In B. Maassen, W. Hulstijn, R. D. Kent & P. H. H. M. Van Lieshout (Eds.), Speech Motor Control in Normal and Disordered Speech. Proceedings 4th International Speech Motor Conference. Nijmegen, The Netherlands: Uitgeverij Vantilt, 258-261.

Stuttering and Syllabic Stress in Preschool Children: Preliminary Observations

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Abstract. Speech samples of six preschool children who stutter were analyzed with regard to stuttering and syllabic stress. The relative stress of each syllable was rated and syllables were categorized into long and short stress, unstressed and intermediate syllables. Short stressed syllables were stuttered more often than unstressed syllables, but long stressed syllables were not stuttered more often than unstressed syllables. Intermediate syllables were stuttered most often. Results indicate that the stress effect previously found in adults is also a feature of early stuttering. As in adults, the stress effect seems to be based almost exclusively on short stressed syllables.

1. Introduction

Since the early work of Brown in the 1930s several studies confirmed his result that stuttering moments occur more often on stressed syllables than on unstressed syllables (e.g. Hahn, 1942; Wingate, 1984; Bergmann, 1986; Klouda & Cooper, 1988; Prins, Hubbard & Krause, 1991; Natke & Kalveram, submitted). In all of the studies regarding this so called *stress effect* only adolescents and adults who stutter participated, thus persons with a long history of stuttering. It is unknown, whether the stress effect is also a feature of early stuttering. This is crucial to the question whether the stress effect is in some way a consequence of stuttering for several years (maybe due to coping or compensation), rather than being related to the origin of stuttering. Therefore in the present study the stress effect is investigated in preschool children who stutter.

In the studies cited above different definitions of stress were used, e.g. primary stress in polysyllabic words or peaks in a stress rating along a continuum. These definitions only incompletely describe the physical parameters characterizing a stressed syllable. For example, stressed syllables can have a long duration like in "*fa*ther" or a short duration like in "*mo*ther". In a recent study with adults it was found that the prominence of stuttering on stressed syllables in word initial position is mostly limited to short stressed syllables, whereas long stressed syllables were not stuttered more often than unstressed syllables (Natke & Kalveram, submitted). Therefore the duration component of linguistic stress determines the prominence of stuttering and the stress effect seems to be actually a "short stress effect", at least in adults.

The purpose of the present study is to investigate the stress effect in stuttering in preschool children. Furthermore it is examined whether there is a relationship between stuttering on stressed syllables and the duration of these syllables.

2. Method

Six children who stutter and whose mother tongue is German, four boys and two girls aged from 3;0 to 4;6 years, participated. Intellectual abilities and acquired skills were tested by the Kaufman Assessment Battery for Children (KABC, German version, Kaufman & Kaufman, 1983). All children performed within normal range. At the time of the investigation children had been stuttering on an average for 10.3 months (see Table 1), as reported by their parents. In two sessions one week apart a play situation between investigator and child was videotaped, while the audio signal was recorded digitally. Speech samples were transcribed and analyzed using CHILDES and CLAN (MacWhinney, 1991), to which a special coding system for dysfluencies was added. Unintelligible utterances as well as isolated affirmatives ("yes", "okay") and negatives ("no"), which are generally produced fluently, were not included. The first 100 syllables of each speech sample were excluded from disfluency analysis. Resulting speech samples consisted of at least 1000 syllables for every child. Stuttering moments were defined as prolongations, blocks, broken words, and repetitions of sounds, syllables and one-syllable-words. Stuttering moments were identified and classified by watching and listening to the recording repeatedly. Multiple stuttering moments, e.g. a prolongation combined with a sound repetition, were counted separately.

Syllabic stress was rated along a continuum using a choral procedure described by Boomsliter, Creel and Hastings (1973): Two adults read the transcription of the speech samples in unison. It is assumed that under these circumstances each speaker uses the stress pattern that he expects other individuals to use, so he employs the typical prosody of his mother tongue. The reading was recorded and played back repeatedly, so that the relative stress of each spoken syllable could be rated on a scale from 1 to 9. The following stress categories were

defined: “Stress peak syllables” are surrounded on each side by syllables with a lower stress value, while “unstressed syllables” are surrounded by syllables with higher stress values. Syllables with stress values in-between were called “intermediate syllables”. Syllables at the beginning and at the end of utterances were categorized as stress peak/unstressed syllables, if the adjacent syllable had a lower/higher stress value and if the stress of the syllable was rated above 6/below 4. Additionally, stress peak syllables were classified in short and long stressed syllables.

