



*Program
and
Book of Abstracts*

NOTE:

The Congress Author Index will be included with the general Author Index for 1989.

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- ★ The Second University of Rome Medical School
- and*
- ★ The International Society for Twin Studies (ISTS)

Organized by

The Gregor Mendel Institute of Medical Genetics
and Twin Studies, Rome
in conjunction with the International Society for Twin Studies *and*
the Italian Ministry of Health

Congress Agent

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Acknowledgments

In addition to the institutional support of the Italian Ministry of Health, the Mendel Institute, and the International Society for Twin Studies, the congress has been granted support from the Italian Ministry of Foreign Affairs, and the Italian National Research Council. A grant proposal has been approved by the National Institutes of Health, DHEW, USA.

The Center for Study of Multiple Births (Chicago) has funded the lectures by Professor Sciarra and Professor Papiernik. The firm IBM of Italy has provided the PC working stations available to congress participants for demonstration of twin data analysis by the ISTS Methodology Working Group.

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TEX[®] Typesetting system – Printed by Edi.Press (V. Chieti 26, 00161 Rome), August 1989

GENERAL INFORMATION

The Sixth International Congress on Twin Studies will be held in Rome from Monday 28 to Thursday 31 August 1989. All scientific sessions will be held at the Ambasciatori Palace Hotel, Via Veneto 70, Rome (tel. 47.493 – Telex 610241 HOTAMB I – Fax 679.9303).

Registration fees. The registration fee is of It. lire 450,000 for congress members and It. lire 200,000 for accompanying persons. The congress member fee includes admission to all working sessions, congress kit with Book of Abstracts and other documents, coffee breaks, and participation to all social events. The accompanying person fee includes participation to all social events.

Participation to Social Program and Congress Badge. The Social Program is open to all registered participants, but individual invitations to the various events will only be issued upon confirmation of participation. Admission to the social events will be restricted to persons who have an invitation card. Participants are kindly requested to always wear their congress badge, both at scientific sessions and at social events.

Secretariate. The Congress Secretariate will be located in the Ambasciatori Palace, Hall 20. The Secretariate will answer questions of a general nature, such as registration, hotel bookings, travel arrangements, and social program, and may provide technical assistance for the arrangement of posters.

Paper presentation. All papers should be presented in English. As a rule, Symposium presentations should last 15 (up to 20) minutes, Workshop presentations 10 (up to 13) minutes, and Paper Session presentations 8 (up to 10) minutes – all plus Discussion. However, variations are possible and individual speakers are invited to check with their Session Chairman well in advance. All speakers should at any rate approach their Chairman in the interval preceding the session, so that the Chairman be informed of the name of the person who will make the presentation and of his/her actual presence in the hall.

Slides. Slides should be given to the hall projectionist in the interval preceding the session. All slides should be identified with author's name and session and the orientation should be marked. Authors are requested to carefully check that their slides be in the correct order and that they project well.

Forum. The Forum, Thursday 31 at 16:00, is meant to allow open interchange between and among researchers of the various areas and twins and parents of twins. Anyone interested in making a contribution should approach the Forum Chairmen before the session and register to speak.

Demonstration of Twin Data Analysis. A couple of IBM PC Working Stations are available for members of the ISTS Working Group on Methodology to demonstrate twin data analysis software. Participants interested in having their data used for a demonstration should apply with the Secretariate.

Congress Proceedings. The proceedings will be published as part of AGMG/Twin Research during 1990. Manuscripts, carefully edited in the journal's style, should be submitted in triplicate to the Editor's Office (Piazza Galeno 5, 00161 Rome) **before 30 September 1989**. As a rule, publication will be assured to manuscripts resulting from invited presentations. All contributors, however, can submit their manuscript for consideration. The submission of a **floppy disk**, in addition to the manuscript, may considerably shorten publication time.





The previous two pages reproduce mosaics from the Mendel Institute's Main Hall celebrating Romulus (p. 6) and Remus (p. 7) as the legendary founders of Rome and Siena, respectively. The cover picture reproduces a painting by Italian painter Quilici-Buzzacchi showing twins sitting in the Mendel Institute's auditorium.

SIXTH
INTERNATIONAL CONGRESS
ON TWIN STUDIES



Program

SOCIAL PROGRAM

Monday 28 Papal Audience at Castel Gandolfo

09:00 Busses leave from the Ambasciatori

11:00 Papal Audience in the Pope's Summer residence at Castel Gandolfo

~ 13:00 Busses return to the Ambasciatori

Opening Ceremony at Rome's Capitol

16:45 Busses leave from the Ambasciatori

17:30 Short guided tour of the Capitoline Museums

18:00 Opening Session in the Capitol's Sala d'Ercole

19:00 Reception in the Villa Caffarelli

~ 21:30 Busses return to the Ambasciatori

Tuesday 29 Roman Ice-cream at Piazza Navona

21:00 Busses leave from the Ambasciatori

Short tour of Rome by night

22:00 Stop at Piazza Navona for an ice-cream

~ 23:00 Busses return to the Ambasciatori

Thursday 31 Banquet at Palazzo della Cancelleria

19:30 Busses leave from the Ambasciatori

20:00 Cocktails in the Palace cloister

20:30 Banquet

~ 23:00 Busses return to the Ambasciatori

NOTE: Participation to any of the events is open to all congress members and registered accompanying persons. However, a list of participants will have to be made for the Papal Audience, the Opening Ceremony, and the Banquet, so that participants are kindly requested to confirm their intention to take part to each of the events. Individual invitation cards will be issued upon confirmation of participation, and participants should make sure to bring their invitation with them: **entrance control personnel will only admit persons who show an invitation card.** All congress participants are also kindly requested to always wear their congress badge.

SCIENTIFIC PROGRAM LOGISTICS

Ambasciatori Palace Hotel

	Hall	Level
Secretariate	<i>Sala 20</i>	Ground Floor
Posters	<i>Sala Palazzo</i>	Ground Floor
Plenary sessions, Symposia and Paper sessions PS1 and PS4	<i>Sala 900</i>	Basement
Workshops, Paper sessions PS2 and PS5	<i>Sala Cavalieri</i>	Basement
Paper sessions PS3 and PS6	<i>Sala Orologio</i>	Basement

08:00 *Sala 20*
Registration of participants to Papal Audience

11:00 *Pope's Summer residence at Castel Gandolfo*
Papal Audience

14:00 *Sala 20*
Registration

Sala Palazzo
Time to mount Posters

Lobby
Time to read Congress documents
and get-together

17:30 *Campidoglio (City Hall)*
Short guided tour of the Capitoline Museums

18:00 *Sala d'Ercole, Capitoline Museums*
Opening Session
Official Greetings

Luigi Gedda: Opening Address

19:00 *Villa Caffarelli, Capitol's Hill*
Reception

Sala 900

08:20 ISTS Presidential Address
Aldur W. Eriksson

09:00 Symposium S1
The Variability of Twinning Rates
Chaired by Paolo Parisi (Italy) and
Aldur W. Eriksson (Netherlands)

The secular variability of twinning rates: An analysis of
maternal age and parity
P. Parisi, G. Allen

Secular changes in the rates of multiple maternities in Sweden,
1750–1987
A. W. Eriksson, M. Bressers, H. Lundström, J. Fellman

Seasonal effects on twinning in a fertile population, the Hutterites
K. Nonaka, T. Miura, K. Peter

Stature of women, twinning and breast cancer: Epidemiological
evidence of a relationship
J. Doherty

10:00 General Discussion

10:15 Coffee Break

Sala Cavalieri

09:00 Workshop W1

Twin Research Methodology - I

*Chaired by Andrew Heath (USA) and
Nicholas G. Martin (Australia)*

The power of multivariate and categorical classical twin studies

M.C. Neale, J.K. Hewitt, A.C. Heath, L.J. Eaves

Incorporation of twins in the regressive logistic model for pedigree disease data

J.L. Hopper, G.G. Giles, G.T. Macaskill, J.B. Carlin

Using twin data to estimate environmental mutation rates

G. Brenci, L. Gedda, C. Rossi

Using MZ twins in experimental research to test for the presence of a genotype-environment interaction effect

C. Bouchard, L. Pérusse, C. Leblanc

Genetic and environmental variation in the birthweight of twins

R. Vlietinck, R. Derom, M.C. Neale, H. Maes, H. Van den Berghe, C. Derom, M. Thiery

10:15 **Coffee Break**

Sala 900

10:45 Symposium S2
The Embryology of Twinning
Chaired by Charles E. Boklage (USA)

Introductory remarks on the embryology of human twinning:
"It is well known that"
C.E. Boklage

Overripe ova, twinning and malformations
S. Harlap

Lessons from the cell biology of artificially ovulated human oocytes
O. Bomsel-Helmreich

Zygoty and sex-pairing vs mortality and malformations in the East Flanders Prospective Twin Study: Implications for the embryology of twinning
C. Derom, R. Vlietinck, R. Derom, M. Thiery, H. Van den Berghe

Low twinning rate in women born in a low birth-rate season:
"Epidemic seasonal infertility factors" vs "varying maternal constitution according to season of conception"
P.H. Jongbloet, R.F. Vlietinck

Oocyte maturation and embryogenesis: Lessons from twinning
C.E. Boklage

12:30 General Discussion

13:00 Intermission

Sala Cavalieri

10:45 Workshop W2
Twin Research Methodology - II: Genetic Epidemiology
Chaired by Lindon J. Eaves (USA)

Parametric and non-parametric methods for analysing the inheritance of substance abuse patterns
A.C. Heath, L.J. Eaves, J. Meyer, N.G. Martin

Modeling the inheritance of time to onset: A survival analysis approach with application to the age of onset of menarche and the smoking habit
J.M. Meyer

Modeling of resemblance for sex-steroid hormones in male twins: Direct phenotype-to-phenotype causality
G.P. Vogler

A closer look at correlated environments: Is it sharing the same rearing environment or being in contact as adults?
N.L. Pedersen

Personality: Nonadditive genetic variance or violation of the equal environments assumption of the twin method?
R. Plomin

Sex differences and non-additivity in the effects of genes on personality
L.J. Eaves, A.C. Heath, M.C. Neale, J.K. Hewitt, N.G. Martin

Developmental trends in IQs of twins and siblings aged one to seven years
D.W. Fulker, L. Cardon

13:00 **Intermission**

Sala 900

- 14:00** Paper Session PS1
Biology of Twinning
Chaired by Grace Wyshak (USA)
- Standardization of the twinning rate
J.O. Fellman, A.W. Eriksson
- Twinning causative origin investigated by Sartwell's biometrical method
P. Philippe
- Hormone levels and follicular activity in mothers of DZ twins and controls
N.G. Martin, D. Redman, M. Payne, S. Shanley, K. Butt, J. Osborne
- Twinning rate in families with X-chromosomal nondisjunction
D.V.M. Crombach, L.P. Kuyt, P.L. Kostense, L.N. Went, A.W. Eriksson
- Fetal deaths with birth defect among Japanese multiples, 1974
Y. Imaizumi, A. Asaka, E. Inouye
- Pregnancy loss in mothers of multiple births and in mothers of singletons only
G. Wyshak
- Seasonality in early loss of one fetus among twin pregnancies
I. Nakamura, M. Uno, Y. Io, I. Ikeshita, T. Miura
- Seasonality in twin vs single births
L. Gedda, G. Brenci, R. Carrega
- Effects of maternal age, parity, and zygosity on twin perinatal mortality
H. Rydhström

16:00 **Coffee Break**

Sala Cavalieri

14:00 Paper Session PS2
**Twin Research in Personality
 and Mental Disorder**
Chaired by Eiji Inouye (Japan)

The personality of twins reared
 together
H. Sloore

Openness to experience, agreea-
 bleness, and conscientiousness:
 Analysis of the Swedish Adoption/
 Twin Study on Aging (SATSA)
H.M. Chipuer

A twin-family study of personality
 disorders
*S. Torgersen, I. Skre, S. Onstad
 E. Kringle*

The temporal stability of symptoms
 of psychiatric distress in an older
 twin sample
J.L. Silberg, A.C. Heath

Twin concordance of anxiety
 disorders
*I. Skre, S. Onstad, S. Torgersen,
 E. Kringle*

A twin study of obsessive compulsi-
 ve neurosis
A. M. Macdonald, R. M. Murray

Criminality and mental illness: A
 preliminary study based on the
 Maudsley twin series
B. Chitkara, S.W. Lewis

Biological and psychological factors
 relating with problem drinking
 behaviour
K. Yamada, A. Asaka

A study of suicide in twins
N.L. Segal, A. Roy

Sala Orologio

Paper Session PS3
**Twin Research in Clinical
 Studies - I**
Chaired by Thomas M. Mack (USA)

Estimated prevalence of twins in
 North America
P. Canole, D. Deapen, T. Mack

Selection bias in twin studies
*K. Romanov, M. Koskenvuo,
 J. Kaprio, K. Heikkilä*

A methodological evaluation of the
 case-control study using U.S. twins:
 Examples from breast cancer data
*A. Walker, D. Deapen, B. Langholz
 T. Mack*

A study of stomach ulcer in the
 Virginia and Norwegian twin
 registries
*L.A. Corey, K. Berg, W.E. Nance,
 P. Magnus, M. Solaas*

A genetic analysis of the contribu-
 tion of exposure to combat during
 the Vietnam war to the current
 health of American veterans
*S.A. Eisen, R. Neuman, J. Rice,
 J. Goldberg, W.R. True*

A twin study of the effects of the
 Vietnam conflict on alcohol
 drinking patterns
*J. Goldberg, S. Eisen, W. True,
 J. Rice*

An Italian Army Twin Register
L. Gedda, G. Brenci, G. Ronzani

A preliminary report: Crohn's
 disease in twins
*B.M. Calkins, L.A. Corey, K. Berg,
 H. Torsvik, A.I. Mendeloff,
 W.E. Nance*

A preliminary report: Ulcerative
 colitis in twins
*B.M. Calkins, L.A. Corey, K. Berg
 H. Torsvik, A.I. Mendeloff,
 W.E. Nance*

16:00 **Coffee Break**

Sala 900

- 16:30** Symposium S3
Twin Research in Development and Chronogenetics
Chaired by Adam P. Matheny, Jr. (USA)
- Longitudinal twin research contributing to fetal outcome study
F. Falkner
- Twins' correlated pathway of temperament development
A.P. Matheny, Jr.
- Developmental behavioral genetics
R. Plomin
- Quantitative developmental genetic models: Implications and applications
J.K. Hewitt, L.J. Eaves, M.C. Neale, A.C. Heath, M. Mosteller, R. Schieken

18:00 General Discussion

18:30 *Sala Palazzo*
Time to view Posters

21:00 **Tour**

Sala Cavalieri

**16:30 Workshop W3
Molecular Genetic Techniques
in Twin Research**
Chaired by Rune Frants (Netherlands)

DNA fingerprinting for identifying
MZ twins
P. Debenham

Definitive methods of zygosity de-
termination in twins
G.A. Machin

Variable number of tandem repeats
in zygosity diagnosis in twins
*S. Costanzi, A. Sciarra, N. Sulli,
M. Piane, R. Gualtieri, G. Del Porto*

Transsexualism in twins
*L. Gooren, R. R. Frants,
A.W. Eriksson, B.R. Rao*

Genotyping macerated stillborn
twin fetuses
*C. Derom, R. Vlietinck, R. Derom,
M. Thiery, H. Van den Berghe*

A revised estimate of twin concor-
dance in systemic lupus erythema-
tosus using DNA fingerprint zygosi-
ty confirmation
*D. Deapen, A. Walker,
P. Roy-Burman, L. Weinrib,
A. Escalante, D. Horwitz, T. Mack*

Sala Orologio

**Paper Session PS3
Twin Research in Clinical
Studies - II**
Chaired by Kåre Berg (Norway)

A genetic analysis of resting blood
pressure and heart rate in prepu-
bertal twins
*R. Schieken, W. Moskowitz,
M. Mosteller, J. Bodurtha, L. Eaves,
J. Hewitt, W. Nance*

Bivariate genetic analysis of systolic
blood pressure and weight in prepu-
bertal twins
*M. Mosteller, R. Schieken,
W. Moskowitz, J. Bodurtha,
L. Eaves, J. Hewitt, W. Nance*

Stress-induced changes in the
effects of genes and environment
on cardiovascular function
*L.J. Eaves, J.K. Hewitt,
R.M. Schieken, M. Mosteller,
W.B. Moskowitz, J. Bodurtha
W.E. Nance*

Chronological changes in genetic
variance and heritability of systolic
and diastolic blood pressure among
Chinese twin neonates
*C.J. Chen, M.W. Yu, C.J. Wang,
S.L. Tong, M. Tien*

Blood pressure in twins
*Y. Nakayama, A. Asaka,
K. Yamada, S. Ooki, I. Nakamura*

Hypertension in Virginia and
Norwegian twins
*L.A. Corey, K. Berg, P. Magnus,
W.E. Nance, M. Solaas*

Hypertension in twins
*H.S. Vuorinen, M. Koskenvuo,
K. Romanov, J. Kaprio*

Genetic influence on aortic stiffness
*H. Verhaaren, D. Matthys,
R. Schieken*

Genetic factors in ischemic heart
disease
*M. Koskenvuo, J. Kaprio,
K. Romanov*

18:30 End of Session

End of Session

Sala 900

08:20 Symposium S4
Twins Reared Apart and Adoption Studies
Chaired by Thomas J. Bouchard, Jr. (USA)

Genetic influence on special mental abilities in a sample of
twins reared apart
T.J. Bouchard, Jr., N.L. Segal

The Swedish Adoption/Twin Study of Aging: An update
*N.L. Pedersen, G.E. McClearn, R. Plomin, J. Nesselroade, S. Berg,
U. DeFaire*

Serum cholesterol and apoprotein E phenotypes in identical twins
reared apart
M. Koskenvuo, K. Kervinen, J. Kaprio, J. Juntunen, Y.A. Kesäniemi

Comments
J.M. Horn

09:45 General Discussion

10:15 **Coffee Break**

Sala Cavalieri

08:20 Multiple Pregnancy: Selected Aspects of International Interest
A special address by the President-elect of the International Federation of Gynecology and Obstetrics (FIGO)
John J. Sciarra (USA)

09:00 Workshop W4
Multiple Pregnancy and Assisted Reproduction
Chaired by Robert Derom (Belgium)

Comparative study of outcome and zygosity in spontaneous and induced multiple pregnancies

R. Derom, R. Vlietinck, C. Derom, M. Thiery

Multiple pregnancy following in vitro fertilization

FIVNAT Study Group: presented by

E. Papiernik and J. Belaisch-Allart

Guidelines for the prevention of multiple pregnancy in IVF treatment

F. Leroy

Assisted reproduction and triplet- and higher order births

A. MacFarlane, E.G. Daw, et al.

Selective termination in the second trimester for major congenital anomalies

R.L. Berkowitz, U. Chitkara, L. Lynch, M. Alvarez

10:15 **Coffee Break**

Sala 900

- 10:45** Symposium S5
Twin Research in Psychophysiology
*Chaired by Jacob F. Orlebeke and
Dorret Boomsma (Netherlands)*

Genetic determination of the human EEG. Survey of recent results
on twins reared together and apart
H.H. Stassen, D.T. Lykken, P. Propping, G. Bomben

Behavior-genetic approach in psychophysiology
I.V. Ravich-Scherbo

Skin-conductance, speed-of-processing, and attention in 9- to 16-
year-old twins
L.M. Sakai, L. A. Baker, M. Dawson

Nerve conduction velocity, intelligence, and information-processing
speed
P. A. Vernon, M. Mori

Genetic influences on vagal control of heart rate: A parent-twin
study of sinus arrhythmia
D. I. Boomsma, C.C.M. van Baal, J. F. Orlebeke

Genetic Spectral Analysis
P.C.M. Molenaar, D. J. Boomsma, C. V. Dolan

- 12:30** General Discussion

-
- 13:00** Intermission
-

Sala Cavalieri

10:45 Workshop W5
Triplets and Higher Order Multiple Births
Chaired by Louis Keith (USA) and
Emile Papiernik (France)

Obstetric aspects from the study of triplets and higher order births
E.G. Daw

Triplets in Denmark, 1980-1989
K.G. Børlum

Management of triplet pregnancy
J.C. Pons, L. Segard, S. Rais, E. Papiernik

The utilization of uterine activity data in the management of
multiple gestation
M. Olson

Triplets and higher order multiple births in Japan
Y. Imaizumi

Observation of 11 cases of triplets and their outcome
K. Matayoshi, K. Yoshida

13:00 Intermission

Sala 900

14:00 Paper Session PS4
Twin Research in Physiology and Anthropology
Chaired by Claude Bouchard (Canada)

Genetic epidemiology of lipoprotein levels:
 A parent-twin study
*D.I. Boomsma, H.J.M. Kempen, J.A. Gevers
 Leuven, J.C. Pronk, E. de Wit, H.A. van der
 Voort, L. Havekes, J.F. Orlebeke*

Apolipoprotein E polymorphism is an im-
 portant determinant of plasma LDL choles-
 terol and apoB levels. Results of a Dutch
 twin study
*P. de Knijff, H.J.M. Kempen, D.I. Boomsma,
 E. de Wit, L. Havekes, R. Frants*

Genetic variance and heritability of serum
 cholesterol and triglycerides among Chinese
 twin neonates
*C.J. Chen, M.W. Yu, C.J. Wang, S.L. Tong,
 M. Tien*

Relationship between blood uric acid level
 and personality traits
S. Ooki, A. Asaka, K. Yamada

Left ventricular structure and physical
 exercise capacity in 7-year old twins
E. Bielen, R. Fagard, A. Amery

Genetic analysis of somatic dimensions and
 motor characteristics. Data from the Leuven
 Longitudinal Twin Study
H. Maes, G. Beunen, R. Vlietinck

Inheritance of body mass index. A study of
 13 299 adult Finnish twin pairs
M. Turula, A. Rissanen, M. Koskenvuo

Chronological changes in genetic variance
 and heritability of anthropometric charac-
 teristics among Chinese twin infants
*C.J. Chen, M.W. Yu, C.J. Wang, S.L. Tong,
 M. Tien*

A twin study of the growth and develop-
 ment of the dentition among Chinese
H.F. Chang, C.J. Chen

16:00 **Coffee Break**

Sala Cavalieri

14:00 Paper Session PS5
Behavioral Development in Twins
Chaired by Ruth Guttman (Israel)
and Marilyn Riese (USA)

Genetic influences on neonatal temperament
M.L. Riese

Four-year follow-up of locomotor- and language development in 34 twin pairs

B. Alin Åkerman, P.A. Thomassen

Relation between sensorimotor status and cognitive functioning in school-age twins and singletons
R. Guttman, M. Nathan

Linguistic components of language acquisition in mono- and dizygotic twins

R. Godijns, E. Thiery, R. Vlietinck C. Derom, M. Thiery, R. Derom

Qualitative and quantitative aspects of mathematics achievement in MZ and DZ twins

A.L. Lange, S. Fischbein

An examination of the psychological and behavioural factors in the development of language retardation in twins

A.C. Sandbank, G.A. Brown

Sala Orologio

Paper Session PS6
Multiple Pregnancy
Chaired by Ferdinand Leroy (Belgium)

Outcome of twin gestations complicated by gestational diabetes mellitus

J.D. Keller, G.O. Utter, S.L. Dooley, J. Minogue, L.G. Keith

Evolution of perinatal outcome in twin gestations: 1971-1988

G.O. Utter, J.D. Keller, M.L. Socol, J.P. Minogue, K. Bozorgi, L.G. Keith

Discordant fetal growth in low birthweight twin gestation not predictive of perinatal morbidity

S.N. MacGregor, L.G. Keith, R.K. Silver

The effects of employment, daily activities, and domestic arrangements on perinatal outcome in twin gestations

S.N. MacGregor, R.K. Silver, D.M. Keith, L.G. Keith

Prediction of fetal weight and discordant growth by various ultrasound-derived formulas in twin gestations

S.N. MacGregor, R.E. Sabbagha, R.K. Silver, R.K. Tamura, J.S. Sholl L.G. Keith

Rationales for a standard of care in compromised twin pregnancies

J.P. Minogue, M.L. Socol, L.G. Keith

First trimester genetic diagnosis in twin pregnancies: Safety and accuracy

E. Pergament, R.J. Wapner, L.G. Jackson, J.D. Shulman N.A. Ginsberg, Y. Verlinsky, S.H. Black

Growth patterns in preterm and term twin deliveries

A.P.M. Smith, D.M. Campbell, J. Lemon

Estimated fetal weight by ultrasound and birthweight in twin pregnancy - How good are we?

D.M. Campbell, A.P. Smith, A.W. Wilson

16:00 **Coffee Break**

Sala 900

16:30 Symposium S6
Twin Research in Major Clinical Conditions and Risk Factors
Chaired by Walter E. Nance (USA)

Application of partitioned twin analysis to measurements
of serum lipoproteins in 11-year-old twins
W.E. Nance

Risk factor variability and coronary heart disease
K. Berg

Twin research in breast cancer
T.M. Mack

An Italian study on obesity: Anthropometric characteristics and
nutritional habits of monozygotic and dizygotic twins
L. Gedda, G. Cairella, G. Brenci, M. Cairella, F. Chiacchiararelli
E. Cravotto, E. Di Renzo, M. Fioravanti, I. Fricano, R. Godi,
P. Graziani, S. Trizza, M. Trovato

18:00 General Discussion

18:30 **ISTS Business Meeting**

Sala Cavalieri

16:30 Workshop W6
Longitudinal Studies and the Follow-up of Twins
Chaired by Kay Phillips (USA)

A three-year follow up of personality in the Swedish Adoption/Twin Study of Aging
N.L. Pedersen

Quantitative developmental genetic analysis of height
K. Phillips, A. P. Matheny, Jr.

Permissiveness - restrictiveness for twins and controls in two educational settings: The Swedish compulsory school and the Israeli kibbutz
S. Fischbein, R. Guttman

Developmental changes in relative contributions of heredity and environment: The effect of transition to schooling
M.S. Egorova

Development, education and living habits of twins
I. Moilanen, P. Rantakallio

Twins at risk? A longitudinal study of twins and non-twins from birth to 18 years of age
B. Alin Åkerman, S. Fischbein

18:30 **ISTS Business Meeting** (*Sala 900*)

Sala 900

08:20 Symposium S7
Twin Research in Substance Exposure and Preventive Medicine
Chaired by Jaakko Kaprio (Finland)

“No thanks, it keeps me awake”: The genetics of coffee drinking
and sleep disturbance
N.G. Martin, A.C. Heath

Genes and the use and abuse of alcohol: A progress
report from ongoing twin studies
R.J. Rose, J.C. Christian, J. Kaprio, M. Koskenvuo

Smoking, genes and disease
*J. Kaprio, M. Koskenvuo, K. Heikkilä, H. Rita,
Y.A. Kesäniemi, A. Haapanen, S. Sarna*

Cardiovascular symptoms and risk factors in a cohort of Italian
twins 30 to 50 years old
A. Maseri, L. Gedda, G. Brenci, F. Crea, R. Carrega

Smoking monozygotic twins have an earlier menopause than their
non-smoking cotwins
K.H. Ørstavik, M.H. Solaas, K. Berg

09:45 General Discussion

10:15 Coffee Break

Sala Cavalieri

08:20 Workshop W7

Psychosocial Aspects of the Twin Condition and Family Interactions

Chaired by Judy Linney (UK)

What information should the multiple birth family receive before, during and after the birth?

C. Gleeson, C. Davies, B. Lorden, D. Mitchell, L. Paton, D.A. Hay

What is it like to be a twin parent?

