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ROUNDTABLE ARTICLE

Birth Order and Rebelliousness: Reconstructing the Research in *Born To Rebel*

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***Abstract*. In *Born to Rebel* (1996), Frank Sulloway proposed that laterborns are more rebellious than firstborns. In the context of Sulloway's theory, this article examines the difficulties of defining and measuring rebelliousness. Rebellious acts (such as attempting to overthrow a government) are one measure of rebelliousness. Using this measure, an analysis of six of Sulloway's samples undermines the theory. As a second measure of rebelliousness, Sulloway relies on the personality traits of his subjects. Many of the rebellious traits he selected, however, appear unrelated to rebellious behavior. A reexamination of 28 scientific revolutions Sulloway analyzed reveals other weaknesses. Finally, *Born to Rebel* contains a meta-analysis of the birth order literature. The application of two methodologies to the reconstructed data is discussed. Neither methodology appears to replicate the results in *Born to Rebel*. The conclusion is that Sulloway's claims for birth order effects should be rejected.**

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Frank Sulloway proposed in *Born to Rebel* (1996) the intriguing theory that laterborn children are more rebellious than firstborn children. Childhood, Sulloway says, is a Darwinian competition, and each child seeks out a different niche. Firstborn children receive undiluted parental attention and become supporters of the status quo. Laterborns must compete with their siblings for parental attention, and become more rebellious.

Sulloway's formula for predicting rebelliousness encompasses a host of variables, including conflict with a parent, shyness, tough-mindedness, friendship with an innovator, and even the effects of world travel. Based on these variables, Sulloway makes specific claims about a variety of famous subjects in his "sample of 6,500 historical figures" (1998c:2). For example, he says that

- Martin Luther had a 67% probability of becoming a Protestant (1996:517, n. 37);
- John Calvin had an 80% chance of joining the Reformation (1996:517, n. 37);
- Voltaire had an 88% chance of becoming a radical (1996:202);
- Charles Darwin had a 94% chance of supporting evolutionary theory (1996:509, n. 47); and
- Jean-Paul Marat had a 98% chance of voting to execute Louis XVI (1996:322).

These numbers imply great precision. Indeed, Sulloway claims that his model "has the explanatory power psychoanalysts always dreamed of having" (quoted in Boynton, 1996:81).

The consequences of birth order, according to Sulloway, are not limited to individual actions. Thus, in discussing the French Revolution, he says that "sibling strife, not class conflict, lay at the heart of the Terror" (1996:325). And the Darwinian revolution, he says, "only became a historical reality because laterborns outnumbered firstborns 2.6 to 1 in the general population" (1996:36). The dynamics of family life, Sulloway says, are "one of the foremost engines of historical change" (1996:xviii).

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These claims are dramatic, and therefore warrant close examination.

Measuring Rebelliousness

In order to determine if laterborns are more likely to rebel, we must be able to measure rebelliousness. Two possible measures are the primary focus of *Born to Rebel,* namely, participation in rebellious acts and rebellious personality traits. As discussed below, these two measures of rebelliousness do not always produce the same results. An examination of several historical examples from *Born to Rebel* illustrates this problem.

During the French Revolution, Maximilien Robespierre and the Committee of Public Safety symbolized revolutionary actions. That committee and its enforcement arm, the Committee of General Security, crippled the Catholic Church, decimated the aristocracy, and overturned many aspects of French society. Under Sulloway's theory, such rebellious acts should presumably be committed by laterborns. However, a majority of the members of these two rebellious committees were actually firstborns.

Twenty-five members (or temporary members) of these two committees have known birth orders. Sulloway reports that the sibship size in France at the time was approximately six (in Feraca, 1996). Thus, one might expect that, if there is no relationship between rebelliousness and birth order, about four members should have been firstborn. Of course, under Sulloway's theory, firstborns should actually be underrepresented in rebellious groups such as these committees. We might therefore predict that there should have been significantly fewer than four firstborn members. However, fifteen out of twenty-five members, or 60%, were firstborn, including Robespierre himself (Sulloway, 1996:526, n. 30; Spitzer and Lewis-Beck, 1999; Patrick, 1972; Bosher, 1988).

Sulloway does not view these data as anomalous. Indeed, he argues that—regardless of their rebellious behavior—the personality traits of the members support his theory. He reports that the members of the Committee of Public Safety were "autocratic, jealous and short-tempered," which are "typical firstborn traits" (1996:315, quoting Palmer, 1969:4). This argument seems contrived. If members of the committee acted rebelliously, what difference does it make how jealous or short-tempered they were?

Nonetheless, Sulloway describes more than thirty personality traits as being characteristic of rebellious laterborns or non-rebellious firstborns (1996:68-75; 1999a:194, Table 1). Some of Sulloway's classifications are reasonably consistent with his theory. For example, openness to experience in laterborns could lead to rebellious behavior. And conformity in firstborns seems non-rebellious. But it is hard to see why being relaxed, disorganized, and forgiving necessarily leads to rebellion. And it is also hard to see why being aggressive, antagonistic, and vengeful necessarily leads to acceptance of authority (1996:68-73).

What is the proper measure of rebelliousness: personality traits or rebellious acts?

Other questionable classifications occur under the Agreeableness dimension of the Five Factor personality model. Sulloway states that "laterborns are more acquiescent, cooperative, easy-going, modest, straightforward, unassertive/submissive, tender-minded and trusting" (1999a:194, Table 1; italics removed). A number of these traits would appear to be misassigned. It is not clear how being *acquiescent* and *submissive* would make one *rebellious*. And rebels would not typically be described as *unassertive, trusting, tender-minded,* or *easy-going*. Sulloway even says that rebellious laterborns can be *timid* (1996:194).

What, then, is the proper measure of rebelliousness: personality traits (as defined by Sulloway) or rebellious acts? If rebellious acts are the proper measure of rebelliousness, then the birth order of Maximilien Robespierre and the members of the two great committees of the French Revolution contradict Sulloway's theory.

The French National Convention

Sulloway also relies on another group from the French Revolution to support his theory. In 1792, Louis XVI was tried for treason by the French National Convention. Firstborn deputies, Sulloway reports, were more likely to vote for the king's death, while laterborn deputies were more likely to vote for mercy (1996:322). Since killing the king could be interpreted as a rebellious act, these data appear to contradict Sulloway's theory. Sulloway, however, claims that these data actually support his theory.

Once again, he relies on personality traits. Tough-minded, vengeful personalities, Sulloway argues, are characteristic of firstborns (1996:321). Firstborns voting to kill the king therefore confirms his theory (1996:321-25). And, of course, the laterborn deputies (despite being rebellious) had personalities that were timid, tender-minded, and merciful (1996:314, 321-25). So, these laterborns voting to spare the king also supports his theory.

Personality traits such as tough-mindedness and tender-mindedness are thus used to explain exceptions to Sulloway's theory of rebelliousness. Sulloway claims, however, that he is not "appealing to tough-mindedness as an ad hoc construct so as to dismiss inconvenient exceptions" (1996: 288-89). Karl Marx and Napoleon Bonaparte might be considered such inconvenient exceptions, as both were laterborns and both might be viewed as tough-minded in-

dividuals. However, Sulloway rates Marx and Napoleon as tender-minded (1996:286-87).

Moreover, Sulloway states that "to merit explanatory acceptance, the construct of tough-mindedness must be applied to everyone" (1996:289). But while tough-mindedness is applied to the French deputies, it is not applied to everyone. Leon Trotsky was the brutal and merciless leader of the Red Army. Vladimir Lenin was a ruthless dictator responsible for the murders of the czar, his wife, and their children. Both Lenin and Trotsky were militant and tough-minded, much like the firstborn members of the Committee of Public Safety. But Lenin and Trotsky were laterborn. Therefore, Sulloway relies on their "revolutionary achievements" (1996:288). When firstborns killed the French king, this supports Sulloway's theory because they had tough-minded personalities. When laterborns killed the Russian czar, this also supports the theory because this was a "revolutionary achievement."

Another example occurs in Sulloway's discussion of the Reformation. He reports that during the Reformation, 23 out of 24 Protestant martyrs were laterborn. However, he relies on their actions alone. There is no analysis of their tough-mindedness (1996:266).

Similarly, Sulloway relies on the voting pattern of firstborns during the French National Convention in support of his theory. He does not address why firstborns were members of the rebellious National Convention at all. But perhaps their decision to join was tough-minded, like voting to kill Louis XVI. In this case, however, firstborns and laterborns acted the same. If tough-mindedness applies at all, they all made the equally tough-minded decision in joining the convention. Thus, birth order effects should clearly be present—firstborns should be underrepresented as members of the rebellious National Convention.

I have identified the birth order of 56 deputies to the convention. Two of them, Herault de Sechelles and Prieur of Cote d'Or, were only children. In accordance with *Born to Rebel*, they are classified as firstborns. Based on a sibship size of six, on a random basis about nine deputies out of 56 should be firstborn. The number should be even less if Sulloway's theory is correct. In fact, 28 or 29 were firstborn (Sulloway, 1996; Spitzer and Lewis-Beck, 1999; Patrick, 1972; Palmer, 1969; Bosher, 1988).[1] In other words, controlling for tough-mindedness, firstborns were heavily overrepresented in this sample from the extremely rebellious French National Convention.

The Cuban Revolution

Another test of Sulloway's analysis occurs in his discussion of the Cuban Revolution. Fidel Castro was laterborn; Ché Guevara was firstborn. Together they overthrew the Batista regime, theoretically a laterborn act, and together they imposed an authoritarian regime, theoretically a firstborn act. Two partners who engaged in the same activities over the same period were of opposite birth orders. How is their behavior analyzed in *Born to Rebel*?

Based on their actions, Sulloway classifies both as radical revolutionaries (1996:297). However, in his analysis of their personalities, Sulloway cites the fact that Ché carried out the executions of Batista's followers as evidence of Ché's "tough-minded firstborn style" (1996:288). His style? What about his lifetime of rebellious acts? And who ordered those executions? "Responsibility lay, in the last analysis, with Fidel Castro himself . . . . For him justice meant vengeance" (James, 1969:114).

Since Castro had the same tough-minded political style as Ché, does Sulloway concede that Castro contradicts his claims about tough-mindedness? On the contrary, Sulloway concludes "Different niches, different political styles" (1996:304).

Ironically, the political styles of Fidel Castro and Ché Guevara after the Cuban Revolution further contradict Sulloway's theory. In the 1960s, Ché (the firstborn) continued his rebellious laterborn ways in South America and Africa, always attempting to overthrow authority. He died in 1967 while attempting to overthrow the government of Bolivia. Castro (the laterborn) continued his authoritarian, tough-minded ways and, forty years later, still rules Cuba with the iron fist that is supposed to be characteristic of a firstborn.

