Prenatal Alcohol Exposure and Ability, Academic Achievement, and School Functioning in Adolescence: A Longitudinal Follow-Up

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Background Prenatal alcohol exposure is associated with learning, behavioral, and academic problems even in children without the fetal alcohol syndrome (FAS). Objective To examine the prenatal alcohol exposure and ability, academic achievement, and school functioning in adolescence. Methods In a longitudinal cohort, intelligence, academic performance, and school functioning were evaluated in 265 low socioeconomic status (SES) adolescents (M age = 15.1 years), 128 prenatally exposed to alcohol, 53 controls, and 84 special education students by using the Wechsler Intelligence Scale for Children, 3rd edition (WISC-III) and the Wechsler Individual Achievement Test (WIAT). School records were abstracted for grade point averages (GPA), standardized achievement test scores, conduct, attendance, and special education placement. Results Alcohol-affected youth had significantly lower IQs than those in the other three groups. Conclusion Although academic achievement (WIAT scores) was most impaired in the special education group who showed lower performance over all as well as in reading and spelling, alcohol-affected youth showed significant deficits on mathematics subtests. There was no increased incidence of conduct problems in school records related to alcohol exposure.

Key words academic functioning; fetal alcohol syndrome.

Prenatal exposure to alcohol is associated with fetal alcohol syndrome (FAS) as well as other alcohol-related neurodevelopmental disorders (ARND) that are expressed as developmental disabilities, behavior, and learning problems (Stratton, Howe, & Battaglia, 1996). Research on the educational implications of FAS and related conditions has been limited, so that practical information regarding academic functioning in this group is hard to provide, although educational issues are usually central to the concerns that bring families for diagnosis and treatment of developmental issues (Kleinfeld, Morse, & Wescott, 2000). The practical importance of this issue is suggested by Streissguth, Barr, Kogan, and Bookstein’s (1996) survey of 441 clients that reported that 60% of clinically referred patients 12 years old or older had disrupted school experiences. These authors defined “disrupted school experience” as being suspended, expelled, or having dropped out of school. These authors found a correlation between academic problems and disruptions in school experience. While in school, individuals with FAS or fetal alcohol effects were reported to have a range of learning problems, as well as attention problems, which were identified in 70% of those described. Half of the adolescents surveyed had failed a grade and most was described as having social problems with peers and being disruptive in class. Approximately 40% had received special education services of some kind, although this may have included infant early intervention and preschool.

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HeadStart programs as well as placement while of school age. While in school, 65% were reported to have received some kind of remedial help in reading and mathematics. A smaller percentage had received vocational or adaptive training or occupational or physical therapy.

These data indicate that academic and school problems are common among patients with FAS. However, the relationship between prenatal exposure to alcohol and such problems in nonclinic samples has been less well explored. Those studies that have been done suggest that there is a small but significant effect of prenatal exposure on academic performance and that this may be more evident in math than in other areas. In a group of preschool children selected prenatally based on maternal drinking patterns, Coles et al. (1991) reported that deficits in premath and reading skills were associated with exposure to alcohol during pregnancy. Streissguth, Barr, and Sampson (1990), reporting on a prospective cohort of middle-class children at 7 years, found that binge drinking (reporting more than five drinks/occasion) before pregnancy recognition was related to learning deficits in arithmetic and reading. Among those children whose mothers reported such drinking, more functional problems at school (i.e., being in special education programs) were also reported by teachers. In an exposure cohort of 6-year olds, Goldschmidt, Richardson, Stoffer, Geva, and Day (1996) found that the relationship between alcohol use in the second trimester of pregnancy and arithmetic scores even when intelligence level (IQ) was controlled. In contrast, spelling and reading scores were affected only when women used more than one drink per day and effects were not significant when IQ was controlled. Olson, Sampson, Barr, Streissguth, and Bookstein (1992) reexamined the Seattle longitudinal sample and found that preadolescents whose mothers reported binge drinking had an increased incidence of school problems. Similar problems were reported in this cohort when they were reassessed at 14 years (Olson et al., 1997). The authors of all these articles noted that, although significant, effect sizes are small and that other environmental factors should also be taken into account in understanding academic functioning.

