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CHILD AND MOTHER VARIABLES IN THE DEVELOPMENT OF STUTTERING AMONG HIGH-RISK CHILDREN: A LONGITUDINAL STUDY

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In this prospective study, 26 of the 93 preschool children with a parental history of stuttering who began to stutter were compared at preonset and 1 year later with those of a matched group of 26 children who continued to be seen as nonstutterers. These two groups of at-risk children were compared in terms of the development of their articulatory and language skills and in terms of the communicative style and speaking behaviors of their mothers. At preonset, the children who started to stutter demonstrated a faster articulatory rate than those who remained fluent. One year later, however, this difference was no longer statistically significant. The two groups of children did not differ in their linguistic skills at either of these time periods. Moreover, the communicative style and speaking behaviors of the mothers of the children who later began to stutter did not differ from that of the mothers of children who did not either prior to or after the onset of stuttering. This suggests that these variables did not contribute to the onset of stuttering or to its course.

INTRODUCTION

This study is one part of a longitudinal study in which 93 preschool children, born in families with a stuttering father and/or mother, were observed for several years. Offspring of this kind are especially at risk for developing stuttering (Kay, 1964; Kidd, Heimbuch, & Records, 1981; Ambrose, Yairi, & Cox, 1993). The children studied were between 2 and 5 years of age (M = 39 months, SD = 9.0) when the investigation began. At that time, their speech

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was regarded by their parents and the experimenters as normally fluent. As previously reported, 26 (28%) of the 93 participants began to stutter in the course of the first 2 years of this research project (Kloth, Janssen, Kraaimaat, & Brutten, 1995a,b). During this 2-year period, the remaining 67 children continued to speak in a normally fluent fashion.

While our earlier reports presented data on early prediction of stuttering, this study follows the children and their mothers over a period of 1 year in order to see if the development of the articulatory and language skills of the children under study and the communicative and speaking behaviors of their mothers discriminated between the children who initially were fluent speakers but who later began to stutter and those who continued to speak fluently.

Overall, during preschool years, the speech and language skills of children developed rapidly (Peters & Guitar, 1991), and it is in this period that stuttering usually begins (Bloodstein, 1995). In addition, there is evidence that children who stutter score more poorly than their nonstuttering peers in regard to the age at which their first word and sentence are produced, the level of receptive vocabulary, mean length of utterance, and expressive and receptive syntax (Andrews & Harris, 1964; Murray & Reed, 1977; Kline & Starkweather, 1979; Wall, 1980; Byrd & Cooper, 1989; Ryan, 1992). Moreover, comparative studies have demonstrated that children who stutter have slower speech movements (Meyers & Freeman, 1985a; Adams, 1987) and show a higher incidence of articulation disorders than nonstutterers do (Andrews & Harris, 1964; Williams & Silverman, 1968; Meyers & Freeman, 1985a; Yaruss, LaSalle, & Conture, 1995). However, as previously reported (Kloth et al. 1995a), we did not found any differences in this respect between children who would later stutter and those who would continue to speak fluently. Only articulation rate appeared to be significantly related to the onset of stuttering. Unexpectedly, the preonset articulation rate of the children at risk who later began to stutter was significantly faster than that of the children who continued to be fluent (Kloth et al., 1995a).

The aforementioned discrepancy between our findings and those of comparative studies in which children who stutter were found to speak at a slower rate and to use simpler linguistic structures than nonstutterers, led us to hypothesize that once our preschoolers began to stutter, their rate of speech and their rate of language development would be damped. If this is the case, it would suggest that the slower speech movement and the retardation in measured language development is a result of stuttering rather than evidence for limited speech–motor and/or language capacity.

