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Impaired Language Performance in Young Children with Heavy Prenatal Alcohol Exposure

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Abstract

The aims of this study were to evaluate the language abilities of young children with heavy prenatal alcohol exposure and to determine if these abilities represent a relative strength or weakness for this population. Two matched groups of children (ages 3 to 5) completed the Clinical Evaluation of Language Fundamentals, Preschool version: 25 children with heavy prenatal alcohol exposure (ALC) and 26 non-exposed controls (CON). Consistent with previous research, the CON group had significantly higher full scale IQ (FSIQ) scores than the ALC group. Receptive and expressive language skills of the two groups were compared. The ALC group had significantly poorer language skills than the CON group and both groups had better receptive than expressive abilities. Language performance did not significantly deviate from what would be predicted by FSIQ for either group. These results indicate that receptive and expressive language abilities are impaired in children with heavy prenatal alcohol exposure but not more so than general intellectual functioning. However, these deficits are likely to impact the social interactions and behavioral adjustment of children with prenatal alcohol exposure.

Key terms

Prenatal alcohol exposure; Fetal alcohol syndrome; Fetal alcohol spectrum disorders; Language; IQ

1. Introduction

Prenatal exposure to alcohol can have devastating effects on the developing fetus and can result in long-term impairments in cognition and behavior. One consequence of heavy prenatal alcohol exposure is the fetal alcohol syndrome (FAS). FAS is a major public health concern, with an estimated prevalence of 0.5 to 2.0 cases per 1,000 live births [23]. Diagnostic criteria for FAS include characteristic dysmorphic facial features, growth deficiency, and central nervous system dysfunction [19]. Though most alcohol-exposed individuals do not exhibit the physical features required for an FAS diagnosis, heavily exposed children with and without FAS often show similar cognitive and behavioral performance [22]. Thus it has been suggested

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that central nervous system dysfunction may be more indicative of alcohol's teratogenicity than the physical abnormalities traditionally associated with this exposure. Determination of a profile or profiles of cognitive strengths and weaknesses associated with heavy prenatal alcohol exposure may aid in diagnostic specificity and treatment design.

Although a robust body of literature exists on the cognitive effects associated with prenatal alcohol exposure, few studies have examined language skills in this population. Many of the existing retrospective studies have had small sample sizes, wide age ranges, limited geographic or ethnic representation, no comparison group, or a small sampling of language abilities. While these studies have some limitations, the results have been fairly consistent and suggest that children with heavy prenatal alcohol exposure have both receptive and expressive language deficits [3,4,7,18,22]. Specifically, one study [3] found that while both younger and older children with FAS demonstrated deficits in receptive and expressive language relative to controls, younger children had more global language impairment, whereas older children showed deficits specific to syntax. However sample sizes were small (FAS n = 10, controls n=17) and all subjects were from a single ethnic group (Native American). Another study [2] identified impaired grammatical and semantic abilities in Native American children with FAS (FAS n = 8, controls n = 6). Children with FAS exhibited poor comprehension of morphology, syntax, verbal commands, and single word vocabulary, and produced fewer spontaneous grammatically correct and complete sentences. These impairments were generally consistent with mental age, suggesting normal yet slowed development. Limited research also suggests that children with prenatal alcohol exposure have emerging difficulties in higher-level language skills (e.g., narrative discourse) as they get older [5,29].

The effects of prenatal alcohol exposure on language abilities are less clear in prospective studies, which typically include children with lower levels of exposure. One prospective study found a dose-response relationship between degree of alcohol exposure and performance on a phonological processing task at 14 years of age [28]. In younger children, results are more variable, even within the same cohort across time. One prospective study [13] found no significant receptive or expressive language impairments in exposed children at ages 1, 2, or 3. In contrast, another research group found reduced language comprehension at 13 months [14], 2 years [11], and 3 years [12], but failed to find language deficits in this same cohort at ages 4 [12], 5 [10], or 6 [10], suggesting a developmental delay in this area. However, many of these studies focused on samples for which levels of alcohol exposure tended to be low (mean 0.19 – 0.31 oz AA/day), with only a few women consuming more than 1 drink per day on average.

