

The Effects of Birth Order on Indicators of Academic Success Among High School Students of Multiple Ethnicities

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Summary:

In many cultures and for many centuries, the implications of birth order have been examined. Birth order has been shown to affect personality, accomplishments, and even career choice. This study investigated the impact of birth order and ethnicity on two measures of academic success in high school: a student's grade point average (GPA) and the number of Advanced Placement (AP) classes he or she took. Based on previous studies, we hypothesized that birth order would have an effect on GPA and the number of AP classes taken. We also hypothesized that ethnicity would not affect this relationship. Survey results from 162 eleventh and twelfth grade students were analyzed by ANCOVA. Despite some prior research to the contrary, we found that birth order had no statistically significant effect on GPA or the number of AP classes taken. Although ethnicity affected GPA, there was no interaction between ethnicity and birth order effects, supporting our hypothesis that these particular birth order effects are not dependent upon ethnicity.

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Introduction

The implications of ordinal position, or birth order, have long been examined (1, 2, 3, 4, 5). As early as Biblical times, birth order implications can be seen. In the fourth chapter of Genesis, the term "firstborn" appears, displaying that the Israelites characterized the firstborn son by distinguishing him with special rights based on his high ordinal position (2). Sir Francis Galton began conducting studies on birth order in 1874, when he found more firstborn sons than lower order sons in prominent work positions (3, 4, 5). Galton attributed the result to chance, but multiple studies through the years have confirmed that birth order correlates with certain personality attributes and accomplishments (2,3,5,6,7,8,9).

While many studies related to birth order have been conducted on an international scale (1,5,6,7,8,9,10), relatively few have compared birth order effects across

ethnic groups. When asked about the importance of race in birth order, Frank Sulloway answered that race and gender affect social aspects, but are not as important as birth order in determining family dynamics and rebelliousness (11, 12). Kantarevic and Mechoulan related income and educational attainment to birth order (7). Their study found that firstborns had greater incomes. They examined this result with respect to ethnicity and found that the results were significant for large African American families and White families of all sizes. Kantarevic and Mechoulan cited other studies in other countries that supported this finding (7).

Black et al in Norway found similar results (1). Black et al correlated family size and birth order with the degree of education received (1). They found a negative correlation between family size and the children's education, meaning that the larger the family, the less educational opportunities the children in that family had. In larger families, children higher in birth order were more likely to receive more education (1).

A more difficult question to address is the fundamental relationship between birth order and intelligence. Kristensen and Bjerkedal found declining intelligence scores with a lower ordinal position (3). They reported that firstborns have a three-point advantage in IQ over the next eldest (13). The study suggested that the tutoring effect accounts for the difference. Not only do older siblings have more educational opportunities, they might also act as teachers for younger siblings. To teach material, the elder sibling must possess a greater understanding of that material. Younger siblings question their older sibling in the same manner they question their parents, and in teaching and rehearsing, the older siblings learn. Last-born children and only children lack the opportunity to learn by teaching (3,9).

Hester et al (6) also addressed the relationship between ordinal position and academic achievement by examining student and parent expectations. They studied college students to compare their perceptions of expected GPA to the parents' actual expectations. They found that the number of sibling cohabitants has a significant correlation with GPA expectations, and that GPA expectations were higher in homes with three or more siblings than in families with two children or one child (6). If children believe they must receive a higher GPA to please their parents, they might become better students. Likewise, as suggested by Sulloway, younger

siblings might rebel against the expectations, not reaching their full scholarly potential (11, 12).

Because birth order is such a widely studied topic, some inconsistencies are present in research results. Longitudinal studies of individual families have discovered varied results, contradicting cross-sectional studies across multiple families. Rodgers examined three theories about birth order: Page and Grandon's 1979 admixture hypothesis, Dowey's 2001 dilution theory, and Zajonc's 1976 confluence model (4). Rodgers suggested that because of the variance in results, nothing significant could be taken from birth order's effect on intellect until further research was conducted. He acknowledged that genes, discipline (as it changes with age), and even hunger and social life change family dynamics (4). Rodgers discounted the effects of birth order even though his own longitudinal study found that family size affects IQ (a trend supported by the admixture hypothesis, the dilution theory, and the confluence model). Rodgers attributed this contradiction to the idea that parents with lower IQ levels tend to have larger families (4).

