

Who Discovered the Twin Method?

Richard D. Rende,¹ Robert Plomin,¹ and Steven G. Vandenberg²

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The twin method is usually credited to Francis Galton's 1875 article on twins. However, Galton did not propose the comparison between identical and fraternal twin resemblance which is the essence of the twin method. Although the twin method was "in the air" in the mid-1920s, the first descriptions of the method appeared in an article by Curtis Merriman and in a book by Hermann Siemens, both in 1924, 50 years after Galton's paper.

KEY WORDS: twin method; history; Galton; Merriman; Siemens.

INTRODUCTION

The classical twin method that compares the resemblance of identical and fraternal twins is the most widely used method in the armamentarium of human behavioral genetics. Textbooks on behavioral genetics usually credit Francis Galton with its discovery. Although Galton deserves to be called the father of human behavioral genetics for many reasons, discovering the twin method is not one of them. The first part of this paper examines what Galton said and did not say about twins, and the second part traces the origins of the twin method, which did not emerge for 50 years after Galton.

FRANCIS GALTON AND TWINS

The discovery of the twin method is usually accorded to Galton's 1875 article in *Fraser's Magazine* entitled, "The History of Twins, as a Criterion of

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¹ The Center for Developmental and Health Genetics, College of Health and Human Development, The Pennsylvania State University, University Park, Pennsylvania 16802.

² Institute for Behavioral Genetics, The University of Colorado, Boulder, Colorado 80309-0447.

the Relative Powers of Nature and Nurture.” This article was reprinted in 1876 with slight revision in the *Journal of the Anthropological Institute* (Galton, 1876). Galton’s first mention of twins was in 1874 in his book, *English Men of Science*:

There are twins of the same sex so alike in body and mind that not even their own mothers can distinguish them. Their features, voice, and expressions are similar; they see things in the same light, and their ideas follow the same laws of association. This close resemblance necessarily gives way under the gradually accumulated influences of difference of nurture, but it often lasts till manhood. (pp. 13–14)

This early quotation presages Galton’s use of twins to test the power of the environment to change twins, that is, to make initially similar twins different and to make initially different twins similar. He did not propose that the resemblance of identical twins be compared to the resemblance of fraternal pairs to assess genetic influence.

Galton began his 1875 article by noting an objection to his studies of families in *Hereditary Genius* (1869) that compared resemblance for first-, second-, and third-degree relatives. His approach had considered environmental factors such as social conditions and education that lead to familial resemblance. The objection was that such systematic environmental factors

are only a small part of those that determine the future of each man’s life. It is to trifling accidental circumstances that the bent of his disposition and his success are mainly due, and these you leave wholly out of account. (p. 566)

Galton indicated that he “attacked the problem from the opposite side”:

The life history of twins supplies what I wanted. We might begin by enquiring about twins who were closely alike in boyhood and youth, and who were educated together for many years, and learn whether they subsequently grew unlike . . . We can enquire into the history of twins who were exceedingly unlike in childhood, and learn how far they became assimilated under the influence of their identical natures. (p. 566)

Thus, in modern terms, Galton proposed in the first case to study nonshared environmental factors in adulthood by following the life history of identical twins after leaving their families. He viewed the second case as a test of shared environmental influence, “to see how far an identity of nurture in childhood and youth tended to assimilate them” (1875, p. 575). Tracking life history changes of twins was a novel idea, and only recently have behavioral geneticists taken seriously the need to study developmental change. However, the origins of the twin method that compares identical and fraternal twins cannot be construed from Galton’s article.

Confusion concerning Galton’s article can arise because it includes a paragraph acknowledging one-egg and two-egg twins, and a study is reported that involved 35 twin pairs of “close similarity” and 20 pairs of “great dissimilarity.” The 35 similar pairs appear to be primarily identical twins. Galton saw

some change and some continuity in the life histories of these twins. He found the results for the 20 pairs of dissimilar twins more conclusive: "I have not a single case in which my correspondents speak of originally dissimilar characters having become assimilated through identity of nurture" (p. 575). The latter data, not a comparison between the two types of twins, led to Galton's oft-quoted statement that "there is no escape from the conclusion that nature prevails enormously over nurture" (p. 576).

