Schizophrenia: Medical Students Are Taught It’s All in the Genes, But Are They Hearing the Whole Story?

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It is common for medical textbooks that discuss the etiology of schizophrenia to focus on genetic factors. In this article we examine what Eric Kandel, a Nobel-Prize-winning psychiatrist, believes is the best data in support of the idea that schizophrenia has a significant genetic basis. Based on Kandel’s popular textbook Principles of Neural Science, most students would conclude that the genetic theory of schizophrenia is not open to debate. However, the readers of Kandel’s text have only received a partial presentation of the data. To support the role of genetic factors Kandel presents evidence from family, twin, and adoption studies, but does not mention several significant methodological problems with these studies. It is our contention that students would think differently about the genetic theory of schizophrenia if these problems were discussed. In each of these three areas of research, we present Dr. Kandel’s evidence and then discuss the problems with that evidence. Given the influence of textbook chapters on students’ subsequent opinions, the widespread acceptance of the genetic theory of schizophrenia must be tempered by the knowledge that medical students and other allied health professionals have heard only half the story.

The idea that schizophrenia is due, at least in part, to a genetic predisposition is seen as an accepted fact in modern day psychiatry. The acceptance of this theory is not only important for how psychiatrists approach the research and treatment of schizophrenia, but also has implications for the entire field of psychiatry. As Edward Shorter, the author of A History of Psychiatry wrote, “Among the most convincing kinds of evidence for a neural origin of major psychiatric illness would be genetic studies” (Shorter, 1997, p. 240).

The genetic theory of schizophrenia is frequently cited as evidence in favor of a genetic predisposition to other conditions; the logic being that if schizophrenia is genetic, then depression, obsessive compulsive disorder, attention deficit disorder and a host of other DSM-IV categories must also have their roots in dysfunctional genes. (By the expression
“genetic theory of schizophrenia” we mean the view that although environmental factors might be important, genetic factors are equally if not more important. Scientists have spent countless hours and numerous resources investigating the role of genes in certain behaviors, but a specific gene has never been found for those disorders which have no known neurochemical or neuropathological markers. In the case of schizophrenia, several scientists have reported finding a “schizophrenia gene” only to eventually retract their findings (e.g., Marshall, 1994; Sherrington et al., 1988).

When citing evidence for the genetic basis of schizophrenia, psychiatry textbooks invariably mention the “twin studies” and “adoption studies.” As a group, these studies are one of the most frequently cited bodies of research in all of psychiatry. It is common for neuroscience and psychiatry textbooks that discuss the importance of genetics to focus on schizophrenia, because it is thought to be best example of a “mental illness” that has a genetic component.

Unfortunately, most textbooks provide only a cursory and superficial review of the evidence supporting the genetic theory of schizophrenia. Two types of errors are commonly found in the standard textbook discussions of this topic. The first is that some of these books misstate the actual data. The second, but perhaps more egregious error is one of omission. It is not so much what the textbooks say, but rather what they do not say. Most of these textbooks fail to point out the studies’ significant methodological problems, and fail to mention peer reviewed published critiques of these studies (Boyle, 1990; Joseph, 1999b; Lewontin, Rose, & Kamin, 1984; Lidz & Blatt, 1983; Pam, 1995). A topic as complex as the etiology of schizophrenia should be presented to students in a fair but critical manner. Students can make sound decisions only by reviewing all the facts and not just selected information that supports a particular viewpoint. For a first-year student who is unfamiliar with the topic, the way the material is presented will have a large impact on his or her subsequent opinions. If students were exposed to a more in-depth review of the actual data, would the genetic theory of schizophrenia at least be open to more discussion and debate?

Principles of Neural Science, sometimes referred to as the “hible of neuroscience,” is assigned to a significant number of first-year medical and graduate students in the United States (Stufflebeam, 1996). Its authors are Eric Kandel, James Schwartz, and Thomas Jessell. Dr. Kandel, recipient of the 2000 Nobel Prize in Medicine, is the author of Chapter 60, “Disorders of Thought and Volition: Schizophrenia.” Kandel’s analysis of the scientific evidence in support of the genetic theory of schizophrenia exemplifies the problems inherent in many textbooks that cover this topic (Kandel, 2000). In light of the fact that Kandel is one of the foremost research psychiatrists in the world, it is interesting to examine the data that Kandel cites in support of his fairly strong statements concerning the etiology of schizophrenia. It would not be an overstatement to say that within the current medical community, a majority of practicing physicians and scientists received their introduction to the genetics of schizophrenia from this textbook.

