

Birth Order

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Birth Order The sequence by which children are born into a family. The most important birth-order positions are eldest, middle, and youngest. As a rule, birth-order differences in personality arise as a result of how children are raised (functional birth order, or rearing order) rather than the sequence in which they are born.

Five Factor Model of Personality A model based on the analysis of psychological questionnaires and natural language. Derived from factor analysis, this model posits the existence of five basic personality dimensions (conscientiousness, agreeableness, openness to experience, extraversion, and neuroticism—also known as “the Big Five”).

Parental Investment The nurturing that parents give to offspring, which can be emotional as well as physical. In Darwinian theory, parents are expected to invest differentially in offspring based on criteria such as age, sex, birth order, and cues of phenotypic quality. Parents make these discriminations in an effort to maximize their reproductive fitness—that is, the number and quality of offspring they successfully rear.

By influencing the strategies that siblings develop in competition for parental favor, BIRTH ORDER fosters differences in personality that in turn correlate with differences in creative achievement. The nature of the relationship between birth order and creativity has long been controversial owing to the failure of researchers to specify exactly what kinds of creativity they have in mind. Firstborns and laterborns do not appear to differ in overall levels of creativity, but they do differ in the ways by which they attain creative distinction.

I. BIRTH ORDER AND EVOLUTIONARY PSYCHOLOGY

In order to understand the association between birth order and creativity, it is first useful to review the relationship between birth order and personality, which owes itself to biological as well as environmental influences. Because there are no genes for being a firstborn or a laterborn, birth-order effects represent one of the best demonstrations of the power of the environment. Nevertheless, birth order interacts with other influences on human behavior, including genetic predispositions, that are known to be under biological control. Biological influences on personality may be separated into ultimate and proximate causes. Ultimate causes

are those that are attributable to evolution by natural selection. By contrast, proximate causes encompass those physiological influences operating during the lifetime of the organism. Proximate causes also include environmental influences, which typically interact with genetic and physiological processes.

Viewed in these terms, sibling rivalry provides an ultimate cause of some aspects of personality development. Darwin's theory of natural selection offers an explanation for this part of the story, because it tells us that siblings are biologically driven to compete for parental favor. On average, siblings share half of their genes. In the early 1960s, William Hamilton recognized that natural selection acts to maximize what he termed "inclusive fitness." This form of Darwinian fitness is defined as an individual's own reproductive success, together with his contribution to the reproductive success of close relatives, discounted according to their coefficient of relatedness. Based on Hamilton's theory, siblings are expected to compete for scarce resources whenever the benefits of doing so are greater than twice the costs. In general, an offspring's idea of fairness is to keep two-thirds of any scarce resource for him- or herself and give only one-third to a sibling. Competition for parental investment is the main cause of sibling rivalry.

By itself, competition among siblings does not lead to birth-order differences in personality. But birth order provides a powerful proximate (and environmental) source of sibling strategies. These tactical differences arise because birth order is correlated with differences in age, size, power, and status within the family. These physical and social disparities cause siblings to experience family relationships in dissimilar ways and to pursue differing ways of optimizing their parents' investment in their welfare.

Competition for parental love and favor has been an important driving force in human evolution, just as have parental decisions about how to invest in their offspring. Before 1800, half of all children did not survive childhood, and even minor differences in parental favor would have increased a child's chances of reaching adulthood. Children who lived long enough to become the eldest in a family were often a better Darwinian bet for their parents, because they had survived the perilous years of life and were more likely than their younger brothers and sisters to reach the age of repro-

duction and to pass on their parents' genes. In every society surveyed by anthropologists, eldest children are accorded higher status. For example, many traditional societies condone infanticide, especially when a child is deformed or when a slightly older infant is still breast-feeding, but no society condones the killing of the older of two siblings.

Parental investment strategies tend to be variable because birth order is only one of many relevant factors in these decisions. Besides taking into account the relative quality of their offspring, parents may invest differently in children based on such factors as the parents' age and the resources available to them. Primogeniture has generally been practiced by affluent parents in agrarian societies, where wealth is tied to land; but this inheritance system is much less common in mercantile societies where wealth can be acquired rapidly through entrepreneurship. Under these conditions, parents tend to hedge their bets by investing equally in all of their offspring.

Even if parents do not favor one child over another, sibling rivalry influences the dynamics of family life because competition serves to limit favoritism. Such competition typically involves the cultivation of family niches that correspond to differences in birth order. That families provide offspring with a series of niches is a conclusion supported by research in behavioral genetics. One of the most remarkable findings in psychology during the last two decades is the discovery that brothers and sisters raised together are almost as different in their personalities as people who grow up in separate families. Based on studies of twins raised together and apart, behavioral geneticists have concluded that only about 5% of the variance in individual personality traits is attributable to the shared environment—that is, growing up in the same family—whereas 35% can be assigned to the nonshared environment. About 40% of the overall variance is believed to be genetic, and the remaining 20% is attributable to errors of measurement. These findings have begun to reshape the understanding of personality development by suggesting that the family is not a single environment, but rather a collection of microenvironments or "niches." The main reason why the shared family environment does not have a greater impact on personality is that very little of the family experience is actually shared. For example, brothers and sisters

are at different ages when they experience the same events, and siblings often interpret shared experiences differently. Two particularly important and systematic sources of nonshared experiences are gender and birth order.

II. BIRTH ORDER AND PERSONALITY

Psychologists have investigated the consequences of birth order ever since Charles Darwin's cousin Francis Galton reported, in 1874, that eldest sons were overrepresented as members of the Royal Society. After breaking away from Sigmund Freud in 1910 to found a variant school of psychoanalysis, Alfred Adler highlighted social influences on personality, including birth order. A secondborn, Adler regarded firstborns as "power-hungry conservatives." He characterized middleborns as competitive, and youngest children as spoiled and lazy.

