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Speaking rate, conversational speech acts, interruption, and linguistic complexity of 20 pre-school stuttering and non-stuttering children and their mothers

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Abstract

This is the second in a series of reports concerning stuttering pre-school children enrolled in a longitudinal study; the first was Ryan (1992). Conversational samples of 20 stuttering and 20 non-stuttering pre-school children and their mothers were analysed for speaking rate, conversational speech acts, interruption, and linguistic complexity. Between-group analyses revealed few differences between either the two children or two mother groups. Within-group analyses indicated differences that involved conversational speech acts and linguistic complexity. Most stuttering occurred on statements ($M = 32.3\%$ stuttered) and questions ($M = 20.9\%$ stuttered). Stuttered and disfluent sentences had higher Developmental Sentence Scoring (DSS) (Lee, 1974) scores ($M = 10.9$, 12.9, respectively) than fluent sentences ($M = 7.6$). Multiple correlation analyses indicated that speaking rate of mothers (0.561) and normal disfluency of children (0.396) were major predictor variables.

Keywords: stuttering, children, mothers, interruption, language, speaking rate.

Introduction

This is the second in a series of reports concerning stuttering pre-school children enrolled in a longitudinal study. The first (Ryan, 1992), described the speech and language test profiles of 20 stuttering and 20 non-stuttering pre-school children at the outset. The present study describes, compares, and interrelates stuttering and normal disfluency, speaking rate, conversational speech acts, interruption, and language complexity of these same 40 children in conversations with their respective mothers during that same first observation.

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The theoretical basis for this study is the Demands and Capacities model of the development of stuttering as proposed by Starkweather and Gottwald (1990) and recently discussed by Starkweather (1997). Simply stated, this model suggests that the young, developing child does not have the capacity to handle the environmental demands made of him or her. The interactional patterns of children with their mothers are viewed as illustrative of the demands part of this model.

Rapid speaking rate, excessive questioning, interruption, and linguistic complexity have all been suggested as possible maternal behaviours or factors (or environmental demands) that may have contributed to the development of stuttering in early childhood (Johnson and Associates, 1959; Van Riper, 1982; Wall and Myers, 1984; Meyers and Freeman, 1985a,b; Gregory, 1986; Bloodstein, 1987, 1995; Nippold, 1990; Bernstein Ratner, 1993, 1997; Nippold and Rudzinski, 1995; Starkweather, 1997). However, some empirical research investigations of these factors have failed to support their importance. For example, Weiss and Zebrowski (1992) found that maternal questioning did not evoke stuttering, and Kelly and Conture (1992) found no speaking rate or interruption differences between stuttering and non-stuttering children, or their mothers. Little is known about the modelling effects of parents' speech on their children's stuttering. The review of these four factors which follows is necessarily brief because comprehensive reviews exist in Nippold (1990), Kelly (1993), Weiss (1993), Bernstein Ratner (1993, 1997), Nippold and Rudzinski (1995), and Zebrowski (1995).

Speaking rate and childhood stuttering

The role of speaking rates of children who stutter and their mothers in the development of stuttering is not clear. Mixed findings are reported in the literature as to whether the speaking rate of children who stutter and/or their mother's speaking rate contributes to stuttering. The variety of different metrics and methods used to measure speaking rate may have led to this confusion (e.g., articulation rate of only fluent syllables per second vs all syllables or words per minute, total time of talking vs only participant talking time) (Ryan, 1974; Perkins, 1975; Costello, 1981; Ingham, 1984; Kelly and Conture, 1992; Walker, Archibald, Cherniak and Fish, 1992).

Children's speaking rate

Studies have shown pre-school stuttering and non-stuttering children's speaking rates to vary from 148.4 to 204.3 SPM (Johnson, 1980; Pindzola, Jenkins and Lokken, 1989; Kelly and Conture, 1992; Ryan, 1992). Meyers and Freeman (1985c) reported that the speaking rate of 12 moderate to severe stuttering pre-school children was significantly slower than that of their 12 non-stuttering counterparts and that speaking rates were significantly negatively correlated to disfluency percentage. In contrast, Kelly and Conture (1992) and Ryan (1992) both observed no significant difference in speaking rates between stuttering and non-stuttering children. The reason for these differences is probably that those subjects in Meyers and Freeman stuttered more severely.

Maternal speaking rate

Meyers and Freeman (1985c) observed that mothers of stuttering children spoke faster with their children than did mothers of non-stuttering children with their

children. Kelly and Conture (1992) reported that the speaking rates of mothers of stutterers and non-stuttering children did not differ. Meyers and Freeman found that mothers' speaking rates were negatively correlated ($r = -0.25$) to their children's, and positively correlated to their children's percentage disfluency ($r = 0.21$). Guitar, Schaefer, Donahue-Kilburg and Bond (1992) also found that a mother's speaking rate was correlated significantly ($r = 0.63$) with her child's stuttering rate. Zebrowski, Weiss, Savelkoul and Hammer (1996) found mixed effects of reducing mothers' speaking rates on their children's stuttering.

Conversational interaction between stuttering children and their parents

In a group of studies by Egolf, Shames, Johnson and Kasprisin-Burrelli (1972), Kasprisin-Burrelli, Egolf and Shames (1972), and Shames and Egolf (1976), parent–child conversations were observed during 15-minute conversational formats. Their basic finding was that parents of children who stuttered used more negative comments than did parents of non-stuttering children.

Mordecai (1979) studied 20 parent–child triads (mothers, fathers and children) involving stuttering and non-stuttering pre-school children. Two of 10 comparisons showed significant differences. 'Parents of stutterers were found to more frequently allow inadequate opportunities for their children to respond to questions before asking another question or making another statement' and 'Parents of nonstutterers were found to comment more frequently on their child's preceding utterances' (p. 83). Mordecai considered these findings to be consistent with those of Egolf *et al.* (1972) and Kasprisin-Burrelli *et al.* (1972).

Meyers (1983, 1986) and Meyers and Freeman (1985a,b,c) reported the results from several analyses of the conversational dyads of 12 moderate to severe stuttering and 12 non-stuttering pre-school children with their own mothers and with the other group's mothers in a clinic setting. Meyers and Freeman (1985a) reported that pre-school stuttering children produced significantly more positive statements and commands, but fewer questions, than did pre-school non-stuttering children. They found that mothers of stuttering children differed from mothers of non-stuttering children only in their less frequent use of routine statements, such as 'thank you' and 'bye', and there were no between-group differences in use of statements, comments, naming/labelling, questions, or imperatives. In a later study Meyers (1989) observed few differences in 12 stuttering children's disfluency (stuttered and normal non-fluency) behaviour during three different conversations with mother, father and a peer, respectively.

Langlois, Hanrahan and Inouye (1986) compared the conversations of eight mild stuttering and non-stuttering children and their mothers in a 'play' situation in their respective homes. They found that mothers of stuttering children produced significantly more imperatives and interrogatives and fewer declaratives.

Interruption in mother–child dyads

Egolf *et al.* (1972), Kasprisin–Burrelli *et al.* (1972), and Shames and Egolf (1976) observed extensive interruption in parent–stuttering child interactions. Meyers and Freeman (1985b) observed that mothers of non-stuttering children interrupted the disfluent speech of stuttering children more often than their own mothers did, and that disfluent speech was interrupted more often than was fluent speech by both sets

of mothers. Guitar *et al.* (1992) found that parental interruptions decreased concurrently with their child's decrease in stuttering. Kelly and Conture (1992) found no differences in interruption between stuttering and non-stuttering parent–child dyads.

Linguistic complexity

Many researchers (e.g., Wall and Myers, 1982, 1984; Homzie and Lindsay, 1984; Nippold, 1990; Weiss, 1993; Bernstein Ratner, 1997) have concluded that a linguistic factor plays a role in early childhood stuttering, although its exact nature is not known. It may be that young stuttering children have an underlying deficiency in language skills (Moore and Boberg, 1987), which would account for consistent findings of slight differences in linguistic proficiency between stuttering and non-stuttering children (e.g., Byrd and Cooper, 1989; Ryan, 1992).

