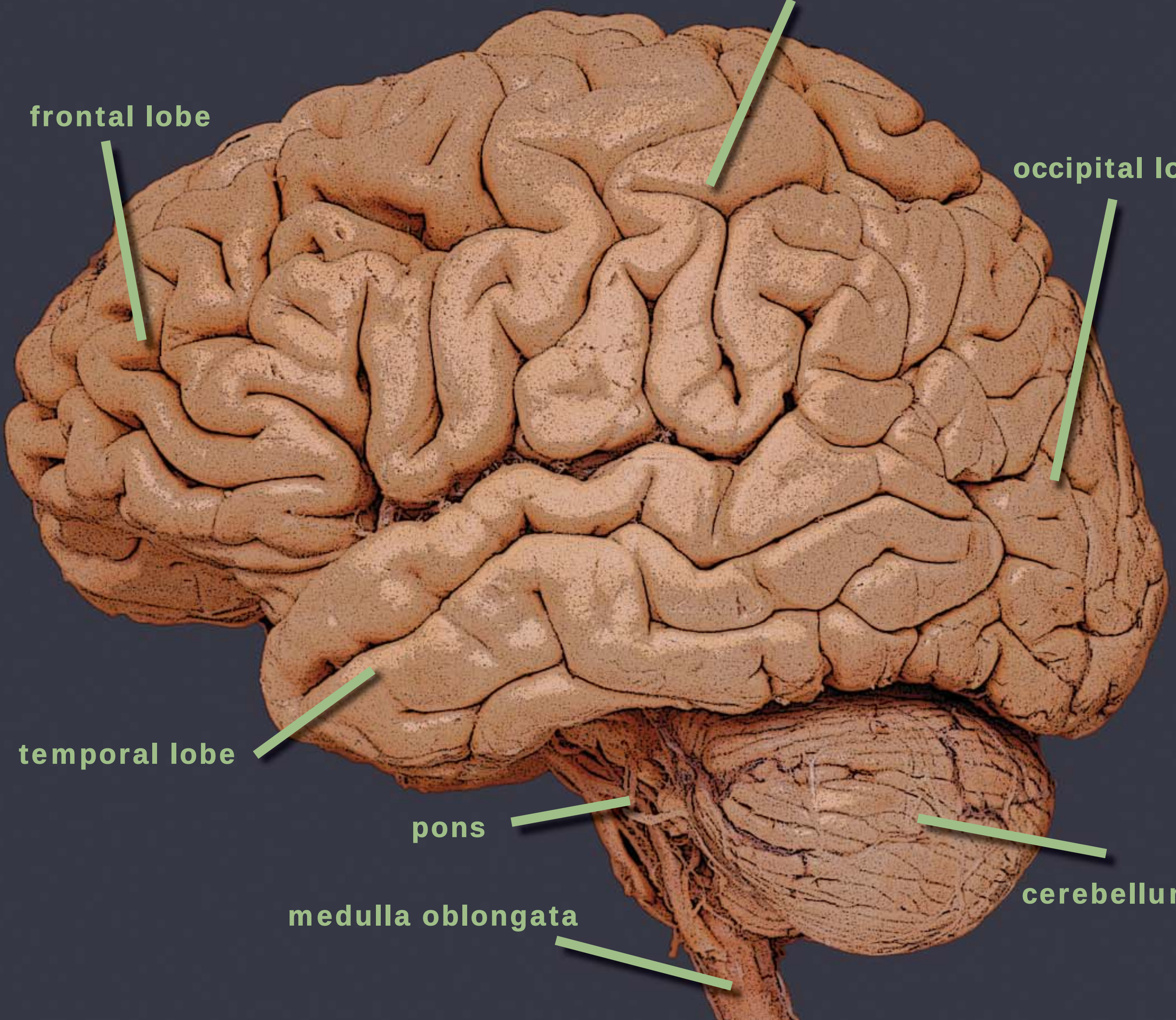
Phi Kappa Phi FORUM
A Publication of
The Honor Society of Phi Kappa Phi

Winter/Spring 2005

The Human Brain



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The views expressed in this publication are not necessarily those of the staff of *Phi Kappa Phi Forum* or the Board of Directors of The Honor Society of Phi Kappa Phi.

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2005 Winter/Spring

PHI KAPPA PHI FORUM, Volume 85, Number 1

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President's Page

Paul J. Ferlazzo

National President of The Honor Society of Phi Kappa Phi

In July 2004, the National Endowment for the Arts (NEA) issued a report that measured an important aspect of the intellectual life of the American public. The report, *Reading at Risk: A Survey of Literary Reading in America*, documents a decline in the commitment to literary reading from 1982 to 2002.

It is important to note that the NEA sponsored this report, rather than another agency. If the Department of Education, for example, had issued the report, no doubt the subject would be basic literacy.

Basic literacy is, of course, a serious problem in the United States, and much work needs to be done. Numerous reports document our falling level of literacy. Organizations such as ProLiteracy Worldwide, Literacy USA, and Phi Kappa Phi have contributed talent and resources to working on the problem of improving basic literacy. (Information about the Phi Kappa Phi Literacy Grants program is available at www.phikappaphi.org. See also the Spring 2004 issue of the *Phi Kappa Phi Forum* devoted to literacy.)

The NEA report, however, assumes basic literacy. It aims to measure not the ability to read and understand basic information, but to document the level of appreciation for literature. The report does not say that reading basic information is at risk; it asserts that reading literature is at risk.

According to NEA Chairman Dana Gioia, "This report documents a national crisis. Reading develops a capacity for focused attention and imaginative growth that enriches both private and public life. The decline in reading among every segment of the adult population reflects a general collapse in advanced literacy. To lose this human capacity — and all the diverse benefits it fosters — impoverishes both cultural and civic life."

What are the "diverse benefits" of literary reading that Gioia refers to? The report documents that readers are more likely to be involved in cultural and volunteer activities than nonreaders. As an example, the report cites that readers are two-and-a-half times more likely to volunteer or perform charity work in the community than nonreaders.

Although it is useful to focus a national conversation on advanced literacy and the added civic and cultural benefits, the report has a number of unsatisfying aspects. To name a few:

- The 17,000 adults who participated in the survey that formed the basis of the report's conclusions were asked if they had read novels, short stories, poetry, or plays in the past year not required for work or school. Why should the reading of literary works in leisure time be privileged? The aesthetic response to literature is as valid in a classroom setting or work environment as in an easy chair at home. College-age respondents (eighteen to twenty-four), who read in their literature classes, for example, were therefore unnecessarily discounted. Yet, their required reading forms the all-important foundation for the aesthetic practice of reading throughout their lives. I understand the need to measure free choice as an element in the study, but students have freely chosen to participate in the world of advanced literacy by seeking a higher education.
- The report makes no attempt to describe the characteristics of literary reading or to establish a hierarchy among the broad range of material available under the category of literature. Within the parameters of the report, the reading of any novel counts, whether written by Henry James or Jacqueline Susann, and the reading of any poetry counts, whether written by John Milton or Hallmark. These vastly different reading experiences are all permitted to qualify as "literary reading." Equating such works surely was not the intention of the NEA, but it is a functional limitation of its method.
- The report also makes an unexplained criticism that electronic media are somehow to blame. The report states that the new media have fostered habits of mind that counter the skills needed for literary reading. If this is true, the report needs to prove it. One might easily counter that the skills needed for the new media are considerably intellectual, though different, and not necessarily antithetical. The rich immediacy of electronic media with its demand for interactivity, heightened response, and expanded consciousness has an important place in our expanding culture.

Reading At Risk is the beginning of an important public conversation. Let it not be the end. I encourage Phi Kappa Phi members to join in the conversation at whatever level is appropriate for them. The report is available online at http://arts.endow.gov/pub/ReadingAtRisk.pdf.

Paul J. Ferlazzo, PhD, is a professor of English at Northern Arizona University. He can be reached at paul.ferlazzo@nau.edu.

Forum on Education & Academics

Jennifer M. Stolpa

2005: The Year of Languages

When most of my students hear how many languages my friend Maria speaks, they are amazed. Born of Greek parents and raised in Germany, she speaks both Greek and German fluently, as well as Spanish and English. Maria's language abilities are matched by many of our international students, particularly those who come from Europe, where many schools introduce English as a required second language in elementary school and require a third, and even encourage an optional fourth language, later on in students' lives.

For too many Americans, the idea of speaking a second language fluently remains either an enviable but unreachable goal or a seemingly unnecessary luxury. Despite the numerous benefits that studying language offers to individuals, communities, and our country, language educators too often still have to fight for their very existence in times of budget cuts. While many state-education departments and government leaders have long encouraged foreign-language study, financial support has not matched the level of stated interest.

The American Council of Teachers of Foreign Languages (ACTFL), in declaring 2005 "The Year of Languages," hopes to change perceptions of the importance of second-language acquisition. The vision statement for the initiative contends that "all Americans should be proficient in at least one language and culture in addition to English. For this reason, foreign language education must be part of the core curriculum and be treated as central to the education of all children" (www.actfl.org).

Unfortunately, this vision is not a reality in numerous school districts across the country. Learning a second language is only an elective in many high schools and too frequently is offered solely as an enrichment exercise in elementary schools. For example, in parts of the United States, particularly in poorer or smaller communities, no sustained language programming for young children exists. While elementary school children may learn colors or numbers in a second language, too few communities offer continuous education in a language from a young age through high school. Those who excel in language courses are still sometimes restricted at the high school level as well; because of budget constraints, some teachers are forced to offer third and fourth years of a language in the same classroom at the same time, thus diminishing the fourth-year students' chances for advancement.

Additionally, when education budgets are cut, high school language educators scramble to justify their positions and are often pitted against each other, asked to argue whether Spanish is more important than German, or Japanese more important than French. Some languages, although they are of great importance, are taught much less often. Chinese, Japanese, Arabic, and other non-European languages are unavailable in many areas of the United States, thus disadvantaging students in our changing world.

Simply put, too many people — inside and outside of education — view second-language acquisition as a luxury, an enrichment activity, or an elective. Despite the current need for culturally and linguistically diverse members to participate in the world economy and in foreign policy, as a whole too many of our students are in awe of students from other countries who know other languages.

To alter this situation, we need to capitalize on our very identity as a nation. The solution to surviving in the twenty-first century and beyond is already here in the treasure that is our rich cultural diversity. In this Year of Languages, we should embrace our heritage and become filled with a passion for learning the languages of our ancestors and our current neighbors. Language study in our schools ought to become, as ACTFL argues, a part of our core curriculum.

Indeed, individuals of all ages benefit from studying another language. It enhances native-language vocabulary and improves one's understanding of native-language grammar and structures. Becoming aware of common roots of words, for example, often introduces people to new ways of determining the meaning of a word — through using this knowledge of such common roots. In terms of structure, knowledge of such concepts as direct and indirect objects in English are crystallized by studying such structures in another language. Making native-grammar structures "foreign" reinforces their meaning in one's first language. Learning a language also improves memory as it "trains the brain" to recall information more efficiently. Finally, like all learning, learning a language provides rewards in self-esteem and can be tremendously gratifying to the individual.

In addition to these individual benefits, learning a language offers numerous benefits to the community at large as well. Economically, small and large companies gain (and thus the U.S. economy gains as a whole) when their employees can speak a second language. Employees able to speak another language help their businesses interact with local customers with different linguistic backgrounds, conduct international business without

(continued on page 5)

Forum on Business & Economics

Anthony J. Dukes

If You Can't Beat Them…

America has a love/hate relationship with Wal-Mart. Its customers love the low prices, and its competitors hate them. Investors admire Wal-Mart's efficient distribution system and low-cost operation, while labor groups protest its low wages and promotion record among women.

The hate side won last April in southern California when the community of Inglewood voted to keep Wal-Mart from opening a store within its district. While labor unions were a major force behind the "No to Wal-Mart" campaign, citing its wages as unfair, local shopkeepers also protested vigorously against the corporate retailer. From their perspective, the shopowners' message is understandable: keep competition out. However, if other Los Angeles communities are unable to keep Wal-Mart away, then shopkeepers in Inglewood may well have wished they had not been so resistant.

This conclusion, part of ongoing research of mine conducted in collaboration with colleagues at Carnegie Mellon University, is based on grocery-store data collected in the Chicago area during Wal-Mart's expansion there in the late eighties and early nineties. From our research, we observed that, while sales for some products fell at the grocery store located next to a newly opened Wal-Mart, sales for certain other products actually rose. In contrast, sales of most products fell at the store located further away from the new Wal-Mart.

Admittedly, our data were collected before the rapid growth of Wal-Mart Supercenters, which include a full-fledged grocery store in addition to the traditional Wal-Mart products. However, the insights learned from this study offer more general lessons about how incumbent neighborhood shops react to entry by a big discounter — even if it is a Supercenter.

Relying on modern economic theories of competition, we developed a model to understand the effect that Wal-Mart would have on two local grocery stores. Like any scientific model, ours is a simplified version of the real world. Nevertheless, it reveals a pattern of consumer movements that seems quite plausible, even though the conclusion is surprising.

To illustrate the explanation behind our results, consider two traditional grocery stores that compete in the same town, and suppose you are the owner of one of them. If Wal-Mart's entry is inevitable, common notions about competition would lead you to hope that it will locate at the other end of town or perhaps, even better, next to your rival.

And this makes sense given that, as anyone who has shopped at Wal-Mart knows, the retail giant carries a large assortment of products, which are also sold at traditional grocery stores. For example, common grocery-store items such as sodas, napkins, chips, and many packaged dry goods are easily found at Wal-Mart — at lower prices. In fact, Wal-Mart's prices are sometimes even lower than the grocery store's wholesale plus stocking costs.

The nearby grocery store's key to survival, however, is that it also stocks a set of products not found at Wal-Mart. Most households must, in fact, visit the grocery store to buy fresh produce, meat, or cheese.

Suppose a shopper makes a trip to Wal-Mart to buy bedding. While there, he might also pick up necessities such as paper towels, toilet paper, or sodas because Wal-Mart usually has the cheapest prices. But, if he also needs fresh vegetables, it would be easier to pick them up at the grocer next door than to travel to the one across town. This suggests that, if you are the store next to Wal-Mart, then you can expect a boost in sales of your unique products.

To be sure, not all shoppers are too pressed for time to shop for a better deal at the distant grocer. But those with busy schedules tend to be those who earn more money and who, therefore, are willing to pay a little extra for the convenience of saving time. Those with less income, in contrast, have more incentives to shop around. The distant retailer, if it is smart, lowers its prices to attract these value-savvy customers. This, however, is not necessarily bad for you because you are now left with customers who have, on average, a higher income. And there is substantial evidence suggesting that customers with higher incomes typically are willing to pay higher prices.

This finding leads to a puzzling conclusion: If Wal-Mart locates next to you, then you should raise some of your prices! The principle behind this unintuitive phenomenon is also at work when we sometimes observe the price of a brand-named pharmaceutical drug increase after its patent expires. When generic-drug makers enter the market, many of those who switch to the no-name brand are more price-sensitive than those who stick with the brand-named drug. The seller of the branded drug is left with, on average, less-price-sensitive buyers, which allows it to raise its price.

Testing the predictions of the theory against the data, we observed that for bakery goods, produce, cheese, and other fresh or frozen product categories, sales increased at the nearby store after Wal-Mart opened, while sales of most products fell at the distant store. Moreover, the data suggest that the average price elasticity of customers at the nearby store decreased — consistent with the theory.

But should you, as the grocery next to Wal-Mart, abandon the paper towels? Not necessarily. It is a safe bet that many neighborhood customers not in need of a drill or a pair of jeans from Wal-Mart will want to visit only one store for all their grocery needs, including the paper towels. Again, such consumers will tend to be the less price-sensitive kind. So, as long as you carry unique products, you will benefit by carrying the products common to Wal-Mart, even if you cannot beat its "every day low prices."

But what about the Wal-Mart Supercenters, which now number almost one-to-one with traditional Wal-Marts? The lesson from our research is that the incumbent grocery store should determine its unique product and highlight it vis-à-vis Wal-Mart's offerings. In our story above, it was produce and fresh foods. But because Wal-Mart Supercenters carry these items too, grocery stores might want to emphasize items that appeal to the higher-income consumers, such as imported or ethnic food alternatives.

One should not take our results too far by concluding that grocers do better when a Wal-Mart is close by. Two sellers in the same market will always fare better than three. But if entry is inevitable, which it would seem so given the chain's ambition to grow by five hundred stores in 2005, then our research suggests that it is better that Wal-Mart locate next to you, rather than next to your local competitor. Inglewood's grocery-store owners may have won last April, but if Wal-Mart is successful in opening stores in neighboring communities, then their victory may be short-lived.

Anthony J. Dukes is an associate professor at the School of Economics and Management, University of Aarhus in Denmark. He holds a PhD in economics from the University of Pittsburgh and conducts research concerning the economics of advertising, marketing, and commercial media.

(2005: The Year of Languages *continued from page 3*)

having to hire outside interpreters or translators, and improve internal relationships between those whose first language is English and those for whom it is a second language. For this reason, some companies are now offering on-site language courses to their employees or reimbursing employees for off-site courses.

Stronger second-language skills in the U.S. population would also have a profound impact on our national security in two ways. First, to gather, translate, and interpret intelligence, we need more individuals with strong second-language skills. Developing such skills takes years and must be supported financially from an early age.

Second, a greater emphasis on language study would enhance our intercultural awareness. Learning another language automatically involves understanding another culture better, as language and culture are inextricably connected. In studying another language and culture, we all become more familiar with the backgrounds of fellow Americans and with the values, morals, and way of life of those in other nations. Cultural understanding reinforces international ties and deepens our respect for other perspectives, thus strengthening our relationships in the global community.

Throughout 2005, the ACTFL is striving to involve local communities in a variety of events focused on promoting learning a language. We should pay attention to such events in our local communities and consider the ways in which learning another language would enhance our lives and the lives of those around us.

Furthermore, during this year, we ought to strive for a deeper transformation in how our country views second-language acquisition. No longer should we view second languages as "electives," but as requirements — at all levels. No longer should language teachers have to fight to justify their jobs to legislators or community members in tough economic situations. No longer should we see speaking a second (or third) language, any language, as a rarity, but as both a laudable goal for all our citizens and a necessity for our individual and collective prosperity.

Jennifer M. Stolpa is an assistant professor of English at the University of Wisconsin-Marinette, where she also teaches Spanish. She can be reached at jstolpa@uwc.edu.

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Summer 2005: Computer Games

Fall 2005: College Athletics

Winter/Spring 2006: Nutrition and Health

Summer 2006: Television

And coming this June, the first issue of the Phi Kappa Phi E-Zine!

Forum on

Science & Technology

Evelyn Tiffany-Castiglioni

The Domestication of the Dog, Part II

In my previous column (Summer 2004) I discussed how all modern domestic dogs can trace their origins from ancestral Eurasian wolves fifteen-thousand years ago. I also discussed the farm-fox experiment, which was a reenactment of how domestication may have taken place. In the fox experiment, researchers showed how wild silver foxes, selectively bred over thirty-five generations and forty years for the sole trait of friendliness to humans, became more dog-like animals. These so-called "domestic elite" foxes are not only friendly to humans and seek human attention, but some of them also have new physical traits that have appeared in parallel with the selection for tameness, even though the physical traits were not selected for *per se*. These traits include spotted or black-and-white coats, floppy ears, tails that curl over their backs, and earlier sexual maturity. In this column I shall discuss a speculative view on how humans and the wolves that became proto-dogs may have interacted at the dawn of domestication, how domestication has been taken one step further through the creation of breeds, and how purebred dogs are not just attractive and intelligent (many of them) but are golden right down to their very genes.

CLEVER ANCESTORS, HUMAN AND CANINE

Fifteen thousand years ago dog domestication was probably not so concentrated or focused an endeavor as the farm-fox experiment, but humans had to have been ready for it. The people who domesticated dogs must have had a society in which a long-term project of this kind could be supported and passed on to ensuing generations, even without the advantage of written records. They must have had some understanding that traits are inherited and must have been able to keep wild wolves from breeding with their proto-dogs. They also must have placed great value in the dog to invest their time and resources into its breeding.

Possibly they had some partially tame wolves to work with, such as self-selected wolves that found an ecological niche as scavengers on the outskirts of settlements. According to Dr. Raymond Coppinger (Hampshire College, Massachusetts), such wolves may have been less fearful of humans than most wild wolves, and this trait must have been inheritable, making these wolves more amenable to domestication. The wolves hypothetically separated into two populations, the village-oriented scavengers and the packs of hunters. The next steps have not been defined, but selective pressure must have been present to sustain the divergence of these populations. At some point, conditions under which social bonds could form between pups and humans, perhaps while the pups were still of nursing age, must have developed. That is an uncomfortable number of "must-haves," but research has not yet shed further light on this aspect of our remarkable pre-history.

The wolf-as-camp-follower hypothesis is unfortunately difficult to test and is supported primarily by observations that in some parts of the world, dogs live as locally adapted village scavengers. However, it may be of value to study other urbanized canids, such as urban coyotes that have become increasingly present as scavengers in Los Angeles and Vancouver for two or three decades. Anecdotal observations indicate that these animals are less fearful of humans than are coyotes remaining in the wild. Is this an example of individual adaptation, or are populations of animals undergoing genetic selection for tolerance to humans? Do they pass these traits on to their offspring? I have been unable to locate any research in this area. What an intriguing project for an evolutionary genomicist, an animal behaviorist, and an ecologist.

The fact remains that our human forebears and dogs' wolf forebears were both resourceful organisms who established a commensal relationship that has endured over millennia. The relationship is still evolving, and with recent revelations from canine genomics, it is evolving in unexpected ways. Not content with the basic dog, humans took to artificial selection for creating races or breeds of dogs with specific appearances, behaviors, and dispositions. More than four hundred breeds, one hundred and fifty of which are recognized by the American Kennel Club, have been created by generations of tightly regulated breeding to a breed standard, mostly in the last one hundred to five hundred years. No other animal seems to have been subject to as much intentional selection as the dog. While purebred dogs were initially bred for specific working behaviors, they are now more commonly bred for desired appearance and temperament, and the job title held by most purebred dogs is "companion and pet." However, their service to humans may expand after the publication in May 2004 of the first detailed genetic comparison of purebred dogs. A serendipitous offshoot of creating dog breeds seems to be new models for human hereditary diseases.

ADDING TO THE DOG'S RÉSUMÉ

Dr. Elaine A. Ostrander and Dr. Leonid Kruglyak (*Science*, Vol. 304, p. 1160; 2004) at the Fred Hutchinson Cancer Research Center in Seattle found that by comparing genetic information among eighty-five dog breeds, they could discover the genetic and evolutionary relationships among breeds. Breeds are revealed to have the same genes but with variants in DNA sequence that are breed-specific. In this respect, dog breeds are even more distinct than are human populations that have evolved on different continents. Surprisingly, the dogs with the closest genetic relationship to ancestral wolves are several ancient Asian breeds, including the unlikely Sharpei, a medium-sized, broad-muzzled dog that looks like it is wearing a much larger dog's skin. In contrast, the Pharoah Hound and Ibizan Hound, which resemble pictures on ancient Egyptian tomb walls, turn out to be modern recreations of the body type from other breeds. Dr. Ostrander's larger message, however, is the usefulness of purebred dogs in the study of hereditary diseases. Various breeds have distinct hereditary health problems. Breeding records have been kept on many breeds for decades. Therefore, purebred-dog populations may be useful for identifying specific genes associated with diseases that affect both dogs and humans, such as cancer, epilepsy, and heart disease.

Just when a purebred-dog's life was getting easy, along comes a new job responsibility. Most terriers no longer have to chase moles and rats, nor do most Labrador retrievers have to fetch fallen game birds. Few if any poodles have to serve their original job function, which, like Labradors, was to retrieve water birds for hunters. Now purebred dogs may have a new role: they are the living repositories of genetic goldmines.

