

NEWS, VIEWS, AND COMMENTS

A Possible Twin: The 1960s Twin Study Revisited/Twin Research: Twin-to-Twin Heart Transplantation; Distinguishing Monozygotic Twins; Twin Conceptions via Oocyte Donation; Factors Affecting Craniofacial Traits/In the Media: Triplet Delivery in the UK; Conjoined Twins and the Concept of Self; Colombian Twin Trainers; Skin Grafting to Save an Identical Co-Twin; Lack of Physical Flaws in Dolly the Cloned Sheep; Possible Conjoined Twins of Opposite-Sex; Passing of the Remaining Twin From the World's Longest Separated Pair

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This article begins with the story of a 51-year-old Los Angeles, California man, Justin Goldberg, whose daughter caught a glimpse of his striking look-alike at a popular market. Many people have so-called dop-pelgänger, but this occurrence is especially intriguing — the individual in question, born in New York City in the mid-1960s to an unwed mother, was an adoptee placed by the Louise Wise Adoption Agency. This agency, under the guidance of a prominent psychiatrist, decided to place twins in separate homes. Some of these twin children were part of a controversial child development study that was hidden from them and their parents. Next, recent and current twin research on heart transplantation, distinguishing monozygotic co-twins, twin conceptions via oocyte donation and factors affecting craniofacial traits are summarized. The article concludes with highlights on twins in the media, specifically, a triplet delivery in the United Kingdom, self-concept and consciousness in conjoined twins, Colombian twin trainers, skin grafting to save an identical co-twin, lack of physical flaws in Dolly the cloned sheep, possible opposite-sex conjoined twins, and the passing of the remaining twin from the world's longest separated pair.

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A Possible Twin: A 1960s Twin Study Revisited

There is a controversial twin study that resurfaces from time to time, calling into question its research ethics regarding investigators' responsibility and integrity. In New York City, in the mid-1960s, the Louise Wise Adoption Agency, at the advice of Columbia University psychiatrist Dr Viola Bernard, placed twins in separate adoptive homes. Bernard's reasoning came from her belief that twin children did not enjoy undivided attention from their parents, making separate rearing a preferred option. However, Bernard's belief was not a research-based conclusion, but one that most likely originated from select, and possibly atypical individual situations that she encountered.

Bernard's colleague, psychoanalyst Dr Peter Neubauer, took advantage of the agency's policy to prospectively study the behavioral development of 13 individuals in five sets of monozygotic (MZ) twins and one set of MZ triplets that had been placed apart. As such, these twin and triplet children became part of a controversial child development study that was hidden from them and their parents — the families never knew that they were raising one member of a multiple birth set. In addition, efforts were made to arrange for the family structures of the separated twins to be the same. For example, if one family already had an older son or daughter, it was important that the other family also had an older boy or girl.

Some findings from this study have been published. Among them was a journal article focusing closely on one of the pairs (Abrams, 1986) and a book about the study by the senior investigator and his son (Neubauer & Neubauer, 1990). A new film about the study, *The Twinning Reaction*, by director Lori Shinseki has also been completed and will be available for viewing in the near future. A book by two of the reunited twin subjects that describes their reunion experience, their feelings about how and why they were separated, and their efforts to obtain access to the data is also available (Schein & Bernstein, 2007). Finally, a number of articles about the study have been written, one by an original research assistant (Perlman, 2005) and another by Segal (2005). However, the actual behavioral measures, video tapes, interviews, and observations have been deposited in the Yale University archives with the stipulation that they not be released until 2066. The twins are able to gain access to these materials, but only after being granted permission from the Jewish Board of Family and Children's Services in New York City.

It was Neubauer's intention that the twins would never meet, but the members of several pairs and the triplets have been reunited. Some met by chance, which is not

unexpected given that all of them were raised in the New York City area. However, some of the separated twin pairs were not in the study, lending particular significance to a recent incident that occurred in late November 2017 in Los Angeles, California, rekindling interest in this project. The incident concerns Justin Goldberg who, at age 51, is an entertainment executive involved in the lively performing arts industry of Los Angeles. He has managed musicians, artists, and writers, and is very involved in online media. Justin (named Michael according to his birth certificate) was born in New York City on April 12, 1966 and adopted as an infant by Jay Goldberg (an attorney) and his wife through the Louise Wise Adoption Agency. The couple later adopted a younger daughter through that agency. Justin was raised in Tarrytown, an area in Westchester County just outside New York City.