During the half-century since Adler's speculations, psychologists have conducted more than 2,000 studies on the subject. This literature has often been faulted, and critics have rightly argued that the findings conflict and that most studies are inadequately controlled for social class, sibship size, and other background influences that correlate with birth order and can lead to false conclusions. The reality of these reported differences is nevertheless supported by meta-analysis—a technique for aggregating findings from different studies in order to increase statistical power and reliability. Considering those well-designed studies that adjust for social class or sibship size, meta-analysis reveals consistent birth-order differences for many personality traits. These findings may be summarized in terms of the Five Factor Model of personality.

Controlled studies generally report that firstborns are more *conscientious* than laterborns, a difference that is exemplified by their being more responsible, ambitious, organized, and academically successful. Laterborns appear to be more *agreeable* than firstborns, in the sense of being more tender-minded, accommodating, and altruistic. Laterborns are also more *open to experience*, as expressed by their being more adventurous and unconventional. Differences by birth order are more restricted for the two remaining dimensions of

the Five Factor Model. Firstborns appear to be more *neurotic* than laterborns, in the sense of being temperamental and anxious about their status. In addition, firstborns are more *extraverted* than laterborns, in the sense of being assertive and dominant, whereas laterborns are more extraverted in the sense of being sociable and fun-loving. Dominance and sociability are substantially different personality traits, even though they are classified together within the Five Factor Model. Firstborns tend to have higher IQs than laterborns, but this difference is small, especially after being controlled for differences in family size. On average, IQ falls one point with each increase in birth rank within the family. (Proponents of the Five Factor Model consider IQ to be a sixth factor, largely independent of personality.)

The personality differences that I have just reviewed are generally consistent with a Darwinian framework, albeit with an emphasis on adaptation through learning. Unlike the propensity to compete with one's siblings, which is an ultimate cause of sibling conflicts, personality is a product of innumerable proximate causes that spur individuals to adapt themselves to the surrounding world. Firstborns often seek the favor of their parents by acting as a surrogate parent toward their younger siblings. As a result, firstborns tend to be parent-identified, conscientious, and respectful of authority. Laterborns cannot baby-sit themselves, so they look for an unoccupied family niche, in part by cultivating latent talents that can be discovered only through experimentation. For this reason, they are often more exploratory and open to experience. Another reason for the divergent personalities of siblings is the different strategies they employ in their relations with one another. These strategies involve behaviors that are typical of mammalian dominance hierarchies. Because firstborns are bigger, they are more likely to employ physical aggression and intimidation, and in general they are more likely to boss and dominate their younger brothers and sisters. Laterborns tend to use low-power strategies, such as whining, pleading, cajoling, humor, social intelligence, and, whenever expedient, appealing to parents for help. Two or more laterborns may also join in coalitions against the firstborn.

A Darwinian approach also leads to specific predictions about middle children, who lack the advantages of being either first or last. When resources are scarce,

parents are expected to invest preferentially in first-borns because they are the first to reproduce. Older parents are expected to invest preferentially in last-borns because these offspring are the most vulnerable to disease and, after parents have ceased reproducing, are the last children they will ever have. As Catherine Salmon and Martin Daly have shown, middle children often respond to their Darwinian handicap by becoming peer oriented and independent of the family. Compared with firstborns and lastborns, middle children are less closely identified with the family, less likely to turn to their parents for help in an emergency, and less likely to report having been loved during childhood. Compared with their siblings, middle children typically live farther away from their parents. In addition, they are the least likely sibling group to visit, and to encourage their own children to visit, close kin. Consistent with their greater allegiance to the peer group, middle children also are the most inclined to diplomacy and cooperation, strategies that may reflect their proclivity for mediating disputes between their siblings. Martin Luther King, Jr., the middle of three children, got his start as a champion of nonviolent reform by trying to prevent his younger brother from teasing their older sister.

Only children represent a controlled experiment in birth-order research. Because they experience no sibling rivalry, they are not driven to occupy a specific family niche. Like other firstborns, they are generally ambitious and conform to parental authority, because these attributes are valued by parents. Contrary to psychological folklore, only children do not appear to be more neurotic or less sociable than other children.

There is often a greater difference between a first-born and a secondborn child, or between a secondborn and a thirdborn, than there is between the firstborn and the thirdborn. The reason is that sibling competition promotes mutual differentiation in order to minimize direct conflicts, and children who are farther apart in age have less need to compete. This process of sibling differentiation, which is sometimes called de-identification, extends to relationships with parents. When a firstborn identifies more strongly with one parent, the secondborn is likely to identify more strongly with the other parent.

Some of these contrasts are striking. Voltaire, the third of three children, had an acrimonious relation-

ship with his elder brother Armand, who became a follower of the Jansenists, a fanatical Catholic sect. Voltaire was particularly repelled by Armand's belief in the need to forgo life's pleasures in order to win God's grace. As a leader of the French Enlightenment, Voltaire was especially noted for his relentless attacks on the Catholic Church. He chose literature as a profession partly to spite his brother, whom he had repeatedly bested in impromptu poetry contests devised by his family.

A different example of sibling contrasts involves the consumer rights advocate Ralph Nader and his three older siblings. In early adolescence, the Nader children took a globe of the world, divided it into four equal portions, and assigned one part to each child. Thereafter, each specialized in the history, culture, and languages of his or her own quarter of the globe. By minimizing direct competition, the Naders were also cooperatively pooling their resources as a family unit, collectively enabling them to learn more about the world. As Darwin recognized in the *Origin of Species* (1859), diversification is an effective way to reduce competition while also realizing the benefits stemming from the division of labor.