Dr. Ostrander's work with dogs makes more plausible the long-standing belief by some scientists that dogs are good animal models for hereditary human diseases. The more convenient, commonly used, and fundable (through federal-granting agencies) models for genetic, molecular, and cellular aspects of disease are laboratory mice (*Mus musculus*) and rats (*Ratus norvegicus albinus*). This state of affairs exists for both practical and circuitous reasons. The practical reasons are that rats and mice are similar to humans at the cellular and molecular levels; develop some of the same diseases as humans, particularly certain cancers; and have very short generation times. Rats and mice have gestational lengths of about twenty days, are ready to breed at four months of age, and progress through aging and death in two years. In contrast, the gestational period of dogs is about sixty days; dogs can breed at seven to twelve months of age; and life spans vary from seven to fifteen years, depending on breed.

In addition, mice can be genetically manipulated to express designer genes, including human genes or mutated genes, or to have gene additions or deletions. This development of "designer mice" in laboratories follows from their short generation times and the wealth of information that scientists have gained about their reproductive biology and genetics. Rats are not used as widely for genetic manipulation, but they are commonly used for toxicologic and neurobehavioral studies. Mice and rats have been studied for nearly a hundred years in the laboratory, which brings us to the circuitous part of the reasoning. We have so much information about mice and rats that we tend to keep using them because other animal species are less well-characterized. However, though rodent models are here to stay for the foreseeable future, a major reevaluation of the value of canine models for human disease is about to take place.

Valuable though they might be to science, the idea of increased use of dogs as research animals is particularly antithetical to our view of them as man's best friend. However, the dog as a subject of study for inheritable diseases will be much more like the human than the mouse, with some of the same ethical considerations. Much can be learned from pet populations through veterinary records and regular health checks, as well as through the store of breeding information maintained by breed clubs and the American Kennel Club. Dr. Ostrander's study, for example, required cheek-swab samples for DNA from purebred dogs at shows or in their owners' residences. Purebred dogs may be much better populations for study than human families because data on groups of related canine individuals over several generations are more likely to be available. It will be interesting to see the next developments in canine genomics. Today dogs, tomorrow — cats? Stay tuned as science strides across this field in seven-league boots.

Evelyn Tiffany-Castiglioni, PhD, is associate dean for Undergraduate Education and head of the Department of Integrative Biosciences, College of Veterinary Medicine, Texas A&M University. She conducts research on the neurotoxicity of environmental contaminants. She recently edited* In Vitro Neurotoxicology: Principles and Challenges *(Humana Press, 2004).

Forum on the Arts

Heidi Tolles Motzkus

Brooklyn Boy: Just Looking For A Home

The French philosopher Louis Althusser (1918-1990) theorized about the way in which individuals are shaped by cultural forces. He originated the notion of "hailing" to describe the way that each of us is called into our culture. Althusser used an example of a police officer calling out, "Hey, you!" to a suspicious-looking person. When that person turns around to recognize the officer, that person recognizes that he has been hailed and recognizes himself in the other's recognition of him. This person then knows how he is to respond, which in this case might be guiltily. Other examples would include the teacher who addresses a student in a manner which acknowledges that the student cannot learn, and the student answering the hail by responding as a student who cannot learn. Conversely, others may be hailed in a manner that recognizes their position of privilege and power.

The main character of Donald Margulies's new play *Brooklyn Boy,* which recently had its world premiere at the Tony-Award winning South Coast Repertory in Costa Mesa, California, is just such a hailed individual. *Brooklyn Boy* is the story of a novelist, Eric Weiss, who also happens to be a secular Jew from Brooklyn. This novelist is finally experiencing commercial success, with his latest novel appearing on the bestseller list. With this success comes much attention to his identity as a Brooklyn Jew and many changes to his personal life.

The audience first meets this likable, but rather forlorn, character in the lobby of a Brooklyn hospital where he is visiting his father, with whom he has many unresolved issues. Eric has not been back to Brooklyn for some time, though he lives in nearby Manhattan, and it is quite evident that he no longer feels at home in Brooklyn. This is notable, given that his new novel, *Brooklyn Boy*, is praised for its authentic portrayal of life in a Jewish community in Brooklyn. Despite Eric's protestations to the contrary, it is clear that this is an autobiographically inspired novel.

Weiss (ADAM ARKIN, left) confronts a series of turning points with his hospitalized father, Manny (ALLAN MILLER). Photo by Ken Howard. Photo courtesy of South Coast Repertory.

As the audience follows Eric from scene to scene, what becomes clear is that Eric is forcefully and continually hailed, in the sense meant by Althusser, as a Jewish writer. He resists these hailings to no avail. He emphasizes that he is a writer first and foremost, with his ethnic identity being only marginally relevant. Ironically, in a hilarious and touching scene, he meets with the Hollywood producer who wants to make a film of the novel, *Brooklyn Boy*. This stereotypical Hollywood producer wants to take the Jewishness out of the script, and it falls upon Eric to explain why it is crucial that these characters be Jewish. Eric, in resisting the hailing of being identified as a Jewish writer and yet being a writer who mines the depths of his Jewish heritage, finds himself in the emotional state that a man without a home or a person without a country might experience. He is not quite inside and not quite outside of the cultural heritage in which he was raised.

Continuing on Eric's journey, the audience meets his soon-to-be ex-wife. There is truly love in this relationship. Sadly, it is Eric's success as a writer that has precipitated the decay of the marriage. Nina, also a writer, finds it impossible to live a life in which she is continually hailed as the famous Eric Weiss's wife. The force of this hailing is a powerful one and a constant reminder to Nina of how his success overshadows her own writing career. In the most literal sense, Eric now has no home.

Another stop on Eric's travels brings the audience to a hotel room, after Eric has done a reading from his novel. A young groupie has come back to Eric's room with clear expectations of having a romantic encounter with the famous writer. In a wonderfully written and revealing scene, we watch as Eric comes to an understanding that he also is not at home in the role of the Hollywood celebrity who exploits the tender feelings of young groupies.

After his father's death, Eric finds himself at his father's Brooklyn apartment, sorting his father's things. Ira, Eric's boyhood friend, stops by to pay his respects and is surprised to find that Eric is not sitting shiva. In another beautifully written scene, Ira hails Eric to return to his Jewish roots through the performance of a certain ritual. Ruthlessly rejecting Ira's hail, Eric is left alone and is visited in his mind by his father. After this imagined visitation is over, in grief, Eric performs the familiar ritual. Despite the intensity of Eric's previous efforts to resist the call, in this one moment

Novelist Eric Weiss (ADAM ARKIN, left) talks about his work with Alison (ARI GRAYNOR), a fan he met at a book signing. Photo by Ken Howard. Photo courtesy of South Coast Repertory.

he appears to be home again. This moment brings into sharp focus how powerfully cultural forces shape us all.

Donald Margulies has stated, "Some writers are very interested in being an outsider. I am not." With two Pulitzer Prizes for drama, for his plays *Sight Unseen* and *Dinner With Friends*, Margulies is clearly not an outsider. But his characters, in this play and others, do grapple with the challenges of being on the outside — of not answering the call of society in the anticipated manner. *Brooklyn Boy* leaves the audience with questions to consider. Is the consequence of not responding to the hailing of our culture the risk of not having a home — spiritual, emotional, or otherwise? If we do not accept the terms of our culture's hailing, do we lose our place in the order of things? Margulies looks at these questions from the perspective of those who have readily answered the call and assumed their expected place in the social order and also from the perspective of those who have resisted. Sharply, he observes the consequences of both actions.

Brooklyn Boy was commissioned and developed by South Coast Repertory and produced in association with New York's Manhattan Theatre Club. *Brooklyn Boy* opened in New York, at the Biltmore Theatre, on February 3, 2005. As California audiences have already seen and New York audiences are now seeing, Margulies presents a finely crafted play about a man struggling with the notion of identity, a man who has unresolved issues with a loved one, a man who suffers loss, and a man just looking for a home.

Heidi Tolles Motzkus is a PhD candidate in Cultural Studies at Claremont Graduate University. She teaches in Los Angeles and has held the positions of dramaturge and theatre critic.

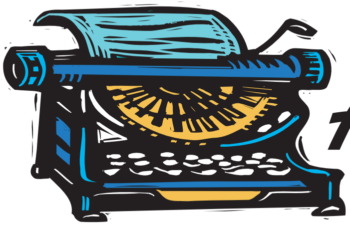
HOLLOW SPACE

In the desert,
a hollow space hides
the quiet of wild cacti,
who watch for you
behind thistle-bloom
stinging with succulent beauty —
their prickles
tart and crisp
like the invisible aridity,
where you become aware
of the pierce
that bursts your hollow space,
heretofore imperceptible,

that you might, too, discover
the barren heights,
its voiceless face
gully-wrinkled,
drizzled etchings of
a crooked-fingered
rain shaft, flowing with emptiness
to waterless seas,
where sand-whistled miles
of hollow space
rush you out,
as distance disappears,
to meet monuments and
pyramids rock-rigid,
who halt you,
then jolt you
skyward.

RONALD J. SMITH

Ron Smith has aviated the globe in his professional life. He brings a spiritual dimension to his writing evoked from these experiences. His poems have recently appeared in the *New York Times* and *The Antarctic Sun*. He now works as a military liaison to the National Science Foundation. He resides in Alexandria, Virginia.



A Note from the Editor

James P. Kaetz

IN THIS ISSUE

A few years ago, my wife and I were watching a television program on perception. During the program, a video was shown involving two groups of people tossing and bouncing a ball. The object, intoned the announcer, was for you to watch the ball tossed by your "team" carefully, counting how many times it was passed from one person to another; at the end of the tape, you were to compare your tally with the true tally. Being a good follower of instructions, I dutifully kept my eye glued to my "team's" ball, as did my wife, and came up with a count. The announcer told us the actual number, and we were both disappointingly just a little off.

But then the announcer asked, "What else did you see during the video?" My wife and I looked at each other with puzzled expressions. The video began to play again, this time with the instructions not to count the passes at all. As we watched, in the midst of all the commotion a man in a gorilla suit walked into the picture, paused, waved, and walked out.

We were stunned. The announcer assured us that it was the same video which we had seen before, but neither of us had seen the gorilla guy, big as life. The point of the exercise, of course, is that the human brain creates reality every moment — we see what we concentrate on, and despite the tremendous processing power of the brain, it allows us to consciously perceive only a fraction of what our eyes actually take in. Often, we see only what we expect to see, or what we have been told we will see, which is why eyewitness testimony can be so completely wrong. The brain is clearly a fascinating organ — tremendously powerful, capable of constructing our entire world through its billions of connections, yet in some ways very limited.

In this issue, our authors explore some of the many facets of the human brain — how it evolved and developed, why it is put together as it is, its abilities, and so on. Leading off is Jon H. Kaas with an article on the evolution of the neocortex in humans. As the neocortex evolved in size and complexity, the brain's flexibility and functionality increased also. As Kaas puts it, "The story of brain evolution is largely a story of the evolution of the neocortex." Following that, Gary Marcus looks at how the tremendous complexity of the brain, with its billions of neurons, springs from the human allotment of possibly fewer than twenty-five thousand genes. If one cannot view the genes as a "blueprint" for the brain or genes as dictating particular brain traits, then how does that most complex of organs come to be?

Next, Lynn C. Robertson discusses the bilateral nature of the brain — how the halves of the brain have very different functions and responsibilities, and why. What advantage does arranging the brain in this way have for us? Robertson talks about how the two halves of our brain cooperate and coordinate, despite their different functions. Simon Baron-Cohen tackles the controversial area of differences in the brain related to gender. He covers recent research that seems to suggest that gender-related tendencies might be a result of gender-specific hormones' influence on brain development.

J. Douglas Bremner then examines how stress affects the brain. Not only does severe stress have a psychological effect on the brain, but it also has a physiological effect, altering brain structure and function and "the stress hormones cortisol and norepinephrine." René Marois offers a fascinating look at the brain's limitations. Even though the brain has enormous capacity (so much that our brain is capable of storing "five times the number of total printed material in the world"), it is severely limited in some areas, leading to, among other things, one's inability to see a man in a gorilla suit walking into the middle of a video.

Finally, Michael A. Arbib tells us about the neurosciences' efforts to organize, categorize, and make available in a useful way all the research information on the brain being generated today. His field, called "neuroinformatics," is the rough equivalent of the Human Genome Project's unraveling of and making available the decoded human genome.

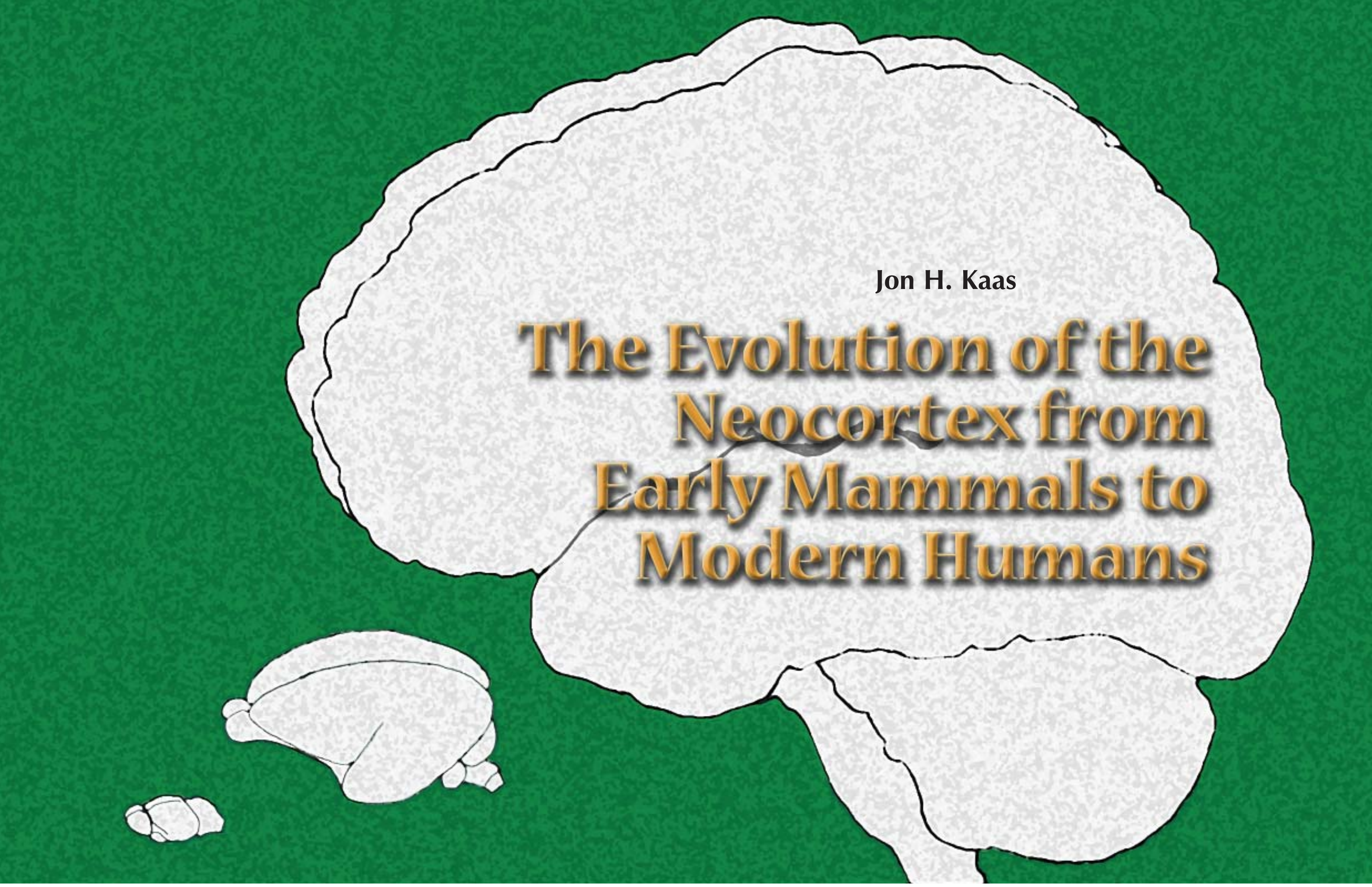
THE "NEW" *FORUM*

As previewed in the Fall 2004 "Editor's Note," this is the first issue of the *Phi Kappa Phi Forum* to incorporate what was formerly the *Phi Kappa Phi Focus* newsletter. Be sure to read all of the latest Society and member news, as well as the President's Page and other articles of interest. Also, look at page fifteen for an exciting announcement about the Society's efforts to keep all of its members ahead of the curve.

APPRECIATIONS

Some of you may have noticed that the name of James T. Barrs, our volunteer copy editor, is missing from the staff listing on our inside cover for the first time in fourteen years. This past December, Dr. Barrs called us and said, "I promised myself that if I made it to age one hundred, I would finally retire from doing the *Forum*; I am calling to let you know that I am officially doing so." So here is one more huge thank you to Dr. Barrs for the help that he has given us over the years and, more importantly, for the service he has given to Phi Kappa Phi for literally decades. If anyone deserves to retire at the age of one hundred, he does. Thanks again, Dr. Barrs!

Enjoy the issue!



Jon H. Kaas

The Evolution of the Neocortex from Early Mammals to Modern Humans

Most of us are extremely interested in human behaviors and abilities. Because these behaviors and abilities are mediated by our brains, it is natural to wonder how the human brain is organized and functions. Understanding the human brain is challenging, largely because of its great complexity. As a result, much of neuroscience has been directed toward understanding simpler brains, such as those of rats and mice, with the expectation of discovering principles that apply broadly. But if some brains are simpler, how did our human brains become so complex? We start this discussion with the first mammals because that is when a novel brain structure emerged, the neocortex, the hallmark of the mammalian brain. While the neocortex is not actually new, as once thought, it did change dramatically from a thin single-cell layer of dorsal cortex in reptiles into a thick sheet of six-cell layers, each having a different functional role, in the first mammals. This new organization proved to be so useful and adaptable, as subdivisions and layers were modified in various ways, that the story of brain evolution is largely a story of the evolution of the neocortex. While the interesting modifications of the neocortex include those that allow echo-locating bats and tactile-driven, star-nosed moles to have their unique food-gathering behaviors, the focus here is on the brain changes that led from early mammals to modern humans.

How do we chart the course of human brain organization? Usually patterns of evolution are deduced from the fossil record. For example, we know from the fossil record that modern horses evolved from a series of ancestors whose number of toes reduced from five to one. However, usually only bones are preserved in the fossil record and not soft tissue, especially not brains. Yet the inside of the skull does reflect the size and shape of the brain, so fossils can reveal brain size and sometimes the locations of major sulci, the folds in the brain that may hint about functional divisions. But fossils tell us nothing about the internal organizations of brains. Because of the limitations of the fossil record, most of what is known about brain evolution has been deduced by comparing the organizations of the brains of present-day mammals.

Brains are subdivided into functionally distinct parts, the subcortical nuclei and the cortical areas. Early investigators constructed theories of human-brain evolution by tacitly assuming that brains evolved by adding parts; they thought that some mammals living today have brains that had changed little from those of the first mammals and that others had added parts to various extents, thereby forming a series of mammals with increasing levels of brain complexity. According to this viewpoint, the study of a series of mammals from those with the simplest brains to those with the most complex ones would reveal the course of human-brain evolution. A suitable series might include a hedgehog (an insectivore with a small, relatively simple brain), a tree shrew (a squirrel-like mammal once thought to be a primitive primate), and a sequence of primate levels (prosimian, New World monkey, Old World monkey, ape, and human). These mammals do reflect a series of increases in relative brain size and complexity, and deductions based on this approach often may be correct. However, this approach provides us with no way of distinguishing between brain traits that are specializations of one line of evolution and those that reflect the ancestral condition. Hedgehogs, for example, are covered with sharp quills, but it would be a mistake to conclude from this that early mammals were covered with quills. Instead, we see that most mammals, including most insectivores, do not have quills; thus, it is logical to conclude that early mammals did not have quills.

This type of broad comparison is the essence of the cladistic method of reconstructing the brain features that characterized the brains of ancestors from first mammals to the recent past. A clade is any group of species that have all descended from a common ancestor, and a trait that is widely distributed in the clade is likely to have been present in the common ancestor. The cladistic approach can be a powerful way of determining when in a phylogenetic tree specific traits emerged, yet this method can be difficult to apply to the study of brains, especially for traits that are revealed only by costly and time-consuming experimental study, as there may be few studied species to compare. In addition, this method tells us nothing about the evolution of brain structures in hominid (bipedal) primates because we are the only living representatives. Fossil-brain endocasts provide information about our hominid ancestors, but only about brain size and shape.

> **The fossil record indicates that early primates were characterized by orbital convergence, suggesting an increase in the importance of binocular and stereoscopic vision. Such a change would have aided them in their roles as nocturnal, arboreal predators of small invertebrates and vertebrates. Their brains were larger than those of early mammals and were similar in relative size and shape to present-day strepsirhine primates (lemurs, lorises, and galagos).**

WHAT IS KNOWN ABOUT BRAIN EVOLUTION IN MAMMALS?

Fortunately, we can say quite a bit about the brains of early mammals. The fossil record indicates that most early mammals were rather small, cat-sized or less, and had small brains relative to body size. For uncertain reasons, brain size tends to follow body size, so it is helpful to consider how much larger or smaller a mammal brain is than is common for mammals of that size. Early mammals had smaller brains and less neocortex for their body sizes than most mammals do today, but some mammals today also have small brains and little neocortex relative to body size. These mammals include the tenrecs of Madagascar. Tenrecs are small, insect-eating mammals once classified as insectivores with moles and hedgehogs but are now recognized as members of a separate order in the superclade, Afrotheria. It is immediately apparent from the tenrec's brain that it has very little neocortex and that olfaction is the dominant sense, judging from the large proportion of the brain that is devoted to the olfactory bulb and piriform (olfactory) cortex (see Figure 1). Experimental studies reveal that the neocortex contains few cortical areas.

Most of these areas have sensory or motor functions. A primary visual area, V1, topographically represents the receptors of the eyes; a primary somatosensory area, S1, represents the receptors of the body; a primary auditory area, A1, represents tone frequencies; and electrical stimulation of a primary motor area, M1, evokes movements. Evidence suggests a second somatosensory area, S2, and perhaps one or two additional auditory, visual, and somatosensory areas exist as well. Other areas further evaluate stimuli and motivate behavior. Overall, the neocortex appears to have only ten to fifteen functionally distinct areas. Areas identified in tenrecs are widely found both in other small-brained mammals such as hedgehogs, opossums, and rats, and in mammals with larger brains, including us. Thus, we can conclude that early mammals had small brains with little neocortex and few cortical areas. Furthermore, these areas have been retained in nearly all descendent mammals, although they have been repeatedly altered in structure, connections, and size to modify their functional roles.

Primates represent one branch of a superclade that includes rodents, lagomorphs, flying lemurs, and tree shrews. Judging from what these mammals have in common, early members of this clade had more neocortex than early mammals, and the temporal lobe had expanded to include several additional visual areas. The fossil record indicates that early primates were characterized by orbital convergence, suggesting an increase in the importance of binocular and stereoscopic vision. Such a change would have aided them in their roles as nocturnal, arboreal predators of small invertebrates and vertebrates. Their brains were larger than those of early mammals and were similar in relative size and shape to present-day strepsirhine primates (lemurs, lorises, and galagos). This increase in size included a considerable expansion of the temporal lobe, and the temporal lobe of all extant primates is dominated by an array of visual areas. Early primates soon diverged into three major lines: the strepsirhine primates noted above, and a diurnal haplorhine line that led both to anthropoid primates (monkeys, apes, and humans) and to a tarsier line that reverted from a diurnal adaptation to become a highly specialized nocturnal predator with large eyes as a readaptation to dim light.