Examples of such studies, which are highly related to this study because they used the Developmental Sentence Score (DSS) (Lee, 1974) to determine complexity in conversational speech, include the following. Westby (1979) measured the DSS for connected speech of 10 stutterers, 10 highly disfluent non-stutterers, and 10 typically disfluent non-stutterers from kindergarten and first grade and found no significant differences among the three groups. Also using DSS, Gaines, Runyan and Meyers (1991) analysed the conversational utterances of the 12 pre-school stuttering subjects from the Meyers and Freeman studies (1985a,b,c). They found that sentences in which stuttering occurred were significantly more complex and longer than were fluent sentences, as did others (e.g., Bernstein Ratner and Sih, 1987; Logan and Conture, 1995).

Summary

It is apparent from this short review of the literature that the relationship of mother and child speaking rate, conversational speech acts, interruption, and linguistic complexity to stuttering in children is uncertain at best. The role of speaking rates of children who stutter and their mothers in the development of stuttering is not clear. Few conversational speech acts including questioning have been shown to vary significantly between stuttering and non-stuttering pre-school mother–child dyads. Only the study of Langlois *et al.* (1986) found significant differences in mother–child stuttering and non-stuttering dyads. Among the little that is known about the role of interruption, there have been mixed findings. Early, less-well-designed studies suggested differences in linguistic ability between stuttering and non-stuttering children which may have contributed to their stuttering. Later studies have shown no significant differences between the two groups. The only conclusive, consistent, major finding is that more complex linguistic utterances tend to be accompanied by more stuttering. The relationship between mothers' linguistic complexity and that of their stuttering children (modelling effect) has been little studied (Nippold, 1990; Bernstein Ratner, 1997). Relatively little is known about the long-term or modelling effects of any of the above behaviours, the research of Yairi and associates not withstanding (e.g., Yairi, Ambrose, Paden and Throneburg, 1996).

The original reason for this study was simply to examine mother–child interactions as described by the factors of speaking rate, conversational speech acts (e.g., questions), interruption, and linguistic complexity (Ryan, 1984) to discover those variables that might be of value to follow up during longitudinal study. At this time

the major motivations for reporting the results of this study are: (a) to provide additional data of replication of previous studies, and (b) to look for possible interactions or patterns of behaviour between, within and among the above four factors between and within the two groups of stuttering and non-stuttering children and their respective mothers for new information.

The following research questions were posed:

(1) Are there differences between and within stuttering and non-stuttering children's groups for stuttering and normal disfluency, speaking rate, conversational speech acts, interruption and linguistic complexity?
(2) Are there differences between and within the two respective mother groups of stuttering and non-stuttering children for these same variables?
(3) Are there correlations (patterns) between and among selected individual and groups of variables for children and mother groups alone and with each other?

Method

Participants

The stuttering participants (male $n = 15$, female $n = 5$) were referred by their parents, and the non-stuttering participants (male $n = 15$, female $n = 5$) were recruited from neighbouring pre-schools. The stuttering children had a mean age of 4 years, 4 months (SD = 8.7 months) with a range of 2 years, 10 months to 5 years, 9 months. Their mothers had a mean educational level of 14.5 years. The non-stuttering children had a mean age of 4 years, 5 months (SD = 9.1 months) and a range of 2 years, 10 months to 5 years, 9 months. Their mothers had a mean educational level of 15.1 years. Participants were matched on age (within 4 months), gender, and mothers' educational level (within 2 years). A stuttering child had to meet these criteria: (a) more than 3.0 stuttered words per minute (SW/M), defined as struggle, prolongation, part-word repetition, and whole-word repetition during the Fluency Interview (FI) (Ryan, 1974, 1992; Ryan and Van Kirk, 1978), (b) English as their first language and (c) perception by an ASHA-certified speech–language pathologist and one or both parents as a child who stuttered. The non-stuttering children also (a) spoke English as their first language, (b) showed less than 3.0 SW/M during the FI, and (c) were perceived by both parents as not stuttering. In addition, no participant had received speech–language therapy prior to the study, medical and psychological histories reported no major problems, and hearing tests revealed that all had hearing within normal limits. The articulation, language, and fluency behaviours of these children on formal tests have been described previously (Ryan, 1992). These data indicated that the stuttering subjects, as a group, had a few slightly lower test scores, but none had a language problem.

Setting, tasks, instructions, and equipment

The data were collected at a University Speech and Hearing Clinic. Following 95 minutes of speech and language testing (Ryan, 1992), including a 15-minute break, two 10-minute mother–child conversational interactions were recorded. The mother and child sat at a table across from each other. During the first 10 minutes mother

and child conversed while playing with Lego, which served as a warm-up, adaptation period. The 10-minute conversational period that followed included only conversation and no toys were available. For both periods, mothers were instructed to: (a) 'have a normal conversation', (b) 'avoid singing, counting, telling stories, and repeating nursery rhymes' with the child, (c) 'be natural' while 'keeping the child in the chair' (on camera), and (d) 'sit up straight with the small of your back against the chair in a comfortable position' (to stay on camera).

Each interaction took place in a 20 by 30 ft clinic room with two video cameras (Panasonic WV-CD 130), one focused on each speaker's face (split-screen recording), providing facial close-ups of both mother and child. The videotape recorder (Sony U-matic VO 2800) was in another room. In addition, an audio recording was made simultaneously on a Sony Superscope C-104 tape recorder to ensure optimum sound quality and a back-up record.

Transcription of conversation

The first 60 turns for each mother and child (120 total turns) of the 10-minute conversation portion were transcribed by a trained and supervised undergraduate or graduate student following a specific set of rules (Allen, 1990). At least six, and most often seven, different people (including a three-person jury who discussed and resolved disagreements with the written script until they reached consensus) saw each videotaped sample and verified the accuracy of the transcript according to written rules (Allen, 1990). The author was the final reviewer. These transcripts were used for all subsequent stuttering, speaking rate, conversational speech act and linguistic analyses. Instances of speaker overlap or interruptions were indicated as described in the Appendix. The final transcripts and subsequent analyses represented the work of several supervised and trained students and were confirmed by the author with further reliability checks performed by independent observers as necessary.

Stuttered and normal disfluencies and speaking rate

Thirteen undergraduate and graduate students were trained and supervised to do the time and count analyses of words, syllables, and stuttered, and normally disfluent, words in the transcripts following written instructions. Four types of stuttering (struggle, prolongation, part-word repetition and whole-word repetition) and four types of normal disfluency (interjection, revision, phrase repetition and incomplete phrase) were counted (Johnson, 1961; Ryan, 1974; Ryan and Van Kirk, 1974, 1978; Ryan and Ryan, 1983). The presence and type of stuttering and normal disfluency were marked on the transcript. Rates of stutterings and normal disfluencies were calculated by dividing their number by total talking time, which yielded measures of stuttered words per minute (SW/M) and normal disfluencies per minute (D/M).

Audiotape recordings of these parent–child interactions were used to obtain speaking rate measures. The mother was timed first, then the child. Only actual talking time was measured using a hand-held stopwatch. When the speaker stopped talking, the person timing stopped timing, so that pauses were not included. This procedure is discussed in Ryan (1974) and Ryan and Ryan (1983, 1995). A stopwatch was used to make the results generalizable to common clinical settings. These results were used to compute stuttered words per minute (SW/M), normal

disfluencies per minute (D/M), words spoken per minute (W/M), and syllables spoken per minute (SPM).

Articulation rate (AR) was determined using a slightly modified version of that first described by Perkins (1975) and later by Costello (1981). The modification was that some stuttering children produced fewer than 15 fluent utterances in the 60-turn sample. Up to 15 of each participant's longest (over four syllables), fluent utterances were selected for analysis. They contained no pauses, stutterings, normal disfluencies, or unintelligible utterances, but single words and one or more sentences were included as long as they were one breath group. These were timed and the number of syllables counted for each fluent utterance. The total number of syllables for all utterances was divided by the total number of seconds to yield articulation rate (AR) of fluent syllables spoken per second (S/S) for each participant.

All timing procedures were done to a tenth of a second, at least twice by the observer. If greater than 90% agreement was achieved between the first two timings, the first of these was used. If less than 90% agreement was achieved, a third timing was done, and the average of three was used.