Three other points buttress the argument that, although aware of the two types of twins, Galton did not suggest that evidence for the influence of nature could be adduced by the comparison between identical and fraternal twins. First, from another paper in the same issue of the *Journal of the Anthropological Institute*, it appears that Galton thought that his same-sex dissimilar twins were identical twins! In this paper on a theory of heredity, he refers to twins from the same ovum as "true twins," and in a footnote, he states,

I had twenty cases of strong dissimilarity in twins, and in all the cases the twins were of the same sex. Now it appears to be a rule without exception that what I have above termed "true" twins are of the same sex. Such twins are by no means uncommon . . . Hence there is much probability that my cases of strong dissimilarity were usually, if not invariably, cases of true twins. But I have no direct evidence one way or the other. (Galton, 1876b, p. 337)

Why would twins from the same ovum be so different? Galton suggested that if division of the ovum was delayed beyond the point at which differentiation occurred, the twin halves "would be strongly contrasted" (p. 337).

Second, Galton's (1908) autobiography bolsters the argument that Galton did not propose the comparison between identical and fraternal twins:

It occurred to me that the after-history of those twins who had been closely alike as children, and were afterwards parted, or who had been originally unlike and afterwards reared together, would supply much of what was wanted. (p. 294)

It is noteworthy that a single paragraph is all that Galton said about twins in his 323-page autobiography. If Galton had realized the value of comparing the two types of twins in order to estimate genetic influence, it is reasonable to expect that he would have conducted other research with twins after 1875 and that he would have had something more to say about the twin method in his 1908 autobiography.

Finally, Karl Pearson's four-volume biography of Galton contains only four pages about Galton's twin work. This discussion is in the second volume of the biography, published in 1924. It merely summarizes Galton's 1875–1876 papers and makes no reference to the comparison of identical and fraternal twins. Furthermore, he introduces this section on Galton's twin work with the following statement:

It seems best to consider here two papers on the subject of twins, because although

they to some extent were associated with Galton's ideas on heredity, yet they sprung, I think, from his work on the influence of the environment. (Pearson, 1924, p. 126)

In summary, Galton's delight in discovering twins was to assess the ability of the environment to make initially similar twins different and to make initially different twins similar. Galton thought that all of his twins—both the similar and the dissimilar pairs—were one-egg twins, what we now call identical twins. He did not suggest comparing one-egg and two-egg twins. Thus, it is not correct to claim that Galton proposed the twin method.

WHO DISCOVERED THE TWIN METHOD?

If Galton did not discover the twin method, who did? Although Galton's article was written in 1875, no other studies of twin resemblance were published until 1905, when E. L. Thorndike, the learning psychologist famous for his work on trial-and-error learning, reported twin resemblance for younger and older twins on a battery of cognitive tests. Thorndike did not compare identical and fraternal twins. Indeed, Thorndike, together with R. A. Fisher (1919), was a leading proponent of the view, based on analyses of the distribution of twin differences, that there were not two kinds of twins. For example, Thorndike (1905) states that "the evidence in the case of the thirty-nine pairs of twins from whom we have extended physical measurements gives no reason for acceptance of the hypothesis of two such distinct groups of twins" (p. 44). Thorndike extended Galton's twin research by using objective tests of cognitive abilities and by formulating additional tests of environmental effects. For example, Thorndike argued that the environmental hypothesis predicts that twins on average grow more similar during childhood and that highly trained tasks such as arithmetic ability should show greater twin resemblance than tasks less subject to training such as quickness in marking A's on a sheet of capital letters. As with Galton's work, nature is suggested only by default. That is, Thorndike attributed performance on his tasks to heredity because he found that twins do not grow more similar during childhood and that twins do not resemble each other more for highly-trained tasks. Like Galton, Thorndike greatly overstated his case for hereditary influence:

The facts then are easily, simply, and completely explained by one simple hypothesis: namely, that the natures of the germ cells—the conditions of conception—cause whatever similarities and differences exist in the original natures of men, that these conditions influence body and mind equally, and that in life the differences produced by such differences as obtain between the environments of present day New York City public school children are slight. (p. 16)

Nearly 20 years after Thorndike's twin study and 50 years after Galton's, a twin study published in *Psychological Monographs* provides what appears to be the first explicit description of the twin method:

Since the “two distinct species” theory is the more widely accepted, let us assume that it is the correct theory and then list the principal claims that it makes, and the results that should follow

1. There are two distinct types of twins, fraternal and duplicate.
2. The fraternal, being of the two-egg origin, should show no greater resemblance than ordinary siblings, since each individual of the pair develops from a wholly independent arrangement of the factors for heredity in the germ cells.
3. The duplicate, being of the one-egg origin, should show a very much higher degree of resemblance than the fraternal because each member of the pair develops from substantially the same arrangement of the factors for heredity in the germ cells.

