Center for High Performance Computing NEWS

THE UNIVERSITY OF UTAH SPRING 2012

Research

Maternal and Paternal Effects on Gene Networks

By Chistopher Gregg, Ph.D.

Things that are not well constructed break often and don't last long. This is true of cars, toasters and all things in life…including life itself. We now know that many diseases, disorders and chronic health conditions that arise later in life are the result of events set in motion long ago during early-life developmental processes. This idea is referred to as the "developmental origins of disease" hypothesis. The recognition that early-life developmental processes contribute substantially to the risk of developing type II diabetes, obesity, cancer, cardiovascular disease, as well as mental health disorders, such as autism, schizophrenia, depression and anxiety disorders, has greatly changed how researchers approach these health problems. Ideally, we would be able to recognize individuals at risk for such disorders and develop interventions that prevent disease onset and steer the person down a path of health and longevity. There are many ways to approach this complex problem and Dr. Christopher Gregg (http://www.neuro.utah.edu/labs/gregg/Welcome.html) in the Department of Neurobiology & Anatomy at the University of Utah School of Medicine has taken a very unique approach that involves analyzing genome scale datasets with resources provided by the University of Utah Center for High Performance Computing.

The Gregg lab uses genome-wide deep sequencing technologies to uncover pathways in the brain and body that are modulated by maternal or paternal effects. The lab is interested in how the interactions between these early-life effects influence offspring gene expression, physiology, behavior and disease susceptibility. Dr. Gregg's approach is partly inspired by breeders that have generated unusual hybrid offspring over the years by mating distantly related species of animals. These breeders recognized that the physiological and behavioral characteristics of offspring are influenced by much more than just genetics. It matters who is the mother and who is the father. Two important examples are the liger and the tiglon. At 900 lbs, the liger is the largest cat in world and twice the size of its parents. It arises from a cross between a male lion and female tiger. A tiglon, the product of mating a male tiger and female lion, is no larger than its parents, and yet it is also genetically half tiger and half lion. These examples demonstrate that interactions between maternal and paternal effects profoundly influence offspring, but what is the nature of these parental effects and what gene pathways and developmental processes do they modulate in offspring? The Gregg lab has devised an approach to uncover genetic pathways in offspring that respond to maternal and/or paternal influences by performing reciprocal matings of distantly related subspecies of lab mice – a less dangerous form of the liger/tiglon example. Dr. Gregg then sequences the entire transcriptome (all of the RNA molecules) expressed in different brain regions and organs of the resulting hybrid off-

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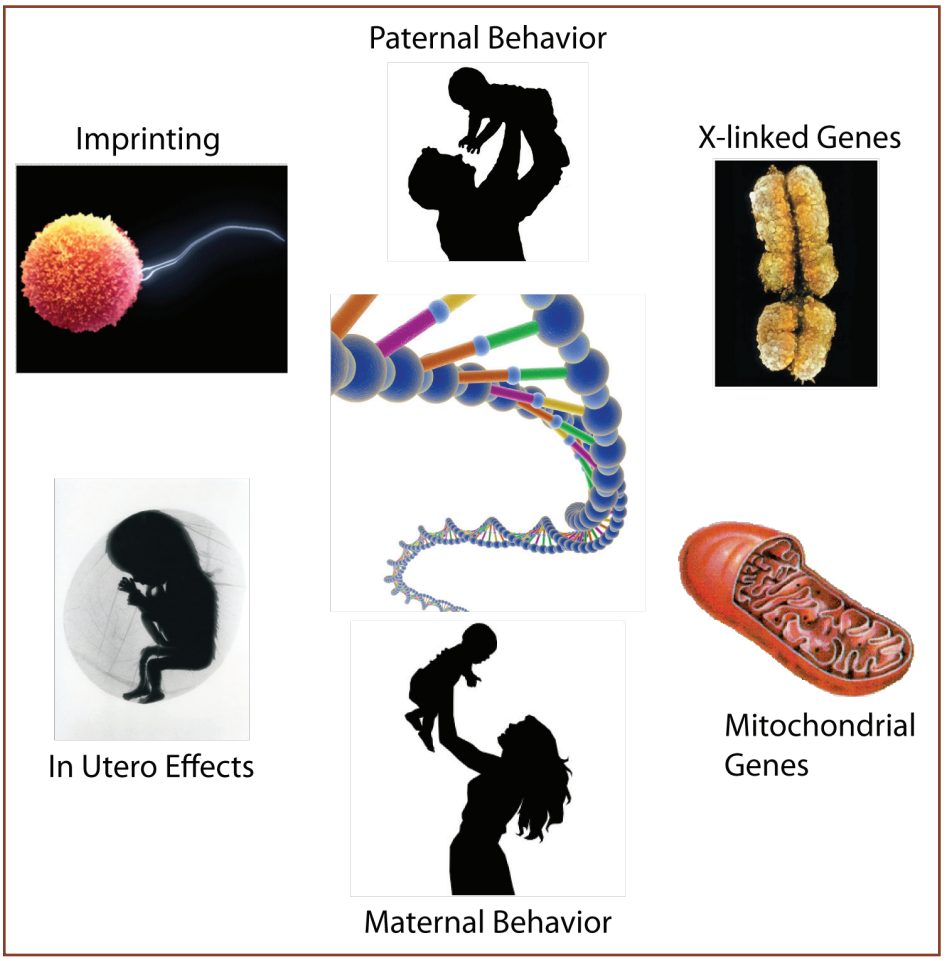