The purpose of this review is to examine what a Nobel Prize winning psychiatrist thinks is the strongest evidence in support of the idea that genes play a major role in schizophrenia. Kandel does not explicitly say that the environment does not play a role in schizophrenia, but in his discussion of the etiology of schizophrenia there is little mention of environmental factors. On the contrary, he writes, “the only reliable clue as to the cause comes from the finding that schizophrenia is due in part to a genetic abnormality” (p. 1193).
The three methods most frequently cited in support of genetic factors in schizophrenia are family studies, twin studies, and adoption studies. Kandel says that all three of these methodologies support the role of genetics in schizophrenia. In this article, we examine the data that Kandel presents for each of these approaches and we also point out the problems with each approach.

FAMILY STUDIES

**Kandel’s Evidence.** The goal of family studies is to determine if a condition is found more often in the biological families of affected persons as compared to the general population or to a control group. According to Kandel, “the first direct evidence that genes are important in schizophrenia was provided in the 1930s by Franz Kallmann.” Kallmann, a German psychiatrist who later emigrated to the United States, noted that while the worldwide incidence of schizophrenia was approximately 1%, there were some instances in which schizophrenia was found in 15% of the family members (Kandel, 2000, p. 1193). At first glance, the finding that schizophrenia is found to cluster in families might suggest a genetic basis for the condition.

**Problems.** There is little disagreement that schizophrenia (or any other psychiatric condition) runs in families. The major problem with family studies is that while they suggest that schizophrenia does, indeed, run in families, this does not mean that genetic factors are involved. Traits can cluster in families for purely environmental reasons, meaning that family studies are suggestive at best. This fact was recognized by Kandel when he wrote, “Not all conditions that run in families are necessarily genetic—wealth and poverty and habits and values also run in families” (p. 1193).

On a minor note, Kallmann did not provide “the first direct evidence that genes are important.” Kallmann’s family study was published in 1938, whereas Rüdin had published a large schizophrenia family study showing similar results in 1916. In addition, schizophrenia twin studies were published in 1928 by Luxenburger and in 1934 by Rosanoff and colleagues. It is also worth mentioning that even before the first family studies were conducted, both Kraepelin and Bleuler (respectively, the creators of dementia praecox and schizophrenia) believed that the condition was hereditary. In 1899 Kraepelin wrote, “An inherited predisposition to mental disturbances was apparent in approximately seventy percent of those cases in which data could be evaluated” (cited in Boyle, 1990, p. 118). And Bleuler would write in his monograph that “heredity plays its role in the etiology of schizophrenia, but the extent and kind of its influence cannot as yet be stated” (1911/1950, p. 337). These views prompted Boyle (1990), a critic of the genetic theory, to write:

Thus, before any attempt at systematic data collection was ever made, the two most prominent users of the concepts of dementia praecox and schizophrenia were disseminating the view that whatever phenomena they included under these terms were largely inherited. (p. 118)

Apparently, the people who created the schizophrenia concept did not need any more evidence than the behavior of their patients’ relatives to support the view that the condition was hereditary.

It is also worth mentioning that Kallmann did not make blind diagnoses and, while working in Germany under Nazi rule, he advocated the forced sterilization of people diagnosed with schizophrenia as well as their healthy relatives (Müller-Hill, 1998).
After emigrating to the United States, Kallmann called for eugenic measures to eliminate the "schizophrenic genotype," which included compulsory sterilization for "absolutely incorrigible schizophrenics who do not need hospitalization and who may be expected to propagate themselves, even out of wedlock and against medical advice" (Kallmann, 1938, p. 267).

It is common for people to erroneously equate "it runs in the family" with "it's genetic." Kandel acknowledges the problems with the family studies and goes on to discuss other research strategies developed to disentangle the relative contributions of nature and nurture. These strategies involve looking at two groups of people: twins and adoptees.