In a similar vein, this study explored whether or not mothers of children who developed stuttering show specific changes in their communicative and speaking behavior which are not present among mothers whose children continue to speak fluently. Comparative parent–child interaction studies have indicated that mother of stutterers make more use of demands, requests, and

commands (Langlois, Hanrahan, & Inouye, 1986) and talk faster than mothers of nonstutterers (Meyers & Freeman, 1985b). However, our preonset findings indicated that mothers of children who later began to stutter did not differ with respect to communicative behavior and speaking rate from the mothers of those children who continued to speak fluently (Kloth et al., 1995b). If a difference between the mothers only appears after the onset of stuttering, it might be because their children's stuttering behavior altered their interactional patterns.

The current report presents updated longitudinal data on the 26 children who began to stutter and 26 who did not during the course of this study. The normally speaking children were selected from the remaining 67 children who continued to speak in a normally fluent fashion to match the 26 children who began to stutter in terms of sex and age. The object of this investigation was to assess the articulatory and linguistic skills of the children and the communicative and speaking behaviors of the mothers at the start of the study when all the 52 children were fluent speakers and 1 year later when 26 children were classified as stutterers.

METHOD

Subjects

Fifty two of the 93 preschool children who were the subjects of the original investigation were the subjects in the present study. These children had a stuttering father and/or mother, and all demonstrated normal development as reported by both their pediatrician and their parents. At the beginning of the study, none of the participating children were reported by their parents as stuttering, and no stuttering forms of speech disruptions were observed by the experimenters. Moreover, each of the participating children passed a pure tone audiometric hearing screening.

During the second and/or third follow-up assessment, 26 children met the criteria that led them to be classified as stutterers. Both parents regarded their child as a stutterer and indicated on the Disfluency Questionnaire (Kloth, Janssen, & Kraaimaat, 1989) that at least one stuttering form of speech disruption had frequently or very frequently been evidenced at home during the previous 2 months. For 21 of these 26 children, stuttering forms of dysfluency were also observed in the speech sample of the child during the test session.[1] Four-

[1]*Stuttering-like dysfluency* was defined as within-word dysfluencies that included fast sound, syllable, and monosyllable whole-word repetitions, and dysrhythmic phonation involving oral or silent prolongations. Normal disfluencies were defined as polysyllabic word repetitions, phrase repetitions, interjections, revisions, and incomplete phrases.

teen of the children were male, and 12 were female. They ranged in age from 23 to 63 months, with a mean age of 37 months.

Twenty-six high-risk children were matched for gender and age with those who were classified as stutterers. These control subjects were viewed as normally fluent by their parents and no stuttering forms of dysfluency were observed during the follow-up assessments. That is to say, they did not meet the criteria required to be regarded as a stutterer.[2]

There were no significant differences between the groups of stuttering and nonstuttering on mother and family variables, such as mothers' age, years of education, number of stuttering mothers, number of siblings, and birth order.

Procedures

Data collection procedures for the initial and follow-up test sessions, recording environment, and equipment were similar to those previously reported (Kloth et al., 1995a,b). Each test session lasted approximately 2 h and took place at the Department of Phoniatrics of the University Hospital of Utrecht. Two rooms separated by a one-way mirror were used. The room in which the subjects were observed contained a selection of age-appropriate toys (e.g., two telephones, a bucket with small toys; Fisher Price farmhouse, tea-set), a Sony TC-158SD audiotape recorder and a Grundig LC-290H video camera. In the control room there was a Phillips VHS video recorder (type HQ-VR-722), a JVC color video monitor (type TM-210PS-K), and a remote control for the video camera.

At the start of each test session a speech pathologist assessed the language development of the children by means of the Dutch versions of the Reynell Language Development Scale (Reynell, 1983; Bomers & Mugge, 1989) and the Peabody Picture Vocabulary Test (PPVT) (Dunn, 1965; Manschot & Bonnema, 1978). Then, 30 min of free-play interaction between mother and child were videorecorded. Prior to this play period, the mother was instructed to converse and play with her child as she would at home.