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spring. These large-scale datasets are analyzed using various computational approaches to uncover hundreds of genetic pathways in the brain and body that change their expression in various ways as a result of maternal and paternal effects. The work has revealed the incredible complexity of maternal and paternal influence over offspring. The lab has also discovered that these effects influence the susceptibility of offspring to diseases, such as diabetes. In addition, by placing mothers and fathers on different diets, Dr. Gregg has uncovered pathways in the brain and liver of offspring that are responsive to maternal or paternal dietary effects.

The discovery of pathways that change their expression in offspring in response to specific paternal or maternal cues may provide exciting new insights into the factors that contribute to the developmental origins of disease. The Gregg lab is working to determine whether the gene expression signatures they have uncovered may contribute to predispositions to particular diseases and whether they indicate potential avenues for early intervention. Currently, the Gregg lab is collaborating with researchers at the Scientific Computing and Imaging Institute (http://www.sci.utah.edu/) at the University of Utah, including Miriah Meyer (http://www.cs.utah.edu/~miriah/) and Sam Gerber, to develop approaches that uncover important gene expression signatures in the data. These are exciting new frontiers, but perhaps one of the most surprising things about this work is the theory that may explain why such maternal and paternal pathways evolved in the first place.

In a seminal paper published in 1974, Robert Trivers proposed a highly influential idea called the Parent-Offspring Conflict Theory. The theory proposes that an evolutionary conflict arose over how much of a parent's resources should be invested in offspring. Since mothers are equally related to all of their offspring, the theory postulates that selective pressures acting on mothers will favor genes that promote equal distribution of maternal resources to all current and future offspring. In contrast, offspring are out for themselves, because they are 100% related to themselves and less to their mother or any other sibling. As a result, genes that increase maternal resource consumption are predicted to be favored by selective pressures acting on offspring. Thus, offspring are expected to act selfishly to maximize their success in the battle for maternal resources. Indeed, any parent knows the incredible behavioral tactics children resort to in order to get what they want. They evolved to behave this way!

In 1989, David Haig proposed an additional perspective to this theory called the Parental Conflict Theory. Haig noted that true monogamy is so rare in nature that fathers can never guarantee the next litter from a given mother will be theirs. Further, fathers invest relatively little in the development and care of offspring compared to mammalian mothers and can impregnate many different females. As a result, fathers are in a competition with each to have their offspring consume as much maternal resources as they can, and subsequently, outcompete litters from other fathers.

Collectively, these two theories suggest the existence of maternally transmitted effects that function to reduce offspring consumption of maternal resources, paternally transmitted effects that increase consumption of maternal resources, and finally, genetic programs in offspring that function to maximize the consumption of maternal and paternal resources. The Gregg lab is testing whether the gene pathways they are finding are at the heart of this evolutionary conflict and whether these pathways set us up for health problems later in life.

SC12

Salt Lake City, Utah

Salt Lake City is hosting the 2012 Supercomputing Conference, the premier international conference on high performance computing, networking, storage and analysis. The event will be held at the Salt Palace November 12 - 15.

SC12 brings together scientists, engineers, researchers, educators, programmers, system administrators and managers from across the country to showcase how developments in these areas are driving new ideas, discoveries and industries.

CHPC will have a significant presence with a booth that highlights our activities and the research being done with CHPC resources. If you would like your research highlighted at CHPC's booth, please contact Sam Liston at sam.liston@utah.edu.