Zajonc offered a different perspective on the debate (9). Though his results were similar to Rodgers', cross-sectional studies showed that birth order affected intellect while there was no effect found in longitudinal studies. He examined his own confluence model in explaining the variance. The confluence model suggests that results differ because family dynamics change as time changes, most significantly with the birth of another child, but also as children grow physically and intellectually. Zajonc used this model to explain the results based on his studies of children at various ages. He found that before the age of 11 (plus or minus two years), the results were random but after age 11, birth order affects intellect (9).

While Zajonc acknowledged the benefit of longitudinal studies, he also noted that cross-sectional studies have purpose and are good for establishing new trends (9). For the purpose of our study, a cross-sectional method was beneficial because ethnicity was compared to the effect of birth order and the larger sample size available in a cross-sectional model enabled more comparisons. The debate only gave more cause for this research.

To our knowledge, no study has examined the effect of birth order on a high school student's GPA and then related it to ethnicity. Other studies, including the landmark Norwegian study (3), examined IQ rates, but IQ is based on one test on one day, while GPA is accumulated by years of choosing classes, completing homework and studying those classes, and taking multiple tests specific to the subject of the class. While Hester et al used GPA in their birth order study, they had

tested different variables (6). Instead of testing parents' GPA expectations compared to the actual GPA of the college student, our study looked at the actual data in relation to ethnicity. Many studies have been performed in many different nations with many different ethnicities of subjects. Though studies have attributed race and controlled for ethnicity, no study examined ethnicity as a factor of interaction.

This investigation examined GPA and the number of AP classes taken in a large, diverse public high school. While these two measures are not comprehensive indicators of academic achievement, the combination of GPA (which has been studied before [5] in relation to ordinal position) and enrollment in AP classes represents an outcome partially dependent on motivation, desire to please, and responsibility. These qualities have been theorized to vary depending on birth order. They also might be more indicative of potential personality differences than other potential indicators of academic success such as ACT or SAT scores, which represent a single day's measure. Furthermore, ethnic bias has been shown to exist in standardized test scores such as the ACT and the SAT (14, 15,16), which would confound this analysis.

We tested the hypothesis that birth order will have an effect on measures of academic achievement in high school students. In particular, we hypothesized that students with higher ordinal positions would have higher grade point averages and take more AP classes than children with lower ordinal positions. Furthermore, we hypothesized that, in this setting, birth order effects would be consistent across ethnic groups. We predicted these birth order-specific results based upon past studies on IQ, the greater educational opportunities available to firstborn children (even in a public school), economic status, the tutoring effect, and a higher expectation to succeed. The ethnicity-related hypothesis was based upon the many birth order studies performed internationally. Furthermore, we reviewed studies that investigated ethnicity, birth order, and personality, although no studies specifically considered these factors alongside academic success.

Results

We distributed surveys (Appendix A) regarding birth order, family demographics, ethnicity, GPA, and the number of AP classes taken to students at a large public high school in an Atlanta suburb. The research protocol was examined by the school's review board for research involving human subjects, and students were aware that by taking the survey they were participating in a research project. A total of 294 surveys were distributed to students in grades 11 and 12. The distribution of ethnic groups across the school's student population