To explore this issue more fully, this study examines ability, academic achievement, and school functioning in a sample of alcohol-exposed and alcohol-affected youth first identified prenatally based on maternal drinking. This age group was chosen because academic problems may be particularly acute during adolescence. At this time, when intellectual, academic, and executive functioning skill demands grow, there are fewer social and institutional supports. Adolescents who fail to meet social standards for achievement during this period may have limited vocational opportunities later and they may exhibit more conduct and social problems in the school setting.

In this study, alcohol-exposed individuals are compared with a nonexposed control group, also identified prenatally, and a contrast group receiving special education services. The goal of the study was the examination of the relationship between prenatal exposure, with and without the physical effects of such exposure, and factors associated with school achievement including intellectual ability (i.e., IQ), academic achievement in verbal and mathematics measured by individually administered achievement tests, adaptive ability, and functioning at school as measured by grade point averages (GPA), special education placement, days absent, number of suspensions, and conduct grades. It was hypothesized that those affected by prenatal exposure would show decreased intellectual abilities, have specific learning deficiencies in math with a relative sparing of language and verbally based skills, and would have a greater number of academic and school problems than those in the control group. Because the literature suggested that those exposed to alcohol who do not show the full FAS syndrome are at higher risk for social and behavioral problems than those who are diagnosed with FAS (Streissguth et al., 1996), these individuals are considered separately in this study. Finally, because many of the school problems associated with FAS are similar to those seen in other individuals with developmental disabilities, a contrast group was selected from special education programs in the school systems attended by the longitudinal study sample to evaluate the extent to which these groups would show the same characteristics and patterns of learning deficits.

Methods
Participants

Participants were 265 adolescents with a mean age of 15 years and 1 month (SD = 0.92). One hundred and eighty-one were born to mothers first recruited between 1980 and 1985 from a prenatal clinic in Atlanta, Georgia serving a predominantly African-American, low socioeconomic status (SES) population (as defined by income and educational level) and were followed longitudinally. As part of a study of the effects of prenatal alcohol exposure (Smith, Lancaster, Moss-Wells, Coles & Falek, 1987), women were recruited prenatally if they reported drinking at least two drinks per week during pregnancy; however, most drinkers in this sample were heavier users (see Table 1).
Nondrinkers were also recruited as a SES contrast group. At the time of recruitment, women provided information about alcohol and drug use. Outcomes of this study have been reported previously (e.g., Coles, Smith, Fernhoff, & Falek, 1985). For this study, caregivers and adolescents in three categories were recruited from the longitudinal cohort. These were (a) exposed/dysmorphic (DYSM; \( n = 46 \)), including alcohol-exposed adolescents who, previous to this follow-up assessment, showed physical effects of this exposure (e.g., growth retardation and dysmorphic features) based on a physical examination by using a dysmorphia checklist (Coles et al., 1985); (b) alcohol exposed but not dysmorphic (ETOH; \( n = 82 \)); (c) control (\( n = 53 \)), adolescents who were not exposed to alcohol prenatally. In addition, to control for the effects of disability status on behavior and academic functioning, 84 adolescents were recruited as a contrast group from special education programs in three urban school districts in the Atlanta Metropolitan area (special education).

There were two methods of subject selection. Children in the longitudinal cohort who were between 13 and 17 years were identified and their mothers or other caregivers recontacted, if possible. The study was explained and those families who agreed to participate and signed a consent form approved by the University’s Human Investigations Committee were brought to the Child Development Laboratory for assessment. Adolescents indicated assent to the procedures by signing a similar form.

The Special Education Cohort was recruited at the time of the follow-up study. To identify a sample, cooperation was obtained from three local school systems serving populations that included those with the ethnic and SES characteristics of the longitudinal cohort. To protect student confidentiality, school systems mailed information about the study to parents of students in special education programs and those who were interested in participating returned consent-to-contact forms to the investigators. Those who volunteered and met the study criteria were eligible to participate. The study criteria included child’s age, sociodemographic variables (e.g., ethnic group, zip code), and disability status (e.g., individuals who had significantly impaired physical mobility, hearing, or vision disabilities, or an IQ < 50 were excluded). These criteria were intended to match characteristics of the contrast group to those in the longitudinal sample.

