

Twinsburg, Ohio; Twinsburg Research Institute; Twin Study Summaries; The Outside World

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Recent plans to establish a Twinsburg Research Institute in Twinsburg, Ohio, home of the annual Twins Days Festival, are reviewed. Included among the topics under discussion were the development of an Ohio and/or national United States twin registry and the appropriate location for such a facility. Next, recent findings on chromosomal anomalies and other adverse consequences of artificial reproduction are summarized — some results are surprising and unexplained. This information is followed by further examination of epigenetic twin studies, supplementing a review in a previous issue. The last section of this article presents insightful material about twin leaders, scholars, athletes, designers and parents.

Twinsburg, Ohio

Most people associate Twinsburg, Ohio with the annual *Twins Days Festival*, when several thousand twin pairs arrive for a weekend celebrating the joys and benefits of twinship (see Segal, 2005a). However, Twinsburg also has an intriguing history, which explains why it attracts so many twins each year. Some historical and factual highlights are provided below; more detailed information is available at <http://www.twinsburg.com> and at <http://www.rootsweb.com/~ohlake/bios/wilcox1.html>.

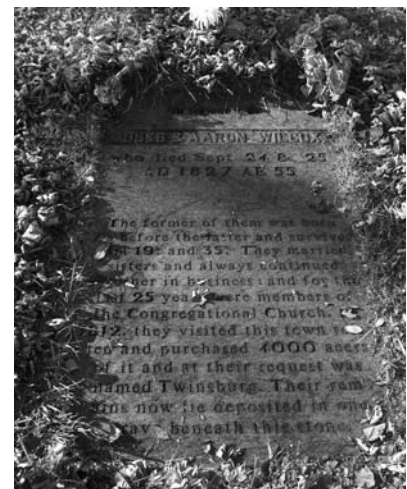
Twinsburg, Ohio is located between Cleveland and Akron in Summit County, in the northeastern part of the state. In 1817, Ethan Alling became the first individual to settle in the area that would later become Twinsburg; the location was first known as Township Five, then Millsville. The name Millsville was later changed to Twinsburg because of the identical Wilcox twins, Aaron and Moses. The Moses brothers arrived in the area in 1819 and worked for the Connecticut Land Company, selling small plots of land to draw settlers. They set aside \$20,000 for a new school and six acres of land for a public square — under the condition that the town's name be changed to Twinsburg. Their offer was accepted and plans moved forward.

The lives of the Wilcox twins were closely intertwined. They continued as business partners throughout their entire lives. They lived one-half mile

apart, married sisters, and had the same number of children. Toward the end of their lives they suffered from the same fatal condition (the specific disorder was not indicated in the various sources I consulted), and passed away on the same day. They are buried in a common grave in Twinsburg's Locust Grove cemetery.

There is another, less well-known fraternal angle to Twinsburg: an area of Twinsburg called Reminderville was settled by three Reminder brothers during the Depression years (1929–1939). In 1955, Reminderville seceded from Twinsburg to become a separate entity.

A meeting to consider the establishment of a Twinsburg Research Institute (TRI) took place on October 20, 2005. The venue was familiar — it was the Hilton Garden Hotel, where I stayed during the Twins Days Festival in 2000. Katherine Procop (Twinsburg's Mayor) and Larry Finch (Twinsburg's Planning and Community Development Director) were instrumental in bringing together 13 individuals (in addition to themselves) dedicated to promoting the TRI's goals and directions: government representatives (Adelle Nykaza, Megan Gordon, Joe Jarabeck and Darryl Revoldt), researchers and physicians (Drs Bahman Guyon, Nick Martin, Stephen Petrill, Nancy Segal and Lee Thompson), Kent State University personnel (Drs Patricia Book and H. David Mohan), and business advisors (Howard Gudell and David Silk). After the



'In Memory of Moses and Aaron Wilcox who died Sept. 24 & 25 AD 1827 AE 55. The former of them was born 7 m before the latter and survived him 19 h and 35 m. They married sisters and always continued together in business; and for the last 25 years were members of the Congregational Church. In 1812, they visited this town selected and purchased 4000 acres of it and at their request was named Twinsburg. Their remains now lie deposited in one grave beneath this stone.'