A. Direct Sibling Comparisons

Birth-order differences in personality vary in magnitude and sometimes even in direction, depending on how they are measured. When assessed by self-report questionnaires, birth-order effects are typically modest and nonsignificant. Yet systematic differences by birth order are generally found when parents rate their own offspring or when siblings compare themselves with one another. In a recent study by Frank Sulloway, 660 business leaders were surveyed. In self-reported ratings, firstborn CEOs did not differ significantly from laterborns on 10 of the 11 personality traits included in the survey. After providing these self-assessments, respondents were asked to compare themselves with their siblings, using the same 11 personality scales. A comparative method of assessment possesses several advantages over more customary methods of self-report. In particular, direct comparison anchors the scales. Additionally, comparative judgments among siblings eliminate any confounding effects associated with differences between families. Using such compari-

sons, 8 of the 11 traits included in the survey elicited significant differences by birth order. Relative to their older siblings, laterborn business leaders were more tender-minded, cooperative, flexible, submissive, empathetic, liberal, unconventional, and even-tempered. Overall, comparative ratings resulted in birth-order differences that were 5 times as large as those previously obtained without using direct comparisons.

A follow-up study involving 6,053 individuals aged 8 to 95 (mean age = 36.8, $SD = 17.1$) has yielded similar results for a broad array of personality traits. Subjects rated themselves on nine-step bipolar scales using adjective pairs that were chosen to represent the 30 facets of the NEO PI-R, a comprehensive personality inventory based on the Five Factor Model. Firstborns were asked to rate both themselves and their next younger sibling, whereas laterborns were asked to rate themselves and their next older sibling. Based on direct sibling comparisons, 23 of the 30 bipolar adjective pairs yielded significant differences, and 26 of the 30 adjective pairs produced correlations in the expected direction. As anticipated, firstborns were judged to be more conscientious than their younger siblings, whereas laterborns were judged as being more agreeable and open to experience. For neuroticism, a dimension for which birth-order differences were expected to be mixed, firstborns were predicted to be more anxious and quicker to anger—expectations that were both confirmed. Laterborns were predicted to be more depressed, vulnerable, self-conscious, and impulsive, but only the last two predictions were confirmed. As anticipated, results for extraversion were also mixed. Laterborns were more affectionate, fun-loving, and inclined to seek excitement. Firstborns were more energetic and dominant.

Controlling for age, sex, sibship size, and social class, the partial correlation between birth order and a scale score of predicted differences was .20, with birth order accounting for 4.1% of the variance. Two other family background variables—sibship size and social class—account for less than 0.1% of the variance in this scale score of predicted differences, as also does age. By comparison, sex explains 2.1% of the variance. (Laterborn personality traits resemble those observed in females.) Controlled for the linear effect of birth order on the scale score, there was also a significant quadratic trend: middle children scored higher than last-

borns on some personality scales, particularly those related to agreeableness (Table I).

Measured in terms of an overall scale score that reflects predictions about birth order, age and sex account for substantially less variance in personality scores than does birth order. It is important to note, however, that age and sex explain considerably more about personality as a whole than they do about birth-order-related traits. Sex differences in my study account for 8.3% of the variance in dimension scores for the Big Five, and age explains another 2.6% of the variance. In accounting for 4.1% of the variance in these same dimension scores, birth order is substantially more influential than age, but less so than sex. Still, on two dimensions of the Five Factor Model (conscientiousness and extraversion), birth order has greater influence than either age or sex.

One should bear in mind that birth order is only a proxy for the real causes that lie behind sibling differences in personality, namely, disparities in age, size, status, and power within the family system. Not all firstborns adopt the role of a surrogate parent toward younger siblings, and some firstborns are less bossy than others. Individual differences in physical size, temperament, and opportunities for surrogate parenting help to explain why some individuals deviate from the patterns of personality that are generally expected by birth order. In the study summarized in Table I, individuals were asked to what extent, during childhood, they acted as a surrogate parent toward their siblings, and also to what extent they bossed their siblings around. High scores for surrogate parenting behavior and bossiness reflect typical firstborn behaviors and are strongly correlated with birth order ($r = -.56$ for the composite measure). This indicator of family niches also accounts for 10.5% of the variance in personality scores, making it considerably better at predicting personality than any other variable in the study. The predictive success of this variable lies in large part in its ability to account for exceptions to predictions based on birth order. For example, laterborns (often eldest daughters) sometimes report having done substantial surrogate parenting with respect to their younger siblings. These individuals also tend to describe themselves as having firstborn personality traits.

Other studies using the NEO Personality Inventory and comparable instruments have generally yielded

TABLE 1
Birth-Order Effects in Scale Scores for the Big Five Personality Dimensions
Based on Direct Sibling Comparisons

Personality dimension ^a	Partial correlation with birth order ^b	N	p <
Conscientiousness	-.18	4,507	.0001
• Firstborns are more <i>deliberate, dutiful, effective, energetic,^a hardworking, organized, self-disciplined, and under control^a</i>			
Agreeableness	.10	4,510	.0001
• Laterborns are more <i>acquiescent, cooperative, easygoing,^a modest, straightforward, unassertive/submissive,^a tender-minded, and trusting</i>			
Openness to experience	.08	4,484	.0001
• Laterborns are more <i>aesthetically inclined, prone to fantasy, attentive to inner feelings, untraditional, attracted by novelty, and drawn to ideas^c</i>			
Extraversion	.14	4,404	.0001
• Laterborns are more <i>affectionate, excitement-seeking, fun-loving, and gregarious</i>			
Neuroticism	-.04	4,278	.001
• Firstborns are more <i>anxious</i> , as well as more prone to depression and feelings of vulnerability	-.04	4,278	.001
• Laterborns are more <i>self-conscious</i>	.05	3,548	.005
Scale score for personality differences, as predicted ^d	.20	4,177	.0001

^aEach of the 30 bipolar adjective pairs, representing the 30 facets of the NEO PI-R, is classified under the Big Five dimension on which it has its highest factor loading. Four of the 30 adjective pairs have their highest loading on a personality dimension other than the one for which they were selected. "Assertive (dominant)/unassertive (submissive)" has its highest loading on Agreeableness (-.54) rather than Extraversion (.32). Similarly, "quick to anger/easygoing" has its highest loading on Agreeableness (-.55) rather than Neuroticism (.47). "Impulsive/under control" has its highest loading on Conscientiousness (-.59) rather than Neuroticism (.24). "Energetic/leisurely" has its highest loading on Conscientiousness (.47) rather than Extraversion (.28).