TWIN STUDIES

Kandel’s Evidence. Twin studies are viewed as important because scientists can compare two different types of twins. Identical (monozygotic) twins have the same genotype, while fraternal (dizygotic) twins share on average only 50% of the same genes. If the development of a certain disease is due to heredity, then genetic researchers would expect more of the identical twins to share the disease as compared to the same-sex fraternal twins. When discussing the twin studies, Kandel groups Kallmann's data and the data from more recent studies together and reports a combined concordance rate of 45% for identical twins, compared to only a 15% concordance rate in fraternal twins. The data seem to provide strong evidence for a genetic basis to schizophrenia, and based on the evidence that is reported most students would probably conclude that the twin studies unequivocally prove that schizophrenia has a genetic origin. However, it is our contention that if students were presented with a more complete discussion of the twin data, they might reach different conclusions.

Problems. The first mistake that Kandel makes is to group together Kallmann and more recent researchers and cite a combined 45% concordance rate for monozygotic twins. What should be mentioned right at the start is that Kallmann and the newer studies are actually quite different. And more importantly, to critically-minded reviewers of these studies it is these differences and not the similarities between Kallmann and the newer studies that have raised concern (Boyle, 1990; Lewontin et al., 1984; Pam, 1995).

Kallmann did not find a 45% concordance rate; he actually found a 69% rate, which he increased to 86% after factoring in an age-correction (Kallmann, 1946). It was more recent research groups that found a 40% concordance rate. The discrepancy between Kallmann and the newer studies was addressed by Lewontin, Rose, and Kamin (1984) who pointed out in *Not In Our Genes* that, while Kallmann’s 86% concordance rate validated his theory of genetic predisposition (which he called "hereditary taint") to schizophrenia, it is difficult to reconcile his findings with the more modest 40% concordance rate found in the newer studies. Thus, the fact that Kallmann found such a high concordance rate makes his data highly suspicious to Lewontin and colleagues. They go so far as to say, "Kallmann's data have faded from the body of acceptable evidence, but the belief for which he was largely responsible—that a genetic basis for schizophrenia has been clearly established—still remains powerful in and out of science" (pp. 212-213). Anyone writing a review that supports the genetic theory of schizophrenia faces a dilemma with the Kallmann data: Should it be included or rejected? Kandel's chapter is an example of the problems one faces when Kallmann's data are included.
Kallmann aside, the validity of the twin method is based on the assumption that identical twins do not have more similar environments than fraternal twins. The equal environment assumption (EEA) is critical for the twin method because if identical twins are treated more alike than fraternal twins, then any difference in the concordance rates between the two types of twins could be attributed to the environment.

One way of judging the validity of the EEA is to compare fraternal twins to non-twin siblings since, in terms of their genetic makeup, fraternal twins are no more alike than non-twin siblings. Therefore, any difference in the rate of schizophrenia between fraternal twins and siblings must be due to something other than genes. According to genetic theory, if a fraternal twin develops a condition, his or her co-twin should have just as much chance of developing it as their other brothers and sisters. If the fraternal twins show an increased chance of developing the condition compared to the non-twin siblings, then this constitutes strong evidence of an environmental effect. If the data show that fraternal twins do, indeed, share a more similar environment than the non-twin siblings, then what about the identical twins? If the equal environment assumption is wrong and the identical twins share a more similar environment than fraternal twins, then the theoretical basis of the twin method is faulty (Jackson, 1960; Joseph, 2001c).

In fact, Kandel acknowledges the importance of EEA and also the importance of the comparison between the non-twin siblings and the dizygotic twins. He defends the validity of the EEA by claiming that fraternal twins have a 15% concordance rate, which he states is the same as that found between non-identical twins and the other siblings. This evidence would seem to support the validity of the EEA, but it is not that simple.

The data showing no difference in the concordance rate between fraternal twins and siblings are from Franz Kallmann, who reported an age-corrected fraternal “morbidity” rate of 14.7% and a full-sibling concordance rate of 14.3% (Kallmann, 1946, p. 313). As we mentioned earlier, significant problems exist with Kallmann’s data and, at this point, the reader is probably asking, why even include the Kallmann data? It is suspicious, it is over five decades old, and newer data supposedly prove the genetic theory of schizophrenia anyway. One reason for citing Kallmann in support of the EEA is because he is the only twin researcher whose data support the EEA. In fact, every twin investigator besides Kallmann that has compared the concordance rates between fraternal twins and siblings found the rate to be higher in the fraternal twins (Fischer, 1973; Gottesman & Shields, 1972; Kringlen, 1967; Luxenburger, 1928; Slater, 1953).