This specific analysis of syllabic stress was chosen for three reasons: (1) In this way stress can be assigned to syllables which were actually stuttered by the children. (2) Stress ratings between children can be compared because the same speakers read all transcriptions. (3) Stress analysis is based on a model of adult prosody, which is assumed as being the target pattern for the children.

In English as well as in German, syllables in word initial position bear more often linguistic stress than subsequent syllables. Furthermore syllables in word initial position were stuttered more often than following syllables. Therefore word initial position and stress are confounded, requiring the isolation of both effects. This was achieved by restricting analysis to first syllables of words. The numbers of first syllables in the speech samples ranged from 695 to 774 syllables. For each child the number of short and long stress peak syllables, unstressed syllables, and intermediate syllables in word initial position was determined. Then stuttering frequency for each stress category was calculated. For comparisons between the stuttering frequencies two-tailed Wilcoxon-signed-rank-tests were calculated. *p*-values without adjustment are reported as measures of effect.

3. Results

The total number of stuttering moments for the entire speech sample was 614, corresponding to a mean stuttering frequency of 10.2 %. From these stuttering moments, 597 (97.2 %) allotted to first syllables of words and 17 (2.8 %) to subsequent syllables. The mean stuttering frequency was 13.6 % for first syllables of words and 1.1 % for following syllables. Therefore a very clear word initial effect was found. Further analysis was restricted to first syllables of words.

Figure 1 shows the stuttering frequencies including *p*-values for comparisons between stress categories. Calculation of stuttering frequencies is based on the corresponding number of syllables in each stress category. Intermediate syllables were stuttered more often than unstressed syllables and long stressed syllables (*p*-values below .05). Short stressed syllables were stuttered more often than unstressed syllables (*p*-value below .1). Stuttering frequencies of long stressed syllables and unstressed syllables seem to be comparable.

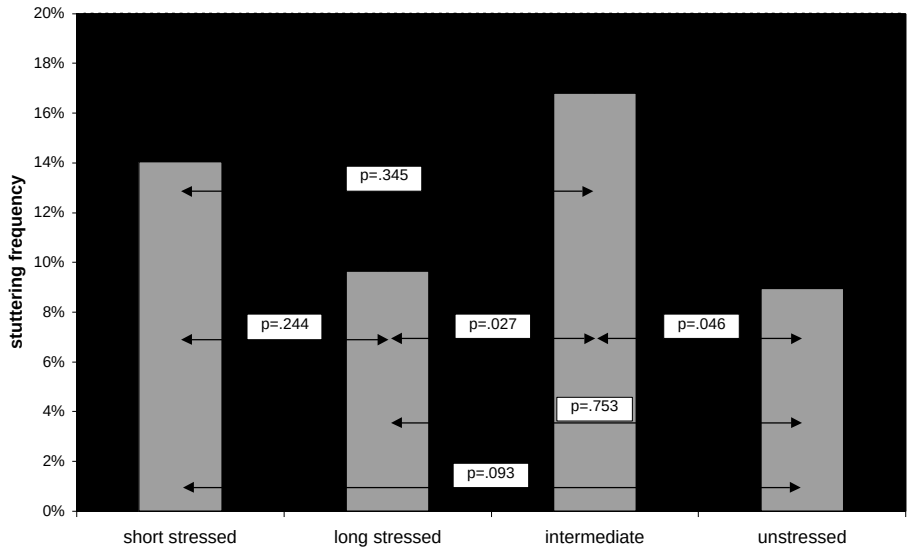

Fig. 1: Mean stuttering frequency and standard error dependent on stress category. Only syllables in word initial position were considered. *p*-values are based on two-tailed Wilcoxon-signed-rank-tests.