S. Fischbein, I. Hallencreutz, I. Wiklund

Measuring the psychosocial impact of twin birth

P.M. Malmstrom, R. Biale

Raising twin babies and problems in the family

C. Chang

Maternal response to stress when disciplining twin children

J.R. Spillman

Cooperation and competition between twin children: Replication and extension

N.L. Segal

The twin bond: Its impact on marriage and identity

J. Greer

10:15 Coffee Break

Sala 900

10:45 Symposium S8
Twin Registers and Standardization of Ascertainment Procedures
Chaired by David Hay (Australia)

Twin children in volunteer registries: Biases in parental participation and reporting

D.A. Hay, C. Clifford, P. Derrick, J. Hopper, B. Renard, T. Theobald

Population-based twin registries in the Nordic countries: Illustrative applications in genetic epidemiology and behavioral genetics

J. Kaprio, M. Koskenvuo, R.J. Rose

The Minnesota Twin Registry: Personality correlates of ease of recruitment

D.T. Lykken, T.J. Bouchard, M. McGue, A. Tellegen

The Vietnam Era Twin Registry: A resource for medical research

W. Henderson, J. Goldberg, S. Eisen, W. True, J.E. Barnes, M.E. Vitek

Database management of the Australian NHMRC Twin Registry

P.L. Derrick

12:30 General Discussion

13:00 Intermission

Sala Cavalieri

10:45 Workshop W8
Multiple Birth Organizations and Service Systems
Chaired by Judy Linney (UK)

“Twins in school” – An Australiawide program
C. Gleeson, D.A. Hay, C.J. Johnston

Recommendations for policies and psychosocial services for multiple birth families
P. Malmstrom, R. Biale

The role of special clinics for families with multiple births
E. M. Bryan, A. M. Elliman

National Organization of Mothers of Twins Clubs: Report to the Sixth International Congress
C. Hradek, M. Meyer

Comparison of data from a non-member local club and the National Organization of Mothers of Twins Clubs
J. Knight, M. Meyer

12:00 Meeting of the Council of Multiple Birth Organizations (COMBO)

13:00 **Intermission**

Sala Palazzo

14:00 **Poster Session**

15:30 **Coffee Break**

Sala 900

16:00 **Forum:**
Twins, Parents of Twins, and Researchers
Chaired by David Hay (Australia)
and Adam P. Matheny, Jr. (USA)

Introductory remarks

The social cost of twinning
E. Papiernik

Position papers

General Discussion

17:30 **Closing Session**
Chaired by Rita Levi-Montalcini (Italy)

The study of twins and practical medicine
Luigi Gedda

20:00 *Palazzo della Cancelleria*
Banquet

SIXTH
INTERNATIONAL CONGRESS
ON TWIN STUDIES



Abstracts

The secular variability of twinning rates: An analysis of maternal age and parity

P. Parisi^{1,2}, G. Allen³

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Analysis of Italian births from 1949 to 1985 confirms previous reports of a drastic decline in the frequency of DZ twins. This is partly due to greatly reduced fertility in older mothers and greatly reduced mean parity. However, after direct adjustment for age and parity the decline is still very large, from 8.8‰ in 1949-1953 to 6.0‰ in 1981-1985. Most of the decrease occurred after the 1959-1963 interval, when twinning in young mothers actually was at its highest. The 1981-1985 interval shows a slight rise of DZ twinning in young mothers and among first births, and a slight rise in MZ twinning, but the overall DZ rate, both crude and adjusted, continued the downward trend. The contrast of this trend in Italy with the increase recently reported for the United States is not due to analytic method. Indirect standardization of the Italian data, nearly like that required for the U.S. data, gives virtually the same results as direct standardization.

Secular changes in the rates of multiple maternities in Sweden, 1750-1987

A.W. Eriksson¹, M. Bressers¹, H. Lundström², J. Fellman³

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Sweden has the oldest continuous statistics in the world for the whole population. The ecclesiastical law of 1686 prescribed that the local clergy (Lutheran ministers) should keep regular lists of births, christenings, etc. In 1749 data collection was made compulsory by law and from that year onwards it is possible to study the development of fertility, including rates of multiple maternities. The highest yearly twinning rates (with values above 18‰) are noted during the last three decades of the 18th century in spite of the fact that the general fertility rate was low during some years of privation, eg, for the 1771-75 quinquennium, as a consequence of the extremely bad harvests in 1771 and 1772 and the very severe famine in 1773 which caused a catastrophically high mortality rate in Sweden that never

has been surpassed. From 1774 to 1816 the average twinning rate in Sweden was around 17‰, ie, the highest noted for a whole nation. After 1816 there was a decrease in the twinning rate and in 1836-1855 the twinning rate was only $13.61 \pm 0.08‰$ although there was a decrease in the fertility rates below the ages of 25 and an increase in the fertility rates among women in the most twinning-prone ages (25-39). In 1856-1930 the twinning rate was mainly between 14 and 15‰ but after 1930 a sharp decline is setting in reaching a minimum in 1969 (below 8‰). This decline was caused mainly by a decrease in mean maternal age (from about 31 up to the turn of this century, to 26 at the end of the 1960s). The twinning rate shows an increasing trend since 1975, with values above 10‰ during the last years. This increase is mainly a consequence of the postponement of births to higher maternal ages. However, the recent increased twinning rate is not only caused by an increase in DZ twinning. Since the 1970s the MZ twinning rate has increased by more than 50%. A similar trend has been noted in the majority of northwestern European countries. For the years 1952-62, before the contraceptive pill era, the average twinning rate in Sweden was 10.7‰, being highest (16.3‰) among women of the age group 35-39 years. This peak is so low that it cannot account for the average twinning rate of over 17‰ in the latter half of the 18th century.

Rates of higher order multiple maternities have decreased still more than twin maternities. The triplet rate decreased from quinquennial values around 0.30 in 1776-1800 to values below 0.10‰ in 1951-75. The decrease in the rate of triplet maternities was setting in considerably earlier in the urban areas than in the rural regions. The rate of maternities of quadruplets was above 7 per million maternities since 1975 but since 1830 to 1960 it has been below 3.5 per million.

Seasonal effects on twinning in a fertile population, the Hutterites

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¹*Department of Hygiene, Teikyo University School of Medicine, Tokyo, Japan;* and ²*Department of Sociology & Anthropology, Simon Fraser University, Canada*

The birth records of the 'Dariusleut', a subgroup of the Hutterite population, starting at the mid 18th century and ranging to 1987 were analyzed. In this fertile population the overall rate of twinning was 0.90% (103 twin maternities per 11,494 maternities). This rate is slightly lower than the usual level of white Europeans. The rate

peaked at the 7th birth order and at the maternal age 40 years and higher. Until the mid 19th century when the Hutterites resided in Russia, the twinning rate was relatively high (1.5%), and it decreased during the migration period in the second half of the 19th century. After the group migrated to the USA, they initially kept a twinning rate about 1.0% until 1965. After 1966 the rate decreased to 0.7% , probably because of the higher proportion of younger mothers. There was a marked seasonal variation: the twinning rate decreases to 0.6% in May-July compared to 1.0% for the other three seasons. This tendency is apparent before the mid 20th century ($p < 0.05$), while most recent mothers do not show such seasonal variation. The twinning rate was also affected by mother's birth season: the mothers born in May-July (or May-September) produced a significantly lower proportion of unlike-sexed twins, which could indicate that they were less prone to multiple ovulations than those mothers born during the other seasons.

Stature of women, twinning and breast cancer: Epidemiological evidence of a relationship

J. Doherty

Medical Service, Food and Agriculture Organization of the United Nations, Rome, Italy

A comparison was made of the stature of women, twinning rates and breast cancer mortality for 32 countries. As height increased, so, too, did twinning and breast cancer mortality ($p < 0.005$). Dizygotic twinning and breast cancer increased sharply with the mean height of the female population. With due caution in drawing causal inferences when uncontrolled confounding variables are present, it is suggested that these findings are an evolutionary consequence of the high mortality found in twin pregnancy.

The power of multivariate and categorical classical twin studies

M.C. Neale¹, J.K. Hewitt¹, A.C. Heath¹, L.J. Eaves¹

¹*Department of Human Genetics, Medical College of Virginia, Richmond, USA*

The power of classical twin study is examined through model-fitting to simulated data for two areas: categorical variables and multivariate analysis. An individual's response to a questionnaire item, or the presence or absence of DZs may reflect a continuous distribution of liability, for which twins correlate. Under this threshold model, the power of data collected from MZ and DZ twins reared together to discriminate between additive genetic and common environmental variance is shown to be markedly attenuated from the power observed for continuous measures. The loss of power is more marked when the response distribution is skewed. Multivariate analysis of cross-sectional twin data allows a wide range of models to be tested; we focus on the direction of causation between two variables. Necessary sample sizes to give 90% chance of rejection of wrong model vary considerably according to the correlation between variables, and the genetic architecture of the two traits. Quite often, the twin study can prove a highly efficient method of establishing direction of causation between phenotypes.

Supported by PHS Grants MH-40828 and AG-04954.

Incorporation of twins in the regressive logistic model for pedigree disease data

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Segregation and twin disease concordance analyses have assumed a theoretical underlying multivariate normal distributed liability. For reasons of computation, of incorporation of measured explanatory variables, and of testing of fit and assumptions, newer analytical methods are being developed.

The Regressive Logistic Model (Bonney, *Biometrics* 1986, 42:611-625) relies on expressing the pedigree likelihood as a product of conditional probabilities, one for each individual. In addition to logistic regression modelling of measured epidemiological variables on disease prevalence, there is modelling of vertical transmission, of transmission of unmeasured genotypes and of sibship environment. This paper extends the model to pedigrees which include twins, so as to explore twin concordance in the context of the twins' common parenthood, the sibship similarities within the family, and the twins' similarity in age, sex, genes and environment. Application is made to the population-based Tasmanian Asthma Survey, in which the parents of seven-year-old children were questioned on asthma and wheeze symptoms of their children and themselves. Data is analysed from the 300 families in which there were seven-year-old twins, or twin siblings of the seven-year-old child, and a large random sample of 'non-twin' families.

Using twin data to estimate environmental mutation rates

G. Brenci¹, L. Gedda¹, C. Rossi²

¹*The Gregor Mendel Institute of Medical Genetics and Twin Studies, Rome, and* ²*Department of Mathematics, Second University of Rome, Italy*

Data from MZ twins, living in different environments, can be used to estimate the two mutation rates, in a bayesian framework, as follows. As the protein stability, defined as the expected probability that a random mutation would have no effect on the aminoacid sequence, is the same for the pair of twins, it can be considered as a nuisance parameter, if it is unknown. The observed data BE1 and BE2, namely the numbers of mutations in the aminoacid sequence for the two twins, can be used to estimate the two mutation rates 01 and 02. By straightforward calculations, the posterior distributions of the parameters can be derived and the posterior modes as functions of the nuisance parameter are obtained. The nuisance parameter can then be eliminated by integration with respect to its probability distribution. The procedure can be easily generalized to take into account twins living in different environments just for some periods of their lives. Some numerical results will be used to give examples of the estimation procedure.

Using MZ twins in experimental research to test for the presence of a genotype-environment interaction effect

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Despite some evidence that genotype-environment interaction ($G \times E$) effects may be involved in the variation observed in behavioral and biological traits, few attempts have been made to detect and quantify this component of genetic variation in humans. We propose that one way to achieve this goal is to challenge several genotypes in a similar manner, submitting both members of several MZ twin pairs to an ethically acceptable experimental treatment capable of inducing an adaptive response. In this situation, the $G \times E$ effect can be assessed with a two-way analysis of variance for repeated measures on one factor, the treatment effect. In this design, twins are considered nested within the pair, the treatment effect is considered a fixed variable. The intrapair resemblance in the response to the treatment is quantified with an intraclass correlation coefficient computed with between sibships and within sibships means of squares. To illustrate this approach, changes induced by overfeeding were studied in 12 pairs of male MZ twins who were submitted to a daily 4.2 MJ, 6 days a week, surplus over 100 consecutive days. Individual differences observed in adipose tissue changes, body composition and regional fat distribution were not distributed randomly among the genotypes as indicated by a significant $G \times E$ effect for the body mass index, total fat mass, the sum of 10 skinfolds, the waist to hip circumference ratio and abdominal visceral fat assessed by computerized tomography. In similar experiments, several MZ twins were submitted to long-term exercise-training programs. Significant intrapair resemblances in the response of muscle enzyme markers of the ATP replenishment pathways as well as of maximal oxygen uptake were observed. We conclude that the $G \times E$ effect appears to be a real source of variation in body composition, fat distribution, muscle energy metabolism and aerobic exercise capacity. This design with MZ twins offers a unique advantage in the study of human variation for multifactorial phenotypes.

Genetic and environmental variation in the birthweight of twins

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²Department of Obstetrics, University of Ghent, and ³Institute voor Lichamelijke Opleiding, Heverlee, Belgium; ⁴Department of Human Genetics, Medical College of Virginia, Richmond, USA

Two novel approaches to the analysis of twin data are illustrated with data from birthweight in twins. First, two possible covariates of birthweight are fitted to the data simultaneously, allowing for linear effects of these variables, and their correlation. Second, information on chorionicity is used to estimate the effects of chorion type on birthweight. The data were collected from a large sample of twins born in East Flanders, Belgium. Variation and covariation in twins was considered as a function of sex, chorionicity, maternal age, gestational age and genotype. No evidence for sex differences in causes of variation was found. As expected, the largest source of variation in birthweight was associated with gestational age. Other common environmental influences were nonsignificant. Heritability was significant, constituting approximately 40% of variation not associated with maternal and gestational age. A small but significant effect of chorionicity was found, such that dichorionic twins show greater similarity than monozygotic.

The embryology of human twinning: "It is well known that ..."

C.E. Boklage

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There is no sound evidence for a two-egg origin for natural DZ twins. There is no sound evidence that variation in twinning rates is due only to DZs. There is no sound evidence that the twin excess of mortality and developmental anomalies is due only to MZs. These basic tenets of twin biology are interpretations, based on inadequate data and assumptions, the plausibility of which can and must be questioned. In several important ways, DZ twins differ from singletons as much as MZs do. Under different assumptions, at least as plausible, MZ and DZ twinning both represent subtle, pervasive variations of embryogenesis, from which we might hope to learn more about the usual version. Strong association of twinning with major malformations provides opportunities for new contributions to understanding normal and abnormal human developmental biology.

Override ova, twinning and malformations

S. Harlap

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Children conceived a day or more after most likely ovulation date include significant excess multiple births and malformations. Excess DZ twinning is clear from the excess of male-female pairs. Weinberg estimates show MZ twinning increasing over several days up to most likely ovulation date, then vanishing. Distorted sex ratios and excesses of malformations otherwise associated with twinning raise other issues. Poor survival, conditional on sex, sex-pairing and associated malformations, confounds the issues of circumstances favoring twin conceptions as assessed by twin births.

Lessons from the cell biology of artificially ovulated human oocytes

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The maturation of the human oocyte in preparation for fertilization differs as a function of its developmental stage at the time of induced ovulation and other circumstances of its preparation. Some of the observed changes in cytoskeletal and cytoplasmic organization, in the structure and position of the second meiotic spindle, and in the zona pellucida represent variations associated with twinning in other animals which also may be involved in human twinning.

Zygosity and sex-pairing vs mortality and malformations in the East Flanders Prospective Twin Study: Implications for the embryology of twinning

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¹Center for Human Genetics, Catholic University of Leuven, and

²Department of Obstetrics, State University of Ghent, Belgium

Twin biology has rested for decades on the belief that twin excesses of malformations and mortality are due exclusively to unusual embryogenesis of MZ twins. The logic by which the zygosity distribution of malformations and mortality have been estimated is tautological and has been shown to yield impossible results for mortality in the largest available American sample. Analyses not dependent on circular logic show that same-sex DZ twins suffer mortality at least as much as MZs. The Belgian sample now includes over 3,000 twin pairs most of which have been genotyped for zygosity. The distribution of mortality and malformation frequencies as functions of zygosity and sex-pairing will be discussed and compared.

Low twinning rate in women born in a low birth-rate season: "Epidemic seasonal infertility factors" versus "varying maternal constitution according to season of conception"

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²*Institute of Human Genetics, Free University of Amsterdam, Netherlands;*
³*Centre for Human Genetics, University of Leuven, Belgium*

In two hospital-based populations, Miura and coworkers found that mothers who are born in a specific season are less susceptible to seasonality of birth in their own reproduction and less prone to give birth to unlike-sexed or double-egg twins. This suggests a constitutional maternal factor, which may be important for elucidating the nature of DZ (and possibly MZ) twinning. In order to explain these reproductive characteristics, an "epidemic seasonal infertility" hypothesis was advanced by these authors: certain women born in a particular low birth-rate season *are those who survived unrecognized epidemic infertile factors in the very early stages of their fetal lives*; in later years, when they become pregnant, they would be immune or different in their susceptibility to these infertile factors. In contrast, we proposed an alternative hypothesis which we think is better substantiated by biological data: certain women born in particular low birth-rate seasons *are those who are conceived in a stable conception rate season*: in later years, when they become pregnant, they would be constitutionally less susceptible to seasonality and less prone to double ovulations. The arguments in favour of such a seasonal alternation of higher and lower ovulation rate, also in humans, are founded on evolutionary biology and on the bimodal fluctuation of neurohormones at the pineal and pituitarian level as well as of ovulations at the ovarian level. The latter is illustrated by the basic animal rhythm, the universality of a bimodal standard birth curve, the "unrecognized natural cycle" after discontinuation of the pill, the seasonal variation of a natural interval between marriage and first conception, and finally, the constitutional characteristics – including the reproductive ones –, which are related to month of birth.

Oocyte maturation and embryogenesis: Lessons from twinning

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Hypothesis: The cellular events of MZ and DZ twinning are parts of the same process, the DZ versions occurring before fertilization and the MZ after. Both may occur in daughter cells of the same oocyte. Both are heritably associated with anomalies of brain and body symmetry development, including the common symmetry-related ("mid-line") malformations. Common elements involve anomalies in maturation of oocyte structural organization and in the establishment of the plan for embryogenesis. The stability and the outcomes of these processes are subject to both genetic and genotype-environment interaction. The overall probability of twin conception in high; twins and their sole survivors represent about one-eighth of all conceptions and about 8% of all live births. Survival is low and birth observations confound conception with survival. Mortality of same-sex DZs is correlated with probability of twinning, giving the appearance that all excess twinning is DZ. The major environmental contributions involve abnormal timing of conception rhythms or the relative timing of ovulation and intercourse. The father's role in DZ twinning may be mediated by his effects on cycle timing.

Parametric and non-parametric methods for analysing the inheritance of substance abuse patterns

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¹*Department of Human Genetics, Medical College of Virginia, Richmond, USA;* ²*Queensland Institute for Medical Research, Brisbane, Australia*

Quantity/Frequency/Abstinence data on alcohol consumption patterns reported by 3810 like-sex Australian twin pairs were analysed. Non-metric multidimensional scaling revealed separate determination of Abstinence, Frequency of consumption, and average Quantity consumed when drinking, rather than inheritance of single continuum of total alcohol consumption. No evidence was found for a fourth dimension separating the very heavy drinkers from other drinkers, consistent with a two-factor continuum model of alcoholism. Parametric models were also fitted to the data, separately for Quantity/Abstinence and Frequency/Abstinence scales. Models which allowed for either a single liability dimension, or for two independent liability dimensions determining Abstinence and Quantity (or Frequency) were rejected. A two-dimensional model, under which those who were not abstainers because of their position on Abstinence dimension might still be abstainers because of their position on the second, Quantity (or Frequency) dimension, gave a good fit to each data-set. Family resemblance for the Abstinence dimension was purely environmental in origin. For the Quantity and Frequency dimensions, heritability estimates were 66% and 57% in females, and 42-75% and 24-61% in males.

Supported by NIH grants GM30250 and AGO4954, and by ADAMHA grants AA06781, AA07535, AA07728, DA05588 and MH40828.

Modeling the inheritance of time to onset: A survival analysis approach with application to the age of onset of menarche and the smoking habit

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Working within a survival analysis framework, a model was previously developed (Meyer and Eaves, 1988; Meyer, 1988) to investigate genetic and environmental influences on the time to onset of developmental milestones and multifactorial threshold traits. Briefly, the accelerated failure time model, a regression model commonly used

for the analysis of failure time data with measured covariates, was modified to include latent sources of variation. For developmental milestones, the model includes a single source of latent variation; an aging effect, determined by genes and environment, which effectively accelerates or decelerates an individual's progression along the time axis. For threshold traits, there are potentially two sources of latent variation: the aging effect and an individual's inherited liability to the trait. Estimating the contribution of each of these sources to variation in time to onset is a necessary step in determining lifetime risks to relatives conditional upon a proband's age of onset. Here, results from simulation and power studies will be presented for both types of traits. In addition, the model is applied to the time to onset of a developmental milestone, the age at menarche in 379 pairs of Australian twins, and to a threshold trait, the smoking habit in two cohorts of twins from Virginia Twin Registry. For the age of onset of menarche, the heritability of the latent aging variable was found to be 0.80. For the smoking habit, the strength and significance of the relationship between liability to the trait and age of onset varied between the sexes and between cohorts.

Supported by NIH Grant DA-05588

Modeling of resemblance for sex-steroid hormones in male twins: direct phenotype-to-phenotype causality

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The general multivariate model for the analysis of twin data involves the concept that phenotypic covariation results from genetic, shared environmental, and/or specific environmental influences that are correlated between traits. This conceptualization is appropriate when considering effects such as pleiotropy or regulatory effects that influence multiple traits. However, in some research contexts a class of models is required in which a measurable phenotype, such as dietary intake, can have a direct causal effect on another phenotype, such as plasma levels of biological substances. Assumptions and consequences of such alternative models are considered in the context of an application to a study of sex-steroid hormones in 155 (72 MZ and 83 DZ) pairs of male twins.

A closer look at correlated environments: Is it sharing the same rearing environment or being in contact as adults?**N.L. Pedersen***Department of Environmental Hygiene, The Karolinska Institute, Stockholm, Sweden, and College of Health and Human Development, Pennsylvania State University, University Park, USA*

The Swedish Adoption/Twin Study of Aging provides an opportunity to examine the importance of correlated environments for twin similarity later in life. In an earlier presentation (Behavior Genetics Association, June, 1988) we reported results from hierarchical multiple regression analyses of the effects of separation and inpair contact on similarity in personality. The present report extends these results with structural equation model-fitting attempts to assess the importance of contact, special MZT effects and sibling interaction.

Personality: Nonadditive genetic variance or violation of the equal environments assumption of the twin method?**R. Plomin***Center for Developmental and Health Genetics, The Pennsylvania State University, University Park, USA*

The usual twin model assumes that MZ correlations can be no more than twice the magnitude of DZ correlations because MZ twins are only twice as similar as DZ twins in terms of additive genetic variance. That is, the MZ:DZ ratio should be less than 2. To the contrary, for some personality traits and most areas of psychopathology, the MZ:DZ ratio substantially exceeds 2. A second relevant finding is that adoption studies generally suggest less genetic influence than do twin studies. Explanations for these findings include nonadditive genetic variance and violations of the equal environments assumption of the twin method such as assimilation and contrast effects. Results from the Swedish Adoption/Twin Study on Aging (SATSA), which combines the twin and adoption methods, suggest that the general reason why twin studies yield greater estimates of heritability than adoption studies involves a violation of the equal environments assumption of the twin method, specifically an assimilation effect for identical twins reared together. On average, this assimilation effect inflates classical twin heritability estimates by as much as a factor of two. The "true" typical heritability estimate for self-reported personality is closer to the adoption study estimate of 20% than to the twin

study estimate of 40%. However, evidence for nonadditive genetic variance emerges for some traits, especially extraversion.

Sex differences and non-additivity in the effects of genes on personality

L.J. Eaves, A.C. Heath, M.C. Neale, J.K. Hewitt¹, N.G. Martin²

¹ *Department of Human Genetics, Medical College of Virginia, Richmond, USA;* ² *Queensland Institute of Medical Research, Herston, Queensland, Australia*

New large-sample data show that non-additive genetic effects, probably epistatic interaction between loci, and sex-limited gene expression are significant features of the genetic architecture of human personality as measured by questionnaire scales of extraversion and neuroticism. Three large data sets - new data on large samples (N=20,554) of U.S. twins, their spouses, parents, siblings and children, hitherto unpublished correlations for Australian twins (N=7,532), and previously published twin data from Finland (N=14,288) - are subjected to an integrated analysis to test alternative hypotheses about the genetic causes of family resemblance in personality. When allowance is made for differences in reliability of the scales, the combined data are consistent with the same model for variation. There are significant amounts of genetic non-additivity for both dimensions of personality. The evidence favors additive \times additive epistatic interactions rather than dominance. In the case of neuroticism, there is especially strong evidence of sex differences in genetic architecture favoring a greater relative contribution of non-additive genetic effects in males. The data confirm previous claims to find no major contribution of the shared environment of twins and siblings to these dimensions of personality. Correlations between spouses are zero, and the correlations for very large samples of siblings and non-identical twins do not differ significantly.

Developmental trends in IQs of twins and siblings aged one to seven years

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Although the Colorado Adoption Project has mainly focused on the parent-offspring relationships, subsequent studies at the Institute for Behavioral Genetics using comparable instruments are generating

data on natural and adopted siblings and MZ and DZ twins. While numbers are, as yet, modest (varying from 662 children at age one to only 120 at age seven) significant trends are emerging. A number of developmental models are employed to evaluate these data.

Standardization of the twinning rate

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There is a great interest in comparing twinning rates. The comparisons may be performed between different time periods for a specific population, between different regions within the same country and between different populations. However, there are several sociodemographic factors which influence the twinning rate. The most dominant one is the age distribution of the mothers. Some kind of standardization is therefore necessary. If we want to compare the twinning rates we have to face another problem. The composition of the data from different countries may differ to a great extent. Often the available data do not allow the traditional (direct or indirect) standardization. Under such circumstances other methods have to be used. In an earlier paper (*Acta Genet Med Gemellol* 36: 297-312) we have proposed and successfully performed a new method. In this paper we discuss the standardization problem more in detail. We suggest different methods and apply them to different data.

Twinning causative origin investigated by Sartwell's biometrical method

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Sartwell's biometrical model is useful to test potential causal factors at the origin of biological phenomena of unknown etiology. It postulates a lognormal distribution of the incubation time. The method has been applied in the past to infectious and neoplastic diseases and, only lately, to genetic diseases. We report here an application to unlike-sex and like-sex twins in an attempt to infer causal origin from a family of potentially related factors. Two hypotheses are tested, that is, the maternal prenatal origin of unlike-sex twins, and the menopausal basis of like-sex twins. The hypotheses are respectively grounded in the presumed genetic origin of DZ twinning, and in the ovarian-dysfunction origin of MZ twinning. The study is population-based, proceeds from a matched control group, and considers various time windows of possible etiologic significance, namely age at onset of twins, the time window from the first to the twin birth, and the

time window until the last birth. The study of lognormality has been carried out with the Box-Cox algorithm, Fisher's cumulants method, and normal probability plots. Results show clearly that unlike-sex (presumably DZ) twins have their causal origin in the maternal prenatal period as age of onset is definitely lognormal. This is interpreted as a multiplicative age-related causal process involving hypophyseal hormones. The menopausal origin of like-sex twins, a mixture of MZ and DZ, is less clearcut as goodness-of-fit to a lognormal distribution of the time window until last birth is partial, correct skewness going with genuine platykurtism. This observation may be due either to mixture of MZ with DZ twins within the group of LS twins, either to the etiologic heterogeneity of MZ twinning, or to another type of relationship of MZ twins with menopause. To sum up, we conclude to the genetic origin of DZ twinning and, tentatively, to the menopausal ovarian-dysfunction basis of MZ twinning.

Hormone levels and follicular activity in mothers of DZ twins and controls

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We wish to establish the frequency of double ovulation in mothers of DZ twins and controls, and to see whether the primary cause of double ovulation is low inhibin levels. We have recruited volunteers through the Australian Multiple Birth Association; controls are mothers of MZ twins who volunteered at the same time. Subjects must be cycling regularly and not using oral contraceptives. On approximately cycle day 12, abdominal ultrasound is performed on both ovaries and any follicles greater than 5mm are measured and recorded. So far we have results for 86 scans on 24 mothers of DZ twins and 26 scans on 11 mothers of MZ twins; we are seeing multiple large follicles more frequently in DZ mothers. In a subsample of DZ mothers and matched controls we are also assaying hormones in blood samples drawn on approximately days 2 and 3 (early follicular), on cycle day 8 (mid follicular), on the day of ultrasound scan (late follicular - usually day 12) and on day 21 (mid luteal). Plasma samples are being randomised and assayed in a single batch for inhibin, FSH, LH, and estradiol.

Twinning rate in families with X-chromosomal nondisjunction

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Studies on families with patients with the Turner syndrome (TS) and the Klinefelter syndrome (KS) have shown an increased twinning rate (TR) both in the sibships of the probands and in the parental sibships. However, the series published are small and there are discrepancies in the reported results. From genealogical records we have studied families of TS and families of KS. Among the 69 sibships of TS there were 278 maternities (incl. 70 probands and 4 sets of twins) the TR being 14.4‰. This is not significantly different from the average frequency of 10-13‰ in the Dutch population from 1925 to 1969. The 99% Confidence Interval (99% C.I.) ranges from 4‰ to 47‰. Among the 8 twins there were 6 girls and no less than 3 of them with the TS syndrome in 2 sets of twins. In the sibships of the 69 fathers of TS probands there were 4 sets of twins (10.4‰) among the 385 maternities. In the sibships of the 69 mothers of TS probands there were 12 pairs of twins (33.3‰) among the 360 maternities. Both this TR (99% C.I.: 16-67‰) and the TR among the mothers of TS (5/69=72.5‰, 99% C.I.: 16-192‰) are significantly higher than expected ($p < 0.01$). In our Dutch series the twinning rate in the sibships of TS was 14.4‰, which is considerably lower than the pooled frequency of 32.6‰ in the sibships of 217 women with TS (Nielsen J., Dahl G., *Clin. Genet.* 1976, 10: 93). Our findings of high frequency of twinning in the maternal sibships, underline previous findings in which also a high TR was reported. Nielsen and Dahl (1976) found that TR was 46.5‰ in the sibships of TS and TR was particularly high (78.7‰, 95% C.I.: 3.2-15.5‰) in maternal sibships with TS probands of other karyotype than 45,X. Among the sibships of 131 KS probands there were 443 maternities (incl. these of the probands). Among these, 6 were sets of twins, 13.5‰ (99%, C.I.: 5-37‰), which is in agreement with expected frequencies. Our results do not support earlier findings of a high twinning rate (32.2‰) in sibships of probands with KS (Nielsen J., *Acta Genet. Med. Gemellol.* 1970, 19: 399).

