

NEWS, VIEWS AND COMMENTS

The 16th International Twin Congress: Highlights from Madrid/Twin Research: Twin Study of Partner Aggression; ABO Incompatibility in Dizygotic Twins; Growth Discordance in a Monoamniotic Twin Pair; Quick Note on Twin Implantation/In the Media: Long-Lost Twins Found; NASA Twin Experiment; Twin Brothers and the Las Vegas Attack; Retired Twin Airline Pilots; Twin Film Clips

Nancy L. Segal

Department of Psychology, California State University, Fullerton, CA, USA

Highlights from the 16th International Twin Congress, held in Madrid, Spain from November 16–18, 2017, are presented. The Twin Congress, formerly held every three years, now takes place biennially with a single-day meeting organized during the off years. This meeting is the largest gathering of scientific twin researchers, medical personnel, and representatives of multiple birth organizations in the world. This overview is followed by reviews of recent twin research and commentary concerning partner aggression, ABO incompatibility in dizygotic twins, growth discordance in a monoamniotic twin pair and twin implantation. The article closes with summaries of timely topics in the media, namely a father's finding of his long-lost twin children, early results from the NASA twin experiment, twin brothers at the center of the October 2017 Las Vegas attack, retired twin airline pilots, and clips from recent films with twin-based themes.

The 16th International Twin Congress: Highlights from Madrid

The 16th Congress of the International Society for Twin Studies (ISTS) took place in Madrid, Spain, from November 16–18, 2017. The 93 participants represented 23 different countries, while the 261 attendees came from 40. The most highly represented nations were Spain, Italy, and Finland. The congress was made possible by contributions from seven supporting industries. Gian Carlo di Renzo (Italy) was Chair and Jennifer Harris (Norway) was Chair of Programming. Other members of

the International Program Committee included José Luis Bartha and Juan Ramon Ordanna (Spain), Jeffrey Craig and Monica Rankin (Australia), Ruben Quintero, Roberto

ADDRESS FOR CORRESPONDENCE: Nancy L. Segal, Department of Psychology, California State University, Fullerton, CA 92834, USA. E-mail: nsegal@fullerton.edu

Romero (United States), Kurt Hecher (Germany), Asma Khalil (United Kingdom), Liesbeth Lewi (Belgium), and Gonneke Willemsen, and Enrico Lopriore (The Netherlands). The event organizer was MCA, an outfit that has arranged past meetings of ISTS.

The congress commenced with nine pre-congress workshops on varied aspects of multiple pregnancy, epigenetics, multiple birth organizations, twin research registries, and early twin research careers. The first day ended with an opening ceremony that included the presentation of the prestigious James Shields Award for Lifetime Achievement in Twin Research, a special invited lecture and a welcome reception. The following two days included three keynote talks, sixteen parallel sessions, and six poster walks on diverse twin-related topics concerning biological and psychological twin research. This article summarizes selected highlights from selected sessions of the congress.

A pre-congress session was devoted to different topics in the study of epigenetics. Jenny Van Dongen (Netherlands) defined the field as molecular mechanisms regulating gene expression that are transmissible. She cited her work showing that monozygotic (MZ) twins who smoke have lower methylation levels than their non-smoking co-twins. Elina Sillanpaa (Finland) noted that telomere length and DNA methylation age serve as 'epigenetic clocks'. Long-term physical leisure-time activity has only minor effects on aging after controlling for genetic factors. Jeffrey Craig (Australia) listed non-shared environmental intrauterine effects that can differ between twins, such as placental dimension, cord insertion, and cord torsion. There is evidence that some MZ twins are more epigenetically different than unrelated infants due to such prenatal influences.

Susan Bailey (United States) delivered the special opening lecture at the conclusion of the first congress day. Her presentation, 'Assessing Telomere Length and Telomerase Activity in Twin Astronauts', included early findings from the co-twin control experiment involving MZ twins and astronauts, Mark and Scott Kelly. Scott volunteered to live at the International Space Station for nearly a year while his MZ co-twin Mark remained on earth. This study is NASA's first venture into the study of omics, such as epigenomics and DNA sequencing, for which these twins are playing vital roles. Before and after his flight, Scott's telomeres were unexpectedly longer than Mark's, a sign of increased aging. However, it may be that Scott lost cells with shorter telomeres, leaving cells with longer telomeres present, rather than showing biological aging.