Conversational speech act coding

To study mother and children's conversational interactions, their comments and actions during their conversations were cast into the form of conversational speech acts (e.g., questions, see Appendix). Previous conversational speech act coding systems were devised primarily to analyse psychological interactions (Patterson, Ray, Shaw and Cobb, 1969; Kasprisin-Burrelli *et al.*, 1972; Mordecai, 1979) or language learning environment (Moerk, 1975; Dore, 1977; Snow and Ferguson, 1977). The coding system used in this study focused on verbal behaviour and concurrent fluency of both children and adults, and incorporated aspects of these systems available (see above) in 1982 when this study was started.

Nineteen different codes were used: the main 12 were mutually exclusive verbal conversational speech acts ('acknowledge, answer, automatic, command, correction, laugh, negative, positive, prompt/prod, question, statement,' and 'other'). Five were descriptors: 'stuttering, disfluency, overlap-simultaneous start, overlap-interrupter,' and 'overlap-interruptee' which were applied to one or more of the previous 12 codes (e.g., a question might be overlapped). Finally, two codes ('compliance' and non-compliance') were also used concurrently with another code (e.g., an answer could also be coded as compliance in certain contexts). These were the codes that were common, reliably observed, often accompanied by stuttering and disfluency, and permitted coding of each turn. The Appendix contains these codes, their definitions and examples. Additional description will be found in Allen (1990) and Marsh (1989).

A copy of the transcript was then used to code the above 19 behaviours for all 40 mothers and children by one of 11 trained and supervised graduate students, with 12 done by the first author of the coding system. During the coding, each coder viewed the videotape recording and listened to the audiotape recording, as the sound was occasionally better on the audio recordings.

DSS scoring

Copies of the 60-turn transcripts were then used to select sentences for DSS analysis. There were 11 graduate students trained and then supervised to select and score

sentences. Training materials included copies of Chapter 4 from Lee (1974) and selected portions from Lively (1984).

One modification was made in Lee's scoring system (Lee, 1974) in order to score both children and adults similarly. Lee suggested that sentences such as 'I can't', or 'Didn't he?', receive no sentence points. Lee proposed that these were shortened versions which, for children, may not accurately reflect their ability to produce the longer form. In this analysis, both adults and children were given both verb and sentence points for sentences of this type, because of their high frequency of occurrence and the assumption that the adult could produce the longer version of this form.

Reliability

Stutterings, normal disfluencies, and speaking rates

The author or one of the two experienced graduate students supervised initial transcription and marking of stutterings or normal disfluencies. The author (a highly experienced observer) listened to each recorded sample while reviewing each transcript to confirm each marked stuttering and normal disfluency. Two reliability probes were conducted. An independent observer selected 10 subjects (25% of the sample of 40 children) at random and counted total disfluencies (stuttered and normal) and found $M = 97\%$ agreement with the counts from the transcripts. Two other observers independently counted stutterings in 33 of the 40 (83%) children's samples which yielded $M = 93.2\%$ agreement between their counts.

An observer reviewed a sample of six unmarked scripts (three mothers, three children) and marked the stuttered and normal disfluencies on the scripts, following original instructions. These point-to-point markings were then compared to those on the original marked scripts and percentages of agreement determined. The percentages of agreement for children were $M = 86.2\%$ and for mothers, $M = 92.7\%$.

Another observer independently retimed and recounted words and syllables of 48 of the 80 (60%) mother and children samples. Percentages of agreement between this count and the original counts for both observers for each of the three rate metrics were: articulation rate (AR), $M = 95.6\%$; words per minute (WS/M), $M = 97.2\%$; and syllables per minute (SPM), $M = 97.0\%$. This observer also recounted 31 samples and compared them to this observer's initial counts. This yielded an intra-judge percentage of agreement of 97.4%.

Coding conversational speech acts

Inter-judge reliability was estimated by comparing a sample of four coders of six subjects' interactions (three stuttering and three non-stuttering, 360 conversational turns) with that of one author of the coding system (Marsh, 1989). There was a $M = 98.2\%$ agreement for the four pairs of observers.

DSS

The first reliability check involved having three graduate student scorers independently select and score sentences from a randomly selected 45-turn sample (23 turns for mother and 22 turns for child that contained 20 scoreable sentences—10 sentences each for mother and child). These six scorings (three for mother and three for child) were compared to the author's previous scoring. The percentage agreement for sentence selection between the author and the three student's six scorings was $M = 96.8\%$ and for DSS scoring $M = 94.5\%$. In addition, the author and two trained

independent observers rescored each of the 40 transcripts for each mother and child. The percentage of agreement between the author and the first of these two observers for total DSS score for children was $M = 92.0\%$ and between the author and the second observer for mothers, $M = 91.7\%$.

For all of the above analyses, in all cases of disagreement, the data of the more or most experienced observer were used.

Results

Two- and three-factor ANOVAs (group × gender, and in some analyses, × repeated measures) were used to analyse the children's data; one- or two-factor ANOVAs (group, and in some analyses, × repeated measures) were used for the mother's data. All statistical analyses involving percentages were analysed following arcsin transformations, but are reported as percentages to facilitate their discussion. All statistical tests used the BMDP statistical program (Dixon, 1983).

The means and standard deviations for the two groups of children and two groups of mothers for 26 variables (9 speaking; 8 conversational speech acts, 8 types × 3 metrics = 24; 4 interruption, 4 types × 3 metrics = 12; and 5 linguistic) are shown in tables 1–4. Multiple measures (e.g., both words per minute and syllables per minute, and percentages and frequency of conversational speech acts) are presented to ease comparison with findings from other studies. If the results were similar for both frequency and percentage data, only the inferential statistical analysis for the frequency data is presented. If percentage was more meaningful than frequency, only percentage analysis is presented. A Bonferroni adjustment of alpha levels (Miller, 1981), alpha level divided by number of tests, to protect against Type I error, was done in the following difference analyses. Alpha levels of less than 0.05 to determine significance were used and reported.

Speaking rate and stuttered and normal disfluency

Table 1 presents the means and standard deviations for speech variables for both children and mothers. The 60-turn transcripts averaged 288.4 words, SD = 88.3 (M and SD = 1.70, 0.5 min talking time, Ryan, 1974) for children and 550.5 words, SD = 131.9 (M and SD = 1.97, 0.5 min talking time) for mothers. Most samples represented the first 5–7 min of the 10-min conversations. Few significant differences were found between the groups of stuttering and non-stuttering children. Stuttered words per minute, percentage of stuttered words and syllables, as expected, differed significantly between the groups.

There were no differences in stutterers' and non-stutterers' speaking rate. The problem of finding long, fluent utterances for stuttering children which are comparable to those of non-stuttering children in order to accurately determine articulation rate arose in this study, also (see Meyers and Freeman, 1985c; Starkweather, 1985; Gaines *et al.*, 1991). Starkweather maintained that long utterances result in different articulation rates compared with short utterances. Analysis revealed there was no significant difference in syllable length of fluent utterances between non-stutterers and stutterers (M and SD = 7.7, 1.3 and 7.3, 2.0, respectively, $t(38) = 0.58$, n.s.).

Table 1. *Means (M) and standard deviations (SD) of nine speech fluency, rate, and total word and syllable output variables for 20 stuttering and non-stuttering pre-school children and their mothers*

	Children				Mothers			
	Stuttering		Non-stuttering		Stuttering		Non-stuttering	
Variable	*M*	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)
Stuttered words/min (SW/M)	12.0	(6.0)	2.2*	(1.2)	2.2	(1.1)	0.9	(1.1)
Normal disfluencies/min	7.8	(4.2)	8.9	(3.4)	4.3	(3.3)	4.9	(2.4)
Words/min	170.0	(35.8)	169.1	(17.9)	283.6	(35.2)	276.7	(29.1)
Syllables/min (SPM)	202.6	(37.9)	205.6	(24.8)	334.3	(38.6)	331.2	(34.0)
Articulation rate†	4.1	(0.7)	3.8	(0.6)	6.2	(0.7)	6.4	(1.0)
Stuttered words (%)	7.4	(3.9)	1.3*	(0.7)	0.3	(0.4)	0.3	(0.3)
Stuttered syllables (%)	6.1	(3.0)	1.1*	(0.6)	0.3	(0.4)	0.3	(0.4)
Total words spoken	298.7	(94.0)	278.1	(83.4)	556.5	(123.2)	544.5	(143.0)
Total syllables spoken	332.2	(86.1)	327.9	(19.0)	659.6	(142.8)	653.2	(173.0)

*$p < 0.05$ for difference between two groups of children.
†Articulation rate in fluent syllables per second.

