

NEWS, VIEWS AND COMMENTS

Twins Reunited: Scientific and Personal Perspectives/Twin Research Studies: Multiple Birth Effects on IQ and Body Size; Life Style, Muscles, and Metabolism; Monochorionic Dizygotic Twin with Blood Chimerism; Amniocentesis for Twins/Twins in the Media: Identical Doctors; Freedom Fighter for Twins; Twin Scholarships; Auguste and Jean-Felix Piccard; Twins Born Apart

Nancy L. Segal¹ and Christy A. Mulligan²

¹*Department of Psychology, California State University, Fullerton, CA, USA*

²*Department of School Psychology, Long Island University, Brooklyn, NY, USA*

A reunion of 38-year-old female monozygotic twins took place in Daegu, South Korea, on January 14, 2014. Scientific and personal perspectives on this extraordinary event are provided. A review of timely twin research follows, covering the effects of multiple births on IQ and body size, lifestyle and physical fitness associations, a rare case of a dizygotic twin with blood chimerism and definitional issues surrounding amniocentesis-related loss in multiple birth pregnancies. Interesting and informative mention of twins in the media includes twin doctors, a twin freedom fighter, the availability of college scholarships for twins, a new book about the Piccard family (two of whose members were twins), and co-twins born before and after the new year. A follow-up to a previous mention of identical twin biathletes is also provided.

Twins Reunited: Scientific and Personal Perspectives

Twin reunions are meaningful at many levels. They allow quantitative analyses of behavioral and physical traits based on data from many separated sets (Segal, 2013a) as well as detailed case studies of individual pairs (Popenoe, 1922; Segal & Hur, 2008). Reared apart monozygotic (MZA) and reared apart dizygotic (DZA) twins provide scientific insights available from no other source. Specifically, the resemblance between MZA twins provides a direct estimate of trait heritability, while DZA twins provide a vital comparison group and tests of various interactions between genes and environments.

Twin reunions also afford glimpses into factors underlying human social attraction and affiliation. Comparing qualitative features of MZA and DZA twins' evolving social relationships with one another highlights the extent to which common behavioral and/or physical traits trigger and/or sustain close social relations. Research shows that

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

MZA twins recall greater closeness and feelings of familiarity toward one another at the time of meeting than to do by DZA twins. MZA twins also indicate greater current closeness and familiarity than do DZA twins (Segal et al., 2003). These tendencies do not characterize all individual twin pairs — cultural differences and other rearing circumstances may intervene in unexpected and informative ways. However, regardless of what transpires following their reunion, virtually all reared-apart twins are grateful for the opportunity to have met.

Monozygotic twins reared apart in different countries and cultures are a relatively rare subset of MZA twins. The special scientific value of this natural experiment comes from opportunities to examine cultural influences on the behavioral resemblance and social relatedness of individuals with the same genes. An article describing several such pairs appeared in an earlier issue of *Twin Research and Human Genetics* (Segal, 2013b), but given the significance of such cases, a more recent twin reunion is documented below.

On January 14, 2014, family members and the first author (Segal) witnessed the first meeting of 38-year-old MZA female twins raised separately since birth in South Korea and the United States. The reunion took place at a hotel in Daegu, located in the southeastern part of South Korea. The twin's separation occurred because the family was financially unable to care for two newborns. Unbeknownst to their mother, the twins' father, feeling that the situation left him little choice, signed papers allowing his first-born twin to be adopted. This decision caused considerable upset in the home. The twins' mother traveled to Seoul in search of her daughter, but eventually learned that the infant had been adopted by an American couple.

These twins were discovered in September 2011 when the first author received a telephone call from the American-raised co-twin, Dr Christy A. Mulligan. Dr Mulligan is an Assistant Professor of School Psychology at Long Island University, in Brooklyn, New York. Her twin sister, Yoonjeung, is a shaman who lives and works in Daegu. Dr Mulligan met Dr Segal on several occasions in New York City to complete life history interviews, cognitive tests, personality inventories, and other measures. A collaborator on this project, Dr Yoon-Mi Hur, administered these protocols to Dr Mulligan's twin sister. (The twins' monozygosity was established by DNA analysis at the start of our the study. A paper reporting findings and conclusions is currently under review, so will not be discussed here, although several new observations will be noted.) The present article focuses on the twins' reunion. Dr Mulligan was invited to provide personal commentary on this extraordinary meeting.