Roberto Romero (United States) delivered a keynote lecture on the second conference day titled, 'Progesterone for the Prevention of Preterm Birth in Twin Gestations: Two Parallel Stories'. He noted that reduced progesterone is associated with cervical ripening, whereas administering progesterone is associated with reduced preterm birth and, consequently, better health outcomes for twins. Jordana Bell (United Kingdom) presented her keynote lecture,

'Twin Studies of Obesity: An Epigenetic and Microbiome Perspective', on the final conference day. She noted, among other things, that epigenetic variation in blood is related to obesity and metabolic disease, and that host genetic variants may operate through epigenetic pathways — cross-omic studies in relevant tissues may uncover mechanisms involved in obesity. The three speakers, Drs Bailey, Romero, and Bell, are shown in [Figure 1](#).

The Bulmer Symposium, hosted once again by Catherine Derom (Belgium) and Nils Lambalk (Netherlands), included a series of papers on the biological bases of twinning. Hamdi Mbarek (Netherlands) described two gene variants (*FSHB* and *SMAD-3*) associated with ova maturity and ovarian responsiveness to *FSHB*, respectively. Claudio Stern (United Kingdom) described cell communication in embryos that prevents zygotic division. He also discussed genetic research on families with unusually high frequencies of both MZ and DZ twinning in India and Brazil. Robert Berkhout (The Netherlands) discussed double embryo implantation, noting that an additional embryo of either good or poor quality does not affect the chance of pregnancy. In other words, double embryo transfer increases the multiple birth rates, but not the pregnancy rate. Henrike Peters (Netherlands) reported on chimerism in dizygotic (DZ) twins after describing the freemartin effect in male–female, opposite-sex cattle twins — the well-known sterility of these female co-twins is explained by prenatal exposure to male hormones. Given the possible human parallels that have produced many interesting but mixed findings, she noted that (1) some sex-discordant monochorionic DZ twins show urogenital anomalies and (2) the Mayer–Rokitansky Küster–Hauser (MRKH) syndrome (Genetics Home Reference, 2017) is phenotypically identical to the freemartin effect seen in cattle. Specifically, the MRKH syndrome occurs in females and causes underdevelopment or absence of the vagina and uterus, although the external genitalia are normal. Catherine Derom continued the discussion of monochorionicity in DZ twin pairs, based on her well-known Leuven twin study. Jeffrey Craig (Australia) argues that single chorion DZ twins are not as rare as many researchers have assumed. Chorionicity can be diagnosed at 12 weeks' gestation, 24 weeks' gestation, and at delivery. Nick Martin (Australia) noted that, seven years ago, linkage studies looking for genes predisposing women to conceive DZ twins did not appear promising. This situation has changed in recent years with replicated findings regarding the *FSHB* and *SMAD-3* genes referenced by Mbarek. Bruno Reversade (Singapore) was not in this session, but his paper described how the hormone *ELABELA* (*ELA*), may enhance placental development, preventing pre-eclampsia (gestational hypertensive syndrome), a condition affecting many multiple pregnancies; see also Ho et al., 2017).

I organized and chaired a symposium to honor the society's late colleague, Dr Irving I. Gottesman, who left a rich legacy of twin research. Topics included

**FIGURE 1**

(Colour online) The Twins Congress special lecture and keynote speakers (left to right) Drs Susan Bailey, Roberto Romero, and Jordana Bell. (Photo credit: Nancy L. Segal.)

personality, psychopathology of reared-apart twins, and much more, as well as personal reflections from his former students and colleagues. Papers from the participants in this session, namely Lisabeth DiLalla, David DiLalla, Sheri Berenbaum, Eric Turkheimer, Danielle Dick, myself (United States) and Kaare Christensen, to be co-authored with one of Gottesman's close colleagues, Aksel Bertelsen who could not attend the congress (Denmark), will appear in a special 2018 issue of *Twin Research and Human Genetics*.

Congress Participants, Officers and Winners

A novel, informative, and very meaningful session titled 'Participant Engagement and User Involvement in Twin Research: Let's Talk About Lessons Learned and Ideas Going Forward' brought together twin researchers and representatives of multiple birth organizations and registries. The discussion was designed to strengthen communication and activities among these different groups. Many themes were raised, a frequent one being the need to rethink mandatory policies for separating twins at school. A related topic was the unfortunate readiness of teachers and professors to charge twins with cheating if they produced similar test scores and assignments. The need to work more closely with educational personnel was emphasized.

