

# Twin Towers: The Ones Left Behind; Research Reviews: Chimeric DZ Twins, DZ Twin Mothers; Revisited: The New York Child Development Center Twin Study; New and Unusual Twins

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Twin victims and survivors of the 2001 World Trade Tower attack are remembered. Central themes from the twin loss literature are also highlighted. Next, new research studies on dizygotic (DZ) twins and mothers of DZ twins are reviewed. Specifically, a rare monochorionic–diamniotic DZ twin pair with chimerism is described, and findings concerning genetic variants of GDF9 in mothers (that are associated with DZ twinning tendencies in families) are summarized. This is followed by another look at the controversial 1960s Child Development Center Twin Study that tracked the development of separated twins. Information on several new and unusual twins is also presented.

## Twin Towers: The Ones Left Behind

September 11, 2006 marks the fifth anniversary of the terrorist attacks on the World Trade Towers, the Pentagon and United flight 93. In the weeks following these events, I learned that approximately 40 twins lost a twin brother or sister on that day. I did not know how many other family members (mothers, fathers, siblings) with twin-related links also perished.

The *New York Times* published brief biographies ('portraits of grief') of 9/11 victims that included information about who they were as people — their particular occupations, unique interests, unusual habits and family ties. A collected volume, *Portraits*, was published in 2002. Several of my students read each entry, flagging those with a twin-related link (e.g., twins, parents of twins, grandparents of twins). We discovered that in addition to the twins (17 of whom were profiled), there were 17 fathers of twins and three mothers of twins, as well as one nontwin brother, one uncle, one

grandfather, one grandmother and one brother-in-law among the victims. There may have been more — it is possible that twin connections were unknown or not provided in some cases. For example, the media mentioned a gentleman (unnamed) who was widowed on that day, who is terribly pained by seeing his wife's twin because she closely resembles his deceased spouse (MSNBC, 2006).

The fifth anniversary of 9/11 offered an opportunity to recall the lives of some of these people, to see the significance of twinship in their lives and to briefly review the literature on the loss of a twin. One person in each of the various relationship categories is highlighted. This information has been drawn from *Portraits*, with the exception of the story of twin Brenda Conway, which I learned first-hand.

**Twin.** Brenda Conway was a 40-year-old systems analyst, working for Marsh & McLennan (a global professional services firm) on the 97th floor

of the north tower. Her twin sister, Linda, was a teacher and was beginning the day's lessons when she overheard a conversation in the hallway about the World Trade Tower attack. She turned on the television in her classroom, then headed home to be with her family. Brenda never called anyone and information about her was never recovered. Today, her name and signature are beautifully etched on Marsh & McLennan's midtown Manhattan monument to their former employees.

Brenda was survived by her husband and two children, her twin, her nontwin brother and sister, and her mother and father. She never learned that her daughter delivered monozygotic (MZ) twin girls, Diamyn and Destiny, on July 3,

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2004. More about Brenda and Linda's story is available in an essay, 'Twin Towers', in Segal (2005a).

**Father of twins.** Anthony Demas was a managing director of the Aon Corporation. According to his wife, his twin sons made him prouder than anything else in his life.

**Mother of twins.** Lisa Trerotola was an administrative assistant, working for the Port Authority. She was the mother of 3.5-year-old twins. She had recently been diagnosed with cancer and was most upset by the fact that treatment meant being away from her twins for 2 weeks.

**Brother of twins.** Mark Zangrilli was attending a business meeting in the World Trade Center. When he was younger, he taught his twin sisters how to ride their bicycles—the ones that he had built for them.

**Uncle of twins.** Anthony Gallagher was an energy broker at Cantor Fitzgerald. He looked forward to telephone conversations with his nieces and nephews. His nieces were 15-year-old twins.

**Grandfather of twins.** John Rhodes was a senior vice president for Aon Risk Services. His first grandchildren were twin boys, about whom he talked constantly.