Ten minutes of each of the mother–child taped conversation, during the initial and follow-up test sessions, were transcribed by a trained coder. The transcription began at the third minute of videotaping allowing for a 2-min long "warm-up" period. Subsequently, the 10-min conversations were separated into utterances using the Golinkoff and Ames (1979) criteria, that is to say, an

[2]Note that the present groups of stuttering and nonstuttering children differ slightly from those reported in an earlier study (Kloth et al., 1995a,b). Two male children were removed from the earlier stuttering sample because the parents' Disfluency Questionnaire scores did not meet the criteria for stuttered speech. Next, two female children, who met the aforementioned criteria within the second year of the longitudinal project, were added to the stuttering group. Moreover, of the initial group of 67 children who continued to speak fluently, six were removed because of reported stuttering symptoms 6 years after the start of this project. The precise course of early and late onset and relapse of stuttering during the 6-year-period of this prospective study will be reported elsewhere.

utterance was defined as a string of words that communicated an idea, were bound together by one breath, and was intended to be continuous. Utterances were separated by pauses longer than 1 s. The transcriptions were checked by two judges. When there was disagreement about an utterance, it was removed from the sample.

MEASUREMENTS

Child Variables

Language Skills. For each subject, age-equivalent scores for receptive language development were obtained from the Reynell and the PPVT test procedures and for expressive language development from the Reynell. In addition, each child's mean length of utterance (MLU) transcribed during the 10-min spontaneous speech periods was used as a measure of their expressive language skill. MLU was determined by dividing the total number of nonrepeated words spoken by the child by the number of utterances. One-word utterances, stereotypical (e.g., thank you) or noninteractive phrases (counting and singing) were not a part of the data analysis.

Articulatory Skills. In order to assess the articulatory skills of the children, an acoustical temporal analysis was performed on the first 10 clearly audible and perceptually fluent utterances, made by each of them during spontaneous speech. Utterances were selected that were equal to their individual mean length of utterance. The utterances were recorded at a sampling rate of 10 kHz and displayed as a time waveform with a duration of 2 s. Each utterance was measured from the onset of the periodic waveform of the first vowel or voiced consonant to the offset of the periodic waveform of the last vowel or voiced consonant. The simultaneous playback of the audio signal facilitated the identification of the onset and offset of the periodic waveform. Within an utterance, *pause duration* was defined as the absence of spectral energy between two words that exceeded 250 ms. Duration of each utterance in milliseconds was automatically calculated by the software following the positions of the cursors on the waveform. Also determined were the number of syllables within the measured utterances.

The subjects articulation rate was calculated by dividing the duration of their utterances, exclusive of pauses, by the number of syllables that they contained. These values were then converted to syllable rate per second. The mean and standard deviation of the utterance durations across the 10 studied utterances were computed for each subject. From these analyses, the mean articulation rate of the children was derived. Intra-subject variability was determined from the coefficient of variation which was derived from the standard deviation divided by its mean (Kent & Forner, 1980).

Mother Variables

Communicative Style. Every transcribed utterance of the mothers was analyzed in accord with an interaction-analysis method developed by the authors (Kloth, Janssen, & Kraaimaat, 1989; Kloth, Janssen, Kraaimaat & Brutten, 1998). This instrument made it possible to assess the mother's communicative behavior on two levels. The first level, which relates to structural organization has reference to measures such as the amount of speech, mean length of turns and pause durations between and within turns. The second level involves the assessment of the communicative function of mother's speech. Utterances were coded based on their communicative intent regardless of syntactic structure. This taxonomy included communicative functions such as commenting, making requests, praise, commands, and warnings.

Previous research (Kloth et al., 1998) involving principal component analysis has shown that the communicative behaviors of mothers talking with their children, factored into three styles, namely, a nonintervening, explaining, and directing style. The nonintervening style reflects a communicative pattern in which there is no direct pressure from the mother on the child to respond verbally. The mother indirectly encourages the child to take over and hold the speaking turn. The explaining style describes the mother who is primarily concerned with providing information to her child. Finally, the directing style is descriptive of a mother who is mainly engaged in directing her child's behavior by means of verbal control. The individual scores on the separate variables of the coding instrument for each of the mothers was first transformed into z-scores. Then, the z-scores belonging to each of the three communicative styles were summated.