**Measures**

**Ability**

Adolescents’ cognitive ability was evaluated by using the Wechsler Intelligence Scale for Children, 3rd edition (WISC-III; Wechsler, 1991). This widely used measure of intelligence is composed of 11 subtests that can be used to obtain standard scores, including: Full Scale IQ (FSIQ), Verbal IQ (VIQ), Performance IQ (PIQ), Verbal Comprehension (VC), Perceptual Organization (PO), Freedom from Distractability (FD) and Processing Speed (PS). All of these summary scores have a mean of 100 and a standard deviation of 15. Subtest scores have a mean of 10 and a standard deviation of 3.

**Academic Achievement**

Adolescents’ academic achievement was measured in several ways. The Wechsler Individual Achievement Test (WIAT; Wechsler, 1992), an individually administered achievement test that has five subject areas: basic reading, spelling, mathematics, math reasoning, and numerical operations were administered and a summary score, called a screener, obtained by summing the reading.
spelling, and mathematics subtests to produce an estimate of overall achievement. In addition, academic achievement in the school setting was measured by obtaining the results of the group achievement tests that were administered by school systems [usually the Iowa Tests of Basic Skills (ITBS); Hoover, Hieronymus, Frisbie, & Dunbar, 1996] and by computing each adolescent’s GPA for the current and previous school years.

Adaptive Behavior
Previous reports (e.g., Thomas, Kelly, Mattson, & Riley, 1998) have suggested that clinically referred alcohol-affected children are significantly impaired in their adaptive behavior skills even relative to their intellectual potential. For this reason, adaptive behavior was measured by using the Vineland Adaptive Behavior Scales (VABS; Sparrow, Bella, & Cicchetti, 1984) with the adolescent’s caregiver as the respondent. This scale is a measure of the individual’s practical coping skills, in contrast to academic skills, and a measure of this type is always included in making an assessment of disability status. The scale includes three domain scores, communication, daily living skills, and socialization, which are summed into an adaptive behavior composite (ABC). All scores have a mean of 100 and a standard deviation of 15.

Special Education Status
Information about the child’s educational placement was obtained from caregivers and from school records. Children were categorized as being placed in special education (a) currently, (b) in the past, or (c) never. If they were classified as meeting the criteria for special education, the category under which they qualified was noted based on school records. These categories are shown in Table VII. Placement in categories is regulated by state and federal law as well as local interpretation of educational regulations.

Conduct and Attendance
Academic performance is affected by children’s attendance and their conduct while at school. Children experiencing behavior and social problems often show poor attendance or may be expelled or suspended. Individuals with FAS who were identified in clinical settings have been reported to show a high incidence of disrupted school experience, including suspensions (Streissguth et al., 1996). For these reasons, we collected information about children’s school attendance in the current and previous school year and noted any conduct problems in the records.

Medical Examination
During the laboratory visit, adolescents were weighed and measured during a medical examination carried out by the project nurse. At this time, they were screened for visual acuity by using the Snellin eye examination. In addition, information about historic vision and hearing problems was obtained. All children were given a physical examination that included an examination of physical dysmorphia associated with prenatal alcohol exposure (Coles et al., 1985). Based on this examination, a dysmorphia score was obtained. This is a weighted summary of physical signs of alcohol exposure, with higher scores suggesting more such effects.

Caregiver Status
Information about caregivers’ current alcohol and drug use was collected from all four groups by using the Addiction Severity Index (McClelland et al., 1985), urine screens by using the enzyme-multiplied immunoassay technique (EMIT) and the γ-glutamyl traspepsidase (GGTP) blood test, which measures liver function and is a sensitive measure of the current and cumulative effects of alcohol use (Wallach, 1987). Birth statistics and information about exposure during pregnancy were abstracted from archival materials. This information was not available for those in the special education group, although the adolescent dysmorphia scores and standard deviations within this group were not significantly different from those of the control group (see Table III).

Procedure
Assessment of Ability and Achievement
Each family was seen during a single day. Ability and academic testing were done as part of a more comprehensive assessment battery that took about 5 hours to complete, with a break for lunch. All assessments were conducted by doctoral level graduate students or postdoctoral fellows who were blind to students’ history and study status. Caregivers were interviewed by outreach staff.

