

TWIN STUDIES IN PSYCHIATRY AND PSYCHOLOGY: SCIENCE OR PSEUDOSCIENCE?

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Twin studies are frequently cited in support of the influence of genetic factors for a wide range of psychiatric conditions and psychological trait differences. The most common method, known as the classical twin method, compares the concordance rates or correlations of reared-together identical (MZ) vs. reared-together same-sex fraternal (DZ) twins. However, drawing genetic inferences from MZ-DZ comparisons is problematic due to methodological problems and questionable assumptions. It is argued that the main theoretical assumption of the twin method—known as the “equal environment assumption”—is not tenable. The twin method is therefore of doubtful value as an indicator of genetic influences. Studies of reared-apart twins are discussed, and it is noted that these studies are also vulnerable to methodological problems and environmental confounds. It is concluded that there is little reason to believe that twin studies provide evidence in favor of genetic influences on psychiatric disorders and human behavioral differences.

KEY WORDS: twins; twin method; genetics; psychiatry; psychiatric genetics; schizophrenia.

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In 1925 psychiatrist Abraham Myerson, who was writing at the height of the eugenics movement's influence and the belief in the overriding importance of genes, observed, "We often hear of hereditary talents, hereditary vices, and hereditary virtues, but whoever will critically examine the evidence will find that we have no proof of their existence" (1, p. 23). The "evidence" of Myerson's era consisted of family pedigrees, preconceived notions, and prejudice; today, it consists mainly of family studies, adoption studies, studies of twins reared-together, studies of twins reared-apart, and molecular genetic research. In spite of the widespread view that the results of these investigations converge on the importance of genetics, there are important problems associated with these methods, and molecular geneticists have failed to find postulated genes for the major psychiatric disorders (other than those caused by a proven brain disease, such as Alzheimer's). Thus, Myerson's 1925 observation is more relevant to today's evidence than is commonly believed.

I want to stress that what concerns us here are differences between people for a particular psychiatric condition or psychological trait. Few would dispute that both genes and environment interact in the development of an organism, or that there are genetically determined traits for a given species. However, the behavior genetics and psychiatric genetics fields emphasize the alleged importance of genes as explaining psychological trait *differences between humans*, and this is what must be addressed.

This paper undertakes a brief overview of the problems with twin studies, which are frequently cited in support of a genetic basis for psychiatric conditions such as schizophrenia, ADHD, and manic depression, as well as for psychological traits such as IQ and personality. By way of introduction I want to briefly discuss family studies, which preceded twin studies and which are still performed today. A family study looks at the biological relatives of a group of people with a particular trait or condition and determines whether these biological relatives are more similar or afflicted when compared to the general population or to a control group. In the past, the results of family studies (and the study of individual family pedigrees) were seen as proof of the genetic position, as a review of the early 20th century eugenics literature will demonstrate. As the well known psychiatric geneticist Franz J. Kallmann put it, the aim of his 1938 schizophrenia family study was "to offer conclusive proof of the inheritance of schizophrenia" (2, p. xiv). Nevertheless, Kallmann spent the next several years personally studying schizophrenia among 691 pairs of twins, in spite of having already "conclusively proved" the genetic basis of schizophrenia.

Today, it is widely acknowledged by proponents of the genetic position that family studies are confounded by environmental factors, since family members share both common genes *and* a common environment. As a pair of psychiatric geneticists recently put it, family studies can provide only “the initial hint that a disorder might have a genetic component” (3, p. 88–89). Thus, the “conclusive proof” of Kallmann’s era is only the “initial hint” of today. If properly carried out, family studies can determine whether a condition is *familial*, which does not mean that it is genetic. There are many familial traits that are not genetically inherited. Spoken language and religious preference are classic examples of cultural traits transmitted through the family unit, while pellagra exemplifies a disease that “runs in families” because of common exposure to environmental factors (in this case, a poor diet linked to poverty).

THE CLASSICAL TWIN METHOD

This brings us to the subject of twin studies. The most commonly used technique is called the “classical twin method,” otherwise known simply as the “twin method.” Inspired by the writings of Francis Galton (4) and developed by Hermann Siemens (5), the twin method has been promoted since the 1920s as a way of determining whether a particular trait has a genetic component. The method compares the concordance rates or correlations of reared-together identical twins (100% genetic similarity; also known as MZ, monozygotic, or one-egg twins) with the same measures of reared-together same-sex fraternal twins (averaging a 50% genetic similarity; also known as DZ, dizygotic, or two-egg twins). For psychiatric conditions, a significantly higher concordance rate among identical or MZ twins when compared to fraternal or DZ twins has been cited as evidence for the operation of genetic factors. I would like to stress that the twin method investigates pairs of *reared-together* twins. Later, we will look at studies of reared-apart twins.