**Grandmother of twins.** Mary Alice Wahlstrom was a retired loan officer, flying to Los Angeles with her daughter on American Airlines flight 11. She had recently helped her twin granddaughters prepare for their freshman year at the Rhode Island School of Design.

Twinship was important to each of these 9/11 victims. Loss of a twin is, unfortunately, generally overlooked by bereavement researchers, but not by researchers who study twins. A special issue of *Twin Research* (Volume 5 Number 3, 2002) included a series of informative studies concerning the loss experiences of surviving MZ and dizygotic (DZ) twins, parental coping and support services. Still, many bereavement professionals are unaware of the unique circumstances faced by bereaved twins (e.g., no longer sharing a birthday; reminding others of the deceased twin). I am especially

reminded of this when I receive calls from twins seeking counselors and therapists who are sensitive to how twin loss differs from other forms of loss.

Several main themes are evident in the relevant psychological literature (Segal, 2000, and references therein). Grief generally appears to be somewhat more intense for surviving MZ than DZ twins. Parents who lose one newborn twin grieve as intently as parents who lose a single newborn child. Adults whose co-twins passed away at birth may still grieve for these individuals. Special support groups for bereaved twins and parents of twins have helped them to cope with their loss. Linda McGee, Brenda Conway's surviving twin, was assisted by a special New York twin support group established for twin survivors of 9/11.

Twinning rates are rising, making it mandatory that behavioral, medical and educational professionals are informed about the unique developmental and experiential aspects of twinship.

## Research Reviews

### Chimeric DZ Twins

Virtually all DZ twins have separate placentae, chorions and amnions, but there are some exceptions. The most recent one concerns a DZ twin pair with one chorion and two amnions (Shalev et al., 2006). Ultrasound performed in the first two trimesters of pregnancy indicated male twins with a monochorionic-diamniotic placenta. Given that the mother was 39 years of age, amniocentesis was advised and indicated one normal fetus and one fetus affected with trisomy 21. Umbilical cord blood was obtained from both fetuses when more detailed sonography did not yield abnormal signs typical of trisomy 21. Two cell lines (normal 46, XY and 47, XY + 21) were found in both twins, and DNA derived from cord blood samples indicated two distinct genotypes.

The investigators concluded that early placental fusion and blood chimerism were able to explain their findings. Specifically, they reasoned that a structurally single placenta was created and anastomoses between the newly formed blood vessels enabled reciprocal blood exchange between the two fetuses.

### DZ Twin Mothers

A variety of factors affecting the frequency of DZ twinning are well known, including maternal age, ethnicity, height, weight, parity and family history (see Segal, 2000). It is also known that GDF9 (growth differentiation factor 9) genes are important for normal human fertility. Rare variants of GDF9 have recently been compared in mothers of DZ twins and controls (Palmer et al., 2006). The prevalence of the rare forms was significantly higher in

mothers of twins (4.12%) relative to the comparison group (2.29%), possibly providing a mechanism by which DZ twinning is transmitted within families.

This study follows a previous report of GDF9 deletion in two sisters who delivered spontaneously conceived DZ twins (Montgomery et al., 2004). However, this deletion mutation was not detected in members of 429 other families. Further study of 379 families (in which sisters had delivered DZ twins), and 226 families (that included mothers of twins and their parents) did not indicate an association between DZ twinning and GDF9. It was concluded that rare GDF9 mutations may affect twinning in some families, but that normal GDF9 variation does not affect twinning frequency. This work was reported in *Twin Research* (2004).

# Revisited: The New York Child Development Center Twin Study

Last year, Dr Larry Perlman and I published companion papers in *Twin Research and Human Genetics* (Volume 8, Number 3, 2005) on the controversial Child Development Center (CDC) Twin Study, in New York (Perlman, 2005; Segal, 2005b). This study, conceived by Dr Peter Neubauer and colleagues, tracked the development of separated twins and triplets from infancy through adolescence. The twins' adoptive families were kept unaware of their children's multiple birth status. Years later, several of the twins met as adults, bitter that knowledge of their real life histories was concealed from them. Several twins are now trying to gain access to the research archive (test scores, film series), donated to Yale University, even though investigators stipulated that the files remain closed until 2066.

