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Brief Report: Brief Syntactic Analysis in Asperger Syndrome: A Preliminary Study

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INTRODUCTION

Asperger syndrome (AS) is characterized by autistic social dysfunction and idiosyncratic interests in the absence of a significant delay in language acquisition and cognitive development (American Psychiatric Association [APA], 1994). Despite increasing interest in its prevalence, there is ongoing debate about its distinction from other conditions, in particular from autism with normal intelligence, also sometimes called high-functioning autism (HFA; Schopler, 1985). Typically, persons with AS possess superficially normal speech with deficits in the social use of language, and are often pedantic (Ghaziuddin & Gerstein, 1996; Wing, 1981). Although they are generally believed to be more verbal than those with HFA, few studies have directly compared the communication skills and syntactic abilities of the two groups. In adults, computer-assisted linguistic analysis (Morice & Ingram, 1982) has been used increasingly to study syntactic abnormalities in conditions such as schizophrenia and bipolar disorder. Using this technique in a patient with AS, King, Fraser, and Thomas (1987) described a distinctive syntactic profile characterized by an increase in the mean length of utterance and by a variety of syntactic and semantic errors. In the present study, we examined subjects with AS using a modified version of syntactic analysis, known as the Brief Syntactic Analysis (Thomas *et al.*, 1996). The purpose of the study was to replicate and extend the work of King *et al.* (1987) in a larger sample using current diagnostic criteria of AS, and to determine if this technique can be used to study syntactic abnormalities in subjects with autism and related disorders.

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METHOD

Subjects

The study was conducted at the University of Michigan Developmental Disorders Clinic. Subjects with AS consisted of those who met the criteria for that disorder (ICD-10; World Health Organization [WHO], 1993). These were consecutive referrals with pervasive developmental disorders who showed evidence of autistic social dysfunction and idiosyncratic interests with a full-scale IQ of 70 or above ($n = 15$; 12 male; 3 female; *M* age:16.2 years; *M* full-scale IQ: 96) without evidence of language delay (phrase speech by 3 years of age). Those with a history of pragmatic deficits were not excluded. Also, none of the subjects met the criteria for autism at the time of evaluation or in the past. Subjects meeting the ICD-10 criteria were later rediagnosed according to the DSM-IV criteria (APA, 1994).

Controls with high-functioning autism (HFA) were referred over the same index period. They met both the DSM-III-R (APA, 1987) and ICD-10 (WHO, 1993) criteria for autism and had a full-scale IQ over 70 ($n = 13$; 12 male; 1 female; *M* age:15.5 years; *M* full-scale IQ: 81.1). The groups differed significantly in their verbal IQ ($p = .026$) and full-scale IQ ($p = .022$) but not in their age, sex, and performance IQs. Both the groups had English as their native language and were born in the U.S.

Assessment

Speech samples (7–20 minutes) were collected during structured taped interviews and later transcribed. The interview consisted of a picture-description task, followed by a semistructured session consisting of

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open-ended questions. The same picture-description task was performed by all subjects except for one patient with AS who participated only in the semistructured session.

Brief Syntactic Analysis (BSA)

The BSA takes place as a series of scans. The first scan establishes sentence boundaries in the unpunctuated transcripts, on the basis of surface structure, meaning, and intonation (in that order). The sentences thus established are classified into well-formed major (those with full clausal structure), minor (those with no clausal structure), deviant (possessing clausal structure but containing errors, either syntactic errors of omission or commission, or semantic errors), and unanalyzable (sentences containing one or more indecipherable syllables). The second scan identifies and tags dysfluencies in each sentence. These include pause fillers (such as er, ah, and um), repeated words, multiple word repeats, and false starts. The third scan produces measures of sentence complexity. The number of words in each well-formed major sentence is counted, and the presence of coordinated and subordinate clauses noted. For sentences containing subordinate clauses, the total number of subordinate clauses, as well as the number of levels of embedding are identified. From these measures the following variables are calculated: the mean length of utterance (mean length of sentences in words), the mean number of subordinate clauses per sentence, and the mean maximum depth of embedding (the mean number of levels of embedded clauses in complex sentences). Two trained raters (F. N. and G. K.) analyzed each transcript blind to the diagnosis, using the BSA protocol. The variables used in the analysis are defined in Table I.

