Given the flourishing of new neuroimaging technologies it must be tempting to fill a conference with fabulous images of thought in action. However, the fact that brains belong to people was not forgotten. The challenges and rewards of working with people who have neuropsychiatric illnesses were discussed in several clinically oriented talks. Sensitive subjects were not avoided, such as the subjective experience of illness in relation to near-death experiences in children, and the impact of caring for a loved one who has CJD. This last topic was discussed by members of the human BSE foundation, who very kindly shared their experiences with delegates. The varied offspring of neuropsychiatry were indeed very much in evidence during this encouraging meeting.

Philip Shaw
Clinical Lecturer in Neuropsychiatry
Institute of Psychiatry, De Crespigny Park,
Denmark Hill, London, UK SE5 8AF.
e-mail: Wphilipshaw@aol.com

Sex, genes and hormones

Stacey A. Fannon, Regina M. Vidaver and Sherry A. Marts

The multidisciplinary symposium convened by the Society for Women's Health Research 'Sex Begins in the Womb' was held at the Crowne Plaza Cabana, Palo Alto, CA, USA, on 1 March 2002.

How do prenatal genetic and hormonal influences affect intelligence and behavior? This was one question explored at 'Sex Begins in the Womb', a multidisciplinary symposium convened by the Society for Women's Health Research (Washington, DC, USA). This was the third in a series of Society-sponsored meetings on the biology of sex differences and how those differences affect human health.

Sex matters in mental retardation

Researchers have long recognized that males make up a majority of the mentally retarded (IQ ≤ 70) population. Genomic technologies are revealing why that imbalance exists. As Charles J. Epstein (University of California, San Francisco, CA, USA) explained, a person's sex can influence the occurrence, nature and transmission of congenital diseases.

Key conference outcomes

- Certain genes contain triplet repeats that cause disease when expanded. Triplet repeats are more likely to expand through subsequent generations, increasing risk of disease.
- Different syndromes can result from deletion in the same chromosomal region, depending on parent of origin.
- Girls exposed to high levels of androgens *in utero* exhibit boy-typical behavior directly related to the degree of prenatal androgen excess.
- A person's sex can influence the occurrence, nature and transmission of congenital diseases.

Many disorders that cause mental retardation occur more frequently and/or more severely in males because the disorders are X-chromosome linked. A prime example is fragile-X syndrome, which occurs approximately twice as often in males than in females. The fragile-X phenotype includes long face, large ears, prominent jaw, and enlarged testicles in postpubertal males. Fragile-X syndrome is caused by expansion of a CGG triplet repeat in the gene encoding FMR-1, located on the X chromosome. Normal individuals have 6–50 copies of the CGG repeat, whereas people with fragile-X syndrome have 230–1000. A normal male might nevertheless have an intermediate number of repeats (50–230), and pass this 'pre-mutation' to his daughter. The repeat is likely to expand in future generations: if the expansion occurs in the daughter's gametes, her sons would have a 50% chance of being affected.

In addition to the sex of the child, that of the parent can determine the phenotype conferred by mutations of certain genetic loci through genomic imprinting, as Epstein noted. The prototypical example of this is a deletion in chromosome 15, which results in Prader–Willi syndrome (PWS) if the deletion affects the paternally derived chromosome, or Angelman syndrome (AS) if it affects the maternally derived chromosome. Although PWS and AS are caused by deletions in the same chromosomal regions, they show completely different phenotypes that indicate essential parent-of-origin effects.

The effect of prenatal androgens on childhood behavior

Prenatal exposure to sex hormones can have powerful permanent effects, not only on genitalia but also on the developing brain. Sheri A. Berenbaum (Pennsylvania State University, University Park, PA, USA) and colleagues (at Southern Illinois University School of Medicine, Carbondale, IL, USA; and Northwestern University School of Medicine and Evanston Hospital, Evanston, IL, USA) observed these effects in studies of girls with congenital adrenal hyperplasia (CAH) and their siblings [1]. Congenital adrenal hyperplasia is caused by an enzymatic defect in 21-hydroxylase, which exposes females to moderately elevated androgens during gestation. Without prenatal diagnosis and treatment, girls with CAH are born with masculinized genitalia.

'Prenatal exposure to sex hormones can have powerful effects…on the developing brain.'

Compared with their sisters, girls with CAH play more with boys' toys (transportation and building toys), show less interest in infants and have higher spatial ability. This boy-typical play behavior is most pronounced in girls with the most severe type of CAH and is unrelated to how well the disease is initially controlled.

One hypothesis is that girls with CAH exhibit boy-typical behaviors because of the parents' response to a child with masculinized genitalia. However, Berenbaum described the work of Anna Nordenstrom and her colleagues (Karolinska Institute, Stockholm, Sweden) who found that boy-typical behavior directly relates to the degree of prenatal androgen excess at diagnosis, not parental behavior. Berenbaum's continuing research with girls who have CAH includes a prospective study of girls with CAH detected through newborn screening.

http://tics.trends.com 1364-6613/02/$ – see front matter PII: S1364-6613(02)01914-9

Other presentations also highlighted the neurobehavioral effects of fetal exposure to various hormones (both endogenous and exogenous), the effects of maternal stress and other aspects of maternal–fetal interaction. A summary of the entire meeting is available from the conference organizers (http://www.womens-health.org).