The reunion was orchestrated by KBS-TV, a major news outfit in South Korea. The event took place in a private room in Daegu's Novotel with filming of an hour-long

program scheduled that aired on January 25, 2014. In addition to meeting her twin for the first time, Dr Mulligan met her father (her mother had passed away), a younger brother, a brother-in-law, a niece and several nephews, and two aunts. She traversed a long hallway before turning right into the meeting room. She smiled, but with some reserve, as her sister embraced her in tears. The twins were the same height (under five feet) with very similar faces and body builds. But their contrasting facial expressions at the moment of meeting and throughout the day were striking — and different from the matched looks of excitement, thrill, and astonishment typically observed among reunited twins in the past. Dr Mulligan comments below on the personal circumstances and/or cultural factors that may have contributed to this difference.

The meeting of Dr Mulligan and her father, a slim, dignified man of 64 years, was memorable. He embraced her quietly, holding a handkerchief to his eyes. Later, upon reviewing the tape of their meeting on an iPad, he can be seen holding the hand of Dr Mulligan's husband, Tom, leaning against him and raising his handkerchief to his eyes. He had always worried about the twin daughter he had given away, a decision he deeply regretted for most of his life. In addition to meeting her for the first time, he met his son-in-law and saw photographs of two grandsons, ages 5 and 3, whom he may never know.

Following separate TV interviews with Drs Mulligan and Segal, there was an invitation to the twin's home for a traditional Korean lunch. During this time and through a translator, several things were learned about the twins. Dr Mulligan has facial freckles, but her twin sister has had them removed. Both twins had chosen tall husbands to increase their chances of having tall children. Both twins had also given birth to boys. The final event of the day was traveling to the mountainside (where the family owned a burial plot) in order to visit the twins' mother's grave. Dr Segal left Daegu for Seoul the following morning to fly home that evening, but Dr Mulligan and her husband remained in South Korea for two additional days of filming.

The twins' reunion was important with reference to both scientific understanding and human interest. The differences between these twins were as intriguing as their similarities, highlighting the ways that environments can modify genetic expression. It is likely that the years of guilt and worry over the adopted away twin's happiness and well-being explain the family's emotional response to finally meeting her. And perhaps Dr Mulligan's secure childhood and successful adulthood helped shape her reactions, as well. One may wonder how Dr Mulligan felt upon observing a life that she would have led had her early placement in an orphanage not been made. In addition, it is interesting to consider whether the twins would have reacted in kind if their positions had been reversed — it is likely that the answer would be yes.

Personal Reflections by Christy Mulligan

My husband and I flew to South Korea on January 12, 2014. At this point in the venture, and in the days leading up to it, I had very ambivalent feelings as to whether I had made the right choice to take this trip to Korea. I was meeting many members of my birth family for the first time: my biological father, brother, and an identical twin sister. I did not know what to expect when I entered my birth country, but I suspected emotions would run high.

My family and I met for the first time at a hotel in Daegu. I walked into a conference room where they were seated around a circular table. My sister walked up to me with tears streaming down her face. She embraced me, and as she hugged me close discomfort set in, and I felt my body rigidly making attempts to reciprocate her affection. The experiences I had were culturally rich and I truly felt touched by the love my sister expressed to me in multiple ways. However, language was a real barrier for us, and I am quite certain that this is an obstacle that cannot be overcome.

There were intermittent moments during which connection occurred between us, that is, sporadic unearthing of similarities. For example, we both have tall husbands, and neither of us is adept at cooking in the kitchen. However, there were mostly differences. Differences occurred in multiple areas including hobbies and interests, religion and politics, emotional regulation and expression, and style and values. Some of the differences may be explained by the disparities in culture, yet some I believe were due to the

differences in the family environments and communities in which we were raised.

I spent five days in Korea, enmeshed in the culture, food and lifestyle. I will always value and treasure what I learned. I hope my travels brought some semblance of peace and rest to my family, especially to my biological father, who was guilt-ridden by his decision to sign papers releasing me for adoption. It is dubious that I will ever return to the country of my birth or that I will see my biological family again. In that respect, I think this situation is unique, as we met and said goodbye all in one visit. The memories created in those five short days will have to carry us all through for a lifetime.

Reflecting upon a life that may have been mine if circumstances were different is an impossible question to answer in my mind. The experience continues to be surreal in many respects, almost dream-like, and any emotion I felt has been intellectualized, which has created distance. If our situations were reversed — if I was the twin reared in Korea and she in the United States — I am unsure if my reaction would be much different. I never had the curiosity about my birth family that strikes many adoptees. I continue to feel quite removed and not exceptionally inquisitive about my twin's life. Although it was interesting to discover our similarities and differences, it was never a dire need. My thoughts of that life in Korea were fleeting at best and for most years, non-existent. My intention is to not sound cavalier, but to provide an honest account of my current feelings and interpretation of the situation I experienced.