Speaking Behavior. Speaking rate and language complexity served as measures of the mothers' speaking behavior. For each mother, three 6-syllable utterances, four 7-syllable utterances, and three 8-syllable utterances were selected and subjected to the same acoustical temporal analysis as described above. The speaking rate of the mothers was calculated by dividing the duration of the utterance, inclusive of pauses, by the number of syllables. These values were converted to syllable rate per second. The means and standard deviations of the utterance durations across the 10 sampled utterances were then computed for each mother. From these data, the mean speaking rate of the mothers was derived.

The measure of language complexity was derived by dividing the total number of words in the 10-min mother's speech sample by the total number of utterances.

Reliability

As previously reported the interjudge reliability for the articulation and speaking rate measures was acceptably high (Kloth et al., 1995a). Similarly, inter-

judge reliability of the instrument to assess the mother's communicative behavior had also been previously reported and found highly satisfactorily (Kloth et al. 1998).

RESULTS

Child Variables

In Table 1 the means and the standard deviations of the articulatory and linguistic skill measures are presented for the stuttering and nonstuttering children at initial testing and at the follow-up test session 1 year later.

Table 1 shows that for all the children under study the articulation rate became faster and their receptive and expressive skills increased, 1 year after initial testing. In order to test for statistically significant differences between the subject groups, over time and for time by group interaction each dependent measure was analyzed by means of a univariate two-factor analysis of variance, with repeated measurements on the time factor that involved the initial and follow-up sessions. Since age was found to correlate significantly with the children's speech–motor and linguistic measures, it was used as a covariate in the analyses of these variables. The results of the analyses are shown in Table 2.

With the exception of the variability of articulation rate, significant time effects were obtained on all the children's measurements. One year after the ini-

Table 1. Means and Standard Deviations of the Childrens Articulatory and Linguistic Skill Measures for the Stuttering ($n = 26$) and Nonstuttering Children ($n = 26$) at Initial and Follow-up Test Session 1 Year Later

	Initial session				Follow-up session			
	Stuttering children		Nonstuttering children		Stuttering children		Nonstuttering children	
	M	SD	M	SD	M	SD	M	SD
Articulatory skills								
Articulation rate	3.68	0.50	3.45	0.42	4.23	0.58	4.16	0.62
Variability art. rate	0.21	0.07	0.20	0.05	0.29	0.08	0.25	0.06
Language receptive								
Reynell	40.73	12.93	41.23	10.50	55.27	13.97	54.65	12.91
PPTV[1]	43.62	14.14	46.17	13.56	61.96	13.08	62.92	13.05
Language expressive								
Reynell	36.92	9.64	39.72	10.01	52.72	15.15	53.38	12.26
MLU	4.11	0.89	4.50	0.88	5.28	0.95	5.47	0.74

[1]PPVT-scores were available for only 24 of the experimental and 24 of the control subjects.

Table 2. Two-factor Repeated Measures Analysis of (co)variance for Time, Group, and Time-by-Group Interactions

	F-value			
	Covariate age	Time	Group	Time × group
Articulatory skills				
Articulation rate	18.08**	71.84**	2.66	1.31
Variability art. rate	4.33*	0.11	0.49	0.51
Language receptive				
Reynell	79.98**	187.06**	0.40	0.30
PPTV	35.56**	226.26**	0.03	0.00
Language expressive				
Reynell	78.68**	171.66**	0.21	0.63
MLU	48.15**	87.62**	2.05	0.75

*$p < 0.05$; **$p < 0.01$.

tial test session both their articulation rate as well as their receptive and expressive linguistic skills increased significantly.

The absence of a significant group and a significant group-by-time effect indicates that the development of the articulatory and linguistic skills of the youngsters who began to stutter followed the same pattern than that of the nonstuttering control group. With respect to preonseet and postonset articulatory rate, the descriptive data in Table 1 showed that the youngsters who later became stutterers had a faster rate of articulation than the children who remained fluent. A post-hoc one-factor analysis of covariance indicates that the preonset between-group difference was significant ($F = 8.56$, $p = .00$). However, this was not the case with respect to the postonset articulation rate ($F = .86$, p = ns). It follows from this that the degree to which the rate increased over the 1-year test period was less for the children who developed stuttering symptoms than it was for those who continued to speak fluently.