The present study was designed to evaluate if previous research on the language abilities of children with heavy prenatal alcohol exposure would be replicated with a larger sample including a matched control group, a narrower age range, and a comprehensive measure of receptive and expressive language with representative normative data and good psychometric properties. We evaluated the receptive and expressive language skills of young children with and without heavy prenatal alcohol exposure, using the Clinical Evaluation of Language Fundamentals, Preschool version (CELF-P). In addition, we were interested in the relationship between language skills and general intellectual functioning in order to determine if language abilities represent a relative strength or weakness for this population. Based on previous research (e.g., [2,3,22]), it was hypothesized the alcohol-exposed children would show significant deficits in both receptive and expressive language, and that language ability would be consistent with general intellectual functioning.

2. Methods

2.1 Participants

Two groups of children between the ages of 3 and 5 participated in this study: 25 children with heavy prenatal alcohol exposure (ALC) and 26 typically developing children with no known exposures to alcohol or other teratogenic agents (CON). Groups were matched on age, sex, race/ethnicity, and socioeconomic status. All children were recruited as part of a larger ongoing study of the behavioral teratogenicity of alcohol. Alcohol-exposed children are recruited into this larger study via several mechanisms, including professional referral or self-referral. Non-exposed participants are recruited from the community via advertising at various agencies and child-related venues. Mothers of children in the ALC group consumed at least 4 drinks per occasion at least once per week or 14 drinks per week during pregnancy. Teratogenic exposure history was determined through multi-source collateral report, including review of available medical, social service, and adoption agency records and maternal report, when available. However, direct maternal report was generally unavailable, as many children with heavy prenatal alcohol exposure no longer reside with their biological families. In contrast, the majority of children in the control group reside with their biological mothers. Therefore, screening for exposure to alcohol or other teratogens in this group was determined through direct maternal report. Mothers of these children reported little (i.e., <1oz AA/day prior to pregnancy recognition), if any, alcohol use during pregnancy and denied use of other drugs. These procedures are in agreement with normative standards for retrospective confirmation of maternal alcohol use within the field of clinical behavioral teratology. Children in the alcohol-exposed group were evaluated by a dysmorphologist with expertise in alcohol teratogenesis. Exams are based on physical measurements (e.g., pre- and or postnatal growth measures), craniofacial structure analysis (e.g., evaluation of palpebral fissures, philtrum, vermillion), alcohol exposure history, and historical record review. Children with or without a diagnosis of FAS were included in the ALC group.

To be included in this study all children had to be between the ages of 3 and 5 and speak English fluently. Exclusion criteria were as follows: (1) significant head injury with loss of consciousness for more than 30 minutes; (2) significant physical (e.g., uncorrected visual impairment, hemiparesis) or psychiatric (e.g., psychosis) disability that would preclude participation; (3) children were excluded from the ALC group based on other known causes of mental deficiency (e.g., congenital hypothyroidism, neurofibromatosis, chromosomal abnormalities); and (4) children were excluded from the CON group if greater than minimal prenatal alcohol exposure (1 AA/day prior to pregnancy recognition) was known or suspected or if information was unavailable. All children participating in this study took part in our larger investigation of neuropsychological functioning in children with prenatal alcohol exposure [cf. 21,22]. As part of this program of study, Full Scale IQ (FSIQ) scores were available from the Wechsler Preschool and Primary Scale of Intelligence, Revised or Wechsler Preschool and Primary Scale of Intelligence, Third Edition. Examiners were blind to group membership. All procedures were approved by the Institutional Review Board at San Diego State University, and children received a toy or financial incentive for their participation.

2.2 Measures

Clinical Evaluation of Language Fundamentals, Preschool Version (CELF-P)— The CELF-P [30] is a standardized measure of receptive and expressive language skills for children ages 3 to 7. It consists of 6 subtests and provides three composite scores: Receptive Language, Expressive Language, and Total Language. The Receptive Language score is calculated from the Linguistic Concepts, Sentence Structure, and Basic Concepts subtests and internal consistency reliability estimates range from .52 to .86 for the individual subtests and .73 to .92 for the composite score for the age range used in this study. The Expressive Language score is calculated from the Recalling Sentences in Context, Formulating Labels, and Word Structure subtests and internal consistency reliability estimates range from .71 to .93 for the individual subtests and .90 to .95 for the composite score. The Total Language score summarizes performance across all subtests and internal consistency estimates range from .92 to .96. Support for validity has been demonstrated through its relationship with other measures of language and general cognitive functioning and its ability to discriminate children with language disorders from children without language disorders. All test protocols were scored by three independent raters.