This excerpt is from a 1924 report in *Psychological Monographs* (pp. 26–27) of a twin study on mental abilities by Curtis Merriman, Assistant Professor of Education at the University of Wisconsin. Merriman’s article contains no clues concerning the conceptual origins of the twin method, although it should be noted that as early as 1901 Weinberg had pointed out that the number of like-sexed DZ twins ought to be the same as the number of boy-girl pairs, and by subtraction this allowed estimates of the incidence of MZ twins (Stern, 1962). Merriman describes Galton’s paper on similar and dissimilar twins in a section appropriately entitled “The Effects of Environment”:

The excess of difference in the first case, and of resemblance in the second, was thought to give a measure of the influence of environment. The persistence of similarities in the first case and of differences in the second was taken as a measure of the influence of nature. (p. 8)

Merriman also discusses Thorndike’s study in the same section on environmental effects. He notes weaknesses in the studies of Galton and Thorndike but does not point out the main one—that they did not compare resemblances for the two types of twins.

Merriman’s study was conducted as his dissertation research at Stanford University, under the supervision of Lewis Terman (Merriman, 1922). Terman’s role in Merriman’s study is not clear. Terman was interested in Galton (Terman, 1917) and he developed the American translation and revision of the Binet IQ test that was used in Merriman’s twin study (Terman, 1916). Although Terman did not write about genetics or conduct twin studies, he discussed the relevance of the nature–nurture issue with regard to intelligence (Terman, 1928), and he is considered to have had an implicit interest in genetic and environmental contributions to intelligence throughout most of his research career (Boring, 1959). In addition, he also supervised the dissertation research of Barbara Burks, which was a classic adoption study of IQ (Burks, 1928).

Communications with the University Archives at Wisconsin revealed that Merriman was on the faculty of the School of Education from 1923 to 1936, where his primary teaching and scholarly interests were education and statistics. In addition, he served as registrar of the University from 1936 to his retirement

in 1945. Merriman remained an active figure on the campus from 1945 to his death, at the age of 100, in 1975. In 1972, the University Archives at Wisconsin conducted an oral history on Merriman's life (Lowe, 1972). During the interview, Merriman commented that he undertook his twin research to "show that there was a difference between the identical twins and the nonidentical" but that he didn't follow up the work, as his dissertation research "got what [he] was after" (p.3).

In addition to outlining the twin method, Merriman's study itself deserves attention. First, recently- developed intelligence tests were used that continue to be used today, including the individually administered Stanford-Binet and the group-administered Army Beta. Second, Merriman was concerned about sampling issues and took pains to test all twins in a given school, an effort that paid off because the proportion of twins in his study "agrees closely with the observed frequency in the general population" (p. 4), as does the relative number of like and unlike sex pairs. Finally, his study used physical similarity to identify same-sex twins who are identical:

Each examiner was asked to report whether the members of the twin pair being studied resembled each other closely enough to frequently cause confusion of identity. (p. 43)

Because "not every examiner made this report," the number of identical twin pairs was only 22. These twins yielded correlations of .98 for Stanford-Binet IQ, .88 for Beta scores, .98 for NIT scores, and .94 for teacher ratings. Merriman concludes,

These are very high correlations. Not only are they high correlations, but with one exception they are materially higher than the results that were found in earlier parts of the study for the resemblance in the entire twin population. (p. 43)

Merriman did not, however, identify a group of fraternal twins and thus he did not compare identical twin correlations to fraternal twin correlations. The first authors who actually compared the correlations of MZ and DZ twins for IQ were Tallman (1928) and Wingfield (1928) (see von Bracken, 1969).