Twin Research Studies

Multiple Birth Effects on IQ and Body Size

A recent study compared the IQ scores, body size and strength measures of Swedish twins and their non-twin siblings (Silventoinen et al., 2013). Participants were Swedish men born between 1951 and 1976. The data were gathered during the conscription exam when the men were 17 to 20 years of age. A key finding was that multiple birth individuals scored slightly below singletons in IQ, body size and muscle strength. The greatest twin-singleton gap occurred among members of lower socioeconomic class families, possibly due to insufficient resources. It was noted that twins and triplets showed no difference in these measures.

The observed twin-singleton IQ gap in this study, albeit slight, is at odds with several recent investigations that detected no such difference (see Christensen et al., 2006; Posthuma et al., 2000). The authors of the Swedish study suggested that their use of a non-conventional IQ test might explain this result, although like IQ tests their protocol included a range of cognitive skills. They also noted that the absence of self-selection in the sample could have affected the findings.

Lifestyle, Muscles, and Metabolism

Naturally occurring co-twin control designs are simple and elegant. This idea is exemplified in a study of seven pairs of MZ twins, discordant for 32 years of physical activity level (Leskinen et al., 2013). A comparison group of nine DZ twin pairs was included. The twins were identified via the Finnish twin cohort, based on self-reported physical activity between 1975–1981. Physical activity histories were obtained for each twin during the 5-year intervals from 2005 back to 1980. Sixteen pairs showing continuous discordance were invited to participate in the TWINACTIVE study for physical assessment. Measurements included isometric knee extension, analysis of mid-thigh tissue composition and muscle volume (magnetic resonance imaging), and fasting blood samples.

The findings underline the importance of physical activity for reducing the risk of cardiovascular difficulties and other complaints, apart from genetic factors. Active co-twins showed a 20% higher knee extension, a lower ratio of mid-thigh fat area and muscle tissue, and a lower fasting plasma glucose value. However, active co-twins showed

only a 4% higher mid-thigh muscle cross-sectional area, relative to the inactive co-twins. This finding suggested that genes make substantial contributions to body structure and muscle function. The results held constant across the subset of MZ pairs under study.

Monochorionic Dizygotic Twin with Blood Chimerism

A case of testicular hypoplasia in a monochorionic DZ twin with blood chimerism was recently reported by South Korean researchers (Choi et al., 2013). The twins were born to a 31-year-old mother who succeeded in becoming pregnant via embryo transfer, following five unsuccessful cycles of timed intercourse and two intrauterine inseminations. The intrauterine death of a female twin was detected at 33.8 weeks, at which time a live male infant was delivered. Placental analysis revealed a single chorion and two amnia. The blood karyotypes of the parents were normal, while the male infant showed both XY and XX cells. STR (short tandem repeat) analysis of the male twin's blood revealed three of four alleles at several loci (chimerism). The only physical abnormality discovered was testicular hypoplasia (reduced testicular development). The authors proposed that the hypoplasia could be linked to the chimerism, although the precise mechanism involved remains speculative.

This case was the first report of testicular hypoplasia in a chimeric male twin with a female co-twin. According to the authors, it adds to the approximately 10 cases of monochorionic-dichorionic (MC-DC) DZ twins described in the literature; the majority of DZ twins have both separate amnia and choria. It was recommended that prenatal

detection of MC-DC DZ twins should be further examined to confirm their zygosity.

Amniocentesis for Twins

The varied definitions of amniocentesis-related pregnancy loss (ARL) have prevented the compilation of accurate statistics regarding the frequency of this event among multiple gestations. In an attempt to address this issue, Vink et al. (2013) mailed surveys to a random sample of 1,000 fellows of the American College of Obstetrics and Gynecology (ACOG) and the ACOG Collaborative Ambulatory Research Network. Usable forms were obtained from 32% of the potential respondents. Selected findings from this study are summarized below.