NEWS

CHPC Updates Vizualization Lab

by Jimmy Miklavcic

The Center for High Performance Computing has updated its Visualization Lab (a.k.a. VisLab Black Box Theater) in INSCC RM 294. The VisLab is now quieter, simpler and much easier to operate. The bank of eighteen projectors and the ten-system cluster has been replaced with a single Acer H5360 HD/3D DLP projector and a single display system. The original 3D system was a passive system utilizing polarized glasses. The new system is an active 3D system powered by a single Nvidia Quadro 5000 graphics card and a single PC running Windows 7 with 24 GB of RAM. Although the resolution is 94% less than the previous display system, it still provides quality representation of researchers' data.

The lab can seat 20 viewers comfortably and is consistent with the number of GeForce 3D Vision active shutter glasses that are available. The active glasses communicate, via an infrared signal, with a small transceiver located on the ceiling just in front of the display screen and connected to the Nvidia graphics card. The graphics card sends a signal to the glasses to shut the left eye when it displays the right eye image and then the right eye when the left eye image is displayed. This occurs sixty times each second, creating the perceived 3D imagery.

The current software inventory on the display system includes Visual Molecular Dynamics (VMD 1.9.0) from the University of Illinois at Urbana-Champaign, VisIt 2.3.1 from LLNL, Integrated Data Viewer (IDV 3.0u2) from Unidata, as well as several stereoscopic viewer and converter packages. Additional software packages can be installed by request.

Access to the VisLab is open to all researchers with a valid University of Utah ID and UNID. It is important, for first time users, to schedule a brief orientation regarding the use of the lab with CHPC staff. Refer to CHPC Visualization Lab Policies at wiki.chpc.utah.edu/display/policy/1.10+VisLab+Policy.

The VisLab Black Box Theater is a versatile space. It can be used for small video conference events, lectures and demonstrations. In order to utilize the lab, the room must be scheduled through the CHPC office. Priority will be given to uses that require 3D resources.

CHPC's Vizualization Lab - Room 294 INSCC

For CHPC Users:

Electronic Allocation Request System

By Walter Scott

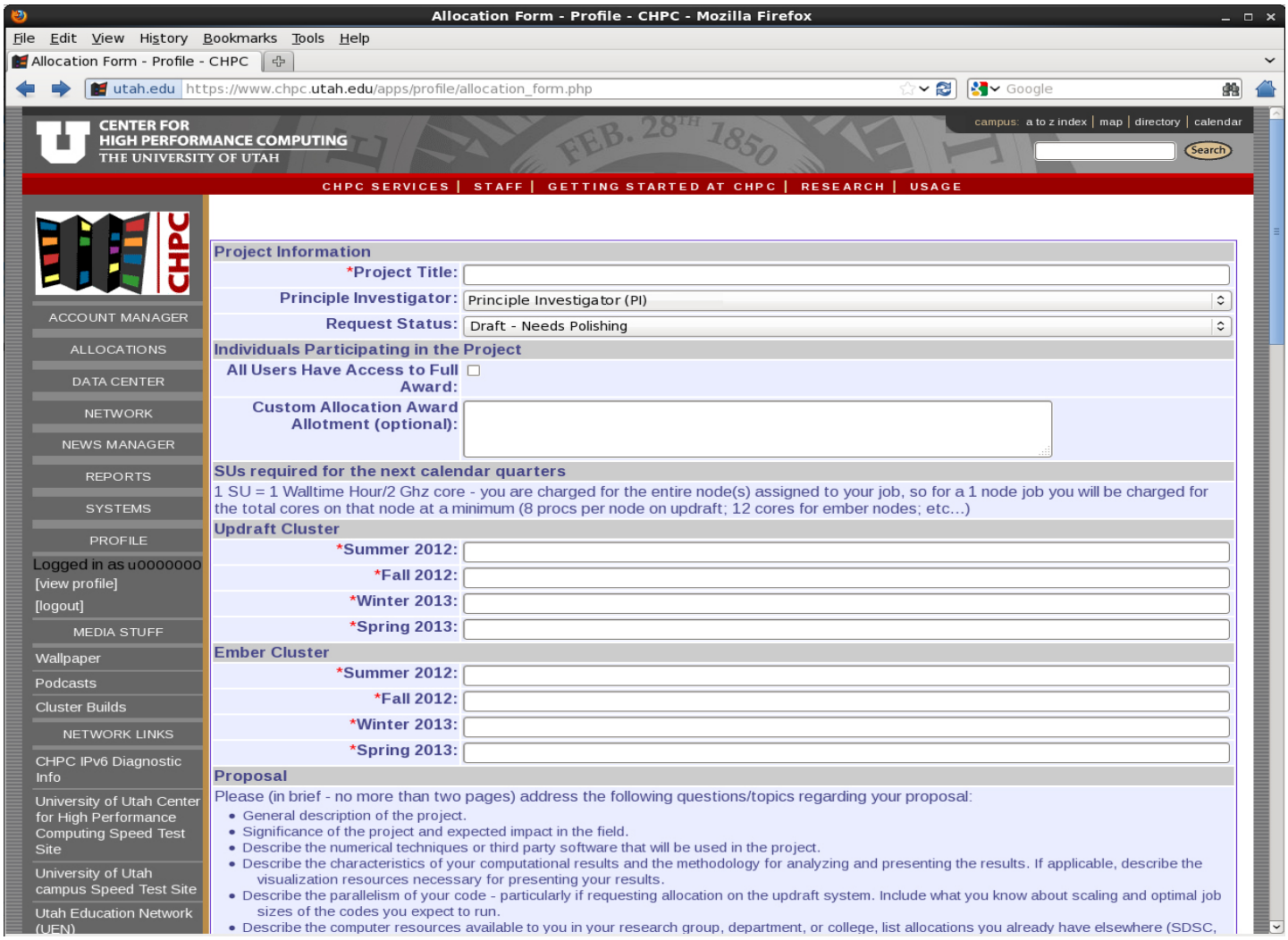
CHPC has moved to a new electronic allocation request system. Starting with the current quarter, requests for time on our clusters can be submitted electronically through our web site. This new tool allows us to streamline record-keeping, minimize errors and reduce our use of paper forms.