Descriptive Statistics					
Ethnicity	Birth Order Category	Mean	Std. Deviation	N	
GPA	African American	Between	3.1400	.36640	5
		Firstborn	3.0963	.77596	8
		Only child	3.1540	.72060	10
		Youngest child	3.3333	.34448	6
		Total	3.1728	.60442	29
	Other	Between	3.7103	.42211	11
		Firstborn	3.5270	.52426	14
		Only child	3.6125	.80868	4
		Youngest child	3.8071	.43606	7
		Total	3.6470	.50391	36
	White	Between	3.2600	.56080	11
		Firstborn	3.5604	.52319	34
		Only child	3.0875	.73180	8
		Youngest child	3.3531	.37732	13
		Total	3.4122	.54808	66
	Total	Between	3.4212	.52125	27
		Firstborn	3.4857	.57600	56
		Only child	3.2132	.72975	22
		Youngest child	3.4708	.42559	26
		Total	3.4237	.57023	131
AP	African American	Between	3.40	3.130	5
		Firstborn	1.63	2.446	8
		Only child	1.30	2.163	10
		Youngest child	2.00	2.898	6
		Total	1.90	2.540	29
	Other	Between	3.45	3.387	11
		Firstborn	4.86	4.400	14
		Only child	1.50	2.380	4
		Youngest child	3.00	3.266	7
		Total	3.69	3.740	36
	White	Between	1.18	2.272	11
		Firstborn	4.06	4.369	34
		Only child	2.00	3.505	8
		Youngest child	.69	1.109	13
		Total	2.67	3.776	66
	Total	Between	2.52	3.030	27
		Firstborn	3.91	4.218	56
		Only child	1.59	2.649	22
		Youngest child	1.62	2.418	26
		Total	2.78	3.563	131

Table 1: Descriptive Statistics with Respect to Birth Order and Ethnicity for GPA: Means and standard deviations of GPA and the number of AP Classes taken, and the number of respondents. Results are grouped by birth order and by collapsed ethnicity. Included in the Other category are an American Indian, Alaska Natives, Asians, Native Hawaiian/Pacific Islander, Hispanic Latinos, and people of mixed ethnicities.

at the time of the survey was 5% Asian, 36% African American, 13% Hispanic, and 46% White. Thirty-nine percent of the students qualify for “free or reduced price lunch” (a measure of the poverty level) (17).

One hundred sixty-two usable surveys were returned, giving a response rate of 55.1%. Twenty-three surveys could not be used for various reasons: the GPA was not filled in; there was more than a 10-year age gap between half-siblings and step-siblings (results like this were not included because such age ranges suggest that the siblings did not live together and therefore would not

be applicable to the study; for example the largest age range between siblings was 42 years); the participants explicitly indicated that they did not live with all of their siblings; both parents of the participants were deceased; the participant reported more than 3 ethnicities; the participant was a twin; or they did not complete the survey. Thirty-one respondents indicated that they had divorced parents, single parents, half/step siblings, or same-gender parents. These results were included in the study.

The usable results included 24 only children,

70 firstborns, 33 middle-born children, and 35 lastborns. Specifically, useable surveys were received from 24 only children, 70 firstborns, 48 second-born children, 15 third-born children, and 5 who were fourth in the birth order. The results included 1 American Indian, 10 Asians, 40 African Americans, 4 Native Hawaiians/Pacific islanders, 76 Whites, and 20 Hispanic/Latinos. Eleven people indicated mixed ethnicities. The average GPA was 3.375 ± 0.566 and the average number of AP classes taken was 2.78 ± 3.56 (Table 1).

Because some ethnic minorities were very small, an analysis was conducted with three collapsed ethnic categories: African American (N=40), White (N=76), and Other (N=46). Similarly, birth order was categorized. When attempting to describe and analyze birth order, for example, a “third-born” child could be the youngest child in the family or somewhere in the middle. Consequently, birth order was compared to the total number of children in the family to identify placement into four levels: FIRST (first born among siblings, N=70), BETWEEN (neither firstborn nor youngest, N=32), YOUNGEST (last born among siblings, N=36), and ONLY (no siblings, N=24).