In January 2006, Dr Larry Perlman and I visited Dr Dorothy Krugman, one of the psychologists associated with the CDC. Dr Perlman reflected on this meeting and on other aspects of the CDC study.

## More Thoughts on the Child Development Center Study of Adopted MZ Twins Reared Apart (Dr Perlman)

After my original article went to press (Perlman, 2005), I made contact with Dr Dorothy Krugman, then 82 years old, who had served as the first psychologist on the CDC study of adopted MZ twins reared apart. We spoke on the telephone at length on May 2, 2005, and she graciously consented to meet with Dr Nancy Segal and me in her home on January 2, 2006. Dr Krugman provided a wealth of information, some of which confirmed the statements made by Dr Neubauer, director of CDC. She elaborated on the context of the study, revealed areas of contention among the staff, and discussed weaknesses in the conceptual framework.

Krugman was hired as a consultant to Louise Wise Services at the age of 26, between 1948 to 1949, while still in graduate school at Columbia University

Teachers College. The agency was professionalized after World War II; it had been a cottage operation run by the founder, a private philanthropy for placing infants from the Hebrew Home for Orphans. On the board were Judge Justine Wise Polier, daughter of the founder, along with Drs Viola Bernard and Marianne Kris, 'the cream of the psychoanalytic profession'. Florence Kreech was the director of Louise Wise.

Being a consultant suited Krugman because she had the flexibility to raise her own children and was able to stay out of agency politics. She continued to be an infant specialist at various adoption agencies until her retirement. Krugman assessed babies and children from 3 months of age and wrote reports that were used as part of the adoption process. Krugman emphasized that she wrote the reports, but was not involved in actual placement decisions.

The study was initiated when the Louise Wise Agency was faced with more than one twin pregnancy. This serendipitous natural experiment posed a research opportunity. The researchers needed to collect data in a hurry and Krugman was drafted. This was the first research study that Louise Wise had consented to join, having passed on previous offers due to great concern with confidentiality. The agency only agreed this time because of Dr Viola Bernard's influence. Thus, it appears that the study was patched together in response to the opportunity that had arisen.

Bernard thought it was important to separate twins — that it was better for the psychological development of each individual. Her belief was that twins reared together shared an ego and would be better off if they could develop independently. Therefore, parents raising twins were encouraged to dress the twins differently and to place them on different schedules, so that they would be treated as separate individuals.

Krugman revealed that there were dissenting views about the value of separating the twins at adoption. 'It was controversial then and still is. Separating twins — whoever heard of such a thing! The mystique of twinship is so strong.'

Many seminars were held with the staff to explain the reasoning behind the project. Social workers who disapproved were permitted to opt out of doing the family studies.

There were discussions about not telling the parents. Bernard was clear that the impact of not revealing the twinship was critical at the beginning of life. If the twins met later, after their ego structure was developed, it would not matter as much because they would be intact individuals who could handle the status of being twins. The possibility of their meeting by chance, since they were placed with Jewish parents in the New York metropolitan area, was anticipated, but would be offset by the advantage of their having already developed stable personalities.

Bernard accepted the likelihood of the twins meeting by chance at a later date; in fact, unlike other staff members, she viewed it as a good thing. However, there was never a plan for debriefing the families and reuniting the twins, though apparently this had been discussed.

Krugman stated that it is difficult to answer questions as to whether the practices were ethical or not. 'How much information should parents receive when they adopt? In those days little information was conveyed to adoptive parents about the biological parents. Now it is not unusual is to have open adoptions in which the birth mother attends birthday parties and participates in other life events, making it almost like shared parenting.'

Bernard needed someone to fill in and start collecting data while the infrastructure was being created at CDC. For almost 2 years Krugman did all the fieldwork; she interviewed adoptive parents, made films, and administered psychological evaluations for the first three sets of subjects, including the triplets. (This would place her participation in the early 1960s.) She visited the families monthly or bimonthly, before and after adoption, until the twins were about 18 months old, at which time the study was taken over by CDC.