^bA positive partial correlation denotes a higher score for laterborns. For each bipolar trait, a sibling difference score was calculated using z-scores and then used to compute each scale score in terms of *predicted* differences. Italicized traits exhibit significant birth-order differences. (All statistical tests are two tailed.) All partial correlations are controlled for age, sex, sibship size, and social class. All dimension scale scores except Neuroticism exhibit a significant quadratic effect, controlled for the linear trend, indicating a higher score for middleborns. For one dimension (Agreeableness), the quadratic trend is larger than the linear trend. Excluded from these statistical results are 548 only children, 71 twins, 112 subjects reporting an age gap of more than 9 years between themselves and the sibling they also rated, 86 subjects whose biological and functional birth orders do not coincide, and 726 subjects who did not provide information on one of more of the dependent or independent variables.

^cBeing "drawn to ideas" was predicted to be a firstborn trait.

^dSome respondents made ratings on fewer than 30 bipolar adjective pairs. In these cases, scale scores have been computed from the observed data.

null results, although most of these studies have possessed only moderate statistical power and none have employed the method of direct sibling comparison. Based on similar discrepancies between self-report rat-

ings, which often yield meager results, and significant differences as judged by family members, some researchers have argued that birth-order effects are parent specific and do not hold up outside the family.

When assessed meta-analytically, however, studies involving nonfamily members exhibit significantly more findings of a confirmatory nature than are expected by chance. Confirmatory findings are also especially likely to occur whenever studies involve real-life behavior. In addition, if birth-order effects are specific only to childhood (and the family milieu), one might expect these differences to diminish with age. In the study reviewed in Table I, birth-order effects do decrease modestly with age for conscientiousness, but they increase modestly for agreeableness. Overall, there is not a significant diminution in the scale score for predicted birth-order effects by age.

The method of direct sibling comparison does not prove that birth-order differences in personality exist outside the family milieu. Direct sibling comparisons may also be susceptible to "contrast effects," whereby small but real differences between siblings are magnified, exaggerating the variance explained by birth order. However, when the scores in Table I for direct sibling comparisons are transformed into binary outcomes (i.e., being higher or lower than a sibling on each trait), birth-order effects are only slightly reduced. Another possibility is that these comparative measures reflect shared stereotypes about personality, rather than true differences. In an effort to determine whether birth-order differences are recognized by people other than siblings, study participants were asked to rate their spouses. Significant birth-order differences emerged in the expected direction, although the mean effect size for the Big Five personality dimensions is somewhat smaller than for direct sibling comparisons. Controlling for age, sex, sibship size, and social class, the partial correlation among spouses between birth order and a scale score for predicted personality differences is .12, which accounts for 1.4% of the variance ($N = 822$).

An analysis of the scores for individual traits reveals that spouses are detecting the same birth-order differences that they reveal when they compare themselves with a sibling. A convenient way of demonstrating this point is to compare the effect sizes for birth order, on a trait-by-trait basis, with the effect sizes for the same traits as judged by spouses. These two sets of effect sizes are substantially correlated ($r = .61$, $N = 30$ traits, $p < .001$). In other words, those traits that are strongly associated with birth order in sibling relationships are the same traits that are strongly associated

with birth order in married couples. Relative to first-born spouses, for example, laterborn spouses are perceived to be less conscientious, but more agreeable, extraverted, and open to experience. A similar pattern in birth-order effects is found among college students who rated both a sibling and a roommate ($r = .72$, $N = 30$ traits, $p < .001$; for roommates, the partial correlation between birth order and a scale score for predicted personality traits is .16, $N = 165$, $p < .05$). Thus birth-order differences are not restricted to family members or the family milieu, as some psychologists have claimed. Rather, these differences tend to manifest themselves in intimate living situations.

III. GENDER, AGE SPACING, AND OTHER MODERATING INFLUENCES

Birth order is only one influence among many that contribute to the development of personality. Accordingly, there are exceptions to any generalization on this topic. The largest source of exceptions are those arising from genetic differences, which collectively explain about 40% of the variance in individual traits. Additionally, as children grow up and spend more time outside the family, they are increasingly influenced by peer groups and by life experience more generally. Some of these extrafamilial influences may nevertheless reflect differences that already exist between siblings.

There is growing evidence that some birth-order differences in personality are influenced biologically by the prenatal environment. Among males (but not among females), laterborns are more likely to become homosexuals. Unlike other behavioral effects associated with birth order, the operative factor is number of older brothers rather than relative birth rank from eldest to youngest child. In other words, a lastborn male who is the eldest of his sex is no more likely to become a homosexual than is a firstborn. These findings can be explained by assuming that a small proportion of mothers develop antibodies to one of the male-specific minor histocompatibility antigens. It has been hypothesized that such immunological responses prevent subsequent male fetuses from being fully transformed from female to male.

These findings about male homosexuality suggest that other aspects of personality—specifically, those

involving gender-related traits such as tender-mindedness—might also be influenced by the prenatal environment. If such biological effects exist, they appear to be very small in normal populations. For example, meta-analysis of the birth-order literature reveals no significant difference in the frequency of birth-order effects by sex, including for behaviors specifically related to agreeableness and extraversion, which include many gender-related traits. In the study reviewed in Table I, birth-order effects were just as substantial among women as among men. For males, moreover, number of elder brothers had no relationship with gender-related traits, with birth order being controlled. In short, the link between number of elder brothers and gender-related traits appears to reflect a developmental outcome of nonpsychological origin that is confined to male homosexuals.