2.3 Statistical Analyses

Demographic data were analyzed by Chi-square (sex, race, and ethnicity) or standard analysis of variance (ANOVA) techniques (age, FSIQ, and socioeconomic status (SES) as measured by the Hollingshead Four Factor Index [16]). Composite scores were used in all language analyses due to their stronger psychometric properties in comparison with individual subtest scores. All analyses were conducted using SPSS version 15.0 (SPSS Inc., Chicago, IL). Language abilities were analyzed by a 2 × 2 repeated measures ANOVA with language Test (Receptive and Expressive) as the within-subject variable and Group as the between-subjects variable. While variables were not true “repeated measures” over time, the repeated measures ANOVA procedure in SPSS is appropriate when multiple measures with the same scaling were administered to the same subjects. This use of the repeated measures ANOVA in SPSS is sometimes referred to as profile analysis. To examine the relationship between language and intellectual functioning, a 2 × 2 repeated measures ANOVA was run with Test (FSIQ and Total Language score) as the within-subject variable and Group as the between-subjects variable. To further examine this relationship, the Language 2 × 2 repeated measures ANOVA was run on a subsample of 20 subjects (10 per group) individually matched on age, sex, and FSIQ (±7 points). Analysis of covariance using IQ was not conducted for the total sample given the group differences in IQ as well as the possibility of a nonlinear relationship between IQ and language function in this population. Effect size estimates (Cohen’s d) were calculated to supplement significance testing. Descriptive ranges for effect sizes were as follows: small effects > 0.2, medium effects > 0.5, and large effects > 0.8.

3. Results

3.1 Demographics

Groups did not significantly differ on age, sex, ethnicity, race, or SES ($p > .05$). Consistent with previous research, the CON group had significantly higher FSIQ scores than the ALC group ($F(1, 49) = 16.31$, $p < .001$). See Table 1.

3.2 Language

See Table 2 for means and effect sizes for composite scores. The 2 × 2 repeated measures ANOVA revealed significant main effects of Test ($F(1, 49) = 5.54$, $p = .023$) and Group ($F(1, 49) = 12.37$, $p = .001$). Comparison of group means revealed that the ALC group had significantly poorer language skills than the CON group and that both groups had better receptive than expressive abilities (See Table 2). The Test × Group interaction was not significant ($F(1, 49) = 2.67$, $p = .109$). Effect size estimates for both language scores were in the large range ($d = 0.82 – 0.96$) according to Cohen’s criteria [6].

3.3 Relationship between Language and IQ

The 2 × 2 repeated measures ANOVA examining the relationship between language performance and FSIQ revealed a significant effect of Group ($F(1, 49) = 16.75$, $p < .001$), with the ALC group having significantly lower scores on both FSIQ and the Total Language composite than controls. Neither the main effect of Test (F(1, 49) = 0.65, p = .426) nor the Test ×Group interaction (F(1, 49) = 0.07, p = .793) was statistically significant. Thus, language performance did not significantly deviate from what would be predicted by FSIQ, indicating that the observed language impairments in the ALC group are consistent with intellectual functioning. In addition, consistent with these findings, the subgroup analysis revealed no significant effects when subjects were matched on FSIQ: language Test (F(1, 18) = 1.56, p = .228), Group (F(1, 18) =.485, p = .495), Test × Group interaction (F(1, 18) = 1.07, p = .314). See Table 3 for demographic data and mean language scores for the subgroup analysis. Effect size estimates (Cohen's d) were 0.42 for receptive language and 0.08 for expressive language for the subgroup analyses, which are in the very small to medium range [6].