Fetal deaths with birth defect among Japanese multiples, 1974

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Source of data is "Survey on Socio-Economic Aspects of Vital Events-Plural Births in 1975", including 13,392 twin pairs, 124 triplet sets, 7 quadruplet sets and one quintuplet set. Numbers of fetal death were 3,285 for twins, 141 for triplets, and 17 for quadruplets, among which the number of birth defects were 78, 3 and zero, respectively. Concordant twin pairs with the same birth defect were 20 among 56 pairs (0.36). As for the remaining 36 twin pairs, 2 pairs had different birth defects, 27 pairs had co-twins with live birth, and 7 pairs were both fetal deaths among which a twin had birth defect. The second-born twins had more birth defects than the first-born twins among fetal deaths (28 vs. 6, respectively).

Pregnancy loss in mothers of multiple births and in mothers of singletons only

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We compared pregnancy loss in mothers of multiple births and in mothers of singletons only. Mothers of one set of like-sexed twins and mothers of one set of unlike-sexed twins had greater pregnancy loss than did mothers of singletons only. Women who had higher-order multiple births comprised only 5% of our sample; in terms of their pregnancy loss these women were similar to mothers of singletons only.

Seasonality in early loss of one fetus among twin pregnancies

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Ultrasound examinations for the confirmation of pregnancy were performed in 519 pregnant women in the first trimester at three hospitals in Tokyo during the period between August 1985 and March 1987. Among 519 ultrasonographically diagnosed pregnant women, 11 cases terminated in spontaneous abortion and one case in artificial abortion. Two fetal heart movements (FHM) were confirmed in five cases. One FHM in one of these five cases had disappeared two weeks later, and this was considered as case of "vanishing twin". Ultrasound images of echo-free-space (EFS) in the uterus were observed among 79 cases. In nine cases among these, the observed EFS were considered to be the probable empty gestational sac (GS-like-EFS-image). The GS-like-EFS-images were more frequently observed during the period of October-December (8/182 vs 1/337 in other months, $\chi^2 = 9.2$, $p < 0.01$) and the case of "vanishing twin" was also observed in this season. The last menstruations among the cases with GS-like-EFS-image occurred only in the months between September and December (9/222 vs 0/295 in other months, $\chi^2 = 9.9$, $p < 0.01$, $df=1$), and that of the "vanishing twin" case was in September. The cases diagnosed as spontaneous abortion were more frequently observed during the period of October-November (6/119 vs 5/400 in other months, $\chi^2 = 4.7$, $p < 0.05$, $df=1$). Some abortive factor is supposed to have prevailed during the period between October and December.

Seasonality in twin vs single births

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The monthly frequency of twin maternities has been compared to the monthly frequency of single maternities for the same areas and periods of time. The two frequencies have been found to be comparable for all months from January through October. In November and December, however, there is a higher relative frequency of twin maternities. One can speculate that maternal factors related to DZ twinning are specifically involved, along with an increased fertility in the period February-March.

Effects of maternal age, parity, and zygosity on twin perinatal mortality

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The aim of this study on all twin births in Sweden between 1973 and 1985 was to evaluate the effect of maternal age, parity, and zygosity on perinatal mortality (PNM), by using data held at the National Medical Birth Registry, Stockholm. Zygosity in this study was estimated using the Hardy-Weinberg formula. In all, 22,374 twins were born; 972 of these died perinatally. The relative risk for perinatal death (after standardization for maternal age, parity, and like sex) decreased significantly in an U-shaped fashion during the study period, and reached its lowest value (0.3) in 1983. Maternal age seemed not to be associated with PNM, while women having their first delivery had a significantly higher PNM than the rest of the parturients. Opposite to the results from previous studies in other populations, the change in twinning rate during the study period was entirely explained by a significant increase in the rate of MZ gestations, from 0.36% during 1973-76, and 0.40% during 1977-81, to 0.44% during 1982-85 ($\chi^2 = 35.8$; $p < 0.001$). Male-male pairs had a PNM 1.23 times higher than that expected ($\chi^2 = 18.5$; $p < 0.001$) while female-female pairs had an average PNM ($\chi^2 = 0.1$; $p > 0.05$). PNM for MZ gestations were 1.9 times higher than that for DZ ones (comparisons were standardized for year of birth, maternal age, and parity).

The personality of twins reared together

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85 pairs of twins (46 MZT + 39 same-sexed DZT), all between 18 and 25 years of age, were tested in this study. All were "normal" young adults and the zygosity diagnosis was established on the basis of blood analysis. Different tests were administered: a general measure of intelligence (Cattell 2A/3A), the MMPI (Minnesota Multiphasic Personality Inventory) and the CPI (California Personality Inventory). The Christian model was used for analysis, the inter- and intraclass correlations, F-ratio's, Holzinger and Falconer indexes were calculated. For the MMPI, only two of the control and clinical scales showed significant evidence of genetic variance: L (lie), and D (depression). As each of these traits consists of a class of aspects, these traits were analysed into their major components, the different subscales. Genetic influence was found for aspects such as depression-related behaviors (Hy3, D4), aspects of social behavior (Pd3, Pd4A, Pd4B) and aspects of loss of contact with reality (Pa1, Sc2A, Sc2B). An important genetic influence was also found for phobic anxiety (PHO). As for the CPI, only three scales showed clearly genetic influence: socialization (So), good impression (Gi) and achievement via conformance (Ac).

Openness to experience, agreeableness, and conscientiousness: Analysis of the Swedish Adoption Twin Study on Aging (SATSA)

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The focus of the present study is to assess genetic and environmental influences on the three components of the five-factor model of personality that have not received as much attention as Extraversion and Neuroticism: Openness to Experience, Agreeableness, and Conscientiousness. An abbreviated version of these scales from the NEO Personality Inventory was administered to 82 pairs of identical twins reared apart (MZA), 132 pairs of identical twins reared together (MZT), 171 pairs of fraternal twins reared apart (DZA), and 167 pairs of fraternal twins reared together (DZT) as part of the Swedish Adoption/Twin Study of Aging (SATSA). The average age

of the sample at the time of testing was 59 years. Estimates of genetic and environmental effects for Openness to Experience and Conscientiousness were similar to those found in studies of Extraversion and Neuroticism: genetic influence was substantial and there was little evidence of shared rearing environment. However, results for Agreeableness were different: genetic influence accounted for only 12% of the variance while shared rearing environment accounted for 21% of the variance.

Supported by NIA grant (AG-04563) and by the Successful Aging program of the John D. and Catherine T. MacArthur Foundation.

A twin-family study of personality disorders

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Preliminary results from an ongoing twin-family study of personality disorders will be presented. Fifty-five index twins with DSM-III-R personality disorders, their same-sexed cotwins, sibs and parents are interviewed. Results as to familial and genetic transmission of personality disorder of any kind, the eccentric, dramatic or fearful personality disorder cluster, and the various, separate personality disorder will be presented.

The temporal stability of symptoms of psychiatric distress in an older twin sample

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Subjects were 1,813 female (1,136 MZ, 677 DZ) and 527 male (354 MZ, 173 DZ) same-sex twin pairs over age 50, ascertained through the American Association of Retired Persons. These twins completed both the Hopkins Symptom Checklist and the Eysenck Personality Questionnaire on two separate occasions approximately 12-14 months apart. The broad heritability of symptoms of depression, anxiety, phobic anxiety, somatization, insomnia, and overall psychiatric distress ranged from .26 to .34 for females, and .26 to .46 for males. The

sharing of a common environment had little effect on the report of these symptoms, whereas environmental experiences specific to the individual accounted for the largest proportion of variation. Test-retest correlations for the symptoms ranged from .52 to .75. These data indicate that approximately 40% of the variance in liability to psychiatric symptoms is due to effects that are stable over time, 30% is due to short term environmental fluctuations and measurement error, and the remaining 30% of the variation is determined by genetic and shared environmental effects. The stability of these symptom states closely approximates the temporal consistency found for the personality traits neuroticism and extraversion.

Supported by NIH grants GM30250 and AG04954, and by ADAMHA grants AA06781, AA07535, AA07728, DA05588 and MH40828.

Twin concordance of anxiety disorders

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Preliminary results from a Norwegian twin study of anxiety disorders are presented. Twins were personally interviewed with SCID-I. In 30 pairs of same-sexed twins (8 MZ and 22 DZ), the proband got a diagnosis of Panic Disorder, Agoraphobia without History of Panic Disorder, Generalized Anxiety Disorder, Social Phobia or Simple Phobia, according to DSM-III-R. Two methods were used for estimating twin concordance: (1) Pairs were considered concordant if the cotwin had the same disorder as the proband; (2) Pairs were considered concordant if the cotwin had any one of a given list of anxiety disorders. The main findings will be presented.

A twin study of obsessive compulsive neurosis

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Preliminary results of a study of a consecutively admitted series of obsessional twins from a psychiatric hospital twin register are presented. The twins were interviewed using a structured psychiatric interview for lifetime symptomatology, and a life events interview.

They also completed a number of questionnaires covering personality, fears, state-trait anxiety, obsessionality and cognitive aspects of anxiety. The study is part of a larger twin study of 200 pairs of twins selected through probands with any anxiety disorder diagnosis, and will be presented in this context.

Criminality and mental illness: A preliminary study based on the Maudsley twin series

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Criminal histories were examined in a consecutive series of ex-Maudsley twin probands and their cotwins in order to investigate the association between criminal behaviour and mental illness. Attempts were made to answer the following questions: a) Are mentally ill probands more likely to have a criminal history than their well cotwins? b) What are the concordance rates for criminality and mental illness in the MZ and DZ twins? c) Is criminal behaviour influenced by genetic factors? d) Does the pattern of offending differ in the well vs ill group? e) Does differential diagnosis influence the pattern of offending, eg, is the schizophrenic group significantly different from the personality disorder group and the affective group? The results will be discussed in the light of these issues.

Biological and psychological factors relating with problem drinking behavior

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A twin study was carried out to investigate the correlation between biological and psychological factors relating with problem drinking behavior. Subjects, composed of 37 MZ and 9 DZ twins, were graduates from the high school affiliated to Tokyo University. We formulated the questionnaire including 13 items relating to ethanol and aldehyde sensitivity (items A), 10 items of drinking motivations (items B) and 14 items of problem drinking (items C). By principal component analysis, factors such as 'sensitivity to aldehyde', 'sensitivity to ethanol', were derived from items A; factors named 'reinforcement', 'taste' were

derived from items B; and from items C, factors named 'social problem', 'dependence'. First, intraclass correlation coefficients of those factor scores were calculated. In MZ, some of the highest values were 'sensitivity to aldehyde' (0.731), 'social problem' (0.775). Next, percent deviations (PD) of those scores were calculated. By multiple regression analysis, 'PD of motivation' was selected as most effective factor to explain 'PD of drinking behavior'. This suggests that psychological factors also play a relatively important role for formulating drinking behavior, if compared with biogenetic ones.

A study of suicide in twins

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In recent years there has been renewed interest in the possibility of a genetic component associated with the suicidal behavior displayed by some individuals. A comprehensive review of the relevant literature on twins by Haberlandt (1967) revealed that 9 out of 51 MZ twin pairs (17.7%), and none out of 98 DZ twin pairs, in which at least one twin had committed suicide, were concordant for suicidal behavior ($p < .001$). A tenth pair of MZ twins concordant for suicide was reported by Zair (1981). It was of interest to identify additional instances of suicide in twins so as to pool them with the existing cases. The genetic transmission of psychiatric disorders has, however, been implicated as a confounding factor in examining both twin and family data with respect to genetic influences on suicide. It was, therefore, of interest to determine if there were twin pairs in which suicidal behavior had occurred in the absence of associated psychiatric symptoms, and to assess the psychiatric status of the surviving cotwin. Eight MZ twin pairs and two DZ twin pairs in which one, or both, cotwins had committed suicide were located by the Twin Loss Study at the Minnesota Center for Twin and Adoption Research, and by referrals from colleagues. Information gathered from interviews with twins and from psychiatric records support the suggestion that psychiatric disorder may have been associated with suicide in these twins. The unique behavioral consequences of suicide for the surviving cotwin will be documented.

Estimated prevalence of twins in North America

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In order to accurately evaluate the population-based effectiveness of continent-wide twin ascertainment conducted by advertising for affected twins, it was thought desirable to construct a model to estimate the prevalence of white twins in North America by region, birth cohort, zygosity, and gender-composition. In constructing the model, rates of delivery and infant mortality were obtained with as much specificity as possible, and the gaps in the available information were reviewed with respect to cohort, region, zygosity, gender-composition, and multiple-birth status. The plausibility of each assumption required by various alternative forms of extrapolation to fill the gaps was evaluated, and the choices made. The sources of information, the nature and plausibility of the assumptions, the probable sensitivity to error of the various assumptions, and the nature of potential improvements will be presented along with the results of the model.

Selection bias in twin studies

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The Finnish Twin Cohort Study contains 4307 MZ and 9581 DZ like-sexed adult twin pairs in Finland alive in 1975. The effect of migration on the pairwise concordance of some diseases was assessed by comparing the pairs living in the same province to the pairs living in different provinces. The cumulative incidence of psychosis and hypertension for the years 1972-1985 were analyzed. The pairwise concordance of psychosis was remarkably higher in MZ pairs living in the same district (15.1% of affected pairs) than in MZ pairs living in different districts (2.2%). The corresponding values for DZ pairs were 4% and 0.8%. The results were similar among males and females. The pairwise concordance of cumulative incidence of hypertension was also higher in MZ pairs living in the same district (31% of affected pairs) than in MZ pairs living in different districts (26.8%). The migration bias was observed also among DZ pairs (17.7% vs 13.7%). These results indicate an overestimation of concordance caused by selective migration. This bias in twin studies is likely to confound heritability estimates in a sample of limited geographical area.

A methodological evaluation of the case-control study using U.S. twins: Examples from breast cancer data

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The theoretical advantages and disadvantages of using twins in case-control (cotwin) studies are described and "tested" with data from the International Twin Study Breast Cancer data set. To date, over 1300 disease-discordant female-female pairs have been ascertained since 1981. Questionnaires obtaining information on potential risk factors have been received from both twins for 54% of these pairs and, for another 31%, one twin has returned the questionnaire. The major methodological issues considered include misclassification, over-matching, control of confounding, and effect modification. Misclassification is addressed by evaluating agreement between nonparametric ranking questions (eg, Which twin had menarche first?) and self-reported quantitative response questions (eg, How old were you when your periods started?). Subgroups most likely to have differing responses between the two types of questions are identified. Results obtained from using only one questionnaire vs joint agreement between both questionnaires are presented for several categories of variables. One drawback of twin case-control studies has been the high degree of similarity between pairs. This problem is assessed by reviewing the numbers of trait-discordant pairs for several variables and comparing them to results from similar non-twin studies. Effect modification is evaluated by looking at sample results stratified by age of diagnosis, family history of breast cancer, and zygosity.

A study of stomach ulcer in the Virginia and Norwegian twin registries

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Data on the occurrence of stomach ulcer in one or both members of Virginia- and Norwegian-born twin pairs was collected by questionnaire in order to determine the role of genetic factors in the etiology of this disorder. The Virginia registry is comprised of both like- and unlike-sexed pairs, while the Norwegian registry contains only like-sexed twin pairs. Complete information was available on both members of 2,567 twin pairs and on one member on 3,300 pairs in

the Virginia sample. For the Norwegian data set, complete information was available on both members of 5,234 twin pairs and on only one member of 3,282 pairs. Zygosity was assigned on the basis of response to an instrument that, in a previous study, has been shown to accurately assign zygosity in greater than 97% of the sample studied. In all, a total of 452 twin pairs in Virginia and 654 twin pairs in Norway reported the occurrence of stomach ulcer in one or both pair members. Pairwise concordance rates for Caucasian MZ and DZ twins were 0.14 and 0.06; and 0.21 and 0.12 in Virginia and Norway, respectively. Probandwise concordance rates for the Norwegian sample were 0.35 (MZ) and 0.22 (DZ), and 0.24 (MZ) and 0.11 (DZ) for the Virginia group. Although there do appear to be some differences between the Virginia and Norwegian samples with respect to occurrence of stomach ulcer, the results obtained are consistent with the existence of a genetic component to this disorder.

A genetic analysis of the contribution of exposure to combat during the Vietnam war to the current health of American Veterans

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The role of combat during military service in the development of persistent physical health problems is controversial. This study examines the relative importance of heredity, combat exposure, and common environmental factors to the self report of current health by 3,586 American male-male twin pairs who served in the military during the Vietnam War. Data was collected in 1987 using mail and/or telephone interviews. Analysis demonstrates that heritability has an important contribution to the report of symptoms of high blood pressure, skin diseases, and stomach and joint ailments among veterans who did not experience combat. When veterans exposed to combat are added to the analysis, heritability remains the primary contributor to the variability in report of symptoms. Thus, heritability is relatively more important to the report of current physical symptoms than specific combat or common environmental factors.

A twin study of the effects of the Vietnam conflict on alcohol drinking patterns

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This study examines the association between military service in Southeast Asia and alcohol drinking patterns in 2,171 male-male MZ twin pairs who both served on active military duty during the Vietnam era (1965-1975). Data on alcohol drinking were collected in 1987 by mail and telephone interview. The alcohol drinking measures include three indicators of abstinence (lifetime abstainer, lifetime non-regular drinker, and current abstainer) and two indicators of consumption (average daily ethanol consumption and high consumption). In unadjusted and adjusted analyses neither service in Southeast Asia nor combat exposure was significantly associated with any of the measures of abstinence. Conversely, in the unadjusted analysis, both measures of consumption were associated with service in Southeast Asia; further, the prevalence of different levels of average daily ethanol consumption and high consumption were positively related to increases in combat exposure. However, after adjustment for co-twin effects, and military service factors, the observed association between alcohol consumption and Southeast Asia service disappears. We conclude that prior military service in a war zone has little long-term impact on the alcohol drinking patterns of male veterans.

An Italian Army Twin Register

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An Italian Army Twin Register has been started consisting of twins called up, at the age of 20 years, for compulsory military service. The twins have been surveyed by questionnaire at the time they undergo medical examination before enrollment. A total of 3,693 twin pairs have first of all been considered with respect to the outcome of the medical check, ie: enrolled, exempted, under medical observation. Within-pair concordance of outcome has been found to be considerably higher than expected. A higher concordance than expected has

also been found with respect to the kind of profession or occupation the cotwins had at the time of call up. Concordance of occupation has also been considered with respect to common environment, particularly whether the cotwins were living together or apart. Basic data collected and analyzed include pedigree analysis with respect to the frequency of other twin pairs in the twins' maternal or paternal line.

A preliminary report: Crohn's disease in twins

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Twins born in Virginia and Norway since 1915 were surveyed by a questionnaire in 1978 and 1979, respectively. The Norwegian registry has 8,516 like-sexed twin pairs; the Virginia registry has 5,866 twin pairs of all types. Twin pairs specifying Crohn's disease (CD) in the original survey were resurveyed during 1988; diagnosis was confirmed by a review of medical records. CD is reported in seven pairs of the Virginia registry and five pairs of the Norwegian registry. This represents a prevalence of about 60 and 30 per 100,000 respectively, approximately what would be expected for populations of these respective sizes, based on data reported in other populations. To date, none of the twin pairs in either registry are concordant for CD, but one extended family of Crohn's and ulcerative colitis affected members has been identified. The probands are female MZ twins. The mother, maternal grandmother, a maternal aunt, and five cousins of the twins have been reported affected. Of the twelve pairs in both registries, five pairs are MZ. Of the seven DZ pairs, three are male, two are female, and two are opposite-sexed pairs in which both of the affected members are female. The age-at-onset of CD is known for three pairs: 14, 38, and 40 years of age. The twin pairs do not differ with respect to birthweight. None report a Jewish background for parents or grandparents. A significant proportion report affected parents and children. The occurrence of other Crohn's related problems, such as joint involvement, were not reported by these twins. Aside from the large pedigree mentioned above, the only other pair reporting a history of CD is one DZ pair in which the mother is reported to have CD; none report any medical or family history of

ulcerative colitis. Two pairs report both a medical and family history of hernia (one MZ, one DZ). Four pairs (all DZ) report a family history of gallstones. The family history of CD, ulcerative colitis, and other digestive diseases, however, remains to be confirmed in ongoing studies. The smoking history of the proband twin is known for eleven pairs. Six probands are smokers. Only one unaffected cotwin is a smoker. The pattern observed here is consistent with findings in the literature reporting an association for smoking and CD.

A preliminary report: Ulcerative colitis in twins

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Twins born in Virginia and Norway since 1915 were surveyed by a questionnaire in 1978 and 1979, respectively. The Norwegian registry has 8,516 like-sexed twin pairs, the Virginia registry has 5,866 twin pairs of all types. Twin pairs specifying ulcerative colitis (UC) and bowel disease, cancer, or surgery, or reporting use of medications consistent with UC therapy, were resurveyed in 1988. The number of twin pairs reporting UC in these registries is at levels 2-4 times what would be expected for populations of this size, if the reports are confirmable. The primary objective of this study was to determine the confirmability of diagnosis among twin pairs using medical records. Among twin pairs reporting one or both members affected by UC in 1978, 29% continued to report UC in 1988. This diagnosis could be validated in only half, to date. The majority of twin pairs reporting UC in 1978 appear to have diagnoses more consistent with irritable bowel syndrome. Those twin pairs reporting bowel disease and specifying 'colitis' do not appear to have diagnoses consistent with UC but had episodes that are explained by such events as a reaction to antibiotic therapy. Among the 1978 respondents not reporting UC but reporting bowel cancer or surgery, or use of medications consistent with therapy for UC, about 10% indicate in 1988 inflammatory bowel disease as a possible condition. The outcome on the validation study has suggested that self report of UC is fairly unreliable. In addition, medical records obtained on the Virginia population appear to be a poor source of information to validate diagnosis in this population. Medical records obtained on the Norwegian population

were more helpful. The lack of adequate medical record information, especially among the USA population, does not necessarily suggest that all of the unconfirmed reports are non-UC. Suspicion remains that a portion of the unconfirmed UC reports are in fact UC affected individuals. Rather, this finding suggests that confirmation of diagnosis is necessary by medical examination and colonoscopy in the absence of medical records containing adequate information to determine presence or absence of disease. A sensitive and specific diagnostic test less invasive than colonoscopy is needed to further study these diseases in populations. The role of a twin registry in that effort is potentially significant. To date, the validated UC twins are all like-sexed pairs in both registries; 36% are male pairs; 64% are female pairs. There appears to be a higher concordance among male pairs (75%) than among female pairs (15%). Overall, probands report other affected family members in significant numbers, especially non-twin siblings. These reports on family members remain to be confirmed by inspection of medical records, however. Only one female pair reported any oral contraceptive usage. Among all of the pairs, 36% have never smoked, 36% are current smokers and 28% are former smokers. A large proportion (56%) report stomach problems, stomach ulcers, and/or irritable bowel syndrome in addition to ulcerative colitis (all Norwegian twins).

Longitudinal twin research contributing to fetal outcome study

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The components of infants of low birth weight (ILB) are broadly pre-term (PT), small-for-gestational age (SFGA) and a combination of both, infants. Since etiology and outcome for these groups is different, and prevention often possible, knowledge on related fetal growth is needed. The key issues are addressed and a demonstration of how fetal growth and outcome of twins can contribute to this needed knowledge.

Twins' correlated pathway of temperament development

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Behavioral inhibition (shyness), a prominent aspect of temperament throughout childhood, is considered for the early development of twins observed at several intervals during the first years of life. The focus is on the organization or synchronization over time of the developmental course of behavioral inhibition as measured for a large sample of MZ and DZ twin pairs. The measures were analyzed for both types of twins to see if MZ correlations exceeded DZ correlations at each of several ages, as well as over a series of ages. The results showed that twin concordance for a feature of temperament becomes quite high with increasing age. The data are compared with twin correlations for mental development, and the comparison suggests that temperament and mental development, although sharing overlapping features, emerge and become regulated by different developmental processes.

Developmental behavioral genetics

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As Professor Gedda has long pointed out, twins represent a unique opportunity to study chronogenetics, the heredity of biological time. He has emphasized the timing of biological events such as the onset of puberty, but a more general issue is the genetic contribution to change during development. This is the focus of a new subdiscipline of behavioral genetics called developmental behavioral genetics. One type of genetic change during development is a change in heritability. A surprising finding is that when heritability changes during development, it appears to increase. More to the point of chronogenetics, however, is a second type of genetic change, genetic influence on age-to-age change. That is, genetic effects on a particular trait at one age can differ from genetic effects on the trait at a later age. A useful construct to describe such genetic change is the genetic correlation which indicates the extent of overlap in genetic effects from age to age. Longitudinal studies, especially twin studies, are needed to analyze age-to-age change. Although few such studies have been conducted, it appears that genetic contributions to age-to-age change are considerable, especially during childhood and especially for personality.

Quantitative developmental genetic models: Implications and applications

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Recent progress in the specification of developmental genetic models has led to an increased understanding of how different developmental mechanisms underlie the different patterns of variation and covariation that can be observed during development. Under some circumstances the changes in mean score may also be informative about the scaling of genetic and environmental influences. The implications of these models for the design and interpretation of developmental genetic studies are discussed in the context of their application to cognitive developmental, temperamental differences, and cardiovascular variables.

DNA fingerprinting for identifying MZ twins

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In 1984 Dr. Jeffreys identified a series of highly variable DNA sequences which, when used as probes, provided a sufficiently informative sampling of an individual's DNA, so as to uniquely identify each person. The exceptions to this observation are genetically identical twins which share the same DNA "fingerprint". Thus, DNA fingerprinting provides a direct and definitive diagnosis of twin zygosity. A series of twins have now been examined (at Cellmark) specifically to diagnose their zygosity.

Definitive methods of zygosity determination in twins

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Most studies of embryogenesis and fate of twin pregnancies are invalidated because zygosity is not determined definitively, or is assumed on the basis of inadequate criteria. This paper briefly reviews methods of zygosity determination. It reports published results and new series of twins in which zygosity was determined by DNA fingerprinting. Implications for methods of prenatal diagnosis of zygosity are discussed in the context of the occasional need for intervention in twin transfusion syndrome or twins discordant for major malformations. Definitive zygosity and placental anatomy (number of chorions and amnions) is discussed as the firm substrate for studies of normal and abnormal twin development.

Variable number of tandem repeats in zygosity diagnosis in twins

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The authors, after a synthetic review of the methodologies used in order to diagnose zygosity in twin couples, present the investigations' preliminary data performed by the latest techniques in molecular

genetics. They compare their results with traditional methodologies and suggest the use of variable number of tandem repeats for a quick and accurate zygosity diagnosis.

Transsexualism in twins

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Transsexualism is an incongruence between the biological sexual differentiation and the self-declared gender identity. Its etiology is obscure. Twin studies might be elucidative. During the past years we have encountered 842 transsexuals of which nine were twins (all male-to-female transsexuals). Four twin pairs were MZ as determined by DNA fingerprinting in one case and blood group typing in three cases, while four were DZ according to blood group typing. Of the MZ pairs, twins of one pair were both transsexuals, while in the remaining three pairs only one twin was transsexual. Of each of the four DZ pairs only one twin was transsexual. These observations demonstrate that: 1) genetic factors are unlikely to be of a deterministic nature in the etiology of transsexualism; 2) neither is the prenatal maternal endocrine milieu. No clustering of transsexuals was noted in the families of the probands.

Genotyping macerated stillborn twin fetuses

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In a macerated stillborn fetus it is most of the time impossible to collect blood or to culture tissue. Accurate genotyping of such a fetus could be critical for the diagnosis of genetic diseases and could be exploited for genetic counseling. Within the frame of the East Flanders Prospective Twin Study (EFPTS) we had stored -20°C the placental tissue of some twin and triplet sets, of which one or two members were stillborn and macerated. Of all these fetuses, sex and zygosity could be determined accurately on the placental DNA. The influence of tissular lysis was evaluated on the placental tissue of monozygotic twins, in which only one member was stillborn and

macerated. This should allow the detection of possible (non-genetic) changes over time in the DNA pattern of the macerated member. The DNA variants in these monozygotic twins were identical whether the subjects were macerated or not. DNA variants can thus be demonstrated accurately on the placental tissue of macerated fetuses, even after prolonged deepfreezing.

A revised estimate of twin concordance in systemic lupus erythematosus using DNA fingerprint zygosity confirmation

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Based on a report of 16 twin pairs, it is commonly believed that the disease concordance rate for systemic lupus erythematosus (SLE) in MZ pairs may be as high as 70% and the significance of environmental etiologies has been assumed to be minimal. The International Twin Study includes 102 pairs of twins with the SLE diagnoses confirmed according to American Rheumatism Association criteria. Of the 42 reported MZ pairs, only 19% (n=8) are concordant; only 2% (n=1) of the 59 reported DZ pairs are concordant. Since we may overascertain concordant pairs, our concordancy estimates may yet be too high. The zygosity information was self-reported and it has been suggested that such estimates are unreliable if zygosity is not confirmed for each pair. To evaluate this, 25 same-sex pairs were selected without regard to reported zygosity and asked to furnish blood specimens. Samples from both members of 21 pairs were provided and a technician, blinded to the self-reported zygosity, used the DNA fingerprinting technique to determine zygosity. All 14 reported MZ and all 7 reported DZ pairs were confirmed. We believe that the MZ concordancy rate of SLE is far lower than that previously published. Furthermore, self-reported zygosity is sufficiently accurate that confirmation of each pair is unnecessary.