Acknowledgement
We thank Nancy Evans for her assistance in the preparation of this meeting report.

Reference

1 Berenbaum, S.A. *et al.* (2000) Behavioral effects of prenatal versus postnatal androgen excess in children with 21-hydroxylase-deficient congenital adrenal hyperplasia. *J. Clin. Endocrinol. Metab.* 85, 727–733

Stacey A. Fannon
Regina M. Vidaver*
Sherry A. Marts
Society for Women's Health Research,
1828 L Street, NW Suite 625,
Washington, DC 20036, USA.
*e-mail: regina@womens-health.org

Techniques & Applications

Using Beowulf clusters to speed up neural simulations

Leslie S. Smith

Simulation of large neural systems on PCs requires large amounts of memory, and takes a long time. Parallel computers can speed them up. A new form of parallel computer, the Beowulf cluster, is an affordable version. Event-driven simulation and processor farming are two ways of exploiting this parallelism in neural simulations.

Simulating large neural networks needs huge amounts of processing power. Each neuron needs to process its data, and to send data to other neurons. The more realistic the simulation, the more processing is required: worse, as the number of neurons being simulated increases, the number of connections generally increases more than linearly. Obviously, as PCs and workstations have become faster, more complex networks can be simulated, but researchers' appetites for simulation power grow even faster than machine power.

Special purpose hardware was developed particularly for use with neural networks for pattern recognition [1,2], and prototype commercial chips were developed by Intel and IBM amongst others (see http://www1.cern.ch/NeuralNets/nnwInHepHard.html). With increased workstation speed and the realization that fast training was less important than fast recall, special purpose hardware is now used primarily in recall in embedded applications. Parallel computers have been used for both computational neuroscience and pattern recognition systems [3–6]. But special hardware and parallel computers have been very expensive options. Special hardware can provide large speed increases, but this has normally been for very specific types of network. Indeed, one often has had to massage the way the simulation operates to make it fit [7]. For parallel machines, one often has needed to learn a new language (or at least to make major changes to the existing code) to accommodate the particular parallel hardware, although there are new techniques to make the simulation description more hardware independent [4,8]. In recent years a new form of affordable parallel computer has emerged, the Beowulf cluster [9] (see also http://www.beowulf.org). This consists of a number of processing elements, each being a standard (commodity) high-speed PC running Linux, connected together using a fast Ethernet network (Fig. 1). Unlike other parallel computers, they are affordable because they use standard components, and can provide a researcher with processing power for a whole lab. The maximum speed-up they offer is the number of workstations in the cluster, providing an achievable and highly attractive linear relationship between processing power and cost.

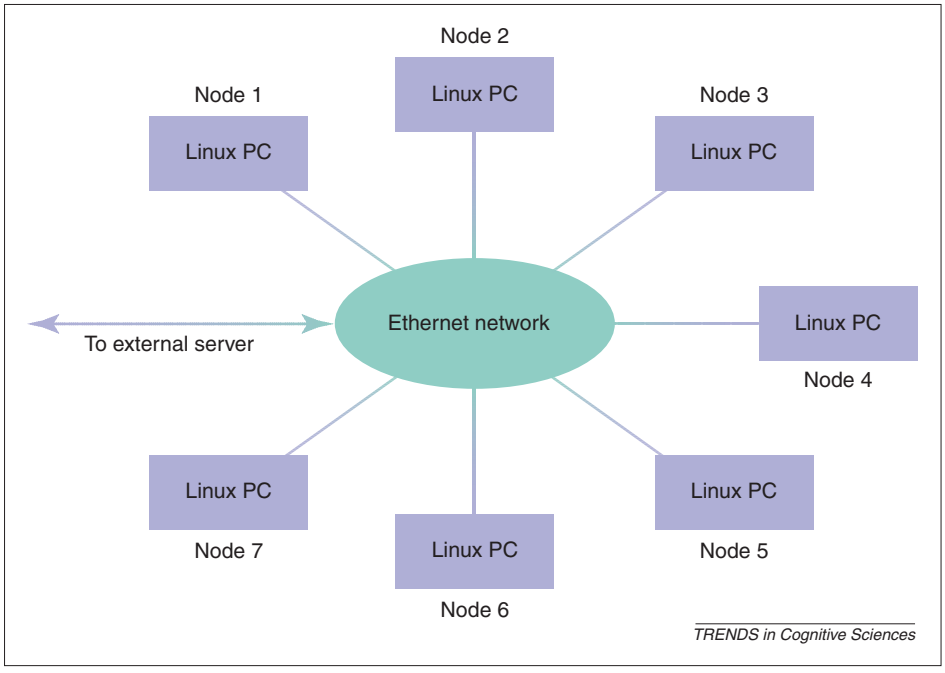

Fig. 1. Schematic of a 7-node Beowulf cluster. Each node is a commodity PC, running Linux. Generally, each will have a CPU, memory, hard disc and network interface, but only one will have a display. The nodes are connected through a high-speed Ethernet switch, generally at 100 Mbit/s. Large clusters can use hundreds of PCs, and more and/or faster networking systems: they often also have dedicated login nodes. See Ref. [16] for a straightforward introduction to Beowulf clusters.

Three groups have produced software that allows neural simulation on Beowulf clusters. Orellana *et al.* [10] have

 1364-6613/02/$ – see front matter PII: S1364-6613(02)01915-0