Revolutionary Leaders from Rejai and Phillips

Like Ché Guevara, rebels who risked their lives revolting against a government should be laterborn, but that has frequently not been the case. Mostafa Rejai and Kay Phillips have written a series of books on revolutionary and political leaders. The most recent one Sulloway discusses is *Loyalists and Revolutionaries* (1988). In that book, the authors analyze rebellions stretching back over three hundred years. They compare loyalists who supported a government with the revolutionaries who tried to overthrow the same government. Their birth order results are summarized in Table 1. These results support Rejai and Phillips's conclusion that childhood appears to be "relatively unimportant" in the formation of revolutionary personality (1983:125).

What should the data have shown if Sulloway's theory is correct? According to Sulloway, "If anyone ever, *ever* discovers a radical revolution led by firstborns and opposed

Table 1. Birth Order of Rebels and Loyalists

Birth Order	Rebels	Loyalists
Firstborns	58%	42%
Laterborns	46%	54%

Source: Rejai and Phillips (1988:50-51, Table 5.2)

In China, Mao Tse-tung, a firstborn, led a radical revolution; Chiang Kai-shek, a laterborn, opposed that revolution. In Mexico, Pancho Villa, a firstborn, led a revolutionary movement; Porfirio Diaz, a laterborn, opposed that revolution

by laterborns, then I'm out of business" (quoted in Boynton, 1996:81). Note that Sulloway is here referring exclusively to rebellious acts. There is no requirement that firstborns or laterborns be tough-minded or have any particular personality trait.

Among the exceptions in the Rejai and Phillips data to Sulloway's prediction that laterborns lead revolutions and firstborns oppose them are some noteworthy examples. Thus, in China, Mao Tse-tung, a firstborn, led a radical revolution; Chiang Kai-shek, a laterborn, opposed that revolution. In Mexico, Pancho Villa, a firstborn, led a revolutionary movement; Porfirio Diaz, a laterborn, opposed that revolution. In Vietnam, Vo Nguyen Giap, a firstborn, led a revolution; Ngo Dinh Diem, a laterborn, opposed the revolution.

How does Sulloway explain such counterexamples? In the case of Mao Tse-tung, he argues that conflict with his father turned Mao into a militant revolutionary (1996:293). Conflict with a parent, Sulloway says, can transform non-rebellious firstborns into militant revolutionaries.

Conformity with a parent, however, can have the same effect. According to Sulloway, this is how Carlos the Jackal, a firstborn, became a revolutionary—he rebelled because he *conformed* to the behavior of his father (1996:289). Firstborns, in other words, can become rebels either by conforming to their fathers or by rebelling against them. And then there is Ché Guevara. As a firstborn, Sulloway says he became a militant revolutionary by conforming to his mother (1996:288).

It is of course possible that variations in individual family environments do explain the many exceptions to the generalization that laterborns rebel and firstborns conform. However, it also seems possible that these are just convenient, ad hoc attempts to explain away the exceptions. This second interpretation is supported by some of the classifications in *Born to Rebel*. In his analysis of the Rejai and Phillips results, for example, Sulloway focuses on subgroups within the Rejai and Phillips data. Thus, he defines the leaders of the Quebec Liberation Front (QLF) as "radical revolutionaries." On the other hand, he defines the leaders of the Irish Republican Army (IRA) as "conservative revolutionaries."[2] Using these definitions, Sulloway says radical revolutionaries (such as members of the QLF) are 18 times more likely to be laterborn than are "defenders of the faith" (such as members of the IRA), who are defined as conservative revolutionaries (1996:297; 522, n. 48).

Where should the leaders of the IRA be placed on a continuum of rebellious behavior? Surely not on the non-rebellious side—bombings and assassinations are generally not the acts of conformists. Is the IRA more rebellious than the QLF? Who knows? Both groups, however, are highly rebellious. In other words, by comparing the IRA with other revolutionaries, Sulloway selects a narrow slice from the far end of the continuum. The results from that narrow slice, he says, show that "conservative" rebels are more apt to be firstborn than "radical" rebels.

But why compare "conservative" rebels with "radical" rebels in the first place? Why not compare rebels with non-rebels? That is the comparison made by Rejai and Phillips in *Loyalists and Revolutionaries*. Their results show that the majority of firstborns were rebels, and that the majority of laterborns were loyalists. This focus on subgroups diverts attention from the fundamental point—the Rejai and Phillips data do not support Sulloway's theory.

Fascist Leaders

Sulloway classifies fascists based on their tough-minded authoritarian personalities (1996:285-86). They should be firstborns, he says. Indeed, he states that "evidence showing that fascists are predominantly laterborns would constitute a convincing refutation of this model" (1996:289). As Sulloway reports, Mussolini was a firstborn (1996:293). However, Adolf Hitler, Hermann Goering, Joseph Goebbels, Heinrich Himmler, Albert Speer, Julius Streicher, and Francisco Franco were all laterborns. Of these laterborn leaders, Sulloway mentions only Hitler. He explains that Hitler was "strongly favored" by his mother (1996:298). A review of the birth order of fascists seems warranted.

Friendship with an Innovator

When Charles Darwin published *Origin of Species* in 1859, firstborns should have rejected his novel ideas. However, a strong supporter of Darwin's theory was firstborn John Lubbock. Sulloway explains that Lubbock was Darwin's next-door neighbor (1996:208). Thus, as a result of this friendship, Lubbock's predicted likelihood of rebellion increased from 41% to 80% (1996: 208-209).

On the other hand, Sulloway says, laterborns should have been open to new ideas such as evolution. One prominent lastborn was Robert FitzRoy, Captain of the *Beagle* during Darwin's famous voyage. If anyone should have supported Darwin's theories, it was FitzRoy. As Sulloway himself asks, "How could a man who for five years shared his *Beagle* cabin with Charles Darwin have later opposed Darwin's theories?" (1996:206). Moreover, Sulloway uses extensive world travel as a powerful predictor of accep-

tance of scientific theories (1996:333-335). As captain of the *Beagle*, FitzRoy traveled extensively. And, FitzRoy was a *last*born, which also should have increased his openness (1996:442, Table 10).

Indeed, Sulloway says that, based on his family dynamics model, FitzRoy's predicted probability of supporting evolution was 66% (1996:206). But after the voyage, FitzRoy became a religious fanatic and vigorously attacked evolution (1996:207). This would appear to be a clear exception to Sulloway's theory. But Sulloway doesn't use the 66% figure for FitzRoy. Instead, he uses a rebellious probability of only 5% (1996:503, n. 25; 243, Fig. 10.3). The reason he gives for using the smaller percentage is FitzRoy's "social attitudes" (1996:503, n. 25).

But social attitudes can change. Sulloway states that FitzRoy was a moderate during the *Beagle* voyage. It was only after the voyage that FitzRoy underwent a religious conversion (1996:207). In other words, FitzRoy's social attitudes depended on when Sulloway stopped the clock during the evolution debate, which he defines as running from 1700 to 1875 (1996:39).

Lubbock, a firstborn, had a rebellious probability of 80%. FitzRoy, the lastborn, had a rebellious probability of only 5%. The birth order of both subjects would appear to contradict the theory. After application of additional variables, however, both subjects support the theory.

A Flexible Theory

In sum, Sulloway explains contradictions in his historical data by analyzing the personality traits of his subjects. But is Sulloway's theory that laterborns rebel? Or is his theory that both laterborns and firstborns (with certain personality traits) rebel, while both laterborns and firstborns (with the opposite personality traits) do not?

Using two definitions covers most possibilities. When firstborns support existing authority, their behavior confirms the theory; when firstborns rebel, however, they are being vengeful, jealous, short-tempered, and tough-minded, and this also confirms the theory. When laterborns rebel, their behavior confirms the theory; when laterborns do not rebel, however, they are being submissive, unassertive, timid, and acquiescent, and this also confirms the theory. A theory so flexible seems incapable of refutation.

The Scientific Revolutions

The application of Sulloway's theory to actual events can also be examined in the context of scientific revolutions. In *Born to Rebel*, Sulloway analyzes data on over three thousand participants in 28 scientific revolutions, from Copernican theory to continental drift (1996:20-54). The birth order correlations he reports are based solely on the acts of the scientists in supporting or opposing the 28 scientific revolutions (1996:39-41, Table 2). Personality traits play no role.

My analysis concerning these 28 scientific revolutions raises three questions: How were the revolutions selected? How were they divided into liberal and conservative categories? And finally, why are the results internally inconsistent?

Controversial Revolutions

Revolutionary scientific events in *Born to Rebel* include the Newtonian revolution, the Darwinian revolution, quantum theory, Freudian psychoanalysis, and phrenology (1996:39-41). Sulloway says that all of these revolutions were supported by laterborns, with phrenology having the highest correlation. However, Sulloway considered, but excluded, other scientific discoveries or theories, including electromagnetism, sociobiology, cold fusion, N-rays, and the structure of DNA (1996:463, n. 58; 330; 1991:2, 36-37).

Consider the discovery of DNA's structure. Michael Ruse has noted that this was "surely one of the most significant breakthroughs of our period" (1997:373). Since the leading scientists were firstborn (James Watson, Francis Crick, and Linus Pauling), this would appear to contradict Sulloway's theory. However, noting that the double helix theory of DNA was quickly accepted, Sulloway argues that this event was not controversial enough to be classified as a revolution (1996:330). Three firstborns are thereby excluded from the list of scientific revolutionaries. In this regard, Ruse concludes, "With a position as flexible as this, I wonder whether one can ever truly move forward . . . " (1997:373).

Liberal and Conservative Revolutions

Sulloway divides the events he classifies as revolutions into liberal and conservative categories, and then subdivides the liberal revolutions into Radical Ideological Revolutions, Technical Revolutions, and Controversial Innovations. He predicts that laterborns should support the three types of liberal revolutions and that firstborns should support the "Conservative Theories." His results confirm 26 out of 30 of his predictions, with two neutrals (1996:39-41, 47). This is impressive. Indeed, Sulloway states that the likelihood of these results arising by chance "is less than one in a billion billion" (1996:47). How were these liberal and conservative classifications made?

Sulloway explains that his Conservative Theories were "explicitly described as such by historians of science" (1996:463, n. 64). However, he doesn't seem to follow this criterion consistently. For example, he states that "preformation theory in embryology is usually portrayed as a conservative theory, owing to its strong links with creationism

and vitalism" (1996:464, n. 64). Moreover, he says, preformation attracted religious conservatives because it "posited that embryos had all been created by God" (1996:345). Nevertheless, Sulloway says that when preformation was a new theory that it was in fact "iconoclastic" (1996:345), and he therefore classifies it as a liberal event for its first hundred years (1996:40). After 1700, however, Sulloway classifies preformation as a conservative theory (1996:40, n. *f*). Preformation was supported by laterborns before 1700 and firstborns after that date (1996:346, Figure 14.5). None of the other conservative events are divided between their early iconoclastic periods and their later conservative periods. They are rated conservative from initiation.

Another test of these classifications is presented by two related theories. During the 1860s and 1870s, Louis Pasteur in France championed germ theory. At the same time, Joseph Lister in Great Britain proposed that surgery must be kept antiseptic to prevent infection. The two events were closely intertwined. In fact, Lister developed his surgical procedures after reading about Pasteur's experiments. It would seem that these theories should have similar liberal-conservative implications. However, Sulloway classifies Lister's antiseptic theory as liberal but Pasteur's germ theory as conservative (1996:41).