A genetic analysis of resting blood pressure and heart rate in prepubertal twins

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Using univariate path analysis, we studied the relative contribution of genetic, individual environmental and common environmental effects to resting blood pressure and heart rate in prepubertal twin children. The study population consisted of 251 Caucasian 11-year-old twin pairs. Correlations were higher for all variables in MZ twins compared to DZ twins, consistent with a significant genetic effect. Path analysis revealed that the model of additive genetic and specific environmental effects fit systolic blood pressure, diastolic blood pressure and heart rate. In boys and girls, sex-specific genetic effects control systolic and diastolic blood pressure. The magnitude of the genetic effects on systolic blood pressure were similar in both boys and girls and accounted for 65% of the variance. In boys, for diastolic blood pressure, the sex-specific genetic effects accounted for 65% of the variance while in girls they accounted for 50% of the variance. Our results provide no evidence for different genetic effects on heart rate in boys or girls. No common environmental effects were identified.

Bivariate genetic analysis of systolic blood pressure and weight in prepubertal twins

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There is a strong epidemiologic association of weight (WT) with systolic blood pressure (SBP) in children. We asked if the covariance of SBP and weight could be attributed to genetic factors, environmental factors, or both. In a population of 249 pairs of 11-year-old monozygotic (MZ) and dizygotic (DZ) twins, the following correlations were observed.

	Pearson Correlation Coefficients		
	SBP1-SBP2	WT1-WT2	SBP1-WT2
MZ Twins	0.64	0.88	0.36
DZ Twins	0.20	0.41	0.14 ^a

^aNonsignificant

These correlations were consistent with a model that included sizeable genetic effects for SBP and weight and for the covariation of SBP and weight. Bivariate path analysis using the LISREL VI program revealed that genetic effects are largely responsible for the covariation of SBP and weight and that environmental effects play a very small role, if any at all. Thus to a large extent, the relationship of SBP and weight in early pubertal children is explained by common genes which influence both of these variables.

Stress-induced changes in the effects of genes and environment on cardiovascular function

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The covariance structure of heart rate measurements of 11-year old monozygotic and dizygotic twins, at rest and under dynamic exercise at four successively increasing loads, has been analyzed. The contribution of environmental factors to the heart rate measures is largely measurement-specific with some persistence from measurement to measurement as the load increases. The structure of the genetic effects is markedly different. Genetic variation increases monotonically with increasing load. Two independent sets of genes appear to be involved. The first set, affecting resting heart-rate, has persistent but decreasing impact on measures made during increasing exercise loads. The second set of genes is expressed continually throughout exercise, with effects which persist and accumulate as the work-load increases. It is the effects of these genes which account for the increasing contribution of genetic factors to heart-rate differences with increasing work-load.

Chronological changes in genetic variance and heritability of systolic and diastolic blood pressure among Chinese twin neonates

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In order to examine the chronological changes in genetic variance and heritability of arterial systolic and diastolic blood pressure (SBP and DBP) of Chinese infants in Taiwan, a total of 339 same-sexed twin neonates given birth in four major general teaching hospitals in Taipei City were studied. Based on the placental pattern and 12 red blood cell antigens, 274 MZ and 65 DZ twin pairs were identified and followed up to the age of one year. Both SBP and DBP were measured by Doppler blood pressure monitor. Although SBP and DBP of neonatal twins did not show any significant heritability, a heritability from 0.20 to 0.55 was observed after the age of one-month for both SBP and DBP. Age-specific intrapair correlation coefficients (r) for MZ and DZ twin pairs and Falconer's heritability indices unadjusted and adjusted for sex, gestational age and physical state during blood pressure measurement are shown in the table below.

Age	Blood pressure	Crude			Adjusted		
		r_{MZ}	r_{DZ}	h^2	r_{MZ}	r_{DZ}	h^2
Newborn	SBP	0.55	0.50	0.09	0.52	0.41	0.23
	DBP	0.48	0.51	^a	0.45	0.49	^a
One month	SBP	0.74	0.69	0.10	0.68	0.57	0.21
	DBP	0.58	0.55	0.05	0.63	0.51	0.24
Two months	SBP	0.48	0.42	0.11	0.51	0.36	0.29
	DBP	0.58	0.40	0.35	0.46	0.23	0.45
Six months	SBP	0.63	0.37	0.52	0.61	0.33	0.55
	DBP	0.54	0.31	0.47	0.52	0.39	0.27
One year	SBP	0.53	0.35	0.37	0.54	0.36	0.35
	DBP	0.46	0.09	0.74	0.40	0.20	0.40

^aIntrapair correlation of MZ < intrapair correlation of DZ.

Blood pressure in twins

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Blood pressure (BP) was investigated in twins. Subjects were 97 MZ and 23 DZ twins aged from 13 to 46. The average systolic and diastolic BP was higher in males than in females. Both BPs increased with age. BP was corrected and standardized using regression lines separately for males and females. The intraclass correlation coefficient for standardized BP of the 97 MZ twins was $r=0.581$ ($p < 0.001$) in systolic BP, $r=0.292$ ($p < 0.01$) in diastolic BP. However, both correlations were not significant for the 23 DZ twins. The correlations of the MZ twins were significantly higher than those of DZ twins. The difference between the pairs was smaller in MZ than in DZ pairs. The heritability was estimated using the correlations of MZ and DZ twins in Holzinger's method. $H^2 = 0.540$ was obtained in systolic BP, 0.267 in diastolic BP.

Hypertension in Virginia and Norwegian twins

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Information on the occurrence of hypertension in one or both members of twin pairs included in the Virginia and Norwegian twin registries was collected by questionnaire in order to examine the factors which might be important determinants of risk for this disease. The Virginia twin registry includes all like- and unlike-sexed pairs born in Virginia between 1915 and 1971, while the Norwegian registry includes all like-sexed pairs born in Norway between 1915 and 1960. Thirteen percent of the 5,769 twin pairs in the Virginia twin registry and 8% of the 8,516 pairs in the Norwegian twin registry for whom health history information was available reported a history of hypertension in one or both pair members. Pairwise concordance rates for MZ and DZ twins were 0.34 and 0.22 in the Virginia sample and 0.29 and 0.09 in Norway. Probandwise concordance rates were 0.50 (MZ) and 0.36 (DZ) for Virginia twins and 0.45 (MZ) and 0.16 (DZ) for Norwegian twins. In both populations, concordance rates tended to be higher in like-sexed female pairs than in their like-sexed

male counterparts. The concordance rates observed for members of opposite-sexed pairs in Virginia did not differ appreciably from that observed for like-sexed DZ pairs. The increased concordance of MZ twin pairs over that of DZ twin pairs with respect to expression of this disease supports a genetic contribution to risk for development of hypertension.

Hypertension in twins

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The relative role of genetic and environmental factors in hypertension was studied in the nationwide Finnish Twin Cohort consisting of 13,888 adult pairs of the same gender. Cumulative incidence of hypertension was analyzed by record linkage from three sources of data: death certificates, hospital discharges, and charge-free medications. Out of 27,776 twin individuals 2,428 were identified with diagnosis of hypertension in one or more of these nationwide registers. The ratio of the observed per expected (O/E) number of pairs concordant for hypertension was 5.20 in MZ pairs aged 28-59 years, and 1.98 in MZ pairs over 59 years. The corresponding figures for DZ pairs were 2.12 and 1.54. The estimated heritability was 0.504 in the age group of 28-59 years, and 0.330 in the older age group. Heritability estimates were higher for females than for males.

Genetic influence on aortic stiffness

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In a cohort of 26 twin pairs (11 MZ and 15 DZ, 18 boys and 34 girls, all 11 years old) the genetic variability of aortic stiffness (S_A) was studied. This Doppler-measured variable, calculated as $S_A = \text{Vel}(\text{max})/T_A$ (time to Vel (max)), describes vessel wall characteristics which may be important in the subsequent development of hypertension. S_A was measured at rest, during 1/3 max. handgrip, max. handgrip and mental arithmetic tests. As a first assessment of genetic variability, Pearson intrapair correlation coefficients were compared:

Condition	MZ	DZ
Resting	.91 (p = .0002)	.35 (p = .20)
Handgrip	.52 (p = .12)	.14 (p = .63)
Max handgrip	.52 (p = .12)	.19 (p = .51)
Mental arithm.	.64 (p = .04)	.76 (p = .0008)

We conclude that a large proportion of the variance of resting S_A is genetic. Both maximal and submaximal handgrip tests trend towards a major genetic component. In contrast, mental arithmetic (a psychological challenge) appears to be under a major environmental influence.

Genetic factors in ischemic heart disease: Data from a nationwide panel of 13,888 adult twin pairs

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The role of genetic factors in IHD was studied in the nationwide Finnish Twin Cohort consisting of 13,888 adult pairs of the same gender. Cumulative incidence of IHD was analyzed prospectively by record linkage from three sources of data (1975–1987): death certificates, hospital discharges from the nationwide hospital register, and charge-free medications from the nationwide drug register. Out of 27,776 twin individuals, 1,621 (1,044 males and 577 females) had a diagnosis of IHD. The estimated heritability was 0.45 for males and 0.26 for females in the age group of 28–59 years, and correspondingly 0.13 and 0.26 in the age group over 59 years, and 0.22 and 0.24 in the whole cohort.

Genetic influence on special mental abilities in a sample of twins reared apart

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The Minnesota Study of Twins Reared Apart (MISTRA) conducts comprehensive medical and psychological assessments of MZ (N=45) and DZ (N=26) twin pairs, separated early in life (average age of separation=5.1 months and 12.7 months, respectively) and reared apart during the formative years (average age of reunion = 30.0 years and 37.3 years, respectively). The twins are administered two special mental ability batteries: the Hawaii Battery (H-B), supplemented by several Educational Testing Service tests, is administered toward the beginning of the assessment and the Comprehensive Ability Battery (CAB) is administered toward the end of the week. All data are age- and sex-corrected. As previously reported (McGue and Bouchard, 1989) the average MZA and DZA interclass correlations for the fifteen H-B subsets were 0.45 and 0.34, respectively. The average MZA and DZA interclass correlations for the thirteen subtests of the CAB were 0.48 and 0.35, respectively, very closely replicating the previous results. A comprehensive genetic analysis of both test batteries will be reported.

The Swedish Adoption Twin Study of Aging: An update

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The Swedish Adoption/Twin Study of Aging (SATSA) is a comprehensive program in gerontological genetics which is currently in its fifth year. The base population is comprised of 346 pairs of twins reared apart and 404 matched control pairs of twins reared together who responded to a questionnaire (Q1) in 1984. Two additional stages of SATSA have recently been completed; a longitudinal follow-up questionnaire mailed out in 1987 (Q2) and extensive in person testing (IPT1) which included a health examination and cognitive battery. A second wave of IPT was started in January, 1989. A summary of some of the major findings from Q1 and preliminary results from IPT1 will be reported.

Serum cholesterol and apoprotein E phenotypes in identical twins reared apart

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Identical twins reared apart (MZA) (N = 18) have been identified in the nationwide Finnish twin panel. Serum lipids and apoprotein E phenotypes were measured in 16 pairs (mean age: 46 yrs). An age-sex matched control group was selected from identical pairs reared together (MZT). Total chol (6.6 vs 4.5) and LDL-chol (4.2 vs 3.0) were higher in MZA than in MZT (p < 0.01). Pairwise correlations for total chol and LDL-chol were 0.30 and 0.43 in MZA, and 0.38 and 0.47 in MZT. The absolute and relative intrapair difference of LDL-chol showed a trend by the Apo E phenotypes:

Group	ApoE	No of pairs	Serum mean	LDL-cholesterol	
				Intrapair difference	Intrapair difference per mean
MZA	E2	6	3.67	0.71	19.1%
	E3	7	3.87	1.33	32.9%
	E4	3	5.77	1.93	31.2%
	Total	16	4.15	1.21	27.4%
	(95%CL)		(3.61-4.69)	(0.65-1.77)	(16.2-38.7)
MZT	E2	1	2.21	0.24	10.9%
	E3	13	3.12	0.50	16.0%
	E4	2	2.71	0.71	27.1%
	Total	16	3.01	0.51	17.5%
	(95%CL)		(2.71-3.31)	(0.26-0.76)	(9.6-25.5)

Supposing that the cotwins of pairs reared apart have lived in uncorrelated conditions, environmental factors explained 57% (1-0.43) of variance of the LDL-cholesterol, which is modulated by the genetic differences in apoprotein E.

Comparative study of outcome and zygosity in spontaneous and induced multiple pregnancies

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Approximately 200 twin and 50 triplet pregnancies following ovulation induction have been investigated regarding fetal outcome (birth-weight, sex, perinatal mortality, congenital malformations) and zygosity. They are compared to a similar group of spontaneous multiple pregnancies of the same order. Assisted reproduction has led to a marked increase in multiple pregnancies in many industrialized countries. Figures will be given for Belgium and some other EEC countries. Consequences for vital statistics and public health will be discussed.

Multiple pregnancies in in-vitro fertilization programmes in France

FIVNAT, presented by E. Papiernik and J. Belaisch-Allart

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Results of GIFT and IVF pregnancies are collected in France by the National Collaborative group on IVF (FIVNAT). In 1987, 2,623 pregnancies have been reported to FIVNAT but forms were fully completed only for 1,210 clinical pregnancies. Amongst these 1,210 pregnancies, 865 (71.5%) resulted in births. These pregnancies included 155 twin pregnancies and 35 triplets or more. The results are summarised in the following table:

	Fetus 1	Fetus 2	Fetus 3 or more
Delivery \leq 36 weeks (%)	9.6	35.0	83.1
Small for date (%)	11.4	37.7	34.4
Stillbirth (‰)	12.3	13.6	30.3
Neonatal deaths	4.6	6.8	30.3

Details of pregnancies will be reported.

Guidelines for the prevention of multiple pregnancy in IVF treatment

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In our center 25% of ongoing pregnancies obtained after IVF/ET treatment were multiple (22.5% twins and 2% triplets). Although we never replace more than 3 embryos, 1 quadruple pregnancy which included a pair of MZ twins was also observed. Most of the serious obstetrical complications that occurred among IVF pregnancies were related to multiples. This group displayed high rates of cesarean section (40%), hospitalisation for premature labour (40%), premature delivery (47%) and perinatal mortality (12%). In the group of multiple IVF gestations, maternal age was lower and the amount of ovulatory drugs given were significantly smaller than in relation to single IVF pregnancies. All multiple pregnancies resulted from triple embryo transfers and the embryos in this group exhibited significantly higher vitality scores. Prior to embryo replacement five criteria can thus be defined of which the combination indicates a high risk of multiple pregnancy after IVF: maternal age below 33 years, E2 peak higher than 1600 pg/ml, a total dose of hMG lower than 1100 IU, triple transfer and high embryonic scores (16-18 points for three transferred embryos). Among 268 triple transfers in our program, 36 cases were found to also fulfil the 4 other conditions. Eighteen of these cases entailed ongoing pregnancies of which 13 were multiple (72%). In cases of triple transfer not fulfilling the above-mentioned criteria only 5 multiple pregnancies occurred among a total of 43 (12%). This difference between the two types of trials was found significant at $P < 0.01$. Therefore it seems warranted to replace only two embryos when all five criteria of risk for multiple pregnancy are fulfilled.

Assisted reproduction and triplet- and higher order births

A. MacFarlane¹, E.G. Daw² and other members of the Steering Group of the National Study of Triplet and Higher Order Births, UK

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The United Kingdom National Study of Triplet and Higher Order Births covered those born in the years 1980 to 1985, except for 1981.

None of the triplet and higher order births before 1984 and under 5% of those in 1984 and 1985 had been conceived using in vitro fertilisation (IVF). This is low compared with data from Belgium and Australia. The UK study did not, however, cover births in 1986 when there was a steep increase in the triplet rate. Data from other sources will be used to try to assess the contribution of assisted reproduction to this rise.

Selective termination in the second trimester for major congenital anomalies

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One fetus with a major congenital anomaly was selectively terminated between 19 and 23 1/2 weeks in 22 twin pregnancies. In the first 6 cases, four pregnancy losses occurred within 3 to 19 days of the procedure. The other two women delivered healthy infants at 30 and 38 weeks, both of whom did well. Fifteen of the remaining 16 cases have resulted in the delivery of viable singleton infants at 28 weeks or greater. One patient is still undelivered and doing well. Gestational ages of the infants in the latter group at delivery were as follows: 28-29 weeks, 1; 29-30 weeks, 2; 30-32 weeks, 1; 34-36 weeks, 2; > 36 weeks, 9. Indications for termination were as follows: Down syndrome, 16; Spina bifida and hydrocephalus, 2; Isolated hydrocephaly, 1; Turner's syndrome with anasarca, 1; San Filippo A, 1; Trisomy 18, 1.

Three problem cases will be discussed. Appropriate decisions were made in two of these cases, but not in the third.

Genetic determination of the human EEG. Survey of recent results on twins reared together and apart

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In this article, we have discussed recent progress in quantifying the genetically determined component of the resting EEG. This progress has been made possible in particular by the application of advanced information processing techniques such as 'supervised learning', and the development of a problem-oriented 'similarity' concept. Our work aimed at modelling previous findings regarding the distinct individuality of human brain-wave patterns, the high similarity between the EEGs of MZ twins, and the average within-pair similarity of DZ twins. Our investigations were based on the empirical data derived from five different populations: (1) 81 healthy subjects, (2) 24 pairs of MZ twins brought up together, (3) 25 pairs of DZ twins brought up together, (4) 28 pairs of MZ twins reared apart, and (5) 21 pairs of DZ twins reared apart. Following our similarity conception, repeated measurements on the set of 81 individuals were used as design samples, and new registrations from the same individuals taken 14 days later were referred to as test samples in order to develop the appropriate method and to determine all required calibration parameters. This specific approach allowed us to construct EEG spectral patterns which, with a specificity and reproducibility of >90% each, largely met the requirements of genetic EEG studies. Hence, we were able systematically to investigate the within-pair EEG similarity of our twin samples. Our results provided ample evidence that the individual characteristics of the resting EEG are primarily determined by genetic factors: (1) There exists an almost perfect one-to-one mapping between each individual and his EEG; (2) MZ twins proved, with respect to their resting EEGs, to be only slightly less like one another (if there is any difference at all) than each person is to himself over time; (3) the average within-pair EEG similarity estimated from a sufficiently representative sample of DZ twins is significantly above the interindividual EEG similarity between unrelated persons (this finding holds true for both samples of DZ twins brought up together and reared apart, and there is also no statistically significant difference in the resting EEG between these two samples) and, (4) the EEGs of MZ twins reared apart are obviously as similar to each other as are the EEGs of the same person over time, and there is no statistically significant difference in the resting EEG between the two populations of MZ twins brought up together and MZ twins reared apart.

Behavior-genetic approach in psychophysiology

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The place of psychophysiological traits in the "genotype-morphophysiological level-behavior" system leads to the development of experimental models which help to approach the problem of the relative contribution of genotype and environment in the variability of these traits from a new perspective. In these models the investigated traits are either included in different concrete activities (functional systems, the types of behavior) or its place in the structure of this activity changes. EEG, EP, and motor reaction studies demonstrated: a) the relative contribution of genetic and environmental determinants of variability are greatly influenced by the functional system in which the trait is included; b) the role of genetic factors decreases if the mechanisms of realisation of the trait are a part of the specific human activity (language conscious, self-regulation, etc.). The results are interpreted in the context of the theory of activity (Vygotsky 1985, Leontjev 1988) and physiology of activity (Bernstein 1947).

Skin-conductance, speed-of-processing, and attention in 9- to 16-year-old twins

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The present study examined genetic and environmental components of skin-conductance, attention, and speed-of-cognitive-processing in a sample of 50 MZ and 25 DZ twin pairs between ages 9 and 16 years (mean = 12.55; sd = 2.37). Average skin-conductance level (SCL) and frequency of non-specific electrodermal responses (NS) were measured during a five-minute rest period, as well as during participation in a continuous performance task (CPT), which is a measure of sustained attention or vigilance. An indicator of perceptual sensitivity (d') to a target stimulus was calculated for each subject from their CPT performance. Each child also completed a battery of paper-and-pencil tests of coding speed, from which composite scores (CSPEED) were computed. An additional measure of speed in perceiving visual information was obtained through a computer-administered backward masking task (MASK). Preliminary analyses yielded moderate heritabilities for both skin-conductance and cognitive variables, ranging from $h^2 = .34$ for MASK to $h^2 = .74$ for CODE. Both NS and

SCL showed weak, positive associations ($r = .06$ to $.25$) with the three cognitive measures, which were explained primarily by correlated genetic factors.

Nerve conduction velocity, intelligence, and information-processing speed

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Eighty-five university students were administered a group test of intelligence; eight reaction time measures of speed of information-processing; and the conduction velocity of the median nerve in their arms was measured. Results replicate the typical negative relationship between intelligence and reaction time (average $r = -.44$) and provides the first evidence of a significant correlation between intelligence and nerve conduction velocity ($r = .42$) and between reaction times and nerve conduction velocity ($r = -.28$). In addition, the more g-loaded the subtests of the intelligence test, the more highly correlated they were with nerve conduction velocity ($r = .46$). Thus, subjects of higher intelligence are not only faster behaviorally but also physiologically. These results may, as Reed (1984, *Nature*, 311, 417) hypothesized, be attributable to genetic variability in the structure and/or the amount of transmission proteins (ie, proteins involved in the transmission of impulses along nerve fibers and across synapses) which set limits on information-processing rates, and, hence, on speed-of-processing and intelligence. The results are also compatible with those of other studies of physiological correlates of intelligence (eg, evoked potentials and cerebral glucose-rate) indicating that more intelligent subjects possess more efficient and faster neural systems. We are currently administering the same tests to samples of adult MZ and DZ twins.

Genetic influences on vagal control of heart rate: A parent-twin study of sinus arrhythmia

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RSA is a measure of heart rate (HR) variability dependent on respiration phase and can be regarded as an index of vagal control of heart

rate, and as an index of invested mental effort. It has been operationalized as the longest inter-beat interval during expiration minus the shortest inter-beat interval during inspiration (in msec). In order to determine RSA and the effect of mental load on it, HR and respiration were recorded during rest and during two task conditions in 160 adolescent twin pairs and their parents. Under task conditions, as compared to rest, RSA usually decreases (average decrease in our study was 15 msec in parents and 30 msec in children). RSA also decreases with age (mean RSA during rest was 60 msec for parents, and 111 msec for offspring) and shows no effect of gender in either generation.

Genetic analyses of the twin data show in addition to a genetic component, an influence of shared environment in both boys and girls. The magnitude of these effects seems to be task dependent.

Genetic Spectral Analysis

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Psychophysiological signals such as heart rate are the outcome of time-dependent biological processes that show stable interindividual variation and that may reflect genetic influences. Two problems in the genetic analysis of such time series that cannot be dealt with using standard multivariate methods, are the large number of repeated observations and the accommodation of the presence of autocorrelation. To assess the genetic influences, special models have to be developed that are based on signal-analysis techniques. Here we extend Spectral Analysis for use in genetic modeling. Spectral Analysis is applied to obtain uncorrelated frequency-dependent scores. Scores associated with each frequency are analyzed by univariate methods, which need to be adapted for use with complex-valued numbers. The outcome is a decomposition of the time-dependent structure of an observed signal into a genetic and a non-genetic part. Applications to heart rate data yield a frequency-dependent decomposition that relates to distinct physiological processes, such as baroreceptor resonance (.10 Hz) and provides separate heritability estimates for each process. The technique is applied to heart rate obtained in a sample of 160 adolescent monozygotic and dizygotic twin pairs. Heart rate was measured during a rest period and during two task conditions (a choice reaction time and a mental arithmetic task). Each 8.5 minute condition yields beats-per-minute time series of 980 time

points (sampling rate 2Hz). These time series are Fourier transformed, after which phenotypic within- and between families spectra can be constructed. Then, complex-valued genetic models are fitted at each frequency-dependent genetic and environmental spectra determined. The results thus obtained are transformed back to the time domain, yielding condition-dependent estimates of the dynamic genetic and environmental influences.

Obstetric aspects from the study of triplets and higher order births

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Following a survey of the UK for triplet and higher order births from 1979 to 1985, final data is presented regarding the extent to which these pregnancies arise through infertility treatment, the process of multiple pregnancy diagnosis, the care given to the mother during pregnancy, labour and delivery. Four hundred and fifty triplet and higher order births were surveyed with a response of over 80%.

Triplets in Denmark, 1980-1989

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Seventy-three completed triplet pregnancies were reviewed. These were all triplet pregnancies occurred in Denmark from 1 January 1980 until 20 March 1989. In addition nine known pregnancies are still ongoing. In all cases, full records from the local hospitals have been available. The mean age of the women was 28.5 years (range 17-38). Forty women were primiparas (range 0-5). Ultrasound examination was performed at least once in all pregnancies, but despite this, the prenatal diagnosis of twins was not corrected before delivery of the third triplet in eleven cases (16.4%). A total of 95.9% delivered prematurely (less than 37 completed weeks); mean 33.4 weeks (range 26-39). The route of delivery was vaginal, elective cesarean and acute cesarean section in 17.8%, 16.4% and 65.8%, respectively. Eleven women (15.1%) experienced intrauterine death of one or two of the triplets. Fifteen children died during the first week of life. The perinatal mortality thus was 12.8%. When only pregnancies of 28 or more gestational weeks were included (N=70), the perinatal mortality decreased to 8.2%. The mean weight of triplets A to C were 1827 g (range 530-3320), 1811 g (525-3480) and 1777 g (646-3150), respectively. The number of triplet pregnancies have been remarkably constant during the years with a frequency ranging from 1:8730 births (1982) to 1:7350 (1985), but in-vitro fertilisation and embryo transfer has lead to a sharp rise in the reported frequency. Eleven triplet pregnancies have been established by this method, and of the ongoing known pregnancies they constitute more than 50%.

Management of triplet pregnancy

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Triplet pregnancy presents serious obstetrical problems: early diagnosis, early decrease of maternal activities, preterm labor, increased incidence of delivery complications and neonatal mortality. A total of 32 triplet pregnancies were followed up from 1977 to 1988. The incidence was 1:846. The mean gestational age at diagnosis was 13 ± 6.4 weeks. The patients were not systematically hospitalized. The prematurity rate was 90.6%. The mean gestation at delivery was 33.6 ± 2.8 weeks. There are different opinions about the best way of delivery for triplets. We almost always performed elective cesarean section. The birthweights of triplets ranged from 780 g to 2,580 g. The mean birthweight was $1,717 \pm 442$ g. The mortality rate was 9.3% (9 children out of 96 died). We use corticosteroids from 26 to 34 weeks. Of the 48 children delivered of treated mothers, 4.8% developed a respiratory distress syndrome. Of the 45 children of nontreated mothers, 20% developed a respiratory distress syndrome.

The utilization of uterine activity data in the management of multiple gestation

M. Olson

Abstract not received.

Triplets and higher order multiple births in Japan

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Multiple birth rates in entire Japan were analyzed using vital statistics for 1951 to 1987. The triplet rate was nearly constant from 1951 to 1974, where the rate per million births was 58, then increased with the year up to 1982 (104), and decreased up to 1984, and suddenly increased thereafter (109 in 1987). The average rate of quadruplets per million births from 1951 to 1968 was 0.93, then increased with the year up to 1975 (7.5), and decreased until 1984 and suddenly

increased thereafter (10.6 in 1987). The rate of quintuplets was 0.77 per million births during the period from 1975 to 1987. The higher multiple birth rate since 1975 was attributed to the higher proportion of mothers treated with ovulation-inducing hormones in Japan. The stillbirth rates for male triplets gradually decreased from 1960 to 1978 and thereafter remained constant at a little higher level. The rates for female triplets gradually decreased with the year. The overall rates gradually decreased to 2/5 during the 36-year period from 1951. The stillbirth rate of quadruplets decreased to 1/5 during the 36-year period from 1951. The stillbirth rate of quintuplets was 0.60 (51/85) during the period 1975-1987. Present study also deals with the effects of maternal age on the birth and the stillbirth rates of multiple births.

Observation of 11 cases of triplets and their outcome

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Since 1961, eleven cases of triplets have been delivered in our institute. Eighteen babies of 6 cases delivered after 37 weeks of gestation were all alive except one fetus papyraceus, and 16 of them were recognized as SFD. Six babies of 2 cases of 34 and 36 weeks of gestation were also alive and well developed except one anencephalus. However, 3 sets of triplets delivered before 29 weeks of gestation were all stillbirths. In the observation of these placentas, a monochorionic placenta was recognizable in 4 cases, trichorionic and triamniotic placentas in one, and 6 other cases showed dichorionic placentas.