Galagos are small rat- to cat-sized primates with a brain that is smaller than those of anthropoid primates of a similar size, while having a number of brain features that characterize primates in general. All primates have a calcarine fissure that enlarges the visual cortex of the medial occipital lobe and a lateral sulcus that expands the cortex devoted to somatosensory processing (that is, the sense of body position, pain, temperature, and so on — rather than senses such as vision and hearing). The lateral geniculate nucleus of the visual thalamus isolates three specialized outputs from the eyes that are partially segregated in their relay to the primary visual cortex and in their distribution from V1 to additional visual areas (Figure 1). The second visual area, V2, is subdivided into band-like processing modules devoted to different V1 outputs. Dorsal and ventral processing streams of interconnected visual areas are specialized for action or object vision, respectively. The dorsal stream includes the middle temporal area, MT, which is devoted to processing visual motion signals, and visuomotor areas in the posterior parietal and frontal cortex for directing eye movements. The motor system has expanded to add dorsal, ventral, and supplementary premotor areas to M1. Somatosensory areas have been added to the parietal cortex, and the posterior parietal cortex contains areas related to visual guidance of reaching and hand use. The many features of galago brains shared with other primates indicate that early primates of perhaps 80 million years ago already had brains that were highly specialized in ways that differed from those in other mammals.

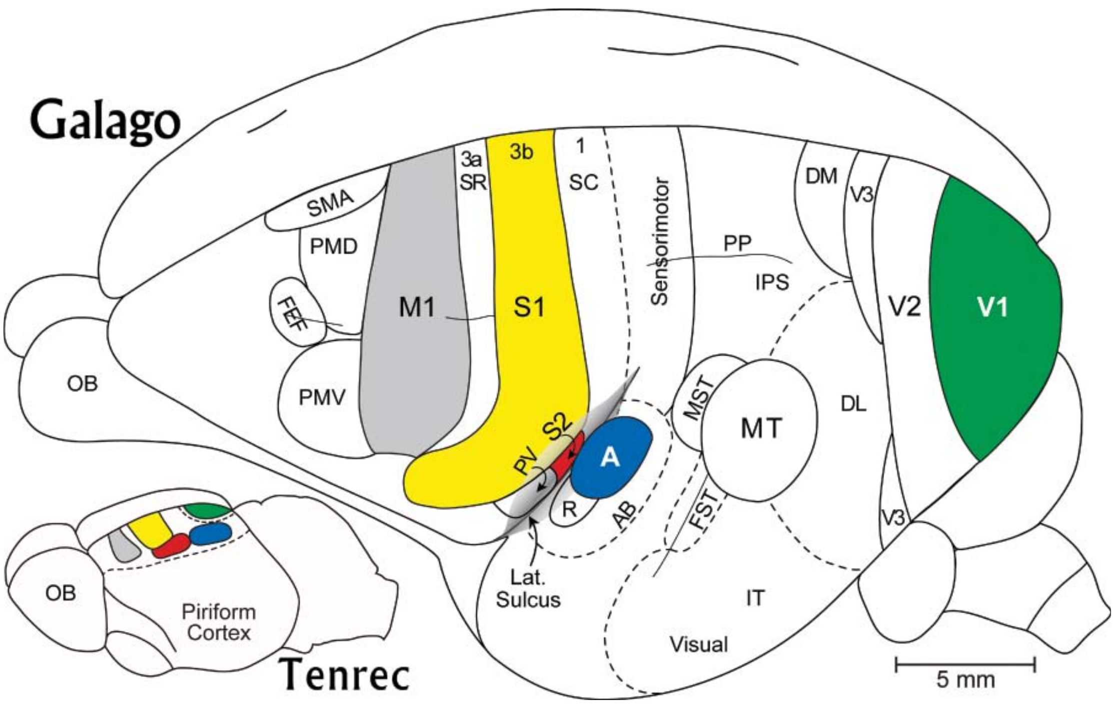


Figure 1. Some of the cortical areas of the tenrec and galago brains. The small tenrec brain has only a small cap of neocortex with only a few areas. Much of the forebrain is olfactory (olfactory bulb and piriform cortex). The larger brain of a galago, a prosimian primate, has so much more neocortex that piriform cortex, the midbrain, and much of the cerebellum are covered, and many of the cortical areas that characterize primates are present, although some areas (S1, V1, M1, A1) are shared with tenrecs.

ANTHROPOID PRIMATES AND HOMINIDS

Early anthropoid primates were African monkeys. One line, somehow, got to South America and diversified into the platyrrhine or New World monkeys to occupy a range of ecological niches. Their brains reflect the basic primate plan of cortical organization, while expressing a number of specializations. The other line, the catarrhine or Old World monkeys, is generally as large or larger than the largest of New World monkeys, and some of them have become highly terrestrial. The brains of Old World macaque monkeys clearly have a large number of auditory, visual, and somatosensory areas. They also have expanded the number of sensorimotor regions of the posterior parietal cortex that interact with an expanded number of premotor areas in the frontal cortex used to guide and plan behavior. Apes emerged as a major and initially successful branch of anthropoid primate evolution, but much of the radiation died out. We know relatively little about the large brains of the few lines of apes remaining today.

The first bipedal hominids diverged from a chimpanzee-like ancestor about six million years ago, and those hominids led to a sequence of human ancestors with ever-increasing brain size. Early Australopithecines had brains only slightly larger than present-day African apes, but hominid brains increased rapidly in size during the last two million years from the 500–800 cm^3 of Homo habilis, to the 700–1200 cm^3 of Homo erectus, to the 1200–1400 cm^3 of modern humans. The transformations in brain organization that occurred over that time are largely uncertain, but humans have areas that are not present or well-developed in monkeys.

Most notably, a large portion of the temporal lobe and parts of the frontal lobe of the left cerebral hemisphere are specialized for language in humans, and regions of the parietal lobe of the right hemisphere are specialized for spatial reasoning and related functions. Part of the ventral temporal lobe is specialized for recognizing individual faces, something very important for us as a highly social species. Our frontal lobes have areas that promote an understanding of the intentions of others and an appreciation of the consequences of our actions. Motor guidance and planning systems have differentiated to mediate an intuitive sense of tool use and an ability to acquire any number of impressive motor skills. Human brains are asymmetric because brain systems have developed differently in the two hemispheres. Similar but less-pronounced asymmetries in the brains of great apes and the fossil endocasts of the brains of our hominid ancestors indicate that the tendency of each cerebral hemisphere to specialize differentially has a long history.

We can make some assumptions about how human brains are organized simply because they have grown so large. Large brains are larger mainly because they have more neurons. Large size creates a connection problem because more neurons mean more and longer connections as neurons are spaced farther apart. To maintain short transmission times over longer connections, axons need to be thicker. Thus, as brains become larger, they need to devote proportionally more of their mass to connections. However, they do so much less than predicted from a model of maintained connectivity and axon function. This discrepancy implies more modularity in organization so that short, local connections can be favored over long connections. As a notable example, the differing functional specializations of the two hemispheres of the human brain greatly reduce the need for long connections between the hemispheres. The possibility of more modularity in the human brain is supported by present evidence for a large number of areas (more than fifty). The number of areas in the human neocortex is far from determined, but theoretical estimates suggest as many as 150. In addition, many areas in other primates are functionally subdivided in a manner that reduces the number of intrinsic connections, and this tendency should be especially pronounced in the human brain.

Thus, the evolution of the human brain was characterized by a great expansion of the brain, especially the neocortex, and a substantial increase in the number of functional areas. Brain functions were greatly enhanced as the greater number of areas allowed additional processing steps and the specialization of areas for new functions.

Jon H. Kaas is Distinguished, Centennial Professor of psychology at Vanderbilt University. His major interest is in how sensory and motor systems are organized in mammalian brains, especially in primates. He is an elected member of the National Academy of Sciences and of the American Academy of Arts and Sciences.

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- Career Connection for posting résumés anonymously, searching newly listed job opportunities, and managing job applications;
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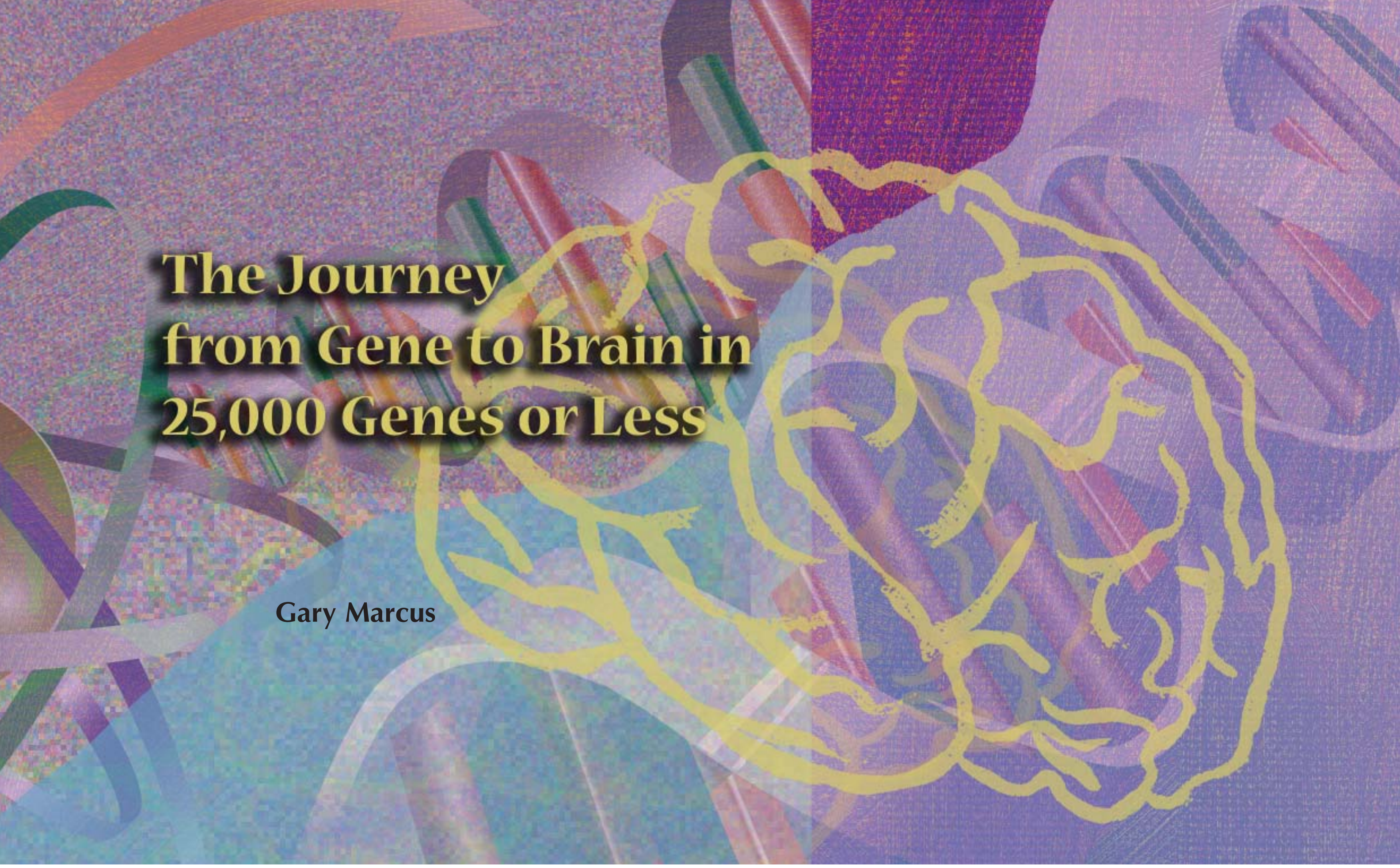
Look for new Phi Kappa Phi logos soon on all Phi Kappa Phi print and electronic communications.

The Journey from Gene to Brain in 25,000 Genes or Less

Gary Marcus



Are human beings genomically challenged? In the space of a less than half a decade, scientists' best estimates of the numbers of genes in the human genome has dropped dramatically, from about one-hundred thousand a few years ago to just twenty-five thousand, according to a report published in October of 2004. At this point, human beings seem to have scarcely more genes than a mustard seed. Stanford biologist Paul Ehrlich has suggested that there is a "gene shortage," and the *San Francisco Chronicle* has gone so far as to suggest that "DNA's significance" should be "downplayed."

But by itself, the sheer number of genes tells us little about the complexity of a species's mental life. Just as we would not try to guess whether a human is more complex than a chimpanzee merely by counting the number of bones each species had, we should not expect that the number of genes would necessarily be more informative.

That said, it is hard not to notice the gap between that comparatively small number of genes and the enormous number of neurons — more than twenty billion — in our brain. Where does the enormous complexity of the human brain come from?

IT IS NOT ALL EXPERIENCE

It is tempting to put the burden of neural organization almost entirely on learning and experience. Virtually any skilled human behavior, from playing the piano to dunking a basketball, depends not just on talent but on years of experience — experience that rewires and fine-tunes your brain's organization. Even if babies are "a lot smarter than you think," as a recent *Life* magazine cover suggested, and human children are born with a remarkable faculty for acquiring human language (as Noam Chomsky and Steven Pinker have suggested), nobody could doubt that practice is still the best way to get to Carnegie Hall.

At the same time, as important as learning, training, and education are, it would be an enormous mistake to simply ignore the role that genes play. For example, on just about any trait you could measure, identical twins (who share all their genes) are more similar than nonidentical twins (who share only half their genes); their brains, too, are more similar than those of nonidenticals. Just as identical twins are more likely to look alike, they are more likely to think alike. Genes clearly play a critical role in shaping the human condition.

Another measure of the extent to which genes influence the development of neural structure comes from sheer neuroanatomy. In keeping with the notion that we are born with significant mental structure (à la Chomsky, Pinker, and the dozens of recent psychological studies revealing the precocious abilities of human infants), the vast majority of the brain's structural details are in place by birth. The brain of an infant is only about a quarter the size of an adult's, but from the cerebral asymmetries to the complex patterns of bends and folds known as gyri and sulci, virtually every significant landmark is already there. To be sure, prenatal experience plays a role — the womb is dark, but not silent, and late-term fetuses can learn — but the complexity of a newborn human's brain is manifest testimony to the enormous influence of our genomic constitution.

How can twenty-five thousand such genes come together to build all the initial complexity of the human brain? By anticipating a trick from computer science: compression. By ferreting out redundancy, computer scientists can store and transmit information in highly efficient ways, and it turns out that nature does much the same thing.

How can twenty-five thousand genes contribute so much? To understand the answer, we need to start by first abandoning two longstanding (and as it turns out somewhat contradictory) habits of thought. One habit is to think of the genome as a blueprint; another is to think of genes as dictating particular traits. The blueprint metaphor suggests (wrongly) that each gene would be like an individual pixel in a picture, as if the genome were a literal depiction of a particular species' structure. The trait metaphor (think "The God Gene," to take the title of a recent book) suggests that there is a simple mapping between genes and traits, as if human traits were as simple as the color and texture of Gregor Mendel's peas. But there is no simple mapping between genes and traits; a single trait may be the product of many genes, and a single gene can influence many traits. Moreover, most genes are shared across all humans and have little if anything to do with the relatively tiny differences between us.

If one wants to understand the contribution of genes to the human mind, one needs to move past these easy metaphors. As the British biologist Patrick Bateson put it, "The idea that genes might be likened to the blueprint of a building… is hopelessly misleading because the correspondences between plan and product are not to be found. In a blueprint, the mapping works both ways. Starting from a finished house, the room can be found on the blueprint, just as the room's position is determined by the blueprint. This straightforward mapping is not true for genes and behavior, in either direction."

IF–THEN

But if genes are neither blueprints nor simple controllers of traits, what are they? Borrowing a notion from computer programming, I would suggest that a better metaphor is the idea of a conditional: an IF paired with a THEN. Just as virtually all computer software is largely made up of IF–THENs ("IF the amount of the withdrawal exceeds the customer's balance, THEN reject the request."), the information contained in the genome, too, consists largely of logical preconditions paired with consequences.

The "THEN" is the better-known part of a gene: the template for building a particular protein. The insulin gene specifies how to build the insulin protein, the keratin gene specifies how to build keratin, and so forth. The lesser-known "IF" (or, more formally, the *regulatory region*) specifies where and when that protein should be built. The recipe for hemoglobin, for example, is followed only in red-blood precursors, the recipe for human-growth hormone only in the pituitary gland. Some genes are expressed only in the brain, others only in the kidneys or the liver, or in a particular kind of cell, or a particular place within a cell. And many genes are just as choosy about *when* they are expressed. Some genes (like those that build proteins that help convert sugar to energy) are on almost all of the time in almost every cell, but most genes are on (or most active) only at select times, during particular situations (for example, during cell division or gastrointestinal inflammation), or during particular moments in embryological development (such as during the leg-growing, tail-shedding process of tadpole-to-frog metamorphosis).

IF some situation holds true, THEN build a particular protein. The net result is a kind of mass empowerment: every gene is a free agent, authorized to act on its own. As soon as the IF part of a gene's IF–THEN rule is satisfied, the process of translating the template part of a gene into its corresponding protein commences. By switching on only at specific times and places, these hordes of IF–THENs modulate the growth of proteins in different ways in different cells.

Those IF–THENs guide every step of development, every bit of the flurry of cell division, cell migration, and cell differentiation that scientists call embryogenesis. The brain, for example, begins as a simple sheet of cells that gradually curls up into a tube that sprouts bulges, which over time differentiate into ever more complex shapes, including the convoluted sheet that we recognize as the human cerebral cortex. And in one way or another, each step of this embryological origami is driven by the instructions carried in the genome's twenty-five thousand IF–THENs.

GENOME AS COMPRESSION SCHEME

But we are only a step closer. How can twenty-five thousand such genes come together to build all the initial complexity of the human brain? By anticipating a trick from computer science: *compression*. By ferreting out redundancy, computer scientists can store and transmit information in highly efficient ways, and it turns out that nature does much the same thing.

For instance, you may have seen the GIF format (pronounced jiff), a way of storing picture files compactly. One of the oldest compression schemes, GIF relies on patterns of repeated pixels (the colored dots of which digital images are made). If a whole series of pixels are of exactly the same color, the software that creates GIF files assigns a code to represent the color of those pixels, followed by a number to indicate how many pixels in a row are of the same color. Instead of listing every blue pixel individually, a GIF-compressed picture saves space by storing only the code for blue and the number of repeated blue pixels. In this way, two numbers can stand for fifty or a hundred pixels. (Today there are dozens, perhaps hundreds, of different compression schemes, ranging from JPEGs for photographs to MP3s for music and MPEG-4s for movies, each one specialized in a different way.)

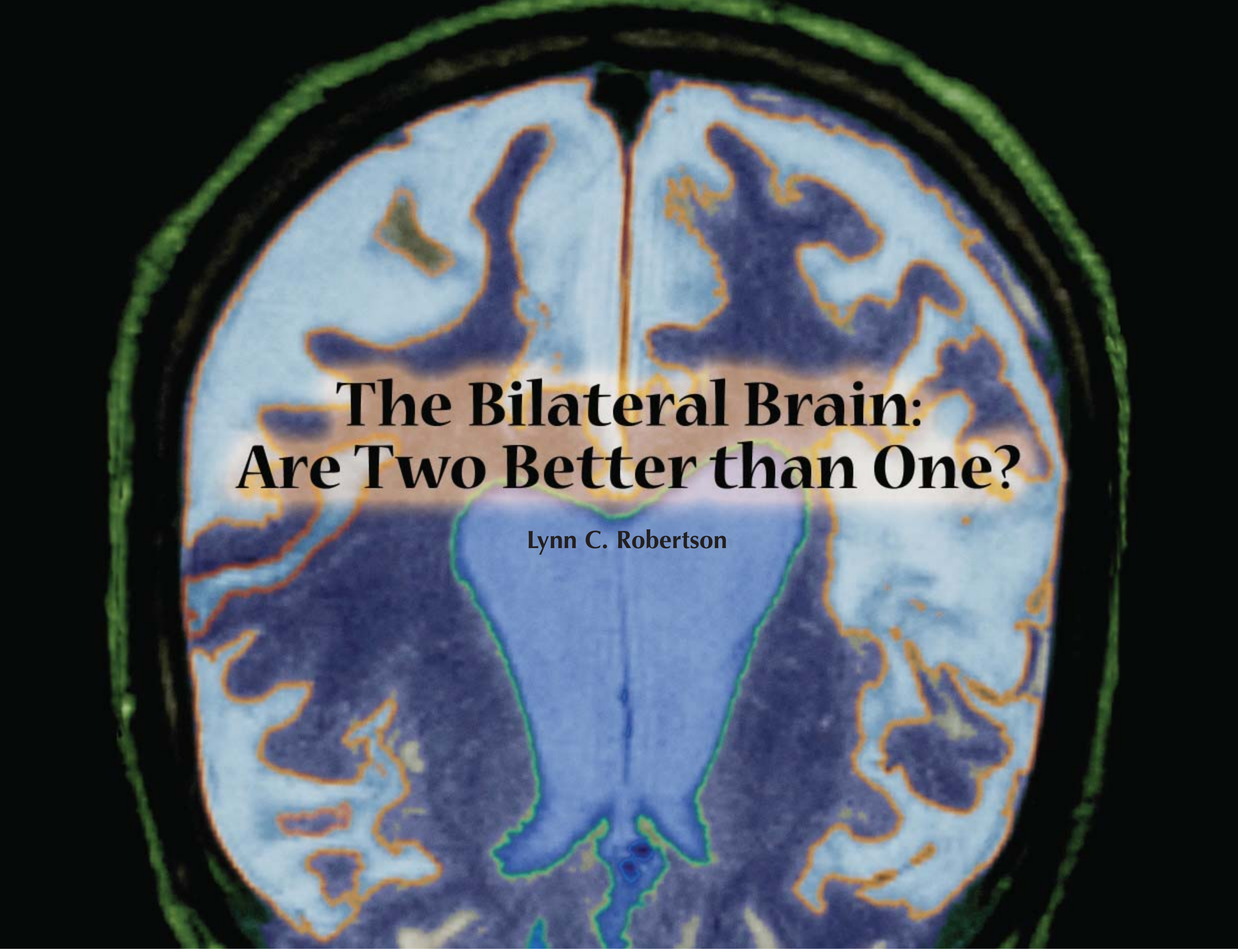
The compressed encodings of biology are genomes. Although they are the product of evolution rather than a programmer's forethought, they too are ways of compactly storing information. The ratio between twenty-five thousand genes and twenty billion neurons would be insuperable if, blueprint-style, each gene corresponded to one and only one neuron — gene #1 for neuron #1, gene #2 for neuron #2, and so forth — but biology was far more clever. Rather than dedicating a particular gene to each neuron (à la the oversold blueprint metaphor), genes specify *processes* that can be used over and over again. By allowing each gene to operate autonomously again and again in any cell where the conditions of its IFs hold true, biology allows individual genes to multiply their influence hundreds or even millions of times. Using cells as factories that serve as biological analogues to Stuffit Expander, biology takes the stuff of the genome and converts it into a living, breathing biological structure. Genome in, organism out.

What is even more amazing is that genomes are what a computer scientist would call "extensible." Rather than always relying on a small, fixed set of built-in "primitives," the nucleotidic language of terrestrial biology stands ever ready to add to its set of basic processes. The compression schemes in a simple drawing program (such as MacDraw or Adobe Illustrator) achieve compression by representing pictures in terms of simple procedures for drawing squares, circles, complex (Bezier) curves, and so forth. You can think of the "compression scheme" of the body as doing the same thing, but with a twist: in the genome's compression scheme, virtually any gene can serve effectively as a new building block. The "master-control gene" for eye formation, pax-6, for example, is a single gene that acts like a subroutine. Triggering it in a fruit fly causes the fly to grow an eye on its antenna — not because pax-6 is "the eye gene," but because that one gene serves as a subroutine that recruits thousands of others. In this way, genes can provide a miraculous shorthand.

To use another example, consider the set of neuronal connections (axons) that run in parallel from your retina to your thalamus. To a first approximation, each axon navigates using the same gene-product markers (a set of protein known as an Eph receptor), but axons originating in the part of the retina that is closer to your ear have more markers than axons originating closer to your nose, and it is this quantitative difference that the axons use as a guide. Somewhat like schoolchildren lining up by height, the axons sort themselves according to their level of Eph receptors, moving to or fro depending on whether they have more or fewer Eph receptors than their neighbors. By slightly but systematically varying a single gene, thousands, even tens of thousands, of axons can organize themselves precisely.