Gender also contributes to personality, doing so in ways that parallel the influence of birth order on some personality dimensions—particularly extraversion and agreeableness. These similarities arise because birth order and gender have comparable effects on the strategies siblings use as they jockey for position within the family. Partly for genetic reasons and partly because of socialization, females tend to be less aggressive than males, just as laterborns tend to be less aggressive than firstborns. Gender also modifies the forms taken by aggression. Firstborn males are more physically aggressive than laterborn males, whereas firstborn females are more verbally aggressive. In addition, males and firstborns tend to be more assertive and tough-minded, whereas females and laterborns tend to be more affectionate, tender-minded, and cooperative. Women tend to be conscientious, whereas laterborns do not, so these behavioral parallels do not apply across the board.

Birth-order effects are modified by age gaps as well as by the sex of siblings. The influence of birth order is muted when the age gap is so small that the relationship between siblings is nearly equal, and also when the age gap is so large that they do not compete for the attention of their parents. When middle children have a large age gap between themselves and their next older sibling, but a small gap between themselves and their next younger sibling, they are more similar to firstborns in their personality.

Although laterborns tend to be more socially lib-

eral, as well as more adventurous and unconventional than their older siblings, there are exceptions to these generalizations that are attributable to other aspects of family dynamics. Firstborn children of socially liberal parents tend to become liberals themselves because they generally conform to parental values. A laterborn child of liberal parents may become a conservative just to be different. Furthermore, firstborns sometimes become social or political radicals because they are in conflict with their parents instead of identifying with them. Mao Zedong, the eldest of four children, was radicalized by conflict with his father, a cruel and tyrannical man who mistreated his wife, his children, and the workers on his farm. Mao once said that there were two political parties in his family, and that he was the leader of the opposition. In general, laterborns are likely to rebel even if they do not have Attila the Hun for a father or the Wicked Witch of the West for a mother. They have elder siblings to induce them to identify with the underdog.

The consequences of birth order are often strongly dependent on the behavioral context, which is one of the most important moderators of human behavior. In different situations, the same person may behave quite differently, and the relevance of birth order likewise varies with the situation. For example, a firstborn may act in a dominant manner toward a younger sibling or a spouse, congenially toward peers, and in a subordinate manner toward authority figures—a behavioral style that constitutes a “pecking order personality.”

Social categories such as age, gender, and socioeconomic status entail standards of behavior that can influence personality. In connection with the study summarized in Table I, respondents assessed the personality of a close friend ($N = 1,002$). Significant birth-order differences emerged, but they did so in interaction with other variables. Upper-class respondents, as well as older respondents, saw their best friends as exhibiting the traits generally expected by birth order. In contrast, college students—especially those from lower-class backgrounds—did not perceive these same birth-order differences. For example, college students did not describe their firstborn friends as being particularly conscientious or conventional, whereas older respondents did.

These seemingly contradictory results are best understood in terms of the attributes that are important

for success within each socioeconomic class, and during different stages of life. College-age students, especially from lower-class backgrounds, are likely to prefer friends who are sociable and who know how to have a good time. Because firstborns are more socially assertive and inclined toward leadership roles than are laterborns, they respond to these behavioral norms by projecting a gregarious and outgoing "persona." When people graduate from college, take a job, and marry, they assume new life roles and greater responsibility. Within such older populations, birth-order effects in personality increasingly conform to the expected pattern. Firstborns, who tend to be more conforming than laterborns, are especially affected by such life transitions. Compared with other individuals, firstborns are significantly more variable in terms of how their personalities are perceived across the social categories of age, class, and marital status. The more responsibility and status firstborns have acquired—for example, by getting married—the more they are judged by their friends as manifesting a typical firstborn personality.

These findings make sense from the perspective of evolutionary psychology, which is also a form of social psychology. The personality traits that are typically associated with birth order develop in the service of competition for scarce resources, principally parental investment. Adolescent individuals do not generally command scarce resources, so their behavioral priorities tend to be different from those of adults. A firstborn who aspires to social approval may be dutiful at home (especially during childhood), agreeable and gregarious during adolescence, and competitive and self-disciplined as an adult member of the workforce. The expression of personality traits related to birth order is likely to be sensitive to these transitions in the life course. In short, birth-order differences are not parent specific, but they are often situation specific. Research on birth order and creativity strongly reinforces this important conclusion.

IV. BIRTH ORDER, OPENNESS TO EXPERIENCE, AND CREATIVITY

As Robert R. McCrae has demonstrated, the various facets of openness to experience can be divided into two contrasting groups. One group reflects "intellect"

and is typified by adjective labels such as *intelligent, perceptive, curious, creative, and cultured*. The second group is defined by adjective labels that are closely associated with "nonconformist" thinking, including *daring, unconventional, original, independent, and liberal*. Not surprisingly, the "intellect" component of openness is more strongly correlated with IQ and years of education than is the second, or "nonconformist," component. Because firstborns tend to have higher IQs than laterborns, and because firstborns also tend to excel at academic pursuits, they are expected to express their creativity most strongly via openness in intellect. By contrast, laterborns are expected to express their creativity in ways that exemplify the nonconformist bent of their personalities. [See INTELLIGENCE.]

Much of the existing research on birth order and creativity is marred by two shortcomings. First, investigators have generally failed to distinguish sufficiently between differing types of creativity; second, researchers have not usually studied creativity in real-life terms. In their monumental review of the birth-order literature from 1940 to 1980, Cécile Ernst and Jules Angst summarized the results of 28 relevant studies. Eleven of these studies, which included such measures as the need for autonomy and the frequency of unusual word associations, showed no differences by birth order. The other 17 studies produced significant findings, but these results were largely contradictory. For example, 3 studies indicated that firstborns were more likely to prefer complex polygons (interpreted as a sign of greater creativity), whereas another 5 studies showed that laterborns preferred complex polygons. Even if these 8 studies of visual preference had yielded consistent results, it may be questioned whether a partiality for gazing at complex polygons is diagnostic of creative achievement in real life. After all, a preference for parsimony and simplicity, not complexity, lies at the heart of modern science.