A session held toward the end of the final day of the congress concerned 'The Use of Twins in Unraveling the Microbiome'. Joochan Sung (South Korea) concluded that irritable bowel syndrome might have two components: (1) dominant psychological symptoms such as anxiety that affect the gut, and (2) increased gut symptoms among some

individuals in which microbial dysbiosis (imbalance) might play more critical roles. Tim Spector (United Kingdom), in collaboration with Claire Steves and others, reviewed research on the genetics of over-eating and under-eating, the heritability of fecal metabolites, and the heritability of some relevant 'environmental traits', such as junk food preferences and vegetarianism. Longitudinal studies of the metagenomes (the collective genome of microorganisms from an environmental sample; Nature.com, 2017) of twins over the age of 4 years, as well as studies of the microbiomes of twin participants in BabyTwinsUK (from birth through age 5) are planned. Serena Verdi (United Kingdom) found a negative association between cognition and gut microbiota diversity and various taxa that stayed significant after controlling for frailty associated with physical health. A paper by Wendy Cozen (United States, who was not present) noted that gut bacteria influence immune responses. Using data from twins enrolled in the University of Southern California International Twin Study, she found that adolescent and young adult survivors of Hodgkin lymphoma show fecal microbiota that differ those of their unaffected co-twins.

A key activity of the congress was the election of new officers and board members. The society welcomes Jeffrey Craig as President-Elect and Asma Khalil as Secretary General. New and continuing board members include Bart Baselmans, Lucia Colondro Conde, Nancy Segal, Karri Silventoinen, and Petra Zwijnenburg. Thanks are due to Jennifer Harris (Past President) and Gonneke Willemssen (Past Secretary General) for outstanding contributions to the society. Mark Kilby will remain on the Advisory Board as a representative of all aspects of the society, and Bart Baselmans will currently represent members who are Ph.D.

candidates. Jennifer Harris will remain on the board as Past President, and Nick Martin will continue as Treasurer and Editor of *Twin Research and Human Genetics*.

The 2017 Galton Award for Best Student Paper was given to Robbert Berkhout (the Netherlands) for his work on double embryo implantation, and the Gedda Award for Best Student Poster was given to Dongli Liu (Australia) for work on the genetic mechanism underlying the dietary fat influence of fat taste. The James Shields Award went to Thalia Eley (United Kingdom).

Other activities concerned the International Network of Twin Registries (INTR), a working group for early inves-

tigators whose spokesperson is Lucas Ferreira (Australia). The relationship of this group to the larger ISTS will be revisited. ISTS also has a Twitter account to increase its presence on social media, run by Bart Baselsman. An individual who will be responsible for this account will be identified shortly.

The 17th biennial meeting of the ISTS is scheduled for November 2019 and will take place in Hong Kong. The local host for this congress is Dr Liona Poon from the Chinese University. Additional details about this meeting will be provided as they become available.

Twin Research

Twin Study of Partner Aggression

Intimate partner aggression (IPA) is known to run in families, but as the authors of the first twin study on this topic point out, most explanations rest on environmental effects (Hines & Saudino, 2004). However, studying twins tells a different story. Even though this twin study was reported over 10 years ago, it is worth summarizing, given the continuing importance of this topic for couples and their families.

One hundred and eighty-five twin pairs (144 MZ and 41 DZ) completed the physical and psychological aggression scales of the Revised Conflict Tactics Scale. Prior to analysis, it was determined that no twin group differences in the prevalence or frequency of aggression were detected. Higher MZ than DZ intraclass correlations for Aggression Use, both psychological (0.25, MZ; -0.14, DZ) and physical (0.17, MZ; 0.05, DZ) were observed. The same correlational pattern was also observed for Aggression Receipt, both psychological (0.26, MZ; -0.08, DZ), and physical (0.17, MZ; -0.13, DZ). Genetic factors accounted for 16–25% of the variance in these four measures, with the remaining variance explained by non-shared environmental effects.

These findings pose considerable challenge to extant environmentally based theories of IPA. Replication of this work is, however warranted, especially with a larger DZ twin sample.

ABO Incompatibility in Dizygotic Twins

Mother–infant blood group incompatibility can result in a range of medical consequences for their infants, ranging from an absence of symptoms to severe hemolytic anemia with jaundice. A unique case report documents ABO incompatibility between male and female twin infants both with their mother (Mundy & Bhatia, 2015). The twins' mother was blood type O+, whereas both twins were blood

type B+. The twins were born at 36 weeks' gestation, with Apgar scores of 8 and 9 at 1 and 5 min after birth, respectively. The male twin displayed no symptoms of ABO incompatibility, in contrast with his female co-twin who showed ABO hemolytic disease. Only two previous cases have documented such wide-ranging differences in DZ twins. Interestingly, female infants generally suffer less severely than male infants from ABO incompatibility as in the two earlier reports, so the present case is atypical in this respect. Further research into the bases of adverse effects from ABO incompatibility in newborns is warranted.