In order to use the system, you will need a valid CHPC account. If you would like to give a member of your research group access to submit proposals for your project, please email us at issues@chpc.utah.edu to give us the name and uNID. We will then identify that person as your delegate for this process.

Here are the steps for submitting an allocation request:

1. Point your browser to https://www.chpc.utah.edu/apps/profile/
2. When prompted, log in using your uNID and your campus password.
3. On the "View Profile" page, scroll down to the "Allocations:" section.
4. Click "Allocation Form" (or "Quick Allocation Form" if this is your first time running on our clusters and you want a one-time small allocation).
5. Fill out all required forms then click the "Submit Proposal" button at the bottom of the screen to save the proposal.
6. Once your proposal is ready to be reviewed by CHPC, you can change "Request Status to "Submitted - Ready for CHPC to Review" and click "Summit Proposal" at the bottom. The allocation committee will then review your request and you' will receive an email about the result.

Allocation requests for the upcoming Summer quarter (July - Sept) are due by June 1, 2012.



Stats Server Now Available to Researchers

by Eric Hughes

For University faculty and students who need statistical software to facilitate their research, CHPC has set up a dedicated statistics server. We call this new server "kachina." The system has 512GB of RAM, 4 Processors with 12 cores each for a total of 48 Cores, and is running Windows Server 2008R2. Applications on kachina include SAS 9.3 with Text Miner, SPSS, R, and Office 2010.

SAS is one of the top comprehensive statistical packages available today. It includes powerful data handling capabilities combined with implementations of most popular statistical routines from simple univariate descriptive statistics to Structural Equation Modeling capabilities.

A CHPC account is required before you can access the server. You can open an account by going to https://chpc.utah.edu and choosing "Online Application Form." There is no charge for this account.

The server is accessible via remote desktop. Here are instructions for accessing kachina:

1. For windows go to 'start' > 'all programs' > 'accessories' 'remote desktop connection' and enter the hostname of kachina.chpc.utah.edu. For mac/linux, use rdesktop kachina.chpc.utah.edu
2. Read (and comply with) the banner warning about authorized access use.
3. Login using your username, which is ad\uNID, and your normal campus password.

If you would like further assistance in accessing this resource, please email us at issues@chpc.utah.edu.

Recent Research Using CHPC Resouces

Bhide R.J, McLennan J.D.,Guilkey J.E. and Green S.J., Numerical Modeling of Quasi-Static Rock Testing, 45th U.S. Rock Mechanics/Geomechanics Symposium, San Francisco CA, 2011.