These classifications have significant consequences. For example, laterborn support for antiseptic surgery was 6.3 times that for germ theory (1996:41). Consider what this means. According to *Born to Rebel*, laterborns rejected germ theory while accepting the theory that germs cause infection during surgery. This appears inconsistent, particularly considering the sharply divergent levels of laterborn support.

An examination of these results seems indicated.

Comparison of Correlations

Sulloway presents birth order results for his 28 scientific revolutions in more than one place in *Born to Rebel*. First, in his Table 2, the correlations between birth order and support for scientific innovations are listed numerically (1996:39-41). Then, in Figure 14.1, these same correlations are plotted, using the vertical axis, against correlations between social attitudes and support for innovation, using the horizontal axis. This creates a scatterplot (1996:332). Sulloway says that Figure 14.1 demonstrates the "linear relationship between birth-order trends and ideological tendencies." He says the pattern is "striking" (1996:333).

However, the data in Sulloway's Figure 14.1 do not match the data in his Table 2. For example, the birth order correlation in Table 2 for preformation was .41, not the approximately .23 shown in Figure 14.1 (1996:40, 332). The correlation for epigenesis was .21, not the approximately .32 shown in Figure 14.1 (1996:40, 332). The correlation for the Devonian debate was .22, not zero (1996:41, 332). Out of 28 revolutions, there are seven clear discrepancies, which are set out in my Table 2 (five less-clear discrepancies have not been included).

In "Technical information for Figure 14.1," Sulloway states that the classifications of the events in Figure 14.1 were taken from Chapter 2, and that the effect sizes for birth order were reported in his Table 2 (1996:531, n. 4). Neither in this technical note nor anywhere else is there any indication of modifications to the birth order results (1996:531-37, nn. 1-44; 329-51; see 539, n. 36). Yet, at least seven differences exist, and six out of seven of these differences place the event closer to the existing trend line.

There is a second anomaly in Figure 14.1. Sulloway's Table 2 contains ten split events, such as Einstein, 1905-1914 and Einstein, 1915-1930 (1996:39-40; 40, n. e). In Figure 14.1, however, eight of these ten events are collapsed into four data points. Combining the eight events reduces the scatter in the scatterplot and enhances the linear relationship in the data. A comparison of the split and combined events is found in Table 3.

As can be seen, collapsing the split controversies places the event closer to the existing trend line in seven out of eight cases. However, one split controversy was not combined. The evolution controversy has two data points in Figure 14.1. Why did evolution remain split, while other controversies were collapsed? *Born to Rebel* does not explain these decisions, but it is worth noting that both the pre-Darwinian and Darwinian events are very close to the existing trend line, much closer than the other four pairs before they were combined.

Sulloway recently republished Figure 14.1 in an article in the *Encyclopedia of Creativity* (1999a:201, Figure 2). This new figure does not match the original. One event is missing—the only remaining event for which the results are opposite to those predicted by Sulloway's theory. There

Table 2. Comparison of Birth Order Correlations in Table 2 and Figure 14.1

Controversy	Table 2	Figure 14.1*	Closer to Existing Trend Line
Liberal Events			
Lavoisier	.25	.18	yes
Preformation	.41	.23	yes
Epigenesis	.21	.32	no
Devonian debate	.22	.00	yes
Conservative Events			
Vitalism	-.24	-.19	yes
Idealistic taxonomy	-.41	-.23	yes
Eugenics	-.06	-.17	yes

*Based upon visual inspection of Figure 14.1

Table 3. Comparison of Correlations in Split and Combined Events

Split Event	Table 2	Fig. 14.1 Combined Event*	Closer to Existing Trend Line
Copernicus (to 1609)	.38	.15	ambig.
Copernicus (after 1609)	.00	.15	yes
Hutton/Lyell (to 1829)	.31	.19	yes
Hutton/Lyell (after 1829)	.06	.19	yes
Freud (to 1919)	.30	.20	yes
Freud (after 1919)	-.04	.20	yes
Einstein (to 1914) [Relativity]	.30	.17	yes
Einstein (after 1914) [Relativity]	.06	.17	yes
Pre-Darwin Evolution (to 1859)	.43	not combined	
Darwin (after 1859)	.36	not combined	

*Based upon visual inspection of Figure 14.1

were originally two scientific revolutions listed in *Born to Rebel* that exhibited opposite results—Freud (late) and Mesmerism (1996:43). Freud (late) was eliminated from the original Figure 14.1 by combination with Freud (early). That left Mesmerism, but Mesmerism has been eliminated altogether from the figure published in the *Encyclopedia of Creativity* (1999a:201, Figure 2).

These differences between Sulloway's Table 2 and Figure 14.1, and between Figure 14.1 in *Born to Rebel* and Figure 2 in the *Encyclopedia of Creativity*, seem to suggest that a reexamination would be appropriate.

The Bar Chart

There is a further inconsistency in the results regarding the scientific revolutions. In addition to a scatterplot, Sulloway presents the results from his 28 revolutions in a bar chart (1996:43, Figure 2.3). Some of the results in this bar chart do not match his Table 2. For example, in Table 2, glaciation theory and the later Copernican revolution are listed as events having equal support among firstborns and laterborns (1996:39-40). But in the bar chart, both revolutions are depicted as being "Laterborn-Led" (1996:43). An examination reveals the source of this discrepancy.

The statistics from Sulloway's Table 2 that were used in the bar chart are odds ratios. When laterborns and firstborns are equally likely to support an event, the odds ratio is 1.0 to 1. At the foot of the bar chart, there is a scale showing "Laterborn-Led Events" extending to the right from zero, and "Firstborn-Led Events" extending to the left from zero. The source of the error is the use of zero as the center of the scale.

These are ratios, not correlations. In order to be *laterborn-led*, an event must have a ratio of laterborn support greater than 1.0 to 1. For the same reason, firstborn-led events must also have a ratio of firstborn support greater than 1.0 to 1. Thus, in this case 1.0 is the minimum possible value and should have been the center of the scale. Indeed, in the next figure (Figure 2.4), Sulloway uses 1.0 as the dividing line between Firstborn-Led and Laterborn-Led events. He labels that line "Equal Support by Birth Order" (1996:46, Fig. 2.4).

Part of the confusion is created by the fact that in his Table 2 Sulloway uses laterborn ratios of less than 1.0 to 1 to denote a firstborn-led event. For example, Idealistic taxonomy has a laterborn ratio of 0.08 to 1 in Table 2. But in the bar chart the ratio is inverted, creating a firstborn ratio of 12.5 to 1 and the longest bar on the chart (1996:43). In the bar chart, all ratios of less than 1.0 to 1 were inverted.

As a result, zero has no meaning in this chart of ratios. The effect of using zero as the center is to make 1.0 and -1.0 two separate values. What results are indicated by those two values? The 1.0 line indicates an event that had equal support by laterborns and firstborns; the -1.0 line also indicates an event that had equal support by firstborns and laterborns. If we look beyond the inaccurate labels and the meaningless negative sign, the underlying results are identical. In other words, there are two units of empty space separating the same value of 1.0 and -1.0. This empty space lengthens all the bars and creates the appearance of greater support for the theory.

The empty space between 1.0 and -1.0 also explains why no results are clustered around zero. For example, the ratio for Einstein (late) is only 0.3 away from neutrality, yet the bar is 1.3 units long (1996:40, 43). The ratio for the quantum hypothesis is 0.2 away from neutrality, yet the bar is 1.2 units long (1996:40, 43). The bars for glaciation theory and the later Copernican event were 1 unit in length. Yet those events were neutral and should not have had bars at all.

Given that the glaciation and later Copernican events do have bars, in which direction should neutral bars point? The laterborn ratio for these events was 1.0 to 1. The firstborn ratio was, of course, 1.0 to 1 (or -1.0 to 1, if you prefer). Thus, the bars for these neutral events could have mistakenly extended in either direction from zero.

But these are classified as liberal events, and bars to the left of zero would mean that glaciation theory and the later Copernican event were firstborn-led, contradicting the theory (1996:47). The bars extend to the right. Thus, the bar chart in Figure 2.3 erroneously indicates that these neutral events were laterborn-led, which supports the theory.

Phrenology

Sulloway's division of his liberal scientific revolutions into three categories creates another problem. In Figure 14.1, phrenology is classified as a Radical Revolution (1996:332). Since phrenology has the highest birth order correlation, this supports the claim made in that figure that Radical Revolutions should have the highest correlations.

However, in his Table 2 and Figure 2.3, phrenology is classified as a Controversial Innovation, the least radical liberal category (1996:41, 43). How can phrenology be a Controversial Innovation in Table 2 and Figure 2.3, but a Radical Revolution in Figure 14.1? Sulloway explains that he "misclassified" phrenology as a Controversial Innovation in Table 2 and Figure 2.3 (1996:44). In fact, he says, phrenology was "manifestly radical," and thus indisputably a Radical Revolution (1996:464, n. 74).

If phrenology was really a Radical Revolution, why did it remain classified as a Controversial Innovation in Table 2? *Born to Rebel* does not answer this question, but the effect of this uncorrected misclassification can certainly be examined. Among Sulloway's events, phrenology had the highest correlation. It would tend to pull up the other events in its category unless they already had high correlations. For example, classifying phrenology with Radical Revolutions in Table 2 would have only increased the correlation in that category by 3%, from .36 to .37. Classifying phrenology under Controversial Innovations, however, increased the correlation in that category by 65%, from .17 to .28 (1996:39; 41, n. *h*; 1997:41, n. *i*). And phrenology is the only Controversial Innovation with a statistically significant result.

The Number of Events

The inconsistencies in Sulloway's Table 2, Figure 2.3, Figure 14.1, and Figure 2 in the *Encyclopedia of Creativity* are part of a larger problem. Sulloway presents data on the scientific revolutions in seven places (six in *Born to Rebel* and one in the *Encyclopedia of Creativity*). None of them match. For example, depending on which table or figure is consulted, these data contain 4, 5, or 6 Radical Revolutions; 10, 11, 12, or 13 Technical Revolutions; 5, 6, or 7 Controversial Innovations; and 5, 6, or possibly as many as 8 Conservative Theories. These seven presentations contain 25, 26, 28, 30, or 32 total events (1996:39-41, Table 2; 43, Figure 2.3; 46, Figure 2.4; 332, Figure 14.1; 335, Table 7; 384-85, Appendix 3; 464, n. 71; and 1999a:201, Table 2). Yet, there was only one set of data.

Comparison of Ratios of Support

There is another inconsistency in *Born to Rebel*. In a 1991 grant proposal to the National Science Foundation (NSF), Sulloway provided an earlier version of the data he subsequently published in Table 2 of *Born to Rebel*. A comparison of the NSF proposal and *Born to Rebel* reveals that the ratios of support for laterborn events increased, on average, over 70% in *Born to Rebel* (Sulloway, 1991:16-17; Sulloway, 1996:39-41). For example, the ratio of laterborn support for the Newtonian revolution increased by 138%, from 1.3 to 1 to 3.1 to 1 (Sulloway, 1991:17; Sulloway, 1996:39).

