

NEWS, VIEWS AND COMMENTS

Twin Reunions: The Science Behind the Fascination/Twin Research Reports: Altitude and Hypoxia; Twin Pregnancy Outcomes; Space Mission/Media Highlights: Chinese Twins Reunited; Twin Loss Discovered; Hidden Twins; Twin Euthanasia; Twin Savior

Nancy L. Segal

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

A description of the unique qualitative features of reunions between separated monozygotic twins is presented. The scientific implications of these observations are considered with reference to understanding human social behavior in general. This is followed by summaries of twin research on altitude and hypoxia, pregnancy outcomes, and space travel. Finally, recent accounts of twins in the media are noted; in particular, a rare reunion of adult monozygotic male Chinese twins, a novelist's personal discovery of twin loss, two renowned but 'hidden' twins, the moving story of an identical Belgian pair, and a twin savior.

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Twin Reunions: The Science Behind the Fascination

When twins reunite they teach us many things about human behavior just by acting naturally. Over the past several years, I have been privileged to witness the first meetings of some separated twins or to hear about the reunions from their families. The reactions of onlookers, in particular relatives and friends, are also rich with information about social affiliation and social values.

Two exemplary reunions involved young monozygotic (MZ) female Chinese twin pairs, aged 6 and 9 years. Twins in the younger pair stared at each other momentarily, then jumped up and down in unison. Twins in the older pair walked toward one another slowly but eagerly, wrapped their arms around one other and held the embrace for several moments. The co-twins in both pairs had been raised in different countries, so the children did not speak the same language. However, to watch them at play almost imme-

diately after meeting showed that this hardly mattered — there was a natural ease with which the co-twins in each pair approached and responded to one another. Members of the media who were present at one of the meetings variously smiled, shouted, and wept. Anyone who heard about these reunions later was intensely interested.

Another recent reunion of 22-year-old MZ female twins, born in South Korea, occurred more or less online (Futerman, 2013; *Huffington Post*, 2013, April 4). Like the young twin children, these adult twins had been also raised in different countries, one in the United States (Samantha) and

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

**FIGURE 1**

(Colour online) These MZA Chinese twin girls were recently reunited. Photo Credit: Dr. Nancy L. Segal.

the other in France (Anais), although the French twin spoke excellent English, having studied in London. The twin raised in the United States is an actress, and a video of one of her performances had been posted on the Internet and seen by her sister's friends. They were astonished to see the striking similarities in appearance, posture, and speech between the two. Another video was posted shortly thereafter, providing Samantha's name in the credits. A series of Facebook communications followed and the likelihood of the women being MZ twins increased as they exchanged information. A documentary film about the twins and their lives is in production with filmmaker James (Jae) Yi.

The twins were born in South Korea on November 19, 1987. Samantha was placed in foster care with Spence-Chapin Adoption Services, while Anais was placed with Holt International Child Services. Why two separate agencies were involved is unknown. Samantha was raised in New Jersey with two older brothers who were the biological children of her adoptive parents, while Anais was raised in Belgium and France as an only child. Samantha attended the High School of Performing Arts in New York City and earned a Bachelor of Fine Arts degree from Boston University, while Anais received a Bachelor of Arts degree in textiles from ENSAAMA Olivier de Serres (École Nationale

Supérieure des Arts Appliqués et Métiers D'Art). She has been working toward a graduate degree (BA + 3) degree in fashion design from the Central Saint Martins College of Art and Design in London.

I met Samantha and her producer several times because they live in Los Angeles, in close proximity to my university. Samantha is a beautiful, lively, and talented young woman. She shares many behavioral attributes with her twin sister. Despite their years apart, both twins sleep 10 hours every day, eat continually while awake, crave cheese despite their shared lactose intolerance, and have a 'twisted' sense of humor. I have never met Anais — she visited Samantha in Los Angeles while I was attending the Behavior Genetics Association meeting in Marseilles, and returned home just as I did. However, in my absence my students invited the twins to California State University Fullerton's Twin Studies Center and administered a battery of tests and inventories. Watching a joint taped session of the twins revealed the familiar blending of personalities and temperaments. I also observed the same ease of interaction so characteristic of the younger twins.

Many psychological studies have demonstrated stronger and more enduring social relationships between MZ than dizygotic (DZ) twins who are more variable (Segal, 2000,

2012). However, few studies have quantified social relatedness between twins reared apart. In 2003, I studied the social relationship information provided for twins in the three early monozygotic reared apart (MZA) twin studies (Juel-Nielsen, 1965; Newman et al., 1937; Shields, 1962). Forty of the 54 pairs for whom information was available developed close social relations soon after meeting (Segal et al., 2003). Based on data from the Minnesota Study of Twins Reared Apart, I also showed that MZA twins expressed greater closeness and familiarity than dizygotic reared apart (DZA) twins, and that both types of twins felt closer to their newly found co-twins than to the unrelated siblings with whom they had been raised (Segal, 2012). More recently, I obtained parental observations of young Chinese twins meeting and leaving one another for the first time (Segal et al., 2011). Only 10 pairs were available at the time (5 MZA and 5 DZA), too few to organize the data by zygosity. However, twins older than 18 months were strongly attracted to one another, while leave-taking behaviors proved more variable. Plans are in place to follow these children as they mature.