This subtle system for ordering is vastly superior to a simple blueprint, because it is far more flexible, like a recipe that can readily be halved or doubled. Axons originating in the retina can expand to fill a larger-than-usual target in the midbrain or contract to match a smaller-than-usual target; one recipe fits all. A brain built by pure blueprint would be at a loss if the slightest thing went wrong; a brain that is built by individual cells which follow self-regulating IF–THEN recipes has the freedom to adapt.

Gary Marcus, associate professor of psychology at New York University, is author of *The Birth of The Mind: How a Tiny Number of Genes Creates the Complexity of Human Thought* (Basic Books, 2004), and *The Algebraic Mind* (MIT Press, 2001).



The Bilateral Brain: Are Two Better than One?

Lynn C. Robertson

When trauma to the human brain occurs, functional loss will depend on the location and extent of brain tissue affected. One striking difference in the deficits observed depends on the hemisphere involved. Most people are familiar with language problems (known as aphasia) that often accompany left-hemisphere stroke. It is obvious when a loved one cannot speak or has difficulty understanding words spoken to them. In fact, the left hemisphere was long referred to as the "dominant" hemisphere. However, the long-term effects of right-hemisphere damage also can be quite devastating. One of the most common effects of right-hemisphere injury is a spatial-orientation problem known as unilateral spatial neglect. Patients ignore one side of space opposite to the damaged hemisphere (for example, left neglect after right-hemisphere stroke). They might eat the food only on the right side of their plate, comb only the right side of their hair, draw in the numbers on only the right side of a clock face, and completely miss visitors approaching from the left. It is as if the left side has disappeared. The clinical signs usually, although not always, recover relatively soon (within the first few weeks or months after injury). Nevertheless, when tested with sensitive behavioral measures several months or years later, these individuals can still be slower when attending to left- rather than to right-sided stimulation (typically only by a few milliseconds, but enough to make a difference when crossing a busy intersection). Other studies have shown that patients showing acute signs of unilateral neglect have poor long-term prognosis in terms of quality of life and nursing-home admissions.

These cases provide dramatic evidence that the hemispheres differ in fundamental ways. But just how independent are the two sides of the brain? Early evidence from patients with "split brains" (surgically cutting the white-matter bundle that transmits signals between the two hemispheres to relieve grand-mal seizures) suggested a bifurcated brain. Language processing was on the left; spatial processing was on the right. Others suggested that the left hemisphere processed information analytically, while the right hemisphere processed information holistically. It was further argued that analytic processing benefited auditory organization, a modality dependent on small differences in timing (and thus better able to support language), while holistic processing benefited vision, a modality that relies more on space. Although these ideas mapped quite nicely onto the observed deficits after right- or left-hemisphere stroke, they were basically a heuristic description of clinical observations. They also made people wonder what all the white matter bundles (called the corpus callosum) were for if each hemisphere could perform a given task on its own. Recent electrophysiological findings have suggested that one of its functions may be to synchronize firing rates between neural populations in the two hemispheres, resulting in an integrated, unified world experience. Without the corpus callosum, the hemispheres act as if they are independent, but when the callosum is intact, they cooperate in ways that we are just beginning to understand.

But before I explore this issue further, it may be useful to clear up some basic assumptions. First, while we are born into a real three-dimensional world, each newborn's brain must work out how to organize the sensory signals it receives for it to perceptually map that world adequately for survival. We are not born with a three-dimensional map, but we end up with one through interactions with the outside world. Second, specialized neural populations respond to different features of a stimulus. For example, we know that visual signals are initially transmitted to areas of the brain different from those to which auditory or tactile signals are transmitted, yet we generally hear a voice and see mouth movements of a speaker as synchronous. This segregation of sensory signals also happens within modalities. Visual, auditory, and tactile stimulations from the left side are primarily transmitted to the right hemisphere, and those from the right side are primarily transmitted to the left hemisphere.

The visual system basically pulls apart the two-dimensional pattern projected onto the retina of the eye, transmitting early signals about different features to specialized systems in the cortex. Yet we do not perceive a fragmented world (at least when our brains are intact), but rather a world that is seamlessly three-dimensional . . .

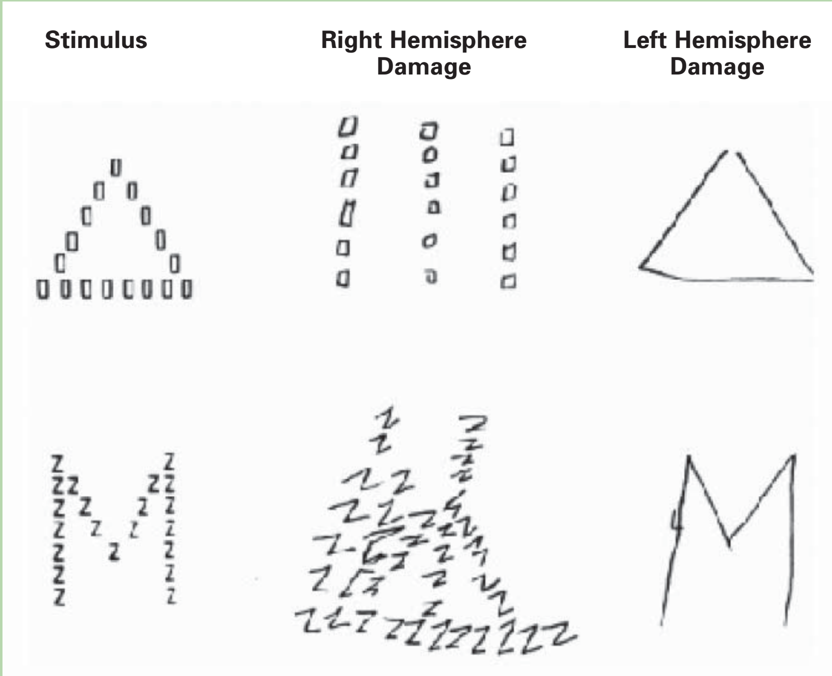
In addition, specialized neural populations exist in different areas of the visual cortex both within and between hemispheres that are more responsive to some features than others (for example, color, motion, size, shape, volume, brightness, and binocular disparity, among others). The visual system basically pulls apart the two-dimensional pattern projected onto the retina of the eye, transmitting early signals about different features to specialized systems in the cortex. Yet we do not perceive a fragmented world (at least when our brains are intact), but rather a world that is seamlessly three-dimensional with objects that are in a given location; of a given color, size, and brightness; and that are shaped in ways which allow rapid discrimination of one object from another. What features of the sensory mosaic are separately processed by specialized neural populations and when and what mechanisms bring the results together to account for integrated perceptual experiences? In turn, what features, if any, are "preferred" by processing mechanisms in the left or right hemisphere? We are just beginning to get some idea about how segregation and integration between specialized neural populations might happen. But we have a long way to go before we can account for perceptual integration in everyday experience.

ANALYTIC/HOLISTIC OR DIFFERENT LEVELS OF PROCESSING?

Natural scenes contain a complex array of objects behind other objects, objects on top of or under other objects, objects in different orientations, at different distances, and so forth. Objects are also interconnected in special ways such that one object can be a part of another. For example, leaves are parts of trees, trees are parts of forests, and forests are parts of the landscape. Likewise, irises are parts of eyes, eyes are parts of a face, and a face is a part of the body. What is holistic in these examples? It would seem to depend on what is seen as the global level at any given moment.

It turns out that the bias in the right hemisphere is to process global information, and the bias in the left hemisphere is to process local. So if the forest is attended, the left hemisphere will "prefer" the trees, and if the trees are attended, the left hemisphere will "prefer" the leaves. But notice that this division means that some mechanism must have already selected the desired object of attention and segregated it into wholes and parts. The global and local information within the selected "attentional window" then appears to be channeled to the right or left hemisphere. Why would the brain evolve to process information in this way? One reason may be that it is efficient. Attentional selection can be done with simply the gist of a scene giving clues to what

Figure 1. Drawings of the stimulus on the left by patients with right or left hemisphere damage.



might be important (for instance, something moving in the grass). Parallel processing of global and local levels of the object that attracts attention would then provide overall shape and finer details more rapidly than if just one mechanism were involved (if it is a lion – flee!).

Laboratory studies of hemispheric differences have used unusual shapes in which global and local information can be more easily controlled. For example, in Figure 1, the triangle can be global on one trial and local on another. This figure shows representative copies from a patient with right-hemisphere stroke who missed the global level and from a patient with left-hemisphere stroke who missed the local level. These drawings were collected shortly after the stroke when the patients were still fatigued and feeling poorly, so the drawings suggest a higher degree of separation between global and local levels than we now know exists. In the acute stages after stroke, the brain is swollen, affecting large areas of the brain and disrupting the electrical-chemical transmission of signals from one neuron to another, even in areas some distance from the lesion.

However, after the acute effects of stroke stabilize and patients are tested several months later, those with left-hemisphere damage are still slower to respond to local than global levels, and those with right-hemisphere damage are still slower to respond to global than local levels. These findings are independent of the overall size of the stimulus itself, consistent with the idea that the global and local levels are defined as such before hemispheric biases are manifested. A number of electrophysiological and functional-imaging studies of the brains of healthy, normal perceivers have provided converging evidence for this hemispheric asymmetry in the strength of response to global and local information.

INTEGRATING LEVELS

Studies with split-brain patients also have supported the hemispheric differences discussed in the previous section. In addition, they have shown that the corpus callosum may be necessary to integrate global and local levels normally. As processing within each hemisphere commences, the hemispheres rapidly send signals back and forth. If communication is disrupted, as occurs when an area of cortex is damaged and cannot transmit or receive messages or when the callosum is surgically cut, then each hemisphere may create its own pictorial organization. Although each hemisphere can respond to both levels after some recovery (showing that the asymmetries are not "all or none," but rather lie on a continuum), the efficiency in responding to the nonpreferred level plummets without communication across the callosum. It is unknown how the temporal order of processing different levels of stimulus structure changes what we see, but it would be surprising if it did not, as timing within the brain has been important in every other domain in which it has been studied.

INTEGRATING RIGHT AND LEFT

Except for a small area around fixation in each eye, all information from the left side of fixation is projected initially to the visual cortex in the right hemisphere, and all information from the right side of fixation in each eye is projected initially to the visual cortex in the left hemisphere. These projection areas within the cortex are known as "primary" visual cortex and are in the occipital lobes at the back of the brain. When you are looking at the center of a television screen, almost the entire picture on the left is projected to the right primary visual cortex, and almost the entire picture on the right is projected to the left primary visual cortex. This brings us full circle back to unilateral neglect. If the left is neglected after right-hemisphere damage, then one might argue that there is some abnormality in the projection of information from the eye to the primary visual cortex. However, this assertion would be wrong because neglect can occur even when the projection from eye to primary cortices are intact. Also, neglect can occur independent of eye fixation. The patient's eyes could be fixated at the left edge of the television and still the leftmost side of the picture would be missed, even though the whole screen (now to the right of fixation) would be projected to the undamaged left hemisphere.

Clearly the brain forms a higher-order spatial representation where left and right sides of the external world are more abstractly coded than what is projected to the right and left primary visual cortex. Just as global and local are defined in relative terms, so are right and left. When looking at the left edge of the television, the screen is on the right side in eye-centered coordinates, but the left side of the screen itself is still on the left of the screen in what are called object-centered coordinates. Left and right depend on which coordinate system is selected, and again we see the need for a selective mechanism before specialization of the hemisphere is involved.

One theory suggests that the hemispheres together select a window of attention based on a rapidly transmitted low-resolution image of the stimulus (one can think of it as a set of fuzzy blobs). With this system, attention can act very rapidly to hone in on what might contain important information, and this fuzzy representation is sufficient to define left and right and global and local features. These features can then be channeled to the right and left hemispheres, respectively, for more elaborate processing. Interactions between these streams of processing would improve integration as the scene or object representation emerges. Of course, all of this happens extremely fast and below the level of conscious awareness. This type of segregated-yet-integrated network would lead to more efficient and faster organization of a display.

I have emphasized vision and space, but this overall scheme can be applied to other sensory modalities as well. For example, a complex sound can be divided into fundamental components that initially map onto different neural responses. As auditory processing proceeds, the basic features must be integrated to account for our perceptual experience of a unitary tone. Studies that have created auditory stimuli with global and local features (that is, the tone as a whole versus its components) have shown hemispheric differences comparable to those found in vision. The computations are similar, but in the case of audition, local-level information is needed for language comprehension (associated more with the left than the right hemisphere).

Some of the most exciting work in this area that is beginning to appear in the literature is based on analysis of temporal coherence between left- and right-neural responses. These studies have been primarily based on electrophysiological analyses of normal brain function, but coherence studies of functional magnetic-imaging data also show promise. The findings to date have shown a higher degree of temporal coherence between neural responses in the right and left hemisphere when visual stimuli are integrated in perceptual experience. When this coherence breaks down, it can appear as if we have two entirely separate brains within our heads, one on the right and one on the left. But the evidence I have discussed in this article is most consistent with one very cooperative brain that includes many specialized neural systems, some of which just happen to be located in opposite hemispheres. When these cannot communicate with each other, the deficits can be striking; a normally small difference in processing can become a large difference that affects fundamental everyday abilities.

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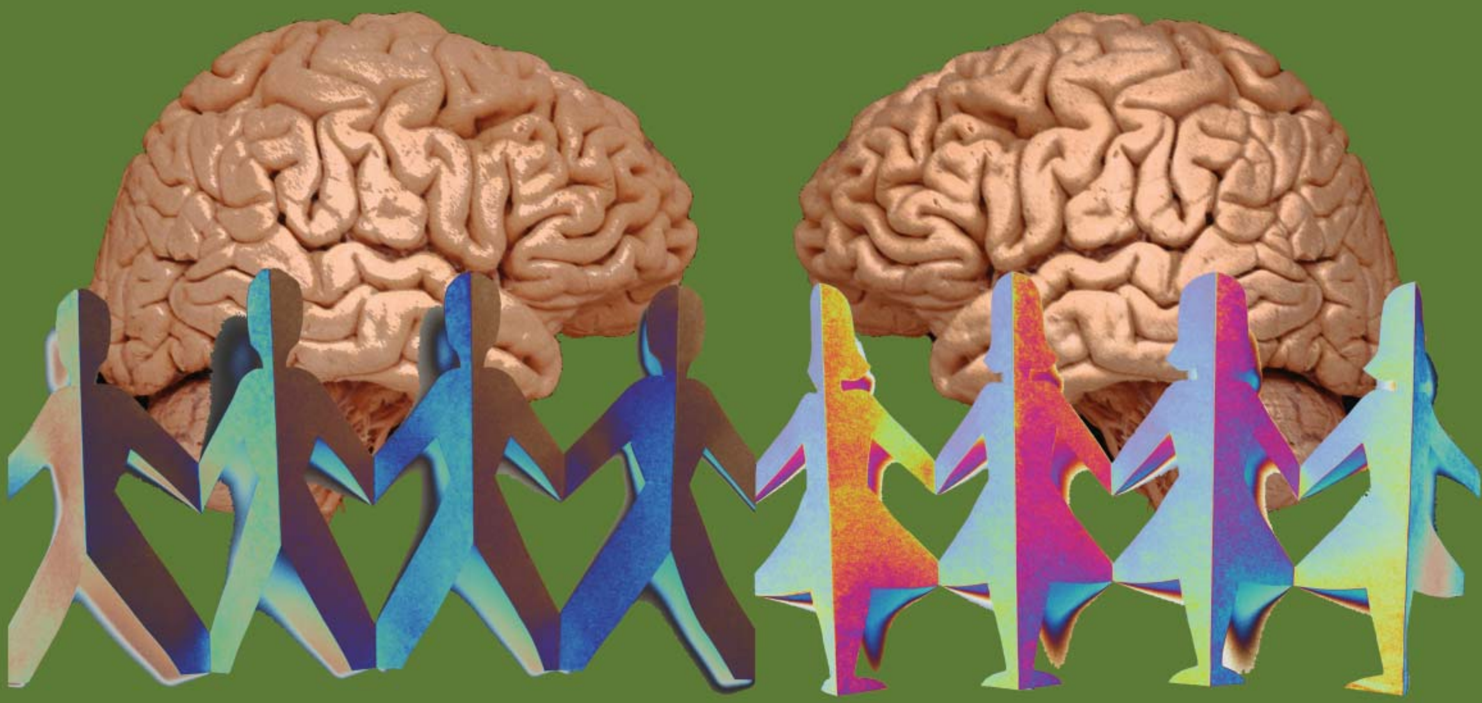

The Essential Difference: The Male and Female Brain

Simon Baron-Cohen

The field of sex differences in psychology is not new, though today it enjoys greater academic freedom than in past decades. The 1960s and 70s, while socially liberating, also made an open-minded debate about any possible role of biology contributing to psychological sex differences impossible. Those who explored the role of biology — even while acknowledging the importance of culture — found themselves accused of oppression and of defending an essentialism that perpetuated inequalities between the sexes. It was not a climate in which scientists could ask questions about mechanisms in nature. Today, the pendulum has settled sensibly in the middle of the nature-nurture debate, and scientists who care deeply about ending inequality and oppression can at the same time also talk freely about biological differences between the male and female brain and mind.

A new theory, known as the empathizing-systemizing (E–S) theory, claims that the female brain is predominantly hard-wired for empathy and that the male brain is predominantly hard-wired for understanding and building systems. "Empathizing" means the drive to identify another person's emotions and thoughts and to respond to those with an appropriate emotion. The empathizer intuitively figures out how people are feeling and thus how to treat them with care and sensitivity. "Systemizing" means the drive to analyze and explore a system, to extract underlying rules that govern the behavior of a system, and to construct systems. The systemizer intuitively figures out how things work, or what the underlying rules are that control a system. Systems can be as varied as a pond, a vehicle, a computer, a plant, a library catalogue, a musical instrument, a math equation, or even an army unit. They all operate on inputs and deliver outputs, using rules.

According to this new theory, a person (whether male or female) has a particular "brain type." There are three common brain types. For some individuals, empathizing is stronger than systemizing. This is called a brain of type E, but we can also call it the female brain, because more females than males show this profile. For other individuals, systemizing is stronger than empathizing. This is called a brain of type S, but we can also call it the male brain, because more males than females show this profile. Yet other individuals are equally strong in their systemizing and empathizing. This is called the "balanced brain," or a brain of type B (Figure 1 illustrates these profiles diagrammatically).

THE EMPATHIZING BRAIN

The evidence for a female advantage in empathizing comes from many different areas. For example, given a free choice of which toys to play with, more girls than boys will play with dolls, enacting social and emotional themes. When children are

The E–S Model

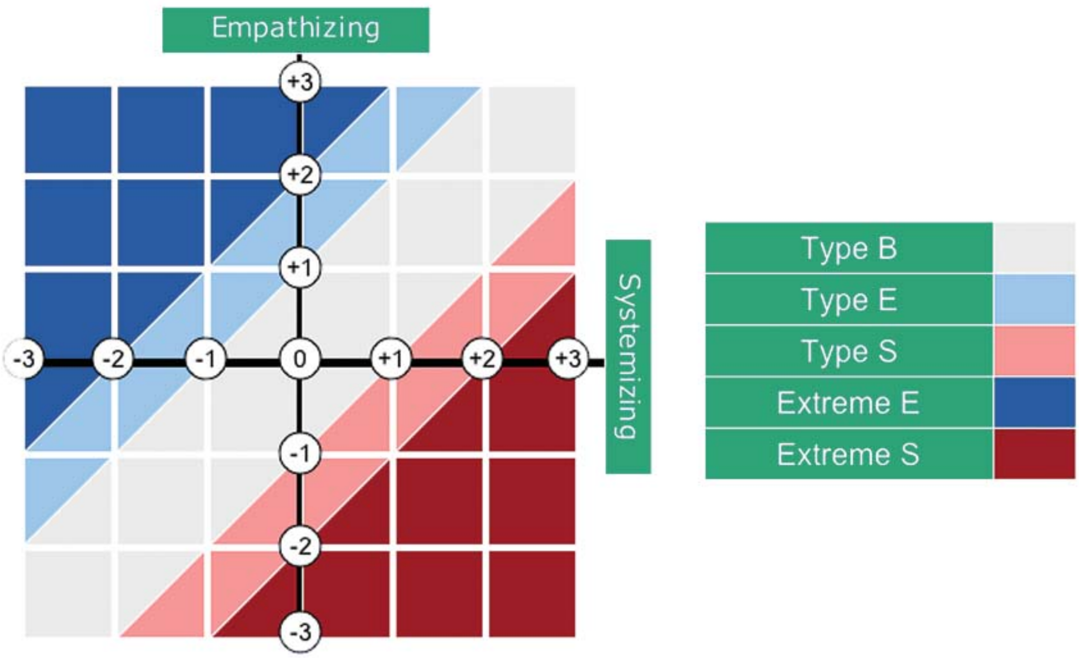

Figure 1.

put together to play with a little movie player that has only one eyepiece, overall boys tend to get more of their fair share of looking down the eyepiece. They just shoulder the other boys out of the way. Or if you let children play with those big plastic cars that they can drive, what you see is that more little boys play the "ramming" game. They deliberately drive the vehicle into another child. The little girls ride around more carefully, avoiding the other children more often. This behavior suggests the girls are being more sensitive to others.

Baby girls as young as twelve-months old respond more empathically to the distress of other people, showing greater concern through more sad looks, sympathetic vocalizations, and comforting. This tendency echoes what you find in adulthood: More women report frequently sharing the emotional distress of their friends. Women also show more comforting than men do. When asked to judge when someone might have said something potentially hurtful — a faux pas — girls score higher from as young as seven-years old. Women are also better at decoding nonverbal communication, picking up subtle nuances from tone of voice or facial expression, or judging a person's character.

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Sex differences also appear in aggression. Males tend to show far more direct aggression (pushing, hitting, punching). Females tend to show more indirect (relational, covert) aggression, which includes gossip, exclusion, and cutting remarks. It could be said that to punch someone in the face or to wound them physically requires an even lower level of empathy than a verbal snipe.

Two other ways to reveal a person's empathizing skill are to see how they (as a newcomer) join a group of strangers, and to see how they (as a host) react to a new person joining their group. These behaviors have been cleverly investigated in children by introducing a new boy or girl to a group of children already playing together. If the newcomer is female, she is more likely to stand and watch for a while, to check out what is going on, and then to try to fit in with the ongoing activity. Her trying to fit in usually leads to the newcomer being readily accepted into the group. If the newcomer is a boy, he is more likely to hijack the game by trying to change it, directing everyone's attention on to him. And even by the age of six, girls are better at being a host. They are more attentive to the newcomer, while boys often just ignore the newcomer's attempt to join in. Boys are more likely to carry on with what they are already doing, perhaps preoccupied by their own interests.

How early are such sex differences in empathy evident? Certainly, by twelve months of age, girls make more eye contact than boys. But a study from Cambridge University shows that at birth girls look longer at a face, and boys look longer at a suspended mechanical mobile. Furthermore, the Cambridge team found that how much eye contact children make is in part determined by a biological factor, prenatal testosterone. This correlation has been demonstrated by measuring this hormone in amniotic fluid.

THE SYSTEMIZING BRAIN

Boys, from toddlerhood onward, are more interested in cars, trucks, planes, guns and swords, building blocks, constructional toys, and mechanical toys — systems. They seem to love to put things together, to build toy towers or towns or vehicles. Boys also enjoy playing with toys that have clear functions — buttons to press, things that will light up, or devices that will cause another object to move.

The same sort of pattern is seen in the adult workplace. Some occupations are almost entirely male: metal-working, weapon-making, crafting musical instruments, or the construction industries, such as boat-building. The focus of these occupations is on constructing systems. Professions such as mathematics, physics, and engineering, which require high systemizing, are also largely male-chosen disciplines.