School Records
Parents or guardians gave permission to release individual school records. A letter including a copy of the signed consent forms was mailed to the principal of each school attended by a research participant. This mailing was followed up with phone calls to arrange to obtain the records. In some cases, copies of records were sent directly to the project, but in others, research assistants visited the schools to pick up records. Information was abstracted from the records in these areas: (a) current enrollment, (b) results of standardized group-administered achievement tests (reading and math), (c) attendance, (d) conduct problems, and (e) special education assignment, if any.
Results

Maternal/Caregiver Characteristics

Maternal/caregiver characteristics are shown in Tables I (birth) and II (follow-up). At follow-up, significant differences were noted in the percentage of adolescents living with biological mothers with those in the two alcohol-exposed groups less likely to be with their birth mothers (DYSM = 76%; ETOH = 78% with biological mothers) than those in the control and special education groups (control = 93%; special education = 87% with biological mothers). As a group, caregivers of alcohol-affected adolescents are several years older than those in the other groups. Mothers/caregivers in the alcohol-exposed group report a higher level of alcohol use both in pregnancy and at the 15-year follow-up. It is notable that, at follow-up, the reported alcohol consumption of the caregivers of dysmorphic children is relatively low. This may reflect the presence of nonmaternal caregivers as well as abstinence by some mothers who are in recovery. However, the GGTP figures, which reflect the current and cumulative effects of alcohol use, suggest that some in the DYSM group continue to use high levels of alcohol. The typical range on the GGTP for adult women is 3–33 units. The mean 103.03 in the dysmorphic group indicates both a history of abusive alcohol use and current use at significant levels (Agarwal & Goedde, 1990). In contrast, the level for caregivers in the special education group (M = 31.38) is similar to that of the nondrinking control group, a result that supports the accuracy of their self-reported low-level of alcohol use. Women using alcohol in pregnancy reported also more gestational tobacco use.

Adolescent Characteristics (Table III)

Despite smaller size at birth (Coles et al., 1985) and during middle childhood (Coles et al., 1997), analyses of adolescents' current physical characteristics indicated no significant differences in growth associated with alcohol exposure at this age. Members of the special education group were slightly older and more likely to be male.

Table II. Caregiver Characteristics in Different Exposure Groups at Follow-up (N = 265)

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 53)</th>
<th>DYSM (n = 46)</th>
<th>ETOH (n = 82)</th>
<th>Special education (n = 84)</th>
<th>Statistics</th>
<th>p value</th>
<th>Post hoc a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>40.86 ± 7.25</td>
<td>45.46 ± 10.65</td>
<td>42.84 ± 8.77</td>
<td>40.59 ± 8.30 F(3, 259) = 4.1</td>
<td>p &lt; .007</td>
<td>2 &gt; 1 and 4</td>
<td></td>
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<tr>
<td>% Biological mother</td>
<td>93</td>
<td>76</td>
<td>78</td>
<td>87</td>
<td>χ² = 8.2</td>
<td>p &lt; .04</td>
<td>1 and 4 &gt; 2 and 3</td>
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<tr>
<td>Education (year)</td>
<td>12.2 ± 1.31</td>
<td>10.58 ± 2.89</td>
<td>10.96 ± 1.72</td>
<td>12.84 ± 1.82 F(3, 263) = 19.7</td>
<td>p &lt; .000</td>
<td>1 and 4 &gt; 2 and 3</td>
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<tr>
<td>Ethnic status</td>
<td>96</td>
<td>98</td>
<td>96</td>
<td>83</td>
<td>χ²(3) = 16.05</td>
<td>ns</td>
<td></td>
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<tr>
<td>(% African-American)</td>
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<tr>
<td>Current monthly income ($)</td>
<td>819.02 ± 643.56</td>
<td>611.4 ± 723.01</td>
<td>485.05 ± 644.04</td>
<td>1,240.08 ± 1,271.45 F(3, 256) = 19.07</td>
<td>p &lt; .000</td>
<td>1 and 4 &gt; 2 and 3</td>
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<tr>
<td>Alcohol and drug use</td>
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<tr>
<td>Current alcohol use</td>
<td>0.71 ± 2.2</td>
<td>4.1 ± 9.78</td>
<td>6.22 ± 8.93</td>
<td>1.33 ± 4.76 F(3, 254) = 9.19</td>
<td>p &lt; .000</td>
<td>3 &gt; all</td>
<td></td>
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<tr>
<td>(oz/Absolute Alcohol/week)</td>
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<tr>
<td>Cigarettes/day currently</td>
<td>9.39 ± 16.55</td>
<td>8.6 ± 9.06</td>
<td>13.72 ± 19.71</td>
<td>6.08 ± 13.44 F(3, 233) = 2.97</td>
<td>p &lt; .03</td>
<td>3 &gt; 4</td>
<td></td>
</tr>
<tr>
<td>Regular marijuana use (%)</td>
<td>22.50 ± 18.50</td>
<td>46.50</td>
<td>10.50</td>
<td>χ²(3) = 18.14 p &lt; .000 3 &gt; all</td>
<td></td>
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<tr>
<td>GGTP (n = 245)</td>
<td>23.44 ± 45.19</td>
<td>103.03 ± 292.77</td>
<td>41.85 ± 60.85</td>
<td>31.38 ± 44.54 F(3, 241) = 3.61</td>
<td>p &lt; .04</td>
<td>2 &gt; all</td>
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</tr>
</tbody>
</table>