Mother Variables

Table 3 presents the means and standard deviations of the communicative and speaking behaviors for the mothers of the stuttering and nonstuttering children at the initial and at the follow-up test session, 1 year later.

In order to test for statistically significant differences between the subject groups, over time, and for time by group interaction each dependent measure was analyzed by means of a univariate two-factor analysis of variance, with repeated measurements on the time factor. Because the age of the children was found to correlate significantly with the mothers' directing style and language complexity, age was used as a covariate in the analyses of these variables. The results of these analyses are summarized in Table 4.

Table 3. Means and Standard Deviations of the Mothers' Communicative and Speaking Behavior Measures for the Stuttering ($n = 26$) and Nonstuttering Children ($n = 26$) at Initial and Follow-up Test Session 1 Year Later

	Initial Session				Follow-up Session			
	Stuttering children		Nonstuttering children		Stuttering children		Nonstuttering children	
	M	SD	M	SD	M	SD	M	SD
Communicative style								
Nonintervening	−0.29	4.25	−0.29	3.86	−0.23	4.97	0.07	4.42
Explaining	−0.45	3.66	−0.36	3.21	0.33	5.00	−0.14	3.78
Directing	0.17	3.38	−0.17	2.68	−0.11	2.57	0.25	2.79
Speaking behavior								
Speaking rate	5.72	0.55	5.59	0.44	5.63	0.64	5.81	0.66
Language complexity	4.78	0.70	5.09	0.65	5.09	0.91	5.33	0.74

As can be seen in Table 4 only the measurement of the language complexity of the mothers reached the level of significance. More specifically, the language complexity, as measured by MLU, increased for both groups of mothers, 1 year after initial testing. No significant time effects were found with respect to the mother's communicative style and speaking rate. With respect to the communicative and speaking behaviors of the mothers, no significant group and group-by-time effects were found.

DISCUSSION

Fifty-two children with a parental history of stuttering who were viewed as nonstutterers at the start of the study participated as subjects. Data from these

Table 4. Two-factor Repeated Measures Analysis of (co)variance for Time, Group, and Time-by-Group Interactions

	F-value			
	Covariate age	Time	Group	Time × group
Communicative style				
Nonintervening	—	0.10	0.02	0.05
Explaining	—	1.73	0.04	0.53
Directing	2.10	0.04	0.01	1.07
Speaking behavior				
Speaking rate	—	0.49	0.04	3.18
Language complexity	8.07**	6.92**	2.08	0.11

**$p < 0.01$.

at-risk children resulted from an initial test session when all the children were fluent and a follow-up session 1 year later. Through systematic periodic observation, 26 children who remained fluent and 26 children who developed stuttering were prospectively identified.

One question explored by this study was whether or not the children who began to stutter differ from those children who continued to speak fluently with regard to the development of their articulatory and linguistic skills. Another was whether or not the mothers of those children who began to stutter showed specific changes in their communicative style and speaking behaviors which were not present among those mothers of the nonstuttering children.

With regard to the development of the articulatory and linguistic skills of the children under study, our results demonstrated quite clearly that both the children at risk who became stutterers as well as those who remained fluent followed the same pattern of articulatory and linguistic development. That is, the articulation rate and the receptive and expressive language skills in both groups of children increased as they became older.