One possible source of these changes was an increase in the number of subjects. The total increased from 1,516 in the NSF proposal to 2,013 in *Born to Rebel* (Sulloway, 1991:17; Sulloway, 1996:39-41). However, the number of subjects added to each event varied. For example, Harvey (the circulation of blood) had only five additional subjects, but the ratio of support more than tripled, from 1.8 to 1 to 5.8 to 1 (Sulloway, 1991:16; Sulloway, 1996:39). The Devonian debate had one additional subject, but the ratio almost doubled, from 1.3 to 1 to 2.5 to 1 (Sulloway, 1991:17; Sulloway,1996:41). And preformation theory had no additional subjects, but the ratio quadrupled, from 1.5 to 1 to 6.0 to 1 (Sulloway, 1991:17; Sulloway, 1996:40).

Moreover, the direction of the changes varied depending on the political classification of the event. In liberal events, where an increase in laterborn support would be favorable to Sulloway's theory, 18 out of 21 ratios increased. In the conservative theories, where a *decrease* in the laterborn ratio would favor Sulloway's theory, all five decreased. For example, the ratio of laterborn support for Pasteur's germ theory fell 63%. In *Born to Rebel*, one subject was added to that event (Sulloway, 1991:17; Sulloway, 1996:41).

The effect on *p* values for these events was also substantial. For example, Vitalism fell from $p < .57$ to $p < .05$, and Idealistic taxonomy fell from $p < .91$ to $p < .01$ (Sulloway, 1991:17; Sulloway, 1996:41). Using Fisher's exact test, Sulloway reports that the results for both events became statistically significant (1996:39, n. *a*).[3]

Sulloway describes how extra subjects were added to the samples in *Born to Rebel.* He states that "based on the suggestions of expert raters, several hundred individuals were added to the samples, but only if their scientific stance could be documented in a published source" (1996:383). It is difficult to see how that process could produce the results shown here. This is especially true in events where few or no subjects were added.

The time periods covered by nine of these events also show some variations. For example, the years for phrenology in the NSF proposal were 1799-1840, compared to 1796-1840 in *Born to Rebel.* Yet the support ratio for phrenology increased 329% in *Born to Rebel* (Sulloway, 1991:16; Sulloway, 1996:41). It is difficult to see how these changes could produce the results reported here.

A closer examination of these results seems warranted.

Unavailable Data

Several reviewers have criticized Sulloway for inadequate disclosure of his data (Orzack, 1998, Rowe, 1997; Falbo, 1997; Marshall, 1997; Freese and Powell, 1998). As Orzack stated, "there is not even one opportunity for the open-minded reader to examine the data for one revolution independently of Sulloway's manipulations and to see how his analysis proceeded" (1998:112).

The results Sulloway does provide are in large measure unreviewable (Falbo, 1997:26). For example, Sulloway asserts that 23 out of 24 Protestant martyrs during the Reformation were laterborn (1996:266). But he does not provide the names of the martyrs or any way of determining who they were (Townsend, 1997:198). Therefore, I requested a list of these 24 martyrs. Sulloway has declined to share this information.

I also requested access to the research that was generated by Sulloway's National Science Foundation proposal discussed above. He has declined to share this information (the proposal itself had to be obtained from the NSF through a Freedom of Information Act request). In his grant proposal, Sulloway stated, "Upon completion of this project, I will donate a complete set of my data and questionnaire results to appropriate archives so that other scholars may have free access to them" (Sulloway, 1991:39).

I wrote to Sulloway requesting access to this research. He refused my request because he was "still conducting research and collecting data on some of the historical events discussed in *Born to Rebel*" (Sulloway, 2000). The listed completion date for Sulloway's NSF project was April 30, 1994.

Personality Traits and Rebelliousness

The claims made regarding the historical subjects in *Born to Rebel* do not seem fully supported by the data. However, there is a second pillar that may support Sulloway's theory—the birth order literature. He asserts that psychological research "proves, incontrovertibly, that birth order shapes personality" (1996:78). One might suggest that this claim is irrelevant. What link is there between the personality traits selected by Sulloway and rebellious behavior?

Under his definitions, rebellious laterborns are unassertive, forgiving, submissive, and timid. Non-rebellious firstborns are violent, vengeful, jealous, and militant. As discussed above, these traits seem misassigned. Sulloway says his claims "must stand or fall on their own empirical merits" (1996:68). On their "own empirical merits," these claims would appear to collapse.

But assuming that the personality traits selected by Sulloway are a valid measure of rebellion, the leading survey of the literature contradicts his claims. The key work is *Birth Order: Its Influence on Personality* (1983). This was a comprehensive review of the literature conducted by two Swiss researchers, Cécile Ernst and Jules Angst. After a thorough analysis, Ernst and Angst concluded that the personalities of firstborns and laterborns showed "no difference" as to anxiety, conformity, and aggression; "no difference" as to authoritarianism, conservatism, dogmatism, and dominance; "no difference" as to interests or values; "no difference" as to creativity, self-esteem, adjustment, introversion, and empathy; and "no difference" as to personality in general (1983:185-88). Their final conclusion: "An environmental variable [birth order] that is considered highly relevant is thus disaffirmed . . ." (1983:284).

Sulloway's list of the original 196 Ernst and Angst findings has not been disclosed. Yet any meta-analysis should provide a list of the studies being analyzed and how they were classified

This powerful negative conclusion from such an exhaustive review was not determinative for Sulloway. He states that, based on his own meta-analysis of the studies in Ernst and Angst, "the overrepresentation of significant birth-order studies is so extreme that it is independent of my designations of [the] results . . ." (1996:472, n. 72). In other words, based on the same studies, Ernst and Angst came to exactly the opposite conclusion from Sulloway.

Confirming Findings

The results Sulloway reports are impressive: "72 of the 196 studies display significant birth-order results that are consistent with my psychodynamic hypotheses" (1996:72). These numbers require some explanation. The 196 studies are not really 196 studies. Two-thirds of Sulloway's "studies" are actually multiple findings from single studies (Sulloway, 1998a:3). This is because he defined each *finding* from a study as a separate independent study (1996:73n).

For example, Koch (1955-1960) had findings on many facets of personality from the same sample, such as neuroticism, anger, anxiety, conformity, dependency, and self-esteem. As a result, Ernst and Angst reported the Koch findings in 12 different places. Sulloway's methodology states that "each reported finding constitutes a 'study'" (1996:73n). Thus, Koch is counted as multiple "studies."

Sulloway has agreed that "multiple findings from the same study are not independent" (in press:n. 2). Nonetheless, he statistically analyzed these 196 findings as independent studies. He reported that "all statistical comparisons are significant at $p < .005$" (1996:73, n. b). There is no mention that two-thirds of his data were not independent. Sulloway has since argued that when the multiple findings are excluded, the results come out the same (1998a:3). However, the findings he reanalyzed have not been disclosed.

Indeed, Sulloway's list of the original 196 Ernst and Angst findings has also not been disclosed. Yet any meta-analysis should provide a list of the studies being analyzed and how they were classified (Falbo, 1997:26). Every meta-analysis contains gray areas that need to be reviewed for error or selection bias or simply differences in interpretation. But no list is available here.

When data are requested from a researcher, the standards for sharing data are unclear. However, the standard Sulloway applied in this case seems inappropriate. When I requested his list of the 196 Ernst and Angst findings (which are all from published scientific studies), Sulloway stated that he had no obligation to make his research available to "unqualified individuals, including people lacking graduate degrees in the behavioral sciences and a serious record of scholarly publications" (Sulloway, 1999b:1).

Reconstruction of the Meta-Analysis

Without Sulloway's list of the 196 findings, it was necessary to reconstruct his research based on the methodology presented in *Born to Rebel* (1996:73n). The results are set forth in Appendix A**.** The total number of unambiguous findings in the appendix is a close match with the number reported by Sulloway (190 versus 196). The problem lies with the classifications. The classifications reported in *Born to Rebel* and in the reconstructed findings are compared in Table 4.

Born to Rebel reported 72 confirming findings in Ernst and Angst. Here, even applying the weak controls Sulloway used (sibship size *or* social class), there are only 51. Moreover, eleven borderline findings were classified as confirming, resolving doubts in favor of Sulloway's theory.[5] Yet the results still come out 21 Confirms short.

Jules Angst (of Ernst and Angst) has stated that he could "neither reconstruct nor understand" Sulloway's reanalysis of the Ernst and Angst data (quoted in Horgan, 1999:142). John Modell (1997) also tried to replicate Sulloway's results from Ernst and Angst. He stated, "I could not do so, try as I might, or even come near" (1997:624). A third review of the Ernst and Angst findings was conducted by Harris (1998). She also could not replicate Sulloway's results. She found only 52 confirming findings, a close match with the 51 reported here (Harris, 1998:371). In other words, several reviewers have concluded that a substantial number of the confirming findings that Sulloway reports are not in Ernst and Angst at all. Where did Sulloway's extra confirming findings come from?

Two Methodologies

Sulloway conducted a vote-counting meta-analysis of the Ernst and Angst data (1996:472, n. 71). Thus, he ignored effect size and sample size and merely counted the number of findings for and against his theory. As discussed above, three researchers have attempted to replicate Sulloway's vote-counting without success. Sulloway says that Modell's results can be ignored because Modell counted independent studies (Sulloway, 1998c:2). However, Harris (1998) and I both counted findings, and neither of us could come near to the 72 confirming findings Sulloway reports.

Table 4. Comparative Findings from *Born to Rebel* and Ernst and Angst (Using Weak Controls*)

Source	Confirm	No Difference	Opposite[4]
Reported in *Born to Rebel*	72	110	14
Reconstructed from Ernst and Angst	51	122	17

* Controlled for sibship size *or* social class

Sulloway's methodology determined which findings he counted, and thus which findings someone attempting to replicate his study should recount. What does he say about his methodology?

> Data are tabulated from Ernst and Angst (1983:93-189), using only those studies controlled for social class or sibship size. Each reported finding constitutes a "study." (1996:73n)

This seems straightforward enough. Sulloway's data were "tabulated from Ernst and Angst." But that was in the original (hardback) edition.

The paperback edition, published after Modell's review in *Science*, presents a different picture. The first sentence of the methodology still states that "data are tabulated from Ernst and Angst" (Sulloway, 1997:73n). In the endnotes, however, Sulloway reveals that a portion of his data were *not* tabulated from Ernst and Angst. He states that he "rectified" errors in Ernst and Angst by reviewing "each published study" (1997:472, n. 68). These rectified findings were, by definition, not reported in Ernst and Angst. This may explain why the word "reported" is missing from the paperback edition. In the hardback edition, the methodology refers to "each reported finding" (1996:73n). In the paperback edition, the methodology only refers to "each finding" (1997:73n).[6]

As a result, Sulloway now claims that his methodology included rectified data. These rectifications are the source of the confirming findings that three researchers could not find in Ernst and Angst. Indeed, Sulloway has said that any researcher attempting to replicate his results would be required to examine the original literature and not rely on Ernst and Angst's own data (1998a:2). But in the hardback edition he states that "Ernst and Angst's own data" revealed "surprisingly consistent trends in birth-order research" (1996:472, n. 68).[7]

Several reviewers have concluded that a substantial number of the confirming findings that Sulloway reports are not in Ernst and Angst. Where did Sulloway's extra confirming findings come from?