The three most commonly offered definitions of ARL included premature rupture of membranes in one or both sacs, delivery of one or both fetuses and/or intrauterine demise of one or both fetuses. The three most commonly indicated time intervals used to indicate ARL were loss at 2 weeks after amniocentesis, loss at 24 hours after amniocentesis and loss at 4 weeks after amniocentesis. The need to identify specific risks linked to specific procedures (e.g., sampling one or both sacs) and specific placental arrangements (one or two choria) was highlighted. For example, physicians varied with respect to the degree of risk associated with chorionicity, with 12.1% reporting that ARL is lower in monochorionic twins than dichorionic twins, 39.6% claiming that the risks are equal, and 38.9% asserting that the risk is higher in monochorionic twins than dichorionic twins. The authors of this study encouraged the use of prospective twin registry studies to clarify the frequencies of procedure-related losses in multiple birth pregnancies.

Twins in the Media

Identical Doctors

Identical twins, Jessica and Jordana Goldman, are first-year students at the Rutgers University Medical School, in New Jersey (Forman, 2013). They share interests in medical genetics and Jewish genetic diseases, knowing that twin studies can provide important insights into the nature and origins of physical disorders. The twins are also willing participants in twin studies, as shown by their participation in a Mt Sinai Hospital project involving head measurements of twins. They are also interested in why MZ twins differ from one another in selected traits. Jordana experiences grapheme-color synaesthesia in which a number triggers a particular color (e.g., 5: red and 6: blue). Jessica does not have these sensations, although one of the twins' cousins expresses this trait. Sir Francis Galton (1880) was the first to report this condition among some otherwise unremarkable individuals. He noticed that the presentation of one modality might

evoke the experience of a different modality. 'Thus, when they think of "six," the figure "6" arises before the mind's eye more readily and vividly than the sound "six" echoes in their mind's ear . . .' (Galton, 1880, p. 494). Galton observed this phenomenon more frequently in females (1/15) than males (1/30). Also see Ramachandran and Hubbard (2003) for additional information on synaesthesia.

The Goldman twins are close sisters who study together and enjoy the benefits of such collaboration. If one twin grasps a concept that the other twin does not, each claims that their sister is the most appropriate person in the world to explain it. If one twin scores higher on an exam, her feelings of success are reduced because her twin did not perform as well. Both twins envision a time when they might establish a joint medical practice, but insist they would never substitute for one another in treating their patients.

Freedom Fighter for Twins

The name Mary Slessor may be unknown to many twin researchers, but should not be. Slessor, born in 1848 in Gilcomston, Aberdeen in Scotland, was a rare missionary working in Calabar in the Niger Delta region in southeastern Nigeria (Ibibio, n.d.; Ette Ibibio is a Belgian NGO specializing in maternal health in Africa.). The atmosphere was very hostile toward Caucasians and the natural environment was quite dangerous. Despite these obstacles that made evangelical work difficult to perform, Slessor dedicated herself toward eradicating the cruel killing of twins and the death of their mothers by isolation in the jungle.

Attitudes toward twinning at that time were horrific. It was believed that twin births signaled the approach of events that were evil and deadly. Slessor worked very hard at changing the attitudes and practices of the people of this region. By the time of her death in 1915, she had saved hundreds of twins, although not all cruel practices had been eliminated (Banjoko, 2012). According to Ibibio (n.d.), twins are still being sacrificed today.

A Mary Slessor Foundation (MSF) was established in 2002 in Scotland to honor her life and work; see <http://maryslessor.org>. The MSF also works to promote good health practices among people of the region in which Mary Slessor worked. The website notes that the first twin birth in the Medical Center took place on December 2, 2008.

I wish to acknowledge Dr Catherine Derom (University Hospital, Leuven) for forwarding a copy of the unpublished manuscript by Ibibio (n.d.), and Professor Davy Vandebroek (University of Ghent) for securing additional information about current practices in the Niger Delta regarding twins. Ibibio's full text may appear in a future issue of *Twin Research and Human Genetics*.

Twin Scholarships

Raising twins poses difficult financial hardships for some families. Going from no children to two, or one child to three can severely strain resources parents wish to make available to their children. Fortunately, there are a number of college scholarships available to families with twins, with the stipulation that both twins attend the same school. Examples include Randolph College in Lynchburg, Virginia (15% tuition discount), Lake Erie College in Painesville, Ohio (full tuition waived for one twin) and the Kelley School of Business at Indiana University, in Bloomington, Indiana (the Layton Frazier McKinley Scholarship is given to twins — MZ twins preferred — who have a minimum 3.33 grade point average and major in accounting). Other scholarships are also available and are described at the same web site (Fierro, 2014).

Such benefits to multiple birth families are desirable. Hopefully, additional colleges and universities, as well as high schools and other institutions, will consider offering such tuition reductions.