Krugman used standard observation inventories like the Cattell scales. She had many discussions with Annemarie Weil, chief psychiatrist at CDC, about which tests to use. Weil wanted to use Viennese measures that were not well known or readily available in the United States. This was a tumultuous period for Krugman and she devoted many hours of her personal life to discussing the study and its structure.

Krugman recalled that 'team meetings were like a Broadway show; Weil and Bernard were often at odds. Peter Neubauer was a doll — charming, delightful, a cavalier. He was a good boy who tried to keep peace'. He offered Krugman hors d'oeuvres and soothed her while this was going on.

Weil wanted *her* psychologist to collect the data, so it was turned over to Annelise Reiss, who used the Austrian developmental schedule that Weil favored. Krugman was glad to be relieved of her responsibilities. Subsequently, a psychologist named Nina took over for a while. There was a lot of turnover of psychologists on the study.

The research was ill conceived from the start. The design seemed sound, but the psychoanalytic concepts of ego development that Weil and Bernard chose to study were difficult to operationalize. This was disturbing to Krugman as a psychologist with research training. CDC was primarily a clinical operation and not strongly research oriented. 'These were well-meaning people with a good theoretical orientation that was not researchable.'

At that time, most of the Louise Wise clients were Jewish girls in their late teens or early 20s who became pregnant out of wedlock. They were housed in a maternity home on Staten Island from the end of the first trimester until they gave birth, and in a mother–baby residence thereafter if they chose to keep their babies. They received schooling and the best medical care and counseling services. Many came from out of town, while girls from New York City might go elsewhere to give birth. All of the adoptive families were Jewish. Some non-Jewish girls came to Wise because they felt that their babies would do best if raised by Jewish parents.

All of the twins were placed as second children, because the adoptive

parents would be experienced and this ensured that each twin would have a sibling. Families were inclined to accept the condition of being in the study because it was difficult to get a second adoptive child; there was not a plentiful supply of infants available at that time.

Biological mothers needed to consent to the separation of the twins. Family studies were done carefully. Adoptive parents were consulted on many issues, such as their willingness to adopt a baby with interracial parentage or from a mother with health or emotional problems. Information regarding the biological fathers was rare, because many of the mothers were reluctant to disclose it. Adoptive parents who were unwilling to accept the risk of receiving a child with a particular hereditary disposition were ruled out.

Louise Wise was one of a few agencies that had postplacement services for families experiencing difficulties after adoption. They would conduct clinical studies, share the information with the adoptive parents, and make referrals for treatment if necessary. Bernard volunteered her time to provide treatment for some emotionally troubled adoptees.

One female twin had serious problems. Bernard personally treated her, providing 'thousands of dollars worth of psychiatric care'. The staff was committed to making sure that the youngsters had the best possible opportunity for successful ego development. The families were provided with 'unmatchable service, contact with professionals, and help whenever they needed it'.

Krugman said, 'It is a shame that the data were never published'. She believes that, because of the ongoing concerns of the adoption agency about confidentiality regarding the natural mothers and others, it was too provocative for the researchers to publish. There had been talk of linking the study to a large child development research project at the Columbia Presbyterian/New York State Psychiatric Institute, where Bernard was the director of community psychiatry. This would have the effect of masking its source so that the findings could be published without revealing the role of Louise Wise Services. Krugman had no further information about this and apparently it never happened.

Krugman mentioned that one set of female twins had been placed separately prior to the initiation of the study and were not part of it. They were reunited by chance when enrolled in the same day camp at the age of 6. If true, this confirms that decisions about separation were based on Bernard's conviction about twins needing to develop independently and strengthens the argument that the twins were not separated for research purposes.