Whatever methodology was used in *Born to Rebel,* reviewing the original studies should not be rejected. Such a review could produce additional information. Thus, I have reviewed the original studies that Sulloway disputes. This review did not produce the results reported in *Born to Rebel.*

Bias by Ernst and Angst?

The original studies are discussed below, but one question should be addressed immediately. Why should the two methodologies produce substantially different results? After all, Ernst and Angst read the "original literature." How does Sulloway explain two significantly different outcomes based on review of exactly the same studies?

Sulloway says Ernst and Angst made 45 mistakes. He lists them in "Errors and Inconsistencies in Ernst and Angst's Literature Review" (Sulloway, 1998b). Even if they exist, random errors should largely cancel each other out. But as Harris reports, Sulloway's "reassessments almost always resulted in an increase in the number of outcomes favorable to his theory and/or a decrease in the number of no-difference outcomes" (1998:369). Based on his report, rectifying these mistakes produced a net change of approximately 36 findings in favor of Sulloway's theory (Sulloway, 1998b).

Sulloway states that the source of these one-sided results was bias by Ernst and Angst (Harris, 1998:369). But why didn't Sulloway reveal this bias in *Born to Rebel*? If his methodology involved reviewing the "original literature," then he must have known about these 45 errors when he wrote *Born to Rebel*. Why did he not disclose this serious flaw in the research he was relying on?

An examination of these "reporting errors" seems warranted. Since Sulloway says that these 45 errors are "a complete list of these errors" (Sulloway, 1998a:2), the remainder of the findings in Ernst and Angst are not in dispute.

"Unreported" Controlled Findings

There are five sections in Sulloway's list of errors. The net effect of Sections 1, 3, and 5, by my count, is the removal of three confirming findings.[8] Thus, the source of the 20 to 25 confirming findings that Sulloway reports, but which are not found in Ernst and Angst, must be found in the largest sections, Sections 2 and 4.

In Section 2, Sulloway lists twelve controlled studies (with fourteen findings) that he says Ernst and Angst "erroneously reported as *not* being controlled" (1998b:1). Sulloway's definition of "erroneously reported" is unusual. Ernst and Angst typically reported on studies in two places—in the text and in summary tables at the end of each section. Sulloway records an error if the controls are correctly reported in the text but are absent from the summary tables. For example, in the text, Purpura (1971) is listed as being controlled for social class (Ernst and Angst, 1983:94; for confirmation, see Purpura, 1971:39-41). Nonetheless, Sulloway says Ernst and Angst committed a reporting error because the summary table was silent on Purpura (Sulloway, 1998b:1). Not wrong, just silent. But summary tables necessarily leave out information. Ernst and Angst intended that their text should be the primary source of information. In sections with only a few studies (such as Empathy), they dispensed with a summary table entirely (Ernst and Angst, 1983:161-62). Sulloway's reliance on this secondary source of information creates many (but not all) of the "errors" he claims were made by Ernst and Angst.

Adopting Sulloway's methodology creates another problem. Sulloway states that "it is customary for researchers undertaking a meta-analysis of a given literature to actually read the literature. Accordingly, I [Sulloway] consulted more than two hundred of these source publications in an effort to verify Ernst and Angst's tabulations" (Sulloway, in press:n. 2). He also reports that these 45 errors are "a complete list of these errors" (1998a:2). Yet his list is not complete.

Limiting review to the summary tables reveals that Sulloway only reported 14 out of 49 qualifying findings. My own review includes 35 findings that Sulloway omitted (see Appendix B). The 14 findings Sulloway added are 58% confirming; the 35 findings he omitted are only 11% confirming. The overall results are reported in Table 5. These results suggest no support for Sulloway's claims and no bias by Ernst and Angst.

Unreported Significant Findings

In Section 4 of his list, Sulloway attributes another type of error to Ernst and Angst. He describes seventeen findings from twelve listings that he contends contain significant findings. He says that they were erroneously reported, or "involve doubt as nulls" (1998b:2). My own review suggests that 10 findings were misclassified by Sulloway, 4 findings were ambiguous, and 3 findings were errors as defined by Sulloway (see Appendix C). In other words, the "reporting errors" were mostly Sulloway's, not Ernst

Table 5. Findings for Which No Controls Were Listed in the Summary Tables of Ernst and Angst

Findings	Confirm	No Difference	Opposite
Findings Reported by Sulloway (14)	8	5	1
Findings Omitted by Sulloway (35)	4	21	10
Total Findings (49)	12	26	11

and Angst's. The conclusion is that Sulloway's rectifications were largely unjustified.

In a survey the size of Ernst and Angst's, there will be questions of interpretation and even some errors. This is why publication of results is so necessary. Indeed, three unsuccessful attempts to replicate Sulloway's results would not have been required if Sulloway had provided a list of the 196 Ernst and Angst findings. Moreover, in my review, I found no evidence of bias by Ernst and Angst. The errors they made appear random, and many of those "errors" were not errors at all, but rather differences in interpretation or definition. In sum, Sulloway's claim of bias on the part of Ernst and Angst is unsupportable.

After reviewing the Ernst and Angst findings and the original literature, my conclusion is that neither the methodology in the hardback edition nor the methodology in the paperback edition produces the results reported in *Born to Rebel*.

Controlling for Sibship Size and Social Class

What analysis should have been conducted on the data? The answer seems simple enough. All the findings should be counted. This includes over one hundred findings Sulloway apparently omitted.[9] The analysis is set forth below. First, however, the question of controls should be addressed.

Both Sulloway (1996:49) and Ernst and Angst (1983:3-7) agree that the most important background variable in birth order research is the number of children in the family—sibship size. They also both agree that social class (or socioeconomic status) must be controlled. In fact, Sulloway states that Ernst and Angst convinced him "of the need for controlling my own historical samples for important background factors such as social class *and* sibship size" (1996:472, n. 65; emphasis added). Then he states that birth order studies are not valid unless they have "adequate controls for social class *and* sibship size" (1996:48; emphasis added). Finally, he says that birth order studies "need to be controlled, at a minimum, for sibship size *and* social class" (1996:504, n. 38; emphasis added).

In his meta-analysis of the Ernst and Angst findings, however, Sulloway only controlled for "social class *or* sibship size" (1996:73n; emphasis added). This means his results include three groups of findings:

- findings controlled only for sibship size,
- findings controlled only for social class,
- findings controlled for both sibship size and social class.

It is hard to justify combining findings that have three types of controls. Therefore, in my own analysis of the Ernst and Angst findings, I have used the strong controls recommended (but not used) in *Born to Rebel*—namely, sibship size *and* social class. Even though tighter controls should produce lower totals, Sulloway's methodology omitted so many findings controlled for both sibship size and social class that the totals actually increased in two categories. These omissions may have been caused in large measure by Sulloway's reliance on the summary tables in Ernst and Angst.

When controls for both sibship size and social class are applied to all of the findings, the effect reported in *Born to Rebel* disappears

My methodology was as follows. I began with the Ernst and Angst findings listed in Appendix A and eliminated those not controlled for both social class and sibship size. Considering only findings with such controls, I added or subtracted the rectifications in Sulloway's "Errors and Inconsistencies in Ernst and Angst's Literature Review" (1998b), as corrected in Appendices B and C. I then added the findings that Sulloway apparently omitted (see Note 9).

It is possible, of course, that there are still more findings in the original studies. However, Sulloway says he examined all those studies and that the 45 findings he lists (and that I reviewed) are the only ones with errors. In fact, he says he provided "a complete list of these errors" (1998a:2).

The results of my analysis are set forth in Table 6. As may be seen, the large majority of the findings from all sources show No Difference, and the significant findings cancel each other out. These results are consistent with the results reported by Ernst and Angst on their own data (1983:184-88). Thus, when controls for both sibship size and social class are applied to all of the findings, the effect reported in *Born to Rebel* disappears.

One final point merits comment. The number of reported Confirms in *Born to Rebel* was 72. Here it has dropped to 23. But these are not 23 independent studies. These are only 23 *findings* from a very limited number of studies. In fact, over half of these 23 findings came from just three studies.

We have come full circle. What is the proper measure of rebelliousness—personality traits or rebellious acts? In the end, the results come out the same.

Table 6. Comparative Findings from *Born to Rebel* and Ernst and Agnst (Using Strong Controls* and Including "Corrections" and Omissions)

Source	Confirm	No Difference	Opposite
Born to Rebel	72	110	14
Ernst and Angst	23	153	25

* Controlled for sibship size *and* social class

Conclusion

An examination of the dramatic claims in *Born to Rebel* raises numerous questions. Can competition between children for parental attention explain the differences between the Quebec Liberation Front and the Irish Republican Army? Between Lenin and Trotsky and Maximilien Robespierre? Between Ché Guevara and Fidel Castro? Between the quantum hypothesis and the structure of DNA? Or between germ theory and antiseptic surgery? Can the effects of sibling rivalry really be that precise? This seems unlikely.

A review of *Born to Rebel* also reveals problems with flexible definitions. When rebellious actions contradict the theory, personality traits confirm it. These interpretative difficulties can be avoided by using rebellious acts to measure rebelliousness. Using that measure, six historical samples were examined that contradict the theory. And an examination of the data Sulloway has reported concerning 28 scientific revolutions indicates several significant unexplained inconsistencies.

Finally, *Born to Rebel* presents two methodologies for a meta-analysis of the birth order literature. Both of these methodologies were applied to the reconstructed data. Neither was able to replicate the results presented in *Born to Rebel*.

The conclusion is that Sulloway's claims for birth order effects should be rejected.

Appendix A

This appendix contains findings from pages 93 to 189 of *Birth Order: Its Influence on Personality,* by Ernst and Angst, 1983 (only the first author of each study is given). Not included are findings Sulloway apparently omitted, as discussed in Note 9. The findings in this appendix were controlled for social class ("Class"), sibship size ("Sibship"), or both social class and sibship size ("Both") (Sulloway, 1996:73n).