Conversational speech acts

Children

Of the 12 conversational speech acts, only eight (all verbal, all mutually exclusive) occurred often enough to be analysed. The acts of automatic, laugh, compliance, and non-compliance occurred neither independently nor frequently enough to be included. The first comparison was of the children for the three measures of frequency (number of times the act occurred), percentage (the number of times a specific act occurred divided by the total occurrence of all acts), and percentage each act was stuttered (the number of stuttered specific acts divided by the total number of specific acts). Means and standard deviations are presented in table 2.

There were no significant differences on the eight variables between stuttering and non-stuttering children or between genders, but significant main effects were found for frequency of acts [$F(7,252) = 77.3$, $p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$]. Newman–Keuls *post-hoc* analyses revealed the major finding that answers, statements and questions (combined $M = 23.7$, 17.8, and 13.1, respectively) occurred significantly more often than did the other five acts ($p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$).

Of special interest was the occurrence of stuttering with a particular act. A three-factor ANOVA (group × gender × repeated measures, conversational speech acts percentage of acts stuttered) revealed a main effect for the percentage of acts stuttered [$F(7,252) = 11.6$, $p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$]. A Newman–Keuls analysis found that statements ($M = 25.5$) and commands ($M = 17.4$) were stuttered significantly more often ($p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$) than were answers, corrections, other, and prompts/prods ($M = 9.5$, 9.05, 0.65, and 0.05, respectively).

In addition, there was a significant interaction effect between groups (stuttering

Table 2. *Means (*M*) and standard deviations (SD) for eight conversational speech acts for 20 stuttering and 20 non-stuttering pre-school children and their mothers*

		Children				Mothers			
		Stuttering		Non-stuttering		Stuttering		Non-stuttering	
Act	Metric	*M*	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)
Question	Frequency of acts	12.8	(6.6)	13.3	(6.9)	45.3	(11.9)	44.2	(10.9)
	% of acts†	17.7	(9.2)	19.5	(10.5)	43.8	(9.7)	41.7	(7.1)
	% stuttered‡	20.9	(17.3)	3.8*	(0.8)	1.0	(2.5)	1.7	(2.3)
Answer	Frequency of acts	23.5	(8.3)	23.9	(6.1)	7.5	(4.1)	9.0	(7.6)
	% of acts	36.1	(13.9)	35.9	(11.2)	6.9	(3.5)	7.7	(5.8)
	% stuttered	14.7	(7.3)	4.5*	(5.0)	0.0	(0.0)	0.0	(0.0)
Statement	Frequency of acts	18.4	(10.4)	17.1	(8.9)	20.9	(9.2)	17.0	(9.1)
	% of acts	25.6	(11.1)	24.4	(9.6)	19.0	(7.6)	15.6	(6.9)
	% stuttered	32.3	(17.5)	8.6*	(9.0)	2.1	(4.2)	0.9	(1.0)
Command	Frequency of acts	5.0	(3.0)	3.9	(2.7)	12.2	(6.5)	14.0	(10.3)
	% of acts	7.5	(4.4)	5.8	(4.2)	11.2	(5.7)	12.8	(9.7)
	% stuttered	24.6	(21.6)	10.1*	(15.8)	2.3	(5.2)	1.0	(2.2)
Correction	Frequency of acts	1.1	(1.3)	0.5	(0.8)	1.0	(1.2)	1.0	(1.3)
	% of acts	1.5	(2.0)	0.8	(1.2)	0.9	(1.6)	0.9	(1.1)
	% stuttered	18.1	(35.1)	0.0*	0.0	2.5	(11.2)	1.7	(7.5)
Acknowledge	Frequency of acts	3.2	(2.7)	3.4	(2.9)	11.3	(5.0)	12.4	(7.7)
	% of acts	4.0	(2.9)	4.2	(3.3)	10.5	(4.3)	12.2	(8.0)
	% stuttered	1.3	(4.1)	0.0	0.0	0.0	0.0	0.0	0.0
Prompt/prod	Frequency of acts	0.3	(0.7)	0.4	(0.9)	5.0	(4.9)	4.4	(4.1)
	% of acts	0.3	(0.7)	0.5	(1.1)	4.5	(3.8)	5.4	(3.5)
	% stuttered	0.1	(0.3)	0.0	0.0	0.0	0.0	0.0	0.0
Other	Frequency of acts	3.4	(2.8)	3.7	(3.3)	1.2	(1.6)	0.9	(1.5)
	% of acts	4.1	(3.7)	4.5	(3.9)	1.7	(3.8)	3.0	(5.2)
	% stuttered	1.3	(4.0)	0.0	0.0	0.0	0.0	0.0	0.0

*$p < 0.05$ for difference between two groups of children.
†Percentage of all conversational speech acts (e.g., 10 questions of 100 acts = 10%).
‡Percentage of this act stuttered (e.g., two stuttered questions of 10 = 20%).

vs. non-stuttering) and percentage of conversational speech acts stuttered [$F(7,252) = 4.4$, $p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$]. A Newman–Keuls analysis of the 16 means (two groups, eight acts) revealed the following. For stuttering children the most stuttering occurred, in order from most to least, on statements, commands, questions, corrections and answers. For non-stuttering children commands produced the most stuttering followed by statements, answers, questions and corrections. Stuttering children demonstrated significantly more stuttering ($p < 0.01$ to $p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$) than did the non-stuttering children in each of the comparisons on the five major acts of questions, answers, statements, commands and corrections. These same five acts were stuttered significantly more ($p < 0.05$,

Bonferroni adjusted $0.05/3 = 0.017$) by the stuttering children than any of the other 11 conversational speech acts for both stuttering and non-stuttering children. Lest frequency of occurrence alone was responsible for the stuttering, a correlation between rank orders of frequency and percentage stuttered for both groups of the children was done. This revealed a moderate, but non-significant $r_s = 0.61$, which suggested that frequency of occurrence was not completely responsible for the occurrence of stuttering. Finally, no analysis of normal disfluencies and conversational speech acts is reported here, but Marsh (1989) found no differences.

Mothers

Two-factor ANOVA comparisons found statistically significant differences in the frequency of occurrence of conversational speech acts [$F(7,266) = 165.7$, $p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$]. A Newman–Keuls analysis of the comparable percentage means (questions, 42.7%; statements, 17.3%; commands, 12.0%; acknowledgements, 11.3%; answers, 7.3%; prompt/prods, 4.9%; corrections, 0.9%; and other, 0.8%). indicated that questions (which were almost three times as common as the next form), statements, commands and acknowledgements occurred significantly more often ($p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$) than did the other four forms. Because there were no differences between the two groups of mothers and two groups of children, their data were combined into a children's group and a mother's group to portray the overall pattern of conversation speech act interaction between mothers and children. These means are shown in figure 1. The pattern for mothers was to ask many questions (around 45% of all utterances) and the children to respond with answers (their most frequent conversational speech act, accounting for around 24% of their utterances, although half of the questions were not answered. Second, for both mothers and children, was statements (around 18%). Least frequent for children were prompts/prods (around 0.3%) and least for mothers was correction (around 1%).