Genetic epidemiology of lipoprotein levels: A parent-twin study

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Variation in plasma lipoprotein levels among individuals is caused by genetic and environmental factors. To assess the separate influences of these factors we measured the concentrations of total cholesterol, HDL-cholesterol, triglycerides (allowing the calculation of LDL-cholesterol), and of apolipoproteins A1, A2 and B in plasma of adolescent MZ and DZ male (M) and female (F) twins and their parents. The number of families analyzed were MZM 35; DZM 31; MZF 30; DZ-MF 29. Zygosity of the twins was determined by analysis of 12 blood group markers and, when reasonable doubt remained, by DNA fingerprinting. Similarity between twin members and between parents and their offspring was assessed by analysis of variance and by offspring/parent regression. Models were fitted to the twin data by maximum likelihood methods, in which the contribution of genes as well as of common and unique environment were examined. Results for HDL-C, LDL-C, apoA1 and apoB show an effect of generation of all parameters, except for HDL-C, parents having higher values than their offspring; and an effect of sex, except for apoA1 in both generations and apoB in children. MZ intraclass correlations are high and lie between 0.73 and 0.89, DZ-same sex correlations are between 0.22 and 0.60, DZ-F correlations being somewhat higher than DZ-M. DZ-MF correlations are of the same magnitude as the DZ-same sex correlations. There is a high correlation between spouses for apoB (0.44), other correlations were between 0.1 and 0.2. Regression of girls on midparent values, finally, shows heritabilities of 0.35 (LDL) and 0.74 (apoA1); for boys estimates are somewhat lower: 0.32 (apoB) and 0.45 (apoA1). Model fitting to the data of the five twin groups shows higher heritability in boys than in girls for LDL-C, apoA1 and apoA2. For girls, however, there is a significant contribution of shared environment to these measures, that is absent in boys. Allowing the genetic or shared environmental effects to be different in both sexes does not improve the fit of these models.

Apolipoprotein E polymorphism is an important determinant of plasma LDL cholesterol and apoB levels. Results of a Dutch twin study

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Chylomicron and VLDL remnants are cleared by a specific liver receptor with apolipoprotein E (apoE) as a ligand. ApoE is polymorphic with three common allelic forms: E2, E3 and E4, giving rise to six phenotypes E2/E2, E3/E2, E3/E3, E4/E2, E4/E3 and E4/E4, Recognition by the liver is in the order: E4>E3>E2. These phenotypes were assessed in parents and children of 160 nuclear families, participating in a twin study (see abstract by Boomsma *et al*), by a method based on isoelectric focusing of whole plasma followed by immunoblotting. The allelic frequencies observed in this sample were:

	E2	E3	E4
Parents	0.104	0.761	0.135
Children	0.108	0.750	0.148

These values are very similar to those previously observed in a large sample (n = 2018) of 35 year-old Dutch males. By ANOVA the plasma levels of LDL-cho and apoB were found to be strongly related to the apoE phenotype, both in parents and children. The allelic effects were:

	Parents		Children	
	LDL-cho	apoB	LDL-cho	apoB
E2	-10.1%	-12.6%	-20.0%	-19.4%
E3	0.0%	+0.5%	+1.1%	+0.9%
E4	+8.3%	+8.2%	+9.1%	+9.5%

The fraction of the total variance of LDL-cho and apoB, explained by the apoE polymorphism is:

5.9%	11.0%	17.0%	27.1%
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For HDL-cho and apoA1 a reverse effect was found in the children, with higher levels in the E2 carriers than the E3 carriers. Data for apoE concentrations will also be presented.

Genetic variance and heritability of serum cholesterol and triglycerides among Chinese twin neonates

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In order to examine the genetic variance and heritability of serum total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C) and triglycerides, a total of 349 same-sexed twin neonates given birth in four major general teaching hospitals were studied. Based on the placental pattern and 12 red blood cell antigens, 271 MZ and 78 DZ twin pairs were identified. The results showed a significant genetic variance and heritability for total cholesterol, HDL-C, LDL-C, and triglycerides with intrapair correlation coefficients (r) for MZ and DZ twin pairs and Falconer's heritability indices unadjusted and adjusted for sex, gestational age and placental pattern as shown in the table below.

	Crude			Adjusted		
	r _{MZ}	r _{DZ}	h ²	r _{MZ}	r _{DZ}	h ²
Total cholesterol	0.82	0.53	0.59	0.81	0.44	0.74
HDL-C	0.78	0.63	0.30	0.78	0.59	0.38
LDL-C	0.84	0.72	0.25	0.84	0.69	0.31
Triglycerides	0.77	0.40	0.75	0.73	0.48	0.49

Relationship between blood uric acid level and personality traits

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The present study deals with the relationship between blood uric acid level and human behaviour. Subjects were 37 MZ and 7 DZ twins aged from 18 to 45. In males, blood uric acid level increased with age, while it decreased with age in females. Blood uric acid level was corrected and standardized using regression lines separately for males and females. The distribution of standardized uric acid level corresponded well with the theoretical curve of normal distribution.

The intraclass correlation coefficient for standardized uric acid level was $r = 0.370$ ($p < 0.05$) for the 37 MZ twins, but the correlation was not significant for the 7 DZ twins. These findings suggest that blood uric acid level is genetically controlled. In the evaluation of the correlation between standardized uric acid level and the YG 12 subscales, significant correlation was observed with respect to 'Lack of Agreeableness' and 'Rhythymia'. Since these two personality traits include 'activity', our findings were consistent with the generally accepted results that persons with high uric acid level are more active and energetic than those with low level.

Left ventricular structure and physical exercise capacity in 7-year-old twins

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The maximal aerobic power of endurance athletes is high and their heart is characterized by a larger left ventricular internal dimension than in nonathletes, and a proportional increase of wall thickness; these traits may be inherited and/or be the consequence of intense physical training. To assess the influence of inheritance on physical exercise capacity and on echocardiographically determined cardiac structure, and to limit the effect of environmental factors as much as possible, we studied 15 MZ and 19 DZ twin pairs aged 6-8 yr. Exercise capacity was expressed as the time at which the heart rates of respectively 150 and 170 bpm were reached during a progressive exercise test on the treadmill. Genetic variance was significant ($p < 0.05$) for these exercise times, both when expressed as absolute values and after adjustment for body weight and gender. As for cardiac structure at rest, the results did not suggest a significant influence of genetic endowment on left ventricular internal diameter or on wall thickness; genetic variance was significant, however, for calculated left ventricular mass ($p < 0.05$) and left ventricular mass adjusted for body weight and gender. The results are compatible with the notion that the high aerobic power of endurance athletes is at least partly inherited. Left ventricular internal dimension and wall thickness, which distinguish athlete's heart at rest from the heart of nonathletes, do not show a significant genetic component.

Genetic analysis of somatic dimensions and motor characteristics. Data from the Leuven Longitudinal Twin Study

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In the Leuven Longitudinal Twin Study (LLTS) anthropometry and motor ability data from 40 MZ and 40 DZ 10-year-old twin pairs were collected. The aim of the study was to determine genetic and environmental contributions to physical fitness and to investigate the genetic determination of individual growth and development patterns. In this presentation only the results on anthropometry and motor ability will be discussed. No significant differences were found between the means and variances of twins and the reference population for all the somatic and motor variables. In order to explore genetic and environmental components of variation, different path models were fitted to the data, using the maximum-likelihood estimation procedure of LISREL. For all the anthropometric data – except for the bicondylar diameters – the addition of a common environmental factor improved significantly the fit of the model. Height and other length variables had a larger genetic component than skinfolds, circumferences and weight. The variation of motor variables was fully explained by genetic and specific environmental factors and thus did not need a common environmental factor. Consequently the heritability estimates for most of the motor variables were higher than for the somatic variables.

Inheritance of body mass index. A study of 13,299 adult Finnish twin pairs

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We studied the inheritance of Body Mass Index (BMI) in 13,299 same-sexed twin pairs, aged 18-54 years ($N = 4,024$ MZ and 8,851 DZ pairs) from the nationwide Finnish Twin Cohort. Twins living together and apart were analyzed as separate groups, and a variable of social contact frequency as a measure of intrapair similarity was included in the analysis of MZ and DZ pairs living apart. The intrapair correlations of MZ pairs (0.7-0.8) were higher than those of DZ

pairs (0.4-0.5). Overall, cohabitation had no significant effect on the correlations of MZ and DZ twins. However, twins with infrequent social contact had somewhat lower correlations than twins with regular contact. This was evident both in MZ and DZ pairs. For men, the heritability estimates increased with age (from 0.64 to 0.74), whereas for females the estimates decreased (from 0.82 to 0.74).

Chronological changes in genetic variance and heritability of anthropometric characteristics among Chinese twin infants

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In order to examine the chronological changes in genetic variance and heritability of anthropometric characteristics of Chinese infants in Taiwan, a total of 521 same-sexed twin neonates given birth in four major general teaching hospitals in Taipei City were studied. Based on the placental pattern and 12 red blood cell antigens, 428 MZ and 93 DZ twin pairs were identified and followed up to the age of one year. None of height, weight, head circumference, chest circumference, and arm circumference showed a significant genetic variance before the age of 6 months; while a significant genetic variance of weight, head circumference, chest circumference, and arm circumference was observed at the age of 6 months. At the age of one year, a significant genetic variance was observed for all five anthropometric characteristics. Age-specific heritability indices of anthropometric characteristics adjusted for gestational age and sex are shown in the table below.

Age	Weight	Height	Head circum.	Chest circum.	Arm circum.
Newborn	^a	0.19	^a	^a	^a
One month	^a	0.24	0.34	^a	^a
Two months	0.05	0.32	0.37	^a	^a
Four months	0.41	^a	0.43	0.26	0.19
Six months	0.51**	^a	0.63**	0.77**	0.53**
Nine months	0.96**	0.10	0.73**	0.70**	0.25*
One year	0.25*	0.30*	0.38**	0.27*	0.37*

^aIntrapair correlation of DZ > intrapair correlation MZ.

*P < 0.05, **P < 0.01 for the statistical significance test of genetic variance.

A twin study of the growth and development of dentition among Chinese

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A total of 98 twin pairs of known zygosity were utilized in this study. A series of panoramic roentgenography of these twins were used to investigate the growth and development of dentition. Thirty-two out of 51 MZ twin pairs (63%) were in complete agreement in alveolar emergence, root development and tooth number. However, only five twin pairs of 25 DZ twins with the same sex (20%) were in complete agreement in alveolar emergence root development and tooth number. Two twin pairs of 19 DZ twins with a different sex (10.5%) were in complete agreement in these items. Without considering the tooth number, 84.3% of the MZ, 40% of same-sex and 10.5% of different-sex DZ twins, respectively, was in good agreement in the alveolar emergency and root development. If considering the root development only, the incidence of complete agreement was 80.4%, 44% and 21.1%, respectively, for the MZ, same sex DZ and different sex. In about 47% of the DZ twins with a different sex, the degree of maturity of root development for some teeth was more advanced in the males than in the females. The females were more advanced than the males in the root development for some of the teeth in only 26% of DZ twins with a different sex. There was no difference in root development for the rest of DZ twins with a different sex. Further investigation in the development of dentition by increasing the sample size and long-term follow up is indicated.

Genetic influences on neonatal temperament

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The genetic contribution to temperament was assessed during the neonatal period in 316 newborn infants from 47 pairs of MZ twins, 39 pairs of same-sex DZ twins, and 72 pairs of opposite-sex DZ twins. No genetic effects were observed on mean ratings from the behavioral variables, on patterns of interrelations among the variables, or on internal consistency within the behavioral areas studied. DZ twins were found to be more variable on specific ratings than MZ twins. Examination of the scores for differences in twin concordance based on zygosity indicated that there was significant within-pair concordance in temperament ratings, but that MZ twins were not more like each other than DZ twins. Thus, genetic influence was not observed on ratings of temperament in the neonatal period. Additional analyses suggested differences in perinatal variables by zygosity. Overall, the findings suggested that pre- and perinatal variables influenced the expression of temperament during the neonatal period.

Four-year follow-up of locomotor and language development in 34 twin pairs

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A group of 34 twin pairs born during 1982 and 1983 have been studied at four years of age. Characteristics of this group were a homogeneous social background, good parental interrelationship and uniform good case during pregnancy and delivery. 24 of the twins were MZ, 44 were DZ. The cesarean section (CS) rate was 50%; 14 of the twins (20%) were born before 35 completed gestational weeks. All the children were tested at 48 months (± 1 week) with the Griffiths' Mental Development Scale. This scale includes six subscales, among which the locomotor and hearing and speech scales were employed in this study. The girls generally showed a higher development quotient than the boys. The birthweight also seemed to be important for the later development; at four years of age the twins with a birthweight < 2 kg had a lower locomotor quotient than those weighing more than 2 kg. The language quotient showed a similar trend: the difference was,

however, not significant. No significant differences in either locomotor or language development could be observed between MZ and DZ twins. CS had no influence on the later development.

Relation between sensorimotor status and cognitive functioning in school-age twins and singletons

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Neurological and cognitive functioning was compared in school-age twins (MZ and DZ) and in matched singleton controls who were each given 20 items of a sensorimotor battery, several subtests of the WISC, the full Raven Progressive Matrices, and the Bender Gestalt test. No serious developmental problems were observed in any of the children but DZ twins, as a group, were found to have a lower sensorimotor developmental level than did same-age MZ's or singletons. The DZ's also scored lowest on some of the cognitive tests and the Bender. Girls were developmentally ahead of boys in the 9-13 years-old population. Correlational analyses and Smallest Space Analysis show an association between sensorimotor level and spatial ability as well as an intercorrelational structure of sensorimotor items which is invariant in twins and in singletons.

Linguistic components of language acquisition in MZ and DZ twins

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To sort out the genetic and acquired dimensions of two important aspects of spoken language, the auditive synthesis capacity and the insight in presuppositions, we investigated a group of 41 9-year-old twin pairs (21 MZ, 20 same-sex DZ) from the "East Flanders Prospective Twin Survey". A Dutch adaptation of the Illinois Test of Psycholinguistic Abilities was used. The auditive synthesis capacity was documented by testing the insight into the phonemic structure of words. The insight in presuppositions was studied by the analysis

of the hidden meaning of sentences. Statistical analysis of the data allows to (1) estimate the genetic impact versus the influence of the environment; (2) compare the performances of our group of twins with singleton controls; (3) relate the performance to the degree of schooling. Our study points out that both the auditive synthesis capacity and the insight in presuppositions are genetically determined whereas the auditive synthesis capacity appears to be more sensitive to unfavourable environmental conditions. The effect of schooling on both proficiencies can be called identical for singletons and twins.

R. Godijns holds a special doctoral grant of the National Fund for Scientific Research (Belgium). The "East Flanders Prospective Twin Survey" is supported by Grant no. 3.0038.82 of the Fund for Medical Scientific Research.

Qualitative and quantitative aspects on mathematics achievement in MZ and DZ twins

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Mathematics achievement test results have been collected for 22 MZ and 24 DZ same-sex twin pairs in the Swedish compulsory school. The twins were approximately 11-13 years of age and attended grades 4, 5, or 6. The twin pairs were part of a larger collaborative study between Israel and Sweden (the KAM-project). Teachers were asked how they planned and evaluated their work in the subjects Swedish and Mathematics. In addition to this, results for the twins on Maths tests given by the teachers in their regular work were collected. These tests were thus used by the teachers as an instrument to evaluate the educational process. Intra-pair similarity for MZ and DZ twins has been compared for qualitative and quantitative aspects of Maths tests. Different tests were used by the teachers but the same criteria have been used in the comparison. MZ twins are somewhat more similar than DZ twins for both the qualitative and quantitative aspects. Only one quantitative aspect, however, percentage correct answers, shows a significant difference between the twin categories. A comparison was also made of intra-pair similarity in classes, where the teachers differed according to planning and evaluation of their education. Irrespective of that, the MZ twins seemed to be more similar than the DZ twins in number of correct answers on the Maths tests. Educational implications are discussed.

An examination of the psychological and behavioural factors in the development of language retardation in twins

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Using therapeutic intervention, the psychological and behavioural factors in the development of language retardation in a pair of MZ female twins aged 5 years and a pair of MZ male twins aged 4 years have been examined. Although some factors are common to those found in singletons with language retardation, the factors peculiar to the twin situation will be highlighted.

**Northwestern University Twin Study X:
Outcome of twin gestations complicated by
gestational diabetes mellitus**

J.D. Keller, G.O. Utter, S.L. Dooley, J. Minogue, L.G. Keith

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The effect of pregnancy on carbohydrate metabolism is well known, but the additional impact of a twin gestation on carbohydrate metabolism is controversial. Less well studied is the effect of altered carbohydrate metabolism on perinatal outcome in twin gestations. We studied 13 twin pregnancies ≥ 24 weeks gestation complicated by gestational diabetes (White Class A); these were matched on the basis of gestational age to 13 twin pregnancies not complicated by diabetes. All patients were delivered at the Prentice Women's Hospital and Maternity Center of the Northwestern Memorial Hospital in Chicago. Maternal and neonatal outcomes in the 2 groups were then examined. Maternal risk factors and complications in the 2 groups were comparable. When infants of diabetic mothers were compared to infants of control mothers, they showed a trend to be more likely affected by respiratory distress syndrome (20% vs 3.8%), hyperbilirubinemia requiring phototherapy (16% vs 3.8%), and NICU admissions longer than 24 hours (32% vs 15.4%). Apgar scores less than 7 at 5 minutes occurred in 2 infants of diabetic mothers and another 2 had umbilical cord artery pH ≤ 7.10 at birth. There was one fetal death in a patient with gestational diabetes and chronic hypertension. No major anomalies were observed. Our experience appears to suggest that altered carbohydrate metabolism in multiple gestations, regardless of etiology, increases the potential for neonatal morbidity. Multiple pregnancies deserve attention toward detection and treatment of gestational diabetes.

**The Northwestern University Twin Study XI:
Evolution of perinatal outcome in twin gestations,
1971-1988**

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L.G. Keith

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We reviewed 366 twin pregnancies achieving at least twenty-four weeks gestation delivered at Prentice Women's Hospital and Maternity Center from January 1, 1984 through December 31, 1988. Prior

reviews (1971-1975; 1978-1983) from this institution have enumerated obstetric and demographic factors correlating with increased risk of perinatal morbidity and mortality in twins. Of these, preterm birth and low birthweight were most consistently noted. This correlation persisted during the most current review period, despite management schemes directed at reducing preterm birth and low birthweight. Despite the absence of significant changes in average birthweight, birthweight distribution, gestational age at delivery, or overall incidence of preterm birth in twin gestations, the birthweight-specific mortality decreased, thus suggesting that neonatal care has had a greater impact in improving twin survival. Although factors associated with perinatal death in twins are well known, our ability to influence these factors remains less than desired.

Northwestern University Twin Study XII: Discordant fetal growth in low birthweight twin gestation not predictive of perinatal morbidity

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Discordant fetal growth in twin gestation has been traditionally associated with increased neonatal morbidity and perinatal mortality. However, several recent reports have failed to confirm this association. These reports included many pregnancies delivered near term or with birth weights in the normal range ($> 2,500$ g). In these groups, adverse perinatal outcomes are uncommon. In this report, we studied pregnancy outcome in low birthweight twins in order to evaluate a possible association between growth discordancy and perinatal morbidity and mortality. Between January 1, 1984 and September 30, 1988, 81 preterm twin pairs were identified. Twin pairs in which the birthweight of the smaller neonate was $> 20\%$ below the birthweight of the larger neonate were considered discordant. Pregnancies complicated by congenital anomalies were excluded. Study pregnancies were divided into groups based upon concordant vs discordant growth and higher vs lower birthweight in each twin pair. Groups 1 and 2 were comprised of the higher and lower birthweight infants, respectively, in concordant twins ($N = 66$). Groups 3 and 4 were comprised of the higher and lower birthweight infant, respectively, in discordant twins ($N = 10$). Data from these groups were compared using analysis of variance and Chi-square tests. Selected neonatal parameters are summarized below. Groups were similar for all these parameters. In addition, the incidence of RDS, pneumothorax, IVH,

NEC, septicemia and apnea were similar among all groups. There were six neonatal deaths; all occurred in the concordant twins (three each in Groups 1 and 2). In this study perinatal outcome was similar in concordant and discordant low birthweight twins. Furthermore, among the discordant twin pairs, neonatal morbidity and perinatal mortality were similar in both smaller and larger birthweight groups. Growth discordancy in low birthweight twins may not be a predictor of adverse neonatal outcome.

	Gest age	Hosp days	02 TX days	Vent days	Photo TX days
Group 1	31.9±2.4	30.5±36.1	12.4±36.0	5.9±11.5	3.2±4.4
Group 2	31.9±2.4	31.6±41.5	12.1±35.0	7.8±18.2	2.9±3.7
Group 3	32.4±3.4	38.0±36.0	13.3±34.7	7.5±17.1	3.2±3.3
Group 4	32.4±3.4	39.8±32.2	10.5±14.2	10.2±15.5	3.9±3.7

Northwestern University Twin Study XIII: Effects of employment, daily activities, and domestic arrangements on perinatal outcome in twin gestations

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In 1969 Papiernik began investigating the effects of gainful employment, activities of daily life and domestic arrangements on perinatal outcome. His findings suggested that these factors influence the incidence of preterm delivery. It is widely accepted that twin gestations are at increased risk for preterm delivery. In this study, we examined the association between these factors and pregnancy outcome in twin gestations. Between December 1, 1985 and March 31, 1989, a total of 160 twin gestations delivered at The Evanston Hospital. The mothers were contacted by telephone after delivery in order to assess specific aspects of their employment, daily activities, and domestic arrangements. Questions were modeled after surveys that were conducted as part of the Hagenau Perinatal Study. Since antepartum protocols varied among caregivers, patients were also questioned regarding selected aspects of their prenatal care. Outcome parameters evaluated included the following: gestational age at delivery, infant birth weight, occurrence of preterm labor, need for antenatal hospitalization, requirement for and duration of tocolytic therapy, and

length of infant hospitalization. Subgroups were constructed based upon questionnaire responses. Perinatal parameters of the subgroups were compared. Detailed analysis of results will be presented.

Northwestern University Twin Study XIV: Prediction of fetal weight and discordant growth by various ultrasound-derived formulas in twin gestations

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Antenatal evaluation of twin gestation includes ultrasound assessment of fetal growth. Suspected discordant fetal growth patterns may suggest the need for more intensive antenatal surveillance. The most commonly utilized formula for estimating fetal weight and predicting discordant growth is based upon biparietal diameter (BPD) and abdominal circumference (AC) measurements (Shepard et al). Use of this formula may erroneously predict discordant growth patterns if varied head shape exists between twin fetuses. In this study we evaluated several formulas for estimating fetal weight using various combinations of fetal measurements in order to assess differences in the prediction of twin growth discordancy. During a two-year period 510 ultrasound examinations were performed in twin gestations at our two institutions. Growth parameters including BPD, head circumference (HC), AC, and femur length (FL) measurements were obtained in each fetus using real-time ultrasound imaging. Twin pairs were excluded from analysis if these measurements were not available in each fetus. Fetal weights were estimated by three formulas utilizing combinations of ultrasound-derived measurements: 1) BPD & AC; 2) HC, AC, & FL; 3) AC & FL. The percent difference in estimated weight of the twin fetuses was calculated using the following formula: $[(\text{Larger weight} - \text{Smaller weight}) / \text{Larger weight}] \times 100$. The percent differences based upon the weights derived from each of these formulas were compared. Results of these calculations and comparisons will be presented.

Northwestern University Twin Study XV: Rationales for a standard of care in compromised twin pregnancies

J.P. Minogue, M.L. Socol, L.G. Keith

Ultrasonography, antepartum fetal heart rate testing, genetic studies, measurement of ΔOD_{450} , have improved the obstetrician's ability to assess fetal well being, as well as, diagnose fetal compromise. Application of these diagnostic technologies to twin pregnancies can lead to isolation of an abnormal fetal heart rate in one preterm twin, while providing a reassuring tracing for its cotwin. Similarly, detecting rh sensitization in one twin and lack of it in the cotwin, or sickle cell trait in one and sickle cell disease in the other creates a situation in which ethical values rather than medical technologies will determine intervention strategies. Parents making these decisions have limited options: either putting a healthy twin at risk for the sake of a compromised cotwin or allowing and/or causing a compromised fetus to die to provide some hope for potentially healthy cotwin. Though every case is unique, good medical practice requires a standard of care by which consistent patient management can be proposed. Three traditional sources of ethical wisdom form the basis upon which a standard of care may be developed in such situations: outcome based criteria (Utilitarian), in-principled based criteria (Kantian or Aristotelian), and criteria based on patient autonomy (Existential and Human Rights). In the pluralistic environment of Northwestern Memorial Hospital our staff has favored a standard of care based on patient autonomy. This approach demands: 1) a practitioner who offers a thorough explanation of the diagnosis and possible treatment approaches; 2) time for the patient and her partner to assimilate this information and test treatment options against their personal value system; 3) a third, but disinterested, party to facilitate patient understanding and value clarification; 4) a practitioner either willing to support the patient's decisions or willing to refer her to another practitioner who will. The strengths of this approach are: 1) it allows the patient, the person who has to live with the consequences of this decision, the final say in the decision; 2) it encourages patients to 'own' and take responsibility for the outcome, rather than 'blaming' it on the physician; 3) it is a functional system in a pluralistic environment of patients and practitioners. The major liability of this approach, however, is that it may leave the practitioner feeling similar to a 'technician', executing the orders of a patient with skill and adroitness, but without a personal professional ethic.

Northwestern University Twin Study XVI: First trimester genetic diagnosis in twin pregnancies - Safety and accuracy

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We wish to report a multicenter study on first trimester genetic diagnosis in twin pregnancies, emphasizing the obstetrical risks associated with chorionic villus sampling and the accuracy of genetic analyses. Chorionic villus sampling was performed transcervically, transabdominally, and transvaginally between 9 and 12 weeks gestation on 151 twin and 3 triplet pregnancies. The indications were advanced maternal age (137), a previous conception with a chromosome aberration (9), and an inborn error of metabolism (7). Six of 154 (4%) pregnancies spontaneously aborted prior to 28 weeks gestation; there were 2 (1.4%) perinatal losses. There were 8 twin pregnancies (5%) that were discordant for either a numerical or a structural chromosome aberration; 4 were selectively terminated, 2 spontaneously aborted and 2 delivered prematurely at 30 weeks gestation and expired in the neonatal period. The results of cytogenetic analyses revealed two instances in which one placenta was sampled two times, an error rate of 0.06; both resulted in normal children. All other newborns conformed to their original genetic analysis. We conclude that first trimester genetic diagnosis by chorionic villus sampling is actually safer than second trimester amniocentesis and as accurate in diagnosing genetic disorders in high risk pregnancies.

Growth patterns in preterm and term twin deliveries

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Some workers have shown that ultrasonographic measurements of fetuses born preterm are smaller than expected (Tamura et al 1984, Weiner et al 1985, MacGregor et al 1988). These studies were based on a singleton population. 125 sets of twins were scanned serially at fortnightly intervals from 16 weeks onwards to establish fetal growth.

One operator performed all the scans (A.P.M.S.). There was no significant difference in the growth pattern in twins delivered before 37 weeks compared to those delivered after this time.

Estimated fetal weight by ultrasound and birthweight in twin pregnancy - How good are we?

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Ultrasonic assessment of fetal weight derived from multiple measurements of the fetus has become accepted in clinical practice as being useful in singleton pregnancies. Several different formulae for estimating fetal weight have been derived from differing measurements of the fetus, such as biparietal diameter, trunk circumference, and femur length. To date, there has been no attempt to evaluate such a technique in multiple pregnancy. This study aims to see whether the formulae derived for singleton pregnancy are applicable to twin pregnancies. Estimated fetal weight will be derived by mathematical modelling from ultrasonic measurements made within a week of delivery and the results compared with the actual birthweight to give an indication of how good such estimated fetal weights are. Factors to be considered in the analysis include whether there are differences between twin I and twin II, differences of presentation with twins and differences by gestation at delivery.

Application of partitioned twin analysis to measurements of serum lipoproteins in 11-year-old twins

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Partitioned twin analysis provides a method of determining whether genetic differences at specific candidate loci make a significant contribution to the overall variation in any measured trait or health risk factor. Dizygotic (DZ) twins are partitioned into three subgroups depending upon whether they share 0, 1 or 2 alleles that are identical by descent at the locus in question. They are compared in an overall analysis with monozygotic (MZ) twins who share two alleles at all of their loci. The model provides separate estimates of the genetic variation arising from the candidate locus and all other loci. Extensions of this design permit the detection of imprinting as well as epistatic interactions between specified pairs of loci. We have applied this method to the analysis of serum lipoprotein levels in a sample of 54 MZ and 51 DZ twin pairs who were classified according to their identity by descent at the Apo B locus by RFLP typing. The twins and their parents yielded joint PIC scores of 0.8 for two closely linked Xba1 polymorphisms. The data showed strong evidence for genetic variation in the total, LDL and HDL cholesterol and triglycerides and were consistent with a major effect of the Apo B locus on genetic variation in HDL. Partitioned twin analysis is a useful method for assessing the contribution of specific candidate loci to genetic variation in any measured trait.

Risk factor variability and coronary heart disease

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Lifestyle and dietary habits as well as genes contribute to the population variation in risk for coronary heart disease (CHD). Attempts to identify genes contributing to CHD risk focus on "candidate genes" (any gene whose protein product is directly or indirectly involved in atherogenesis, thrombogenesis or thrombolysis). Genes associated with risk factor level may be referred to as "level genes" to distinguish them from "variability genes", which are genes involved in establishing the framework within which environmental influences may cause risk factor variation. A high level of genetically determined Lp(a)

lipoprotein is a definite risk factor for CHD. An XbaI restriction fragment length polymorphism at the apolipoprotein B (apoB) locus corresponding to amino acid 2488 in the mature protein is associated with cholesterol as well as triglyceride levels and there is suggestive evidence for variability gene effect on apoB as well as body mass index in the 3' part of the apoB locus. The locus for cholesteryl ester transfer protein exerts level gene effect on apolipoprotein A I in non-smokers and apparently also variability gene effect on cholesterol. The hypercholesterolemic effect of the apolipoprotein E4 isoform may depend on genotype with respect to normal genes at the low density lipoprotein receptor locus. Thus, gene-environment as well as gene-gene interactions must be considered in CHD risk factor studies.