The claim that the twin method provides evidence in support of genetic factors is based on three critical assumptions: 1) there are two types of twins, and researchers can reliably distinguish between them; 2) the results from twin studies are generalizable to the single-born population; and 3) the environments of MZ and DZ twins are roughly equal. Assumption #3 is commonly referred to as the “equal environment assumption,” or “EEA” for short.

The twin method has been making a comeback in recent years after reaching its low point in the mid-1960s following the publication of

Don Jackson's devastating 1960 critique (6,7). Today, the journals are filled with reports of twin studies of psychiatric disorders, cognitive ability (IQ), personality, criminality, dietary preferences, and so on. To cite one example of the twin method's proliferation, there have been at least 16 published attention-deficit hyperactivity disorder (ADHD) twin studies—the vast majority of which have appeared since 1992 (8). In most twin studies, the authors conclude that significantly greater MZ concordance or correlation supports the genetic basis of the trait or condition in question.

However, the twin method has been the subject of criticism. Problems include the lack of an adequate and consistent definition of the trait under study, non-blinded diagnoses, inadequate or biased methods of zygosity determination (that is, the determination of whether the twins are MZ or DZ), the unnecessary use of age-correction factors, the use of non-representative sample populations, and the lack of adequate descriptions of the methods used in some of the studies. I mention these problems only in passing because I would like to focus on the main problem with the twin method, which is the doubtful validity of the equal environment assumption. I will argue that the assumption is not tenable, and that it is unlikely that the twin method measures anything more than the greater environmental similarity of identical versus fraternal twins.

There are essentially two definitions of the equal environment assumption, or EEA. The first, which was the only definition until the 1960s and is still used by some today, is what we might call the "traditional EEA definition." The traditional definition simply states that the environmental conditions of MZ and DZ twins are roughly the same, and that the greater phenotypic similarity of MZs must therefore be due to their greater genetic similarity. The problem with the traditional EEA definition is that most people—including many prominent twin researchers (9–15)—recognize that it is false, since MZs are treated more similarly by their parents and by the social environment, spend more time together, and share a closer emotional bond. For example, behavior geneticist and twin method proponent Sandra Scarr has written, "the evidence of greater environmental similarity for MZ than DZ twins is overwhelming" (15, p. 528). The most graphic evidence comes from a table included in Kringlen's 1967 schizophrenia twin study (16).

Kringlen assessed the childhood and adult environments of 75 MZ and 42 same-sex DZ pairs, of whom one or both were diagnosed with schizophrenia (16, p. 115). The results showed that the physical and psychological environments of these Norwegian twins were quite different. Over 90% of MZs experienced "identity confusion" in childhood,

which was true for only 10% of the DZs. A full 72% of MZs were “brought up as a unit,” while only 19% of the DZs were. Other important environmental factors showed significant differences as well. For the last category, “Global evaluation of twin closeness,” 65% of MZs had an “extremely strong” level of closeness, which was true for only 19% of DZs. Clearly, the greater environmental similarity of identical twins is correlated with their greater behavioral similarity. I should also mention that I have never seen the results from this study (specifically, 16, Table 46, p. 115) discussed by any twin researcher other than Kringlen.

A good example of the effects of the identity confusion and closeness experienced uniquely by identical twins is the case of 24 year-old MZ twins “George and Foster,” whose story is found in Rosanoff and associates’ 1934 schizophrenia twin study (17). (In contrast to today’s investigations, many of the older twin studies contained detailed histories of the twins under study.) This pair was judged concordant for schizophrenia “but in a manner quantitatively dissimilar.” George was committed to a mental hospital in 1930 and was diagnosed with dementia praecox (schizophrenia). According to Rosanoff and associates’ account, “The twins had always been together and had always been devoted to each other. When George was taken to the hospital, Foster began to worry greatly . . . He lost all ambition to work [and] sat around at home ‘just thinking,’ [and] paid no attention to any one who spoke to him.” Foster was finally talked into admitting himself to the hospital:

While he was there word came that George was better and could come home on a trial visit. *“The minute Foster heard that, he snapped right out of it, brightened up, and the two boys came home the same day* [italics added].” He resumed his work and seemed as well as ever. At the time of our observation of the case he appeared quite normal mentally. (17, p. 258)

This is a very touching story of a young man who was emotionally devastated by his twin brother’s admission to a mental hospital. Upon hearing that George was going to leave the hospital, Foster’s “subacute schizophrenia” symptoms vanished almost immediately and he happily rejoined his brother at the family home. Many other vignettes in the twin study literature tell similar stories (7).