Growth Discordance in a Monoamniotic Twin Pair

Growth discordance in the rare pairs of monoamniotic twins is usually associated with twin-to-twin transfusion syndrome. A case of fetal growth discordance detected in the second trimester of pregnancy is, therefore, of interest (Guo et al., 2017). Examination by ultrasound revealed that the two umbilical cords were joined into a single cord located 1 cm from the insertion point into the placenta. Most significantly, however, was the fact that the diameters of the cords differed substantially (1.5 cm vs. 0.8 cm), causing an unequal distribution of blood and nutrients. The novel conclusion from this case is that the twins' growth discordance was most closely related to the cord-size discordance. Increased attention to this feature in monoamniotic pregnancies was emphasized.

Quick Note on Twin Implantation

I came across this sentence in a newspaper article on conception by University of Southern California Professor of Obstetrics and Gynecology, Dr Richard Paulson (2017): 'It [the multicellular preimplantation embryo] is also potentially more than one individual, since identical twins

are the result of a single implantation' (p. A13). I wondered if this was a reference to in vitro fertilization (IVF) twins, reasoning that MZ twinning can involve separate implantations. Dr Paulson's response was that early zygotic splitting *does* involve two implantations. In contrast, the more common later splitting that produces

monochorionic–diamniotic MZ twins involves single implantation, the formation of two fetal plates (the fetal part of the placenta made up of the chorionic plate with its placental villi, cytotrophoblast layer, and intervillous spaces; Human Embryology, 2017) and a single placenta (Paulson, 2017, personal communication).

In the Media

Long-Lost Twins Found

Forty-year-old Roberto Gaspar lost track of the twin sons he had fathered in Canada 21 years ago (Stevenson, 2017). His then girlfriend, the twins' biological mother who passed away last year, had relinquished them and their sister Angelica for adoption soon after they were born. The twins were adopted together, while their sister was raised by a different family. However, their father never forgot about his two sons, even while raising a new family of his own. He decided to place a post on Facebook and was shocked to learn that within days it had been shared over 27,000 times. The post finally reached one of his sons in Edmonton, Ramando Gaudette, who was stunned to see the resemblance between himself and his father in the photo that had accompanied the post. Ramando contacted his twin brother, Robert, and the next day, the father and two sons had a three-way conversation. The twins appear to be identical, based on inspection of a photograph showing them as newborns.

Aside from finally knowing their father, the twins learned that their sister had been found and they look forward to meeting her, as well. A family reunion is planned for the December holidays, 2017. Uncles, aunts and grandparents will attend this event to be hosted by Roberto Gaspar at his Manitoba home. It will be an exceptional gathering — moreover, the separation of genes and environment involving the twins, sister, and father would make for an extraordinary case study.

NASA Twin Experiment

Preliminary results from NASA's co-twin control experiment have been released (IFL Science, 2017). The identical twins in question are astronauts Scott and Mark Kelly who volunteered to participate in a study in which Scott would live at the International Space Station for nearly a year, while his twin brother would remain on earth. (Also see the results reported at the International Twin Congress by Susan Bailey, described above.) This unique situation allows novel insights into the effects of space travel on human behavioral and physical functioning because the genes are controlled. Recent findings are that living in space increases DNA methylation, a process affecting gene expression; in

fact, some of these epigenetic changes lasted temporarily after Scott returned to earth. Results from this research concerned with the effects of microgravity on body organs, perception and reasoning, and the microbiome will be released as data analysis continues.

Twin Brothers and the Las Vegas Attack

Thirty-three-year-old identical twin brothers, Detective Casey Clarkson and Sargent Branden Clarkson, were caught up in the vicious attack on the October 1 country music festival in Las Vegas, Nevada (Medina, 2017). It was Casey's first overtime shift in 4 years and when he heard gunfire he headed toward the concert area to help people to safety. He was injured in the neck, either by shrapnel or by a bullet, but continued working. His twin brother heard about the attack and texted his twin, but even though he received no response he assumed that Casey was safe and just doing his job. Then he learned that his twin had been taken to a hospital, but was not injured fatally, yet he continued doing his own work at the command center. But when the twins were reunited, there was silence as they hugged.