DSYM, alcohol exposed/dysmorphic; ETOH, alcohol exposed/nondysmorphic; GGTP, y-glutamyl traspepsidase.

aBonferroni, Dunnett.
reflecting the usual referral patterns for such groups (Anderson, 1997). For this reason, growth data for males and females were analyzed separately initially but the same pattern of growth was observed so data are presented grouped with gender controlled in the analysis. Adolescents who were noted to have physical effects of alcohol (i.e., dysmorphic features) during infancy and childhood were more likely to have such features at follow-up.

**Ability and Achievement (Table IV)**

Ability level, as indicated by WISC-III IQ scores, did not differ across most of these low-income, disadvantaged groups. However, those in the alcohol-affected dysmorphic group had significantly lower cognitive scores than all other groups. All groups, however, scored in the “Borderline” range of intellectual functioning. No significant discrepancy was noted between verbal and performance IQ scores in any of these groups. Individuals with the physical effects of alcohol had lower scores than those in the other groups on all the WISC-III summary scores with the exception of freedom from distractibility. The processing speed index score was lower for both the dysmophia group and the special education group.

The examination of the subtest scores that comprise the WISC-III indicates that the dysmophia group showed significantly more problems on picture completion, coding, block design, object assembly, vocabulary, arithmetic, comprehension, and symbol search. The special education group demonstrated more problems on the coding subtest.

Academic achievement measured by using the WIAT indicated that the special education group was more impaired, over all, than the other three groups, showing significant deficits on the screenner, an academic summary, as well as basic reading and spelling subtests. In contrast, the dysmorphic group did not differ significantly on these subtests, but showed significant differences on mathematics and math reasoning.

**Adaptive Functioning**

Adaptive functioning data are shown in Table V. Results indicate that the special education group was more impaired across all three domains assessed on the VABS: communication skills, daily living skills, and socialization skills. The special education group also had a significantly higher (i.e., more maladaptive) score on the maladaptive behavior scale of the Vineland. Scores of
alcohol-affected youth did not differ from those of the control group.

Information from Academic Records
These data are shown in Table VI. On the school-administered, standardized achievement tests, both clinical groups, dysmorphism and special education, were significantly lower than the other groups on reading but only the dysmorphism group differed from the other groups on math. There were no significant differences among these groups in GPA for either the current or previous year, with all groups receiving relatively low grades. No
differences were reported in the percentage of days attended for either year with all adolescents attending between 80 and 90% of the school year. As might be expected, more adolescents in the special education group than in the other groups were in special education placements. Most of those in a special education setting were eligible under a behavioral disorder or learning disability category. About twice as many children in the dysmorphia group were enrolled in special education services than in the control and exposed groups. Table VII summarizes the categories under which the adolescents were served in special education.