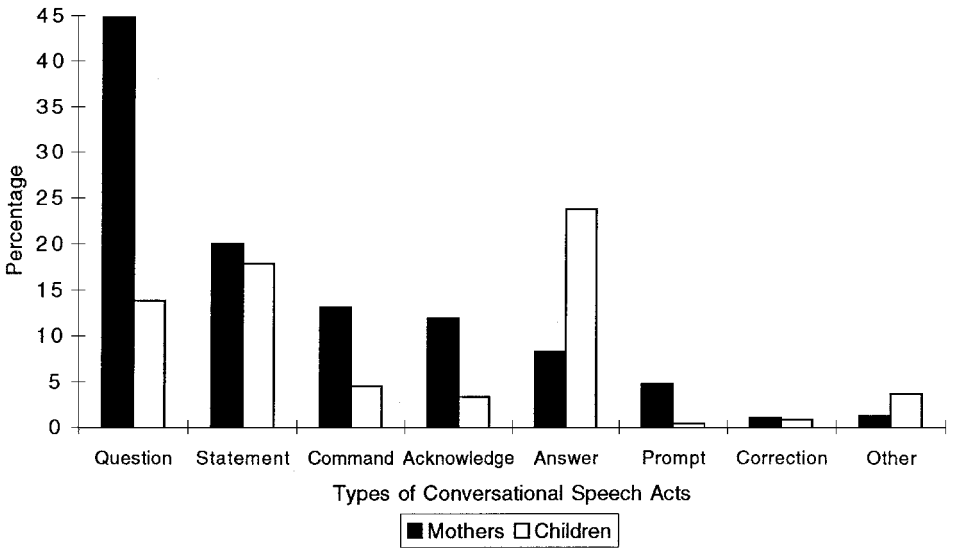

Figure 1. *Percentages of conversational speech acts for 40 mothers and 40 children.*

Interruptions

The means and standard deviations for interruptions are shown in table 3. There were no differences between the stuttering and non-stuttering children or mother groups on frequency or percentage of interruption. As expected, stuttering children evidenced higher percentages of interruption that were stuttered than did non-stuttering children [$F(1,36) = 15.7$, $p < 0.05$, Bonferroni adjusted $= 0.05/3 = 0.017$].

Three three-factor ANOVAs (group × gender × repeated measures) were run for frequency and percentage of occurrence, and percentage of forms stuttered of the three forms of interruption (simultaneous start, interrupter and interruptee) for the two groups of children. The frequency of occurrence analysis found only a main effect across the three types [$F(2,72) = 4.77$, $p < 0.05$, Bonferroni adjusted $= 0.017$]. A Newman–Keuls *post-hoc* analysis revealed there were significantly ($p < 0.05$) more simultaneous starts ($M = 5.2$) than either interruptee ($M = 4.0$) or interrupter ($M = 3.3$).

For the children, a third ANOVA analysis of stuttering percentage revealed the expected main effect for groups [$F(1,36) = 12.1$, $p < 0.05$, Bonferroni adjusted $0.05/3 = 0.17$], with the stutterers stuttering more during interrupted utterances than non-stutterers. No differences were found among the three types of interruptions combined for the two groups of children although the means were quite different (simultaneous starts $M = 7.9$, interrupter $M = 18.6$ and interruptee $M = 17.1$). This was probably due to the large variance in scores, from 0% occurrence to 100%. It should be noted, however, that stutterers demonstrated the most stuttering when

Table 3. *Means (*M*) and standard deviations (SD) of total and three types of interruption for 20 stuttering and non-stuttering pre-school children and their mothers*

	Children				Mothers			
	Stuttering		Non-stuttering		Stuttering		Non-stuttering	
Type and metric	*M*	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)
Total interruption								
Frequency	11.5	(6.8)	13.3	(9.8)	11.5	(6.8)	13.3	(9.8)
% of turns†	19.2	(11.3)	22.1	(16.3)	19.2	(11.3)	22.1	(16.3)
% stuttered‡	20.1	(14.0)	4.7*	(5.9)	4.6	(10.3)	0.9	(12.4)
Simultaneous Start (SS)								
Frequency	5.2	(3.4)	5.2	(3.0)	5.2	(3.4)	5.2	(3.0)
% of interruption	46.2	(20.8)	41.5	(14.8)	46.2	(20.8)	41.5	(14.8)
% SS stuttered	11.7	(16.4)	4.1	(8.4)	1.1	(3.6)	0.8	(3.7)
Interrupter (OR)								
Frequency	3.1	(2.7)	3.5	(2.5)	3.3	(2.3)	4.6	(5.7)
% of interruption	24.7	(14.8)	27.1	(15.4)	28.6	(17.0)	31.4	(19.5)
% OR stuttered	25.1	(14.0)	12.1	(25.6)	9.0	(24.6)	1.0	(4.5)
Interruptee (OE)								
Frequency	3.3	(2.3)	4.6	(5.7)	3.1	(2.7)	3.5	(2.5)
% of interruption	28.6	(17.0)	31.4	(19.5)	24.7	(14.8)	27.1	(15.4)
% OE stuttered	31.1	(35.0)	3.2	(8.0)	5.7	(22.4)	1.3	(4.1)

*$p < 0.05$ between the two groups of children.
†Percentage of 60 turns where one or more interruptions occurred.
‡Percentage of interruptions stuttered.

they were the interruptee ($M = 31.1\%$). No analysis of normal disfluencies and interruption is reported here, but Marsh (1989) found no differences.

A similar pattern of findings prevailed for the mothers for frequency, [$F(2,76) = 7.54$, $p < 0.05$, Bonferroni adjustment $0.05/3 = 0.017$]. There were no significant differences in stuttering percentage for the mothers across the various types of overlap or interruption frequencies.

Developmental Sentence Scoring (DSS)

The means and standard deviations for DSS measures are shown in table 4. A two-factor ANOVA (group × gender) revealed no significant difference for Developmental Sentence Scores total (DSS) between the stuttering and non-stuttering children groups. A one-factor ANOVA between mother groups also found no difference.

Next, three types of sentences were analysed: (a) fluent (DFL), those with no stuttering or disfluency; (b) stuttered (DST), those with at least one stuttering which may also have included one or more normal disfluencies; and (c) disfluent (DDY), those with no stuttering, but at least one normal disfluency. The number of sentences available in each of these calculations varied. They were dissimilar for the stuttering children vs non-stuttering children comparisons (*M*s for DST = 11.4, 2.4; DDY = 2.4, 4.6; and DFL = 15.6, 20.4 sentences, respectively). They were very similar for the mothers of stutterers vs mothers of non-stutterers comparisons (*M*s for DST = 1.2, 1.5; DDY = 3.2, 3.4; and DFL = 45.6, 45.1, respectively).

A three-factor ANOVA (group × gender × repeated measures of different DSS sentence type: DSS for fluent sentences, DSS for disfluent sentences, or DSS for stuttered sentences) for children indicated a significant main effect for sentence type [$F(2,72) = 15.41$, $p < 0.05$, Bonferroni adjusted $0.05/3 = 0.017$]. A Newman–Keuls analysis revealed that both stuttered (DST) and disfluent (DDY) sentences (DSS *M*s = 11.50 and 11.89, respectively) obtained significantly ($p < 0.05$) higher DSS scores than did fluent (DFL) sentences (DSS $M = 8.1$). A similar analysis with the mothers' DSS data yielded similar findings. Both groups of mothers had significantly higher DSS scores for DST and DDY sentences than for DFL sentences.

Table 4. *Means (*M*) and standard deviations (SD) of four DSS scores and total number of sentences for 20 stuttering and non-stuttering pre-school children and their mothers*

	Children				Mothers			
	Stuttering		Non-stuttering		Stuttering		Non-stuttering	
Variable	*M*	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)
DSS†	8.9	(2.4)	9.5	(1.8)	11.9	(1.1)	12.2	(1.5)
DSS fluent‡	7.6	(1.7)	8.6	(1.3)	11.7	(1.2)	12.0	(1.5)
DSS disfluent§	12.9	(5.3)	10.9	(2.7)	16.1	(7.0)	16.2	(5.3)
DSS stuttered¶	10.9	(3.8)	12.1	(5.1)	12.6	(4.1)	18.5	(7.5)
Number of sentences	29.4	(8.9)	27.4	(7.8)	50.0	(0.0)	50.0	(0.0)

†Developmental sentence score (Lee, 1974) for all sentences.
‡Developmental sentence score for only fluent sentences.
§Developmental sentence score for only normally disfluent sentences.
¶Developmental sentence score for only stuttered sentences.

Note: There were no statistically significant inter-group (mothers or children) differences.

Thus, in answer to research question one, there were no major differences between the two groups of children except for stuttering. In answer to research question two, there were none that pertained to the research purposes of this study between the two groups of mothers. There were some interesting within-group differences (e.g., children demonstrated the most stuttering on statements, and mothers most often used the speech act of questions).

Correlations

Single

Pearson *r* correlation coefficients between pairs of all 50 variables (26 stuttering, normal disfluency, conversational speech acts, interruption, and linguistic complexity with various metrics of each, see tables 1–4) were computed for different groups, stuttering and non-stuttering children, their respective mothers, males and females, all children together, and finally, mothers of the two groups with their respective children. Because of the large number of correlations obtained, page limitations of this report, and the focus of this study, only significant correlations for stuttering children and for stuttering children with their mothers are shown in table 5.