4. Discussion

Previous research on the language abilities of children with prenatal alcohol exposure has found impaired receptive and expressive language deficits, but many of the studies in this area have small sample sizes, lack a comparison group, or use less comprehensive measures with weaker normative data. In the current study, we attempted to replicate previous findings in a sample of young children with histories of heavy prenatal alcohol exposure in comparison with non-exposed controls using the CELF-P, which has strong normative data and psychometric properties. We also had a relatively large sample size, compared to other clinical samples, and included a matched control group. Results suggest that young children with heavy prenatal alcohol exposure have significantly poorer receptive and expressive language skills than their non-exposed peers. In addition, both groups of children had stronger receptive than expressive language abilities. These findings are consistent with previous studies that have found both receptive and expressive language impairments in children with prenatal alcohol exposure [3,4,7,18,22]. Our results differ, however, from three prospective studies that noted no effect of prenatal alcohol exposure on receptive or expressive language skills [10,12,13]. A difference in level of alcohol exposure could account for this discrepancy: the three prospective studies involved children with relatively low levels of exposure (mean 0.19 – 0.31 oz AA/day), whereas our study focused on heavily exposed children (i.e., at least 4 drinks per occasion at least once per week or 14 drinks per week during pregnancy).

In addition to assessing basic language functions, a second aim of this study was to examine the relationship between language and general cognitive functioning. This set of analyses was conducted to assist in developing a profile or profiles of cognitive strengths and weaknesses associated with prenatal alcohol exposure. One previous study [2] found that the language abilities of a small sample of children with FAS did not differ from those of a comparison group of children matched on general cognitive ability. This suggests that language develops normally in children with FAS although at a slower rate than expected based on chronological age. Results from the current study are consistent with these findings and suggest that the language skills of children with heavy prenatal alcohol exposure are commensurate with estimates of general intellectual functioning. In other words, relative to IQ, language abilities do not represent a strength or weakness for young children with histories of prenatal alcohol exposure. This knowledge may be useful in understanding the patterns of performance in children with prenatal alcohol exposure when considered in combination with other cognitive domains.

It is possible that the small sample sizes, especially in the FSIQ matched subsample, may not be adequate to detect discrepancies between intellectual functioning and language skills. A power analysis was conducted using G*Power software [9] with effect sizes from the FSIQ matched subsample to evaluate this possibility. With an alpha of 0.05 and power of 0.95, 591 subjects would be required for each group to detect the small effect (Cohen's d = 0.21) for the Receptive Language composite, and 4062 subjects per group would be required to detect the

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effect (d = 0.08) observed for the Expressive Language composite. Thus, while sample sizes were limited, effect sizes were small and likely do not represent clinically meaningful differences when IQ is controlled.

Based on estimates of general intellectual functioning, the current study represents a relatively high functioning sample of young children with heavy prenatal alcohol exposure. The relationship between language and general cognitive ability should also be examined in a more impaired sample to determine if this relationship holds in a sample of lower cognitive ability. Future studies should also replicate the findings of the current study in an older sample as a previous study suggested that the extent of impairment varies by age [3]. In addition, limited research suggests that children with FASD may have emerging difficulties in higher-level language skills (e.g., narrative discourse) as they get older that are not well assessed by standardized language tests [5,29]. Such higher level language skills are not assessed using tests such as the CELF-P, in part because such skills are not well developed in younger children. It is possible that emerging difficulties in higher-level language skills may not be commensurate with IQ estimates in older school-aged children. Thus, conclusions from the current study may not necessarily apply to older children who are undergoing more advanced language development.

Several studies have identified abnormalities in speech production and hearing in children with prenatal alcohol exposure and suggest that they may impact the acquisition and comprehension of language. In one sample of 20 children with FAS, 90 percent of children demonstrated speech pathology ranging from mild production errors on 1 or 2 consonant phonemes to marked difficulty with production resulting in low speech intelligibility [4]. Some of these speech defects were attributed to structural defects of the jaw and pharyngeal cavities, whereas others were likely influenced by hearing, cognitive, and oral-motor impairments; 77 percent of children had intermittent conductive hearing loss due to recurrent ear infections and 27 percent had sensorineural hearing loss in addition to conductive hearing loss. According to an enrollment questionnaire used in the current study, 24% of children with heavy alcohol exposure and 11.5% of controls were noted by their parents to have difficulty with hearing. The majority of parents of these children reported problems with repeated ear infections. Another study also identified abnormalities in articulation and oral-motor abilities in a small sample of children with FAS [2]. Future studies should replicate these findings in larger samples including alcohol-exposed children with and without FAS to determine the prevalence and severity of these effects. In addition, the relationship between language and speech and hearing deficits should be examined.