I had the opportunity to hear more about the impact of the study on the twin subjects when I met with Paula Bernstein and Elyse Schein on June 9, 2006. These were twin girls, named Jean and Marion, whom I had observed at 28 days of age while they were still in foster care. They were reunited 2 years ago when Elyse contacted the Louise Wise Services to obtain information about her birth mother and discovered that she had a twin. They learned of my participation in the study from Dr Nancy Segal and were eager to rescue any tidbits of information regarding their origins. Now 37 years of age, these women feel that they were cheated out of the opportunity to share their twinship. They suspect that the study had been the determining factor in their separate adoptions.

Ironically, these twins were dropped from the study at the time of their adoptions at 5 and 9 months of age. It is not clear why this happened, although they speculate that it was because one of them had exhibited some developmental delays. This does explain the fact that the index for the research files at Yale only refers to records on 11 individuals, while there were five sets of twins and one set of triplets in the original study (a total of 13 individuals).

It is interesting that their twinship was not revealed to their adoptive parents, even though they were no longer subjects. This tends to confirm that Bernard's dogmatic belief about separating twins, misguided as it may have been, was the operative factor rather than the research itself.

Please note: Anyone with additional information or thoughts on this study is invited to contact Drs. Larry Perlman (lperlman@umich.edu) or Nancy Segal (nsegal@fullerton.edu).

# New and Unusual Twins

## Triplets, Then Quads

A 40-year-old Los Angeles mother of five (two daughters, followed by IVF triplets) delivered a set of quadruplets in July 2006 (Associated Press, 2006). The quads (two boys and two girls) were conceived without artificial reproductive technology (ART). They were born after 32 weeks' gestation and weighed 4 pounds (girls) and 3.5 pounds (boys). The two girls (17 and 17.5 inches) were longer than the two boys (16 inches). The boys were thought to be MZ, although that was not confirmed. These quadruplets were born 3 years after their older triplet siblings, so lingering effects from their mother's previous fertility treatment, in addition to her older age, may explain their unusual birth.

## Twins Paradox

Albert Einstein's twins paradox, developed in 1905, has undergone two recent 'tests.' What is required is that one MZ twin goes on a flight into space, traveling close to the speed of light. He/she does this while the co-twin stays on earth. Einstein's theory of relativity specifies that time would have gone by more slowly for the traveling twin than for the earth-bound co-twin. When the traveling twin returns, he/she would be younger because aging is affected by time (Davis, 1995; Hawking, 1988).

In 1972 MZ twin, Charlie Duke, landed on the moon as part of the Apollo 16 mission. He did not travel long enough or quickly enough for detectable aging effects to have occurred, when compared with those of his brother Bill (Segal, 2000). This scenario repeated in July 2006 when astronaut Scott Kelly took part in The Shuttle Discovery mission. His identical twin brother, Mark (also an astronaut) remained behind (Malik, 2006).

## Doublemint Twins

Most people are familiar with the *Doublemint Twins*, the identical women who appeared on Doublemint gum billboards in the 1930s (Howard,

2006). Over the years, other identical twins have been featured in advertisements for Wrigley chewing gum. Recently, new advertisements have been created to promote Doublemint mints — only this time the pairs include unlikely unrelated individuals representing diverse looks and backgrounds, for example, a Caucasian man and a Black woman. It turns out that older people prefer the genuine identical twins, while younger people favor the different ones. The new slogan is, 'Doublemint Twins are different. They're mints'.

## Surgical Separation

This year, 10-month-old conjoined female twins, Regina and Renata Salinas Fierros, were separated in a 22-hour operation at Children's Hospital in Los Angeles (Lin & Chung, 2006). The twins were fused from the lower chest to the pelvis. The operation was successful. In its aftermath, ethicists, economists and others questioned the ethics and advisability of spending nearly one million dollars (part of which came from public funds) on such surgical procedures. One individual noted that it is difficult to understand why such costly medical care may be easier to secure than ordinary life-saving treatments.

The hospital staff agreed that the operation was worth doing — and the ethicists believed that the concerned public would want to do everything possible to help the twins. They pointed out, however, that this case raises important issues over how best to allocate medical resources.

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