For the stuttering children there were six correlations that achieved the 0.05 or 0.01 level of significance most of which concerned age and normal disfluencies. Of interest is the lack of significant correlations between stuttering and any other variables. For mothers of stuttering children with their children, there were only nine correlations which reached the 0.05 or 0.01 level of confidence. Most important was that of mother speaking rate with child stuttering rate ($r = 0.56$).

Multiple correlation

One of the goals of this study was to analyse the interactions between and among the four major variables (speaking rate, conversational speech acts, interruption and linguistic complexity). Previous studies have analysed only one or two of the four

Table 5. *Selected significant correlations for 20 stuttering children and mothers with their stuttering children*

Stuttering children	
Age and syllables per minute	0.49*
Age and DSS score	0.59**
Age and total words spoken	0.58**
Normal disfluencies per minute and syllables per minute	0.53*
Normal disfluencies per minute and articulation rate	0.53*
Normal disfluencies per minute and total interruption	0.46*
Mothers and their stuttering children	
Mother syllables per minute and children syllables per minute	0.59**
Mother articulation rate and children articulation rate	0.62**
Mother articulation rate and children stuttering rate	0.56**
Mother corrections with children normal disfluency	0.66**
Mother corrections with children speaking rate	0.47*
Mother total interruptions with children normal disfluency	0.46*
Mother total words spoken with children normal disfluency	0.48*
Mother total words spoken with children syllables per minute	0.55*
Mother stuttering rate and children total words spoken	− 0.51*

*Degrees of freedom = 18, $p < 0.05$, 0.44. **$p < 0.01$, 0.56.

major variables at a time. In order to do this multiple analysis, a final series of analyses was made using stepwise and all possible subset multiple regression analyses (BMDP 2R, 9R, Dixon, 1983) with the child's stuttering as the dependent variable and selected predictor variables for children alone, mothers alone and both together. The variables were chosen because they represented one of the four areas of interest (e.g., questions for conversational speech acts) or had been observed to have high single correlations with stuttering behaviour (e.g., normal disfluencies).

This was done separately for the stuttering mothers' and children's variables, the non-stuttering mothers' and children's variables, and combined groups. This last total combined group (40 children, or 40 mothers, or 40 mothers–children) analysis was done in case there was a possible children or mothers or mothers–children pattern which could be detected by increasing the number of subjects. Also, there had been minimal inter-group differences. The variable of the children's age was always added as a sixth predictor variable at the end of each analysis because age was highly correlated to many other variables in the preceding single correlational analyses, possibly due to the wide age range of the children (2–5 years). Although AR and SPM were significantly correlated (0.67, 0.68, 0.67, 0.77 for the two groups of children and their mothers, respectively), AR was found to be more powerful than SPM in preliminary analyses; therefore AR was used in the following analyses.

It is suggested that the number of variables be limited to no more than 10–20% of the number of subjects (20 or 40 subjects for most of the analyses yielding two or four variables) in such multiple analyses (Marascuilo and Levin, 1983, pp. 97–98; Glass and Hopkins, 1984, p. 140). This limit was exceeded in some of the analyses discussed below in order to detect a pattern for later study, but only the top six predictor variables (including age) in each of the nine analyses are shown in table 6.

For children the five predictor variables selected for analysis were: normal disfluencies per minute, articulation rate, developmental sentence score, percentage of statements, and total interruption percentage. These five variables represented behaviours of major interest. They had demonstrated correlation patterns in the single correlation and preliminary multiple correlation analyses (especially in 9R of BMDP). For stuttering children, as shown in table 6, the first variable chosen was normal disfluency and the best prediction included age which accounted for 55.2% of the variance. For non-stuttering children, DSS was chosen first and the total, including age, accounted for 33.8% of the variance. This was a pattern quite different from that of the stuttering children, especially for the contribution of age which greatly increased the multiple correlation for stuttering children. For the two groups combined, articulation rate was chosen first, but adding the remaining five variables accounted for only 27% of the variance.

For assessing the relationships between mothers' behaviours and children's stuttering (stuttered words per minute or SW/M), the 10 predictor variables were: articulation rate, percentage of questions, percentage of statements, developmental sentence score (representing maternal language complexity), percentage total interruption, percentage interrupter, total words spoken, prompts/prods, normal disfluencies per minute and stuttered words per minute. These variables, double the number of those for children, represented variables of interest, first, for mothers as models (e.g., stuttered words per minute) and second for mothers' interaction style (e.g., questions). These 10 variables also appeared to have potential combined predictability power in the preliminary multiple analyses (especially, 9R of BMDP).

For mothers of stutterers the first variable selected was mothers' articulation rate

Table 6. *Multiple correlation analyses (*R*) to predict children's stuttering (SW/M) for stuttering and non-stuttering children (C) and their respective mothers (M) and both (combined)*

	Stuttering		Non-stuttering		Combined	
Group	Variable	*R*	Variable	*R*	Variable	*R*
Children						
	Normal disfluency	0.396	DSS	0.496	Articulation rate	0.376
	Statement	0.489	Statement	0.531	DSS	0.410
	Articulation rate	0.516	Normal disfluency	0.553	Statement	0.443
	DSS	0.564	Articulation rate	0.556	Interruption	0.458
	Interruption	0.566	Interruption	0.557	Normal disfluency	0.486
	Age	0.743	Age	0.582	Age	0.520
Mothers						
	Articulation rate	0.561	SW/M	0.340	Statements	0.293
	Normal disfluency	0.627	Normal disfluency	0.398	DSS	0.346
	Questions	0.694	Statements	0.465	SW/M	0.383
	SW/M	0.748	Questions	0.494	Questions	0.455
	Prompt/prod	0.757	Prompt/prod	0.498	Interrupter	0.467
	C Age	0.764	C Age	0.527	C Age	0.473
Mothers and children						
	M Articulation rate	0.561	C DSS	0.496	C Articulation rate	0.376
	C Normal disfluency	0.609	M Prompt/prod	0.667	M DSS	0.458
	M Prompt/prod	0.672	C Statements	0.684	M Normal disfluency	0.519
	C Statements	0.810	C Normal disfluency	0.696	M SW/M	0.564
	C Articulation rate	0.838	M Articulation rate	0.715	M Statements	0.600
	C Age	0.854	C Age	0.721	C Age	0.615

DSS = Developmental Sentence Score, SW/M = stuttered words per minute.

and the total correlation, including age of the children, explained 58.4% of the variance. For mothers of non-stutterers the first variable selected was mothers' stuttered words per minute and, with age, they best explained 27.8% of the variance. Four of the top five variables for the two mother groups were the same, and differed only in the order and the amounts added to the total *R*. Further, articulation rate for mothers of stutterers was replaced by statements in the analysis of mothers of non-stutterers. Finally, the combined mothers group's analysis explained only 22.4% of the variance.

A third (mothers–children) analysis combined the five children predictor variables and the 10 mother predictor variables from the analyses described above. For the stuttering group, mothers' articulation rate was picked first. With child's age the top six predictor variables explained 72.9% of the variance. Two were mother variables and four were child variables. Mothers who spoke fast, and often used prompts/prods, had children with higher stuttering rates. The conversational speech act of prompts/prods was included in this analysis probably because it had such a low correlation with all the other variables or as a suppressor variable.

For the non-stuttering group again four of the variables including age were child

variables, and two were mother variables. Four variables (mothers' articulation rate, children normal disfluencies, mother prompts/prods and children statements) also appeared as stuttering group predictors although in differing order and contribution. The first variable picked was children's DSS and the total correlation, with age, explained 52.0% of the variance. Using both mother and children variables to predict children's stuttering produced higher multiple correlations than using either group individually. This suggests the importance of the analysis of the interaction between mothers and children. The combined analysis selected four different variables (all mother variables) and the one child variable of articulation rate (0.376), with age, taking the R to 0.615 to explain 37.8% of the variance.

In answer to the third research question, there were some interesting significant intra-group single and multiple correlations. There were also a few significant single and multiple correlations between mothers and their children.