Research on divergent thinking is another area where birth-order findings have tended to conflict. Inasmuch as divergent thinking correlates substantially with IQ (a firstborn trait) as well as with unconventional thinking (a laterborn trait), this construct conflates these two different forms of intellectual ability. In fields such as literature, architecture, invention, and science, studies of creative achievement are generally limited by a failure to consider the nature of the creative act. It should

come as no surprise that research in these various intellectual domains has generally yielded inconsistent results. [See DIVERGENT THINKING.]

Some of the most compelling evidence for birth-order differences in creativity comes from intellectual and social history, especially in areas where the nature of the creative act is sufficiently public to be classified by experts in terms of differing forms of openness to experience. Considerable research indicates that laterborns are more inclined than firstborns to change their views during times of radical political, social, or scientific change. This is because radical revolutions tap the nonconformist component of openness. During the Protestant Reformation, laterborns gave their lives to serve rebellion and firstborns to preserve orthodoxy. Laterborns were proportionately nine times more likely than firstborns to suffer martyrdom in support of the Reformed faith. In countries that turned Protestant, such as Henry VIII's England, firstborns were five times more likely than laterborns to become martyrs by refusing to abandon Catholicism. (These statistics are corrected for the greater number of laterborns in the population.)

The responses of scientists to radical conceptual transformations show similar differences. The Copernican revolution challenged church doctrine by asserting that the earth rotates around the sun. During the first half-century of this debate, laterborns were five times more likely than firstborns to endorse this heretical view. Nicholas Copernicus himself was the youngest of four children. George Joachim Rheticus, the young colleague whose zealous efforts finally prodded the 70-year-old Copernicus into publishing his unorthodox theory, was also a lastborn. In Darwin's own era, younger siblings were 10 times more likely than elder siblings to become evolutionists. Darwin himself was the fifth of six children, as was Alfred Russel Wallace, codiscoverer of the theory of natural selection (Figure 1).

During other notable revolutions in science, including those led by Bacon, Descartes, Newton, Lavoisier, and Einstein, laterborns have been 2 to 10 times more likely than firstborns to endorse the new point of view. This trend holds true even when the initiators of revolutions, such as Newton and Einstein, happen to be firstborns. Laterborns are more likely to endorse radical revolutions even after their scientific stance

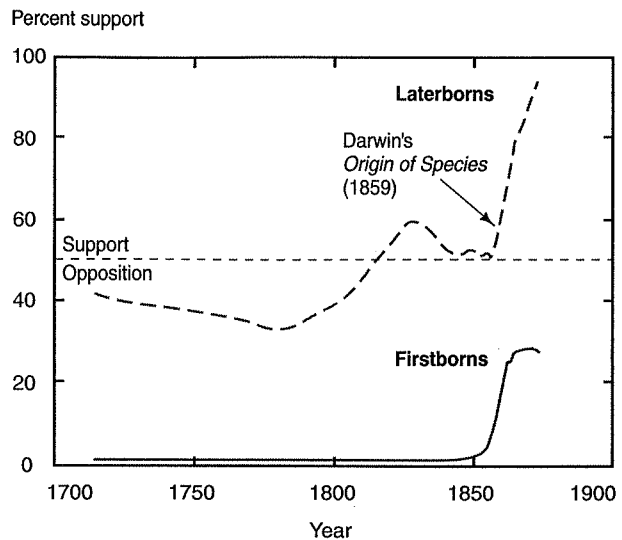


FIGURE 1 The reception of evolutionary theory from 1700 to 1875 by birth order ($N = 448$). During the long period of debate preceding publication of Darwin's *Origin of Species* (1859), individual laterborns were 9.7 times more likely than individual firstborns to endorse evolution. These group differences are corrected for the greater frequency of laterborns in the population. (From Sullo way, 1996, p. 33.)

has been controlled for social attitudes (which are themselves a good predictor of the acceptance of such events). Accordingly, birth-order effects cannot be reduced to attitudinal differences, although birth order does influence social attitudes, which in turn influence openness to radical innovations.

A. Social Desirability Effects

Birth order exerts substantially more influence on behavior during radical revolutions than it does on self-reported personality traits, including those directly related to openness to experience. Radical revolutions typically constitute struggles over who controls valuable resources. It should come as no surprise that revolutionary challenges to the status quo provide a better test of personality differences (including those associated with birth order) than do self-report questionnaire data. In the study whose results are summarized in Table I, firstborns claimed to be significantly more open to experience than their own younger siblings ($d = .16$, equivalent to a correlation of .08). But later-

borns claimed to be even more open to experience than their own older siblings ($d = .33$, equivalent to a correlation of $.16$ in the opposite direction). The significant net difference between these two correlations strongly suggests that laterborns are more open to experience than are firstborns, despite firstborns' claims to the contrary. That the judgments of firstborns were generally incorrect about this aspect of their personalities is corroborated by their responses to an open-ended question. Subjects were asked, "What would your friends consider to be the two or three most unconventional or rebellious things, if any, that you have done during your life?" In answering this question, the number of words that respondents wrote down was significantly correlated with their total score for openness to experience. Relative to firstborns, laterborns tended to produce longer responses and to list a higher proportion of truly unconventional behaviors, as assessed by independent judges.

Other findings from this study reinforce the conclusion that social desirability influences self-reported judgments about personality. For example, older respondents believed that they were just as open to experience as younger respondents ($r = .00$). Yet these same respondents claimed that their siblings and friends were significantly less open to experience with age (mean-weighted $r = -.14$). Both answers cannot be correct, and real-life evidence helps to arbitrate this issue. During radical revolutions, age is a reliable predictor of responses to change. As I have documented in a study of 121 major controversies in science and social thought, older individuals generally oppose radical changes (mean-weighted $r = -.21$, $N = 4,505$). In my questionnaire study, people appear to have correctly recognized in others what they failed to acknowledge in themselves, namely, a reduction in open-mindedness with age.