It is problematic to cite Kallmann in support of the EEA and students would probably think differently about its validity if they were told the following:

1. Six twin investigators have compared the concordance rates between fraternal twins and non-twin siblings;
2. The only investigator who found similar rates was Franz Kallmann;
3. The other five investigators found that the fraternal twins had a higher concordance rate compared to the non-twin siblings;
4. Two of the investigators found statistically significant differences between these two groups (see Table 1).

Thus Kallmann is the odd man out here and his numbers are not a fair representation of the overall data. Furthermore, Kallmann himself reported data that is not supportive of the EEA. Contemporary reviewers almost never mention that Kallmann’s fraternal same-sex twins had a 12% concordance rate, versus a 6% rate in his fraternal opposite-sex pairs. The
TABLE 1. Schizophrenia Concordance Rates for DZ Twins and Non-Twin Siblings of Schizophrenic Twins

<table>
<thead>
<tr>
<th>Study</th>
<th>% DZ**</th>
<th>% Siblings</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxenburger (1935)a</td>
<td>14.0</td>
<td>11.8</td>
<td></td>
</tr>
<tr>
<td>Slater (1953)</td>
<td>11.3</td>
<td>4.6</td>
<td>.007</td>
</tr>
<tr>
<td>Gottesman (1972)†</td>
<td>9.1</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>Fisher (1973)b</td>
<td>17.7</td>
<td>8.3</td>
<td>.048</td>
</tr>
<tr>
<td>Kringlen (1967)c</td>
<td>8.1</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Kallmann (1946)†</td>
<td>14.7</td>
<td>14.3</td>
<td></td>
</tr>
</tbody>
</table>

*Fisher's Exact Test, one-tailed.
**DZ Same sex and opposite-sex where reported.
†Age-corrected rates.
*aLuxenburger's final twin study xreport. Figures from Kringlen (1968, p.54).
bBased on a strict definition of schizophrenia.
cBased on a strict definition of schizophrenia, hospitalized and registered cases. Sibling rate is for sibs of MZs only as reported by Kringlen (1976). In his 1976 paper, Kringlen noted that his table 57 (1967) reported incorrect cases.

difference, in fact, is statistically significant and it argues strongly against the validity of the EEA (Joseph, 1998). It only seems fair that if we reject Kallmann’s concordance rate of 86% found in identical twins, then we should likewise reject his findings when it comes to the discussion of the fraternal twins versus siblings. We should not pick and choose which numbers support the position we want, especially when we are presenting the material to students. Even if the Kallmann data is not rejected, it seems fair to point out to students that his data is not typical of the twin studies.

The issue becomes still more complicated because Kandel reproduces a figure from Gottesman (1991, p. 96) which is inconsistent with the EEA. According to Gottesman’s figure, the fraternal twin of a person diagnosed with schizophrenia has a 17% chance of receiving the diagnosis, whereas the non-twin sibling of a person diagnosed with schizophrenia has only a 9% chance (see Figure 1). Thus, the very data that Kandel reproduces in his textbook demonstrates the fallacy of the EEA and contradicts his earlier statement that dizygotic twins and non-twin siblings have the same concordance rate.

If fraternal twins have an increased rate of schizophrenia compared to their non-twin siblings, what might account for this? A plausible explanation is that they share a more similar environment and emotional bond than siblings. Furthermore, the increased rate of schizophrenia found in monozygotic twins could then be explained by their more similar environments when compared with fraternals. Since Kandel has acknowledged the importance of the equal environment assumption to the study of twins, and given the fact that the data do not support the validity of the EEA, it is evident that the schizophrenia twin studies are flawed.