In these modified categories, mean GPA varied between 3.088 (White Only Children) and 3.781 (Other Youngest Children) (Table 1). Analysis of covariance for GPA with these collapsed categories showed significance for ethnicity ($p=0.004$) but not for birth order ($p=0.841$). Covariates of age and gender, factors that were not controlled in the study but could have affected the outcome, were not significant ($p=0.738$ and 0.327 , respectively). Interaction between ethnicity and birth order was not significant ($p=0.626$). Plots of estimated marginal means, in which any effect of the covariates is removed, show non-significant differences in GPA due to birth order (Figure 1a) and significant differences due to ethnicity (Figure 1b). Two particularly low GPAs may have had an effect on the outcomes for firstborn and youngest children. We removed the outliers, but the difference was still not statistically significant ($p = 0.529$) (Figure 2).

Using the same categories, the analysis was repeated with number of AP classes as the dependent variable. In this analysis, birth order had a stronger effect ($p=0.067$) than ethnicity ($p=0.339$), though neither was significant. In a subsequent analysis of the number of AP classes taken between firstborns and younger children (with Only children excluded), the effect was significant ($p=0.003$); firstborns took more AP classes than students of lower ordinal position. There was a significant relationship between age and the number of AP classes taken. Plots of estimated marginal means again reveal differences between ethnicities and birth order categories, with the “other” category taking more AP classes than African Americans and Whitesm

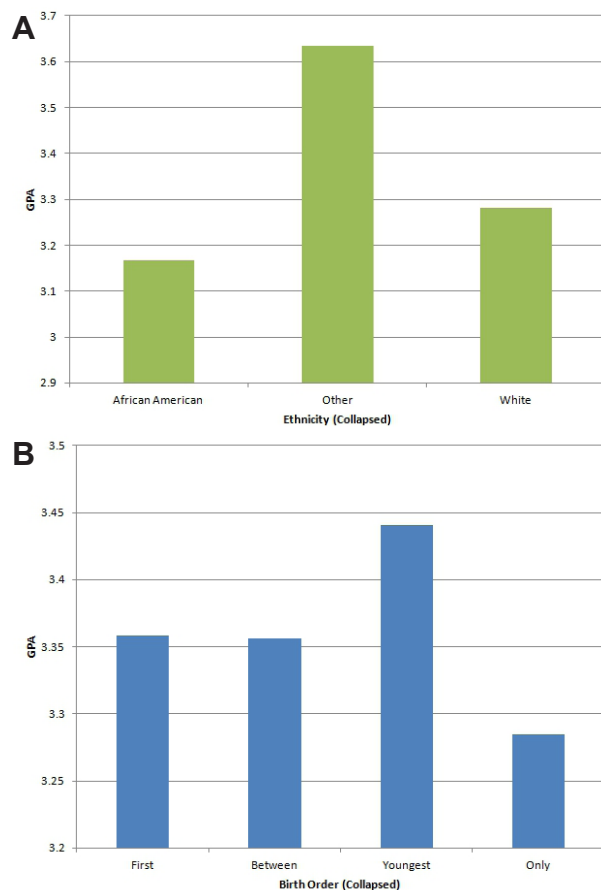


Figure 1: The Effects of Birth Order (1a) and Ethnicity (1b) on GPA: Estimated marginal means for Grade Point Average for each collapsed birth order category and ethnic category. Birth order did not have a statistically significant effect on GPA ($p=0.841$). Ethnicity differences were statistically significant in an ANCOVA that included Gender and Age as covariates ($p=0.004$). Included in the Other category are an American Indian, Alaska Natives, Asians, Native Hawaiian/Pacific Islander, Hispanic Latinos, and people of mixed ethnicities.

(Figures 3a and 3b).

Standard deviations were larger for the number of AP courses taken (Table 1) than they were for GPA, indicating more variability (Figure 4).