Burghardt, Jeffrey A., Nonlocal plasticity, instablility, and well-posedness of the elastic-plastic initial-boundary value problem, 2011 Thesis (Ph.D.), Dept. of Mechanical Engineering, University of Utah.

Crosman, Erik T., Idealized large-eddy simulation sensitivity studies of sea and lake breezes. 2011 Thesis (Ph.D.) Dept. of Atmospheric Science, University of Utah.

Crowl, L.M. and Fogelson, A.L., Analysis of mechanisms for platelet near-wall excess under arterial blood flow conditions, Journal of Fluid Mechanics, (2011), 676, 348-375.

Cooper, T. E.; Carl, D. R.; Omens, J.; Steill, J. D.; Armentrout, P. B. Infrared Spectroscopy of Divalent Zinc and Cadmium Crown Ether Systems, J. Phys. Chem. A (2011), 115, 5408–5422.

Jacobson, L. C., Matsumoto, M., and Molinero, V., Order parameters for the multistep crystallization of clathrate hydrates," J. Chem. Phys., 135 (2011), 074501.

Ma, H., Pazmino, E., and Johnson, W. P., Surface heterogeneity on hemispheres-in-cell model yields all experimentally-observed non-straining colloid retention mechanisms in porous media in the presence of energy barriers. Langmuir (2011). 27(24): 14982-14994.

Peterson, M., and Liu, C. Global statistics of lightning in anvil and stratiform regions over tropics and subtropics observed by TRMM. J. Geophys. Res. 116 (2011), D23201, doi:10.1029/2011JD15908.

Mist into Past by Beth Miklavcic, Multimedia, CHPC

CHPC Semi-Annual Metrics Report
Period: 01/01/2011 to 01/20/2012

1. **Computational Power (Theoretical Peak)**

	July 29, 2011	December 31, 2012	Growth %
CHPC	88.73 Tflops	90.9 Tflops	2.54%
TOP 500 Mean	170.36 Tflops	215.3 Tflops	26.38%
CHPC/TOP500 Mean	52.08%	42.22%	-9.86%

2. **Service Units (1 SU= 1 hour wallclock hour on 2.0 Ghz core)**:

	Jan-Jun 2011	Jul-Dec 2012	Growth %
Total Service Units Available (Theoretical)	31,463,370	36,564,320	+9.16%
Total Service Units used (all systems)	27,645,425	30,178,115	+16.21%
Utilization	87.9%	82.5%	-5.33%

3. **Desktops Supported**

	June 30, 2011	December 31, 2012	Growth %
Linux	95	109	+14.74%
Windows	133	124	-6.77 %
Macintosh	111	141	+27.03%
Total	**339**	**374**	**+10.32%**

4. **Other Metrics**

	June 30, 2011	Decemeber 31, 2012	Growth %
Total Number of Accounts	1393	1491	9.42%
Number of New Research Groups (PIs)	19	28	
Total Publications (from 1988 to present)	639	694	+55
Disk Space Backed Up	43.4 Tbytes	54.0 Tbytes	+10.6 Tbytes (+24.42%)
Total Disk Space for Home and Group Directories	593.6Tbytes	873.6 Tbytes	+280 Tbytes (+47.37%)
Total Archival Backups (new service)	141 Tbytes	164 Tbytes	+23 Tbytes (+16.31%)

CHPC Staff Directory

Administrative Staff	Title	Phone*	Email	Location
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*All phone numbers are preceded by area code 801 unless otherwise noted.

The University of Utah seeks to provide equal access to its programs, services, and activities to people with disabilities. Reasonable prior notice is needed to arrange accommodations.

THE UNIVERSITY OF UTAH

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Welcome to CHPC News!

If you would like to be added to our mailing list, please fill out this form and return it to:

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FAX: (801)585-5366

(room 405 of the INSCC Building)

Name:
Phone:

Department or Affiliation:
Email:

Address:
(UofU campus or U.S. Mail)

Thank you for using our Systems!

Please help us to continue to provide you with access to cutting edge equipment.

ACKNOWLEDGEMENTS

If you use CHPC computer time or staff resources, we request that you acknowledge this in technical reports, publications, and dissertations. Here is an example of what we ask you to include in your acknowledgements:

"*A grant of computer time from the Center for High Performance Computing is gratefully acknowledged.*"

Please submit copies or citations of dissertations, reports, pre-prints, and reprints in which the CHPC is acknowledged to: Center for High Performance Computing, 155 South 1452 East, Rm #405, University of Utah, Salt Lake City, Utah 84112-0190