imagery and Learning

**Jerry Russell**

Two major characteristics of

the canonical microcircuitry of the neocortex are recurrence (dense local connections between basal dendrites and local axonal ramifications) and reentrance (forward and reverse axonal projections between hierarchically related areas of the cortex). This pattern of connections suggests a design for carrying out Bayesian inference. The Bayesian prior is stored in the synaptic weights of local (recurrent) circuits within a cortical area. Transformations between different representations of the sensory panorama are carried out by reentrant projections.

After an introductory historical and philosophical review of topics related to neuromorphic modelling of biological nervous systems, the techniques of Bayesian inference are demonstrated in an example problem drawn from ERP source localization. Then a neuromorphic architecture for Bayesian inference in the early visual system is detailed, and tested for its ability to resolve edge locations at hyperacuity levels, and for its capabilities for signal detection in noise. The model is compared with the Grossberg models of early vision, both in terms of its basic operating characteristics and in terms of performance in the signal detection task.

Because the entire design of the visual system is unlikely to be coded genetically, it is necessary to explain the pattern of connections in terms of self-organizing processes. Learning of Bayesian priors in recurrent networks is experimentally approximated using Oja's Hebbian learning rule. The wake-sleep algorithm is used as a model for learning in reentrant networks. An experiment demonstrating the rate of learning vs. network width, network depth and training set complexity is implemented, and a modification of the wake-sleep algorithm for supervised learning is demonstrated in a character-recognition problem, as well as in a

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## Dissertations

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paradigm requiring position-independent recognition of characters. Finally, the anatomy of reentrance and recurrence in the mammalian cortex are reviewed, and the mapping between the Bayesian reentrant model and the mammalian anatomy is illustrated.



**INSTITUTE**

**TECHNICAL**

## REPORTS

- No. 96-1** "Recognition Memory and Modality Judgments: A Comparison of Retrieval Dynamics"  
by **Douglas L. Hintzman and David A. Caulton**
- No. 96-2** "Conflict, Target Detection and Cognitive Control"  
by **Michael I. Posner and Gregory J. DiGirolamo**
- No. 96-3** "The Time Course of Parietal Activation in Single-Digit Multiplication: Evidence from Event-Related Potentials"  
by **Markus Kiefer and Stanislas Dehaene**
- No. 96-4** "Anatomy, Circuitry and Plasticity of Word Reading"  
by **Michael I. Posner, Yalchin G. Abdullaev, Bruce D. McCandliss and Sara C. Sereno**
- No. 96-5** "Time Course of Activating Brain Areas in Generating Verbal Associations"  
by **Yalchin G. Abdullaev and Michael I. Posner**
- No. 96-6** "Emotional Expectancy: Patterns of Brain Electrical Activity as Depressives Consider Life Events"  
by **Phan Luu, Don M. Tucker and Lynn McDougal**
- No. 96-7** "Vertical Integration of Neurolinguistic Mechanisms"  
by **Phan Luu and Don M. Tucker**
- No. 96-8** "Comparing Conditions for Learning Syntactic Patterns: Attentional, Nonattentional and Aware"  
by **J. Schachter, P.L. Rounds, S. Wright and T. Smith**
- No. 96--9** "On the Role of Metaphors in Science: Metaphors of Attention in the History of Psychology"  
by **Diego Fernandez-Duque and Mark L. Johnson**
- No. 96-10** "2-D Center-Surround Effects on 3-D Structure-From-Motion"  
by **Margaret E. Sereno and Martin I. Sereno**
- No. 96-11** "Interaction Among Depth Cues in Structure-From-Motion"  
by **Margaret E. Sereno and Martin I. Sereno**
- No. 96-12** "Sequential Representation and the Neural Basis of Motor Skills"  
by **Steven W. Keele, Matthew Davidson and Amy Hayes**

## FALL COLLOQUIUM SCHEDULE

During the fall term the following people are scheduled to give talks at the Institute's weekly Colloquium Series. They are held in room 156, Straub Hall, 3:30 pm. Be sure to attend.

September 30	Helen Neville (UO) followed by OPEN HOUSE
October 7	Michael Leyton (Rutgers)
October 14	Frank Roesler (Phillips-University Marburg, Germany)
October 21	TBA
October 28	Steve Keele (UO)
November 4	Don Tucker (UO)
November 11	TBA
November 18	Michael Corballis (University of Auckland)
November 25	William Stokoe (Gallaudet U)
December 2	Brigette Roeder (Phillips-University Marburg, Germany)

## SUBMITTING TO THE NEWSLETTER

When preparing an article for submission to The Newsletter that is more than a page long, please include your disk. It is possible to transfer both IBM and Apple data onto the Macintosh. Formatting suggestions (to save time after transferring, as well as to assure the formatting that you want): IBM—save in or convert to DCA format if possible, otherwise save as text or ASCII; Apple—Appleworks Word Processor files; and of course, Macintosh (Microsoft Word, Microsoft Works or MacWrite) can be accepted. For any questions on formatting, consult your reference manuals. Also, be sure to include the name of the relevant document(s) on the disk. You can give these disks either to that month's feature editor, or directly to Vonda at the institute. It will be returned as soon as it's been transferred, which, in some cases, can be a matter of only minutes.

### THE NEWSLETTER

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