Larry Finch, Twinsburg Planning and Community Development Director, and Dottie Oliver, Twinsburg Visitors Center Coordinator, provided the photograph and inscription.

meeting ended, Larry Finch brought Nick Martin and me to the Wilcox twins' gravesite, shown in the accompanying photograph. It was memorable.

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Twinsberg Research Institute

The idea of a TRI is appealing. When I first learned about the idea in July 2005 I was enthusiastic — after all, thousands of twin pairs (albeit mostly identical and self-selected) arrive in the city each summer to participate in contests, talent shows, golf tournaments, social gatherings and more, all with a twin-based theme. In recent years, researchers have set up tents and booths to attract participants for psychological and medical studies. In 2000, I secured a spot in the Exhibition tent and distributed questionnaires to assess social relationships in monozygotic (MZ) and dizygotic (DZ) twin families (Bryner, 2005). That study continued over the Internet and has attracted over 400 twins (<http://psych.fullerton.edu/nsegal/twinparent>).

The session opened with welcoming remarks from Mayor Procop and Community Director Finch. The remainder of the meeting was presided over by David Silk, Principal with SGI, Global Business Advisors, LLC. Howard Gudell, also of SGI, worked with him, recording notes and posing challenging questions. Topics for discussion were organized into four categories: I. Science and the Need for an Institute, II. Data Collection, Storage and Dissemination, III. Putting the Institute Together and IV. Next Steps. A final report was issued to attendees several weeks later — key issues are summarized below.

I. Science and the Need for an Institute

The United States currently lacks a national twin registry, although registries have been established in some states including Virginia, Minnesota and California. Ohio lacks a twin registry, although Case Western Reserve University investigators (Petrill and Thompson) have arranged to obtain background information on twins via the Ohio Bureau of Vital Statistics. The need for a twin registry was underlined by the fact that analyses of twin data can substantially advance behavioral and medical research. However, the consensus among attendees was that development of a registry in Ohio should precede development of a registry at the national level.

Then, should a decision be made to convert the Ohio state registry into a national resource, Twinsburg's name recognition would make that city an excellent location. Furthermore, Twinsburg is fairly centrally located in the United States, making it accessible to twins, investigators and visitors.

The key distinction between a registry and institute was underlined. Specifically, an institute can process information and materials gathered via a registry, so it can exist independently of a registry; however, close collaborations between the two are desirable. Another important theme was that efforts should be made to attract nonidentical twins, as well as twins with specific behavioral or medical traits of interest, thus widening the research possibilities.

II. Data Collection, Storage and Dissemination

Data collection at the TRI could occur in several ways, including personal visits, regular mail and courier services. All such methods would require prior Institutional Review Board (IRB) approval. Twins are, however, interested participants and informal, personalized relationships with investigators have proven successful.

Required storage facilities would include computers, refrigerators, alarm systems, back-up generators and security procedures. Adequate space for offices, investigation and data analysis would be required. Setting up the TRI within a university or university hospital is currently under discussion, given that appropriate professional relationships would emerge from such an arrangement.

III. Putting the Institute Together

Two key elements — people and equipment — are needed to put the TRI together. Both require considerable funding.

It was decided to establish two boards for the governance and operation of the TRI: an Advisory Board and an Executive Board. The Advisory Board would be composed of scientists and investigators experienced in twin research, as well as in legal and business matters. This board would advise and

guide the scientific activities of the TRI. The Executive Board would include the Institute Director, an individual with a scientific background in twin research, who would be responsible for institute operations and direction. It would also include individuals such as a medical school dean, foundation members and government representatives. Guidance and advice would be sought from individuals with diverse scientific expertise.