Discussion

The results indicate that birth order appears to have different effects on different indicators of high school achievement. While firstborn children consistently reported the highest number of AP classes taken, they did not demonstrate the highest grade point averages. The hypothesis regarding ethnicity was supported. Though there was a significant effect of ethnic category on GPA, there was not a significant interaction between birth order and ethnicity in the ANCOVA. The null hypothesis was supported as birth order did not affect GPA or the number of AP classes taken and the hypothesis that

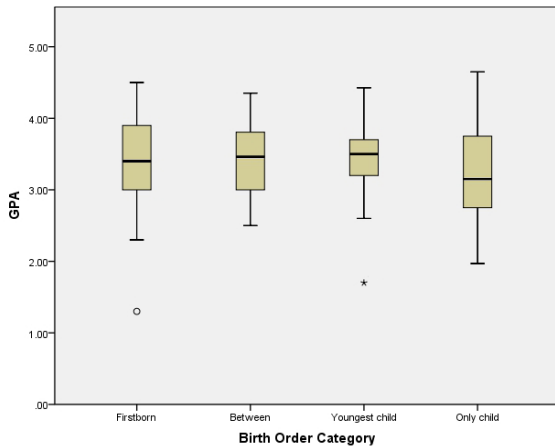


Figure 2: Box and Whisker Plot of GPA and Birth Order: Medians, quartiles, and ranges for GPA in the collapsed divisions of birth order. Displays two outliers who reported unusually low GPAs and could have brought the average down for youngest and firstborn children. When these outliers were removed, birth order was still not significant ($p = 0.529$) in an ANCOVA that included gender and age as covariates.

ethnicity would not affect these trends was supported. In general, these results suggest that current theories on birth order may not be accurate for GPA; the debate on the significance of birth order continues.

Statistically significant results were found in the relationship between ethnicity and GPA and in the relationship between age and number of AP classes. Age affects the number of AP classes taken because older participants had more opportunities to take AP classes, making their number of classes taken much higher. The two ethnicities with the highest mean GPAs (Asian, Hispanic) were in the Other category, potentially explaining the effect ethnicity had on GPA (Figure 5).

Though trends relating to birth order were not statistically significant, certain trends supported other studies. Youngest children displayed a higher mean GPA but firstborn children took more AP classes. The latter result was significant when firstborns were compared to younger children, removing only children from the analysis. This can be explained by the desire of firstborns to please and meet parent expectation levels. Baskett found that firstborns were characterized as achievement-oriented, antagonistic, anxious, assertive, conforming, extraverted, fearful, jealous, organized, plan-oriented, responsible, self-confident, and leaders (12). Furthermore, an older sibling might take an AP class offered by the school that is more difficult than other AP classes, and then suggest that their younger sibling should not take the class since receiving a higher grade is more challenging, thus affecting GPA. Our study did not compare to the findings of others with respect to only children.

Relating more to ethnicity, a reason for the trends

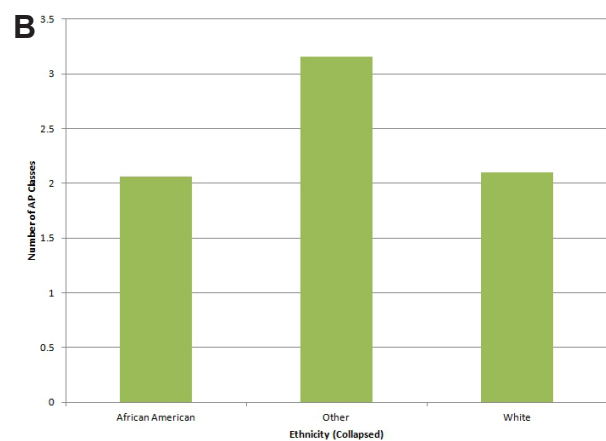
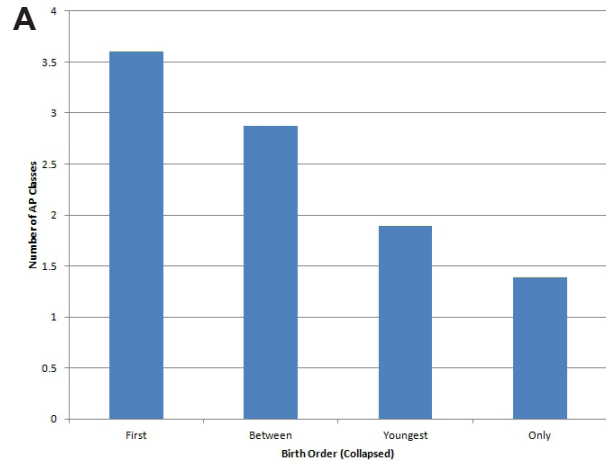