Table A1. Reconstructed Birth Order Findings from Ernst and Angst (1983:93-189)

Page	Author	Subject	Controlled for Social Class or Sibship Size	Highest Score or Result	Classification
93, 95	Corsello (1973)	Authority & Control	Class	1stborn males	Confirm
93, 95	Schaller (1972)	Authority & Control	Sibship	1stborns, 1% var. explained	Confirm
93, 95	Koch (1960)	Favored by Mother	Both	2ndborns	Opp.
93, 95	Corsello (1973)	Affection	Class	No Diff.	No Diff.
93, 95	Singer (1971)	Affection	Both	No Diff.	No Diff.
93, 95	Bartelt (1973)	Discipline	Both	No Diff.	No Diff.
94, 95	Smith (1971)	Acceptance of parental authority	Both	Male 1stborns	Confirm
94, 95	Singer (1971)	Parent Orientation	Both	1stborn girls in small sibships	Confirm
94	Tomeh (1970)	Parent Orientation	Class	No Diff.	No Diff.
94, 96	Tomeh (1971)	Parent Orientation	Class	1stborns & youngest	Confirm
94, 96	Frankel (1968)	Parent Orientation	Both	No Diff.	No Diff.
94, 96	Sutton-Smith (1970)	Parent Orientation	Both	No Diff.	No Diff.
94, 96	Laitman(1975)	Parent Orientation	Sibship	1stborns	Confirm
94, 96	Palmer (1966)	ID with Parents	Class	1stborns	Confirm
94, 96	Sutton-Smith (1971)	ID with Parents	Sibship	1stborns	Confirm
94, 96	Purpura (1971)	ID with Parents	Class	1stborns	Confirm
94, 96	Singer (1971)	ID with Parents	Both	No Diff.	No Diff.
95-97	Bartelt (1973)	Parent Orientation	Both	No Diff.	No Diff.
95-97	Rosen (1964)	Parent Orientation	Both	No Diff.	No Diff.
95-97	Biegelsen (1976)	Parent Orientation	Both	No Diff.	No Diff.

97	Koch (1960)	Sib. Diff. (Aggr.)	Both	1stborns	Confirm
97	Sutton-Smith (1970)	Sib. Diff. (Aggr.)	Class	Not analyzed	Ambig.
97	Sutton-Smith (1970)	Sib. Diff. (Aggr.)	Class	1stborns	Confirm
97	Bigner (1974)	Sib. Diff. (Power)	Class	1stborns	Confirm
98	Schachter (1976)	Sib. Diff.	Both	Person. trait not given	Ambig.
98	Verger (1968)	Sib. Diff.	Both	Person. trait not given	Ambig.
98	Schachter (1978)	Sib. Diff.	Both	Person. trait not given	Ambig.
98	Hayden (1973)	Sib. Diff.	Both	No Diff.	No Diff.
98	Bragg (1973)	Aggression	Both	No. Diff.	No Diff.
103, 104	Catlin (1972)	Anxiety	Class	1st, lastborns	Ambig.
103, 104	Miller (1976)	Anxiety	Sibship	No Diff.	No Diff.
103, 104	Rosenberg (1964)	Anxiety	Sibship	No Diff.	No Diff.
103, 104	Sampson (1962)	Anxiety	Sibship	No Diff.	No Diff.
103, 104	Bartlett (1968)	Anxiety	Class	Laterborns	Opp.
103, 104	Roberston (1971)	Anxiety	Class	Laterborns interaction with class	Opp.
103, 104	Koch (1957)	Anxiety	Sibship	Inconsistent	Ambig.
103, 105	Mealiea (1973)	Anxiety	Sibship	1stborns	Confirm
105, 106	Nisbett (1968)	Fear in real life	Sibship	1stborns	Confirm
106	Nisbett (1968, 2nd test)	Fear in real life	Sibship	1stborns	Confirm
106	Casher (1977)	Fear in real life	Both	1st, 2ndborns	Ambig.
107	Sears (1957)	Admissions of Guilt	Both	1stborns	Confirm
107	Sears (1970)	Self-Criticism	Both	Laterborns	Opp.
108, 110	Fox (1976)	Contact with adults	Class	1stborns	Confirm
109, 110	David (1973)	Conformity	Class	No Diff.	No Diff.
109, 111	Yando (1975)	Conformity	Both	No Diff.	No Diff.
112, 114	Purpura (1971)	Conformity	Class	1stborns	Confirm
112, 114	Rhine (1968)	Conformity	Class	1stborns	Confirm
112, 114	Sampson (1967)	Conformity	Sibship	1stborn males	Confirm
118-119	Stewart (1967)	Field dependent (insecurity)	Sibship	1stborns	Confirm
118-119	Schooler (1972)	Field dependent (insecurity)	Both	No Diff.	No Diff.
119, 122	MacDonald (1971)	Affiliation	Sibship	No Diff.	No Diff.
119, 122	MacDonald (1971)	Affiliation	Sibship	No Diff.	No Diff.
119, 122	Macbeth (1975)	Affiliation	Sibship	No Diff.	No Diff.
119, 122	Macbeth (1975)	Affiliation	Sibship	No Diff.	No Diff.
120, 122	Owyang (1971)	Affiliation	Sibship	No Diff.	No Diff.
120, 122	Masterson (1971)	Affiliation	Sibship	1stborn females with two sibs	Confirm
120, 122	Boor (1972)	Affiliation	Sibship	No Diff.	No Diff.
120, 122	De Avila (1970)	Affiliation	Sibship	1stborns 1 factor in 3	Confirm
120, 122	Sampson (1967)	Affiliation	Sibship	No Diff.	No Diff.
120, 122	Waters (1967)	Affiliation	Sibship	No Diff.	No Diff.
120, 122	Krinsky (1963)	Affiliation	Sibship	No Diff.	No Diff.
120, 123	Macbeth (1975)	Affiliation	Sibship	No Diff.	No Diff.
120, 123	Macbeth (1975)	Affiliation	Sibship	No Diff.	No Diff.
121	Schmuck (1963)	Affiliation	Sibship	No Diff.	No Diff.
121	Brittain (1966)	Affiliation	Sibship	No Diff.	No Diff.

121	Stenning (1968)	Affiliation	Class	No Diff.	No Diff.
121, 123	Solomon (1977)	Affiliation	Sibship	Inconsistent	Ambig.
124, 125	Dixon (1980)	Conformity	Class	No Diff.	No Diff.
124, 125	Hess (1971)	Conformity	Sibship	1stborn males	Confirm
124, 125	McAllister (1974)	Attitude towards fam.	Sibship	No Diff.	No Diff.
125, 126	Stokes (1977)	Conformity	Both	No Diff.	No Diff.
125, 126	Koch (1955a,b)	Conformity	Both	No Diff.	No Diff.
125, 126	Blustein (1967)	Conformity	Sibship	1stborn males	Confirm
128	Schettino (1976)	Affiliation	Sibship	No Diff.	No Diff.
130, 131	Roodin (1978)	Volunteering	Sibship	No Diff.	No Diff.
132, 137	De Avila (1970)	Need for Achiev.	Sibship	1stborns 1 factor	Confirm
132, 137	Sampson (1967)	Need for Achiev.	Sibship	1stborns	Confirm
133, 137	Hornsbostel (1980)	Need for Achiev.	Sibship	Inconsistent	Ambig.
133, 137	Yang (1973)	Need for Achiev.	Class	No Diff.	No Diff.
133, 137	Falbo (1979)	Need for Achiev.	Both	No Diff.	No Diff.
133, 137	Munz (1968)	Need for Achiev.	Sibship	No Diff.	No Diff.
133, 137	Keetz (1979)	Need for Achiev.	Both	No Diff.	No Diff.
133, 137	Rosen (1961)	Need for Achiev.	Both	No Diff.	No Diff.
133, 137	Rosen (1961)	Need for Achiev.	Both	No Diff.	No Diff.
133, 137	Stenning (1968)	Need for Achiev.	Class	1st, lastborns	Ambig.
133, 137	Stenning (1968)	Need for Achiev.	Class	No Diff.	No Diff.
134, 138	Mukherjee (1968)	Need for Achiev.	Class	Inconsistent	Ambig.
133, 138	Macbeth (1975)	Need for Achiev.	Sibship	No Diff.	No Diff.
133, 138	Macbeth (1975)	Need for Achiev.	Sibship	No Diff.	No Diff.
134, 138	Adams (1967)	Academic Achiev.	Class	1stborns	Confirm
134, 138	Adams (1972)	Academic Achiev.	Class	1stborns	Confirm
134, 138	Blustein (1967)	Academic Achiev.	Sibship	1stborns	Confirm
134, 138	Rosenbluth (1970)	Academic Achiev.	Class	No Diff.	No Diff.
134, 138	Janisch (1973	Academic Achiev.	Both	No Diff.	No Diff.
135, 138	Turner (1962)	Academic Achiev.	Both	No Diff.	No Diff.
134, 138	Elder (1962)	Academic Achiev.	Both	Earlierborns	Confirm
135, 138	Glass (1974)	Academic Achiev.	Both	No Diff.	No Diff.
135, 138	Struempfer (1973)	Academic Achiev.	Both	No Diff.	No Diff.
135, 138	Biegelsen (1976)	Academic Achiev.	Sibship	No Diff.	No Diff.
135, 138	Biegelsen (1976)	Academic Achiev.	Sibship	No Diff.	No Diff.
135, 138	Elliot (1970)	Need for Achiev.	Both	No Diff.	No Diff.
139, 140	Abramson (1973)	Aggression	Sibship	No Diff.	No Diff.
139, 140	Rosenberg (1969)	Aggression	Sibship	No Diff.	No Diff.
139, 140	Sutton-Smith (1970)	Aggression	Sibship	No Diff.	No Diff.
140	Koch (1955a)	Aggression	Both	1stborns	Confirm
142	Stenger (1975)	Dominance	Sibship	No Diff.	No Diff.
141, 144	Leventhal (1970)	Dominance	Sibship	No Diff.	No Diff.
141, 144	Frankel (1968)	Dominance	Sibship	No Diff.	No Diff.
142, 144	Hall (1963)	Dominance	Both	1stborn males	Confirm
142, 144	Hall (1977)	Dominance	Sibship	1stborn females small sibships	Confirm
142, 144	Majoribanks (1979)	Dogmatism	Both	No Diff.	No Diff.
143, 144	Hall (1963)	Dogmatism	Both	1stborn males	Confirm
143, 145	Macbeth (1975)	Dogmatism	Sibship	No Diff.	No Diff.
143, 145	Macbeth (1975)	Dogmatism	Sibship	No Diff.	No Diff.