In late November 2017, Justin's 16-year-old daughter Charlotte was enjoying dinner with friends at Marconda's Puritan Poultry, located in Los Angeles's popular Farmer's Market. She noticed a gentleman who looked exactly like her father, so much so that she nearly approached him to say hello and to learn what brought him to the market. But Charlotte also knew that he was *not* her father — instead, she took a short video of the man with her cell phone. Justin, her real father, was shocked by the physical likeness between himself and this stranger, observing that the man reached into his pocket and pulled out his cell phone in exactly the same manner as he would have done. Shortly thereafter, Justin visited the market and filmed himself at the same location and from the same angle. Next, he placed the videos next to one another in a longer filmed segment that also summarized his childhood history and the Child Development Center Twin Study — he was just starting to learn about the study as he began researching the Louise Wise Agency looking for clues to his past. The possibility that he could be part of a separated MZ twin pair was beginning to take shape and it felt life-changing. The video he made and an article about his experience by journalist Haring (2017) can be viewed at <http://deadline.com/2017/11/justin-goldberg-hollywood-executive-twin-brother-search-adoption-1202213641/>. A photograph of Justin and his daughter Charlotte is shown in Figure 1.

I learned about this case from a professional colleague who forwarded the link. Following some discussion with Justin, I referred the case to ABC's producers of the program *20/20*, who have been involved in the airing of a special program about Lori Shinseki's film that will explore the study in detail. They were immediately interested and arranged for a local producer, camera crew, and me to

**FIGURE 1**

(Colour online) Possible twin Justin Goldberg (left) and his daughter Charlotte (right) who saw and filmed his look-alike. Photo credit: Nancy L. Segal.

capture Justin's situation as it was unfolding. I persuaded them that telling this story would attract public attention, possibly revealing the identity of the gentleman Justin's daughter had seen in the market. Even if the man himself did not see the program, it was likely that someone who knew him might see it. Justin's story was riveting and will, hopefully, be aired in full in the near future. Several revealing excerpts about his adoption, childhood, and perspective on finding a possible identical twin are presented below, edited slightly for clarity:

My [adoptive] parents were extraordinary, very conscious and careful. They were very involved in my life and still are. Half the kids we knew were adopted so adoption never ever became an emotional issue. My mother was just such a warm person and has such a presence to her. She was always paying attention, always said the right thing and always made the extra effort ... But I did have the feeling all along that I was not really where I was supposed to be. I would see pictures of California and that lifestyle and I longed to go there when I was as young as age six or seven.

There was some physical resemblance between my parents and me, and at times we looked remarkably similar. However, I felt that just from my parents' personal characteristics growing up I was not a lot like them. I'd go fishing and they would never get into

a boat — my father didn't know how to swim. I remember we had a flat tire when I was about ten and they didn't know how they were going to drive. I said there was a spare tire in the back and I put it on and they were just astounded that I could manage something like that. I was also drawn to activities like skateboarding that had an element of risk and danger.

When I heard about what my daughter saw I thought that maybe it deserved a second look and then I started finding out about a secret [twin] study. Some life-long things came to mind — not that I had a twin, but something in my life was missing.

How much does he look like me? On a 1–100 scale I would say 98, based on the features of which I am aware. But I look very different depending on the angle — my nose looks large or small from different sides, so when people comment that I look like someone I take it with a grain of salt.

I spoke to people about this and they sent me links to publications about this study. There is a list of the top 20 most unexplainable documents in the world, and one was the Neubauer study that is about twins and is sealed at Yale University. It had a dark origin.

This situation does make me curious about my biological mother. I have more empathy for what my mom must have gone through; it must have been extraordinary. As an adoptee you are in this position of feeling guilty for existing — you are lucky — but someone

carried you in the womb ... If I am a twin it seems odd to have been separated; it's traumatic and the trauma lasts a lifetime ... I do think I will feel some sense of both relief and resentment if we find each other. I am curious about his story, but feel I would know it a little bit. Maybe it's the wrong thing to say, but I am curious to know if we share odd traits. I have a few more oddities than most and while they are all hilarious and great, they are hard for others to live with. Does he have them too?

I think the researchers had the best of intentions. Neubauer was unapologetic, but at that time in the 1960s there was a raging debate over what we now take for granted, that you improve kids' lives by opportunities. But maybe DNA is the ultimate decider of our fate and not how our parents raised us. I am sure my parents agonized over things my sister and I were not cut out to be. My dad was a Harvard lawyer who represented lots of famous clients. I was nudged in this direction, but it was not for me, it was hard to make that 'orchestra go into tune'.