In summary, the methodological problems with the schizophrenia twin studies indicate that they do not provide evidence of a genetic predisposition to schizophrenia. Kandel even mentions that “the high concordance rate in identical twins is still insufficient evidence for a genetic basis for schizophrenia” (p. 1193). We agree with Kandel that the twin studies are insufficient and do not prove that schizophrenia is genetic. To overcome the problems inherent in twin studies, researchers have looked at adoptees.
ADOPTION STUDIES

Kandel’s Evidence. The first adoption study that Kandel cites was conducted by Leonard Heston in 1966. According to Kandel, Heston began with adoptees who were diagnosed with schizophrenia. Since Kandel only briefly mentions Heston’s paper we will not discuss it in detail other than to point out that Heston did not start with adoptees who were diagnosed with schizophrenia, as Kandel reports. Heston actually started with women diagnosed with schizophrenia who had given up a child for adoption (Heston, 1966).

The most convincing evidence for Kandel (and many others) that schizophrenia has an important genetic component comes from the work of Seymour Kety, David Rosenthal, Paul Wender, and their Danish colleagues, who examined adoptees in Denmark. There are several variations on these adoption studies, but the one that Kandel focuses on involved finding people who grew up as adopted children and were later diagnosed with a “schizophrenia spectrum disorder.” The goal was to then examine the rate of schizophrenia spectrum disorders among these adoptees’ biological family members (whom they did not grow up with) and compare that rate to the rate among the biological relatives of control adoptees, who were not diagnosed with a schizophrenia spectrum disorder.

The most important papers from the Danish-American adoption studies were published in 1968 and 1975, with Seymour Kety as the lead author. The 1968 study was based entirely on institutional records (Kety, Rosenthal, Wender, & Schusinger, 1968). The 1975 study used the same index and control adoptees (plus one additional control adoptee) from the 1968 study, but the investigators added the additional step of attempting to interview as many adoptive and biological relatives as possible (Kety, Rosenthal, Schusinger, & Jacobsen, 1975). Because Kandel’s chapter primarily focuses on the 1975 study, in the interest of uniformity we will primarily discuss the Kety and colleagues 1975 study.

Kandel presents a table claiming that 14% of the biological relatives were diagnosed with schizophrenia, while only 3.4% of the control relatives were so diagnosed (Kandel, 2000, table 60-1, p. 1194). If this evidence is valid, and if the study is otherwise method-
ologically sound, it makes a strong case for the role of genes in schizophrenia. In Kandel's words, "In addition to documenting the importance of genetic factors in schizophrenia, these studies of adoptees in whom schizophrenia developed showed that rearing does not play a major role in the disease" (p. 1194). But is the evidence valid?

**Problem #1: The Widening of the Schizophrenia Spectrum.** The only way that Kety and associates could diagnose 14% of the biological relatives with schizophrenia was to greatly broaden the definition of schizophrenia to include diagnoses such as "latent schizophrenia," "uncertain latent schizophrenia," and "inadequate personality." Kandel claims that these categories are "thought to be a mild form of the disease, a nonpsychotic condition related to schizophrenia" (p. 1194). But why should these cases be included in the overall totals when there is little evidence that chronic schizophrenia and the spectrum disorders are genetically related (Joseph, 2001a)? Kandel also claims, on the basis of family studies, that "odd" people are found among the relatives of people diagnosed with schizophrenia: "They are socially isolated, have poor rapport with people, ramble in their speech, tend to be suspicious, have eccentric beliefs, and engage in magical thinking" (p. 1194). The claim that "odd" people are found among the relatives of people diagnosed with schizophrenia means little, and was often made on the basis of non-blind diagnoses by investigators devoted to the genetic position. In addition, it could just as easily be the result of the negative psychological and social environments experienced by family members. The fallacy here is that correlation is seen as being directly related to genetic causation, when there is little evidence to support this view.

If one limits the comparison to cases of chronic schizophrenia among the Kety and colleagues (1975) biological relatives, one is left with 5 cases of chronic schizophrenia among the 173 biological relatives of index adoptees (2.9%) and zero cases of chronic schizophrenia among the 174 biological relatives of control adoptees. Yet, 5 cases of chronic schizophrenia out of a group of 173 individuals (2.9%) is not much higher then the general population rate of 1% (Joseph, 2001b).

