

however, extended his early work on the quads' sustained attention via the follow-up studies described above. He also recalled comments and conversations with the sisters over the years, some humorous, that offer insights into their personalities as well as their illnesses. One sister volunteered an especially memorable denunciation of a stimulus presented prior to a PET scan; interested individuals can contact this author for the "raw" data.

We can look forward to further findings from the Genain quadruplets. Plans

include brain and blood studies that may reveal new clues to the onset and course of their disorder. I most enjoyed Mirsky's response to my initial inquiry:

"How nice to hear from another Genain researcher! I saw the sisters for the first time in 1958 or 1959, or thereabouts, when we were all in our 20s. Now, *mirabile dictu*, we are all in our 70s. I visited them several weeks ago (in November, 2000) in Michigan and had a marvelous time. We brought along a group of neuropsychology trainees from the

U of Michigan, and as usual the sisters were gracious and welcoming. They sang for us "My sweet little Alice blue gown", something they had been doing for last 60+ years. It nearly brought me to tears. I do think that they are a kind of national research treasure, and because of their kindness and cooperativeness, we continue to learn more about this most enigmatic of all human disorders."

P.S. I think of Dave Rosenthal often, and his wonderful research legacy. ■

Research Reviews

Zygoty Diagnosis in Chimpanzee Twins

The incidence of twinning among non-human primates offers insights into the nature and origins of human twinning (Segal et al., 2000). It is generally presumed that twinning among close human ancestors is dizygotic because monozygotic twinning reduces genetic variability among offspring. Furthermore, DZ twinning is partly genetically mediated. Given the hazards associated with multiple births, twinning among most nonhuman primates is rare and pairs born in the wild generally do not survive. (Exceptions include marmosets and tamarins, small primates from Central and South America, among whom twinning occurs commonly). Currently, the relative frequencies of MZ and DZ pairs among nonhuman primates remain uncertain.

The birth of chimpanzee twins, Teeone and Teetoo, in June, 1996, at Kansas's Sunset Zoo attracted considerable research interest (Zhang et al., 2000). DNA extracted from blood samples provided by the father (Big Mac), mother (Rachel) and twins was examined via study of microsatellites. (Microsatellites are tandem repeats of short nucleotide motifs. They are well-suited to pedigree analysis because of high allelic diversity at each locus.) Primers developed for humans were used by California researchers to screen 34 microsatellite loci of the twins, of which 25 loci proved useful. The prob-

ability of dizygosity was calculated as 3.7×10^{-11} , indicative of MZ twinning.

Debate surrounding the bases of MZ twinning and its relationship to DZ twinning may be reinvigorated in light of the twins' mother's family history. Rachel was a twin herself and the twins' grandmother delivered six sets of twins, two pairs known to have been DZ. The possibility of multiple influences on MZ twinning (e.g., genetic factors, random processes) within different families remains unsolved.

Communication Disorders in Schizophrenia

Traits signaling genetic vulnerability to schizophrenia can facilitate early diagnosis and treatment of this disorder. A recent twin study of communication disorders may be breaking new ground (Docherty and Gottesman, 2000). The sample used schizophrenic MZ and DZ twins, their non-schizophrenic co-twins and twins from non-intact pairs who had participated in the well-known Maudsley study. Twins' speech samples were analyzed by the Communications Disturbances Index (CDI), which yields scores for six types of unclear speech references. Three speech characteristics, thought to be associated schizophrenia were targeted: missing information references, ambiguous word meanings and structural clarities. An Object Sorting Task (OST), in which participants group objects together and justify objects'

associations, was also administered. Key findings were that (1) missing information references occurred more frequently in the speech samples of MZ than DZ non-schizophrenic co-twins, and (2) missing references showed higher associations with OST performance than with the other two language problems. The researchers suggested that inheriting more severe forms of the specific speech deficit may affect vulnerability to schizophrenia. Individuals who are "preschizophrenic" may make frequent language mistakes, perhaps as many as do schizophrenics. This possibility could be tested with high-risk samples.

Proposal: Breast Cancer and Co-Twin Control

An unpublished study has suggested links between bra wearing and breast cancer (Poole, 2000). One hundred non-twin women suffering breast pain did not wear bras for a three-month period. Pre-menopausal participants experienced a 7% reduction in days of breast pain, while post-menopausal women did not. The investigator speculated that the garment may suppress the lymphatic system — vessels removing toxic waste from the body. This could conceivably lead to an accumulation of toxins in breast tissue. Of course, further efforts are needed to confirm these very preliminary findings and conjectures. Co-twin control studies in which one twin wore a bra and the

other did not might illuminate this matter. Potential problems with this proposal include (1) ethical justification for placing one twin in a potentially health-hazardous situation and (2) locating MZ female twins with different preferences for the article in question.