Families whose twin children were in the Child Development Center study were periodically visited by members of Dr Neubauer's research staff. Justin's parents do not recall such visits but, as I indicated above, not all separated twins were in the study. There are several possibilities. It may be that Justin is not a twin and that his daughter simply encountered an unusual look-alike. However, the fact that Justin was adopted through the Louise Wise Agency, known for separating twins, gives his daughter's experience a significance it might not otherwise have. It is also true that some separated MZ twins have been reunited just because they were mistaken for someone else (Segal, 2012), and this may prove true in Justin's case. If so, he will have the unique opportunity of gaining fresh perspectives on his behaviors, habits, and medical life history. He may acquire in-laws, aunts, uncles, nieces, and nephews he never knew about. And, like most reunited MZ twins, he may have the chance to develop a close personal relationship with someone very much like himself and to

see the person he might have become in a life he did not live.

If Justin *was* one of Neubauer's subjects, this will refocus attention on the origins and methods of this controversial study. Such dialogue will be important for researchers everywhere. It is important to keep in mind that the twins were not initially separated for research purposes — they were separated with the idea of giving them a more favorable family situation, but this was *not* a research-based decision. The twins' separation was welcomed by Neubauer, who exploited it for his own purposes and sought separated twins from other sources, such as Catholic Charities in New York. Catholic Charities would not cooperate at first, stating that twins occur naturally and so should not be apart. In response, Neubauer argued that mothers and children also occur naturally, but can be separated by adoption. Neubauer said that the sister he spoke with eventually agreed to help him, but never provided any pairs (Segal, 2005).

Prior to his death, I had the opportunity to meet Dr Neubauer. Even years after his study ended he showed no remorse over depriving the twins of a relationship they may have enjoyed together and hiding the true purpose of the study from their parents, who cooperated willingly. This study reminds us of the important obligation researchers have toward twins and their families, who contribute so much to what we know and what we can know about human behavioral and physical development. It is vital to provide feedback and helpful information at all times.

Unfortunately, twins are still being separated for various reasons (e.g., parents' financial inability to care for two children simultaneously; assisted pregnancies that produce more children than families had planned for). As someone who has worked closely with reared-apart twins and witnessed a number of twin reunions, I would urge researchers and social workers to make every effort to keep twins together — this is a research-based assertion (Segal, 2012; Segal et al., 2003, 2011).

Twin Research

Twin-to-Twin Heart Transplantation

The first case of heart transplantation between dizygotic (DZ) twins was described by physicians at the Riley Hospital for Children at Indiana University Health, in Indianapolis, Indiana (Blitzer et al., 2017). Most significantly, this paper reported the successful 25-year follow-up of a female DZ twin who received the heart of her deceased co-twin at

3 days of age. The procedure was undertaken to overcome the surviving twin's hypoplastic left heart syndrome that was responsible for her hemodynamic instability. Two options were available: twin-to-twin transplantation or a more standard treatment, such as corrective surgery. The twins' parents chose the former, given the greater likelihood of success, but as the authors of the paper sensitively noted,

this decision was not easy. In support of the transplant was the fact that the twins were ABO compatible and matched across four out of six antigens; subsequent research has shown that survival rates improve when there are three or more such matches.

The surviving twin followed a long-term course of immunosuppressive medication. As is typical of heart transplant patients, she developed late renal dysfunction, but the problem was relieved following a change in medication.

The authors concluded that this case adds importantly to knowledge and discussions surrounding pediatric heart transplantation. They also emphasized their hope that such a case does not recur.

Distinguishing Monozygotic Twins

There have been several documented cases in which forensic methods were unable to distinguish between innocent and guilty MZ co-twins, such that neither twin could be held responsible for the crime or misdemeanor that one twin committed. However, genome-wide scanning of deoxyribonucleic acid (DNA) methylation markers is promising to be an effective and novel approach to this situation. Du et al. (2015) identified 38 differential methylation regions capable of distinguishing between the members of four MZ twin pairs who varied in age. As expected, the oldest twins (age 36 years) showed the greatest number of differentially methylated regions, relative to the three younger pairs. However, the youngest pairs (newborns) showed the next highest number, followed by a pair of 12-year olds and a pair of 24-year olds. The very small twin sample ($n = 4$ pairs) precluded firm conclusions on this point, but it was noted that the intrauterine period is a very sensitive time for establishing epigenetic variability, due to environmental exposures and underlying genetic factors.