Ideally, scientists with training in molecular biology, neuroscience, psychology, epidemiology and oncology would be associated with the institute. Research areas might include, but are not limited to, obesity, aging, cancer and selected behavioral and medical traits. For example, Ohio's Oak Clinic, located in Uniontown and affiliated with Kent State University, is a well-known facility for treating patients with multiple sclerosis (MS). MS occurs when the myelin sheath that wraps around nerves in the brain and spinal cord becomes damaged, thus affecting nerve function. Twin studies show that MS has a partial genetic basis — between 30 and 50% of affected MZ twins have affected co-twins, whereas only 5% of affected DZ twins do. It appears that unknown environmental events trigger the disease in susceptible individuals, mostly young and middle-aged adults (Riskind, 1996). The Oak Clinic and TRI could, therefore, contribute to, and benefit from, associations with one another.

Equipment and facilities would include testing rooms, audio-visual materials, a conference center, hotels, diagnostic equipment and specialized laboratories. On-site studies could be combined with data gathered from other sources.

IV. Next Steps

It was estimated that a sum of 10 million dollars, over 5 years, would be required to support the TRI as envisioned. The next series of efforts will be directed to seeking commitment for university space and support, creating a hiring package for the TRI Director, arranging relationships with academic and medical institutions, and developing a proposal to secure financial support.

Closing Thoughts

Planning for a TRI is in its earliest stages. Such a facility would be very desirable, although considerable planning for financing and operations remains to be done. Dr.

Bahman Guyon continues to be a key player in securing a relationship between the institute and his university. Business advisors, David Silk and Howard Gudell, are holding discussions with representatives of

twin registries around the world to better acquaint themselves with daily operations. Individuals interested in this project should contact Larry Finch at LFinch@TWINSBURG.oh.us

Twin Study Summaries

Artificially Conceived Twins

Two recent studies have compared the rates of chromosomal anomalies in infants from nontwin and twin pregnancies, conceived naturally and via artificial reproductive technology (ART; Newswise, 2005). This work was presented at the October 2005 Conjoint Annual meeting of the American Society for Reproductive Medicine and the Canadian Fertility and Andrology Society, in Montreal, Canada. ART includes *in vitro* fertilization (IVF), gamete intrafallopian transfer (GIFT) and zygote intrafallopian transfer (ZIFT). Both investigations were conducted at the Cedars-Sinai Medical Center, in Los Angeles. Mothers in these studies were 35 years of age and older.

Approximately 70% of early pregnancy loss (loss occurring in the early part of the first trimester) is associated with genetic anomalies. This is true for conceptions achieved both artificially and naturally. However, less is known in this regard with respect to loss occurring later in pregnancy. The first study, therefore, focused on nontwin pregnancy loss occurring between weeks 9 and 12. It was found that genetic anomalies did not occur more often during this stage of gestation, nor did they occur more often as a function of type of infertility treatment. However, follow-up studies are planned to determine if those fetuses aborted spontaneously between 9 and 12 weeks were linked to infertility or to infertility treatments.

The second study focused on multiple births. There has been previous evidence suggesting an increased frequency of chromosomal disorders in twins. For example, women conceiving naturally in their late 30s have a one in 60 chance of delivering a child with a chromosomal disorder; however, this risk rises to one in 34 in the case of twins. Thus, the crucial

question in the second study was: is there an increased risk of genetic anomalies in twins conceived via ART, especially IVF? (IVF often leads to DZ twin and higher order multiples, given the fertilization of separate eggs by separate sperm.) It was found that IVF treatment did elevate the risk of chromosomal anomalies in ART twins. However, women conceiving twins via ART were 2 years older than women conceiving naturally (39 years vs. 37 years), a slight but possibly important difference. Follow-up analyses are planned to address the contribution of age to the pregnancy outcomes.

Dr. Irving I. Gottesman brought this research cited in Newswise to my attention — just after I had reviewed other research suggesting an early health advantage enjoyed by twin infants, relative to nontwins.

Some studies examining the effects of ART have reported earlier deliveries and lower birthweights for artificially conceived infants than for naturally conceived infants (Kovacs, 2002). However, an unexpected and surprising finding was that ART twins did not have a higher risk of poor health outcomes than twins conceived naturally (Helmerhorst et al., 2004). In fact, twins conceived via ART were shown to have a 40% lower risk of perinatal mortality than twins conceived naturally. Reasons why this may be so are speculative, but the authors suggested that the development of two fetuses may offer an implantation advantage — although what this advantage is remains to be determined. Overall, however, twins and twin pregnancies are at greater physical risk than nontwins and nontwin pregnancies.