The three twin reunions described above are consistent with the more formal, quantitative analyses of twin relationships. These rare reunions also allow unique tests of evolutionary-based hypotheses concerning social relatedness. Evolutionary theory predicts that cooperation, altruism, and related behaviors should occur more frequently with increasing genetic relatedness. This is based on Hamilton's (1964) theory of inclusive fitness, namely that natural selection favors genes predisposing individuals to act

in ways promoting the transmission of those genes. Alleles influencing individuals likely to carry copies of those alleles is an indirect way in which those genes can be transmitted into future generation. People do not consciously calculate their relatedness to others, but behave as though they do. As such, young children may offer the best tests of evolutionary-based reasoning because they are less aware of the distinction between twin types, and may be more likely to behave spontaneously than older reunited twins. Shields (1962) described a pair of young MZA female twins who lived close to one another, but whose parents tried unsuccessfully to keep them apart. I believe that the social glue drawing these twins together comes from their perceptions of behavioral similarities that underlie their coordinated interactions.

Interest in reunited twins is widespread, as evidenced by the extensive media coverage that such pairs inevitably attract. Why interest in these events is so high is itself an interesting and vital question. Such interest may speak of the universal importance of family ties. I have been continually impressed with the degree to which these twins' parents do everything possible to enable their children to be together and to enjoy this closest of human social relationships. Occasional families who have contacted me suspecting that their children are twins (based on physical similarities gleaned from photographs posted on web sites for parents with adopted Chinese children) have been disappointed to discover that their children are unrelated. Their disappointment may be another indication that family relationships matter.

Twin Research Reports

Altitude and Hypoxia

A recent literature review of twin research on genetic and environmental contributions to altitude acclimatization is informative (MacLeod et al., 2012). The most heritable measure proved to be the hypoxic ventilatory response (HVR). HVR refers to the body's reaction to the decreased availability of oxygen, such as reflexive increase in ventilation (Rajalingam, 2011). Large HVR values indicate a strong response, while small HVR values indicate a weak response. Heritabilities have been reported for HVR across the life span; one study reported a value of 0.70. The only twin study that examined the heritability of altitude sickness found high concordance for acute mountain sickness among both MZ and DZ twins, suggesting shared environmental influences.

The authors noted that small sample sizes render many of the findings questionable at present. For example,

the 0.70 HVR heritability was based on only 12 MZ and 12 DZ twin pairs. Further behavioral genetic analyses of response to hypoxia, including candidate gene association and genome-wide association studies were encouraged.

Twin Pregnancy Outcomes

Researchers in Israel compared twin pregnancy outcomes among women aged 45 years and older ($n = 32$) with women aged less than 40 years ($n = 109$; Laskov et al., 2013). The older group included women who had conceived via in vitro fertilization (IVF) with ovum donation. The control group of younger women included those who had conceived via IVF and delivered during the same time period. Delivery before both 37 and 32 weeks occurred significantly more often among older mothers than younger mothers (65% vs.

40%, and 15% vs. 5%, respectively). In addition, the rate of maternal complications and intensive care was significantly higher among older than younger mothers (18% vs. 2%, and 6.3% vs. 0%, respectively). The authors suggested that older mothers may be less well adapted to successful multiple pregnancies, and that single-embryo transfer may be recommended to increase the likelihood of favorable pregnancy outcomes.

Space Mission

In 2015, NASA scientists will conduct the near perfect experiment to assess the physical and behavioral effects of space travel: Identical twin Scott Kelly will spend one year living in the International Space Station, while his brother Scott will remain on earth (Aron, 2013). The twins provide perfect genetic controls for one another. However, this ex-

periment is not new, as I have documented elsewhere (Segal, 2000).

It seems that some scientists have overlooked astronaut and identical twin Charlie Duke. Duke participated in the 1972 Apollo 16 mission to the moon, while his brother Bill, a physician, stayed behind. Bill suffered from congenital cardiac weakness, so this unintended 'experiment' clearly had confounds. In discussing these twins, I also indicated that they offered a novel test of Einstein's 1905 twins paradox — that time would pass more slowly for the space-bound twin than for his earth-bound co-twin. As such, upon reunion the former would be the younger twin because aging is a function of time. To some degree, the Duke twins provided a better test of the paradox than will the Kellys because both Kelly twins have had experience in space. A NASA scientist's claim that 'the only twins [the Kellys] we have access to are both astronauts' warrants revision.

Media Highlights

Chinese Twins Reunited

Zeng Yong and Liu Yonggang are identical twins, but neither knew this until they turned 41 years of age (*Huffington Post*, 2013, July 16). Zeng Yong's friend told him about a man living in a different city in China 125 miles away. The two friends were able to locate Zeng Yong's look-alike, after which the twins found their biological mother living over 1,000 miles away. It seems that extreme poverty made giving up her twin sons her only viable option.