In the face of the “overwhelming” evidence in favor of the greater environmental similarity of identical twins, some twin researchers felt compelled to redefine the EEA. In 1972, Gottesman and Shields defined the EEA in schizophrenia twin studies as meaning the assumption of equal environments “in respects which can be shown to be of etiological significance for schizophrenia” (10, p. 25). This has been referred to as the “equal trait-relevant environment assumption” (18). Here, we

will call it the “trait-relevant EEA.” The trait-relevant EEA has been taken up by Bouchard, Kendler and other leading twin researchers. In essence, these investigators admit that twin method critics are correct in their observation that MZ twins experience more similar environments than DZs, but claim that the question is really about whether MZs experience more similar environments *as they are etiologically relevant to the trait in question*. Furthermore, twin researchers place the burden of proof for demonstrating this on the shoulders of twin method critics. Bouchard has called this “a very difficult task” (9, p. 33).

Therefore, since critics often are unable to pinpoint the “trait-relevant” environmental factors for a given condition, the twin method remains, in the view of its defenders, a valid instrument for the detection of genetic factors. However, this is not the case.

The implausibility of the trait-relevant EEA becomes apparent when we realize that, as we have seen, genetic researchers acknowledge that *family studies* do not prove the existence of genetic factors—since the clustering of a condition among family members could be caused by purely environmental factors. However, no one to my knowledge has argued for a “trait-relevant EEA” for *family studies*; that is, the claim that family studies prove the existence of genetic influences unless specific environmental factors shared by family members are demonstrated to have a causal relationship to the condition in question. Quite the contrary; family studies are acknowledged to be confounded by the simple fact that family members share a common environment. In the same way, the twin method is confounded by the greater environmental similarity of MZ twins, regardless of whether the specific trait-relevant environmental factors are known. A group of prominent “trait-relevant” twin method proponents correctly observed that family studies are “confounded” because “offspring are likely to share exposure to toxic or infectious agents that could lead to similar outcomes for the siblings” (19, p. 124). However, they are blind to the fact that *the twin method is similarly confounded because identical twins share exposure to potential toxins to a greater degree than fraternal twins*. Proponents of the trait-relevant EEA commit the logical fallacy of “special pleading,” since they apply the “trait-relevant” argument to the twin method but refuse to apply it to family studies, when in both methods environmental and genetic similarities are correlated.

Without realizing it, proponents of the trait-relevant EEA have redefined the assumption in a way that can lead only to the obsolescence of the twin method. If we extend their logic to family studies, it follows that family studies offer definitive proof that the familiarity of a condition demonstrates its genetic basis, unless it can be shown that the

affected families were exposed to an environmental agent *proven* to be etiologically relevant to the condition in question. Since family studies would thereby settle the question of the existence of genetic factors, there would be little reason to conduct twin studies. Therefore, the now-definitive “trait-relevant” family studies would eliminate the need to use the twin method for determining the existence of genetic factors. Contrary to the wishes of leading behavior geneticists and psychiatric geneticists, *the trait-relevant equal environment assumption has transformed the twin method into nothing more than a special type of family study* (8).

In another attempt to defend the validity of the twin method, some of its proponents (20,21) maintain that MZ twins experience more similar environments because the genetically produced similarities in their personalities induce parents and others to treat them more similarly. In other words, it is argued that identical twins are treated more alike because they act more alike, as opposed to the conventional idea that they act more alike because they are treated more alike. As Kendler has written, “Although the similarity in environment might make MZ twins more similar, the similarity in behavior of MZ twins might *create for themselves more similar environments*” (22, p. 706). I have referred to this idea elsewhere as the “twins create their environment theory” (23).

Kendler’s idea cannot be accepted for two main reasons: 1) because according to his theory, parents’ behavior is ever-changing and adaptive to their twins’ needs, while the behavior of twins are seen as being rigidly determined by genetic factors. In other words, parents and children are attributed vastly different potentials for exhibiting plasticity. And, 2) even if the “twins create their environment theory” were correct, the twin method could still be measuring nothing more than environmental effects. Contrary to Kendler’s viewpoint, it is not important to determine the reason that identical twins are treated more similarly and spend more time together, because the simple fact that this is true means that they will be more similarly exposed to environmental causative agents. Suppose that schizophrenia is caused by an excess of lead in the brain. MZ twins would be more concordant for schizophrenia for the simple reason that they spend more time together and are therefore more similarly exposed to lead than DZ twins, who spend less time together. (MZs also would be more similarly exposed to “schizophrenogenic” rearing environments.) The *reason* that MZ twins spend more time together and are treated more similarly is completely irrelevant to the question at hand. Kendler (11,20) has pointed to a body of evidence which, he argues, has tested the validity of the equal

environment assumption and has shown it to be valid. However, the evidence from these studies (as it pertains to the EEA's validity) does not stand up to critical analysis (23,24).