**Problem #2: Misleading Statistics.** To some students even a 2.9% rate among these biological relatives compared to 0% in the controls would still seem important. This 2.9% index biological relative chronic schizophrenia rate serves as a demonstration of how statistics can be deceiving, since 4 of these 5 were half-siblings (second-degree relatives). The problem is that genetic theory would predict that first-degree relatives would have a higher rate, but Kety's research team found precisely the opposite result. In fact, all of the major conclusions from the 1968 and 1975 studies depended on counting second-degree relatives. Benjamin (1976), one of the early critics of the adoption studies, noted that "this finding is peculiar and contradictory. It shows, in effect, that the less consanguinity, the greater the 'genetic' effect. Differences should be weakest, not strongest, in the half sibling category" (p. 1131). Even behavior geneticists Gottesman and Shields (1976) commented that "genetic theory predicts a much higher risk for full siblings" (p. 370). And finally, David Rosenthal, one of the co-authors of the Kety and associates adoption study, stated in an earlier paper that in order to "demonstrate that genes have anything to do with schizophrenia," the investigator must show that "the frequency of schizophrenia in relatives of schizophrenics [is] positively correlated with the degree of blood relationship to the schizophrenic index cases" (Rosenthal, 1974, p. 589).

Kandel further complicates the issue by again citing Gottesman's 1991 figure (see Figure 1). Kandel uses this table to show that data from ordinary family studies indicate that the incidence of schizophrenia is higher in first-degree relatives than among second-degree relatives. Kandel summarizes the importance of this figure by saying "These data
strongly support a genetic contribution to schizophrenia.” On the one hand Kandel is acknowledging that a genetically based condition would be expected to appear more often in first-degree versus second-degree relatives, but on the other hand he fails to acknowledge that the Danish-American adoption studies found opposite results. Kandel, like many other textbook authors who address this topic, also fails to mention the fact that in the Kety and colleagues 1968 study not one of the 63 biological index parents was diagnosed with chronic schizophrenia.  

The fact that the statistically significant findings of the Danish-American adoption study were dependent on the inclusion of the half-sibling diagnoses and on the widening of the definition of schizophrenia is an important omission from Kandel’s presentation on the genetics of schizophrenia, and is certainly worthy of being mentioned to students.

**Problem #3: The Lack of Statistical Significance.** Kandel claims that the Kety and associates 1975 index versus control chronic schizophrenia biological relative difference is statistically significant (2.9% vs. 0%), but again this is not the case. In their 1975 paper Kety and colleagues simply decided not to count a control biological father who had a 1968 hospital diagnosis of chronic schizophrenia, but who had died and therefore could not be interviewed. Nevertheless, several other non-interviewed 1968 diagnosed relatives were counted in other statistical calculations when it supported Kety and associates’ argument. The counting of this control biological father is no longer an issue, since in 1988 Kety began counting him as a 1975 chronic schizophrenia biological control relative diagnosis (Ingraham & Kety, 1988; Kety et al., 1994). Therefore, according to Kety’s own data, the rate of chronic schizophrenia among the 1975 index versus control biological relatives is not statistically significant (2.9% vs. 0.6%; 5/173 vs. 1/174, p = .10, Fisher’s Exact Test, one-tailed).

**Problem #4: Alternate Explanations.** Kandel says that the adoption studies show that “rearing does not play a major role.” This is not a fact; it is an interpretation. Alternative ways of looking at the data lead to different interpretations. One example is that Kety and colleagues found only 16 hospital diagnoses of chronic schizophrenia out of a pool of 5,483 adoptees. This rate of 3 per 1000 is less than half the rate found in the general population. One could therefore conclude that being reared in an adoptive home reduced the chance that a person growing up in mid-20th century Denmark would be diagnosed with schizophrenia by over 50%! This finding alone speaks powerfully for the importance of the environment.

**Problem #5: Discounting the Environment.** It is common for researchers who support the genetic theory of schizophrenia to pay very little attention to the environment. In the current edition of Kandel’s textbook he mentions that genetics cannot account for everything, but he does not discuss what other factors might be involved. However, in the previous edition (3rd) of the textbook he wrote, “Environmental influences include not only parenting and other early social interactions but also, and perhaps particularly important, perinatal injury and infections of childhood” (Kandel, 1991, p. 857). Why Kandel has moved from his 1991 acknowledgement that the environment might be a factor to the deletion of any discussion in his current edition about environmental factors is unclear. We believe that it likely has more to do with the changing patterns of thought within the field of psychiatry in general than with the findings from any one specific study. Kandel’s decision not to discuss possible environmental influences is just one example of how far the pendulum has swung within psychiatry towards the biological model of mental illness. For those critics who declare that this shift is based on “science,” we turn our attention to the most modern adoption study.
Pekka Tienari’s “Finnish Adoptive Family Study of Schizophrenia” is similar in design to Leonard Heston’s 1966 study and David Rosenthal’s 1968 and 1971 studies, but whereas these earlier studies failed to look at the family environment, Tienari has extensively looked at the adoptive family environment (Tienari, Lahti et al., 1987; Tienari et al., 2000). According to Tienari, “The major goal of the Finnish Adoptive Family Study is to reassess genetic contributions to schizophrenia and to add measures of the adoptive family rearing environment” (Tienari, Sorri, et al., 1987, p. 477).