Discussion

Speaking rate, stuttering, and normal disfluency

The relationship between speaking rate and stuttering continues to be a puzzle (Meyers and Freeman, 1985c). To further complicate the situation there are at least three speaking rate measurement issues. First (mentioned earlier), speaking rate has been measured in several ways, for example: words or syllables spoken or read per minute (W/M, or SPM) (Ingham, 1984; Ryan, 1974) or as articulation rate (AR) in fluent syllables per second (SPS) or per minute (SPM) (Perkins, 1975; Costello, 1981; Kelly and Conture, 1992; Walker *et al.*, 1992). Second, speaking rate data have been collected differently. Some researchers (e.g. Ingham, 1984) have timed speakers for a set period of time, which often included pauses, while others (e.g. Ryan, 1974, 1992) have timed talking time only, without pauses. Third, as noted by Starkweather (1985), utterance length may affect rate; longer utterances are said more rapidly, or at least are more accurately timed, than are shorter utterances. As a result, valid inter-study comparisons of speaking rate are difficult, if not impossible. Although these issues have previously been addressed in work with adults, children obviously present more problems than adults in this respect because they are likely to pause more often and to have shorter runs of fluent utterances (Starkweather, 1985, 1987). In addition, speaking rate does not have a simple correlation with stuttering rate (e.g., some people who stutter speak at very high rates while others speak noticeably very slowly—Bloodstein, 1995).

Despite all these possible inherent variations, no differences were found in this study in articulation rate, word rate, or syllable rate between stuttering and non-stuttering children, or their mothers. The findings of this study are, in fact, quite similar to those reported by Kelly and Conture (1992) for children (e.g., stuttering children, 202.6 vs 200.2 SPM, respectively), but somewhat different for mothers (e.g., mothers of stuttering children 334.3 vs 250.9 SPM, respectively). Both the mean rates of this study and that of Kelly and Conture appear higher than those of other studies (e.g., Pindzola *et al.*, 1989, for non-stuttering children, 148.4 SPM).

Meyers and Freeman (1985c) found AR values of Ms = 3.51, 4.01, respectively, for stuttering and non-stuttering children and Ms = 5.48, 4.96 for their mothers, respectively. These articulation rates for children are similar to those of this study (Ms = 4.1, 3.8), but differ for mothers (Ms = 6.2, 6.4). Walker *et al.* (1992) found

articulation rates of Ms = 3.7 and 4.1 syllables per second for normal 3- and 5-year-old children, respectively (or an interpolated $M = 3.9$ for 4-year-old children). This is similar to the finding in this study of $M = 4.0$ for our 40 2–5-year-old children. In this study it was found that maternal speaking rate (syllables per minute) or articulation rate (fluent syllables per second) was significantly correlated with the stuttering children's speaking rate (0.59, 0.62, respectively). In contrast, Meyers and Freeman (1985c) found a negative correlation ($r = -0.25$) between the speaking rates of the mothers of stutterers and non-stutterers and their children's speaking rate. This could be explained by the fact that the children who stuttered in the Meyers and Freeman research were moderate to severe stutterers, and spoke slowly.

Meyers and Freeman did report a low, but significant, positive correlation ($r = 0.21$) between mothers' articulation rate and the percentage of their children's disfluency, which may be in error. Re-examination of this finding (Meyers and Freeman, 1985c, table 7, p. 441) indicated that they used 'dfs.: 70. $r = 0.23$ for significance. $*p < 0.05$'. With their 24 subjects (12 mothers and 12 children, the d.f. values should have been 22, as indicated in their table 8 (p. 442), in which case a correlation of 0.23 would not be significant at 0.05. The present study found a higher, significant positive correlation ($r = 0.56$) between mothers' articulation rate and child stuttering rate.

A related observation is that the mothers in this study did not demonstrate either high stuttering or normal disfluency rates, nor stuttering or normal disfluency rates which correlated significantly with their children's stuttering or normal disfluency rates. Kelly and Conture (1992) and Yairi and Jennings (1974) reported similar findings. Finally, stuttering children did not demonstrate more normal disfluencies than non-stuttering children, which is different from the finding of Yairi and Lewis (1984).

Conversational speech acts

The finding of no differences between groups is similar to those of Meyers and Freeman (1985a) for seven different acts, but vary from those of Langlois *et al.* (1986), who found significant differences for declarative, interrogative and imperative acts. Although the conversational speech acts categories varied in definition, the findings of both studies (this study and Meyers and Freeman, 1985a) were similar on those categories which were the same (e.g. questions, statements and imperatives).

Of secondary interest was the observation of more stuttering by children on the conversational speech acts of statements, commands, corrections and questions than on answers. Common, one-word answers were seldom, if ever, stuttered. Long answers which took on the form of statements were similar in stuttering to statements. Weiss and Zebrowski (1992) also concluded that parent questions did not evoke stuttering because there was less stuttering in shorter answers. Most stuttering came during the child's generation process (e.g., statements), during longer and more complex sentences (see DST), or in questions or commands, or corrections which may be seen as more linguistically complex, or communicatively stressful. Wilkenfeld and Curlee (1997), in a single-subject study, found that there were no differences between mothers' statements and mothers' questions in evoking stuttering from their children, which is compatible with the findings of this study. It was the form of statements, not answers, that was selected among the first variables in all

three multiple correlation analyses in this study, suggesting that more talkative children (as measured by percentage of statements) had higher rates of stuttering.

Interruption

There was substantial variability in interruption behaviour, both in frequency of occurrence and in percentage of stuttering when it did occur. The most common event was simultaneous start for stuttering and non-stuttering children, which occurred significantly more often than either interrupter or interruptee behaviours. Simultaneous start may reflect competition for the floor, and is probably a coincidence rather than an anticipated act. It would seem to differ from interrupter and interruptee behaviours, in which it is clear that one of the speakers already has the floor. It was noted that the least amount of stuttering, for stuttering and non-stuttering children, occurred with the simultaneous start type of interruption compared to interrupter and interruptee. One might expect that, because simultaneous start always occurs after silence and at the beginning of an utterance where most stuttering occurs (Bloodstein, 1987, 1995), there would have been more stuttering. However, what might explain this unexpected finding is that often a child interruptee simply stopped talking and gave up the floor, which resulted in no stuttering and produced the normal disfluency, incomplete phrase (Marsh, 1989). Simultaneous start in relationship to stuttering has been little studied.

Meyers and Freeman (1985b) found that mothers of stutterers interrupted their children more than mothers of non-stutterers overall (means = 16.0% vs 13.0%, respectively), but the difference was not significant. Mothers of stuttering children also tended to interrupt children's disfluent speech more often than their fluent speech. Kelly and Conture (1992) found no significant differences in interruption behaviour between children who stuttered and children who did not, or between their respective parents. Interruption may be a normal conversational behaviour which plays little or no role in the development or maintenance of stuttering. This does not preclude the possibility that an individual child may be susceptible to interruption and may stutter in response to it.

Linguistic complexity, DSS

The two groups' of children DSS scores (*M*s = 8.9 and 9.5, respectively) are well within normal limits (Lee, 1974, p. 167). The Lee DSS norms for children aged 4 years, 6 months, are 8.04 (50th percentile) and 9.1 (75th percentile), respectively. The stuttering children did demonstrate slightly lower (non-significant) DSS scores, which is consonant with previous findings of their reduced performances in formal language tests (Ryan, 1992). Enger, Hood and Shulman (1988), Bernstein Ratner and Sih (1987), and Westby (1979) have also noted no significant differences on a variety of language measures (e.g., DSS, MLU) between their stuttering and non-stuttering children.

Correlational analyses revealed significant correlations only between DSS and the variables of age, total words spoken, DSS stuttered and DSS fluent. DSS and total words spoken of mothers of stutterers and non-stutterers were non-significantly correlated with their children's DSS and total words spoken (− 0.26, − 0.15, 0.11, 0.27, respectively).

The only significant finding concerning language proficiency and stuttering was

that sentences with stuttering and/or normal disfluency obtained higher DSS or language complexity scores than did fluent sentences. This has been observed in at least three other studies (Bernstein Ratner and Sih, 1987; Gaines *et al.*, 1991; Logan and Conture, 1995).