145, 148	Sutton-Smith (1964)	Leadership	Sibship	No Diff.	No Diff.
146, 148	Macbeth (1975)	Leadership	Sibship	No Diff.	No Diff.
146, 148	Macbeth (1975)	Leadership	Sibship	No Diff.	No Diff.
146, 148	Biegelsen (1976)	Leadership	Sibship	No Diff.	No Diff.
146, 148	Biegelsen (1976)	Leadership	Sibship	No Diff.	No Diff.
146, 148	Oberlander (1971)	Int. in group activ.	Class	2ndborns exp. 2% of var.	Confirm
146, 148	Stenger (1975)	Vocational interest	Sibship	No Diff.	No Diff.
146, 148	Hardy (1972)	Task-Oriented	Class	1stborns	Confirm
146, 148	Oberlander (1971)	Conservatism, morality	Class	1stborns	Confirm
146, 148	Hall (1963)	Conservatism, morality	Both	1stborns	Confirm
146, 148	Schwartz (1976)	Conservatism, morality	Sibship	No Diff.	No Diff.
147, 149	Macbeth (1975)	Conservatism, morality	Sibship	No Diff.	No Diff.
147, 149	Macbeth (1975)	Conservatism, morality	Sibship	No Diff.	No Diff.
147, 149	Koch (1956b)	Choice of playmates	Both	No Diff.	No Diff.
147, 149	Koch (1956c)	Planning	Both	1stborns	Confirm
147, 149	Klockars (1968)	Leadership	Sibship	No Diff.	No Diff.
147, 149	Neetz (1974)	Leadership	Sibship	No Diff.	No Diff.
150, 152	Sampson (1967)	Need for Autonomy	Sibship	No Diff.	No Diff.
150, 152	Krinsky (1963)	Need for Autonomy	Class	1stborns	Opp.
150, 152	Stewart (1967)	Creativity	Sibship	No Diff.	No Diff.
150, 152	Macbeth (1975)	Creativity	Sibship	No Diff.	No Diff.
150, 152	Macbeth (1975)	Creativity	Sibship	No Diff.	No Diff.
150, 152	Wiedl (1977)	Creativity	Sibship	No Diff.	No Diff.
151, 153	Wilks (1977)	Creativity	Sibship	No Diff.	No Diff.
151, 153	Farley (1978)	Creativity	Sibship	2ndborns interaction w/sibship size	Confirm
151, 153	Sellwood (1975)	Creativity	Both	No Diff.	No Diff.
151, 153	Kaltsounis (1978)	Creativity	Both	2ndborns	Confirm
151, 153	Corneau (1980)	Creativity	Both	1stborns	Opp.
154, 155	Laitmen (1975)	Self-esteem	Sibship	No Diff.	No Diff.
154, 155	Watkins (1980)	Self-esteem	Sibship	No Diff.	No Diff.
154, 156	Rosenberg (1965)	Self-esteem	Sibship	No Diff.	No Diff.
154, 156	Koch (1955a, 56d)	Self-esteem	Both	No Diff.	No Diff.
155, 156	Blustein (1967)	Self-esteem	Sibship	No Diff.	No Diff.
154, 156	Hall (1963)	Self-esteem	Both	2ndborns	Confirm
155, 156	Kaplan (1970)	Self-esteem	Class	No Diff.	No Diff.
155, 156	Bartelt (1973)	Self-esteem	Both	No Diff.	No Diff.
156	Blustein (1967)	Self-esteem	Sibship	No Diff.	No Diff.
157, 158	Lessing (1967)	Neuroticism	Both	No Diff.	No Diff.
157, 158	Lessing (1972)	Neuroticism	Both	No Diff.	No Diff.
157, 158	Lessing (1972)	Adjustment	Both	1stborn females better adjusted	Opp.
157, 159	Koch (1956)	Neuroticism	Both	1stborn boys, 2ndborn girls less neur.	Opp.
158, 159	Davie (1972)	Neuroticism	Class	Earlierborns less neur.	Opp.
158, 159	Swanson(1972)	Neuroticism	Sibship	No Diff.	No Diff.

158, 159	Macbeth (1975)	Neuroticism	Sibship	1stborns less neur. 2 scales in 8	Opp.
158, 159	Macbeth (1975)	Neuroticism	Sibship	No Diff.	No Diff.
158, 159	Owyang (1971)	Neuroticism	Sibship	1stborn	Confirm
158, 159	Robertson (1971)	Neuroticism	Both	No Diff.	No Diff.
158, 159	Eysenck (1969)	Neuroticism	Sibship	No Diff.	No Diff.
158, 159	Farley (1975)	Neuroticism	Sibship	No Diff.	No Diff.
159, 160	Eysenck (1969)	Introversion	Sibship	No Diff.	No Diff.
159, 160	Farley (1975)	Introversion	Sibship	No Diff.	No Diff.
159, 160	McCormick (1975)	Introversion	Sibship	2ndborn males 1stborn females	Confirm
160	Robertson (1971)	Introversion	Class	1stborn, onlys 1 class in 3	Opp.
160	MacFarlane (1954)	Introversion	Class	1stborn males	Opp.
161	Staffieri (1970)	Empathy	Sibship	No Diff.	No Diff.
161	Sutton-Smith (1970)	Empathy	Sibship	No Diff.	No Diff.
162	Ballante (1973)	Empathy	Sibship	No Diff.	No Diff.
162, 163	Frankel (1968)	Responsibility	Sibship	No Diff.	No Diff.
163, 164	Koch (1956c)	Responsibility	Both	No Diff.	No Diff.
163, 164	Hall (1963)	Responsibility	Both	1stborns 1 factor	Confirm
163, 164	Harris (1968)	Responsibility	Class	No Diff.	No Diff.
165, 169	Stroup (1965)	Personality	Class	No Diff.	No Diff.
165, 169	Hall (1963)	Personality	Both	No Diff	No Diff.
165, 169	Sutton-Smith (1970)	Personality	Both	No Diff.	No Diff.
165, 169	Stewart (1967)	Personality	Sibship	No Diff.	No Diff.
166, 169	Stenger (1975)	Personality	Both	Inconsistent	Ambig.
166, 169	Hall (1963)	Personality	Both	No Diff.	No Diff.
166, 169	Klockars (1968)	Personality (leadership)	Both	Middle	Opp.
166, 169	Klockars (1968)	Personality	Both	No Diff.	No Diff.
166, 170	Vaughn (1975)	Personality (adjustment)	Sibship	Laterborns less adjusted	Opp.
166, 170	Macbeth (1975)	Personality	Sibship	No Diff.	No Diff.
166, 170	Macbeth (1975)	Personality	Sibship	No Diff.	No Diff.
167, 170	Koch (1955a,56d,57a)	Personality	Both	Inconsistent	Ambig.
167, 168, 170	Vuyk (1959)	Personality (Introv.)	Both	1stborns	Opp.
167, 170	Newbert (1969)	Personality	Both	2nd vs. 1st & 3rd	Ambig.
167, 170	Dean (1947)	Personality (Neur.)	Both	1stborns	Confirm
167, 170, 159	McArthur (1956)	Personality (Serious)	Both	1stborns	Confirm
167, 170	Vuyk (1961/63)	Personality(Serious)	Both	1stborns	Confirm
167, 170	Vuyk (1961/63)	Personality	Both	No Diff.	No Diff.
167, 170	Newbert (1969)	Personality	Both	No Diff.	No Diff.
168, 170, 159	Price (1969)	Personality(Introv.)	Both	1stborns	Opp.
	Price interpreted “the differences to connote greater introversion” (1983:168).				
171, 172	Sears (1970)	Sex-typing	Sibship	No Diff.	No Diff.
171, 172	Gormly (1968)	Sex Typing	Sibship	No Diff.	No Diff.
172	Barrett (1976)	Sex-typing	Sibship	No Diff.	No Diff.
173-176	Brim (1958) (duplicates Koch), plus 19 Role Differentiation findings, all Ambig.				
177	Ward (1974)	Marriage Pref.	Sibship	Own rank	Ambig.

178	Mendelson (1974)	Dating Success	Both	Own rank	Ambig.
181, 182	Sells (1963)	Popularity	Sibship	Only & youngest	Ambig.
181, 183	Miller (1976)	Popularity	Sibship	Youngest, 1% exp. var.	Confirm
182, 183	Adams (1967)	Popularity	Class	No Diff.	No Diff.
182, 183	Alexander (1966)	Popularity	Both	1stborns	Opp.
182, 183	Murray (1971)	Popularity	Both	No Diff.	No Diff.
182, 183	Koch (1956)	Popularity	Both	No Diff.	No Diff.
182, 183	Miller (1976)	Popularity	Both	Laterborns	Confirm

Appendix B

Table B1. Findings with Controls Unreported in the Summary Tables of Ernst and Angst

A. Findings Included by Sulloway

Study*	Pages in Ernst & Angst	Controls	Classification
Altus (1963a)	*144*	Sibship	Confirm
Altus (1970)	172, *172*	Sibship	Confirm
Farley & Farley (1974)	*145*	Sibship	No Diff.
Fisher et al. (1968)	*138*	Both	Conf./No Diff.
Hendershot (1969)	*125*	Sibship	No Diff.
Jamieson (1969)	101, *102*	Sibship	No Diff.
Klockars (1968) (coll. samp.)	82, *149*	Both	Opp.
MacDonald (1969a)	*125*	Sibship	Confirm
Murdoch (1966)	*125*	?	Confirm
Murdoch (1969)	*125* (some findings)	?	Conf./No Diff
Purpura (1971)	94, *114*	Class	Confirm
Yang and Liang (1973)	133, *137* (2nd entry)	Class	Confirm

B. Findings Omitted by Sulloway

Study	Pages in Ernst & Angst	Controls	Classification
Bharathi (1976) (Indian samp.)	*105*	Sibship	No Diff
Choynowsky (1973)	*140*	Both	No. Diff.
Crandall (1965)	162, *163*	Both	Conf./No Diff.
Conners (1963)	*123*	Both	Opp.
Coopersmith (1967)	80, 154, *155*	Both	Opp.
Damrin (1949)	*158*	Sibship	No Diff.
Dauphinias (1978)	117, *117*	Both	Opp./No Diff.
Douglas (1964)	157, *159*	Class	Conf./Opp.
Fisher et al. (1969)	130, *131*	Both	No Diff.
Gandy (1973)	*148*	Both	No. Diff.
Hreshko (1977)	*163*	Sibship	Conf./No Diff.
Krumboltz (1958)	*148*	Sibship	No Diff.

Lichtenwalner (1969)	150, *152*	Class	Opp.
MacDonald (1972a)	*131*	Class	No Diff.
MacDonald (1972b)	*131*	Both	No Diff.
Marquette (1972)	120, *123, 172*	Sibship	No Diff./No Diff.
McCormick (1975)	*159*	Both	No Diff.
McGurk (1972)	*110*	Both	Opp.
Mehta (1969)	134, *138, 148*	Both	No Diff./No Diff.
Miller et al. (1976)	54, *114, 155*	Both	No Diff./No Diff.
Nystul (1974)	*156*	Sibship	No Diff.
Prakash (1963)	*159*	Sibship	Conf./Opp.
Rothbarth (1970)	141, *144*	Sibship	No Diff./Opp.
Sears (1970)	87, 154, *156*	Both	Opp.
Shrivastava (1977)	151, *152*	Sibship	No Diff.
Unruh (1971)	*111*	Sibship	Opp.

Note. For the studies in section A, Sulloway only reports study and page information (1998b:1). Controls are based on my review of the original articles. Classifications are unmodified from Ernst and Angst, except for Hendershot (1969), which Sulloway changed to No Difference (1998b:2). Citations to the summary tables are in italics.

Appendix C

Section Four of Sulloway's list of errors in the Ernst and Angst data refers to "studies erroneously reported as not being statistically significant that *are* significant (or that involve doubt as nulls)" (Sulloway, 1998b:2). This raises the question of which findings within a study should be counted. MacBeth (1975), for example, administered the CPI, ACL, WEPT, EPPS, MMPI, SVIB, CPRI, and the CCPI (MacBeth, 1975:10). Counting five personality dimensions for eight measures multiplied by two samples equals 80 findings from just one study. And almost all were No Difference findings. Which ones should be included?