Figure 3: The Effect of Birth Order (3a) and Ethnicity (3b) on AP Class Record: Estimated marginal means (accounting for uncontrolled variability in gender and age) for the number of Advanced Placement classes taken for each collapsed birth order category and collapsed ethnic category. Birth order did not have a statistically significant effect on the number of AP classes taken overall ($p=0.067$), but when firstborns were directly compared to younger children, firstborns were shown to have taken significantly more AP classes ($p=0.003$). There was no statistically significant difference in the ethnicities ($p=0.339$). Included in the Other category are an American Indian, Alaska Natives, Asians, Native Hawaiian/Pacific Islander, Hispanic Latinos, and people of mixed ethnicities.

could be explained by Herrera et al (2) in their analysis of ethnicity in the perception of intelligence. Acknowledging ethnicity, they used African American or Hispanic college students who were young, childless, and unmarried as these parameters best let the study maintain and display ethnic diversity. Specifically related to birth order and intelligence, firstborn children were believed to be the most intelligent. However, they confirmed a perceived difference in intelligence and creativity as lastborn children were believed to be the most creative and firstborns were the least creative in the majority of perspectives. Furthermore, firstborns were described as obedient, stable, responsible, and the least emotional.

GPA is built up of more than just intelligence (11). Stable and responsible characteristics (even if just perceived, there must exist some basis for a perception to be made) induce diligence, improving GPA. These results were true in people who were believed to best represent their ethnic group (2). High school students may be more representative of their ethnic group because they live at home and are influenced by their family, but our study found no interaction between ethnicity and the birth order effects. At the age of 16 and 17 students begin listening more to friends as they begin making decisions about college. This could be one reason for the lack of significance. Another reason could be that the students all attend the same school and for the most part, have a similar education that is not dependent on their ethnicity.

One reason for the lack of statistical significance could be that there exist so many confounding variables that were difficult to control. Dysfunctional families do not always produce children with birth order characteristics that resemble other families. While dysfunctional families have been studied (Kristensen and Bjerkedal's study of 400 abused children and their 795 siblings revealed certain correlations among the abused), variables exist in studies not focused on dysfunction. Variables include the addition of siblings through remarriage or adoption; the death of a sibling or parent; the age of the mother in relation to the age of the child; the birth order of the parents; the mental, physical, and emotional abilities of siblings; and even the gender of the siblings (although as gender opportunities equalize, further differences in ordinal position due to gender shrink). It is possible that differences in socioeconomic standing between ethnic groups could influence variation in indicators of academic achievement; this potential confounder was not controlled for in the study.

The official records of the school are not accessible by students. Thus, GPA was self-reported anonymously through our survey. Although participants were not directly told the objective of the study, they still might have lied about their GPA, possibly influencing the study. Another limitation was the quasi-random method used. Every person in the 11th and 12th grade did not have an equal chance of being selected because students are grouped into their homeroom class alphabetically.

The controversy of the birth order effect continues, begging for more research to be completed to answer very basic questions. Perception is an important aspect in character traits; therefore a study focusing on the perception of traits correlated with birth order would be interesting. In the future, we could focus the study on the question "Which sibling, including yourself, do you think is the smartest?" to see if the general population believes that birth order affects their lives.