More Epigenesis

A previous issue of *Twin Research and Human Genetics* included a section summarizing recent findings from Fraga et al.'s. (2005) study looking at epigenetic

differences in 40 sets of MZ twins (Epigenesis: MZ Twin Differences and Their Implications; Segal, 2005b). To quote from my review: 'The key finding from the study was that very young twins do not differ epigenetically, but older twins do show some marked differences in the content and distribution of 5-methylcytosine DNA and histone acetylation. Additionally, twins who spent fewer years together and/or showed greater differences in their health histories showed the greatest differences in the epigenetic profile. The authors pointed out that small epigenetic differences can translate into large phenotypic differences between co-twins' (p. 540). The foregoing implies that environmental events, in the conventional sense, are associated with twins' epigenetic differences.

Given these findings and findings from related studies, it is clear that conceptualizations of the environment and its impact on development have changed. However, important questions, such as those raised earlier by Wong et al. (2005), deserve attention. In their detailed review, they summarized numerous findings from studies of MZ twins reared apart and together, showing comparable similarity across measures in many physical, behavioral and medical domains. Included among the cited works is a study of migraine headaches by Swedish investigators, showing greater similarity among twins separated earlier than later. Clearly, the environment does not work in straightforward ways.

Wong et al. (2005) went on to address a 'third component' — random nongenetic variability that is not due to the environment. They turned to a study by Gartner and Baunack (1990) that found phenotypic variability among laboratory animals raised under both controlled and natural

conditions. In fact, 70 to 80% of the variability was linked to this 'third factor', thought to operate either at, or before, fertilization. This 'third factor' is well illustrated in another paper by Baunack et al. (1984) that I referred to often as a graduate student.

Baunack et al. (1984) compared the social, emotional and psychomotor behaviors of artificial MZ and DZ mouse twins and nontwins. MZ twins were created by dividing fertilized eggs at the eight-cell stage and transferring them to foster mothers. DZ twins were created from separately fertilized eggs that were also transferred to foster mothers. MZ twins showed lower activity, emotionality, aggressivity and social interest than the DZ twins and nontwins. The investigators concluded that 'psychic' or 'somatic' factors were responsible. On the psychic side: both MZ and DZ twin animals were raised with unfamiliar mothers and littermates, placing them in 'conflict' positions. However, MZ twins may have retreated to their 'twin-microcosmos', whereas DZ twins behaved aggressively toward one another and toward others. On the somatic side: the division of the embryonic mass in the case of the MZ twins could explain their behavioral patterns. It was also suspected that mismatch in the age of the

embryos (3.5 days) and mouse mothers' pseudopregnancy (2.5 days) could have caused endocrine signals to reach the embryo at the wrong time, or to have inappropriate effects. Various prenatal events could explain some within-pair twin differences in human twins.

Wong et al. (2005) also described striking phenotypic differences in health and in lifespan among cloned animals. Genetic causes could not be responsible because cloned offspring are genetically identical to their donors. Environmental factors were also ruled out because the conditions under which the animals were kept were highly controlled. Epigenetic effects — effects associated with genomic functions — were thought to be a more likely explanation for the observed phenotypic variation.

It is not difficult to resolve the paradoxical findings that MZ twins reared together and apart show similar levels of resemblance across many traits. This can be done by invoking active gene–environment correlation, the concept that individuals with identical genotypes seek common experiences within their respective environments. It is more difficult to resolve observed differences between MZ twins reared together. Some early personality studies actually found that MZ twins reared together were less alike

than MZ twins reared apart on some measures (see Segal, 2000). This phenomenon was attributed to the social differentiation (e.g., leader–follower) that can evolve between MZ co-twins reared together, resulting in small but meaningful personality differences between them. In contrast, MZ twins reared apart would be unaffected by the presence of a co-twin, allowing more similar expression of their genetic predispositions. I believe that this explanation is still valid, but that it is incomplete — analyses of twins' epigenetic profiles are a necessary complement to psychological studies. Such an approach will assist understanding of MZ co-twin differences, in particular, and complex human behaviors, in general.