Twin research in breast cancer

T.M. Mack

Abstract not received.

An Italian study on obesity: Anthropometric characteristics and nutritional habits of MZ and DZ twins

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A twin study on obesity, a major health problem in western countries, has been undertaken. A sample of 385 twin pairs born in 1968-1970 have been invited to the Gregor Mendel Institute to have their health conditions checked and to receive information on correct nutritional habits. Anthropometric measurements (body weight, height, waist and hips) have been taken. In addition, zygosity, and previous presence of obesity and other metabolic disorders in the twins themselves and their parents, have been investigated. As far as psychological

aspects are concerned, a multidimensional questionnaire has been administered to evaluate the attitude toward nutrition and the way of living the situation of "normality" or "abnormality". To obtain a wider picture of personal characteristics, questionnaires focused on the self, the ideal projection of the self and the stereotype of the obese subject, have been also administered. The study is in progress and preliminary results will be presented.

A three-year follow up of personality in the Swedish Adoption Twin Study of Aging

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Longitudinal data have been collected in a three-year follow up of the Swedish Adoption/Twin Study of Aging. Phenotypic stabilities from time 1 to time 2 for personality measures ranged from .54 to .71. Genetic correlations estimated from model-fitting analyses were quite high ($r_G = .88$ to 1.0) whereas environmental correlations were lower ($r_E = .34$ to .59). Despite the substantial genetic stability, genetic effects accounted for approximately half of the phenotypic stability.

Quantitative developmental genetic analysis of height

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The Louisville Twin Study was originally initiated by Dr. Frank Falkner over thirty years ago as an investigation of physical growth in children, and since then many behavioral variables have been added to the extensive testing protocols. We now have the methodology needed for quantitative developmental genetic analysis of large longitudinal twin-sibling-parent data sets. The methodology obviates the assumption of random mating made so frequently in twin studies. Previous analyses have been implemented on large longitudinal data sets, but none of these has included data covering the whole range of development from one sample. Results from the application of a quantitative genetic model to the longitudinal twin-family height data, spanning birth to maturity, will be presented.

Permissiveness-restrictiveness for twins and controls in two educational settings: The Swedish compulsory school and the Israeli Kibbutz**S. Fischbein¹, R. Guttman²**

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In a previous longitudinal twin project, a model was developed for studying heredity-environment interaction. One important environmental dimension in this model is permissiveness-restrictiveness. The purpose of the present study has therefore been to investigate perceived and imposed restrictiveness at the societal and classroom level and possible interactional effects on pupil behavior. Results are reported from grades 4 to 6 and preliminary data will also be discussed for grade 8. In both Swedish schools and Israeli kibbutzim permissiveness-restrictiveness will vary depending upon perspective (perceived or imposed) and upon content (type of subject or rule-breaking activity). Preliminary within-pair comparisons for the Swedish twins are reported for different types of test results. In agreement with the model, logical abstract thinking as well as reading and mathematics achievement seem to be less influenced by hereditary factors in a restrictive educational setting than in a permissive one.

Developmental changes in relative contributions of heredity and environment: The effect of transition to schooling**M.S. Egorova**

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The aim of the study was to trace developmental changes, which occur during transition to schooling. The subjects were 82 pairs of identical and fraternal twins. Twins were tested twice - when they were 6 years old and a year later, when they entered the school. The testing included WISC, the battery of tests on nonverbal mental abilities, tests on spatial abilities, tests on creativity. In the interview with mothers there were evaluated environmental influences and intrapair relationships of twins. Mothers, preschool and school teachers rated questionnaires on children's temperament and personality, adaption of twins to the school and their scholastic abilities. The results show developmental changes both in the structure of cognitive abilities and personality on one hand, and on the other in genetic influences. It

is suggested that processes of socialisation, which take place in the course of development, differently change the relative contribution of nature and nurture in characteristics, which refer to different levels in the hierarchy of psychological features. There are discussed: 1) Changes in heritability; 2) Genetic changes, which occur during transition to schooling; 3) Differences in the continuity for IQ, specific cognitive abilities and temperament; 4) The roles of shared and nonshared environment.

Development, education and living habits of twins

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The development, education, and living habits such as smoking, drinking and truancy at the age of 14 years were studied in 289 twins and 11,623 singletons in one-year birth cohort, beginning during pregnancy and followed up to 19 years. Early development of the twins was somewhat slower than that of the singletons, but this difference vanished when the comparisons were made between the twins and control singletons matched by sex and perinatal morbidity. The same finding was made of the activity to apply admission to further education after the compulsory schooling at the age of 16 years. The intrapair similarity of vocation and various living habits in the same-sex twin pairs was higher than the similarity between the twins and their controls matched by sex, place of residence and some maternal factors.

Twins at risk? A longitudinal study of twins and non-twins from birth to 18 years of age

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The purpose of this study has been a comparison of a group of twins (145 pairs) and a whole cohort of singletons (115,117 individuals) born 1953 in the Stockholm metropolitan area. The twins and singletons have been followed from birth onwards. A pertinent question is whether twins are at greater risk at birth and whether such risk factors predispose twins to below-average mental and physical growth.

The results show that twins are more susceptible to risk factors such as lower birthweight, shorter gestation period and a larger propensity to birth complications. These factors also seem to have a lasting effect on later physical and mental development. Monozygotic twins, twin girls and twins with low birthweight seem to be particularly at risk for below-average mental and physical growth. An interaction between social background and birthweight can also be seen for the twin group.

“No thanks, it keeps me awake”: The genetics of coffee drinking and sleep disturbance

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3,808 adult twin pairs were asked in a mailed questionnaire, “If you were to drink coffee in the evening would it stop you from getting to sleep at night?”. 10% responded “always” or “usually” and a further 20% “sometimes”. Twin correlations were much higher for MZ than DZ pairs, indicating that about 43% of variation in liability is genetic in origin. The key question is whether this variation is distinct from that affecting general sleep characteristics and related personality attributes. Path analysis indicates that both genetic and environmental influences on coffee-related insomnia are largely distinct from those affecting general sleep quality and insomnia symptoms related to anxiety, depression and neuroticism. We thus have evidence for specific genetic modulation of the reported effect of coffee drinking on sleep.

Genes and the use and abuse of alcohol: A progress report from ongoing twin studies

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Genetic variance contributes to individual differences in use and abuse of alcohol through multiple paths that include personality dispositions underlying early initiation of social drinking, as well as differences in acute behavioral and subjective susceptibility to non-intoxicating blood alcohol levels. We report interim results from two twin research programs studying such pathways between genes and use/abuse of alcohol. Questionnaire data from the Finnish Twin Cohort reveal that significant gender differences in abstinence and frequency, quantity and density of consumption are not attributable to gender modulation of gene effects, but, apparently, arise from non-familial sources. Age-to-age stability of drinking habits and heritability of the observed stabilities differ between older and younger twin cohorts, so genes importantly contribute to both consistency and change in drinking patterns. In Indiana, laboratory studies of

acute susceptibility to alcohol are completed for > 90 young adult twin pairs, divided by gender and zygosity. Interim analyses focus on evaluating heritable variance in behavioral (eg, standing steadiness) and subjective (bodily sensation) responses to a 0.66 mg/kg challenge dose administered during a standardized laboratory procedure.

Support: Finnish Foundation for Alcohol Studies, AA-06232 and AA-07611

Smoking, genes and disease

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The modulation of the association of smoking with coronary heart disease and its risk factors by genetic factors has been the subject of a series of studies in the Finnish Twin Cohort. About 2,500 twin pairs discordant for smoking were identified from the first questionnaire survey in 1975 of this population-based panel of like-sexed twins. Mortality and morbidity follow-up has extended to over 10 years. Significant excess mortality was found among the smoking cotwins, both MZ and DZ, of male pairs initially discordant for current smoking compared to their non-smoking twin brothers. In a subsample of 49 MZ pairs, the effect of smoking on atherosclerosis was studied. The smokers had significantly more atherosclerosis in their peripheral arteries as assessed by non-invasive duplex sonography. Differences between smokers and non-smokers could not be ascribed to differences in established or putative biological or psychosocial risk factors for coronary heart disease or atherosclerosis; only alcohol use was greater among the smoking cotwins. The studies indicate that smoking increases the risk of both asymptomatic and clinical atherosclerotic disease independently of genetic predisposition

Cardiovascular symptoms and risk factors in a cohort of Italian twins 30 to 50 years old

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A self administered questionnaire was sent to a sample of twins aged between 30 and 50 years who were registered in the files of the Mendel Institute in Rome. The questionnaire comprised 46 questions exploring cardiovascular symptoms and risk factors: 1) cardiovascular symptoms and family history of cardiovascular disease; 2) hypertension; 3) diabetes; 4) hyperlipidemia; 5) obesity; 6) sedentary life; 7) smoking. Completed questionnaires were received by 72 pairs of MZ, 129 pairs of DZ and 17 pairs of undetermined zygosity. Data were analysed in terms of frequency distribution and intrapair concordance in MZ and DZ pairs. Cardiovascular status could be classified into four categories: 1) healthy; 2) mild and uncertain cardiovascular symptoms; 3) clear cardiovascular symptoms; 4) documented cardiovascular disease. Comparison of data from the two series of twin pairs and cluster analysis of risk factors and family history is in progress, and the results will be presented.

Smoking monozygotic twins have an earlier menopause than their nonsmoking cotwins

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Several studies have shown that smoking has an effect on age at menopause. Menopause occurs 1-2 years earlier in smoking than in nonsmoking women. This is important since early menopause is a risk factor for coronary heart disease and breast cancer. The effect of smoking on age at menopause may be constitutional or causal. We have compared the age at menopause in smoking-discordant MZ twin pairs drawn from the Norwegian Twin Panel. The twins had answered a questionnaire that included questions on smoking habits and menstruation. The effect of smoking on age at menopause was confirmed in this material as mean age at menopause was 48.5 years for nonsmokers and 47.7 years for smokers among 1,060 postmenopausal MZ and DZ twins ($p = 0.001$). Fifty-two MZ pairs only were discordant for both age at menopause and smoking behaviour. In 33 of these pairs, the smoking twin had a lower age at menopause than

her nonsmoking cotwin, whereas the opposite was the case in the remaining 19 pairs. The difference is significant in a paired sign test ($p = 0.035$). This study shows the same effect of smoking on age of menopause within smoking-discordant MZ twin pairs as in the general population. It is probable that the effect of smoking on age at menopause is a causal one.

Twin children in volunteer registries: Biases in parental participation and reporting

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The biases in voluntary participation by adult twins are well known but less attention has been paid to twin children where parents decide on participation and provide much of the information. The incidence of childhood behaviour problems is compared in four large Australian data bases: 1) a nationwide compulsory (and hence representative) survey of literacy and numeracy; 2) a nationwide "Twins in School" survey of parents and teachers of twins run through Education Departments and AMBA, the parents organisation in conjunction with La Trobe; 3) the La Trobe Twin Study which is a longitudinal program involving frequent interactions between families and researchers, and 4) the Australian NHMRC Twin Registry which has surveyed a large sample of their families with twin children by mail. One potential bias comes when recruitment is on a continuing basis as in the LaTrobe Twin Study and the Australian Twin Registry and differences between "early" and "late" enrolling families are discussed. The most significant difference between the four samples arose from parents being much more likely to contrast their twins and to report problems in one but not the other. Teachers' and psychologists' assessments of these same children generally reported much smaller intrapair differences. Correcting for this bias gave fairly similar incidence estimates across the four samples. Future studies should have some common questions to provide comparative data on such biases and six key questions are proposed, mainly on the perceived need for different forms of remediation.

The LaTrobe Twin Study and the Australian Twin Registry are supported mainly by the National Health and Medical Research Council (Australia).

Population-based twin registries in the Nordic countries: Illustrative applications in genetic epidemiology and behavioral genetics

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The population-based twin registries of Denmark, Finland, Norway, and Sweden represent extraordinary resources for scientific and medical research. While each register has its own history and characteristics, each can be related to the entire population of its respective country, for all Nordic nations have a long tradition of civil registration that includes data on births, marriages and deaths; all enjoy high standards of social and medical care and all maintain health-related registers of good quality for epidemiological research. The size and completeness of the Nordic twin registries renders them uniquely valuable for representative studies of diseases of rare occurrence. Examples of research made possible by these twin registers will be illustrated with past and planned work with the Finnish Twin Cohort, which was expanded in 1986 to include all multiple births since 1958 (> 23,500 sets) and linked to 1°-relatives. Illustrations include co-twin control studies of twin pairs discordant for exposure (eg, smoking) or disease (eg, cancer), appraisal of gender differences over development among dizygotic twins of like and unlike sex, extensive families-of-twins research with twins in either parental or offspring generations, and prospective, longitudinal high-risk research using entire birth-cohorts of young twins who are classified by familial history of a medical or behavioral disorder.

Support: Finnish Foundation for Alcohol Studies and BRSO S07 RR07031.

The Minnesota Twin Registry: Personality correlates of ease of recruitment

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The procedures used to create the Minnesota Twin Registry allow us to divide the sample into volunteers (individuals who heard about the study and contacted us), and twins who required varying numbers of prompts before completing out tests. The data show that easily

recruited twins tend to be better educated, more extraverted, and better adjusted than twins who are more difficult to recruit. There was a slight, but consistent tendency for pairs discordant for ease of recruitment to be less similar than concordant pairs on a variety of variables. These results, taken together with other findings within our sample, suggest that the twin correlations computed from the registry twins slightly overestimate the true correlations for MZ twins and do so somewhat more for DZ twins. Some key questionnaire items are presented, which could be routinely used to give a measure of such response biases.

The Vietnam Era Twin Registry: A resource for medical research

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The Vietnam Era Twin Registry consists of 7,369 male-male monozygotic and dizygotic twin pairs born between 1939 and 1957 with both brothers having served in the U.S. military during the Vietnam War. The Registry was originally developed to provide the best control group for Vietnam-exposed servicemen to study the long-term health consequences of service in Vietnam. A 28-page Survey of Health was completed by 4,774 pairs and 1,433 additional unmatched singletons. It is estimated that 53.5% of the 4,774 pairs are MZ, 43.8% are DZ and 2.7% are of indeterminate zygosity. Eighty-five percent are in the 35-44 year age groups. Ninety-three percent are Caucasian, and 6.5% are Black. Although currently in excellent health, this cohort is at an age where it will soon be developing the major chronic diseases. Over 600 MZ and 600 DZ twin pairs report that they are discordant for smoking cigarettes and drinking alcohol. Recognizing the potential usefulness of the Registry for future medical research, the Veterans Administration is maintaining the Registry and has established a mechanism to permit its use by other medical researchers inside and outside the Veterans Administration.

Database management of the Australian NHMRC twin registry

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The management of twin data in a scientific registry environment will be examined with respect to the design of the database, and to the use of the database as a tool for scientific research. Areas that will be examined are: Planning the database, Twin data and the Relational model, Query techniques, and Retrieval efficiency. Application of these ideas to management of the Australian National Health and Medical Research Council (NHMRC) Twin Registry will be described. Registration information from over 18,000 pairs, baseline questionnaires from over 8,000 pairs and data from other questionnaires comprise this dynamic database. Entry of new twins following recruitment, routine updating of addresses and other information, deletion either by request or by failure to relocate following return-to-sender, mailout technique (an Annual Newsletter is sent to all registered twins), and the use of the VAX/VMS package DATATRIEVE will be demonstrated.

What information should the multiple birth family receive before, during and after the birth?

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Advances in the management of the multiple pregnancy and delivery must be accompanied by corresponding improvements in service access outside key centres and especially in the information families receive about what may happen during or after the pregnancy. A major review of birthing services in Victoria has focussed attention on four areas where the quality of information is often inadequate: 1) Prepregnancy and the standard of counselling about the incidence of multiples as a result of fertility drugs and IVF procedures and the risk of congenital abnormalities. 2) Antenatal. At what stage of the pregnancy should parents be told of the multiple pregnancy and how should monitoring of the mother and procedures such as bedrest take into account what are often conflicting demands within the family? 3) Perinatal. Families are frequently ill-prepared for a Caesarian delivery and for the procedures for premature multiples. The problem is often compounded by separation of the mother from one or both twins. While bereavement services are improving, much still needs to be learned about handling congenital abnormalities in one or more multiples. 4) Postnatal. Irrespective of the level of prenatal advice, families greatly underestimate the workload with multiples. The resulting stress contributes to the incidence of postnatal depression, child abuse and divorce now being reported from multiple birth families. Some suggestions are made from social psychology and genetic counselling about how families can best handle risk information to achieve the goal of neither under- nor overestimating the risk at these different stages of the multiple pregnancy.

What is it like to be a twin parent?

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Parents of Swedish MZ and DZ male and female same-sex twins (approx. 70 pairs) have answered a questionnaire regarding their role as twin parents. This is part of a larger study (the KAM-project) of twins attending Swedish compulsory schools and Israeli Kibbutz

schools. The results for the Swedish sample indicate that parents are confronted with different problems depending upon whether the twins are MZ or DZ. MZ twins, and especially female pairs, are more dependent upon each other than DZ twins, and problems with identity and separation might appear at puberty. For the DZ pairs, and especially the boys, competition is more pronounced. A majority of both MZ and DZ twin parents say that they do not want to influence their children to become similar (approx. 80%) or dissimilar (approx. 55%). This is a dilemma, since a "dissimilar" treatment might be necessary to avoid identity problems in MZ twins, while a "similar" treatment might be indicated to avoid competition problems in DZ twins. A comparison of the maternal and paternal answers to the questionnaire indicates that especially the mothers of MZ twins find their situation more laborious than the fathers. Fathers of twins also seem to treat their twins more similarly than the mothers.

Measuring the psychosocial impact of twin birth

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Data to document psychosocial stresses in women expecting twins in comparison with women expecting singletons and mothers of twins during their first year in comparison with mothers of singleborn is being collected by TWINLINE during spring 1989. Data analysis will identify the primary stresses affecting mothers of multiples and women expecting twins and their families. TWINLINE staff will incorporate this information into a tool to screen for high psychosocial risk in the perinatal period and develop appropriate care plans. Issues explored in the questionnaire, preliminary data analysis, and implications for service will be discussed.

Raising twin babies and problems in the family

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"Double trouble" is the phrase often mentioned by the parents of twins; however, few studies have attended to the special needs of and special problems encountered by the parents of twins in Taiwan. 277 mothers of twins have been interviewed about difficulties encountered

while rearing twins. Results show a disturbance of daily life. For example, 49% mentioned inadequate sleep, but the frequency of this complaint decreased by age. 18% mentioned financial strain, 49% experienced emotional disturbance. 22% mentioned disturbance in the marital relationship. 43% reported a lack of time to take care of other children. With the growth of twins, the disturbance gradually decreased but not for emotional disturbance; therefore, the most vulnerable group consists of parents in the first-year period. Only 17% reported difficulties in distinguishing the twins. Most of the parents distinguish their babies by appearance (68%), height/weight (14%) and by sex. Only 15% reported leaving the babies in the care of their relatives during the day time. Overall, the percentage feeling support from the father was 32.7%, but 39% of them felt the support was useless. 49% felt support by grandmother but 43% of them regarded the grandmother to be of no help. 35% were supported by their own mother, but 54% mentioned that they received little help. Therefore, we conclude social support from relatives was inadequate. Public policy should take this fact into account and provide that public health nurses as well as local social workers offer help to the mothers of twins, especially during the first year. Moreover, the ways of coping to release the tension of mothers of twins should also be provided at least for the first three years.

Maternal response to stress when disciplining twin children

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Mothers of twins perceive themselves to be under greater stress than mothers of two closely spaced singleton children. They use harsher and different methods of punishment and discipline for similar offences. The arrival of twin children is identified by the mothers as affecting their own personalities and behaviour. Stress is rated at different levels at certain times of day and certain periods of the year. Mothers living in urban areas rate their stress level higher than those bringing up their twins in the countryside.

Cooperation and competition between twin children: Replication and extension

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Twin studies may be highly informative with respect to social-interactional outcomes and processes, as they may "help to elucidate the interplay of biological and psychosocial/environmental forces that influence children's altruism and aggression" (Zahn-Waxler 1986). In an earlier study, cooperation, competition and altruism were compared within young MZ and DZ twinships (Segal 1984). Included in this study were 105 pairs of twins (70 MZ and 35 DZ pairs), between six and eleven years of age. MZ twin pairs demonstrated greater cooperation and altruism, relative to DZ twin pairs, during a series of joint activities. The aim of the present, ongoing study is to replicate and extend twin research on cooperation and competition, using an independently identified sample and more elaborate experimental design. In this analysis, interaction is compared between MZ and DZ cotwins *and* between MZ and DZ twin individuals from unrelated pairs. This study includes 64 pairs of twins (29 MZ and 35 DZ; two triplet sets are counted as three pairs each), between seven and eleven years of age. The theoretical perspectives (social-genetic and kinship-genetic principles of behavior), methodological aspects, and progress to date will be discussed.

The Twin Bond: Its impact on marriage and identity

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The twin population in the USA is currently at four million, with multiple births occurring at a rate of one in ninety and increasing. Multiple birth impacts powerfully on the family system and each of its members. It is imperative to understand the bond shared between twins and its influence on others. This presentation will explore the dynamics of the twin bond from a developmental perspective. The role twinship plays in identity and its impact on marriage and family life will be discussed. The stress that the multiple birth experience has on the family system will be delineated with emphasis on the differing needs of twins themselves. The discussion will be illuminated by the research hypotheses and findings from my study on marriage and twins. The study examined identity formation based

on the quantity of maternal attention an infant receives, and marital adjustment based on how stable one's identity is upon marrying. The hypotheses and findings are the following: 1) Successful completion of the separation-individuation process is not positively related to marital adjustment; 2) Twins do not have a lower degree of separation-individuation developmental success than non-twins; and 3) Twins do experience greater difficulty in their overall marital adjustment than singletons. The implications of these findings will be addressed.

"Twins in School" - An Australiawide program

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The multiple birth family is more likely to have a dispute with the education system than with any other service. So many potential areas of conflict exist over the abilities and behaviour of multiples and over such issues as separation or keeping back one twin. One reason for disputes is the lack of good data to adequately reflect the different perspectives of parents and teachers and the differing needs of families - the same solution does not apply to all. To provide the first large-scale data base and building upon an initial survey of 85% of all primary school teachers in South Australia, the LaTrobe Twin Study and AMBA worked with Education Departments to set-up in each state Education Research Teams (ERTS) of parents of multiples who were also teachers. The ERTs were crucial in three phases. 1) Developing and circulating questionnaires and publicising the nationwide survey. 784 families and 1264 teachers of their children completed these questionnaires, many reporting that simply having to address the issues raised in the questionnaire was a valuable learning experience. 2) Exploring the data base. Issues arising included the very different bases on which parents and teachers judged separation desirable, with teachers emphasising the unsubstantiated claim that separation is essential to individual development. Separation became more common over the first three years of schooling but 20-25% of twins separated one year were back together the next. 3) Running regional meetings of parents, teachers and administrators to discuss the results and to pool experiences and plan policies at the local level. A need clearly exists to improve the level of consultation between families and school personnel and to ensure the widespread availability of information which identifies key issues in making decisions for the multiple birth family.

Recommendations for policies and psychosocial services for multiple birth families

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TWINLINE, Service for Multiple Birth Families, Berkeley, California, USA

Parents and expectant parents of multiple birth children must cope with a constellation of unique physical, mental and emotional stresses which can jeopardize health and the functioning of the family. U.S.

health delivery systems and social services are ill-prepared to provide them with appropriate education, psychosocial support and resources to meet their special needs. Under contract with the California Department of Health Services, TWINLINE, Services for Multiple Birth Families, provides psychosocial services and is developing guidelines for statewide policies, health education and services to meet the special needs of this high-risk population. Highlights of TWINLINE recommendations and implications for social service systems will be presented for discussion.

The role of special clinics for families with multiple births

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In order to give better support to families with multiple births, the Twins and Multiple Births Association (TAMBA) has established six clinics in the UK; two are General, two Bereavement, a Super-twins and one for Special Needs (disability). Over 350 families have attended in the first two years. A monthly prenatal talk (including the biology of twinning, early mother-infant relationships, infant care and development) are given to expectant parents. They also serve as a teaching forum for professionals. On the same day, families attend a children's clinic run by two pediatricians and volunteer parents for routine developmental checks or for special problems (eg, language delay, discordant growth, behaviour problems, zygosity determination, financial stress). In the TAMBA support room, volunteers provide practical help, information, advice and refreshments. The Special clinics are held threemonthly and include a mutual support lunchtime meeting where parents share experiences. As a result of the demand from families, TAMBA is hoping to start Twins Clinics throughout the UK.

National Organization of Mothers of Twins Clubs, Inc.: Report to the Sixth International Congress

C. Hradek, M. Meyer

National Organization of Mothers of Twins Clubs, Inc., USA

Presentation of the final Multiple Birth Data Form and general data from the 3000 completed forms. Explanation of the purposes of the data base and availability to researchers.

Comparison of data from a non-member local club and the National Organization of Mothers of Twins Clubs, Inc.

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To note the similarities and differences in data obtained from a local nonmember mothers of multiples club survey with that available in National's Data Bank.

Personality difference between identical twins

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In spite of the similarities between identical twins, it is known that there are some personality differences among the two. The most typical differences somewhat originate from the tendency in the Japanese society, whereby elder and younger children are differently treated by parents and others. But gradually this seems to fade out because young parents nowadays prefer equal treatment. However a great part of the Japanese society still tends to distinguish "the elder-one" from "the younger-one". When twins grow up to kindergarten or school age, they learn that people like to compare them, and expect them to behave like elder one or younger one. In this way they soon become aware of such a relationship between themselves and thus "elder-brother-like" and "younger-brother-like" characteristics appear.

The influence of complications at birth in the first-born and second-born twins

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Subjects were 461 pairs of twins, who were the applicants of the Junior High School affiliated to Tokyo University during 1981-1988. Complications at birth, including asphyxia, cyanosis, severe icterus, breech presentation and so on, were more often seen in the second-borns than in the first-borns (257 vs 197), indicating that the second-borns had biological handicaps from the time of birth. In order to clarify the influence of the complications, the following items were analyzed: height and weight at birth, at one year and at 12 years of age; entrance examination I (Japanese) and II (mathematics), and standard achievement test, consisting of Japanese, history & geography, mathematics and science. After standardization of each value by sex, the analysis was carried out. The total sum of the difference (the value of the first-born minus that of the second-born) revealed 83.64 in the weight at birth, and -2.78 in the entrance examination I and 0.30 in II, respectively. The results showed that the biological handicap seen in the second-born at birth did not last till the later developmental stage.

Common chromosomal fragile sites. A population study in twins

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Chromosomal fragile sites are constant points on chromosomes where gaps, breaks and rearrangements are induced by specific culture conditions and/or chemical agents. The chromosomal locations of these induced aberrations are distributed in a nonrandom manner. The molecular basis and function of these sites remains an enigma. Fragile sites are not unique to humans, and over half of the chromosomal rearrangements that have occurred in primate chromosome evolution involve breakpoints at or near fragile sites. Many known oncogenes are located at or near fragile sites. Finally, although common fragile sites are thought to be ubiquitous, individuals vary in the degree to which specific sites are expressed in lymphocyte-derived chromosomes. To better understand the factors which underlie the expression of these sites, we undertook a twin study of common fragile sites to assess the effects of genetic determinants on site expression. Blood was obtained from 28 pairs of twins (15 MZ and 13 DZ) and fragile sites were induced in their cultured lymphocytes with aphidicolin. The number and location of every aberration were recorded from 100 metaphases for each twin. Using LISREL we fitted data for the combined expression frequency at 10 common sites. The model that best fitted the data included additive genetic and random environmental effects. Estimates from the best-fitting model partitioned variation into 92% additive genetic and 8% random environment.

Maternal smoking and alcohol consumption and birthweight in twins

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Both alcohol consumption (about 90 grams at term) and smoking (about 230 grams at term) are known to decrease birthweight in singletons. From the National Netherlands Twin Data Bank we studied the effect of alcohol consumption and smoking on birthweight in 874 twin pregnancies. With respect to the duration of pregnancy in twins

no effects due to alcohol consumption and/or smoking were found. With respect to birthweight in twins an effect due to maternal alcohol consumption was not found. Maternal smoking, however, showed a mean effect on birthweight of about 300 grams. These observations allow two important conclusions:

- 1) A practical one: Smoking should be absolutely forbidden in multiple pregnancies;
- 2) A basic one: Obviously the twin placenta functions at the very border of its capacity and (common) environmental factors therefore have a relatively important effect as compared to singletons.