Some psychological tests also show the male advantage in systemizing. For example, in the Mental Rotation Test, you are shown two shapes, and asked if one is a rotation or a mirror image of the other. Males are quicker and more accurate on this test. Map-reading has been used as another test of systemizing. Men can learn a route in fewer trials, just from looking at a map, correctly recalling more details about direction and distance. If you ask boys to make a map of an area that they have only visited once, their maps have a more accurate layout of the features in the environment — for example, showing which landmark is southeast of another.

If you ask people to put together a three-dimensional mechanical apparatus in an assembly task, on average men score higher. Boys are also better at constructing block buildings from two-dimensional blueprints. These are constructional systems. The male preference for focusing on systems again is evident very early. The Cambridge study found that one-year-old boys show a stronger preference to watch a film of cars (mechanical systems) than a film of a person's face (with lots of emotional expression). Little girls showed the opposite preference. And one-day-old boys look far longer at a mechanical mobile.

Culture and socialization certainly play a role in determining if you develop a male brain (stronger interest in systems) or female brain (stronger interest in empathy). But these studies of infancy strongly suggest that biology also partly determines this.

> **The Cambridge study found that at one-year old, boys show a stronger preference to watch a film of cars (mechanical systems) than a film of a person's face (with lots of emotional expression). Little girls showed the opposite preference. And at one-day old, boys look far longer at a mechanical mobile.**

BIOLOGICAL CAUSES

Some of the most convincing evidence for biological causes for sex differences in the brain comes from studies of the effects of hormones. At one time, women were prescribed a synthetic female hormone (diethylstilbestrol) in an attempt to prevent repeated spontaneous miscarriages. Boys born to such women are more likely to show female-typical, empathizing behaviors, such as caring for dolls. And if a female rat is injected at birth with testosterone, she shows faster, more accurate maze learning, compared to a female rat who has not been given such an injection. So masculinizing the rat hormonally improves her spatial systemizing.

Some important lessons have been learned from studies of clinical conditions. Male babies born with IHH (idiopathic hypogonadotrophic hypogonadism) have very small testes (and therefore very low levels of testosterone), and they are worse at spatial aspects of systemizing than are normal males. Other male babies born with Androgen Insensitivity (AI) Syndrome (testosterone is an androgen) are also worse at systemizing. Compare these with female babies born with CAH (congenital adrenal hyperplasia), who have unusually high levels of androgens and who have enhanced spatial systemizing.

Leaving aside these clinical conditions, evidence exists for the effects of hormones on the mind in the typical child. Recall that the Cambridge study found that toddlers who had lower fetal testosterone had higher levels of eye contact. Eye contact may be related to sociability and empathizing. And a group of Canadian researchers found that the higher your prenatal testosterone, the better you do on the Mental Rotation (systemizing) Test.

The E–S theory does not stereotype. Rather, it may help us explain why individuals are typical or atypical for their sex. For every ten men, six have a male brain, two have a balanced brain, and two have a female brain. In contrast, for every ten women, four have a female brain, four have a balanced brain, and two have a male brain. This variation means you cannot tell what kind of brain a person has just from knowing their sex. The E–S theory also may help us understand the childhood neurological conditions of autism and Asperger Syndrome, which appear to be an extreme of the male brain. Such individuals may have severe impairments in empathizing, yet normal or even talented systemizing.

Earlier studies of psychological sex differences have focused on what is sometimes called "the holy trinity": spatial ability, mathematical ability, and verbal ability. The first two of these are areas where males perform at a higher level, while the last typically shows a female advantage. However, spatial and mathematical abilities involve systemizing and so may simply be further evidence for the E–S theory. Verbal ability may have nothing to do with empathy, in which case it will need to be regarded as an additional dimension along which the sexes differ psychologically. However, good empathizing and good verbal skills both facilitate communication, so verbal and empathy skills may not be truly independent.

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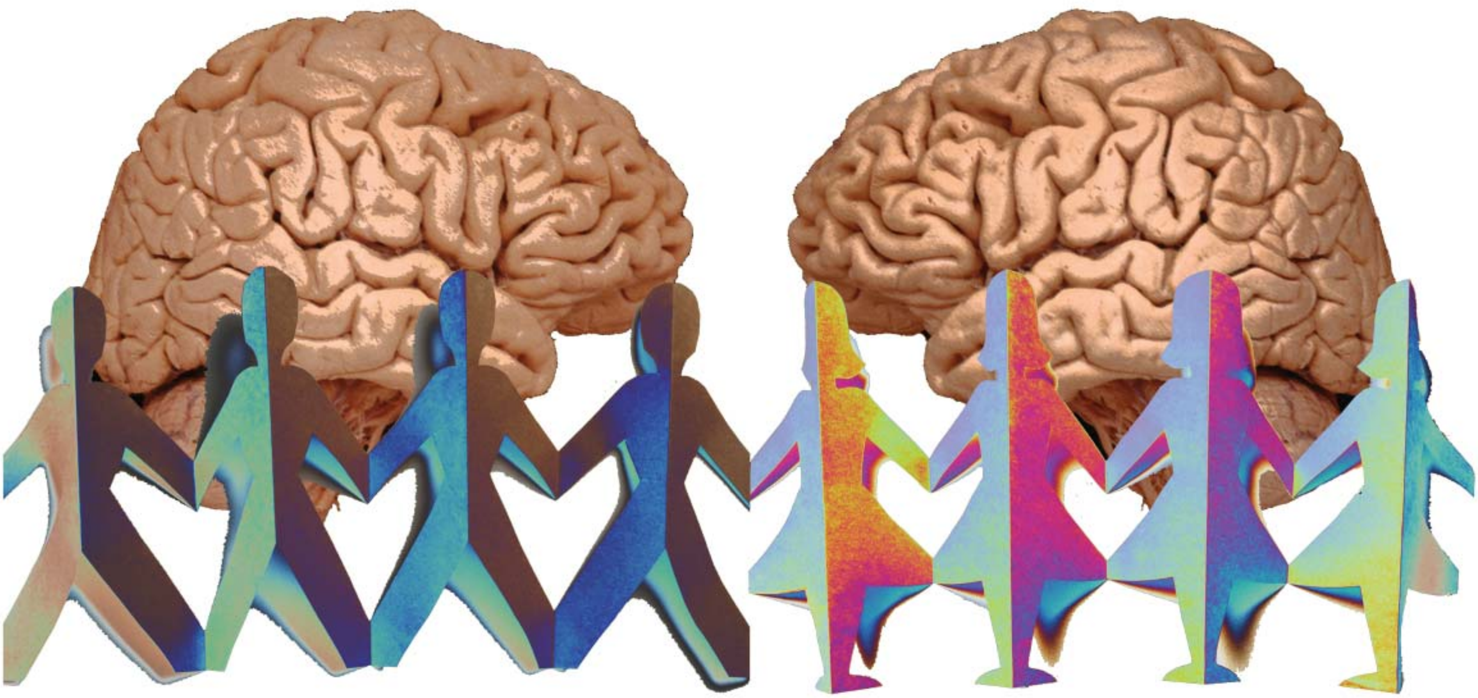

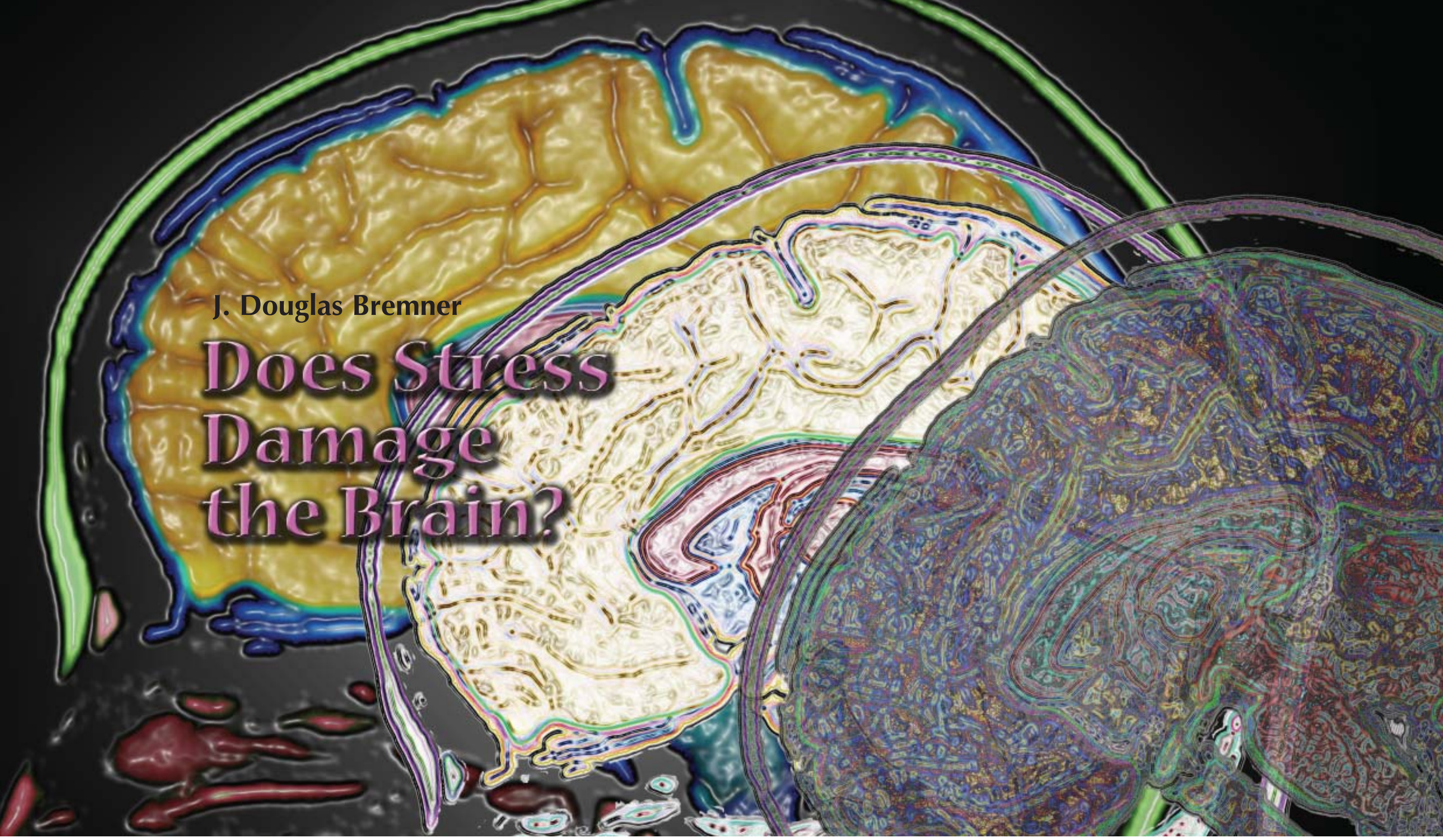

J. Douglas Bremner

Does Stress Damage the Brain?

Scientists have long recognized that stress can have long-term effects on the brain and on physiology. Often the scientists themselves did not think about the possible implications for the effects of stress on humans. However, recent research has shown that humans with a history of exposure to extreme trauma and who develop post-traumatic stress disorder (PTSD), with its associated nightmares, intrusive memories, avoidance of reminders of the trauma, sleep disturbance, hypervigilance, and other symptoms, have changes in actual brain structure and function. Research shows changes in brain areas including the hippocampus and frontal cortex, as well as alterations in levels of the stress hormones cortisol and norepinephrine, all of which underlie symptoms of PTSD.

In 1980 the American Psychiatric Association (APA) classified PTSD as a psychiatric disorder for the first time and listed criteria for inclusion in the Diagnostic and Statistical Manual III (DSMIII). This inclusion was the first time that psychological trauma (that is, things that happen to you when there is no physical injury) was recognized as having the potential to cause long-term changes in mental balance.

ROLE OF THE HIPPOCAMPUS

Research on the effects of stress on the brain in animals has a long history; however, such research on humans has just begun to catch up. Studies in animals exposed to stress show deficits in hippocampal-based memory function and damage to a part of the brain called the hippocampus that mediates memory. A variety of mechanisms has been proposed for these findings, including elevated levels of the stress-hormone cortisol or an inhibition of the ability to grow new neurons in the hippocampus, something called neurogenesis. Stress has been shown to inhibit neurogenesis, while antidepressants have the opposite effect. In fact, research suggests that antidepressants may cure depression by promoting neurogenesis in the hippocampus, although scientists continue to debate this fact.

The role of the hippocampus in learning and memory and the wide range of memory alterations seen in PTSD patients led to the hypothesis of hippocampal dysfunction in PTSD. Neuroimaging studies showed hippocampal atrophy in PTSD patients, with deficits in hippocampal-based learning and memory. Other studies provoked symptoms of PTSD by showing traumatic pictures, reading back personalized scripts of trauma, or other methods. These studies most consistently showed a failure of activation in the frontal cortex, the part of the brain involved in shutting off the fear response by inhibiting the amygdala, which mediates the fear response.

Considering findings related to the effects of antidepressants on neurogenesis, we assessed the effects of the antidepressant paroxetine (Paxil) on outcomes related to function of the hippocampus. Patients with PTSD showed a significant improvement in PTSD symptoms with treatment. Treatment resulted in significant improvements in verbal-declarative memory and a 4.6 percent increase in mean hippocampal volume. These findings suggest that long-term treatment with paroxetine is associated with improvement of verbal-declarative memory deficits and an increase in hippocampal volume in PTSD.

STRESS AND HORMONES

Hormones (including norepinephrine and cortisol) play a critical role in the stress response. Norepinephrine (commonly known as adrenaline) is released in both the brain and the body and has several functions that are critical for survival. Norepinephrine sharpens the senses, focuses attention, raises the level of fear, quickens the heart rate, raises blood pressure, and in general prepares us for the worst. The norepinephrine system is like a fire alarm that alerts all areas of the brain simultaneously. This system sacrifices the ability to convey specific information to specific parts of the brain so that it can obtain more speed.

Norepinephrine focuses the senses by activating the neurons that collect information from the senses so that we may rapidly and efficiently obtain information about dangers in the environment. At the same time that it stimulates the cells of the brain to collect information more efficiently about what dangers are out there, it also stimulates the heart to beat more rapidly and blood pressure to increase. These physiological changes result in an emergency transfer of oxygen and nutrients needed for survival to all the cells of the body. The beauty of the system is that the same chemical messenger that “turns on” the brain also stimulates the heart (as well as other bodily organs) to facilitate survival. Chronic stress in animals leads to increased levels of norepinephrine.

A variety of studies shows long-term dysregulation of the noradrenergic system in PTSD. Noradrenergic response (heart rate, blood pressure, and galvanic skin response) increases to traumatic reminders, such as traumatic photographs and sounds or traumatic scripts, in PTSD. Studies of norepinephrine in plasma and urine have shown increased levels at baseline, while traumatic reminders result in a potentiated release of norepinephrine in PTSD. Administration of medications that stimulate norepinephrine release results in an increase in PTSD-specific symptomatology in PTSD patients.

Animal studies have shown that increasing norepinephrine release up to a certain level improves cognition and attention, but beyond that point it reduces performance. Using positron emission tomography (PET) imaging, which allows us to measure brain activity while we stimulate norepinephrine release in the brain with medication (yohimbine), we found that lower levels of norepinephrine stimulate brain activity in the prefrontal cortex, but at very high levels (as are seen in PTSD), the brain shuts off. The findings are consistent with an inverted U-curve for norepinephrine, where lower levels of norepinephrine stimulation increase the efficiency of the brain, whereas very high levels make it more inefficient.

Everyone knows that a little bit of stress can be a good thing. For instance, it is always hard to study if you do not have any real reason to learn the material, especially if you do not find it all that interesting. However, we learn better and faster if we have an important exam to study for that we do not want to mess up. But sometimes people get so stressed out that they “choke” and actually do worse because they release too much norepinephrine in their brains. This reaction lies behind the common practice of taking propanolol (which blocks the effects of norepinephrine in the brain) to improve performance during public speaking.

Again, evolution may have preferred the caveman who could survive attacks by wooly mammoths long enough to pass his genes to the next generation, even if it meant that he could not remember where he left his favorite spear when he was old. In other words, evolution prefers short-term survival at the expense of long-term function.

The cortisol system also plays an important role in the stress response. Like norepinephrine, cortisol is released during times of threat and is critical to survival. Cortisol redistributes the energy of our bodies when we are under attack; to help us survive, it suppresses functions that we do not need for immediate survival, including reproduction, the body’s immune response, digestion, and the feeling of pain. Although cortisol has actions that are beneficial for short-term survival, it may perform these functions at the expense of long-term viability of the body. For instance, chronically high cortisol levels can cause gastric ulcers, thinning of the bones, and possibly even brain damage. Again, evolution may have preferred the caveman who could survive attacks by wooly mammoths long enough to pass his genes to the next generation, even if it meant that he could not remember where he left his favorite spear when he was old. In other words, evolution prefers short-term survival at the expense of long-term function.

The corticotropin-releasing factor (CRF)/hypothalamic-pituitary-adrenal (HPA) axis system plays an important role in the stress response. Exposure to stressful situations is associated with a marked increase in cortisol release from the adrenal. Glucocorticoid release from the adrenal is regulated by adrenocorticotropin-releasing hormone (ACTH) release from the pituitary, which in turn is primarily regulated by CRF release from the paraventricular nucleus (PVN) of the hypothalamus. Intraventricular injection of CRF results in stress-related behaviors (for instance, fearfulness). Stressors early in life may have long-term effects on the CRF/HPA axis, including increased glucocorticoid response to subsequent stressors.

PTSD has been associated with long-term dysregulation of the HPA axis. Baseline levels of urinary cortisol were either decreased or unchanged in chronic PTSD, while decreased levels were found in twenty-four-hour samples of plasma cortisol levels. Exposure to a stressor or a traumatic reminder was associated with a potentiated release of cortisol, however, in PTSD. Cortisol also may be elevated in the more acute phase of PTSD, although further research is needed in this area. A replicated finding has been a super-suppression of the cortisol response to lower doses of DST (0.5 mg), a finding which is the opposite of patients with major depression who are nonsuppressers with the standard 1 mg DST test. PTSD patients had elevated levels of CRF in the cerebrospinal fluid. One possible explanation of findings to date is an increase in neuronal-CRF release, increased central glucocorticoid receptor responsiveness, and resultant low levels of peripheral cortisol due to enhanced negative feedback.

Psychological trauma with a stress-related mental disorder is associated with long-term changes in the brain and stress-responsive systems. Brain areas affected include the hippocampus and frontal cortex. Stress systems involved include cortisol and norepinephrine. These changes may lead to both memory problems and maintenance of abnormal fear responses and other psychiatric symptoms. Although the effects of stress were once felt to be merely psychological, research is showing that stress has lasting effects on the mind, brain, and body that lead to long-term effects on neurobiology and physical function.

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IN A BOAT ON THIS LAKE

That we live in an unusual age
and must forswear metaphor as a slack
and shallow lake our provincial fathers
over-fished, seems wrong. I say, go ahead,
sit long enough on this lake in any
vessel whose to-and-fro on the water
you like — fisherman's craft or pleasure yacht —
and unless something has poisoned the pool
into apocalypse, I can tell you,
it's a fact, that sometimes water will swell.
Go ahead, sit long enough on this lake.

One minnow, lifted by a synchronous
pool, may pop a round and palpable mouth
softly at the seam of water and air.

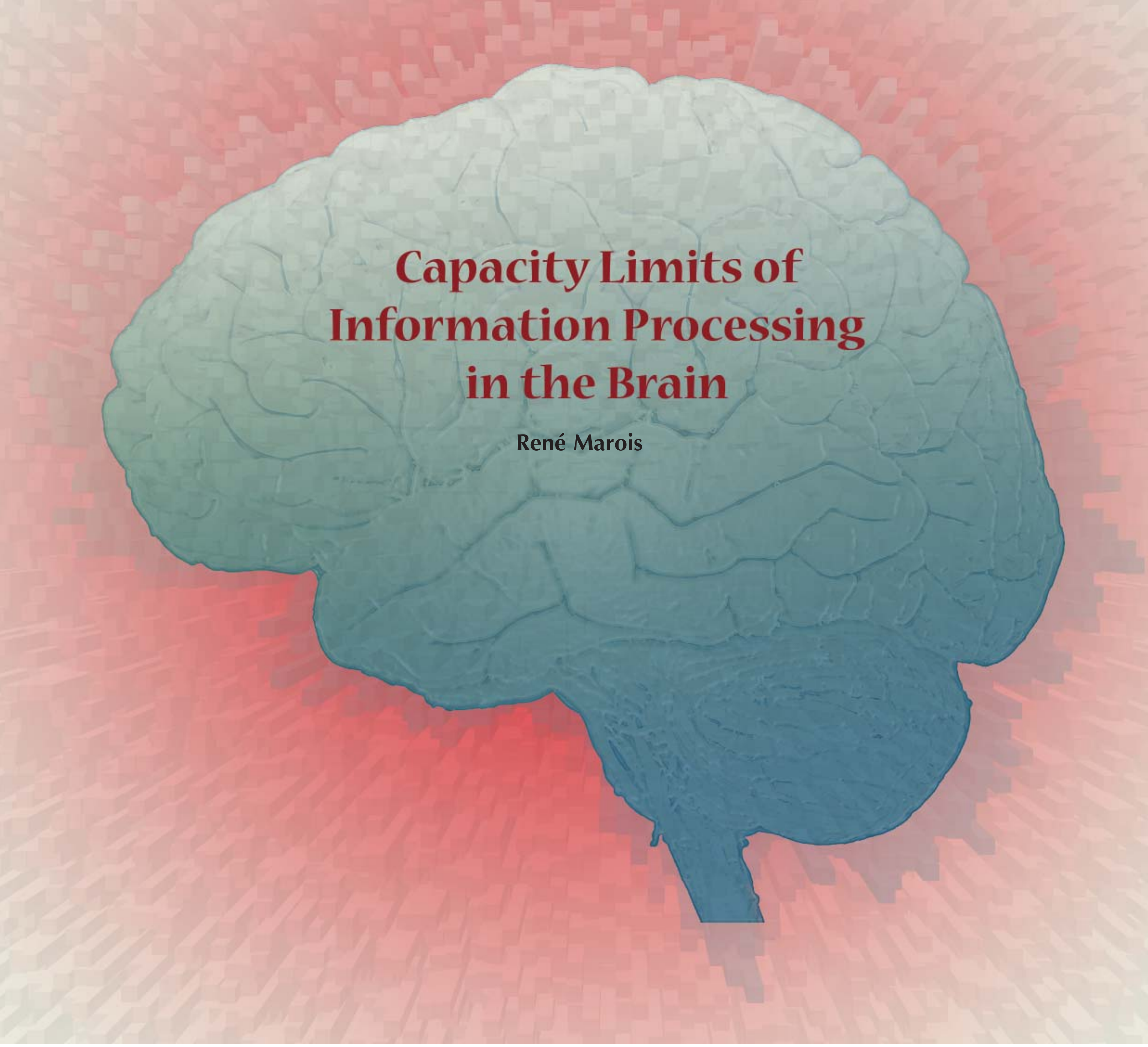
It's a fact, a fact that bodies believe,
that its rising from a deep, deep green feels
as common, as religious as a kiss.

JILL MANCINA

Jill Mancina lives in Lake Arrowhead, California.

Capacity Limits of Information Processing in the Brain

René Marois



The human brain is heralded for its staggering complexity and processing capacity. Its hundred-billion neurons and several-hundred-trillion synaptic connections can process and exchange large amounts of information over a distributed network of brain tissue in a matter of milliseconds. Such massive parallel-processing capacity permits our brains to analyze complex images in one-tenth of a second, allowing us to visually experience the richness of the world. Likewise, the storage capacity of the human brain is nearly infinite. During our lifetime, our brain will have amassed 10^9 to 10^{20} bits of information, which is more than fifty-thousand times the amount of text contained in the U.S. Library of Congress, or more than five times the amount of the total printed material in the world!