Auguste and Jean-Felix Piccard

Members of three generations of the famous Piccard family were great explorers. They launched and tested balloons, one in 1930 that had a cabin equipped with pressurized air that later became common in airplanes (de Latil, 2014). Less well known is the fact that two family members of the first generation, Auguste and Jean-Felix, were twin brothers. August piloted his own balloon in 1931 and Jean-Felix followed 3 years later. In 1960, Auguste's son Jacques continued this pursuit in 1960, followed by his own son Bertrand in 1991. Bertrand was the first person to travel around the world in a balloon (Rattini, 2013).

The accomplishments and lives of the Piccard family are chronicled in a new book, *The Explorer Gene: How Three Generations of One Family Went Higher, Deeper and Farther Than Any Before*, by Tom Cheshire. The first part of the title may be unfortunate because there is no such thing as an 'explorer gene'. Instead, various physical and behavioral attributes (e.g., body size; sensation-seeking), known to have genetic effects (Hur & Bouchard, 1997; Speliotis et al., 2010), in conjunction with relevant opportunities, are likely to explain the similar extraordinary undertakings that may repeat across family generations. The twins appear to be fraternal, based on inspection of their adult photographs, although the book indicates that they were indistinguishable as young children.

Twins Born Apart

Two new sets of twins were born in different years (2013 and 2014), with co-twins arriving just prior to and after midnight (Harris, 2014). Opposite-sex twins, Lorraine and Brandon Begazo, were delivered at the Medstar Washington Hospital Center, in Washington, DC. Lorraine, who weighed 6 pounds, 4.9 ounces, arrived at 11:58 pm on December 31, while her brother who weighed 5 pounds, 10.4 ounces, followed on January 1 at 12:01 am. A Canadian pair, Gabriela and Sophia Salgueiro, who appear to be fraternal, were born 8 minutes apart at the Credit Valley Hospital, in Mississauga, Ontario. Gabriela, who weighed 7 pounds, arrived just before midnight on December 31, while Sophia, who weighed 5 pounds, 15 ounces, followed just 38 seconds after midnight on January 1.

It is fortunate that these twins will be raised together. Separated DZ twins who participated in the Minnesota Study of Twins Reared Apart was born in different months, one on November 30 and the other on December 1. This quirk of fate delayed their reunion by years because the twin in search was looking for someone with the same birth date. Hopefully, the new twins' different birthdays will not negatively affect their school entry, classroom placement or other life events.

Follow-Up Note

The Olympic aspirations of identical twin biathletes, Tracy and Lanny Barnes, were described in a previous issue of

Twin Research and Human Genetics (Segal, 2014). In a stunning turn of events, Tracy earned a spot on the United States team, but relinquished her place to her twin sister (Stump, 2014). Tracy knew that Lanny had missed three of the four qualifying races due to an illness. 'I see how hard she works . . . If I can be the one to give her that [Olympic] opportunity, then that is an honor and sacrifice I am willing to make.' This level of selflessness is rare, but such occurrences may be more typical among identical twins than among most other pairs of siblings. Tracy's actions reminded me of Phil Mahre's words to his identical twin brother Steve after Phil had just completed a likely gold medal performance in the 1984 Olympic slalom event, in Sarajevo: 'Here's what you have to do to beat me' (see Segal, 2000). Steve won the silver medal.

The 2014 Olympic Biathlon was held February 14. Lanny Barnes placed 64th with a time of 53:02.2.

Nancy Segal's 2012 book, BORN TOGETHER-REARED APART: THE LANDMARK MINNESOTA TWIN STUDY (Harvard University Press) was a clue on the widely watched quiz show, JEOPARDY, February 13, 2014. You can see this by clicking on the link below; the question comes up in the first two minutes of the program.