Presence of a tubelike structure in the interface of the amniotic membranes in twins with double placenta

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A histomorphological study of the amniotic membranes in fullterm twins with double and single placenta was carried out by means of the silver impregnation staining technique suitably modified. Specimens of interface of amniotic membranes were prepared by means of sections. The constant presence of a tubelike structure was observed. Proceeding from the amniotic cavity the following histological layers were noted: 1) single layer of amniotic cubic cells; 2) amorphous substance with fibrocytes; 3) single layer of endothelial cells. The same order of single layers is present in the amniotic membrane of the second fetus. The above described tubelike structure is present only in cases of twins with double placenta. If the placenta is single with two umbilical cords, the tubelike structure is not present and only a central amorphous substance surrounded by two single layers of amniotic cells is observed, to confirm the single embryogenetic derivation. Therefore, through this histological method, we can recognize the true single placenta of twin pregnancy from the pseudo-single placenta so said for the presence of adherences of adjoining surfaces that make it appear single. On the contrary, by manual dissection it is possible to identify a twin pregnancy with two placentae. From the physiological point of view, the walls of the tubelike structure have probably the function to realize exchanges of amniotic liquids between the two fetuses, so as to obtain a balance of electrolytic ions and of intercavity pressure. Growth factors (vascular endothelial factor) are probably involved in the genesis of the endothelial tubelike structure.

Two recent pairs of craniopagus conjoined twins in Southern Africa: Perspectives on the phenomenon

J. Bosman

South African Multiple Births Association (SAMBA)

The incidence of conjoined twins is approximately 1 per 50,000 - 100,000 births. Roberts reports that only 2% of conjoined twins are craniopagus - joined at the head. Over a period of two years, two pairs of craniopagus conjoined twins have been born in South Africa. Both pairs were referred to Baragwanath Hospital in Soweto. Because of the rarity of the condition, and the relatively small population of South Africa (30 million), it is remarkable that two such sets should have been born in the region within two years. The first pair was separated in a three-stage operation - the first in October 1987 and the final in May 1988 - with an excellent result. The second pair, born in January 1989, is not yet anatomically mature enough to undergo the extensive investigations required to assess the degree of cranial and possible brain involvement in the join. Some African cultures still regard twinning as a curse. The mother of the older girls was initially terrified when she gave birth to undiagnosed conjoined twins. However, because of the positive publicity relating to their hospital management and surgical separation, the parents of the second pair were neither alarmed nor horrified.

They anticipate an equally successful separation of their babies, although their doctors have cautioned that the extent of the join requires detailed evaluation before any surgical approach can be evaluated. Schematic illustrations of the surgical techniques will be demonstrated, and psychosocial aspects of conjoined twins will be discussed briefly.

Communicative competences in twins, siblings and single borns

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The current study compares communicative interactions within twin couples to those between singletons and to those between siblings with a minimal age difference. Moreover, twin couples interacting with unrelated children were compared to those of siblings and single borns interacting with unrelated children. Subjects were 54 children: 18 twins, 18 siblings and 18 single borns. Each group was composed

of five pairs of boys and four pairs of girls aged from 7.11 to 10.6 years. Three different referential communicative tasks were used to investigate the following research questions: 1) Whether significant differences exist between the communicative skills of twin pairs and that of single born children. 2) Whether communicative skills of twin pairs are limited to the "intra-geminal society" or can be generalized to any other interlocutor. 3) The importance of familiarity between partners for the communicative performance of twins. In other words, are the communicative performances of twins due to their long lasting familiarity to interact with each other, or can their communicative performance be explained in terms of their unique interpersonal situation? Results showed that no differences exist between twins and singletons with respect to referential communication. It was also found, however, that twins, in contrast to siblings, were more limited in their communicative competence in the sense that they were less able to generalize their abilities when interacting with other children.

The Taipei Twin Study: Genetic variance and heritability of intellectual development

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In order to understand the relative influence of genetic and environmental factors as well as the effects of growth on intellectual development, a three-year follow-up study has been proposed. This is the first-year cross-sectional report. 210 pairs of twins aged 3 months to 30 months have been recruited from another project under the supervision of C.J. Chen. Zygosity has been identified based on sex, placenta, Mendelian traits, RBC blood types (ABO, MN, Rh, P, Le systems), and dermatoglyphic measurement. A structured questionnaire concerning twin-rearing habits, parental attitudes, and other environmental factors supplemented the Home Observation for Measurement of Environment (HOME) instrument developed by Bradley and Caldwell in the interview of the parents of twins. The Bayley Scale of Infant Development has been administered to those twins during a home visit. After excluding the outlier and the mentally retarded twin pairs, the mental and motor development (MDI and PDI) of 192 pairs of twins (119 MZ, 73 DZ) has been studied. After separating the subjects into age groups 3,6,9,12,15,18,24 and 30 months, the intrapair correlations were between 0.86 and 0.93 on MDI (but only 0.73 on the 24 months group) and 0.93-0.99 on the PDI of MZ twins. The range was 0.66-0.96 on MDI and 0.75-0.97 on

the PDI of DZ twins. PDI shows much higher intrapair correlation than MDI. However, measures of the Falconer heritability index were much lower because of the higher intrapair correlation on both MZ and DZ groups. They were 0.04-0.50 on MDI and 0.02-0.47 on PDI. After adjusting for age, the total group showed 0.13 on MDI and 0.08 on PDI of the Falconer index.

Genetic variance and heritability of temperament among Chinese twin infants

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In order to examine the genetic variance and heritability of temperament of Chinese infants in Taiwan, a total of 62 same-sexed twin neonates given birth in four major general teaching hospitals in Taipei City were studied. Based on the placental pattern and 12 red blood cell antigens, 44 MZ and 18 DZ twin pairs were identified. The temperament of twins was assessed at the age of six months by the Chinese edition of Carey's temperament scale. Significant genetic variance was observed for activity level, approach or withdrawal, intensity of reaction, quality of mood, and threshold of responsiveness. Intrapair correlation coefficients (*r*) for MZ and DZ twin pairs and Falconer's heritability indices of eight dimensions of temperament are shown in the table below.

	<i>r</i> _{MZ}	<i>r</i> _{DZ}	<i>h</i> ²
Activity level	0.66	0.34	0.64
Rhythmicity	0.85	0.90	0.14 ^a
Approach or withdrawal	0.80	0.52	0.56
Adaptability	0.67	0.55	0.25
Intensity of reaction	0.71	0.34	0.74
Quality of mood	0.81	0.61	0.39
Attention span and persistency	0.85	0.62	0.45
Distractability	0.72	0.61	0.22
Threshold of responsiveness	0.83	0.60	0.45

^aChristian's among-component heritability.

Seasonal variation and sociodemographical characteristics of twinning in Chinese population

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In order to examine the seasonal variation and sociodemographical characteristics of twinning in Chinese population, a total of 64,325 deliveries from October 1985 to December 1988 in four major general teaching hospitals in Taipei City were studied. Based on the sex distribution of 741 twin deliveries and the method of Weinberg, MZ and DZ twinning rates were estimated as 7.57 and 3.95 per 1,000, respectively. There was no significantly consistent seasonal variation in both MZ and DZ twinning rates in Taipei City during the study period. In the examination of sociodemographical characteristics of twinning rates, a total of 1,496 singletons matched with twins on delivery date were studied. There was no significant association of MZ and DZ twinning rates with the paternal age and the educational level, ancestry and ABO blood type of parents. Logistic regression analysis showed a negative association of both MZ and DZ rates with the maternal age, while a positive association was observed for the maternal gravidity. There was no significant interaction of maternal age and gravidity on the determination of MZ and DZ rates.

Dilated cardiomyopathy in monozygotic twins

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Familial forms comprise a small percentage of dilated cardiomyopathies (DCM). The role genetic factors play in the pathogenesis of DCM is unclear. However the study of monozygotic twins with this disease holds great interest. Until now only one case of twins with DCM has been described. In this case the monozygosis has not been properly documented, and the clinical picture is doubtful owing to overlapping pathology. We found two identical twins with DCM. They were males, and 60 years old at the moment of cardiac diagnosis. The first came to our observation for congestive heart failure with a typical echocardiographic pattern of DCM (left ventricular and diastolic diameter: 60 mm; left ventricular and systolic diameter: 56 mm; global

left ventricular hypokinesis; signs of increase of left ventricular and diastolic pressure). At the date of this diagnosis, the second twin was asymptomatic, but the echocardiographic pattern was similar (left ventricular and diastolic diameter: 65 mm; left ventricular and systolic diameter: 55 mm; global left ventricular hypokinesis). The symptoms began 6 months afterwards, and the patient needed hospitalization for cardiac failure. No cause of cardiac dilation was found in either twin, and the cardiac alterations appear primitive. In both twins we reported that the diagnosis of monozygosis has been proven by immuno-emathological investigations. The examination of HLA antigens demonstrated a significant probability of monozygosis ($p < 0.01$). The finding of DCM in two identical twins leads us to believe that there is a genetic predisposition to this form of DCM.

Odontometric asymmetry in Punjabi twins with special reference to methods for detecting spurious genetic variance

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Bilateral human odontometric asymmetry generally shows very little genetic variance. In Indian twins, we find unusual levels of disproportionate MZ similarity and/or DZ dissimilarity for asymmetry, giving the appearance of significant genetic determination using the simplest methods. Thus, dental asymmetry constitutes an interesting test case for the application of methods for the detection of zygosity biases; such methods invalidate all instances of spuriously significant genetic variance ratios.

Some personality and cardiovascular characteristics of twins

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To replicate and extend the currently available data pertaining to the environmental and/or genetic contributors to the personality and cardiovascular characteristics of twins, psychometric and cardiovascular measurements were made on a series of 20 sets of MZ and DZ twins

15 years and up. Demographic and psychological test data were collected over two sessions, and psychophysiological measurements were recorded during a third. Although the study is still in progress, the data assembled to date were analyzed, and from them some tentative inferences were drawn. The results were partially integrated with previously available evidence and interpreted in terms of current developments and experimental design.

Fetoscopic laser occlusion of chorioangiopagus in severe twin transfusion syndrome

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The majority of monochorionic twin pregnancies manifesting severe twin transfusion syndrome before 27 weeks' gestation result in perinatal death. Prior attempts at therapy ranging from repeated amniocenteses and tocolytics, to selected feticide by in utero cardiac injection or surgical removal of one fetus are often unsatisfactory to patients, rarely successful, and do not address the pathophysiology. We have developed a technique for in utero isolation of the respective fetoplacental circulations of the twins using a fetoscopically directed neodymium: YAG laser. The operation was performed in two patients at risk for pregnancy loss from acute hydramnios at 18 and 22 weeks' gestation. The procedures were uneventful and the pregnancies subsequently delivered at 27 and 33 weeks respectively. Clinical and ultrasonographic evidence, and pathologic examination of the placentas verified the photocoagulation of the vascular communications and resolution of the syndrome. Three of the four infants survived. This initial experience suggests that fetoscopic laser occlusion of placental vessels may be superior to previous therapies by resolving the pathophysiologic mechanism directly using a procedure of relatively low risk.

Vanishing twins in the Hungarian Optimal Family Planning Program

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Approximately 1000 conceptions were diagnosed by early ultrasound examination and HCG β -subunit measurement were analyzed in a Program for Optimal Planning of the Family in Hungary. The participants planned the conception after three months preparing time and partly with multivitamin supplementation. The authors examined the frequency of vanishing twins, the missed abortions and the miscarriages in two groups considering the multivitamin supplementation.

High twinning rates in insular populations in the Baltic Sea

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We studied the rates of multiple maternities in the archipelago in southwestern Finland with more than 200 permanently populated islands around the turn of this century. In the archipelago of Åboland (Turunmaa) the parishes of Kustavi (Gustav), Rymättylä (Rimito), Iniö, Houtskär, Korpo, Nagu and Hitis were comprised. The whole population of the Åland Islands and the whole Island of Gottland were included. Details of the multiple maternities in the Åland and Åboland archipelagos have been obtained from the parish registers starting in the 1650s. For Gottland the data have been compiled since 1750 from various official statistical sources of Sweden and from Wargentin's tables. In all these insular populations, particularly in the outer parishes, the rates of multiple maternities (above 20‰) up to recently were significantly higher than on the mainlands of Finland and Sweden, in spite of the fact that both Finns and Swedes have had among the highest noted twinning rates among Whites, ie, varying from 14 to 17‰. After the 1920s Åland, Åboland and Gottland, like Sweden, displayed a decline in the twinning rate, whereas in Finland

the twinning rate was rising up to the 1960s and was higher than in Åland, Åboland or Sweden. The insular populations showed a more markedly decreasing trend of twinning, particularly of DZ twinning, than the mainland populations. This steep decline in twinning cannot be explained by a lower mean maternal age or a decrease of parity only, but may partly be a consequence of changes in the matrimonial migration patterns (breaking up of isolates). The same may hold true for Finland where the urbanisation and decrease in endogamy started 1-2 generations later than in Sweden.

A mathematical model for recurrent twinning

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In an attempt to further understand the factors that affect human twinning we applied Fellman's mathematical model to four different populations. This model assumes that the number of twin sets (multiple maternities) in a sibship follows a geometric distribution. However, the geometric distribution assumes a long (infinite) fertility period. The model was applied here to data from Åland Islands (1750-1939), Nimes (1790-1875), Stuttgart (1786-1898) and Utah (1850-1900). The product mean sibship size times total twinning rate may be considered as a crude estimate of the expected number of sets of twins in a sibship. The same may be said about the parameter in the geometric distribution. These estimates are in good agreement. If the geometric distribution holds, $\log(N_k)$, where N_k is the number of mothers with k twin maternities, is a linear function of the number of recurrences. Graphically this property is easily checked. For sibships containing three or more sets of twins all four populations show higher values than expected, particularly the populations from Stuttgart and Utah, which also show bad agreement according to the χ^2 -test. A more exact model should demand more detailed demographic information, such as distribution of sibships sizes, maternal age, age-specific twinning rates and temporal variations in twinning. When the occurrence of multiple maternities was predicted by Peller's rule, the observed number of mothers in Åland with several recurrences of multiple maternities shows a considerable excess over the expected number. Hence, Fellman's mathematical model shows better agreement with Hellin's law. The fecundity in mothers in Åland with recurrent twin maternities was high, almost 10 children per mother, and a high proportion (about 50%) of unlike-sexed twins. This indi-

cates that polyovulation is the chief cause of recurrent twinning.

EEG spectra in 4-10 month old twins

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The subjects of this study were 21 pairs of twins. Before the study of twins we had assessed the long-term stability of EEG spectra in children. The EEG electrodes were placed at F_3 , F_4 , C_3 , C_4 , T_3 , T_4 , O_1 , O_2 ; the time constant and high frequency response for EEG were 0.3 sec and 60 Hz. The received parts of EEG records were used, with analysis epoch of 5 sec and discretization frequency - 64 counts/sec. Delta, alpha, theta, delta-1 (0-2), delta-2 (2-4), theta-1 (4-6), theta-2 (6-8) EEG rhythms were assessed. Analysis of EEG spectra in 22 single-born children (aged from 4 to 6 months, 9 ss; from 8 to 10 months, 13 ss) in the period of one week, and in 11 ss (aged 4-6 months) in the period of 6 months showed the stability of spectral characteristics of each individual. Interindividual differences, however, were high. It may be assumed that the variability of EEG spectra was influenced by the genotype. EEG spectra were studied in 10 MZ and 11 DZ pairs (aged from 4 to 10 months) in the same conditions. Intraclass correlation for MZ twins were higher than for DZ twins. The genetic influence was found in theta-2, alpha both in the right and left hemisphere, as well as in delta in the right hemisphere.

Spontaneous drawing and the psychology of twins

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Spontaneous drawing has been studied to investigate the psychological individuality of twin subjects in the selection of colors and other aspects of the drawing. Cotwins are placed in separate rooms, with paper and pencils of 12 different colors, and are then requested to make a drawing of their family at meal-time. Drawings are then analyzed in terms of color used (number and types), size and perspective of the drawing, details (such as furniture, etc.) given for the meal-room, and colors used for each family member, table-ware, and food.

Functional laterality and crossing in twins by sex and zygosity

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Left-handedness has been studied in a sample of twins and the frequency distributions of Right-Right, Left-Left, and Right-Left pairs have been analyzed by sex and zygosity. Discordant MZ pairs have then been further studied with respect to thumb-, arm-, and leg-crossing. The finding of MZ pairs discordant for all three types of crossing is taken to confirm the presence of mirror imaging.

Changing trends in multiple births in India

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Data based on 5.8 million births corresponding to the period 1939-1988 indicate that MZ twinning has declined while DZ twinning and higher multiple births, triplets in particular, have considerably increased. The average frequency of triplets was very high in the "Dacoit infested" area of Central India (1 in 880 births) during 1960-1975, while it has now declined (1 in 1700 births). Hormonal imbalance due to fear and anxiety might be responsible for such a high incidence. In cosmopolitan towns the triplet rate is quite low (1 in 4000).

Fraternal Component constitutes genetic proportion of the growth in human population

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The reproductive data was collected in relation to inbreeding coefficients, stillbirths and abortions from 1800 families (4050 mothers) and it was opined that the fraternal component was nearly equivalent to the DZ twinning rate of the population in question. We have tested this formula with statistical approaches from the population data, estimated in earlier publications and confirm that rise in human population has a definite proportion of genetic component. This is named as Fraternal Component which is equivalent to DZ twinning.

This gives a clue that DZ twinning may be of greater evolutionary importance and probably exhibits wider adaptability.

Cytogenetic studies on twins: Fragile sites

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The report of concordant fragile site in a MZ twin pair is extremely rare. This becomes of particular clinical significance when a fragile site is recorded in association with some anomaly or disease. In a study of 8 MZ twin pairs, their parents and sibs, we have detected three fragile sites, 3p14, 7q31 and 10q25, to be concordant in 1, 5 and 3 twin pairs respectively. The fragile site at 7q is found in all myopic individuals. Since lymphocytes were cultured in folic acid free media (TC 199, Mc Coy's) the appearance of fra 10q25, which is Brdu dependent for appearance, is not tenable with the hypothesis that this may be associated with myopia. However, this is highly intriguing that 7q31 and 10q25 fragile sites are detected in degeneratively myopic individuals.

Hypothesis-making study in twins

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Twinning method was employed to analyse genetic and environmental effects on the formation of individual differences by the indicators of hypothesis forwarding and testing process, viewed as one of the cognitive activity mechanisms. A special method has been worked out to unfold the process of hypothesis forwarding and testing so as to make possible their quantitative assessment by a series of indicators. This method includes task-posing (the task is not specified enough). Temporal and quantitative indicators of hypothesis-making process were used for the analysis. The obtained data were compared to the results of Wechsler intelligence test. The results revealed no relation between intelligence level and hypothesis-making characteristics. The research involved 52 identical (26 male and 26 female) and 50 non-identical (24 female and 26 female) twin pairs aged 17-28. The obtained coefficients of correlation in identical and non-identical twins testify to the fact that temporal indicators of hypothesis-making process are influenced by hereditary factors.

Triplets and higher multiples: Wonder or failure of therapy?

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By uncontrolled therapy of sterility many multiples have been induced within the last years. Despite the progress of neonatology a high percentage of the premature children die or they are disabled for lifetime in different ways, and the whole family too. The situation will be demonstrated by families with quadruplets, quintuplets and sextuplets, known by the International ABC-Club. The oldest members are quintuplets of 1912.

Intrapair difference of blood pressure levels and personality in adult identical twins

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An association between hypertension and personality has been highlighted in the field of public health. We have examined the relations between blood pressure levels and personality in 110 pairs of adult twins aged over 50. Maudsley Personality Inventory (MPI) was used for personality typing in this study. Intraclass correlation coefficients were calculated for systolic blood pressure (male MZ 0.502, female MZ 0.362), diastolic blood pressure (male MZ 0.560, female MZ 0.368), MPI E-scale (male MZ 0.436, female MZ 0.539), MPI N-scale (male MZ 0.326, female MZ 0.650) and MPI L-scale (male MZ 0.420, female MZ 0.548). The influence of socio-environmental factors, besides psychological factors, are also examined in this study.

Sex-role self-concepts in twins

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The purpose of this study is to compare sex-role identity of the five types of twins as determined by zygosity and biological sexual assignment. Two instruments, the Personal Attributes Questionnaire

and a zygosity questionnaire, are being administered to the sample of 50 twin pairs, consisting of ten sets of each of the five twin types, ages 13-19. Group data for each twin type will be obtained by comparing the variables of sex and zygosity to scores on the Personal Attributes Questionnaire. The study will seek to determine whether: 1) MZ twins are more alike than DZ twins with respect to levels of masculinity and femininity, and 2) whether there are significant differences in levels of masculinity and femininity across types of twin (ie, MZ same sex, DZ same sex, and DZ opposite sex). This study, which is expected to be completed by June, 1989, will address the relationship of biological factors in social aspects of personality determination.

The nature of the interindividual variance of coherence function parameters in background EEG and orienting response

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Genetic and environmental determination of coherence function parameters of background EEG and OR (3.9-6.7 Hz; 6.7-8.7 Hz; 8.7-10.3 Hz rhythms) in MZ (20 pairs) and DZ (17 pairs) 5.5 years-old twins was investigated. Unipolar EEG was recorded in F3, F4, C3, C4, P3, P4, O1, O2. Coherence function parameters in background EEG are found to be genetically determined in most brain areas (F3 and F4; P3 and P4; C3 and P3; P3 and F3; P4 and C4 in the range of 6.7-8.7 Hz and F4 and C4; F4 and P4; C4 and P4; C3 and P3 in the range of 3.9-6.7 Hz). Environmental determination of the function of coherence in C3 and C4 in the range 6.7-8.7 Hz and F3 and F4 in range of 8.7-10.3 Hz. Coherence function parameters in OR are found to be genetically determined in most of the brain areas in the range of 3.9-6.7 Hz (F3 and P3; C3 and P3; P3 and O1; F4 and C4; F4 and P4; F4 and O2; C4 and O2). In the range of 6.7-8.7 Hz genetical determination was found only in the F4 and C4; P3 and O1 areas. Coherence function parameters F3 and C3; P3 and P4 in OR are determined by the environmental factors.

Models of cotwin interactions: Are they important in heritability analysis?

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40 MZ and 40 DZ pairs of adult twins were tested on the EPI and WAIS. The same Ss were interviewed in order to determine some characteristics of the interactions between the twins of the same pair (their closeness, perception of each other, conflicts, etc.). 4 models of interactions were distinguished, and accordingly all pairs were sampled in 4 groups. Intraclass correlations for IQ, Extraversion and Neuroticism were obtained in each group for MZ and DZ separately. Clearly, the models of interactions of MZ pairs differ from those of DZ pairs. In some ways, MZ cotwins were closer than DZ cotwins. As to intraclass correlations in different groups, the results are not fully conclusive. We can only say that the type of interactions influences personality traits more than IQ.

Differentiation of twins and maternal educative practices in infancy

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The present study examines parental attitudes towards the differentiation of twins. Thirty families of 1-year old twins were interviewed and observed in the home. The data covers three areas: a) parental beliefs and educational concerns with twinship; b) amount of emphasis on outward manifestations of twinship (dress, physical environment, choice of first names); c) reactions to similarities and differences between the twins in terms of physical and somatic traits, development and temperament. The findings are analyzed in terms of zygosity (MZ, DZ, different gender DZ), and mothers' socioeconomic status.

Abnormal rate of bHOG as a predictor of the vanishing twin

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The phenomenon of the vanishing twin (VT) has been observed in multiple pregnancies before and after ultrasound detection of fetal heart activity (FHA). Pathologic findings in placentas from VT pregnancies have recently been described. However, the associated hormonal changes have not been delineated. In this study, 33 patients with two gestational sacs were followed with weekly ultrasound examinations and frequent (1-3 wk) sampling of bHOG in the first trimester. Twenty-three patients (Group I, 70%) had normally progressing twin pregnancies (NPP) and 10 patients (Group II, 30%) demonstrated a VT. Half of these losses occurred after FHA was established and the other half in the presence of fetal pole. Linear regression analysis of the Ln of bHOG was performed for three phases: 1) day 20-41; 2) day 42-56; 3) day 57-65 according to Daya. For each phase, the rate of rise for bHOG was significantly ($p < 0.05$) lower for Group II than for Group I. In conclusion, VT represented a large proportion of twin pregnancies. FHA was not a reliable predictor of continuing fetal viability. VT pregnancies were characterized by a markedly slower rate of rise in each phase. The rate of rise for bHOG, in early stages of gestation, reflects the fate of multiple pregnancy.

Mobility of nervous system in certain kinds of training

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This experimental study is devoted to the investigation of the compensatory psychological mechanisms of the nervous system mobility (B.M. Teplov, V.D. Nebylitsin), which is a genetic factor. The experiment was based on the twin control method. 50 adult, both sexes MZ twins (ages ranged from 18 through 25 years) had to accomplish as quick as possible the following: first, they had to identify complex interferent geometrical objects ("Perception" series); second, to tape interferent texts on the 3-keyboard device ("Motor" series). The subjects were specially trained. It was necessary that the subjects could switch attention (or nervous system mobility) to fulfil the action. Half of the twins received traditional training. As a result, the positive correlation between the limited speed of these actions and

individual mobility was discovered. Others learned to fulfil the same actions by the "step by step formation" method (L. Vygotsky) and exercises. After skills obtained the speed increased significantly and the dependence between the limited speed and individual NS mobility disappeared.

Human twinning rate in the Iniö Islands at the South-West coast of Finland

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To evaluate the human twinning rate in archipelagial conditions, the author performed a secular demographic study on the Iniö Islands at the South-West coast of Finland. The results showed an even stronger decline of twinning rates than in the Åland Island and the rest of the archipelags. Twinning rates in the Iniö Islands decline, in fact, from about 30‰ to less than 10‰. Possible factors related to this phenomenon will be discussed against knowledge received from this area by an interdisciplinary scientific research project.

A psychophysiological method for discrimination of MZ and DZ twins: A study based on impedance cardiography

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The amount of genetic determination of stress-related cardiovascular reactions was investigated in 10 MZ and 10 DZ twin pairs in two experimental conditions, mental arithmetics (MA) and cold pressor test (CP). The relative contribution of vagal and sympathetic influences were studied by simultaneous registration of vagal and sympathetic indices. Systolic time intervals (STI) as contractility-based measures are useful indicators of inotropic changes of the myocardial activity. Continuous on-line computer determination of ST-s was realized on the basis of impedance cardiogram (dZ/dt) and electrocardiogram by the aid of an algorithm which recognized the landmarks of STI-s on the dZ/dt curve, thus makes phonocardiogram recording unnecessary (Szilágyi, Láng 1988). To assess the contribution of vagal influences

on the heart rate the spectral estimate of respiratory sinus arrhythmia (\hat{V}) has been obtained. The statistic \hat{V} is of value in providing information concerning vagal control of the heart (Porges 1982). MZ twins showed reliable higher intraclass correlations than DZ twins for contractility-based indices during MA. Several discriminant analyses were applied to identify variables that are important for distinguishing between MZ and DZ twins.

Hepatitis B virus markers in Chinese twins

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Chinese like-sex twins were recruited to study the genetic influence in the response of different markers of hepatitis B virus (HBV) infection including HBsAg, anti-HBc, anti-HBs, HBe and anti-HBe. A total of 289 pairs of MZ twins, 102 pairs of DZ twins and 375 pairs of age-sex-matched singleton controls were studied. No significant difference in the concordance of HBV infection was observed in the MZ and DZ twins. However, highly significant differences were noted between MZ twins and controls and between DZ twins and controls. Highly significant differences were also observed in the concordance of carrier status between MZ and DZ twins and between MZ twins and controls, but not between DZ twins and controls. As for other HBV markers, no significant differences were observed. It is concluded that the trait of chronic carrier status may be multifactorial, which means that the traits are due to combined effects of alleles at many loci, and are also influenced by environmental factors.

TWINLINE, Services for multiple birth families

P. Malmstrom

TWINLINE, Services for Multiple Birth Families, Berkeley, California, USA

TWINLINE is a non-profit health education and social service agency dedicated to improving the health and family functioning of parents and expectant parents of multiple birth babies. TWINLINE's services for parents and providers include a professionally staffed telephone "Warmline" for counseling and referral; a variety of free and low cost publications for parents and providers; training and technical assistance for health and family service providers; and in the

San Francisco Bay Area: classes, seminars, clothing and equipment exchange, and a respite care program for low-income multiple birth families in crisis.

Movement related brain potentials (MRBP) and activity: A study of adult twins

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The twin method (25 MZ and 25 DZ pairs) was used to investigate MRBP evoked by one and the same overt movement that differ only in degree of volition and awareness. All Ss took part in two experiments. In the first, Ss had to press the button (1). In the second Ss had to predict events with the probabilities of 0.5 (2) and 1.0 (3). EEG electrodes were placed at F3, F4, C3, C4, the time constant and high-frequency response for EEG were 1.5 sec and 60 Hz. Amplitudes and temporal parameters of MRBP, CNV-like wave and P300 were assessed. In (1) the motor behavior is an independent voluntary act in which the movement is the aim of the action (A.N. Leontiev, 1983). In (2) and (3) the same movement is included in the prognosis situation ($p = 0.5$; $p = 1.0$). In this case, the motor act is a part of a more complex prediction behavior. Thus, the movement that initially was the aim of the action became the means to perform another action. The most interesting result is that the relative value of genetic and environmental factors in variability of MRBP, CNV-like wave and P300 depends on experimental situation. The effect of genetic component on variability was found in 53.6% of all parameters in the prediction situation $p = 0.5$; in 46.4% in $p = 1.0$ and 20% in voluntary movements. The share of genetic and environmental variations of potentials differed according to the meaning of the act in the structure of integral behavior, ie, to the extent of its volition and awareness.