Language impairments are likely to impact other areas of cognitive and behavioral functioning. Research has demonstrated that children with specific language impairments (SLI) exhibit deficits in nonlinguistic cognitive domains such as working memory, response inhibition, visual processing and memory, numerical reasoning, and motor speed [1,17,25,27]. Several studies have suggested that the pattern of difficulties seen in children with SLI may be best accounted for by generalized processing limitations [15,17,27]. Behavioral problems are common in children with SLI, especially in the internalizing domain [8]. Language impairments are also likely to impact the social interactions and adjustment of children. Children with speech and language impairments are more likely to exhibit behavior considered to be socially inept due to their increased difficulty with interpersonal communication [26, 31]. Childhood social relationships play an important role in the development of language and therefore increased difficulty interacting with peers is likely to lead to decreased opportunities for establishing and practicing language skills, role modeling, providing natural consequences, and feedback [24]. Research has demonstrated that peer acceptance is important for adult functioning, and rejection can lead to significant problems later in life [20].

In conclusion, this study demonstrates impaired language performance in children with heavy prenatal alcohol exposure. Utilizing a larger sample including a matched control group, a narrower age range, and a comprehensive measure of receptive and expressive language with representative normative data and good psychometric properties, this study supports previous findings and allows for more confidence in the literature in this domain. In addition, results from this study suggest that language abilities in this population are consistent with estimates of general intellectual functioning. Impaired language skills in children with prenatal alcohol exposure are likely to contribute to difficulty with interpersonal relationships and may lead to peer rejection and further problems later in life.

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Table 1

Demographic information for children with heavy prenatal alcohol exposure (ALC) and non-exposed controls (CON).

Variable	ALC	CON
N	25	26
Sex [N (% Female)]	10 (40.0)	12 (46.2)
Race [N (% White)]	20 (80.0)	17 (65.4)
Ethnicity [N (% Hispanic)]	6 (25.0)	5 (19.2)
FAS Diagnosis [N (%)]	7 (28.0)	n/a
Age in Years [Mean (SD)]	4.47 (0.86)	4.35 (0.85)
SES [Mean (SD)][a]	44.76 (12.58)	49.65 (11.52)
FSIQ [Mean (SD)]	91.16 (11.51)	105.46 (13.64)
Below 85 [N (%)]	7 (28.0)	1 (3.8)
85 – 115 [N (%)]	18 (72.0)	18 (69.2)
Above 115 [N (%)]	0 (0.0)	7 (27.0)

[a]Socioeconomic status (SES) was measured using the Hollingshead Four Factor Index of Social Status.

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Table 2

Means and effect sizes (ES) for alcohol-exposed (ALC) and non-exposed control (CON) subjects. All scores are standard scores with a mean of 100 and a standard deviation of 15.

Variable	ALC	CON	ES[a]
Receptive Language Score [Mean (SD)]	93.44 (16.45)	109.62 (17.21)	0.96
Expressive Language Score [Mean (SD)]	92.16 (12.51)	102.54 (12.79)	0.82
Total Language Composite [Mean (SD)]	92.76 (12.84)	106.27 (14.75)	0.98

[a]Effect sizes are Cohen's d with small effects > 0.2, medium effects > 0.5, and large effects > 0.8.

Table 3

Demographic information and language test scores for a subgroup of children with heavy prenatal alcohol exposure (ALC) and non-exposed controls (CON) individually matched on age, sex, and Full Scale IQ (FSIQ).

Variable	ALC	CON	ES[b]
N	10	10	
Sex [N (% Female)]	5 (50.0)	5 (50.0)	
Race [N (% White)]	9 (90.0)	6 (60.0)	
Ethnicity [N (% Hispanic)]	2 (20.0)	2 (20.0)	
FAS Diagnosis [N (%)]	2 (20.0)	n/a	
Age in Years [Mean (SD)]	4.13 (0.63)	4.48 (0.75)	
SES [Mean (SD)][a]	43.90 (10.69)	50.35 (9.57)	
FSIQ [Mean (SD)]	95.00 (9.45)	95.90 (10.03)	0.09
Receptive Language Score [Mean(SD)]	96.30 (18.55)	100.20 (18.58)	0.21
Expressive Language Score [Mean(SD)]	95.60 (11.93)	96.60 (13.27)	0.08

[a] Socioeconomic status (SES) was measured using the Hollingshead Four Factor Index of Social Status.

[b] Effect sizes are Cohen's d with small effects > 0.2, medium effects > 0.5, and large effects > 0.8.