It is likely that refinement of this procedure for distinguishing between MZ co-twins will be useful in future forensic cases. Other techniques for accomplishing this goal have also been described, such as MZ co-twin comparison of de novo mutations (see Segal, 2017).

Twin Conceptions via Oocyte Donation

Industrialized countries have seen a steady increase in the mean age at which women deliver their babies, as well as, in the proportion of women over 40 years of age who become mothers. These trends associated with the greater availability of assisted reproductive techniques. Given the physical risks involved in such pregnancies, French investigators, Guesdon et al. (2017), compared reproductive outcomes (maternal and perinatal complications) between women conceiving twins and singletons via oocyte donation. The study sample was organized into two groups: women aged 50 years and older ($n = 40$) and women aged 46–49 years ($n = 146$). The rate of multiple pregnancies was similar in both groups (35% in the older group and 37% in the younger group). It was determined that complication rates were high and similar in both groups, but higher among women with multiple-birth pregnancies. Limitations to the study were the collection of data from a single center and the relatively small sample size that precluded the study of very severe birth difficulties. Nevertheless, the goal of single embryo transfer was recognized.

Factors Affecting Craniofacial Traits

An assessment of genetic and environmental contributions to craniofacial growth and development was undertaken by Reddy et al. (2017) from Andhra Pradesh, India. The sample included eight MZ twin pairs and seven DZ twin pairs, who ranged in age from 12 to 18 years. The twins were classified as MZ or DZ according to DNA analysis. Genetic factors were found to underlie the anterior cranial base, anterior and posterior facial height, mandibular length, saddle angle, and gonial angle. Heritability was non-significant for the posterior cranial base, upper and lower anterior facial height, and various angular measures. Interestingly, it was the linear parameters that showed genetic effects, confirming previous findings from related studies. These results are of interest, but require additional replication with larger and more diverse twin samples.

In the Media

Triplet Delivery in the UK

Identical male triplets, now toddlers, were delivered at 31 weeks of pregnancy to a woman from the United Kingdom. Her family had no previous history of such births (Finkel, 2017). The triplets' birth weights were 3 pounds, 5 ounces (Rocco), 3 pounds, 6 ounces (Roman), and 3 pounds, 10 ounces (Rohan), and all three newborns required immediate neonatal care over a 3-week period. The chance of having identical triplets was cited as between

1/60,000 and 1/200,000,000; however, the lower figure is closer to the natural identical triplet rate, based on a natural twinning rate of 1/240 births. Like most mothers of identical multiples, the triplets' mother is aware of individual personalities among her three sons; for example, Rocco is laid back, Roman is complaining, and Rohan is loud. Nevertheless, she admits that they look more alike physically as they age, but insists that she confuses them only when they are sleeping.

Conjoined Twins and the Concept of Self

The scientific community and the public learned about 4-year-old conjoined twins Krista and Tatiana Hogan, 6-years ago (Dominus, 2011). This pair is of special interest because they are craniopagus twins (joined at the head), and it appears that the thalamus of one twin is linked to the thalamus of her co-twin by a structure called the thalamic bridge. The thalamus is located in the middle of the brain, between the cerebral cortex and the midbrain. It coordinates a number of mental processes, including consciousness, sleep, and sensory interpretation (study.com, 2017). Physicians suspected that sensory input received by one twin would be transmitted to the other twin.

Physicians continued to track Krista and Tatiana over time, and now they are 11 years old (Harris, 2017). It has been determined that their skulls are not just fused, but form one continuous cranium that includes four hemispheres. A new documentary, *Inseparable*, by director Judith Pike, uses these twins to address the fascinating questions and concepts of self and shared consciousness. It was observed that when the twins were newborns, a pacifier placed in one twin's mouth was able to soothe the other twin. And when one twin tastes a particular food, it can elicit a reaction on the part of her co-twin. It is worth noting that the twins say they can 'converse inside their heads'. These twins have a lot to share with science, but it is important to remember that they are young girls who need time and space to develop within their unique situation.