Of special interest is the pattern of development of the articulatory skills in both groups. This is because it was demonstrated in a previous study (Kloth et al., 1995a) that the preonset articulatory rate of those children who later evidenced stuttering was significantly faster than that of their nonstuttering peers (Kloth, et al., 1995a). A different picture presents itself at the follow-up test session when 26 children were classified as stutterers. At that point of time, the articulatory rate of both the stuttering and nonstuttering children did not differ significantly. Given our data, it is not clear if these results are attributable to a slowing down of the articulatory rate of the stutterers, once they began to stutter, or to a speeding up of the nonstutterers, or to a combination of both. In any event, our results indicate that our youngsters who began to stutter were not characterized by limited speech motor skills. This contention is further supported by the findings of a recent study of Hall and Yairi (1997) in which articulatory rate was assessed in stuttering children (mean age 43.8 months) and nonstuttering children (age 41.3 months) at three occasions 12 months apart. They did not find a statistically significant difference between either the articulatory rate of normally fluent children and young children at the early stage of stuttering or at subsequent recording sessions in which they continued to stutter.

A similar conclusion can be drawn with regard to the development of the measured linguistic skills. The results of the present study suggest that the stuttering and nonstuttering children follow the same course of linguistic development. The current findings do not provide support for either a causative or effective role of language in relation to stuttering. There is no indication that youngsters who subsequently develop stuttering are either linguistically impaired (Kloth, et al., 1995a) or develop language skills more slowly than nonstutterers do. This is supported by the findings of a longitudinal study of

Yairi, Ambrose, Paden, and Throneburg (1996). These authors found that stutterers did score above average on language comprehension and verbal expression, measured both soon after the onset of stuttering and 1 year later. Moreover, the stuttering children did not differ from the nonstutterers on language comprehension and MLU at either of the time periods.

Our results, with regard to the development of articulatory and linguistic skills, are in contrast with research findings which suggest that stutterers are delayed in their speech and language development. The assumption that stutterers are retarded in language skills resulted in most cases from cross-sectional studies in which children who do and children who do not stutter were studied postonset (see Nippold, 1990, for a review). It requires no discussion that a cross-sectional design is an inadequate method for studying developmental aspects. The longitudinal character of our study and the study by Yairi and colleagues (1996) is more suitable to investigate this matter.

With regard to the communicative and speaking behaviors of the mothers, the results of the present study indicate that the mothers of the children who came to stutter did not react differently to the preonset speech of their children than did the mothers of the children who remained fluent. Furthermore, mothers of the former children did not change either their communicative style or their speaking behavior after their children began to stutter. These findings add to our earlier longitudinal data which indicated that neither the communicative style nor the speaking behavior of the mother contributed to the onset of stuttering (Kloth, et al., 1995b). Thus, it may be concluded that the behavior of the mother is not a predictive factor relative to the etiology of stuttering in high-risk children or influenced by the emergence of stuttering.

Overall, it can be concluded that our high-risk preschoolers who began to stutter were not delayed in their speech and language development. Furthermore, our results indicate that the communicative style and speaking behavior of the mothers were not involved in the cause or course of stuttering. These findings are in line with those of Cox, Seider, & Kidd (1984). Based on data attained by interviews and self-report inventories they too found no evidence for the occurrence of specific environmental and developmental predisposing factors for stuttering. In their study the subjects had, just like in our study, a family history of stuttering. Therefore, the possibility exists that our results may be limited to a subgroup of stuttering children; that is to say, children who are genetically vulnerable to developing this form of dysfluent speech. But, if this is the case, the subgroup is likely relatively large since stuttering is known to run in families (Andrews & Harris, 1964; Bloodstein, 1995). In this regard, Ambrose et al. (1993) have found that a child who begins to stutter has a 42% chance of having a stutterer in the nuclear family and a 71% chance in the extended family.

Last but not least, it should be mentioned that our findings may be influenced by the fact that our data were collected in very young children before

and relatively just after the onset of stuttering. These children are still developing speech and language skills. At this point of time in our study it is unclear if and how many of these incipient stutterers recover or develop into chronic stutterers. In other words, it is possible that our 26 incipient stutterers are not a homogeneous group. Therefore, it may be that at a later date, when the dysfluent speech of our beginning stutterers becomes a persistent problem, the contribution of environmental and developmental factors may become evident. A follow-up study with updated results with respect to those children who recover from stuttering and to those who continue to stutter is in progress.

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