Table 1 gives detailed information about individual participants. All children except one show stuttering frequencies in accordance with the effects indicated by *p*-values. This is especially true for the two children who had been stuttering for three months at the time of the investigation. In the last two lines the number of syllables in each stress category is given. The numbers of short and long stressed syllables in the speech samples are comparable. Intermediate syllables were found most often, whereas unstressed syllables were found less often.

Table 1: Stuttering frequency dependent on stress category. Calculation is based on the corresponding number of syllables in each category. Only syllables in word initial position were considered.

Subject	Age/ Sex	Duration of stuttering (months)	Short stressed	Long stressed	Intermediate	Unstressed
1	4;4/m	22	20.3 %	3.5 %	12.6 %	7.6 %
2	4;6/m	10	17.7 %	16.0 %	25.9 %	9.9 %
3	3;9/m	13	7.6 %	4.3 %	13.2 %	5.3 %
4	3;2/m	11	11.4 %	6.6 %	11.3 %	14.8 %
5	3;0/f	3	8.0 %	12.8 %	20.1 %	3.8 %
6	3;4/f	3	19.4 %	14.7 %	17.7 %	12.1 %
Mean	3;8	10.3	14.1 %	9.7 %	16.8 %	8.9 %
Mean Number of Syllables			175.3	185.7	283.8	106.7
Range of Syllable Numbers			148-201	150-212	231-323	52-151

4. Discussion

Although preliminary results are reported, which are not significant in a statistical sense, results indicate that the stress effect in stuttering can be found also in preschool children who stutter. The children stuttered more often on short stressed syllables than on unstressed syllables. As in adults, this was not the case for long stressed syllables. Therefore it is indicated that in adults and preschool children both alike the stress effect seems to be almost exclusively based on short stressed syllables.

In contrast to adults, for whom stuttering frequency of intermediate syllables lie between stressed and unstressed syllables (Prins et al., 1991; Natke & Kalveram, submitted) just as their stress level is rated in-between unstressed and stressed syllables, in our preschool children intermediate syllables represent the stress category which is stuttered most often. This may indicate that the stress effect in stuttering is not as strong in preschoolers as in adults, indicating a possible developmental pattern.

It should be noted that participating children had been stuttering on an average for less than one year and also the two children who had been stuttering for only three months showed the effect. Therefore results make it more likely that the stress effect is not a consequence of stuttering. Rather it seems to be present at the very onset of stuttering.

Analysis of speech samples of a greater number of preschool children who stutter is still in progress. Supposing that our results will be confirmed, an explanation of the prominence of stuttering on short stressed syllables shall be already offered at this point. This explanation is based on a theory of stuttering as a developmental disorder of sensorimotor automation processes (Kalveram, 2001; Kalveram & Natke, 1998; Kalveram et al., this volume). One major task in early speech development seems to be the increase of speech rate. It is assumed that at an early stage the production of all syllables requires auditory feedback. The increase of speech rate could then be achieved by automation of less informative parts of speech – loosely speaking, by learning to “unstress” less important syllables. Actually by the age of 4 to 5 years speech rate increases and more unstressed syllables are produced, so the rhythm becomes more adult-like (Allen & Hawkins, 1980). The learning task of automation would require the reduction of auditory control of unstressed syllables. Only peak informative syllables, which are stressed, would be uttered under control of auditory feedback. Evidence for this is provided by experiments in adults in which manipulations of auditory feedback (frequency shift, delay) results in altered production of long stressed syllables, but leaving short syllables almost unaffected (Natke & Kalveram, 2001). The learning task is complicated by the fact that also short stressed syllables, which are similarly timed like unstressed syllables, have to be produced. This may lead to the conflict whether the speech controller should switch auditory control to high or low levels. In each case, the selected level of auditory control has also consequences for higher levels of speech processing. If, as outlined in detail elsewhere (Kalveram, 2001), the controller has acquired an inappropriate switching, dysfluencies especially on short stressed syllables could occur.

Acknowledgments

This research was supported by grant Ka 417/28-1 of the Deutsche Forschungsgemeinschaft (DFG).

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