Conduct
Previous studies (Streissguth et al., 1996) suggest that individuals with FAS identified in clinical settings have a high incidence of disrupted school experience, including suspensions. For this reason, researchers collected information about children’s conduct problems in the current and previous school year. Results indicate that there were no significant differences in conduct problems, both minor and major by school system criteria, among the four groups in this study. Nonclinically referred adolescents with FAS actually experienced fewer conduct problems in these school settings than the other three groups, although the differences were not significant. Table VIII reports the results for both years for which conduct data were collected.

Discussion
This study reports the results of an examination of ability and school functioning in alcohol-affected youth and three contrast groups. To examine the impact of such exposure, researchers administered intellectual, academic, and adaptive measures and collected academic records to evaluate the hypothesis that prenatal alcohol exposure

### Table VI. Information from Academic Records (N = 264)

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 56)</th>
<th>DYSM (n = 46)</th>
<th>ETOH (n = 83)</th>
<th>Special education (n = 79)</th>
<th>Statistic</th>
<th>p value</th>
<th>Post hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Special education enrolled</td>
<td>16.07 ± 27.66</td>
<td>16.05 ± 93.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours/week special education (n = 88)</td>
<td>10.2 ± 7.596</td>
<td>7.289 ± 19.71</td>
<td>7.432 ± 8.959</td>
<td>14.3 ± 9.85</td>
<td>F(3, 84) = 2.47</td>
<td>p = .067</td>
<td>ns</td>
</tr>
<tr>
<td>% Days attended (previous year)</td>
<td>84.85 ± 16.67</td>
<td>14.95 ± 8.47</td>
<td>13.84 ± 87.79</td>
<td>13.02 ± 15.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Days attended (current year)</td>
<td>84.21 ± 14.95</td>
<td>12.89 ± 86.47</td>
<td>12.89 ± 86.47</td>
<td>13.84 ± 87.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA (previous year)</td>
<td>1.71 ± 1.03</td>
<td>1.95 ± 2.00</td>
<td>1.01 ± 2.00</td>
<td>1.95 ± 1.28</td>
<td>F(3, 240) = 1.73</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>GPA (current year)</td>
<td>1.91 ± 0.98</td>
<td>1.06 ± 1.91</td>
<td>0.86 ± 1.91</td>
<td>0.84 ± 1.28</td>
<td>F(3, 141) = 6.11</td>
<td>p &lt; .002</td>
<td>4 &lt; all</td>
</tr>
<tr>
<td>Percentile reading (n = 138)</td>
<td>30.52 ± 24.04</td>
<td>17.16 ± 17.06</td>
<td>32.84 ± 12.06</td>
<td>27.53 ± 16.73</td>
<td>F(3, 134) = 3.95</td>
<td>p &lt; .01</td>
<td>2 and 4 &lt; 1 and 3</td>
</tr>
<tr>
<td>Percentile math (n = 144)</td>
<td>31.88 ± 21.75</td>
<td>22.33 ± 14.11</td>
<td>35.29 ± 27.53</td>
<td>18.73 ± 16.73</td>
<td>F(3, 141) = 6.11</td>
<td>p &lt; .002</td>
<td>4 &lt; all</td>
</tr>
</tbody>
</table>

DSYM, alcohol exposed/dysmorphic; ETOH, alcohol exposed/nondysmorphic; GPA, grade point averages

### Table VII. Special Education Status (%) by Category (N = 264)

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 56)</th>
<th>DYSM (n = 46)</th>
<th>ETOH (n = 83)</th>
<th>Special education (n = 79)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular program</td>
<td>83.93</td>
<td>72.34</td>
<td>83.95</td>
<td>6.17</td>
</tr>
<tr>
<td>Previously in special education</td>
<td>7.14</td>
<td>2.12</td>
<td>2.47</td>
<td>9.87</td>
</tr>
<tr>
<td>Behavior/emotional disorder</td>
<td>1.78</td>
<td>0</td>
<td>3.7</td>
<td>23.46</td>
</tr>
<tr>
<td>Learning disabilities</td>
<td>1.78</td>
<td>4.26</td>
<td>2.47</td>
<td>37.03</td>
</tr>
<tr>
<td>Speech/language impaired</td>
<td>0</td>
<td>2.13</td>
<td>1.23</td>
<td>0</td>
</tr>
<tr>
<td>Other health impaired (OHI)</td>
<td>1.78</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intellectually impaired: mild</td>
<td>1.78</td>
<td>10.64</td>
<td>4.94</td>
<td>14.81</td>
</tr>
<tr>
<td>Intellectually impaired: moderate</td>
<td>0</td>
<td>2.13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dual category</td>
<td>1.78</td>
<td>6.38</td>
<td>1.23</td>
<td>8.64</td>
</tr>
</tbody>
</table>