Yet, for all our neuro-computational sophistication and processing power, we can barely attend to or hold in mind more than a few objects, and we can hardly perform more than one task at a time. We are routinely reminded of these severe shortcomings, for instance when attempting to read a complex passage while keeping an eye on some television program or when talking on the cell phone while driving. These anecdotal evidences have been rigorously documented in the laboratory; maintaining a cell phone conversation impairs simulated driving performance and can lead to 90 percent of observers failing to detect an unsuspected salient visual stimulus! The costs to society of our capacity limits in processing information are likely to be immense. For instance, driver inattention and other human errors have been estimated

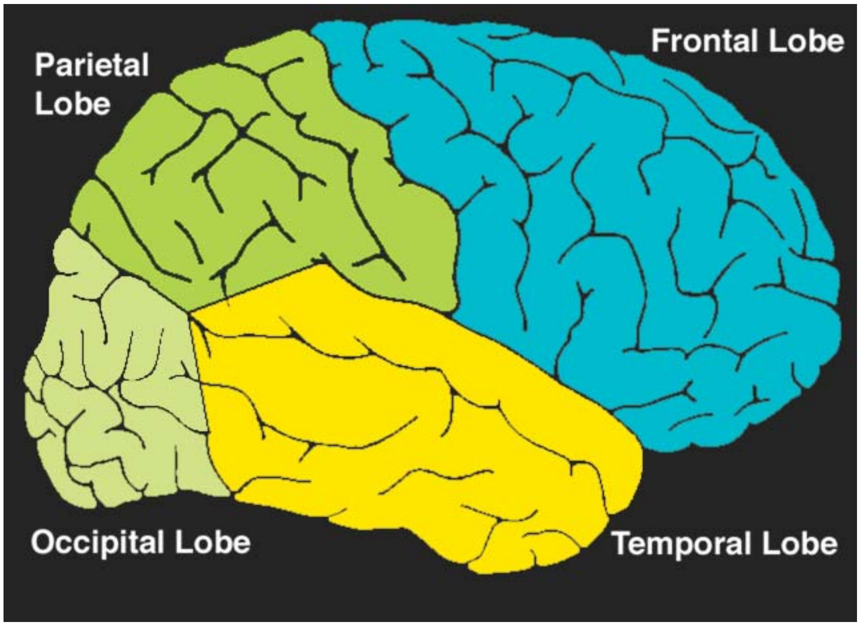


Figure 1. The lobes of the human cerebral cortex.

to account for nearly 40 percent of motor-vehicle accidents. How does such a sophisticated, multipurpose processing machine as the human brain exhibit such severe and, quite frankly, humbling limitations?

A rich history of scientific research has highlighted three major roadblocks during the flow of information from sensation to action. The first limitation concerns the time that it takes to consciously identify an object. We may have the impression that identification is instantaneous, but in fact this process can take more than half a second before our brain is free to identify a second object. A second, severely limited capacity is the number of objects that can be simultaneously maintained in short-term memory, estimated to be about four objects. It does not matter if more objects are shown to you; you will be able to remember or monitor only four of them. Finally, a third bottleneck arises when one must choose the proper course of action for an object or event. Suppose that while driving you see a road sign indicating your highway exit. While you are busy taking the proper action (for example, shifting lanes), you may be impaired at making other responses (such as answering a question from a passenger in your car).

WHY DO WE EXHIBIT SUCH SEVERE LIMITS IN CAPACITY?

Why does the sophisticated, multipurpose processing machine that is the human brain exhibit such severe limitations at multitasking? We can only speculate. The limited capacity of short-term memory is particularly puzzling, given that we can easily build computers that can rapidly store thousands of items. One possibility is that our brain did not need to be built to maintain a detailed representation of the visual world in our mind's eye because this detailed representation is just one look away. All we need to do is to open our eyes, and our visual system presents us with a detailed view of the world. It is also unlikely that during the evolution of the primate brain there was any strong pressure for our nervous system to fully identify visual objects or events in very rapid succession. Even under fight-or-flight situations, probably only one predator or rival needs to be identified at a time.

Similarly, it is unlikely that our ancestors had to make several split-second decisions at once. Action towards an object typically requires an orchestrated effort from our limbs; picking a fruit out of a tree may require using both hands (one for holding the branch and the other for plucking the fruit), fixing the eye on the fruit to optimize reaching accuracy, and positioning the legs in a particular way to ensure a stable posture. The same can hold true for escaping predators as well. Thus, our ancestors could get away with not having to make more than one split-decision at a time. However, now that we live in a fast-paced world and drive on densely populated roads, these capacity limits have become all too real, and dangerous.

To be sure, these are not the only brain processes that exhibit capacity limitations. Indeed, it can be safely argued that all brain processes are capacity-limited. However, the three we highlight here are arguably the most severe ones that can cripple our ability to be aware of, hold in mind, and act upon information present in a visual scene. Below, we discuss each of these three bottlenecks of information processing.

CAPACITY LIMITATIONS IN CONSCIOUS VISUAL PERCEPTION

A visual scene is not analyzed by a single part of our brain, nor is it analyzed by all parts of our brain. Our visual system appears to work in a divide-and-conquer fashion. The visual information coming through the retina and transmitted to the cortex is processed by different regions of the visual cortex in the occipital lobe (Figure 1), with each region being specialized in processing different attributes, such as color or motion. The first stations of the visual cortex appear to process simpler features of the visual scene, such as the contours of a face, whereas later, deeper areas of the visual cortex may be more specialized, for instance, for identifying a particular face. Research has shown that the early stages of visual processing can quickly process a large amount of information in parallel. By contrast, later stages are much more limited in their processing power; they can process only one item at a time. The division between capacity-limited and capacity-unlimited stages of information processing is a prominent feature of theoretical models of visual cognition. In these two-stage models, the early stage permits the rapid, initial categorization of the visual world, while later attention-demanding, capacity-limited stages are necessary for the conscious reporting of and action upon the stimuli.

If you are presented with images of objects very quickly in succession, say ten per second, and you are asked to determine if two particular objects (say, a radio and a bottle) were presented among eight other objects, you will be able to detect the first of the two target objects presented, but you will fail to perceive the second one if it was presented within half a second of the first. Most interestingly, even though you may be convinced that the second target object was not presented, using clever behavioral paradigms and powerful, noninvasive instruments that can measure brain activity, scientists can clearly demonstrate that the early parts of your visual system did nonetheless respond to the second target object because its neural activity changed. On the other hand, the neural activity of other regions of your brain, specifically in the parietal and frontal lobes (Figure 1), changed their activity only when you consciously perceived the second target object. These results have two profound implications. First, some parts of the human cerebral cortex can be activated even in the absence of visual awareness of the object. Second, the neural activity of other parts, particularly in the parietal and frontal lobes, is strongly associated with the conscious perception of the visual object. These latter regions are therefore likely candidates for the neural locus of our capacity limit in consciously perceiving target objects.

In our society in which time is becoming scarce and demands imposed on us increase incessantly, the ability to multitask is becoming more of a serious issue. Yet, the process of doing two actions at once is another stage that is severely capacity-limited. The selection of the appropriate action for one event almost invariably delays for more than half a second the selection of the appropriate action for the other event.

CAPACITY LIMITATIONS IN SHORT-TERM MEMORY

Capacity limits are present not only in how fast information can be consciously perceived but also in how much of that information can be stored in our short-term memory. Suppose you are briefly shown two photographs of a scene in succession, one second apart from each other, and your task is to determine whether the two scenes are identical or not. The likelihood is that you will fail to notice even a

Figure 2. When shown one second apart two scenes that differ by one change, most people miss the change (in this example, the color of the lady's coat on the right).

gross change between the two scenes (see Figure 2). This embarrassing phenomenon is called "change blindness." One of the reasons that we fail to detect the change is that our brain has a very limited capacity for storing a detailed mental representation of a visual scene when it is taken out of our sight.

In fact, it is estimated that we are able to keep in short-term memory only the equivalent of about four objects. In the same way that it is difficult to keep a phone number in mind after having looked it up in the phone book, it is even more difficult to keep in mind a visual memory of an unfamiliar scene. Using a technique called functional magnetic resonance imaging (fMRI), scientists can peer inside the intact human brain and determine which brain regions are active when people are engaged in the type of short-term memory task just described. The results of such experiments reveal that the activity of a region of the posterior parietal cortex correlates strongly with the number of objects that one can hold in mind. That is to say, this brain region was more active as more objects were stored in visual short-term memory, but only up to the capacity limit of the number of objects that could be stored. When more objects were shown than could be stored, these additional objects did not cause more activity in the parietal cortex. Thus, the activity of this brain region could predict the number of objects that were held in mind, not the number of objects that were in the visual scene. The objects that were out of mind were, for all intents and purposes for this brain region, out of sight as well. This brain region is therefore likely to represent a key neural locus of our impoverished mental representation of the visual world.

CAPACITY LIMITATIONS IN ACTION AND DECISION-MAKING

Doing two things at once is difficult. If you have ever tried patting your head while simultaneously drawing circles on your stomach with your other hand, you know that. Likewise, talking on the cell phone while driving may impair your ability to notice and react to unexpected visual events on the road. In our society in which time is becoming scarce and the demands imposed on us increase incessantly, the ability to multitask is becoming more of a serious issue. Yet, the process of doing two actions at once is another stage that is severely capacity-limited. The selection of the appropriate action for one event almost invariably delays for more than half a second the selection of the appropriate action for the other event.

To understand dual-task impairments in the laboratory, scientists use simple tasks, such as requiring a response with one of two hands to the presentation of one of two possible colors, while simultaneously demanding a verbal response to the presentation of one of two possible tones. Even when using such simple tasks, dual-task limitations are readily observed. The execution of the visual-manual task can delay the auditory-vocal task by several hundred milliseconds. Such delay may appear to be relatively benign, but it is more than sufficient to trigger dire consequences in driving situations. When people perform these dual-task situations in an fMRI scanner, evidence suggests that the lateral frontal cortex is implicated in this deficit. The frontal cortex may therefore represent the neural locus of another capacity-limited process, that of multitasking.

CONCLUSIONS

The research on the neural basis of the capacity limits of information processing in the human brain is still in its infancy. We are just beginning to understand the brain regions involved in limiting our abilities to consciously perceive, to hold in mind, and to act upon the visual world. Yet, it may seem that this research is already painting a picture of our brain that is rather gloom-and-doom; our nervous system has failed to keep up with the rigors of our technology and society. This is not the case. Our brain is arguably the most complex biological structure ever put together, a marvelous organ that the most sophisticated computers do not even remotely equal, save for very specific computational domains such as chess.

Furthermore, our brain is nevertheless well endowed to allowing us to perceive, feel, and act in our day-to-day life. It is when the brain is pushed to its limits, as in the laboratory when submitted to cleverly designed tasks, that we can see it break down. Finally, one should not think that these capacity limits are necessarily immutable. For instance, compelling evidence now suggests that our ability to dual-task increases appreciably with practice. Only when we understand the neural basis of these capacity limitations will we able to overcome or circumvent them, or build better road- and work-related infrastructure so that we can go on in our daily business without our brain hitting one of its speed bumps.

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Neuroinformatics

Michael A. Arbib

INTRODUCTION

The key level of analysis of the brain is the *neuron* — a cell specialized to respond to complex patterns of activity from receptors (the body's sensors) or other neurons both to change its state (this provides the key to memory) and also to send a timed pattern of signals to other neurons and then through the complexity of networks of neurons to the glands and the muscles (the body's effectors). The point at which one neuron connects to another is called a synapse. The synapse is a complex chemical machine, but so too is the cell itself; understanding gene expression is a crucial part of understanding this machine. The human brain has hundreds of anatomically and functionally distinct regions. Among them, these regions have perhaps as many as one-hundred-billion neurons, and some neurons have tens of thousands of synapses.

Just to add one more daunting number, the October 2004 meeting of the Society for Neuroscience (SfN) drew more than thirty-thousand people to the San Diego Convention Center, and almost all of them are active researchers, adding several papers a year to the literature on the brain. In short, the brain is an incredibly complex system, and responses to the challenge of understanding its functions and mechanisms produce a vast torrent of both new empirical data and publications presenting that data.

FROM GENES TO BRAINS

Neuroinformatics, then, might be defined simply as the use of computers (information technology) to assist neuroscientists in managing that torrent. However, the use of computers has become so ubiquitous in the developed world that we need a more restrictive focus. One key element that must be included is the extensive use of databases, as was set forth in the deliberations of the Committee on a National Neural Circuitry Database of the Institute of Medicine (*Mapping the Brain and Its Functions: Integrating Enabling Technologies into Neuroscience Research*, Constance Pechura and Joseph Martin, Editors, National Academy Press, Washington, D.C., 1991). Although that report used the word "database" hundreds of times and mentioned the concept of simulation only in passing, it is now widely accepted that *neuroinformatics* goes well beyond the use of databases, the World Wide Web, and visualization in the storage and analysis of neuroscience data. The structuring of masses of data by a variety of computational models is essential to the future of neuroscience. From this perspective, neuroinformatics includes *computational neuroscience*, the use of computational techniques and metaphors to investigate relations between neural structure and function.

In recent years, the Human Genome Project has become widely known for its success in sequencing the complete human genome and providing the results in comprehensive databases such as GenBank, the National Institutes of Health (NIH) genetic sequence database, which is an annotated collection of all publicly available DNA sequences. It contained approximately thirty-eight billion bases in thirty-three million sequence records as of February 2004. However, the key data are rather simple, taking the form of annotated base-pair sequences of DNA.

In the hope of doing for neuroscience what the Human Genome Project has done for human genet-

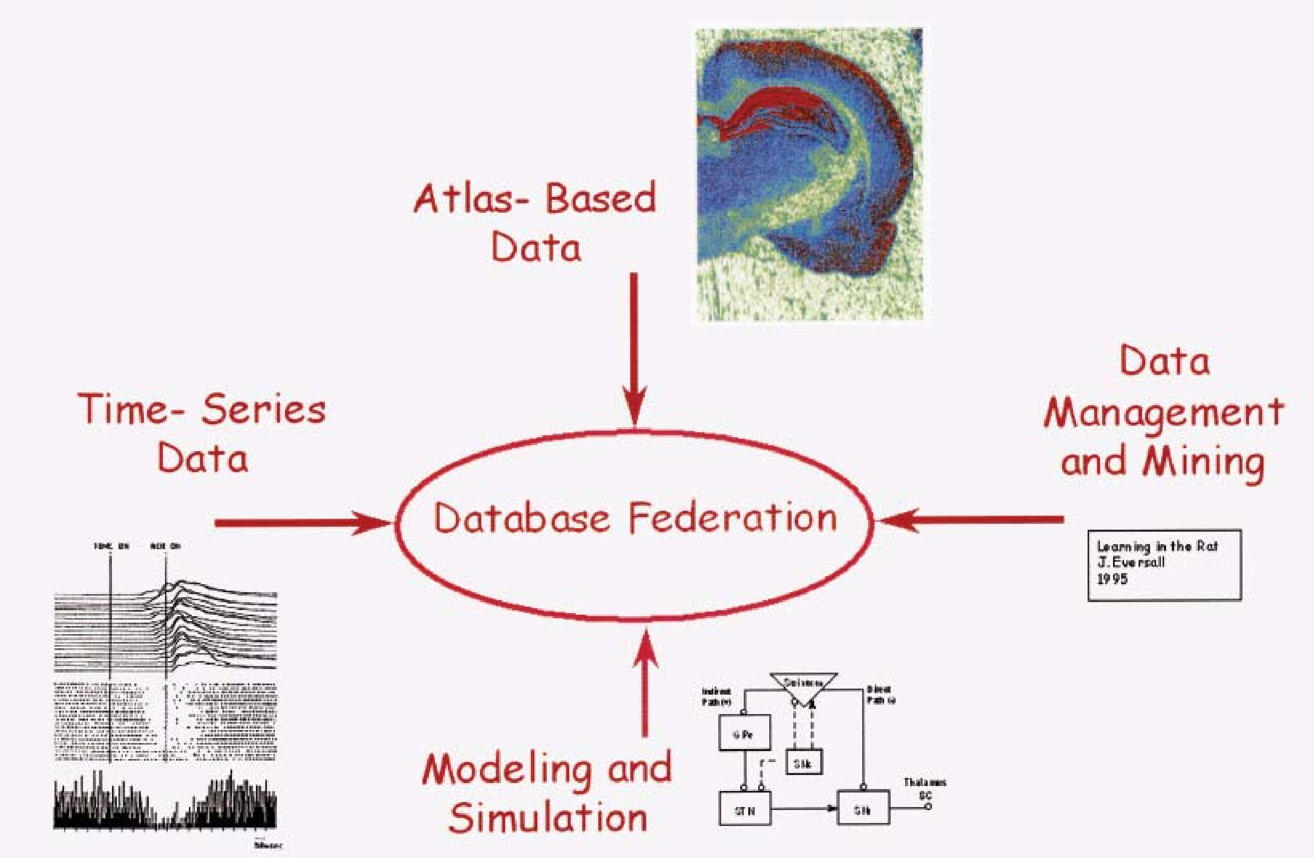


Figure 1. Conceptualizing a Neuroinformatics Network.

ics and inspired by the report *Mapping the Brain and Its Functions* described earlier, NIH announced the Human Brain Project (HBP) on April 2, 1993, with the goal of providing a World Wide Web-based set of neuroscience databases interoperable with each other as well as with genomic and other databases. However, by contrast with the single-data format that allows GenBank to rapidly absorb millions of new entries every year, neuroinformatics databases must be built for immensely heterogeneous sets of data. Not only must one contend with the many orders of magnitude linking the finest details of neurochemistry to the overall behavior of the organism, but also one must integrate data gathered by many different specialists. Neuroanatomists characterize the brain's connectivity patterns; neurophysiologists characterize neural activity and the "learning rules" that summarize the conditions for, and dynamics of, change; neurochemists seek the molecular mechanisms that yield these "rules"; computational neuroscientists seek to place all these within a systems perspective.

To give some sense of the scope of neuroinformatics, I will briefly survey the contents of a book I coedited that describes the first five years of work of the University of California Brain Project (USCBP) on neuroinformatics (Arbib, M.A., and Grethe, J., Eds., *Computing the Brain: A Guide to Neuroinformatics*, San Diego: Academic Press, 2001) and then give some sense of the databases and resources made available via the Neuroscience Database Gateway of the Society for Neuroscience.

Figure 1 suggests the diversity of databases that need to be interconnected to form a *federation* which provides access to many forms of data, with illustrative material from work at the University of Southern California. The time-series data shown here are behavioral records (top traces), firing patterns of an individual neuron (middle traces), and a histogram (bottom) from studies of classical conditioning in the laboratory of Richard Thompson. The picture at top, from the laboratory of Michel Baudry, shows staining of a slice of brain for substances related to memory mechanisms; we call it atlas-based because interpretation requires registration of the slice against a standard atlas of the rat brain. At right, we are reminded of the wealth of information (such as published articles) distributed across the World Wide Web, and the challenges of "mining" and managing this overwhelming body of data. Finally, at bottom, the schematic of a model by Michael Crowley and me of the basal ganglia (disorders of which include Parkinson's disease and Huntington's disease) indicates the importance of theories and models needed to structure the manifold data of neuroscience. The key point, of course, is that data from very different sources will need to be brought together, thus challenging neuroinformaticians to do far more to make their resources interoperable.

COMPUTING THE BRAIN: A GUIDE TO NEUROINFORMATICS

Our book aims to show how to integrate database, visualization, and simulation technology to gain a deeper, more integrated view of the data of neuroscience, introducing the *NeuroInformatics Workbench* as a unified architecture for neuroinformatics combining three main components: *NSLJ*, a modular, Java-based language and environment for neural simulation; *NeuroCore*, a system for constructing and using neuroscience databases; and *NeuARt*, a viewer for atlas-based neural data.

For a variety of behaviors, we sought to understand what must be added to the available databases on neural responsiveness and connectivity to explain the time course of cellular activity and the way in which such activity mediates between sensory data, the animal's intention, and the animal's movement. The attention paid by neuroscience experimentalists to computational models is increasing, as modeling occurs at many levels, such as the systems analysis of circuits using the NSL Neural Simulation Language developed at USC and the use of the GENESIS language developed at Caltech and the NEURON language from the University of North Carolina and Yale University to relate the detailed morphology of single cells to their response to patterns of input stimulation.

Part of our modeling has been concerned with the following question: "How can the data from animal neurophysiology be integrated with data from human-imaging studies?" We developed a methodology called Synthetic PET (the "real" PET is Positron Emission Tomography, an important approach to imaging the human brain, though in great part now supplanted by fMRI, functional magnetic resonance imaging) that allowed us to use computational models of the activity in circuits in the monkey brain to predict the activity that could be revealed by imaging the brain of a human performing similar tasks. Examples of the application of this to reaching, grasping, and imitation were later published in "Synthetic Brain Imaging: Grasping, Mirror Neurons and Imitation" (Arbib, M.A., Billard, A., Iacoboni, M., and Oztop, E., *Neural Networks*, 13: 975–997, 2000).

Our USC Brain Project group saw the key to building repositories for the storage of experimental neuroscience data to be the notion of the *experimental protocol* that defines a class of experiments by specifying a set of experimental manipulations and observations. When linking empirical data to models, we translate such a protocol into a simulation interface for "stimulating" a simulation of the empirical system under analysis and displaying the results in a form that eases comparison with the results of biological experiments conducted using the given protocol. NeuroCore was our novel extendible object-relational database schema. The schema (structure of data tables, and so on) for each NeuroCore database is an extension of our core database schema that is readily adaptable to meet the needs of a wide variety of neuroscience databases.

But how are data from diverse experiments on the brains of a given species to be integrated? Our answer was to register the data — whether the locations of cells recorded neurophysiologically, the tract tracings of an anatomical experiment, or the receptor densities revealed on a slice of brain in a neurochemical study — against a standard brain atlas for the given species. There are interesting parallels here with Geographical Information Systems, but the fact that we have one Earth but brains of many species, and tremendous inter-individual variability within a species, raises huge new challenges for neuroinformatics. Add to this developmental changes and the ravages of disease, and providing "standard" views clearly becomes a research challenge rather than a solved problem. Our key contribution was NeuARt (the NeuroAnatomical Registration Viewer), but although it was billed as a system for registering data against brain atlases, it concentrated on one atlas, namely that developed for the rat brain by USC's Larry Swanson.

A continuing challenge for neuroinformatics is that of "federating" databases. As the databases accessible through the SfN portal make all too clear, as we will see later, there will not be a single monolithic database that will store all neuroscience data. Rather, there will be a federation of databases throughout the neuroscience community. Each database has its own "ontology," the set of objects that create the "universe of discourse" for the database. However, different databases may use different ontologies to describe related material, and we discussed strategies for dynamically linking the ontologies of the databases of a database federation. An important concept we added to the notion of a database of empirical results was that of the *summary database*, one that serves some area of research by summarizing key hypotheses gleaned from a wide variety of empirical and modeling studies in attempting to maintain a coherent view of a nearly overwhelming body of data. We also described *Brain Models on the Web*, a database that was to provide access to a wide range of neural models but also supports links to empirical databases, and tools for model revision; *NeuroScholar*, which offers a general philosophy on the construction of summary databases; and the *Neurohomology Database* (NHDB), which supports the analysis of homologies between the brain regions of different species, returning us to the issue of how best to integrate the findings of animal studies into our increasing understanding of the human brain.