When we consider the fact that social desirability biases can produce correlational discrepancies as large as $.3$, and that most birth-order effects are about one-third this magnitude, it becomes more clear why self-report data might tend to underestimate birth-order differences. On every dimension of the Big Five, social desirability effects dwarf those associated with birth order. Unfortunately, we cannot assume that such social desirability biases cancel themselves out with the use of direct sibling comparisons, because research has

consistently shown that firstborns are more likely than laterborns to conform to social expectations. Because the degree to which self-ratings are embellished in a favorable direction is probably different for firstborns and laterborns, it is difficult to know what is the true influence of birth order for any particular personality trait. For these reasons, real-life behavior remains the best test of the magnitude of birth-order differences in personality.

Age and birth order are only two of many significant predictors of individual responses to radical change. Being socially liberal is another substantial predictor. So is parent-offspring conflict, which disrupts birth-order effects among firstborns and makes them into "honorary laterborns" in terms of openness to experience. Multivariate models that include these and other predictors of openness to radical innovation are significantly more powerful than predictions based on single variables. In general, people who are the most likely to endorse radical changes are also more likely than average to *initiate* such changes. Hence a willingness to endorse heterodox viewpoints is a necessary, but by no means a sufficient, condition for intellectual discovery.

These findings do not mean that young people, laterborns, and social liberals have a monopoly on scientific creativity or truth. For example, laterborns run the risk of accepting new and radical viewpoints too quickly, just as firstborns run the risk of resisting certain kinds of necessary changes. Laterborns were nine times more likely than firstborns to support Franz Joseph Gall's false theory of phrenology—the notion that character can be read by tracing bumps on the head. Firstborns correctly rejected this theory as pseudoscientific. (They also disdained phrenology because of its materialistic implications.)

During everyday "normal" science, firstborns have a small but consistent advantage over laterborns. They are more successful academically and are more likely to become scientists in the first place. In addition, firstborns tend to win more Nobel prizes, which are generally awarded for creative puzzle solving (openness in the sense of "intellect") rather than for revolutionary innovations (openness in the sense of "nonconformity"). Einstein revolutionized physics with his theories of special and general relativity. The Nobel Prize committee was wary of these theories and honored him instead for his discovery of the photoelectric effect.

Owing to publication of the *Origin of Species*, Charles Darwin lost a knighthood that he had previously been slated to receive. A good indicator of a radical scientific revolution is the widespread opprobrium, not the accolades, that initially befall the instigators.

When scientific innovations involve ideologically conservative implications—as occurred, for example, with vitalistic doctrines during the 17th and 18th centuries—firstborns possess an even greater intellectual advantage over laterborns than they do during “normal” science. Historically, firstborns have repeatedly championed new theories that bolstered God’s role in the Creation. Assessed jointly in terms of birth order and the ideological implications of innovations, four classes of innovation are possible, but only two have ever been documented. For example, laterborns have generally led radical revolutions, such as Copernicanism and Darwinism, that strongly challenged social and religious authority. Firstborns have generally backed innovations, such as eugenics and spiritualism, that also appealed strongly to religious and political conservatives. By contrast, there has never been an instance of a firstborn-backed radical revolution; nor has there ever been a case of a conservative revolution that was advocated by laterborns and opposed by firstborns. In sum, the relevance of birth order to scientific innovation is strongly dependent on the nature of the innovation (Figure 2). [See INNOVATION.]

V. BIRTH ORDER AND ACHIEVEMENT

Controlled for social class and sibship size, firstborns are overrepresented as scientists. Among laterborn scientists, middle children are particularly underrepresented, as they are among eminent individuals. These findings accord with the evidence that firstborns are more conscientious than laterborns, and that parents, especially under conditions of limited resources, tend to invest preferentially in firstborns and lastborns.

On closer examination, evidence from the history of science indicates that firstborns and laterborns tend to achieve eminence in dissimilar ways. Firstborns have generally excelled in the physical sciences, where intellectual problems tend to be more clearly defined than

in the life sciences. By contrast, laterborns have gravitated toward the biological and social sciences, where success often depends on knowing what the most important problems really are. The scientific achievements of laterborns have been facilitated by their tendency to pursue multiple research interests, a strategy that has been particularly fruitful within the life sciences where unsolved problems often transcend disciplinary boundaries. Charles Darwin distinguished himself in geographic exploration, geology, zoology, botany, ethology, and psychology. His knowledge of these diverse disciplines was crucial to his ability to develop his theory of evolution by natural selection. [See DARWIN, CHARLES; EMINENCE.]

Laterborns often achieve distinction in those walks of life that allow expression of their tender-minded qualities. For instance, laterborns are overrepresented among winners of the Nobel prize in literature and peace. Among participants in the abolition and Black Rights movements—who were mostly laterborns—middle children were the most likely group to employ nonviolent methods of persuasion. By contrast, firstborns and lastborns advocated militant strategies. During the French Revolution, firstborns such as Maximilien Robespierre rose to power within the National Convention by supporting the Reign of Terror. Younger siblings (particularly middleborns such as Georges Jacques Danton) opposed these extreme political measures and were ultimately responsible for the overthrow of Robespierre’s Montagnard (and largely firstborn) political party.