Colombian Twin Trainers

Ever since completing research on the identical male Colombian twins, who were switched at birth (Segal et al., 2017; Segal and Montoya, in press), I have been sensitized to all things Colombian. It appears that identical Colombian twins Margarita and Natalia Guzman are on their way to developing careers as body trainers (Chandler & Peoples, 2017; Sharon, 2017). The twins now live in Orange County, California, but were raised in the Colombian town of Tunja near the eastern edges of the Andes mountains. Their father owned a gas station and their mother was an economist, indicating that the family had financial means. This may explain why the twins received threatening telephone calls and their father was wounded in an attempted robbery. The family, therefore, decided to move to southern California where they had relatives. At first, the move was not easy for the twins, who spoke little English and were bullied by their high school classmates.

The twins soon took up running and began to engage in other fitness activities as they approached their twenties. They sought jobs as trainers and took part in rigorous races. They have appeared on a number of television programs, including the *Broken Skull Challenge* (CMT) and *Tough Mudder X* (CBS). These pursuits have led to their opening of a gym in Tustin, California, as 2018 begins.

Skin Grafting to Save an Identical Co-Twin

A French identical twin, Franck Dufourmantelle, aged 33 years, was severely burned over 95% of his body in an industrial accident that occurred in September 2016 (Sage, 2017). Such patients usually receive skin grafts from other parts of their body or from deceased donors; in the latter case, immunosuppressive medication is required to avoid rejection of the graft. Neither of these options proved viable in the case of Dufourmantelle, so it was fortunate that he had an identical twin brother, Eric — doctors learned this news when Eric revealed his twinship amid the emotion of his brother's situation. After four and a half months in the hospital, Franck, who received skin grafts from his co-twin, is doing well, although he experiences some difficulty walking. He observed that he and Eric still look-alike, calming Eric's fear that they might lose their identical looks as a result of the accident.

The article indicated that identical twins can accept skin grafts from one another without fear of rejection, due to their identical genes. However, this is not true in all cases; see Segal (2017).

Lack of Physical Flaws in Dolly the Cloned Sheep

Identical twins are clones, by definition — genetically identical organisms — but clones are not twins for several reasons, including their conception at different times and prenatal development in separate wombs (Segal, 2017). As such, news about the physical status of cloned organisms is of interest in the event that human reproductive cloning becomes a possibility some day (Whipple, 2017). A recent follow-up report on the health of Dolly, the cloned sheep, revealed that she did *not* show premature aging (osteoarthritis, in particular) as was initially suspected. This conclusion was based on the study of Dolly's skeleton, which is housed at the National Museums of Scotland, in Edinburgh.

Possible Conjoined Twins of Opposite Sex

A letter to the editor of the *American Journal of Medical Genetics* called attention to what the writer of that article believed to be the first and only reported case of conjoined twins presenting external and internal genitalia that are morphologically of the opposite sex (Martínez-Frias, 2009). Chromosomal analysis showed that both twins were female, causing the original author to propose that the twins resulted from the fusion of monoamniotic twins, rather than the more commonly invoked mechanism of incomplete zygotic division. Martínez-Frias went on to describe what she believes is actually the first known such case, represented by a Nigerian figurine dated from 300 BC to 500 CE. The figure shows conjoined twins, one a female as indicated by breasts and the other a male who is taller in stature; the twins'

fused legs indicate monozygosity. These unusual cases may inform current scientists about the bases and consequences of conjoined twinning. Other unusual conjoined pairs of historical significance are described in Segal (2017).

Passing of the Remaining Twin From the World's Longest Separated Pair

In May 2014, I reunited 78-year-old fraternal twin women at my campus in Fullerton, California. These twins had been apart longer than any other pair in the world, earning their deserved acknowledgment in the *Guinness World Records* (GWR) (Guinness World Records, 2016; Segal et al., 2015). The twins, Liz Hamel and Ann Hunt, were born in England and were separated at 5 months of age when their single mother, who could not care for two children, relinquished Ann for adoption. Liz moved to the United States in her twenties and, while she always knew she had a twin, she did not believe it would be possible to find her. Ann never knew she had a twin until her daughter Samantha began looking for her mother's biological relatives, a search that led her to Liz.

Unfortunately, the twins did not have much time together once they met. After spending several days in Fullerton, California, they enjoyed several more days together at Liz's home in Oregon. Once they parted, they stayed in touch by telephone and by Skype. Sadly, Liz passed away from cancer in November 2014, just 6 months after they were reunited. In December 2017, I received word that Ann had passed away earlier that month from a heart attack that occurred while she was out Christmas shopping (Demony, 2017). I understand that the GWR is preparing a tribute to both twins.

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