The significance of twinship is becoming increasingly recognized, so that adoption agencies are making greater efforts to place twins and siblings together in adoptive homes. However, family circumstances sometimes overrule, and private adoptions mean that some twins will be placed apart. Identical twins are fortunate in the sense that their occasional confusion by others may lead to their discovery of twinship and reunion. In contrast, non-identical twins have a much lower probability of finding one another — or even learning that they are twins.

Twin Loss Discovered

Novelist James Carlos Blake was born in Mexico, but at the age of 6 years he and his family arrived in Brownsville, Texas. Most recently, Blake is the author of a moving essay on discovering his lost twinship (Blake, 2013).

Blake's twin died at several weeks of age when a maid accidentally dropped him, causing his skull to shatter. His traumatized parents never mentioned this tragedy to their surviving son, but he learned the truth from his grand-

mother soon after leaving Mexico. When he further questioned his father about his lost twin it was denied. Over the years, Blake set that story aside. He found that while he had many friends and contacts, he experienced a chronic loneliness, what he calls a feeling of being 'incomplete'. Then, in conversation with his father, he learned that he had an older half-brother, related to him through his father. Upon hearing this, Blake recalled the story of his deceased twin. This time his father admitted that it was true, and that the two infants had been physically identical. Blake interpreted his loneliness as a longing for his twin, something that his half-brother and other siblings could not quell.

The psychological literature on twins includes numerous studies demonstrating a close social relationship between identical twins (Segal, 2000). However, there is no evidence of intrauterine knowledge of having a twin — if there were, then many of the separated twins in the Minnesota Study of Twins Reared Apart and other reared apart twin investigations would have been aware of their twinship, but many were unaware until they were told. Discovering as an adult that one's twin was lost early on can understandably lead to sadness, longing, and regret. It does not explain a lifetime of loneliness.

Hidden Twins

It may be a little known fact — it was a surprise to me — that the renowned statistician, Sir Ronald A. Fisher, was a twin (O'Connor & Robertson, 2003). Fisher was born in London, England on February 17, 1890 to parents Katie

Heath and George Fisher. The family had a total of seven children, four boys and three girls, several of whom died at a young age. Ronald and his twins were among the later-born children; unfortunately, his older twin sibling was stillborn.

I learned this interesting fact from Professor Thomas J. Bouchard, Jr., albeit indirectly. Bouchard forwarded an attachment with a note that read: ‘Did you know Fisher was a twin?’ I immediately thought of Sir Ronald Fisher, so without reading Bouchard’s attachment I reviewed Fisher’s biography to discover that he was, in fact, a second-born twin. However, when I examined the attachment I found myself reading an excerpt from anthropologist Helen Fisher’s (2012) essay on temperament. She began by referencing her own identical twinship and the temperamental differences between herself and her sister. Actually, I did know that Helen Fisher is a twin, having discussed this with her at length at an early meeting of the *Human Behavior and Evolution Society*. I did not know that Sir Ronald Fisher was a twin.

Twin Euthanasia

Identical twins, Marc and Eddy Verbessem, aged 43 years, were well known in their village (Bendavid, 2013). The twins, who were deaf, were close friends who appeared to be contented and lively — they were often seen driving together in town and communicating in sign language. However, the twins developed a genetic condition causing them to lose their vision. Given their consequent extreme discomfort and unhappiness, they sought euthanasia, a request that was ultimately fulfilled. Together with their families they shared a final cup of coffee, then received their injections.

Euthanasia is controversial, with different countries adopting different policies. The twins’ decision most likely represents a complex mix of personality traits, cultural influences, and dire circumstances. Social attitudes have a demonstrated genetic component, with approximately 50% heritability (Martin et al., 1986). A twin study that included an item on voluntary euthanasia reported intraclass correlations of 0.45 and 0.21 for MZ and DZ twins, respectively, with a heritability of 0.44 (Olson et al., 2001). The Belgian twins’ mutually agreed upon decision appears comprehensible in light of these data.

Twin Savior

Aristedes de Sousa Mendes is among the individuals honored as ‘righteous among the nations’ at Israel’s Yad VaShem Holocaust Memorial (Minder, 2013). Mendes was a Portuguese consul in Bordeaux, France when Nazi Germany invaded that nation. He and others with whom he worked provided approximately 30,000 Portuguese visas to save French citizens, beginning in 1939, shortly before the in-

vasion, ignoring Portuguese orders not to do so. He saved the lives of many Jewish citizens as well as artists, such as Salvador Dali and his wife, Gala (Sousa Mendes Foundation, 2012). Mendes began these efforts largely because of his twin brother — a diplomat stationed in Warsaw, Poland who was aware of the atrocities. Since 2011, the Sousa Mendes Foundation has been compiling a database of those who were spared because of his efforts.

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