Voice analysis in twins: Preliminary report

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The degree of dissimilarity between twin voices was measured in 17 MZ and 11 DZ twin pairs, aged between 9 and 11. The voice of every twin (= speaker) was recorded twice with a time lap of about 2 hours, and each recording session was composed of the same 5 sentences. On the average, every session provided about 20 seconds of speech. The speech was sampled at a rate of 10 kHz. Then, successive 20 ms time windows were analysed and represented by a parameter vector. For every session we computed an average parameter vector: the average autocorrelation function (= inverse Fourier transform action of the power spectrum), and the average pitch (= vibration frequency of the vocal cords). A weighted Euclidean distance between the session vectors is used to express the degree of dissimilarity between the sessions. Using this distance the following results were obtained. If comparisons within twin pairs are omitted, 95% of the sessions of the same speaker can be recognized as 'identical' with a false alarm rate of no more than 8%. If comparisons within twin-pair are considered, the false alarm rate is about 25%, meaning that in 75% of the situations the two twins of a pair can be distinguished. We are so far unable to find any indication that MZ twins sound more alike than DZ ones.

Aided by grant no. 3.0038.82 of the Fund for Medical Scientific Research, Belgium.

Iatrogenic influences on the heritability of childhood tonsillectomy

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In 1980-82 a mailed questionnaire was completed by 3,810 pairs of adult twins enrolled on the Australian NHMRC Twin Register. Twins were asked whether they had had their tonsils out and, if so, at what age. For the purposes of analysis, the sample was divided into four birth cohorts of approximately equal size and only childhood tonsillectomy (to the age of 18) was considered. The prevalence of

tonsillectomy differed markedly between cohorts, being highest in those born in the 1940's and early 1950's. Within each cohort the prevalence was very similar in MZ and DZ twins, yet concordance was much higher in MZ twins indicating the importance of genetic factors in predisposition to tonsillectomy. However, the proportions of variance in liability due to genetic and *shared* environmental factors differed markedly between cohorts. In the 1950's when tonsillectomy was fashionable, shared environment accounted for 60% of variance and genetic factors only 29%. However, by the early 1960's, when tonsillectomy was going out of fashion, heritability was up to 0.82 and shared environment accounted for only 10% of variance. Our results illustrate once again that heritability is not a constant, but depends on the precise characteristics of the population and the time at which it is studied.

Genetic influences on the evoked potentials to various visual stimuli

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Intrapair comparison of evoked potentials (EP) to light flashes, checkerboard pattern, house picture, the word "house" and a number of other stimuli in 20 MZ and 20 DZ adult twin pairs has on the whole shown a genotypic determination of these brain responses. The specific manifestation of the genetic factor depends on the character of the visual stimulus, the recording brain area and the parameter of EP. In the occipital area the maximum of genetic dependence was characteristic of EP to flashes, the minimum - to the word "house". In the right temporal area the level of genetic influences on EP on the whole was higher than in the left one. This difference was more prominent in the responses to spatial-structured stimuli such as checkerboard pattern, house picture and some other. In the left temporal area the genetic influences were manifest mainly in latencies of EP to linguistic stimuli. In vertex the genetic influences were higher than in any other brain area and manifest irrespectively of the stimulus type. Genetic influences differed for the amplitudes and latencies of EP components: amplitudes of brain EP were less genetically determined than latencies.

Clinical evolution of a MZ twin pair with renal malformation: A three-year follow-up

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We performed a three-year follow up in a couple of hypertensive MZ twins (males, aged 18). We had already presented this case in the Fifth International Congress on Twin Studies as the first case of double bilateral renal vessels in both twins of a MZ pair. Although they had simultaneously developed a marked hypertension at the same age (7 years), their clinical evolution was different. So we assumed an identical future evolution because they are MZ. In order to verify our hypothesis, we performed a follow-up based on aldosteron, renin, ECG, echocardiogram, ECG Holter, pressure Holter twice a year, while we carried out a cardiac scintiscan once a year. We were able to verify a progressive odds reduction between the twins since they have reached a situation of clinical identity, except for the W.P.W. syndrome, that is still present in only one subject. A further pair check will indicate the sense of the W.P.W.'s discordance and will contribute to the etiopathogenetic understanding of this clinical condition.

Heritable variation in response to exposure to ionizing radiation as observed in monozygotic twins

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We carried out a study of the variation of response to ionizing radiation exposure in clinically normal individuals (MZ). We wished to answer the following questions: 1) What is the variation in a control population; 2) Does it consist of more than one population; 3) Is the variation heritable; 4) Can it be measured; 5) Would it be useful to measure in patients undergoing therapy for cancer. We irradiated fibroblast skin cultures from twins and assayed chromosomal damage utilizing the micronucleus assay. An analysis of variance has shown considerable variation in observed micronucleus frequency. The range was from as little as 8 to as much as 95 per 1000 cells. Most of the variability can be accounted for by differences between twin pairs. Intrapair micronuclei production is more alike than nontwin or interpair micronuclei production.

Congenital limb reduction deficiencies in twins

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The twin study of index patients born with congenital limb reduction deficiencies (CLRD) makes it possible to estimate the role of genetic and environmental factors in the formation of these special defects. The Hungarian Congenital Malformation Registry showed a significant increase in the birth prevalence of CLRD in 1975-1978. It prompted a case-control epidemiological study of index patients born with CLRD in Hungary. The study material included a ten-year period, 1975-1984. The completeness of notification of index patients with CLRD was over 90%. The parents were asked to come with their children to our Department when index patients and family members were examined. Thus, the existence of CLRD was checked; X-ray and photographs were taken of the limbs of affected persons. The birth prevalence of CLRD in twins was not higher than in total births. The distribution of isolated and multiplex CLRD was 64.7% and 35.3%, respectively. The types of congenital anomaly entities (ADAM sequence and VACTERL association) had significantly higher occurrences than expected. It indicates a causal connection between these congenital anomaly entities (including CLRD) and twinning. Concordant pairs have not been observed in the study material which is an important argument against the genetic origin in these types of CLRD.

"Mother's child" and "father's child" in a twin pair

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In a follow-up study of 235 twin pairs, now aged 12-20 years, the development of parental attachment on each child in twin pairs, as reported by the parents, was analysed in relation to perinatal and developmental factors. 68% of the twins were equally favoured by the mothers and fathers, 20% were reported to be closer to their mothers and 12% to their fathers. No perinatal factors were showed to affect significantly on the development of parental preference of a twin. The "mother's twins" had developed verbally faster, they had more vivid temperament and were reported as having better fine motor abilities, but they also had more often psychosomatic complaints, while the

“father’s twins” were physically stronger and scored higher in some items of Children’s Depression Inventory (CDI). Total scores in CDI did not, however, differ significantly between the “mother’s twins” and the “father’s twins”.

Effect of lifestyles on human lymphocyte chromosomes from twins

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A large interest has been focused on the effect of toxic substances on human lymphocyte chromosomes, especially with relation to sister chromatid exchanges (SCE). Furthermore, it is well known that lifestyles have a certain effect on the induction of SCE by several carcinogenic substances such as MMC (mitocycin-C). However, our genetic backgrounds are too complex to allow further investigation to quantify the distribution of sensitivities to the induction of SCE by environmental hazardous agents in a general population. The present study compares a dose-response relationship between lifestyle scores and the induction of SCE and chromosomal alterations by genotoxins in human lymphocytes from MZ and DZ twins, and is planned to

- 1) investigate the induction of SCEs and micronuclei by MMC, CSC (cigarette smoke concentrate) and radiation;
- 2) investigate twins on the basis of a questionnaire about their lifestyles;
- 3) compare intraclass correlation coefficients between MZ and DZ twins.

The nature of individual differences on mental activity among senior preschool children

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The study’s aim is to investigate the nature of the mental activity plan that is a criterion of the intellectual level of preschool children. Under the investigation, there were 30 MZ and 32 DZ twin pairs from 5 years 11 months through 7 years 5 months at the time of the study (mean 6 years 8 months). As a criterion of the intellectual level it is

taken the superior plan of mental activity within the framework of which a child can fulfil a new task after the explanation without training. This criterion reflects child's learning possibilities. Three levels of mental development are represented in the study's results. They are: visual-action, visual-imagic and verbal logical plans of mental activity. The most typical intellectual level for the investigated category of children is the visual-imagic one. In general $K_{MZ} = 70.4\%$, $K_{DZ} = 44.4\%$ ($H = 0.47$). As to the visual-imagic level the results are the following: $K_{MZ} = 60\%$, $K_{DZ} = 30\%$ ($H = 0.43$). Among the concordant twin pairs, the higher the intellectual level the lower the percentage of MZ: among the K pairs with the visual-action plan MZ are 8% ; with the visual-imagic plan - 66% ; with the verbal-logical plan - 37.5%. That means that with the development of intelligence the role of genetic factors is reduced.

Reduction in twinning rate in a hospital in Tokyo during World War II

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The reduction of the twinning rate during hard years of the great wars or severe famines was reported. Though Japanese had also experienced severe famines or civil wars, any historical records on birth data useful to investigate twinning rate have not yet been found in Japan. In recent years the people in Tokyo had suffered from malnutrition in the latter half of the World War II period and post-war years. To investigate the change in twinning rate during these years of malnutrition, we examined about 80,000 delivery records in 1924-1986 at one maternity hospital in downtown Tokyo. The twinning rate decreased from 1.47% in 1920s to 0.77% in 1980s. During 1940s, while the rate was 1.03% for 1940-1942 and 0.94% for 1948-1949, it dropped down to 0.70% for 1943-1947. In 1945 when Tokyo was heavily bombed repeatedly to be burnt out, and the people suffered from severe malnutrition, only one case of twinning was found among 305 deliveries at this hospital (0.33%). While the mean birthweight of term singleton babies was 2953g in 1940-41, it decreased to 2918g in 1943-47, with 2856g in 1945. This change in birthweight demonstrates that the nutritional conditions in Tokyo became the worst in 1943-1947. While the decline of twinning rate at this hospital during 60 years is mainly due to the rapid increase of the hospitalized delivery after 1950 and the decrease of the parity, the reduction of the rate in 1943-47, however, cannot be due to these two changes. It must

be caused by the nutritional or some other hard war-time circumstances in this period. This report suggests that the twinning had decreased also in Tokyo during the years when the people suffered from malnutrition.

Zygosity diagnosis of twins by questionnaire

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Subjects were 189 twin pairs, consisting of 165 MZ and 24 same-sexed DZ who entered the junior high school affiliated to Tokyo University (sample T), and 93 twin pairs, consisting of 71 MZ and 22 same-sexed DZ who were registered at Kinki University (sample K). The zygosity among them was previously identified by many genetic markers. This study aimed at the zygosity diagnosis by questionnaire. Questionnaire included three questions. The first question was the similarity of twins: 'How are you alike?'. The second was the frequency of being mistaken: 'How often are you mistaken?'. And the third was to ask the person: 'By whom are you mistaken?'. According to the degree, 1-3 points, 1-3 points, and 1-4 points were given for each question. And the sum of the points of each pair of twins was calculated. Zygosity was determined by the sum of points, distributed from 6 to 20. Namely, if the sum is 6-13, we consider the twin pairs as MZ, and if the sum is 14-20, as DZ. It was revealed that more than 90% of twins were diagnosed correctly by use of this cutting point. And this result was in accordance with that obtained by use of discriminant function analysis. It was concluded that zygosity diagnosis by questionnaire was convenient and useful, in particular, for epidemiological research.

Weinberg's rule reconsidered

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Consideration of epidemiological twin figures, obtained in the Netherlands from 1904 until 1987 revealed an unexpected negative correla-

tion of $r = -0.69$ between MZ and DZ twinning rate. This correlation was rather consistent during the whole 84 years epoch, ie, it was present – be it in variable strength – in every 10-year period. Furthermore, the decreasing trend in DZ-rate and the increasing trend in MZ-rate, so obvious during the last two decades, appeared to be present since the beginning of the century. This correlation is supposedly caused by the application of the Weinberg-rule, which assumes that the number of like sex DZ twins equals the number of opposite sex DZ twins. Several authors have furnished evidence that this assumption is debatable because several twin samples show a 10-15% DZ like sex excess over DZ opposite sex. By ignoring this difference the MZ rate is systematically overestimated and the total DZ twinning rate is underestimated accordingly. Since these under- and overscoring effects are directly proportional to the opposite sex twinning rate, DZ and MZ rates become correlated. Other authors, however, presented data – obtained from a Belgium twin register – that are in line with the Weinberg rule. Recent data from a Dutch twin register, on the other hand, confirm the correctness of the observations of a DZ like sex excess. In a sample of 874 baby twin pairs 390 were categorized by their parents as DZ like sex, whereas 270 appeared to be of the opposite sex type. Considering the twin figures in the Netherlands, a relative DZ rate superiority over MZ rate before WW II, average rates for both MZ and DZ between 1945 and 1965 and relative MZ superiority after 1965 are apparent. The post-1965 situation can be ascribed to the before mentioned DZ like sex excess which leads to unjustified MZ overscoring and DZ underscoring. The combination of these facts strongly suggests that in the pre-WW II period the like sex twinning rate was *lower* than that of the opposite sex. At present we are investigating comparable epidemiological figures of some other countries. A differential revision of the Weinberg rule should be considered when this interpretation of the figure is correct.

Disinhibition and cardiac orienting/defending: Environmental and genetic influences

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Several authors have demonstrated a clear relationship between Disinhibition (Dis), as measured with Zuckerman's Sensation Seeking Scale, at one hand, and involuntary attention as indexed by brain event potentials and phasic heart rate changes at the other. It is

very likely to assume that both the Dis-attention relationship and these separate parameters as such are under the control of genetic as well as environmental influences. The present investigation is aimed at disentangling the nature and the magnitude of these environmental and genetic influences. Therefore Disinhibition (Dis) and phasic cardiac response amplitude (to an 80 Db tone stimulus) were measured in a group of 60 MZ (30 male, 30 female) and 75 DZ (25 male, 25 female, 25 opposite sex) twin pairs, as well as their parents. LISREL was used for the fitting of several models in order to assess the contribution of genetic and environmental factors in Dis and cardiac orienting/defending as well as in the relationship between these variables. Results of analysis will be presented.

Secular decline of twinning rates in Italy: An update

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The sharp decline that has characterized Italian twinning rates in the past several decades has somewhat stabilized since the late 1970s. The overall rate of multiple maternities declined from about 14‰ in the 1930s down to a low point of less than 9‰ in 1979. In the late 1970s, however, the rate was already stabilizing and has then remained at levels of slightly over 9‰ in the 1980s. Such a stabilization does not imply that the factors that caused the previous decline are no longer at work. First of all, the effect of these factors may now be overshadowed by the increased frequency of polyovulations apparently induced by the increasing use of fertility drugs. This apparently affects the frequency of quadruplets and quintuplets more than that of triplets, but presumably plays a role at the level of twinning rates as well. Moreover, detailed analysis shows that opposite-sex twin maternities are still close to their lowest point in the secular series, whereas same-sex twin maternities have been slightly going up. That seems to indicate an increase in the MZ share of twin maternities, in line with what is being observed in other countries. The tentative conclusion is that the recent stabilization of twinning rates in Italy is the combined effect of an increase in MZ rates and of a higher number of polyovulations that however affect essentially higher multiple births. The factors that have caused the previous decline of the DZ twinning rate may still be operating.

Transfusion syndrome in a dizygotic triplet pregnancy

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A case is reported of a transfusion syndrome in a triplet DZ pregnancy with intrauterine death of two of the fetuses. This is an exceptional occurrence in a triplet pregnancy and raises the problem of the management of multiple pregnancies associated with the death of one or more of the fetuses. In triplet pregnancy, we always performed cesarean section. However, in this case, we decided to perform a vaginal delivery because of the existence of a single surviving fetus, maternal-fetal infection, the rapidity of the labour, the potential risk of coagulopathy and the cephalic presentation of the surviving fetus.

Quadruplet pregnancy

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The rate of multiple pregnancies with more than two fetuses has significantly increased since the introduction of ovulation induction agents. From 1977 to 1988, there were 6 quadruplets in the authors' department. The incidence was 1:4515. The 6 pregnancies were obtained with ovulation induction agents: 3 after clomiphene citrate and 3 after hMG therapy. The mean gestational age at diagnosis was 14 ± 5 weeks. The duration of hospitalization ranged between 0 and 65 days, with a mean duration of 50 ± 13 days. The prematurity rate was 100%. The mean gestational age at delivery was 32 ± 3 weeks. Cesarean section was systematically performed. The mortality rate was 29% (7 out of 24 children). The birthweight of quadruplets ranged from 900 to 1,900 g. The mean birthweight was $1,339 \pm 385$ g. The evolution of quadruplet pregnancies does not seem to be affected, no matter what type of preventive measure is instituted. We consider the possibility of reducing the number of embryos in quadruplet pregnancies as a means of preventing prematurity (in the remaining fetuses).

Conservative management of multiple gestation with intrauterine death of one or more fetuses

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One of the less common complications of multiple gestation is intrauterine death of one or more fetuses. The growing number of induced ovulations together with the increasing use of ultrasonography has highlighted this potentially dangerous problem. Among potential problems are premature delivery, infection, damage to the sibling by the same process and foremost - the development of disseminated intravascular coagulopathy. Despite numerous case reports there are no firm guidelines in the literature regarding the management of this problem. We report 2 sets of twins with second trimester death of one, one of triplets with second trimester death of two fetuses and one case of quadruplets with third trimester death of one. All were managed conservatively with frequent measurements of clotting profiles and close surveillance of fetal growth and well being. Time and mode of delivery were individualized. No maternal complications developed and all fetuses found alive at the initial diagnosis survived and are doing well on post delivery follow up. We recommend the conservative approach to all such cases that do not present any complications. We feel that growing experience in this direction will aid in decisions regarding second trimester selective feticide for malformations or chromosomal aberrations.

The problem of the twin method in psychology

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Two research trends can be seen in recent psychogenetics: in the first, the twin method is used in its traditional form to distinguish hereditary and environmental determinants of behavior; in the second, twin pairs serve as an experimental model for the study of parent-child relations, of personality formation process in the child, etc. Analysis of the interaction between the parents and the child and between the twin partners themselves revealed more similarity of environmental conditions in MZ than DZ twins. Specific links between MZ twins and their parents and between MZ twins themselves can lead to the convergent development of one of the central personality formations, "the self system", and also to the development of highly similar self-

evaluations of MZ twins in the same pair. The data on the development of self-consciousness in MZ twins have special importance for the study of hereditary and environmental determinants in personality traits. The high degree of similarity in some psychological traits in MZ twins, which is often explained by hereditary influences, may in fact be a result of the specific development of self-evaluation in MZ twins.

Comparative genetic variance and heritability of head and facial traits in Northwest Indian and Belgian twins

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Genetic variance analysis of 13 head and facial traits is based on cross-cultural comparison between Northwest Indian and Belgian twins. None of the t' tests indicate differences between MZ and DZ mean values in either sample. Heterogeneity of variance is observed for some traits in both samples, which invalidates conventional within-pair genetic variance estimates. The patterns of environmental bias on zygosity differ between sexes and also between the two samples. Both samples exhibit substantial genetic variance. Revised genetic variance ratios lessen the genetic variability for some traits. There is also evidence of stronger environmental covariance for MZ than DZ twins.

Norwegian twins born 1979-82. Are there any maternal or paternal social determinants of twinning?

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From a combination of data of births from the Norwegian birth registry and socioeconomic status of parents from census data 1980, all twins (4,018 children from 2,009 deliveries) born 1979-82 were compared with a random sample of 4,018 singletons. There were complete data on maternal age and parity. Information about paternal age, maternal and paternal educational level, socioeconomic status, income, hours of work, as well as maternal marital status and parity were recorded for a large number of the registered births. The analysis shows that in Norway there are no major social differences between the parents of twins compared with the parents of

singletons. But mothers of twins are significantly older than mothers of singletons, and there is a slightly increased tendency of twinning with higher social status shown by several social standard measures including a British standard. Paternal age and parity also explains some of the variance in the twinning tendency.

High ability and personality: Investigation of the mathematical ability and personality of six-year-old twins

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A hundred MZ and DZ twins' mathematical ability was investigated by the Neményi method before entering school. Children with very high and very low achievement were further examined together with their twins. We suppose that there are differences in the factors B, C, E, G, H, O in the Cattell ESPQ test between our extreme groups. Differences between children (with very high and very low mathematical achievement) and their siblings are also analysed in all the variables. Mathematical creativity and the creativity measured by Torrance test are compared as well, in both relations, as we assume that there is a strong correlation between the two creativity tests. The research helps us to understand the relation between the mostly inherited mathematical abilities and the personality traits influenced by the twin situation.

Study of gene-environment effects of development of hyperopia: A study of 191 adult twin pairs from the Finnish Twin Cohort Study

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The Finnish Twin Cohort material was used to estimate genetic and environmental effect in the etiology of hyperopia (farsightedness). All twin pairs in the cohort born before year 1927 (ages 60 years and over at the time of the study), with both members alive, were sent a questionnaire. The questionnaire included questions of past and present

eye diseases, visits to ophthalmologists, use of glasses and other vision related questions. The hyperopia was assessed by asking the patients to send their last prescription for glasses to the authors. Twins with any eye disease affecting refraction (cataract, corneal damage), operation or trauma to their eyes were discarded from the present study. In 191 pairs (80 MZ and 111 DZ pairs) one or both members of the twin pairs had a hyperopic refractive error. Intraperson correlations of refractive error (right eye vs. left eye) in this group was high (Spearman rank correlations of 0.81-0.95) in both MZ and DZ twin pairs. The intrapair correlations were higher in MZ pairs (0.44 and 0.45) compared to DZ pairs (0.24 and 0.15) in both right and left eyes. The difference in intrapair correlations was even greater between MZ and DZ pairs, when only twin pairs (N=60) with more than two diopters of hyperopia, were included. The results suggest that genetic factors are important in hyperopia and especially in hyperopia of higher degree.

A twin analysis of effects of the Vietnam war on post-traumatic stress symptomatology

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This study examines the psychiatric impact of military service using a sample of 2,224 male-male MZ twin pairs who served on active duty during the Vietnam era (1965-75). Symptoms of post-traumatic stress disorder are ascertained in three distinct clusters according to the current psychiatric diagnostic system as published in the *Diagnostic and Statistical Manual III-R*: a) persistent reexperiencing of the traumatic event, b) persistent avoidance of stimuli or numbing of general responsiveness, and c) persistently increased arousal. Symptoms of reexperiencing the traumatic events increase sharply with increasing combat; a twin with high combat exposure is 16 times more likely to report nightmares (95% confidence interval, 8.0 to 35.5), 21 times more likely to report painful memories (95% confidence interval, 9.8 to 46.3), and 11 times more likely to report flashbacks (95% confidence interval, 5.4 to 26.6) than his cotwin who did not serve in Southeast Asia. Symptoms related to numbing and arousal dis-

play smaller associations with combat. A presumptive diagnosis of post-traumatic stress disorder was almost nine times more frequent in twins who experienced high combat (95% confidence interval, 4.3 to 18.5). Thus, combat has had a profound impact on the current psychological health of Vietnam veterans.

The function of the secret language in twins: A neuropsychological hypothesis

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In twin subjects, the psychological differentiation (*Zazzo*) intrinsic to the life of the couple, is referred to the natural overproduction of connections during development (formation of neuronal primary repertory in Edelman's view) and to the following extensive loss of synapses occurring as a normal development (formation of secondary repertory). The secret "cryptophasic" language and the exclusive communication between twin partners are interpreted as the moment of homologation of psychological and neuronal structure, with cohesive function, and balancing for the couple relation. Theoretic studies are confirmed by situations which have been longitudinally followed and which are briefly reported.

A study of common genetic variability between personality, depression and premenstrual syndrome reporting

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Previous research had indicated that PMS may contain a genetic component. Information about menstrual cycle variables, however, was obtained retrospectively. As a consequence, the genetic component may have reflected differential reporting resulting from personality or current mood. Data was obtained from 245 MZ and 170 DZ female twin pairs recruited through the London and Birmingham registers. In addition to menstrual cycle variables, extraversion and neuroticism from the EPQ and depression from the Zung depression scale were assessed. Maximum likelihood estimation was used to fit multivariate factor models to the data. These analyses tested whether

the genetic contribution to premenstrual symptom reporting, indicated by previous research, could be accounted for either by genetic variation in (non-cyclical) personality variables, or a transient mood state. Analyses are currently in progress.

High resolution electrocardiography in Cooley MZ twins

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We studied a pair of MZ Cooley twins aged 5 years, who underwent transfusional and chelating therapy from the age of 6 months. We found a high similarity in standard ECG tracings regarding spatial vector orientation and F-wave, QRS and T-wave morphology. High resolution tracings, instead, showed differences concerning particularly amplitude and spike numbers of the atrial activation waves and confirmed similarity of ventricular activation. The differences between the two techniques may be due to a higher sensitivity of high resolution electrocardiography that demonstrates early atrial involvement.

High resolution electrocardiography in newborn DZ twins

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High resolution electrocardiography (HRE) was previously found to show higher similarity in tracings of adult MZ than DZ twins. In this study, we performed HRE in two pairs of newborn DZ twins and found that atrial and ventricular activation and morphology showed some differences between DZ cotwins also in the neonatal period. These differences are not due to the maturational process. HRE allows us to detect these findings in a more precise way than standard electrocardiography.

The feasibility of twin studies in third world countries: The Barbados experience

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Twin studies are known to be an economical method to understand the relative influence of genetic and environmental factors on chronic diseases. Therefore, in countries with limited resources, twin studies should be particularly attractive. We tested the feasibility of the twin model in Barbados – a third world country – with an established twins association. The study, the Twins for LifeTM Research Project: The Barbados Study, was designed to understand why many Barbadians suffer from high blood pressure. The Barbados Twin Association (BTA) gave us a list of 200 twin sets (TS). We selected 75 TS which met our criteria: 16 years of age or older, same sex, both on the island during the week of the study. Of the 75 TS which met our criteria, 52 TS agreed to take part, 21 expressed a desire to participate but could not agree on a time, and 2 refused. Out of the 52 TS which scheduled an appointment, 9 TS did not appear (7 sent regrets and cancelled); thus, 43 TS participated in the study (included ECG, blood and urine analysis, and 24 hour blood pressure monitoring). Preliminary findings from an exit interview were as follows: 46% of the subjects said they participated in the study primarily to “help mankind”, 34% to “learn facts about twins”, 12% for “curiosity”, 3% for “free medical checkup”, and 4% for “other” reasons. In addition 100% of the subjects said they would participate in a future Twins for LifeTM project. We attributed the tremendous response to local media stories, personal commitment of the key recruiters (TWW & DMW), and to the active involvement of the BTA. In the future, we will test the feasibility of the “Twins for LifeTM” model in Nigeria, another Third World country, but without an active twins association.

A study on prognosis of one surviving cotwin

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It has been suggested that the surviving cotwin and the mother are seriously affected when intrauterine fetal death of one MZ twin has occurred. Several authors have reported the brain damage in the surviving twin coexisting with intrauterine death of a MZ cotwin. Most of such instances are monochorionic and they have vascular communication between paired twins in the placenta. In a total of 133 pairs of monochorionic twins, death of one twin during pregnancy occurred in 33 cases (24.8%). Of 33 surviving twins, 8 babies have suffered from pencephaly, cerebral palsy and other abnormalities. More unfavorable prognosis was recognized when a cotwin died in the latter half of pregnancy, while when a monozygous cotwin died in the early stage of pregnancy, a surviving twin uneventfully grows to term in most cases. We will present some clinical cases and discuss the factors which may affect the prognosis of a surviving cotwin.

Variation of chosen characteristics of muscles of the lower limb in pairs of fetal twins

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The studies were conducted on 120 fetuses of single pregnancies (both males and females) and 58 pairs of fetal twins (17 pairs of females, 22 of males and 19 of opposite sex) at 4 to 7 months of fetal age. Based on the extensive scientific literature concerning the differentiation of the muscles of the lower limb among the adults, investigation of variation of analogous features of muscles among human fetuses were undertaken. The analysis of the material enable to make following statements:

a) Variation within the joints of m. gluteus maximus, m. adductor magnus, m. extensor digitorum longus, m. peroneus tertius, m. tibialis anterior, m. flexor hallucis longus and m. solleus; b) Variation of existing and the manner of division of m. gemellus superior and inferior, m. peroneus longus and m. plantaris with regard to its belly and tendon; c) Variation in the manner of joints long head and short head m. biceps femoris and variation of division of m. semimembranosus; d) Variation of characteristics of heads of m. gastrocnemius and variety of its joints with the m. solleus. The remaining muscles of the lower limb have not showed variety considering the aspect of the

planned studies. Then the variations of analogous features of muscles among pairs of twin fetuses were analysed. The statement has been made that, taking into account the above mentioned features of muscles, differences are bigger among pairs of fetuses of opposite sex than in pairs of fetuses of the same sex.