The finding of no significant differences between the two groups of children or between their mothers and minimal correlational evidence suggests that mothers' linguistic complexity probably plays little or no role in their children's stuttering. Mothers of stuttering children did not use more complex language than did their counterparts, and their children did not reflect their linguistic sophistication, nor did the stuttering children use more complex language than non-stuttering children.

Interaction among the four variables of interest

Speaking rate, as represented by articulation rate, was the most powerful predictor variable for stuttering, especially mother's articulation rate for stuttering children ($R = 0.561$). For stuttering children, speaking rate was selected first over both linguistic complexity and interruption in the multiple correlation. Multiple correlation analyses in this study selected questions, statements and prompts/prods among the top five of 10 mother variables that predict children's stuttering. The highest percentage of questions (63%) was demonstrated by the mother of a stuttering child.

The multiple correlation analyses suggested that interruption was not an important variable in predicting the stuttering behaviour of children. It was picked last in the two child group analyses, adding little to the correlation (e.g., for stuttering children an R of 0.564 became 0.566 when the variable of interruption was added). It was not selected in the top five variables for either of the two mother groups to predict child stuttering, or among the combination of mother–children variables to predict child stuttering. It was the last variable selected in a combined mother group analysis.

In the multiple correlation analyses DSS was the fourth of five variables selected to predict stuttering (SW/M) and made a minimal contribution (without DSS, 0.516, with DSS added, 0.564). Only non-stuttering children demonstrated a DSS contribution in the multiple correlation analysis. Mothers' DSS was selected only in the total mothers group analysis to predict stuttering and made a minimal contribution. Although longer, more complex utterances evoke more stuttering (this study, Bernstein Ratner and Sih, 1987; Gaines *et al.*, 1991; Logan and Conture, 1995)—hence the higher the DSS score, the higher the probability that stuttering will occur—neither stuttering nor non-stuttering children use many complex forms in their conversational speech (Scott, 1988; Ryan, 1995).

The strongest pattern ($R = 0.854$) to emerge was in the mother and stuttering children analysis, which suggested that dyads of a mother with a high speaking rate, using many prompts or prods, may co-occur with stuttering children with high rates of normal disfluency, statements and speaking. Analysis of individual children's performances using the criterion that three of the five variables must pertain revealed seven (two female, 40%; five male, 33%) of the 20 (35%) stuttering children who met that criterion.

It should also be recognized that the clinical setting of this study was not the home setting. It is very possible that observation of mother–child interaction in the home setting may produce different results. However, such study will always be limited, regardless of where it is conducted, if the participants are aware of being

observed, a requirement of the right to privacy in a free society. Further, the findings of this study may be useful to the clinician in the clinic who wishes to extrapolate the results of this study to another clinic setting.

The minimal findings of this study, supported by those of other studies, suggest that no further research into mother–child interaction is necessary. However, longitudinal analysis of the four areas studied may suggest something about their permanence or contribution to stuttering over time, and should be considered, if for no other reason than to rule out this possibility.

Modelling effect

The results reveal little modelling effect of mothers for their children. Of several hundred correlations run for mothers' of stuttering children behaviours and those of their children there were only nine statistically significant (mostly moderate, a range of 0.46 to 0.66) correlations. Only three of these (all involving some metric of the one variable of speaking rate) suggested a possible relationship between mothers' behaviour and that of their children. Conspicuously absent was any significant positive or negative correlation between mothers' level of linguistic complexity and that of the child, or any relationship between mothers' speech fluency and that of their children.

Limitations

These results of minimal differences between stuttering and non-stuttering children and their respective mothers should be evaluated in the light of a number of limitations of the design. There was a relatively small sample size, which would increase the probability of a Type II error (Glass and Hopkins, 1984), that is, failure to detect a difference when there really is one. The wide range of ages (i.e., 2 to 5 years) of the children explains some of the significant correlations between age and some of the other variables, especially any measures of linguistic ability. Finally, it must be recognized that the conversation interaction of the mother and child facing each other across a table with no manipulanda such as toys—while desirable in terms of standardization, ease of analysis, and replicability in a clinical setting—was contrived and somewhat artificial. Were the results (e.g., high frequency of parent questions) overly influenced by this physical arrangement and the instruction 'Get your child to talk?' Replication of these data will be sought through longitudinal study of these subjects in this same format. Given these limitations one might expect the findings of this study to vary greatly from those of other studies, but they did not.

Conclusions

Finding so few differences in behaviour between stuttering and non-stuttering children or their mothers supports the conclusions drawn by Nippold and Rudzinski (1995) in their review of the literature. This also causes one to speculate that there is either a physiological basis for stuttering (e.g., Moore and Boberg, 1987) or something else, as yet unidentified, or some combination of these factors. None of the factors studied, except for speaking rate, or possibly linguistic complexity, was found to be a major, consistent contributor to predicting stuttering.

These findings also offer only minimal, mixed support for the demands portion

of the Demands and Capacity model of the development of stuttering (Starkweather and Gottwald, 1990; Starkweather, 1997). Interruption, for example, was not shown to be a contributing factor, while speaking rates of both mother and child were. The only conversational speech act which was commonly accompanied by stuttering was statements of the child, not any conversational act of the mother. The role of linguistic complexity was slight other than that more complex utterances tend to be more often accompanied by normal disfluency and/or stuttering, an observation which pertained to both stuttering and non-stuttering children.

Despite these minimal findings the relationship between stuttering and the variables of speaking rate, conversational speech acts, interruption and linguistic complexity should be explored further through both longitudinal or single-subject design studies, lest there be an important functional relationship to be observed only in those circumstances. Studies like that of Stephenson-Opsal and Ratner (1988) for the variable of speaking rate or that of Wilkenfeld and Curlee (1997) for mothers' questions and statements and their functional relationship to stuttering should be done.

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Appendix: Conversational Speech Acts

Abstracted from Allen (1990) and Marsh (1989)

M = Mother, C = Child, ( ) = non-verbal behavior, + = descriptor codes.

1. AK [acknowledgement] A neutral or positive indication of acceptance or agreement, for example, M: 'Uh huh.' AK
2. AN [answer] A verbal or non-verbal response to a question, for example, M: 'Do you want to go home?' QU C: 'Yes.' AN
3. AU [automatic] Includes singing, poems, and counting, for example, C: 'One, two, three.' AU
4. CM [command] An order or direction indicating behaviour expected either immediately or in the near future, for example, M: 'Stop that.' CM
5. (CO) [compliance] Doing what was asked, for example, M: 'Sit down.' CM C: (Child sits down) (CO)
6. CT [correction] Making a change in another speaker's utterance form or content, for example, M: 'These are for little kids.' SA C: 'I'm not little.' CT
7. +DY [disfluency] Phrase repetition, incomplete phrase, interjection and revision, for example, C: 'I'm not, I'm not.' DY CT
8. LA [laugh] Laughing as in responding to a joke. Use sparingly, for example, M: (mother laughs) LA
9. (NC) [non-compliance] Not doing what was asked, for example, M: 'Sit down.' CM C: (Child remains standing) (NC)
10. NO [negative] Negative response either verbal or non-verbal, for example, M: 'Sit down.' CM C: 'I don't want to.' NO

11. +OV [overlap] When two speakers' utterances overlap one another and it is not clear who started talking first (also known as 'simultaneous start, SS'), for example:
    M: 'I am going to go there.' SA OV
    X
    C: 'Are you coming?' QU OV
12. +OE [interruptee] Speaker who was talking before other speaker began, for example:
    M: 'I am going to go there.' SA OE
    X
    C: 'Are you coming?' QU OR
13. +OR [interrupter] Speaker who starts talking after other speaker already has the floor, for example, see example in no. 12.
14. PO [positive] An affirmative response, for example, M: 'Thank you.' PO
15. PR [prompt/prod] Includes both prompts and prods. Request to respond which follows question, for example, M: 'What do you want?' QU 'Huh?' PR
16. QU [question] Something asked in order to get information, for example, M: 'What?' QU
17. SA [statement] A declarative utterance, for example, C: 'It's hot in here.'
18. +ST [stuttering] struggle, prolongation, part-word repetition, or whole-word repetition, for example, C: 'I I I want that.' ST CM
19. OTH [other] All audible, verbal behaviour which cannot otherwise be coded (commonly unintelligible) and marked with a one inch underline '_____'), for example, C: 'I _____.' OTH