THE SfN NEUROSCIENCE DATABASE GATEWAY

The Brain Information Group (BIG) of the SfN, chaired by Floyd Bloom, held three meetings in 2003 to survey existing neuroscience databases, their objectives, features, strengths, and limitations. Their White Paper, "The Information Infrastructure Needs of Neuroscience Research: Opportunities and Issues of Implementation" (http://web.sfn.org/content/Programs/NeuroscienceDatabaseGateway/whitepaper.html), may be considered the latest update of the vision set forth in 1991 in *Mapping the Brain and its Functions*. The group agreed that a centralized gateway for accessing neuroscience-related databases would be of great use, and a subgroup (Luis Marenco, Gordon Shepherd, Maryann Martone, Dan Gardner, and David Van Essen) developed NDG (the Neuroscience Database Gateway: http://big.sfn.org/NDG/site/) as a pilot project that is currently housed in the SenseLab facility at Yale University. (Incidentally, both *NeuroScholar* and the *Neurohomology Database* mentioned in the previous section can be accessed via NDG.)

To help ensure that the present article provided an up-to-date view of neuroinformatics, complementing the perspective of the previous section, I made a thorough review of the Gateway in mid-December of 2004. The good news is that many of the resources are excellent; the bad news is that some seem less useful or less relevant for neuroscience. The truly sad news is that NDG provides no progress in federating its databases, nor does it give an illuminating high-level overview of their contents. (Fortunately, changes are now being made in the Gateway, so some of my criticisms may have been addressed by the time that this article is published.)

A top-level table in NDG provides three entries for each Web site — *Name, Description, URL* — but *Description* is often too brief to make an informed decision on the interest of the resource. If one clicks on Name, one gets a page with a table that provides *Notes* (which expand on the description — this is sometimes useful but on other occasions too brief); and a *DB Category* (one or more of *Databases of experimental data; Knowledge bases; Software tools for neuroscience*, but this is too coarse-grained to help one find a database relevant to one's interests); as well as a few other details. In some cases, the *Notes* give one a fairly good feel for the contents of the database; in other cases one has no choice but to click on the URL and inspect the database itself.

Here one is in for an unpleasant surprise — the work of the Brain Information Group stopped with providing the format for the *Name*-form. The format of the different Web sites is completely idiosyncratic. Some provide an informative homepage that gives a good sense of the data or tools that the Web site makes available; in other cases it requires some inspired searching through the Web site to get any sense of what it has to offer. A further problem in general is that there is no easy way to assess the holdings of a particular Web site — some provide a general resource that is well populated; some a general resource that still has few entries; some are very limited in scope, perhaps even to the data of a single laboratory; some are active sites that constantly receive new data; some have been dormant for quite some time. A systematic effort needs to be made to link far more neuroinformatics resources to NDG, and the passage from the Gateway to a particular Web site should be via a standard Web page designed by the SfN Brain Information Group to meet concerns such as those I have expressed above.

But even with this, the fact remains that the current structure provides no way of getting a comprehensive overview of the resources that the Gateway makes available. To address this, I spent a day rather compulsively going through all ninety resources listed in the Gateway, consulting the database itself where the *Notes* section of the *Name*-form was insufficiently informative, and then doing my best to replace the three rather uninformative categories *Databases of experimental data, Knowledge bases,* and *Software tools for neuroscience* with nineteen categories that I believe will help the user understand the overall structure of Gateway resources. My list is as follows:

General Sites:

Administrative Sites and Position Papers; Portals; Non-Neuroscience Resources

Neuroscience Tools:

Brain Imaging Tools; Database Tools; Neural Simulation Tools; Neurophysiology Tools

Neuroscience Data:

Brain Atlases and Collections of Brain Sections; Brain Structure Data; Neurosurgery Data; Human-Brain Imaging; Cell-Level Data: Microscopy; Cell-Level Data: Neurophysiology; Subcellular-Level Data; Special Sensory Systems; Neurogenetic Resources; Invertebrate-Neuroscience Databases; Mouse-Neuroscience Resources; Model Repositories

Twenty entries provide direct access to neither the tools nor data of neuroscience (they include administrative sites, portals to actual resources, and a variety of resources not directly related to neuroscience);

fourteen give access to tools; and fifty-one give access to data. The total count is eighty-five rather than ninety because I pruned some of the redundancy in the original tabulation.

It is beyond the scope of this article to review the details of these resources, but the very diversity of my nineteen categories will give the reader some sense of both the vitality of neuroinformatics and of the very daunting research challenges that lie ahead in making the format of such diverse resources more accessible by providing much more shared structure between the different resources, structure that can be exploited to increase federation of the resources.

A CASE STUDY

Aside from neuroinformatics, a central concern of my research is the evolution of the "language-ready brain" (Arbib, M.A., "From Monkey-like Action Recognition to Human Language: An Evolutionary Framework for Neurolinguistics," *Behavioral and Brain Sciences*, 2005). Recently, Mihail Bota and I (Arbib, M.A. and Bota, M., "Language Evolution: Neural Homologies and Neuroinformatics," *Neural Networks* 16:1237–1260, 2003) enriched the discussion of the *Neurohomology Database* (NHDB) by setting forth the challenges that must be met to make it useful in this evolutionary research. A key concern was to review data on brain regions and their connections in both the macaque monkey brain and the human brain relevant to the search for homologies to ground hypotheses on the changes that have occurred from the brain of the macaque-human common ancestor of perhaps twenty million years ago to the brain of *Homo sapiens*. In this regard, NHDB is a repository for relevant data that is equipped with inference engines for integrating data grounded in different atlases and combining diverse information to compute "degrees of homology" for brain regions in different species. However, the set of data included in NHDB is incomplete and — of course — scientists are continually publishing new data.

How, then, can we ensure that all potentially relevant data are entered into databases that are federated in such a way that they can be searched together? This effort requires both that the creators of different databases take the issue of federation seriously to support multidatabase searches and that neuroscientists come to consider the entry of their data in such databases as part of the publication process. This has a sociological and a technological component: to create a culture that rejects "data hugging" (that is, the policy of releasing a few data in publications but not making full datasets publicly available) and to provide tools that make data entry relatively easy. We currently face a "chicken-and-egg" problem: Given the vast heterogeneity of neuroscience data, it is hard (unlike the situation for the Human Genome Project) to reach the critical mass for any one kind of data that will reward scientists for data entry by giving them ease of access to a pleasingly large collection of like data prepared by others.

A related problem is how to determine what data are relevant to a given piece of research. For example, my approach to language evolution (developed with Giacomo Rizzolatti of Parma in Italy) gives a key role to brain mechanisms for grasping — suggesting how hand gestures might have provided necessary scaffolding for the evolution of speech mechanisms. Yet "grasping" would not be a keyword for search by those who take a "speech only" approach to evolving the language-ready brain. However, they might come to data on mechanisms for grasping either by launching a search for data on macaque homologues of Broca's area or by asking for data on brain areas discussed in high-citation literature on evolving the language-ready brain. This stresses that neuroinformatics is not limited to simple searches of databases but requires the use of "knowledge engines" that can stitch together diverse information and inform the users about the available strategies to let them bias the search if they have good reasons to do so.

As Figure 1 suggests, though, we need to find not only relevant data but also computational models to help organize those data. My group has developed diverse models of neural mechanisms of visuomotor coordination but has not modeled the auditory system or linked the visuomotor models to detailed models of language processing. Clearly, our future modeling must be augmented by the ability to survey models from different laboratories, extract general principles, and use these to integrate portions of different models to rapidly prototype new models that can integrate, explain, and predict a wide range of data. We are currently developing a Brain Operation Database (BODB — pronounced "Beau DB") as a step in this direction. BODB integrates models and summaries of empirical data via Brain Operating Principles (BOPs) that make explicit general insights into "how the brain works." The full payoff for this effort will be realized only by wholesale federation with other databases.

THE CHALLENGES AHEAD

Meeting these challenges will require diligent research by computer scientists to find data formats, data-entry tools, and ways of locating and assembling data across the federation. Also needed is an increased willingness of empirical neuroscientists to release full datasets, not just the limited extracts published in journal articles, to develop the skills necessary to master the methodologies developed by computer scientists, and to engage in careful analysis of models with computational neuroscientists. We need a true merging of minds to support the merging of databases of both empirical data and computational models in a federation that can truly serve the interests of the vast community of researchers studying the brain at all its levels of complexity.

Michael A. Arbib is the Fletcher Jones Professor of Computer Science, as well as holding the title of University Professor and being a professor in Neuroscience, Biomedical Engineering, Electrical Engineering, and Psychology at the University of Southern California. The author or editor of more than thirty-five books, Arbib recently edited *Who Needs Emotions? The Brain Meets the Robot* and *The Handbook of Brain Theory and Neural Networks* (Second Edition). His current research focuses on brain mechanisms of visuomotor behavior, on neuroinformatics, on biologically inspired approaches to computation, and on the evolution of language.

FAIRVIEW FARMHOUSE

Outside and soaking wet, the winter fields lie dormant,
cotton already gone. In the far-off kitchen,
the coffee's not in the pot. The fire's not started
in the stove. The wood's stacked on the porch
and getting damp as the wind blows.

The quilt on the bed's curled up and wrapped,
its patches of flannel and muslin a testament
to Grandma's scraps, collected like rain water
and sewn together on cloudy days in fallow months.

Rain pelts the tin roof, and the rooms inside echo
the extra breath in the lungs of the clouds.
Wet switches lash the leaky windows
behind curtains with sun bleached pleats.

A cold sparrow sleeps in the chinkapin,
and if daybreak didn't seem so gray,
the grits would already be cooking.

BONNIE STANARD

Living in Brussels, Atlanta, and Richmond, Bonnie Stanard was writer/editor with regional publications: *Rendez-vous*, *Innside Track*, *FairView News*, and *Fanfare*. In addition, her work has been published or is forthcoming in *Lumina*, *Beacon*, *The Quill*, *RE:AL*, *The Cumberland Review*, and *The Distillery*. Currently she lives in Columbia, South Carolina.

Book Reviews

JOHN FERLING. *Adams vs. Jefferson: The Tumultuous Election of 1800*. New York: Oxford University Press, 2004. 260 pages. $26.00.

John Ferling, in his book *Adams vs. Jefferson: The Tumultuous Election of 1800*, provides deep insights into the political in-fighting and alliances that helped shape the outcome of the election in 1800. The author cites examples of electioneering, voting irregularities, campaigning, personal attacks, and so on that seem eerily similar to what the electorate has experienced in modern elections. Déjà vu!

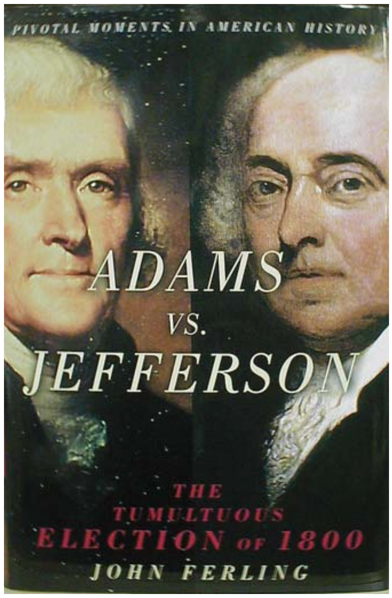
The author uses the election of 1796 and the interim period to 1800 as a segue into the events of the election of 1800. The 1796 election featured several contenders for the presidency, but the author indicates that George Washington had begun to groom John Adams as an heir-apparent to succeed him because Washington was not interested in serving a third term. And, after Washington's presidency, the author suggests that Washington largely removed himself from any involvement in national affairs of any type, so no mention is made of him after Adams is elected to the presidency.

Though the author indicates that the campaign of 1800 paved the way for the establishment of political parties (Federalists and Republicans), it seemed to me that the evolution toward political parties had begun as early as the events leading up to the election of 1796 because each side had chosen a platform of sorts on which they ran. Ferling writes that (in conjunction with other issues), the Federalists stood for a very strong central government, ceding few powers to the states, and the Republicans wanted the central government to maintain authority and control over only national issues, while ceding certain other powers to the states.

Before the election of 1800, Thomas Jefferson was not really interested in staying in national politics or any type of public service; instead, he preferred overseeing the building of Monticello and its day-to-day operation. Ferling goes on to say that Jefferson's mind would be changed because of the direction in which the Federalists were taking the new republic. Jefferson was afraid that the spirit of the revolution had been lost and that those currently in power would model the form of government to mirror that of Great Britain, up to and including a presidency of the aristocrats and wealthy, not of the people.

In Chapter Two, Ferling describes the diverse backgrounds of Adams and Jefferson. Adams was of modest means and was educated at Harvard University, whereas Jefferson was wealthy and educated at the College of William and Mary. The distinctions between the two men's lifestyles are important, because later in life, the two forged a close friendship based on their roles during the revolution and afterward in government service to the new republic as ambassadors — Adams to England and Jefferson to France.

In Chapter Seven, Ferling describes the events that created a rift between the two. Their political viewpoints were quite divergent during Adams's presidency, and those differences came to a head when Jefferson said that Adams's rhetoric, regarding the situation with France, was so inflammatory that it would create a spirit that would inevitably lead the nation to war. When Adams learned of Jefferson's criticism, he felt betrayed and privately called Jefferson "full of ambition, yet weak, confused, uninformed, and ignorant."



Ferling writes that Jefferson was a hands-on politician. He read numerous newspapers, gathered information from various sources, supported pro-Republican newspapers, and so on. He also listened to Senate orations, gathering additional information to help the Republican cause.

In subsequent chapters, Ferling provides information on major issues that affected the outcome of the election of 1800. For example, since the Federalists had been in power, they had thundered about France's attacks on American merchant vessels to the point where a diplomatic solution was no longer an option. They whipped up a public frenzy over the incidents and kept feeding it as a subterfuge to their real goal: war with France and an alliance with Britain. Ferling states that Alexander Hamilton was the real architect of this plot, which would raise taxes on just about everything to support the transformation of a littoral navy into one that was capable of warfare on the high seas, in addition to expansion of the Continental Army, using the Alien and Sedition Act to squelch opposition. Ferling goes on to state that Jefferson was horrified at all that the Federalists were doing and how the public seemed to embrace their policies. And, while Jefferson was desperately trying to stop any declaration of war with France, he was a steadfast proponent of free trade and political neutrality with all countries.

John Adams, Thomas Jefferson, Aaron Burr, Charles C. Pinckney, and John Jay were on the 1800 ballot. Jefferson and Burr were the two top vote recipients, each receiving seventy-three electoral votes. Adams lost with sixty-eight votes. Because each member of the Electoral College voted along party lines, it was the independents whose vote could make a difference about which man was elected President. Time was spent in the various "swing" states in an effort to gather support for their election. When the election went to the House of Representatives, more behind-the-scenes electioneering occurred. House members were well aware that Jefferson enjoyed immense popularity among the general population, while Burr's past was clouded by suspicion. Even Federalists, including Hamilton, preferred Jefferson over Burr and lobbied the House members in favor of Jefferson.

Ferling writes that the election of 1800 was viewed by many as a rejection of Federalist ways in favor of a more republican form of government. Jefferson also viewed his election as a mandate to return to the values for which the war was fought.

Friends of Jefferson and Adams urged them to reconcile their relationship. In 1812, Adams took the first step and wrote Jefferson. Jefferson responded, and the two corresponded on a regular basis almost to the end of their lives. Both men passed away on July 4, 1826, Jefferson first at age eighty-three, then Adams five hours later at age ninety.

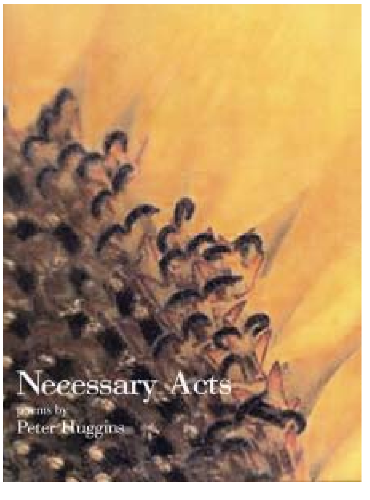
As a history buff, I found this book to be interesting, although there were a few places that were a tad dry. However, Ferling presents a great number of interesting details on each man, plus others mentioned in the book, to which an individual may not be privy as part of a general American History course.

Robert D. Wold is a technical instructor and instructional designer for the Boeing Company, located in St. Louis, Missouri.

PETER HUGGINS. *Necessary Acts: Poems*. Montgomery, AL: River City Publishing, 2004. 90 pages. $20.00.

Peter Huggins's third collection of poetry, *Necessary Acts*, reveals a mature poet extending and deepening his vision and his voice. Its focus is the reflective human consciousness connecting, and reconnecting, to the world. In poems of wide geographical and temporal range, it witnesses to fundamental themes of faith, love, fear, death, and rebirth.

Recurring images and references unite the poems in the volume. References to classical literature, the Bible, folklore, mythology, music, and geologic history abound. In "In Louisiana, Late December, Thinking of Saint Augustine," the speaker imagines St. Augustine taking no special notice of the Visigoths at the city gates. In "Leda Afterwards" he picks up where the myth leaves off. In "The Flute Player" a neighbor plays Bach, Prokofiev, and Mozart while the speaker sets out tomato plants. The "hope and trust" that "reside in this music" testify to the triumph of love and wisdom, something even the natural world acknowledges in the poem. In "Gingko" the tree prompts a meditation on persistence and survival over eons. In the hands of a less mature poet, the many classical, biblical, and mythic references could overwhelm the vitality and urgency of individual experience. In this volume, however, they give it a rootedness, an organic connectedness that helps make sense of life.



Huggins is equally fluent with the things of the natural world. Trees — hickories, chinkapins, balsam firs, pines — birds, bodies of water, and boundary lands where the wild and the domestic brush up against each other figure themes of birth, death, and fertility. In poems such as "Parable in October" and "This Week in the Blue Ridge," nature brings us to ourselves. And while mindful of the quotient of awe and even fear that nature can inspire, the poems nevertheless iterate a reverent regard for the wild world.

Other poems take place in grocery stores, junkyards, and gyms, in the familiar, even mundane settings for so much of life. Here, too, the poet finds connection, humor, significance. Taken together, the poems of *Necessary Acts* are the expressions of a poet witnessing to his world. As the speaker in "In Louisiana, Late December, Thinking of Saint Augustine" attests, this seems simple:

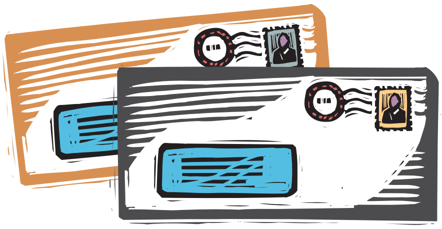
> As for me I do my work.
> I weigh my options. I consider consequences,
> I make my plans. And I shore up,
> Like Augustine, whatever I can.

Yet what more important role for the artist than to find meaning in the world and honor it? In the volume's final poem, "Adding a Stone," the speaker is building a cairn in his backyard. Individual stones stand for misery, sorrow, joy, and memory, but like the poems of this book, they suggest connection and faith:

> And I'm adding a stone for you,
> So that you can help me remember these stones,
> Their order, weight, meaning, and heft — all that
> They are and all that we'll need tomorrow
> When we will add new stones to these stones.

Huggins is author of two previous collections of poetry, *Hard Facts* (1998) and *Blue Angels* (2001), as well as a novel for middle grade readers, *In the Company of Owls* (2004), and a picture book, *Trosclair and the Alligator* (2004).

Jay Lamar is interim director of the Center for the Arts & Humanities at Auburn University.



Letters to the Editor

A NEW ROLE FOR EMERITUS FACULTY

I took particular delight in Diane G. Smathers's article in the Fall 2004, *Phi Kappa Forum* on Emeritus Faculty ["Professors Professing," Fall 2004 p. 38]. It is well done and a very important contribution to our considerations on the meaning and stability of the university, one of the most (if not the most) important of our institutions in civilized society.

To the phrase about "the goodwill created when faculty stay involved is (may be) expected to lead to reciprocal generosity," I would suggest adding this thought: Such an example of appreciation and institutional respect for our former leaders, examples, and forefaculty is of itself encouragement to younger faculty of the treatment that they may expect in their later years.

That should be encouraging as we all wonder from time to time whether we chose the right and a good professional path for our lives, and whether our professional lives have meaning and value. Have we contributed to the common good? Smathers's article says yes. Thank you.

John Only Greer
Texas A&M University

ADJUNCTS, PERMATEMPS, AND PART-TIMERS

Your Fall 2004 series of articles on "Adjuncts, Permatemps, and Part-timers" was poignant and well-written ["Professors Professing," Fall 2004]. As a part-time instructor who has taught some fifty classes in nearly a half-dozen local colleges in the Baltimore-Washington area, I can testify firsthand to most of the inequities described by these writers. Poor pay, no benefits, lack of support from administration, and lack of respect from peers are among the more evident facts of life associated with this less-than-professional existence. Nonetheless, allow me to provide some additional insight on this matter that the others might have been too afraid or too politically correct to mention.

Because most community colleges derive their funds from three sources — the state, the local government (including bond issues), and student tuition — when one or more of these sources begin to decline, then the college, seemingly with no recourse, appears justified in reducing its full-time professoriate in favor of part-time contract workers.

But why must cost-cutting measures be struck first and foremost against the teaching profession? Walk into almost any college office and you will probably see a managerial core surrounded by an extensive host of assistants, clerks, aides, and others. Many of these workers perform only seasonal or asidual duties, yet they receive classified benefits and pay unknown to many adjuncts (whose workload may well exceed any notion of comparable worth). Depending on the students' major field of interest (for example, business/accounting), the amount of their tuition going towards administrative overhead or operating costs could be as high as 80 to 90 percent. In other words 80 to 90 percent of what students invest in their educational future may go toward services and expenses totally unrelated to their needs. So much for a healthy return on investment! Those most shortchanged are the adult students who, because of time and work constraints, seldom avail themselves of computer labs, tutoring, or even library facilities.

No doubt some of these expenditures may be eminently worthwhile, even necessary; still others, such as disability support, meet specialized needs. But little do students realize how much of their tuition is claimed either directly or indirectly by extraneous causes such as foreign-student support, campus sports, community events, student organizations, and a panoply of other bureaucratic functions, the operating personnel of which are generally exempt from funding cutbacks.

Why then should teachers take the first and sometimes only hit when money becomes scarce? The answer could be likened to why county governments threaten the loss of police and fire protection or the demise of public schools when their tax revenues are failing. Hit them where they will feel it most! The frontline teachers! How else to justify the tuition increases and the cries for more funding from politicians?

W. Boswell
Brandywine, Maryland

Letters to the Editor

Phi Kappa Phi Forum publishes appropriately written letters to the editor every issue when submitted. Such letters should be no more than 300 words in length.

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POMPEII DREAM

He shouts out loud, one man laboring above
    one woman. She thinks — at first — he can’t,

he can’t hold back another moment. They ride
    until the ash covers his back, shoulders, neck,

until she smells burning hair. *My God*, she cries.
    He thinks, only a moment, he has become divine,

he is nothing less than The Flaming Spear
    of Love, the way he moves her, and she will be

grateful, she will be his the rest of her life.
    Suddenly screaming as one, they can think only

of scrubbing their bodies with cold pumice
    and lemon water and leaping into the sea,

of being together like this forever.

DAVID CITINO

David Citino teaches at Ohio State University, where he is Poet Laureate of the university. He is the author of twelve books of poetry, most recently *The News and Other Poems* (University of Notre Dame Press), *The Invention of Secrecy*, *The Book of Appassionata: Collected Poems*, and *Broken Symmetry*, named a Notable Book by the National Book Critics Circle. He writes on poetry for the *Columbus Dispatch* and is contributing editor of *The Eye of the Poet: Six Views of the Art and Craft of Poetry* (Oxford U. Press). A book of essays, *Paperwork*, is just out from Kent State University Press.

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Member Focus

Phi Kappa Phi Enhances Profile and Member Benefits

As the oldest all-discipline honor society in the United States, Phi Kappa Phi has embraced opportunities for positive change while maintaining its heritage and remaining true to its mission.

Today Phi Kappa Phi continues to evolve, welcoming innovation, technology, and creative ideas that will benefit the organization and its members. This year the Society is introducing several major enhancements to its profile and is expanding its member-benefits package. Society leadership recognizes that an earnest, ongoing commitment to continuous improvement is what its members expect and deserve.