RESULTS

AS subjects scored higher than the controls in the percentage of well-formed major sentences (F = 8.94, p = .006), mean maximum depth of embedding (F = 10.52, p = 0.003) and mean length of utterance (F = 5.86, p = .02). No differences were found in their percentage of deviant sentences, percentage of simple sentences, and in the dysfluency index. On the whole, subjects with AS produced longer sentences with higher levels of structural complexity while controls with HFA used either short sentences or longer sentences with dysfluencies and errors. There were no significant correlations between performance IQ and linguistic variables, but verbal IQ (VIQ) correlated significantly with mean maxi-

Table I. Linguistic Variables Used in the Analysis

Percentage of simple sentences	A simple sentence consists of a subject and a predicate, constituting one independent clause. It contains a single finite verb.
Mean maximum depth of embedding	The mean number of levels of embedded clauses in complex sentences (see example below).[a]
Mean length of utterance	The sentence length is a count of the number of words in each well-formed major sentence, excluding all dysfluencies and errors.
% of well-formed major sentences	A major sentence is structurally complete and grammatical. It is defined as a conceptual unit containing at least one independent clause.
Percentage of deviant sentences	Deviant sentences are either syntactically deviant, with errors of omission or commission, are semantically deviant, or contain both types of errors. Their identification relies on the intuitive judgments of the coders, as native English speakers.
Dysfluency index	The average of all dysfluencies (pause fillers, repeated words multiple word repeats, false starts retraced and other dysfluencies) in well-formed major and minor sentences.

[a] Mean maximum depth of embedding: The sentence, John who was tired went home, contains an embedded clause, *who was tired.* This is because, the meaning of this clause is dependent upon another clausal element (John went home). It contains one clause at top (first) level—John went home, and a clause at second level (who was tired). It thus contains 2 levels of embedding.

mum depth of embedding ($r = .40$, $p = .05$) and the percentage of well-formed major sentences ($r = .38$, $p < .1$).

We performed an analysis of covariance to study the effect of verbal IQ on the group differences. For mean maximum depth of embedding, the effect of VIQ as a covariate was not statistically significant ($F = 1.14$, p = ns) and the group differences remained significant ($F = 5.07$, $p = .05$). For percentage of well-formed major sentences, VIQ was not significant as a covariate ($F = 0.77$; p = ns), and the difference in group means was still significant ($F = 4.52$, $p = .05$.). For mean length of utterance, the effect of VIQ as a covariate was not significant ($F = 1.11$; p = ns); however, the group differences were no longer significant ($F = 2.23$; p = ns). Thus, when the effect of verbal IQ was controlled, subjects with AS continued to score higher on their mean maximum depth of embedding and also had a higher percentage of well-formed major sentences; however, no differences were observed on their mean length of utterance.

To further clarify the effect of verbal IQ on the findings, we compared the lowest third number of subjects, both AS and HFA ($n = 9$), with the rest of the sample ($n = 19$). The low verbal IQ group scored lower than the high verbal IQ group on the percentage of well-formed major sentences ($t = 2.596$ $p = .015$); however, for the other two variables, mean maximum depth of embedding and mean length of utterance, a trend for lower scores was seen but the differences did not reach statistical significance. This again indicates that the syntactic differences between the two groups were not entirely accounted for by the higher verbal IQ of the Asperger subjects.

To exclude the effect of gender, we analyzed the data in males only. Findings remained significant for mean maximum depth of embedding and for percentage of well-formed major sentences; however, group differences for mean length of utterance, while showing a trend, failed to reach statistical significance at the 0.05 level ($p = .09$). This suggests that the difference in the group means was only partly accounted for by the differences in the verbal IQ or by sex differences, and that the group differences in measures of sentence complexity (that is, depth of embedding and percentage of well-formed major sentences) appeared to be robust.

DISCUSSION

This study examined syntax in Asperger syndrome. Compared with controls with HFA, subjects with AS showed more complex speech patterns as reflected by the percentage of well-formed major sentences and mean maximum depth of embedding. Also, they tended to use longer sentences. Overall, therefore, these findings support the clinical impression that persons with AS have better and more complex speech than those with HFA, at the average age of 15–16 years. It is important to note, however, that AS cannot be distinguished from HFA on the basis of syntax alone. Nor is it clear as to how the two groups show changes over time in their syntactic skills.

Since recruitment of the subjects was based on consecutive referrals, no attempt was made to control for the verbal IQ of the AS subjects, which was significantly higher than the HFA comparison group. However, further analysis showed that after controlling for the effect of verbal IQ, subjects with AS continued to score higher on mean maximum depth of embedding and percentage of well-formed major sentences, while for mean length of utterances, only a trend for higher scores was noted. In addition, subtests of verbal intelligence (similarities, information, etc.) are not identical with the measures of syntactic analysis used in this study. Also, when the data were analyzed in males only, the findings remained significant for mean maximum depth of embedding and for percentage of well-formed major sentences; however, group differences for mean length of utterance, while showing a trend, did not reach statistical significance ($p = .09$). Taken together, these preliminary findings suggest that patients with AS possess a more syntactically complex speech than those with HFA, and that verbal IQ and gender only partly account for this finding. Since a history of language delay depends on parents' recall, a study of syntactical abnormalities may assist in clarifying the features of Asperger syndrome.

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