"Twin-Wide" Web

Use of the World Wide Web for conducting a randomized, multicenter

trial of treatment for twin-twin transfusion syndrome has been reported (Dornan et al., 2000). Transfusion syndrome affects approximately 35% of monochorionic-diamniotic MZ twin pairs, with 60-100% perinatal mortality. Treatments variously include laser ablation of anastomotic placental vessels, amniotic septostomy and serial amnioreduction of excessive amniotic fluid. According to the report, infant survival rates for these three methods are 50%, 49% and 83%, respectively.

The authors note, however, that published, randomized trials comparing these procedures are unavailable. Thus, a Web site was created for submission of patient data from multiple sources. The site is now accessible to 13 centers in the United States, Canada, England and Australia, and 7 additional centers are completing enrollment processes. Major advantages of this resource are the rapid transmission and retrieval of data valuable to twin researchers and their families. ■

Twin Assortment

First Time Transplant

Malaysian surgeon, Dr. V. Pathmanatham, performed a first time transplant when he attached an arm to a 4-week-old female twin infant born with a malformed limb ("Girl Receives Arm", 2000). The arm originated from the baby's MZ twin sister whose severe brain damage led to her early death. News of this operation was reported five months after it took place so the procedure has been successful thus far. The child was described as reaching with her "chubby, dimpled arm for the furry Garfield toy in front of her ... "

Political Dual

The world watched as the 2000 United States presidential battle edged toward a difficult conclusion. This may explain why a smaller, but equally compelling twin-based political contest in Jasper County, Missouri drew less attention ("Brotherly Love", 2000). Republican County Coroner Ron Mosbaugh sought reelection following his appointment to the position in 1998. (Mosbaugh, originally a Democrat, switched parties with the hope of improving his chances for victory.) His challenger was his MZ twin brother, Don — Don's mission was facilitated by simply altering his brother's name on campaign signs (changing R to D!). Ron proved the clear favorite on election night, but invited his twin to his celebration party. This political congeniality is

surely rare, but exemplary of MZ twins' affiliative spirit.

Quadruplets Times Two

The rise in higher order multiple births from fertility treatments is becoming a familiar story. As such, natural conceptions of triplets, quads and more inspires greater interest. The April, 2000 birth of a unique, naturally conceived quadruplet set in Boston, Massachusetts will surely excite the interests of twin researchers everywhere (Scammell, 2000). Kyle, Max, Sam and Cam, delivered at 31 weeks, have now been home for several months. They are unusual in being composed of two MZ twin sets: Kyle and Max, and Sam and Cam (Today Show, 2000). This arrangement also generates four DZ twin pairs and four MZ/DZ triplet sets. The parents have a two-year-old son, Jack, for a total of five children. The boys' father, when questioned about caring for the quadruplets, admitted that this process felt closer to a "custodial" relationship than to a "love" relationship. His response is understandable, given the countless responsibilities posed by the four newborn infants in contrast with his older singleton son. Both mother and father are, nevertheless, delighted and, awed by their exceptional family.

The simultaneous occurrence of MZ and DZ twinning in this family will not escape the notice of researchers concerned with the origins of the different twin types. As suggested above (see *Zygosity Diagnosis in Chimpanzee*

Twins), it is remarkable that available explanations for these basic twinning phenomena are not yet definitive.

Years Apart

MZ and DZ twins are unique co-celebrants on their days of birth. Very occasionally, however, twins are born days, weeks or even months apart. Twin births occurring in different years may be more unusual, but a new case has surfaced (The Jewish Journal, 2000). Obstetrician Yinon Gilboa, in Jerusalem, Israel assisted in the delivery of his twin daughter, born at 11:58 p.m. on December 31, 1999 and his twin son, born in the early minutes of January 1, 2000. The delivery was by Cesarean section. I recall working with a pair of reared apart twins whose search would have ended months earlier had they known that the few minutes between them were on different sides of October. History repeats itself yet again. A Massachusetts family celebrated the new millenium with the birth of twin sons, Aaron and Luke, born minutes apart in 2000 and 2001 (Evening News, 2001). The infants were five weeks premature. Only one is tax deductible.

17th Century Transfusion

Art informs even as it inspires. The Muiderslot, a medieval castle outside Amsterdam, the Netherlands holds a painting that will pique the interest of