NEW AND IMPROVED PHI KAPPA PHI IN 2005

Phi Kappa Phi carefully evaluated feedback from its members to develop an expanded benefits package that will launch in 2005. During a period of nearly two years, Phi Kappa Phi conducted several membership surveys to find out what benefits and advantages members want to derive from their membership and what would keep them interested and actively involved. After considering survey results, Phi Kappa Phi board and staff members recognized the need to update the public profile of the Society and to improve its benefits package.

"Our goal is to retain our current active members, reconnect with inactive members, and differentiate ourselves from an increasing number of new honor societies," said Phi Kappa Phi National Vice President Donna Schubert.

"Phi Kappa Phi will now be of greater value to its members and other key audiences that our Society affects," Schubert added. "We can demonstrate our relevance in terms of delivering an extremely bright and talented pool of individuals who can contribute to the global community and gain a competitive edge through the benefits that Phi Kappa Phi offers. And we can extend our reach to appeal to even more individuals, corporations, institutions of higher learning, associations, and community and governmental agencies throughout the United States."

To plan and implement the changes, Phi Kappa Phi has added headquarters support staff and has expanded its former communications department to become the Marketing and Member Benefits Department. A new publicity coordinator will help increase the number of news releases distributed about new members and will publicize individual member's achievements. A new national manager for strategic partnerships will secure even more members-only discounts and other opportunities with organizations that can provide benefits to the approximately 250,000 members in the Phi Kappa Phi database.

Additionally, Phi Kappa Phi enlisted a professional design firm to revamp its logo and create a brand-identity standards manual to strengthen its brand recognition and build consistency between the national- and chapter-level communications. (See the updated logo variations on the following page.)

"Our design team has done an excellent job of updating our brand identity while maintaining the Society's heritage," said Phi Kappa Phi Executive Director Perry Snyder. "I am confident that the new look will capture the spirit of Phi Kappa Phi and make our members and volunteers proud," he said.

Phi Kappa Phi will begin updating and streamlining its Web site, www.phikappaphi.org, in March to improve navigation and incorporate new online benefits.

The logo and its variations.

The member-benefits package for 2005 now includes:

- A certificate of initiation and Phi Kappa Phi emblem;
- A one-year subscription to the *Phi Kappa Phi Forum* with three print editions annually;
- Access to members-only online resources at www.phikappaphi.org, including an online membership directory useful for professional networking;
- Opportunities to apply for awards and scholarships valued at more than $700,000 per year;
- Three e-zines each year focusing on topics such as job search techniques, careers, life skills, and graduate schools;
- Web-based seminars that will address both educational and career-related topics;
- $75 discount on *The Princeton Review* classroom or online test preparation courses for the GMAT, GRE, LSAT, MCAT, SAT, or ACT;
- Member verification letters and logo graphics for résumé use;
- Products and services offered by Answer Financial, Inc., a leading financial-services organization;
- MBNA's MasterCard, featuring the Phi Kappa Phi key, strong customer service, and highly competitive interest rates;
- Exclusive Phi Kappa Phi merchandise.

Expanded resources on the Society Web site include:

- Career Connection — an expanded résumé posting center that will allow members not only to post their résumés anonymously, but also to search for job openings and manage job applications;
- Student and alumni profiles;
- "Ask the Expert" message board.

OPEN TO NEW IDEAS

As we seek ways to better serve the needs of our members, chapters, and future strategic partners, Phi Kappa Phi invites comments and feedback on the improvements that we have made and will continue to introduce in 2005. We also welcome comments and suggestions for anything else we may be able to do to expand our member benefits and increase value for all members. Please forward all comments and suggestions to Traci Navarre, director of marketing and member benefits, at tracin@phikappaphi.org, or call 800-804-9880 with any questions or comments.

Member News

PHI KAPPA PHI MEMBERS CHOSEN AS RHODES SCHOLARS

Phi Kappa Phi members **Michael D. April** (U.S. Military Academy), **Chauncy S. Harris, Jr.** (University of Wisconsin at Eau Claire), and **Trevor C. Thompson** (U.S. Naval Academy) were among thirty-two American students to be named Rhodes Scholars. This distinction will enable them to study for two or three years, starting next fall, at the University of Oxford in England and will pay all tuition and expenses averaging a total value of $35,000.

PHI KAPPA PHI MEMBERS CHOSEN AS JACK KENT COOKE GRADUATE SCHOLARS

Phi Kappa Phi members **John Kiess** (University of Georgia), **Mireille D. Truong** (Virginia Commonwealth University), and **Derid S. Ure** (Idaho State University) were recipients of the 2004 Jack Kent Cooke Graduate Scholarship. This scholarship awards up to $50,000 per year for up to six years for college seniors and recent graduates pursuing graduate or professional degrees.

PHI KAPPA PHI MEMBERS CHOSEN AS FELLOWS BY THE AMERICAN COUNCIL ON EDUCATION

Phi Kappa Phi members **Anita D. McDonald, PhD** (University of Arizona), **Jose Vicente** (University of Florida), and **James W. Kho** (University of Philippines) were selected as Fellows by the American Council on Education.

Joseph W. Augustine, MBA (Jacksonville University), has been named Worldwide Product Marketing Manager for the SAS Institute, Inc. Augustine will manage global marketing efforts for the world's largest privately owned software company.

Kalen C. Andrew (Minnesota State University, Mankato) received two Level Two Recognition Awards for the ingenuity, resourcefulness, and teamwork that he has shown at the Canada Revenue Agency where he has worked as an income tax auditor for more than five years.

Adelmo Archuleta (New Mexico State University) was recently named the Outstanding Alumnus of New Mexico State University College of Engineering. Archuleta has served two terms on New Mexico State University's Board of Regents and was president of the board twice.

Karen L. Bune (American University) has been selected to appear in the 2005 edition of *Marquis Who's Who in America* and also has been named a Fellow of the American Academy of Experts in Traumatic Stress. Bune is an adjunct professor in the Department of Criminal Justice at Marymount University and George Mason University and serves as a national consultant for the United States Department of Justice.

Frank Cáceres, PhD (University of South Florida), recently earned his PhD in Natural Health from Clayton College of Natural Health in Birmingham, Alabama. Cáceres, who was diagnosed with multiple sclerosis in 1996, conducted research for his thesis and found that attendance at support-group meetings can have a positive impact on the quality-of-life issues faced by persons with multiple sclerosis.

Larry Chambers' (University of Utah) book, *Recondo*, has been named editor's choice by the Military Book Club. Chambers served as a "Lurp" in the 101st Airborne, earning two Bronze Stars, a Purple Heart, two Air Medals, the Combat Infantryman Badge, the Army Commendation Medal, and the Vietnam Cross of Gallantry.

Gail Beth Heffner-Charles, MA (Ohio State University), was the recipient of Ohio State University's Publications Award. Heffner-Charles has been teaching Spanish for thirty-three years and recently accepted a position teaching advanced Spanish at Eastmoor Academy High School in Columbus, Ohio.

Clyde E. Chesney, PhD (Tennessee State University), Cooperative Extension Program Administrator at Tennessee State University, was recently installed as chair of the Extension Committee on Organization and Policy at the 117th Annual National Association of State Universities and Land Grant Colleges meeting held in San Diego, California.

Alex Chung (Louisiana State University) was chosen to greet President George W. Bush as he landed at the Baton Rouge Metropolitan Airport to speak at Louisiana State

SUBMISSIONS

Member News

To submit a recent honor/achievement or career news, e-mail (kaetzjp@auburn.edu) or mail a brief write-up and picture (if available) to:

Member News
Phi Kappa Phi Forum
129 Quad Center, Mell Street
Auburn University, AL 36849-5306

Please include your name, member number, chapter in which your were initiated, e-mail address, and/or telephone number. Regretfully, any items submitted cannot be returned, and all submissions may not be included.

Phi Kappa Phi Bookshelf

If you are an author and would like your work to be considered for inclusion in the "Bookshelf" segment of *Member Focus*, please send a copy of the book along with a one-page synopsis to:

Phi Kappa Phi Bookshelf
Phi Kappa Phi Forum
129 Quad Center, Mell Street
Auburn University, AL 36849-5306

All submitted books will be added to the Phi Kappa Phi Library, housed at the Society Headquarters, and be included on the Online Phi Kappa Phi Bookshelf at www.phikappaphi.org/bookshelf.php.

"Member News" and "Bookshelf" features will appear in the Winter/Spring and the Fall issues of the *Forum*.

University's graduation ceremony last May. The President wanted to personally thank Chung for her long-term commitment to service programs such as Boys Hope Baton Rouge and Conversational English classes through University Baptist Church.

Donna J. Dean, PhD (Berea College), received the 2004 Award for Scientific Achievement in Health Sciences from the Washington Academy of Sciences. Dean was cited for her professional contributions as researcher, regulatory scientist, administrator, and manager of the National Institute of Health's peer-review process and founding/acting director of the National Institute of Biomedical Imaging and Bioengineering.

Ryan Diehl (Emporia State University) was recently awarded a Rotary Ambassadorial Scholarship from the Rotary District 5710. The $25,000 scholarship will fund one year of graduate-level study for Diehl at the University of Melbourne in Parkville, Victoria, Australia.

Mary Helen Dirkx (University of Louisiana at Monroe) had an essay published in the September 13 issue of *Newsweek* magazine detailing her experiences in Germany during the Auschwitz trial. Dirkx teaches English Literature at North Lake College in Irving, Texas.

Arthur A. Dugoni, MSD (University of the Pacific), announced that he will conclude his service as dean of the University of the Pacific in 2006. Dugoni has served as dean for twenty-six years, and the university recently named its nationally renowned school of dentistry as the Arthur A. Dugoni School of Dentistry.

Angela (Ann) Farmer (Wichita State University), language arts educator and forensics coach at Douglass High School, was honored as the Region 4 Secondary Teacher of the Year for the State of Kansas.

Joan Faust, PhD (Southeastern Louisiana University), has been named assistant dean of Southeastern Louisiana University's College of Arts and Sciences, SLU's largest academic college. As president of the university's chapter of Phi Kappa Phi, Dr. Faust organized a College Intramural Quiz Bowl Tournament with funding from a Phi Kappa Phi Promotion of Excellence Grant.

Gary D. Gilmore, PhD (University of Tennessee-Knoxville), has completed the third edition of his text, *Needs and Capacity Assessment Strategies for Health Education and Health Promotion*, published by Jones and Bartlett Publishers. He is a professor and director of community-health programs at the University of Wisconsin.

Rita E. Jones, MS, EdM, EdS (Florida State University), recently joined the Pensacola Civic Band, playing the same clarinet that she first played in 1942. Jones owns a small management-consulting business and volunteers with many local community organizations in Pensacola, Florida.

E. Ann Nalley, PhD (Cameron University), has been voted president-elect of the American Chemical Society for 2005. Nalley will serve as president in 2006 and as a member of the Society's Board of Directors from 2005–2007. Dr. Nalley served on Phi Kappa Phi's board of directors for many years, including a term as president from 1995–98.

Harvey Parker (University of Illinois-Urbana), a Seattle-based consulting civil engineer, was elected to serve a three-year term as president of the International Tunneling Association. The International Tunneling Association, composed of fifty-three member nations, supports and represents the entire underground industry working to benefit the public, the environment, and sustainable development.

Maximiano Jun M. Rivera, Jr., PhD (Tennessee State University), has been promoted to assistant director of the Honors Program at Tennessee State University and was recently honored by the Tennessee State University Faculty Senate for his outstanding service and leadership.

Jerry Robbins, EdD (Georgia State University), has retired from a thirteen-year position as dean of the College of Education at Eastern Michigan University.

Matthew C. Rodrigue (University of Maine) has been named a 2004 Laureate by Tau Beta Pi at the association's annual program recognizing gifted engineering students who have excelled in areas beyond their technical majors. Rodrigue recently graduated from the University of Maine with double degrees in electrical engineering and computer engineering.

Fred H. Rodriguez, Jr., MD (University of New Orleans), was recently installed as president-elect of the American Society for Clinical Pathology. Rodriguez is the national director of Pathology and Laboratory Medicine for the Department of Veterans Affairs in Washington D.C., the Director of Pathology and Laboratory Medicine at the VA Medical Center in New Orleans, and professor of Pathology and Medical Technology at the LSU Health Sciences Center in New Orleans.

Christine M. Smallman (University of Toledo), director of College Relations and Facilities Management in the College of Engineering at the University of Toledo, was recently awarded the Outstanding Staff Award for the College of Engineering as well as the campus-wide Outstanding Staff Award.

Charles J. Smith, MM, DMA (University of Illinois Urbana-Champaign), recently won an Honorable Mention for Musicianship at the IBLA Grand Prize in Sicily, Italy. He is a part-time vocal accompanist at the Chicago College of the Performing Arts at Roosevelt University.

Richard J. Smith, PhD (Iowa State University), has recently been named Tau Beta Pi's 11th National Outstanding Advisor for his important contributions to students and collegiate chapters in the field of engineering. Smith is the advisor to the Iowa Alpha Chapter of Tau Beta Pi and professor emeritus of agricultural and biosystems engineering and of mechanical engineering at Iowa State University.

James Tackach, PhD (University of Rhode Island), received the 2004 Carter G. Woodson Secondary Book Award for *Early Black Reformers*, a collection of writings by civil-rights activists who preceded Martin Luther King, Jr. Tackach is a professor of English at Roger Williams University and is president of the Phi Kappa Phi chapter at the University of Rhode Island.

Lieutenant Jason R.W. Weir (Mississippi State University) is Battalion Medical Officer and Medical Platoon Leader for the $2^{nd}/3^{rd}$ Infantry Regiment, 1^{st} Stryker Brigade Combat Team, stationed in Mosul, Iraq. Lieutenant Weir has been awarded the Combat Medical Badge and the Unit Combat Patch for providing medical aid to an infantry unit engaged in active ground combat.

IN MEMORIAM

Preston B. Allison, PhD, a member of the Southeastern Louisiana University chapter of Phi Kappa Phi, passed away at the age of ninety. Allison formed and headed the division of religious education at the Mid-America Baptist Theological Seminary and was instrumental in the seminary's efforts toward accreditation.

William M. Cahill, Jr., MD, a member of the San Jose State University chapter of Phi Kappa Phi, passed away at the age of ninety-three. He did research in the area of human nutrition as a biochemist and published articles in English, German, and French. Later, he changed careers and reached his ultimate goal of becoming a physician, practicing medicine until his eighties.

Alice Denton, a member of the Texas A&M University chapter of Phi Kappa Phi, passed away at the age of seventy-eight. Denton, a graduate of Texas A&M University, was a teacher for twenty-two years for the College Station school district in Texas.

Ralph Dorff, MPA, a member of the California State University-Long Beach chapter of Phi Kappa Phi, died at the age of eighty-eight. Dorff served thirty-two years as a Lieutenant Colonel in the United States Air Force in addition to being a sales manager and agent, marketing specialist, educator, lecturer, and published author of fiction and non-fiction.

Ferrell Ervin, a member of the Southeast Missouri University chapter of Phi Kappa Phi, passed away of cancer. He was the department chair of mass communication as well as a former Phi Kappa Phi chapter president at Southeast Missouri State University.

Patrick Guerra, a member of the Florida International University chapter of Phi Kappa Phi, died July 31, 2002. He was twenty-two. Guerra completed graduate work in political science at Ralph Bunche Summer Institute for Political Science at Duke University and was a Congressional Intern in the Miami office of U.S. Senator Bob Graham.

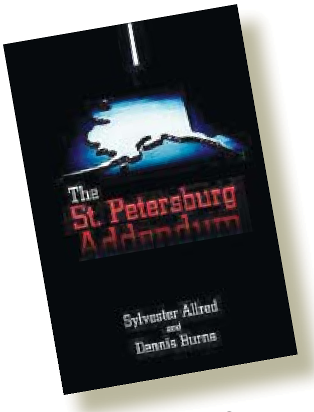
Colonel Carlton J. Martin, a member of the University of Florida chapter of Phi Kappa Phi, passed away at the age of ninety. He was a retired Air Force officer, serving in the Air Force for thirty years, as well as a former instructor of economics at Purdue University.

Marian C. Spears-Ralston, PhD, a member of the Kansas State University chapter of Phi Kappa Phi, passed away at the age of eighty-three. She was an emeritus professor of hotel, restaurant, institutional management, and dietetics at Kansas State University.

Phi Kappa Phi **Bookshelf**

The St. Petersburg Addendum

Authors: Sylvester Allred and Dennis Burns

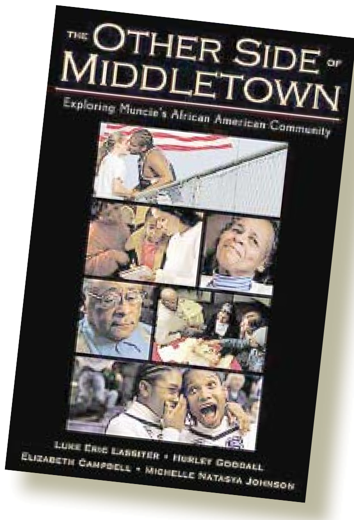


In this environmental thriller, State Representative and king crabber Clint Hammond has witnessed firsthand the unimpeded exploitation of Alaska's resources by greedy men, and he desperately wants to prevent this tragedy from happening in the Arctic National Wildlife Refuge. However, backroom deals from oil lobbyists and politicians are proving difficult to defeat. The "St. Petersburg Addendum," a mysterious Russian document discovered inside a WWII Japanese Zero off Kodiak Island, changes everything. Drawn further into the mystery of the Addendum, Hammond comes to realize just how ruthless men can be in order to control the oil that lies beneath the fragile tundra of the Arctic National Wildlife Refuge.

Sylvester Allred was inducted into the Northern Arizona University chapter of Phi Kappa Phi in 2003.

The Other Side of Middletown: Exploring Muncie's African American Community

Authors: Luke Eric Lassiter, Hurley Goodall, Elizabeth Campbell, and Michelle Natasya Johnson



Prompted by the omission of Muncie, Indiana's black community from a famous study written by Robert S. Lynd and Helen Merrell Lynd almost three decades ago, *The Other Side of Middletown* reveals for the first time the unrecorded history and contemporary life of "Middletown." In this ethnography, the editors capture Muncie's black community in a way that is accurate, authentic, and in many cases painfully recalled by examining their day-to-day lives, struggles with racism, and efforts toward achieving equality.

Luke Eric Lassiter was inducted into the Ball State University chapter of Phi Kappa Phi in 2004.

Phi Kappa Phi **Chapter News**

Chapter Installation: Slippery Rock University (#294)

Newly initiated Phi Kappa Phi members at Slippery Rock University (PA) received membership certificates and gold pins to commemorate their induction into the Society.

Outstanding Chapter Growth in the Past Triennium

Not since the early nineties has The Honor Society of Phi Kappa Phi experienced such a large increase in the number of chapters. During the 2001–2004 triennium, eleven chapters were installed, bringing the total number of chapters to 294. In early 2005, another installation will bring the total to 295.

The driving force behind this noteworthy expansion has been the Board of Director's commitment to a goal of at least six new chapters for the 2001–2004 triennium. That commitment, combined with a streamlined chapter-petitioning process, resulted in the projected goal being surpassed nearly two-fold.

"These new chapters provide added vitality for the Society," notes President Paul J. Ferlazzo. "With new chapters comes the opportunity to involve even more students and faculty in the life of Phi Kappa Phi."

Slippery Rock (PA) University is among the eleven new chapters. The speaker for its first initiation on November 4, 2004, was Dr. David Scobey, director of the Arts and Citizenship Program at the University of Michigan. He complimented the university on its having earned a chapter: "A chapter of Phi Kappa Phi reflects the Society's confidence in both the quality of the faculty and the quality of the educational experience that the university provides its students. The quality of the educational experience that the university provides its students is also a measure of the intellectual achievement and seriousness of SRU's students."

"Our new chapters are receiving strong support from their universities," said President Ferlazzo. North Carolina A&T University is a good example. "Our chapter received a competitive grant from the university to host a lecture series for the 2004-2005 academic year," relates Ray J. Davis, PhD, chapter president at North Carolina A&T State University (Chapter 291), installed in 2003. "This series has provided outstanding name recognition for Phi Kappa Phi on our campus."

The Board's strategic-planning retreat held in October 2004 identified the continued addition of new chapters as a priority. This goal was among the reasons that the Chapter Relations Department at the Society's headquarters has been expanded to include an additional Chapter Relations Director, Marcus Watson. His focus will be on the Northeast, South Central, and part of the Western regions. He joins Kathy Marcel, whose primary responsibilities now will be the Southeast, North Central, and part of the Western regions.

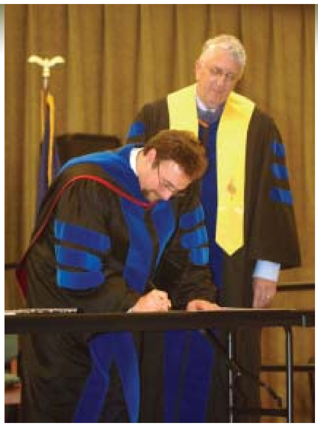
On November 4, 2004, Slippery Rock University was installed as chapter 294 of The Honor Society of Phi Kappa Phi.

Forty students were proudly inducted into the Society.

"It's quite an honor," said Angele Waugaman, a senior accounting student. "I am proud that Phi Kappa Phi has come to SRU and am honored to be asked to become a member." She added, "It is a big honor because it shows where the university is going."

Northeast Region Vice President Ronald Johnson participated in the ceremony as the installing officer. In addition, Slippery Rock University's President Robert Smith, Interim Provost William Williams, and Dean William McKinney were among the many faculty and administrators present. Five SRU faculty were initiated as members with eleven other faculty and administrators, including Smith and McKinney, initiated as charter members.

"Phi Kappa Phi will make Slippery Rock more visible to people who may be looking for a place where they can find a niche," said SRU's Dr. Thomas Gaither, a professor of biology. "It is respected in science but is primarily known as a society that recognizes excellence in all fields of higher education."



SRU's Dr. Bill McKinney, Dean of the College of Humanities, Fine and Performing Arts, signs the charter. He was installed as chapter president. Behind him is Northeast Region Vice President Dr. Ronald Johnson.

FUNDING FOUNDATION PROGRAMS

The Phi Kappa Phi Foundation endowment fund was established in 1972 to help finance the numerous awards, fellowships, and grants that the Society gives its members. Annual contributions to the Foundation account are added to the fund's principal, and only the income generated is used to offer an average of nearly $500,000 annually in member awards. The programs and amounts awarded are reviewed each triennium by a Board-appointed committee. For the current triennium, the Foundation supports six different programs: Fellowship, Promotion of Excellence Grants, Study Abroad Grants, National Artist Award, National Scholar Award, and Literacy Grants. Each triennium, approximately five hundred Phi Kappa Phi members receive these grants and awards.

The generosity of Phi Kappa Phi members sustains funding for these programs at their current levels. Twice a year, Phi Kappa Phi members are given the opportunity to contribute to the Foundation fund: at renewal time and during the annual mail appeal. Unlike membership dues, donations to the Foundation are fully tax deductible. A thank-you letter stating the amount of the gift is sent to every donor.

Life members also are sent a statement once a year to give these members the chance to donate to the Foundation or to the Chapter Scholarship Fund. The national dues line on the renewal statements for life members should be marked "paid." Renewal statements for life members are usually mailed in February.

Donations of all amounts to the Foundation are welcomed. The sixteen-million-dollar endowment fund has been built with thousands of modest donations. In the last twenty years, fewer than ten gifts to the Phi Kappa Phi Foundation have exceeded $5,000. Each member is encouraged to donate a minimum of $25 annually.

Even though cash is the most common form of donation, gifts of stock or other kinds of assets are also welcomed. Gifts of appreciated stock may represent significant tax deductions to donors.

Your giving means so much to the Foundation; be as generous as you can be the next time that the opportunity arises.

FOUNDATION PROGRAMS 2004–2007