In order to determine the role of the family environment in the etiology of schizophrenia, psychiatrists classified the adoptive families into one of five categories ranging from (1) “healthy” to (5) “severely disturbed” (Tienari, Lahti et al., 1987, pp. 40-41). Tienari’s study has shown the importance of the family rearing environment in the etiology of schizophrenia. In Tienari’s words, “all adoptees who had been diagnosed either as schizophrenic or paranoid had been reared in seriously disturbed adoptive families” (Tienari, Sorri, et al., 1987, p. 482).

While there are several problems with the Finnish adoption study, such as the use of a schizophrenia spectrum and the evidence of selective placement of the adoptees (Joseph, 1999a, in press), there is no way to reconcile Kandel’s omission of environmental factors with Tienari’s finding that, “The combination of a schizophrenic biological mother and a seriously disturbed adoptive family was associated with a notably high likelihood of severe disturbance and a low likelihood of health in the adoptee” (Tienari, et al., 1989, p. 30 for a more extensive review of the Finnish adoption study, see Joseph, 1999a). By not mentioning the Finnish adoption study in his review, Kandel has left out an important contribution to the discussion.

**Problem #6: Ignoring the Critics.** Many of the problems with regard to the twin and adoption studies that we have pointed out have been addressed previously, yet the authors of psychiatry and medical textbooks typically ignore these criticisms. As just one example, Lewontin, Rose, and Kamin’s *Not in Our Genes* pointed out many of the problems with the twin and adoption studies, yet is almost never mentioned in textbooks. Why textbook authors have ignored these criticisms is unclear, but one possibility is that most textbook authors are simply unaware of this literature and are too reliant on what the proponents of the genetic theory of schizophrenia have written. Another possibility is that textbook authors have indeed read the critics, but have so completely discounted what the critics are saying that the textbook authors do not even feel the need to mention them. However, it is quite likely that readers of Kandel’s chapter would think differently about the genetic theory of schizophrenia if they were exposed to some of the criticisms.

**THE HUNT FOR SCHIZOPHRENIA GENES**

Contrary to reports that often appear in the mainstream media, no one has discovered a gene for schizophrenia. Yet, because twin and adoption studies have convinced a generation of scientists that a “schizophrenia gene” exists, the search continues. Joseph Alper and Marvin Natowicz (1993) address the perils and pitfalls involved with searching for genes associated with psychiatric conditions and point out that genes for schizophrenia and other psychiatric conditions have been “discovered,” only to be retracted later on. Alper and Natowicz do not believe that the failure to find genes for psychiatric disorders is due to our limited technology, but rather to the flawed belief that there is indeed a genetic basis for these conditions. In the words of Alper and Natowicz, “In view of the lack of
scientific evidence for the hypothesis that there are genetic bases for mental diseases, we conclude that nonscientific beliefs play a major role in laying this hypothesis" (p. 388).

Keeping this statement in mind, it is interesting to focus on the last section of Kandel's chapter where he discusses the ongoing search for schizophrenia genes. In 1988 Sherrington and colleagues announced that they had found, "the first strong evidence for the involvement of a single gene in the causation of schizophrenia" (Sherrington et al., 1988, p. 164). In this study, which was published in Nature, Sherrington and colleagues reported the finding of a susceptibility locus on chromosome 5. In the very same issue of Nature, however, there was a conflicting report by Kennedy and colleagues (1988) who did not find any susceptibility locus on chromosome 5. Sherrington's results were never replicated and are now frequently cited as an example of the problems involved with searching for genes associated with behaviors classified as mental illnesses (Marshall, 1994).