In keeping with the methodology described in the paperback edition of *Born to Rebel*, I have included findings listed in Ernst and Angst, but as they were characterized by the author in the original study. It is possible, however, to search through the wealth of material in studies such as MacBeth and select results for subsamples or interaction effects, such as males from large sibships for one personality dimension in the MMPI. However, to be methodologically sound, all such findings should then be included. In that case, the total number of findings would have exceeded 500, not the 196 reported.

Sulloway's list of what he claims are errors in Ernst and Angst contains the entries below. Following each entry, I indicate the results of my own reexamination of the study in question and how that fits with Ernst and Angst's classification of the study.

- *Biegelsen (1976) (three findings).* *Dissertation Abstracts International* states that this study concluded that "statistically common effects are not manifest in these results" (1976:1872-B). Biegelsen herself concludes, "In summary, this study does not find significant differences related to birth order" (1976:79). Ernst and Angst rated these findings as no difference (1983:96, 138, 148).
- *Eysenck and Crookson (1969) (two findings).* In the *British Journal of Educational Psychology*, Eysenck and Crookson concluded that their findings demonstrated that "position within the family is irrelevant" to personality (1969:128). Ernst and Angst classified these as no difference findings (1983:159, 160).
- *Harris and Howard (1968).* This study contains significant findings, but the subjects were "firstborns of *their sex*, but not firstborns in the conventional sense . . . " (1983:163). Thus, Ernst and Angst classified this as a no difference. However, some results arguably support Sulloway's theory, and so he is given the benefit of the doubt.
- *Koch (1955, 56).* In their text, Ernst and Angst provide the results from Koch (1955, 56). Sulloway admits that "E&A's text is mostly correct" (1998b:2). He claims, however, that Ernst and Angst were incomplete in their summary table. But the summary tables (being summaries) were necessarily incomplete. Ernst and Angst reported the results in the text.
- *Krinsky (1963).* Krinsky concluded that "first borns (only and eldest children) were found to be more autonomous than later borns" (1963:168). Ernst and Angst state that Krinsky found firstborns to be more autonomous that laterborns (1983:152).

- *Macbeth (1975) (two findings). Dissertation Abstracts International* describes the Macbeth findings as follows: "Results failed to confirm the predicted relationships except for a first-born superiority in verbal aptitude" (1975: 4757-B). Macbeth herself concluded, "Results from this study show significant birth order effects for one measure of aptitude/achievement [verbal aptitude], but essentially negative findings for a whole series of personality variables" (1975:54). The two findings discussed in Ernst and Angst involved need-achievement and empathic behavior, not verbal aptitude (1983:136, 145). Thus, Ernst and Angst correctly classified these findings as no difference (1983:138, 148).
- *Sampson and Hancock (1967).* There is a finding in this study that appears unreported in Ernst and Angst, as Sulloway says.
- *Sutton-Smith and Rosenberg (1970:101-2) (1983:94, 96, 1st listing).* The reported results show that firstborns had more positive involvement with their fathers, but more negative involvement with their mothers as compared to laterborns, who had more involvement with older siblings. These findings appear to be ambiguous in the context of Sulloway's theory.
- *Sutton-Smith and Rosenberg (1970:113)* (*two findings, 1983:140, 169).* These findings refer to raw scores. Ernst and Angst stated that "levels of significance were not given and differences seem small and inconsistent" (1983:165). These results appear ambiguous.
- *Sutton-Smith and Rosenberg (1970:121).* There are findings on this page that appear to be unreported in Ernst and Angst, as Sulloway says.
- *Tomeh (1970).* Sulloway classifies Tomeh (1970) as containing a significant result (1998b:2). However, Tomeh writes that the "results reported in the investigation are not significant" (1970:367).
- *Yando et al. (1975).* The authors write that "the clear effects of birth order appear to be so vitiated by other variables, such as the number of siblings, the last-born phenomenon, and possibly the time between sibling births, that no simple birth order formulation does justice to the complexity involved" (1975:109-10).

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Notes

1. The birth order for Joseph Fouché is in dispute. Sulloway classifies him as a laterborn (1996:528, n. 54), but Spitzer and Lewis-Beck classify him as a probable firstborn (1999:266).
2. Sulloway's criteria for being a conservative revolutionary include "being a member of the IRA in Northern Ireland" (1996:522, n. 48). The criteria for being a radical revolutionary include being given the highest classification by Rejai and Phillips as "agitators, professional revolutionaries, and elders" (1996:522, n. 48). All but one of the QLF leaders are so classified (Rejai and Phillips, 1983:102-111).
3. In calculating *p* values in both the NSF proposal and in *Born to Rebel*, Sulloway reports using Fisher's exact test. However, in the NSF proposal he used one-tailed tests, while in *Born to Rebel* he used two-tailed tests (1991:16, n. 1; 1996:39, Table 2, n. *a*). Sulloway states that two-tailed tests have the effect of doubling one-tailed *p* values (1996:374). Yet rather than doubling, *p* values in *Born to Rebel* declined dramatically. This result is difficult to explain.
4. An Opposite finding is a significant finding in the opposite direction predicted by Sulloway's theory. For example, a finding that laterborns are significantly more conforming than firstborns would be an Opposite. This differs from *Born to Rebel*, which used "Negating" instead of "Opposite" (1996:73). Sulloway seems to suggest that No Difference findings are not negating (1996:74; "no disconfirming ones"). But No Difference findings negate the hypothesis that the proposed theory is significant. In order to avoid this ambiguity, the term "Opposite" has been used. Thus, both Opposite and No Difference findings are negating.
5. Findings described by Ernst and Angst as conflicting or inconsistent (or where the information provided was insufficient to make a classification) are listed as Ambiguous and were not counted. Borderline determinations were made in favor of the proposed theory. For example, Tomeh (1971; p. 94 in Ernst and Angst) found both firstborns and youngest parent-oriented, but is rated a Confirm. De Avila (1970; 120, 122) is rated a Confirm despite the fact that two factors showed no difference and only one factor showed a "very slight birth order effect" (120, 122). Similarly, Singer (1971; 94, 95, 2nd listing) and Oberlander (1970; 146, 148) were rated Confirms. Where there was a conflict between results for males and females, the male result has been followed in order to favor the proposed theory: Hess (1971; 124, 125); Sampson (1967; 112, 114); Blustein (1967; 125, 126); and Smith (1971; 94, 95). But Koch (1956; 157) and MacFarlane (1954; 160) become Opposites. Both McArthur (1956; 170) and Vuyk (1961/63; 170) have findings describing firstborns as more "serious, sensitive." These might well be classified as introversion findings (Opposites), but they are classified as Agreeableness/ Antagonism findings, which makes them Confirms. From all sources, a total of eleven Confirms were added.
6. A simultaneous reading of both editions of *Born to Rebel* has revealed over 120 revisions, including changes to the sections on the French Revolution, missing data, conflict with a parent, representative samples, social attitudes, Margaret Mead, the Reformation, and the Declaration of Independence, among many others: xv, xvi, 39-40, 53-54, 73, 78, 95-96, 118, 147, 159, 171, 204-205, 214, 226, 268-269, 280-283, 324-326, 332, 366-368, 376-382, 389-393, 406-407, 416, 439, 444, 463-464, 466, 472, 482, 483, 494, 496, 498, 499, 502, 507, 516, 518, 523-540, 636, 641, 650.
7. Sulloway made several other statements inconsistent with the paperback methodology. Thus, he stated that "researchers owe a considerable intellectual debt to Ernst and Angst for their systematic analysis of the birth-order literature" (1996:472, n. 65). After eliminating uncontrolled studies, he stated that "196 controlled studies remain in Ernst and Angst's survey . . . " (1996:72). However, 196 studies cannot remain in Ernst and Angst's survey if 45 of 196 were not in Ernst and Angst. Sulloway further stated that "the bulk of these 196 studies are already grouped by Ernst and Angst . . . . In all such instances, I have followed their own classifications" (1996:72). Why would Sulloway follow their classifications if he thought that Ernst and Angst was riddled with errors? He stated that "the trend in favor of firstborns is equally impressive, based on 35 controlled studies reported by Ernst and Angst" (1996:473, n. 76). Finally, Sulloway's original article in *Psychological Inquiry* states that the data were "tabulated from Ernst and Angst" (1995:78n).

8. Section 1 concerns "studies erroneously reported as being controlled for sibship size or social class" (1998b:1). Section 3 concerns "studies erroneously reported as being statistically significant that were *not* (or that present no formal statistics)" (1998b:2). Section 5 concerns "miscellaneous studies whose findings are reported in incomplete, inaccurate, or otherwise problematic manner" (1998b:2).
9. *Born to Rebel* did not include all the relevant personality findings in Ernst and Angst. Over one hundred findings were apparently omitted. For example, Sulloway's methodology only covers pages 93 to 189 of Ernst and Angst (1996:73n). Yet, on pages 256 to 267, there are 13 findings from a massive, well-controlled study conducted by Ernst and Angst themselves. Twelve of these findings reported no difference. They were all omitted. Sulloway did cite in *Born to Rebel* the thirteenth finding, on masculinity, the only one that supports his theory (1996:475, n. 92). Also omitted was Ernst and Angst's study of drug use by birth order conducted on the same sample (1983:267-282). Secondly, Ernst and Angst described most of these findings in two places, a detailed description in the text and a single line in a summary table that necessarily compressed the results and usually eliminated null findings. As a result, the text of Ernst and Angst in the pages cited contains over 300 findings, not the 196 Sulloway reports. Thus, *Born to Rebel* apparently omitted findings in the text as follows: Smith (1971) 94; Blustein (1967) 125; Hayden (1973) 98; Lessing (1972) 157; Sears (1970) 107; Alexander (1967) 182; Stenning (1968) 121, 133; De Avila (1970) 120; Schaller (1972) 93; Farley (1978) 151; Koch (1956) 157; Koch (1955, 56, 57) 167; Hall (1977) 142; Hess (1971) 124; Macbeth (1975) 119, 158; Masterson (1971) 120; Mukherjee (1968) 134; Neetz (1974) 147; Janisch (1973) 134; Rhine (1968) 112; Palmer (1966) 94; Sampson (1967) 112; Robertson (1971) 160; Sutton-Smith (1970) 161; Stenger (1975) 166; Tomeh (1969) 94; Tomeh (1972) 94; Vaughn (1975) 166; Vuyk (1959) 167; Vuyk (1961/1963) 167; Elder (1962) 134; Leventhal (1970) 141; Mealiea (1973) 103; Rosen (1961) 133; and Sellwood (1975) 151. Moreover, twenty studies are listed under the heading of "Personality in General" (Ernst and Angst, 1983:164-70). These studies measured the entire personality with such tests as the MMPI, CPI, EPPS, and other personality scales. Thus, all of these studies could count as many as five times, once in each of the Big Five personality dimensions.

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