It is important to understand that the conclusions drawn by researchers using the twin method, as with any other theoretical model, are based entirely on the assumptions underlying the method. Without the equal environment assumption, the twin method is transformed into a measure of the differing natures of MZ and DZ *environments*. Because the equal environment assumption is of doubtful validity, the twin method is, contrary to the beliefs of its supporters, a tool enabling us to gauge the striking environmental and psychological differences between the MZ and DZ twinships. There is little reason to believe that it tells us anything about genetic factors (7,23,25).

STUDIES OF TWINS REARED APART

I would like to discuss the problems with studies of twins *reared-apart* because the results of these studies have received a lot of coverage in the popular press and have been promoted in several recent books (26–29). Due to small samples, there have been no systematic reared-apart twin studies for any psychiatric condition. There have been a few systematic studies of personality and IQ among reared-apart twins since the late 1930s. The most well-known are the scientifically unusable and probably fraudulent papers of Cyril Burt (30), and the recent studies by Bouchard and associates in Minnesota (31). On its face, the study of reared-apart twins would seem to eliminate the problem of environmental confounds in the twin method. However, these studies are plagued by methodological problems and are *also* vulnerable to environmental confounds.

Methodological problems include, 1) the bias of the sample towards twins who are more similar, 2) the fact that most twins under study grew up in very similar socioeconomic and cultural environments (often in different branches of the same family), 3) the fact that twins often lived in the same home for many years and had frequent contact, and 4) the bias of the researchers in favor of genetic conclusions. These and other problems are documented in Leon Kamin's classic 1974 critique (32), and in Susan Farber's lengthy 1981 examination of the reared-apart twin literature (33). In the case of the Minnesota studies, the investigators have published very little biographical information on the twins under study and have refused to provide independent investigators access to the raw data. The biographical information they have

released typically supports the views of the researchers. Many people have read about some of these pairs in the popular press, such as the "Jim Twins" of Ohio. The allegedly similar pairs are reported, whereas information on dissimilar pairs is (with rare exceptions) kept secret. One commentator compared these cases with stories in the astrology and ESP literature, where accurate predictions are reported, while inaccurate predictions are left unreported (34). The twin sample as a whole is biased in favor of similarity, since the twins had to have known of each other's existence in order to respond to the researchers (33).

However, the main problem with studies of reared-apart identical twins is that the investigators mistakenly compare reared-apart MZs to *reared-together* MZs—forgetting that both sets share several important environmental similarities, which include common age, common sex, similar appearance, similar socioeconomic and cultural environment, and a common prenatal environment. (The Minnesota study also used reared-apart DZs as a comparison group, but they also share several of the environmental influences experienced by reared-apart MZs.) Bouchard and associates attempted to adjust correlations for age and sex effects (35), but the formula they devised is inadequate (36). The effects of common age should not be underestimated since people born at the same time grow up in the same birth cohort and therefore experience important cultural influences at the same stage of their lives. For example, a 40-year-old woman likes The Beatles for the same reason that her parents like Benny Goodman and her son likes Britney Spears—because it's the music they grew up with. As an *extreme* example of the confounding nature of cohort effects, let us suppose that a 20 year-old pair of German reared-apart male MZ twins, separated at birth and brought up in different parts of the country, had been reunited in 1940. A researcher would probably notice several striking similarities. Both might be wearing swastika armbands, have short-cropped hair, give stiff arm salutes and rail against "the enemies of the Reich." The values, beliefs, behaviors, and even wardrobes of these twins might be remarkably similar, yet the conclusion that these similarities are caused by common genes would be quite erroneous.

As Farber noted—and this is the crucial point—reared apart MZs "are not so much similar to each other as they are similar to people of their eras and SES" (32, p. 77). It therefore follows that behavior geneticists and reared-apart twin researchers have made an enormous theoretical and methodological error, since the only valid study would compare the similarity of MZ twins *reared apart from birth and unknown to each other* to a control group of *biologically-unrelated* pairs of same-sex age-like strangers who are matched on

all other post-natal environmental variables shared by reared-apart identical twins (36,37). Until this occurs, no valid conclusions about genetic influences can be drawn from the studies of reared-apart twins (36).

CONCLUSION

Today, most psychiatric conditions are believed to carry a genetic predisposition, and twin studies are frequently cited in support of this belief. However, we have seen that apart from methodological problems, the conclusions drawn from the twin method are based on an unsupported theoretical assumption. The equal environment assumption of the twin method is untenable however it has been defined, and studies of reared-apart twins fail to control for the common environmental influences shared by twins reared-together *and* twins reared apart. To the extent that, like family studies, twin studies are confounded by environmental factors, twin researchers' claim that their studies demonstrate the influence of genetic factors should be treated with extreme caution. There is little reason to accept that studies of twins, whether reared-together or reared-apart, measure anything more than environmental influences, error, and bias.

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