It will be important to resolve discrepancies between studies. If Fraga et al.'s (2005) findings are correct — that is, if older twins and twins with differing lifestyles show greater epigenetic differences than younger twins and twins with more similar lifestyles — then why do MZ twins reared apart and together show comparable resemblance across many measured behavioral and physical traits, as Wong et al. (2005) have documented? Subsequent developments in epigenetic analysis will be exciting to track.

The Outside World

President and Prime Minister

Newspapers in September and October 2005 included closely watched accounts of identical Polish twins, Jaroslaw and Lech Kacynski (Bernstein, 2005). The twins were poised to become the top political leaders of Poland — President and Prime Minister. This would not be the first time that the twins were in the public eye — as 12-year-olds they costarred in a movie entitled *Who Stole the Moon*, a children's story known to all Polish citizens.

In October 2005, Lech Kacynski, Mayor of Warsaw and leader of the Law and Justice party, was elected President of Poland. He went on to appoint not his twin, but Kazmier

Marcinkiewicz as Prime Minister. Before the election, Jaroslaw Kacynski pledged to give up the position of Prime Minister so as not to hurt his brother's chances of becoming president. News analysts suggested that there were both advantages and disadvantages to having identical twins in office simultaneously. On the positive side was the fact that the twins were seasoned politicians and strong allies. On the negative side was the concern that these advantages would be held against them. Some people felt, however, that Jaroslaw's forfeiting of the Prime Ministership might give the impression that the substitute would have reduced power.

Brains and Brawn

Identical performances by MZ twins, whether athletic or intellectual, draw attention. Most people marvel at unusual skill, particularly when it is closely matched as it generally is in MZ twins. Research shows that such phenomena are understandable, given the twins' identical genes that appear to underlie their similar interests and activities. Research also shows that identical twins' common genes contribute to their close social relations that, in turn, facilitate practice, performance and success (Segal, 2000). Most scientists, while accustomed to such stories, are nevertheless intrigued because each story

is a unique take on human development and behavior.

A recent article in *Rafu Shimpo* (2005), the Los Angeles newspaper covering events of interest to the Japanese–American community, chronicled the stunning achievements of MZ twins, Ryan and Brandon Ting. The Ting twins are defensive backs for the Trojans at the University of Southern California. They are also in the top 1% of their class, with grade point averages of 3.8 and 3.9. The twins are half-Chinese and half-Japanese, a distinguishing factor given that football teams include few Asians, with the exception of Samoans. The twins' coach called them 'the finest young men that I have been around in my 20 years of coaching ...'. In addition to their flair for football, both twins have earned first-degree black belts in karate. Clearly, twin athletes, whether elite or amateur, enjoy the advantage of having a constant partner with whom to practice (Segal, 2000).

Identical twins have been popular as players in team sports, such as football, basketball and soccer. This may be explained by their understanding of each other's abilities and the emotional support that they lend to one another. Furthermore, their physical identity makes them interesting to fans. Consequently, outstanding twin athletes are easier to name and recognize than are twin scholars. Of course, physical resemblance would not carry weight in academics and, with very few exceptions (e.g., California State University, Northridge twins, Rheem and Jheem Medh, in the Departments of Biology and Chemistry, respectively, and Richard and Robert Docter, formerly in the Departments of Psychology and Educational Psychology, respectively), MZ twins do not secure positions at the same institution. Scholarly MZ twins do, however, show matched academic achievements, often in the same field, such as political scientists Earl and Merle Black, from Rice University and Emory University, respectively, and former University Presidents Harold and Bernard Shapiro, at Princeton University and McGill University, respectively. Even more exceptional, however, were identical twins who held jobs at the same university *and* in the same department — University of New

Hampshire twins, Dean and David Kopsell, formerly in the Department of Horticulture. Another reason why twins may be less well-known among academia is that, on average, they score below nontwins in general intelligence tests (although some recent studies have challenged this finding, as do the Tings, the Docters, the Kopsells, the Shapiros and the Medhs; also see Posthuma et al., 2000).