After a 50-year hiatus in the use of twins, a spate of twin studies appeared in the second half of the roaring twenties. Several twin studies were published in America after Merriman's (Hirsch, 1930; Holzinger, 1928; Lauterbach, 1925; Tallman, 1928; Wingfield, 1928). Surprisingly, these studies do not usually refer to the origins of the twin method. When they do, they vaguely credit Galton for first studying twins and mention in passing the twin studies of Thorn-dike and Merriman. Only Lauterbach (1925) gives explicit credit to Merriman, and that is for providing statistical evidence for two types of twins:

Merriman has shown statistically that a distribution of the intelligence quotients of a twin population represents two types of population and he concludes that these two types are determined by one-egg and two-egg genesis. (p. 568)

One reason that Merriman's work did not receive more attention may be that he did not indicate that the comparison between identical and fraternal twin resemblance could be used to assess hereditary influence on a trait. Instead, in accord with the zeitgeist, Merriman assumed that heredity was all-important for performance on intelligence tests and interpreted his results only in terms of their support for the existence of two types of twins.

During the same year that Merriman's article appeared in America, a book published in Germany provided the first explicit description of the twin method. Hermann Siemens, a dermatologist, proposed that hereditary influence on features such as skin disorders could be assessed by comparing the occurrence of the feature in identical twins with the occurrence in fraternal twins:

If an illness is regularly dominant, then both of the identical twins either suffer from it or are free from it . . . whereas the nonidentical twins correlate as the siblings of a two-child family With the help of twin pathology, we found a possible way to judge hereditary influence on the investigated features The assessment is based on the comparison of the findings in identical and nonidentical twins (p. 21; translated from the original German).

In his book, Siemens discusses results of his method as applied to identical and nonidentical twin pairs. Although the emphasis was on skin disorders, psychological features were also examined. For example, Siemens reports that 37 of 48 identical twin pairs had the same performance in school, while 8 differed slightly. In contrast, of 29 nonidentical pairs, 17 performed considerably different in school, 6 differed slightly, and 6 had similar performances. On the basis of these results, Siemens concludes that

. . . it is reasonable to assume that the one group with its similarities of body features and mental capacities derives it from a hereditary pool (p. 32).

In Europe, Siemens is often credited with introducing the twin method (e.g., von Bracken, 1969), although some researchers in the 1920s did not completely embrace Siemens' proposal, because of what they interpreted as a "strong claim" that identical twins had to demonstrate nearly total concordance in order for a trait to be considered hereditary (e.g., Dahlberg, 1926). However, in his book Siemens argues that the comparison of identical and fraternal twins can be used to assess hereditary influence on features which are not totally determined by heredity:

On the basis of the similarities between identical and nonidentical twins, another question can be tackled which has been neglected so far: that is the hereditary disposition of non-hereditary features [such as birthmarks] (p. 23) Even there, where the conditions are not as clear, one can find proof of an idiotypical disposition of paratypical features with the help of a suitable method. It was found, that the correlation of the amount of birthmarks on both identical twins was 0.40 (\pm .013), the correlation between the nonidentical twins was only half of it 0.20 (\pm 0.19), and that among siblings the correlation is dubious 0.10 (\pm 0.20). These results are exactly as one would anticipate in an idiotypical nevus disposition; one may not assume that there are no hereditary differences in the development of the nevus. (p. 29)

This investigation of the origins of the twin method leads to more questions than answers. How did Merriman and Siemens both arrive at a clear statement about the twin method? To answer this, it may be fruitful to explore the gap between 1905 and 1924. Why did two decades pass with no twin studies after Thorndike's 1905 study? Could it be that Thorndike's forceful denial that there are two types of twins slowed the discovery of the twin method until the 1920s when the biological evidence for the two types became overwhelming? A related question is why nearly 50 years transpired between Galton's article on twins and the use of the twin method. Could it be that Galton's conclusion that "nature prevails enormously over nurture" (1875, p. 576) was so widely accepted that it stifled the need for further research on the importance of heredity? Merriman, for example, states that "in spite of the imperfections of Galton's method, his general conclusion as to the persistence of nature has been fairly widely accepted" (p. 8).

A reasonable hypothesis is that the twin method was "in the air" in the 1920s, when it became clear that twins were either from the same egg or from two separately fertilized eggs. The twin method first materialized, however, in 1924, in the article by Curtis Merriman and in the book by Hermann Siemens.

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