DSYM, alcohol exposed/dysmorphic; ETOH, alcohol exposed/nondysmorphic.
is correlated with school failure and adaptive and learning problems. Results indicate that alcohol-affected youth had significantly lower intelligence scores than those in the three comparison groups. However, achievement was most impaired in a special education comparison group, overall, as well as in reading and spelling skills, whereas alcohol-affected youth showed significant deficits on mathematical measures. Perhaps most interestingly, alcohol-affected status was not related to conduct problems within the school setting or disrupted school experiences. There was no significant difference in minor or major conduct offenses within the school setting based on alcohol exposure with or without dysmorphia, and absenteeism was not higher.

These findings suggest several things. First, it is notable that all the young people in this sample demonstrate the negative effects of low SES. The average standard scores are low even in the unexposed contrast group. This finding suggests the importance of including a SES-matched contrast group when carrying out research on drug and alcohol-exposed children and youth because it would be easy to interpret these low scores as the effect of alcohol exposure without the evidence provided by the contrast group.

Second, along with significantly lower intelligence scores, specific academic deficits associated with prenatal alcohol exposure can be identified. Alcohol-affected youth performed significantly more poorly on the WIAT mathematical subtests in comparison with normal controls and to alcohol-exposed but unaffected youth from the same cohort. That this discrepancy is specific is demonstrated by a comparison with the special education group. In contrast to the alcohol-affected group, the adolescents who have been identified by educational systems as needing educational support have nonspecific academic deficits across both verbal and mathematical subtests.

Another finding suggests that it is important to discriminate the effects of alcohol from postnatal environmental factors. Despite previous reports, these children's academic records indicated that the alcohol-exposed and -affected groups did not show increased absenteeism, conduct problems, or school drop out when compared with appropriate control groups. Similarly, despite previous findings that suggest significant problems with adaptive behavior, there are no differences reported in this cohort. Sampling differences are probably responsible for this discrepancy. If these students had been selected from a clinically referred population, like most of those in previously reported studies, it is likely that conduct problems and adaptive behavior deficits would have been observed.

In summary, these results suggest that prenatal alcohol exposure affects cognitive functioning even when SES is controlled, and that specific academic problems are associated with prenatal exposure. However, behavior and conduct problems at school and adaptive behavior deficits cannot be attributed directly to such exposure.

The interpretation of outcomes should reflect the limitations of this study. The special education contrast group was not followed longitudinally, so there may be specific cohort effects which did not affect this group when compared with the longitudinal group. In addition, the study population was low SES and predominantly African-American and there may be some limitations in generalization to other groups. For instance, in more privileged social groups, the relative discrepancy in academic functioning could be more or less apparent. In addition, the assessment of academic functioning in this study was relatively superficial, so that the observed deficits in mathematics are only suggestive of areas that will reward further investigation. Finally, although analyses comparing those who did and did not participate in the adolescent follow-up indicate that these groups are functionally equivalent, it is possible that those families who agreed to continue to participate in this study over a period of 15 years may be different from other families in which alcohol exposure occurs.

**Conclusions**

These results suggest that prenatal exposure has significant and specific effects on cognition and academic
functioning but that behavior and adaptive functioning are not affected. Some of these findings are not consistent with those reported previously (e.g., Streissguth et al., 1996). In clinically referred samples, many academic and behavioral problems have been found. The results of this study suggest that, rather than interpreting such outcomes as the direct result of teratogenic exposure, it may be more reasonable to suggest that they reflect the impact of neurological damage unfolding within a compromised environment over the course of a lifespan. This study was an attempt to control for the effects of disability and SES on behavior and academic functioning. These results suggest that behavior problems seen in the academic environment, while common in children with FAS, may be associated as much with clinical status or adverse environmental experiences as with prenatal exposure. Finally, the identification of specific cognitive process and academic deficits in alcohol-exposed youth may provide information that will support appropriate interventions in this group.

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