It is likely that we will hear more about the Ting twins in the future, — as well as 29-year-old identical Russian twins, Olesva and Yelena Nurgalyeva.

The Nurgalyeva twins were spotlighted prior to their running of the New York Marathon on November 6, 2005 ('Faces in the Crowd', 2005). The twins finished first and second in last year's Frankfurt Marathon, further testimony to identical twins' matched athletic skills. On Marathon day I flew across the United States, from New York to Los Angeles, but was able to follow the race on the small screen. I was disappointed that Olesva and Yelena did not place in the top three, but I not surprised that their performances were so close: they came in 48th and 55th (out of over 36,000 entrants), 12th and 13th among women, and 4th and 5th among women in their age group. Their pace (5:42 and 5:49, per mile) and finish times (2:29:35 and 2:32:36) were nearly the same. I was not surprised — but I was amazed.

Identical twins give competition a new slant. In general, they work hard to stay abreast of one another, not to outdo one another. Twenty years ago, British marathon runners Angella and Chris Hearn finished the New York Marathon just 12 minutes apart — at 2:39 and at 2:51 (Tanser, 2005). They say that their sports advantage came from hours of training together. Chris also knew that Angella had better results, but she insisted that it never bothered her.

Surviving Twin Loss in New York

My father sent me a moving newspaper article about the life of surviving twin, Jed Johnson (Hamilton, 2005). The article was also a tribute to Jed's deceased twin brother, Jay. They were described as a pair of 'extraordinarily handsome men', and 'as different as

night and day' despite the fact that they were twins. Jay was identified as his deceased twin's 'best friend' and 'public half'. It is unclear from their photograph if they were identical or fraternal, although they look quite similar. Regardless, their life story illustrates the profound effects that twin loss can have on one's life.

The former Jed Johnson directed Jed Johnson and Associates, a multimillion dollar interior design firm. His celebrity clients included the actor Richard Gere, the rock star Mick Jagger, and the singer Barbra Streisand. The artist Andy Warhol was Jed's lover for 12 years. Jed's life ended suddenly in the 1996 explosion of TWA flight 800.

The twins' past was a mixed picture. They were born in 1948 in a small Minnesota town. The twins' mother divorced their alcoholic father when they were 18, after which the family (which included four children besides the twins) moved to Arizona and then California. The twins enrolled in college, but left school at age 19 to hitchhike to New York. They took jobs delivering telegrams, leading to their acquaintance with Andy Warhol. Jed eventually established a decorating company — Jay worked for his twin until his drinking and drug habits interfered. Then, following a period of absence for drug rehabilitation, Jay returned to his job in his twin's business.

Jed was the driving force behind the company, so no one expected Jay to assume its leadership after his twin's death. But he has done so successfully, with one important addition: the company's new logo now has double Js.

Cash Bonus for Twins

During the last few decades, limiting family size has been strongly promoted by several Asian nations, such as China and South Korea. However, South Korea's steadily declining birth rate recently prompted measures to reverse that trend (Onishi, 2005). One such measure is vasectomy reversal, paid for by the government. Other policies under consideration include tax breaks for couples with several children and paid maternity leaves. The change in policy has shown some positive results. In winter, 2005 Seocheon County celebrated its first birth in 4 years — a double celebra-

tion because twins were born. The two infants appear to be male and MZ, based upon inspection of photographs. The twins' parents received \$1100 dollars in cash for the twins. Their mother Lee Ji Yun, aged 28, and their father Park Dae Soon, aged 32, already had a young daughter — she was the last child born in Seocheon County 4 years earlier.

It will be interesting to follow changing trends in childbirth in South Korea and in other nations that have relaxed their child-bearing policies. Cash bonuses in particular might have novel effects on our thinking regarding twins and on our assessment of twinning rates.

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