<http://www.youtube.com/watch?v=VYzl2cwKKKc>

References

- Banjoko, O. (2012). *Mayborn: 'Mary Slessor'*. Retrieved from <http://www.dallasnews.com/entertainment/books/20120511-mayborn-mary-slessor.ece>
- Choi, D.-H., Kwon, H., Lee, S.-D., Moon, M.-J., Yoo, E.-G., Hong, Y.-K., & Kim, G. (2013). Testicular hypoplasia in monozygotic dizygous twin with confined blood chimerism. *Journal of Assisted Reproductive Technology*, *30*, 1487–1491.
- Christensen, K., Petersen, I., Hershkind, A.-M., & Bingley, P. (2006). Twin/singleton differences in intelligence? A Danish nation-wide population-based register study of test scores and classroom assessments. *British Medical Journal*, *333*, 1095.
- de Latil, P. (2014). Auguste Picard. *Encyclopaedia Britannica Online*. Retrieved from <http://www.britannica.com/EBchecked/topic/459310/Auguste-Picard>
- Ette Ibibio. (n.d.). *Mary Slessor: A legacy of struggle for rights and freedom of twins*, unpublished manuscript.
- Fierro, P. P. (2014). *College scholarships for twins and multiples*. Retrieved from <http://multiples.about.com/od/twinsinschool/a/twinscholarship.htm>
- Forman, R. (2013, November 13). Identical twins in med school study to be doctors — and learn about themselves. *Rutgers Today*. Retrieved from <http://news.rutgers.edu/feature/identical-twins-med-school-study-be-doctors—and-learn-about-themselves/20131112#.UsWquqWHrwl>
- Galton, F. (1880). Visualised numerals. *Nature*, *22*, 494–495.
- Harris, N.-E. (2014, January 2). New Year's twins born in different years: Two families, in Toronto and DC, have twins straddling 2014. *Medical Daily*. Retrieved from <http://www.medicaldaily.com/new-years-twins-born-different-years-2-families-toronto-and-dc-have-twins-born-straddling-2014-video>
- Hur, Y., & Bouchard, T. J. Jr. (1997). Genetic influence on impulsivity and sensation-seeking. *Behavior Genetics*, *27*, 455–463.
- Leskinen, T., Sipilä, S., Kaprio, J., Kainulainen, H., Alen, M., & Kujala, U. M. (2013). Physically active vs. inactive lifestyle, muscle properties, and glucose homeostasis in middle-aged and older twins. *Age*, *35*, 1917–1926.
- Popenoe, P. (1922). Twins reared apart. *Journal of Heredity*, *5*, 142–144.
- Posthuma, D., De Geus, E. J., Bleichrodt, N., & Boomsma, D. L. (2000). Twin-singleton differences in intelligence? *Twin Research*, *3*, 83–87.
- Ramachandra, V. S., & Hubbard, E. M. (2003). *The phenomenon of synaesthesia*. Retrieved from http://cbc.ucsd.edu/pdf/Ramachandran_JCS2003.pdf
- Rattini, K. B. (2013). All in the family. *Americanway*, *46*, 32.
- Segal, N. L. (2000). *Entwined lives: Twins and what they tell us about human behavior*. New York, NY: Plume.
- Segal, N. L. (2013a). *Born together-reared apart: The landmark Minnesota twin study*. Cambridge, UK: Harvard University Press.
- Segal, N. L. (2013b). Twin reunions: The science behind the fascination. *Twin Research and Human Genetics*, *16*, 1008–1013.
- Segal, N. L. (2014). Stolen twin: Fascination and curiosity. *Twin Research and Human Genetics*, *17*, 56–61.
- Segal, N. L., Hershberger, N. L., & Arad, S. (2003). Meeting one's twin: Perceived social closeness and familiarity. *Evolutionary Psychology*, *1*, 70–95.
- Segal, N. L., & Hur, Y. M. (2008). Reared apart Korean female twins: Genetic and cultural influences on life histories, physical and health-related measures, and behavioral traits. *International Journal of Behavioral Development*, *32*, 542–548.
- Silventoinen, K., Myrskylä, M., Tynelius, P., Yokoyama, Y., & Rasmussen, F. (2013). Social modifications of the multiple birth effect on IQ and body size: A population-based study of young adult males. *Pediatric and Perinatal Epidemiology*, *27*, 380–387.
- Speliotes, E. K., Willer, C. J., Berndt, S. I., Monda, K. L., Thorleifsson, G., Jackson, A. U., . . . Loos, R. J. (2010). Association analyses of 249,796 individuals reveal 18 new loci associated with body mass index. *Nature Genetics*, *42*, 937–948.
- Stump, S. (2014, January 15). Honor and a sacrifice: US biathlete gives up Olympic spot for twin sister. *Today*. Retrieved from <http://www.today.com/sochi/u-s-biathlete-gives-olympic-spot-her-twin-sister-2D11929572>
- Vink, J., Anderson, B., Fuchs, K., Shulkin, J., & Alton, M. E. (2013). Opinions and practice patterns of obstetricians-gynecologists in the United States regarding amniocentesis in twins. *Prenatal Diagnosis*, *33*, 899–903.