The current (2000) edition of Kandel's chapter does not mention the events surrounding either the discovery or the failure to replicate Sherrington's findings, but instead focuses on the ongoing efforts to find the gene or genes. However, in the third edition of the text, Kandel (1991) mentioned Sherrington and colleagues' discovery but did not mention Kennedy and associates' negative findings, even though both studies were published in the same edition of Nature. The events surrounding the enthusiasm and subsequent disappointment about chromosome 5 would appear to be a perfect opportunity for textbook authors to describe the inherent problems associated with the quest for genes associated with psychiatric conditions.

CONCLUSIONS

Based on the data that Kandel presents in support of the genetic theory of schizophrenia most students would probably conclude that schizophrenia has a significant genetic component. However, these students have not heard all the facts, and it is likely that if the material were presented with a more complete discussion of the evidence, students would not so quickly accept the genetic theory of schizophrenia. Even though scientists who firmly believe that the genetic theory of schizophrenia is on solid ground would most likely agree that sound educational practice dictates a balanced discussion for such a complex topic. After all, a sound scientific theory should be able to stand up to a complete airing of the data.

There will certainly be textbook authors who point out that in a short presentation to medical students it is impossible to present all the details of some very complicated studies, and that, furthermore, it is unnecessary because the genetic theory of schizophrenia is such a well-accepted fact. For these authors, we suggest the following sentence as an example for future chapters:

The compelling evidence from the most frequently cited schizophrenia adoption study rests its case on the basis of counting spectrum disorders among index and control paternal half-siblings.

Pointing out the limitations of the adoption studies would serve two purposes. First, medical students and other health professionals would be forced to think more critically about these studies, and second, those authors who maintain the validity of the genetic theory of schizophrenia would be compelled to support the theory in light of all the facts,
and not by just selectively choosing those facts which support their views. Kandel's conclusion that "schizophrenia is due in part to a genetic abnormality" should at least take into account the fact that the famous Kety and colleagues adoption studies are dependent upon spectrum disorders diagnosed among half-siblings.

It is not our intention to single out Dr. Kandel. He is an exceptional scientist who has made great contributions to our understanding of how the brain works, particularly in the field of learning and memory, and the overwhelming majority of his textbook is outstanding. He and his co-authors have done an excellent job of presenting the material to students. However, his textbook chapter on schizophrenia is just one example of how psychiatry, in general, has uncritically accepted the genetic theory of schizophrenia. Most undergraduate, graduate, and medical textbooks do not go into the problems with the schizophrenia twin and adoption studies and commit similar errors (Joseph, 2001d).

In light of the discrepancy between Kandel's conclusion about the validity of the genetic theory of schizophrenia and the evidence that is presented, there are two choices for future editions of Principles of Neural Science and other such textbooks. The first choice is to present a more complete discussion of the data, especially the all-important adoption studies, and to alter the conclusion. The second choice is to maintain the same conclusion but provide more evidence to support that conclusion. In other words, either the conclusion or the evidence has to change, because, as of now, the two are incompatible. The dilemma, for those who accept the genetic theory of schizophrenia, is to justify the theory and at the same time present a more balanced discussion of the data.

In addition, because so much of the current thinking in psychiatry depends upon genetic theories, and because most textbook presentations of these theories have been very one-sided, we suggest that the debate concerning the role of genetics in schizophrenia be reopened and reevaluated in a more critical manner. We can only speculate as to how many physicians and scientists have concluded that psychiatric disorders are caused by problematic genes after hearing only half the story.

NOTES

1. In the Kety and associates (1968) study, index adoptee S3 was diagnosed with "latent schizophrenia" (B3). In the Kety et al. (1975) study the diagnosis of index adoptee S3 was changed to "chronic schizophrenia" (B1). Thus, in Kety's 1975 study, just one of the 66 biological index parents was diagnosed with chronic schizophrenia.

2. As just one example, take Nancy Andreasen's book The Broken Brain (1984). Andreasen correctly points out that genetic factors cannot be all important; after all if schizophrenia were entirely due to genetics then there would be a 100% concordance rate among identical twins. But when Andreasen hypothesizes about possible environmental factors, her list includes a virus and a difficult delivery; for her, societal or family influences are not even remote possibilities as factors in the development of schizophrenia.

REFERENCES


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