The relationship between birth order and creative achievement has not yet been studied with sufficient rigor for many intellectual domains, including music, art, literature, and business. When undertaking such future studies, researchers should bear in mind the differing kinds of openness to experience and their potentially distinct relationships with birth order. Studies also need to be controlled for other covariates—especially sibship size, social class, parent–offspring conflict, and social attitudes—that are required either for methodological reasons or because these variables moderate the influence of birth order. Ordinal position is only a proxy for differences in family niches (such as acting as a surrogate parent), and these proximate–causal mechanisms of personality development need to

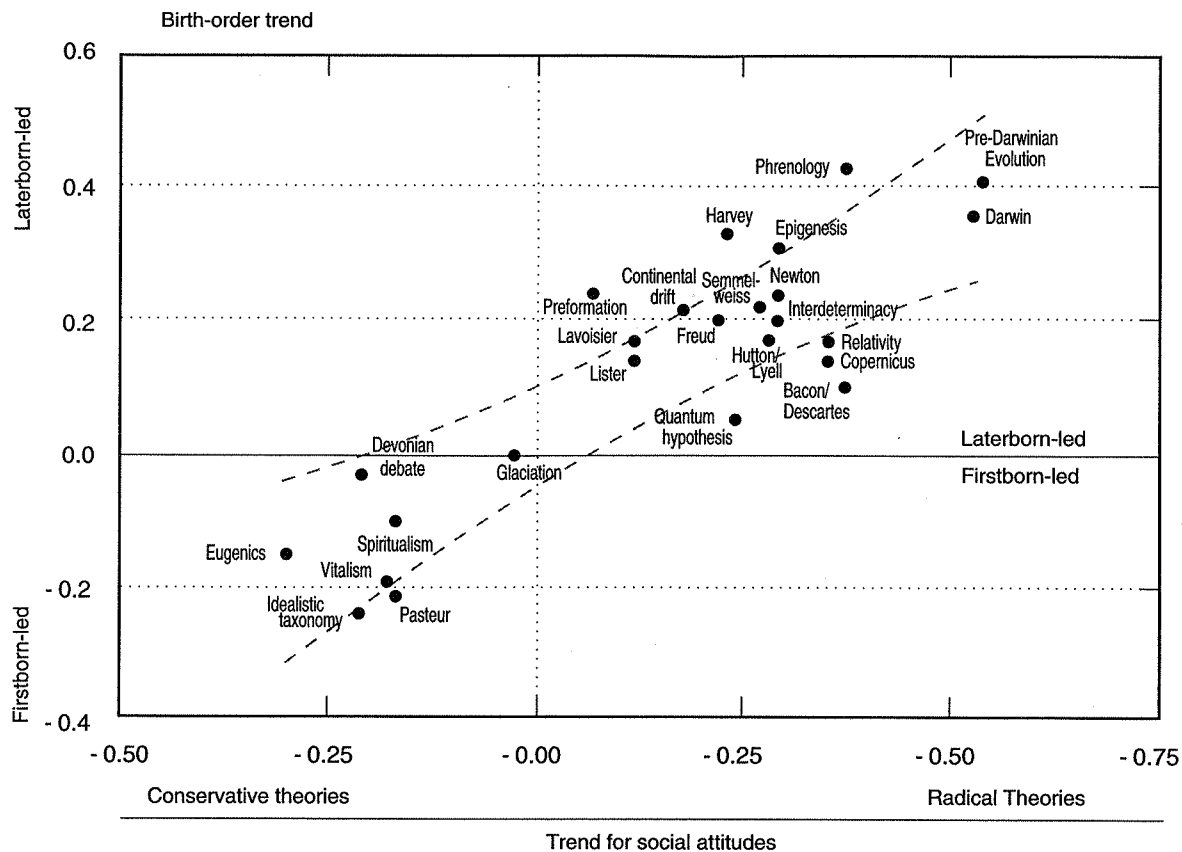


FIGURE 2 Birth-order effects in science, as they relate to the religious and political implications of 28 different innovations. The vertical axis depicts the correlation of birth order with support for scientific innovation ($N = 2,013$). All events above the horizontal line (0.0) were endorsed by laterborns and opposed by firstborns, whereas all events below the line reflect greater support by firstborns. The horizontal axis indicates the correlation of social attitudes with support for each innovation. Events to the left of the vertical line (0.00) were endorsed by social conservatives and rejected by social liberals. Events to the right of the same line reflect support by social liberals and opposition by conservatives. Determinations of social attitudes involve more than 19,000 ratings made by expert historians, who judged the religious and political attitudes of participants in these 28 debates. The dashed lines indicate the 99% confidence limits for the regression line. This analysis establishes a simple generalization: *The more socially radical the innovation, the more it was supported by laterborns and opposed by firstborns.* Missing from the history of science are two classes of potential events. There are no radical revolutions that are backed primarily by firstborns, just as there are no conservative theories that are backed primarily by laterborns. (From Sulloway, 1996, p. 332.)

be investigated in greater detail. Finally, the nature of the behavioral situation is often a powerful moderating variable. In radical revolutions, birth-order effects tend to fade over time, as new and initially controversial ideas become more widely accepted. In addition, some new ideas are more controversial than others and tend to elicit correspondingly larger birth-order effects. National differences sometimes mediate these effects.

Given their allegiance to Descartes' rival theory of celestial mechanics, French physicists—especially firstborns—manifested strong opposition to Isaac Newton's theory of universal gravitation. British scientists, including firstborns, welcomed Newton's ideas. Ultimately, the relationship between birth order and creativity needs to be approached in meta-analytic terms that include explicit roles for the nature of the innova-

tion, as well as the social and intellectual contexts in which such innovations arise.

VI. CONCLUSION

Birth order provides one important source of personality differences, which in turn underlie differences in creative achievement. Disparities in birth order cause siblings to experience the family environment in dissimilar ways. In addition, birth order introduces the need for differing strategies in dealing with sibling rivals as part of the universal quest for parental favor. This is a Darwinian story, albeit with a predominantly environmental twist. Siblings appear to be hardwired to compete for parental favor, but the particular strategies they adopt within their own family are determined by the specific niche in which they have grown up. As children become older and leave the family, they modify their behavioral strategies—both competitive and cooperative—as they adapt themselves to new life roles. The enduring imprint of childhood learning, and its manifestations in adult personality, is nevertheless discernible in those abilities that come to us most naturally and that owe themselves to prior niche partitioning within the family. Through its context-sensitive relationship with birth order, creative achievement represents a case in point. Evidence from intellectual and social history highlights the conclusion that firstborns and laterborns do not differ in overall levels of creativity. Rather, brothers and sisters are preadapted to solving disparate kinds of problems, which they generally tackle using differing kinds of creative strategies.

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