In conclusion, this study found that birth order

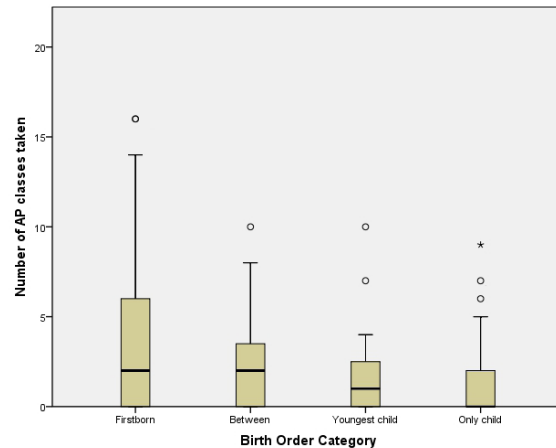


Figure 4: Box and Whisker Plot of Birth Order and Number of AP Classes Taken: Medians, quartiles, ranges, and outliers for GPA in the collapsed divisions of birth order compared to the number of AP classes taken. This graph is helpful in displaying the large ranges of responses. It also demonstrates that 25% of each birth order and 50% of only children took zero AP classes.

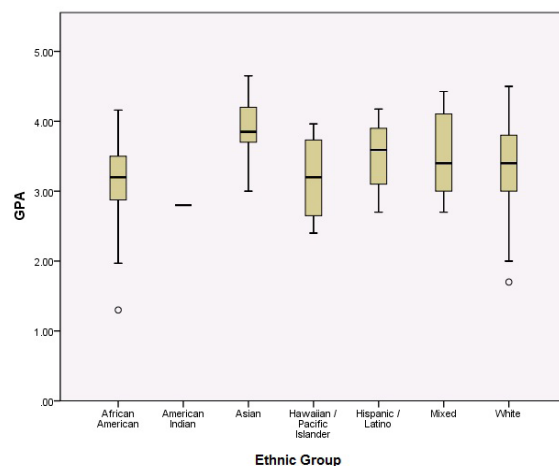


Figure 5: Box and Whisker Plot of Ethnicity and GPA: Medians, quartiles, and ranges for GPA in the original (non-collapsed) divisions of ethnicity. This graph is helpful in highlighting the statistically significantly higher GPA of the Asians surveyed. It also demonstrates that only one American Indian responded, giving cause for the ethnicities to be collapsed.

played no statistically significant effect on the number of AP classes a student took or the GPA of the high school student. The effect was consistent across ethnic groups, supporting our hypothesis. So while this study adds to the debate on the simple question of birth order, it also hints at new trends.

Methods

To test our hypothesis, we created a survey (Appendix A). We did not include samples indicating mixed marriages, deceased siblings, or families with twins in the analysis. (This decision was based on previous studies (9, 13, 18) that determined that different

family structure abnormalities nullified birth order's effects). The survey did not directly ask for birth order to avoid any potential preconceived bias. Instead, the survey asked for respondents' and siblings' ages.

We distributed 294 surveys to homerooms in North Cobb High School in a quasi-random manner by selecting every fourth homeroom. Homerooms are divided alphabetically by students' last names. We only selected 11th and 12th grade homerooms because upperclassmen's GPAs are more reflective of their entire educational experience. Enrollment in Advanced Placement classes is not limited to any particular student group at this high school. The school offers a wide variety of AP subjects, and typically provides more than 18 AP classes each year.

We analyzed the results by performing two ANCOVAs, or analyses of covariance with more than one factor (SPSS, version 18). GPA and the number of AP classes taken were initially analyzed to determine the presence of outliers. We included a test of interaction to find ethnicity's relationship with birth order. The analyses of covariance main effects were birth order and ethnicity. Covariates (uncontrolled factors that could possibly affect the outcome) were gender and age. Estimated marginal means were reported to account for any potential effect of the covariates. Two ANCOVAs were performed for the number of AP classes taken and for the GPA. Alpha levels for significance were set to 0.05.

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Appendix A

Survey: This survey was used to obtain the grade point averages and number of sibling cohabitants that the students had.

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