Retired Twin Airline Pilots

British airline captains and identical twins, Jeremy, and Nick Hart, celebrated their 60th birthday and retirement by landing their planes together at Heathrow airport (BBC, 2017). Between them they have clocked 45,000 h of flying time. The twins never flew together because they were both captains. They also worked for different airlines — Jeremy was employed by British Airways and Nick flew for British Midland. However, their identical appearance caused them to be confused from time to time. On one such occasion, Nick noted that his brother had never mentioned to anyone that he had a twin, causing a startled British Airways pilot to ask what 'Jerry' was doing wearing a British Midland uniform.

Twin Film Clips

Identical twins are often used in film, most likely because of their visual interest, as well as their behavioral resemblance and close social connection. Twins are also convenient

devices for exploring dualities, such as good and evil. Two recent films will intrigue both twins and researchers who study twins. The first is *Indivisible*, the third feature from Italian director Edoardo De Angelis, which may be loosely based on the well-known conjoined vaudeville twins, Daisy and Violet (Catsoulis, 2017). A summary of the film indicates that the twins express different reactions to people and experiences, which is not atypical for conjoined twins (Segal, 2000). The fact that Daisy and Violet are played by actual identical twins, Angela and Marianna Fontana, is welcome news; I have seen films and plays in which identical twins are depicted by non-identical individuals, making it hard for viewers to take many of the scenes seriously.

Thy Father's Chair is a documentary film featuring a pair of identical male twins from Brooklyn, New York's Hasidic Jewish neighborhood (Crust, 2017; Wild About Movies, 2017). The twins are shown living a secluded existence after the deaths of their parents to the point that authorities must intervene and clean their apartment, which poses various health hazards. The film touches more broadly on issues of coming to terms with one's past and confronting one's present.

References

- BBC. (2017, September 30). Twin airline pilots retire by landing at Heathrow together. Retrieved from <http://www.bbc.com/news/uk-england-41446043>.
- Catsoulis, J. (2017, September 13). Review: What happens when conjoined sisters have divergent desires? New York Times. Retrieved from <https://www.nytimes.com/2017/09/13/movies/indivisible-review.html>.
- Crust, K. (2017, October 15). The father's chair. The guide: Movies. *Los Angeles Times*, p. E10.
- Genetics Home Reference. (2017, November 26). Retrieved from gnr.nlm.nih.gov/cond.
- Guo, Y., Sun, Y., & Yang, H. (2017). Growth discordance of monoamniotic twin because of difference of cords diameter in forked umbilical cord: Case report. *Medicine*, 96, e8042.
- Hines, D. A., & Saudino, K. J. (2004). Genetic and environmental influences on intimate partner aggression: A preliminary study. *Violence and Victims*, 19, 701–718.
- Ho, L., Van Dijk, M., Chye, S. T. J., Messerschmidt, D. M., Chng, S. C., Ong, S., ... Lim, C. Y. (2017). ELABELA deficiency promotes preeclampsia and cardiovascular malformations in mice. *Science*, 357, 707–713.
- Human Embryology. (2017). 10.2 Development of the placental villi. Retrieved from <http://www.embryology.ch/anglais/fplacenta/villosite04.html>.
- IFL Science. (2017). NASA's twin study reveals something very, very strange happens to your genes in space. Retrieved from <http://www.iflscience.com/space/nasa-twin-study-shows-that-space-travel-alters-gene-expression/>.
- Medina, J. (2017, October 6). 'My stomach dropped': Harrowing night for twin brothers of the Las Vegas Police. New York Times. Retrieved from https://www.nytimes.com/2017/10/06/us/vegas-police-casey-clarkson.html?_r=0.
- Mundy, C. A., & Bhatia, J. (2015). Variable clinical presentations of ABO incompatibility in dizygotic twins. *Neonatal Network: Journal of Neonatal Nursing* 34, 317–319.
- Nature.com (2017). "Metagenomics," <https://www.nature.com/subjects/metagenomics>.
- Paulson, R. (2017, October 26). Why life doesn't begin at conception. *Los Angeles Times*, p. A13.
- Segal, N. L. (2000). *Entwined lives: Twins and what they tell us about human behavior*. New York: Plume.
- Stevenson, S. (2017, October 22). Father finds long-lost twin sons in Edmonton. Retrieved from <http://www.cbc.ca/news/canada/edmonton/roberto-gaspar-twins-reunited-1.4364716>.
- Wild About Movies. (2017). *Thy father's chair*. Retrieved from <http://www.thyfatherschair.com/>