Differences in production of disfluencies in children with typical language development and children with mixed receptive-expressive language disorder

Axel Bergström [1], Martin Johansson [1] and Robert Eklund [2]
[1] Institute of Clinical and Experimental Medicine, Linköping University, Sweden
[2] Department of Culture and Communication, Linköping University, Sweden

Abstract

There are several studies about non-fluency in people who stutter, but comparatively few regarding children with language impairment. The current research body regarding disfluencies in children with language impairment has been using different study-designs and definitions, making some results rather contradictory.

The purpose of the present study is to expand the knowledge about disfluencies in children with language impairment and compare the occurrence of disfluencies between children with language impairment and children with typical language development in the same age group.

A total of ten children with language impairment and six children with typical language development participated in this study. The subjects were recorded when talking freely about a thematic picture or toys and then analysed by calculating disfluencies per 50 words including frequency of different kinds of disfluencies according to Johnson and Associates' (1959) classic taxonomy.

Our results show that children with language impairment do produce statistically significant more disfluency in general, notably sound and syllable repetition, broken words and prolongations.

Background

There are several studies on about non-fluency on people who stutter, but comparatively few regarding children with language impairment. The current research body regarding disfluencies in children with language impairment has been using different study-designs and definitions, making some results rather contradictory.

The purpose of the present study is to expand the knowledge about disfluencies in children with language impairment and compare the occurrence of disfluencies between children with language impairment and children with typical language development in the same age group.

A total of ten children with language impairment and six children with typical language development participated in this study. The subjects were recorded when talking freely about a thematic picture or toys and then analysed by calculating disfluencies per 50 words including frequency of different kinds of disfluencies according to Johnson and Associates' (1959) classic taxonomy.

By extensive mapping of the disfluencies used by children with language disorder possible predicative factors concerning their continued language development might be found, as well as potential new connections between disfluencies and linguistic deficiencies. This also expands upon the previously limited amount of research on the subject and can possibly be of clinical value in assessment of language disorders.

Language production can be viewed as a series of interconnected modules as in the Levelt (1989) psycholinguistic model, which (in a simplified form) explains disfluencies as delays in retrieving certain linguistic components of an utterance, or as a way of revising errors found in the utterance.

Studies of disfluency production in children with typical development have shown that the total rate of disfluency per 100 words does not change significantly between four and eight years of age (Haynes & Hood, 1977). A certain increase of interjections and a decrease of word repetitions was found, which might be attributed to the pragmatic maturation seen between ages four and eight (Haynes & Hood, 1977). The overall rate of disfluency seems to decrease first between eight and eighteen years of age, which also is thought to be due to the further development of pragmatic skill that takes place during that time period (Yairi & Clifton, 1972).

Studies searching for possible differences in disfluency production between boys and girls have shown somewhat contradictory results, though those that did find a significantly higher disfluency rate in girls than in boys attributed this to mostly contextual factors during testing (Hedenqvist & Persson, 2014; Buaka, Ström & Lóránt, 2016). One study that found a higher disfluency rate in boys than in girls used adult participants and the significance was only found in interjections and repetitions (Bortfeld et al., 2009) while Haynes and Hood (1977) and Kools and Berryman (1971) found no significant difference between sexes.

A study by Yaruss, Newman and Flora (1999) showed that the disfluency rate in children increases

in longer utterances, which is supported by McLaughlin and Cullinan (1989) who found that disfluency rate increases when the relative linguistic complexity of an utterance increases.

Bishop (1997) describes children with language disorders as a very heterogeneous group defined by when one or more domains of language is impaired. Children with language disorders generally get lower results on tests for assessing language development than their age-matched peers with typical language development. For example, Westby (1974) found that children with language disorder score lower in naming test than children with typical development.

Ullman and Pierpoint (2005) suggest that a language disorder is a result of impairments in nerves which constitutes the procedural memory, basal ganglia and parts of the frontal lobe cortex including Broca's area and supplementary motor cortex, also known as the *Procedural Deficit Hypothesis*.

Alm (2005) focused on stuttering but did also suggest that fluency disruptions are the result of neurological perturbations but etiologically because of disturbances in the '*medial premotor system'*. This is defined as nerves which travels through the cerebral cortex, the basal ganglia and finally to the supplementary motor cortex. Many of these structures seem, according to Murdoch (2010), to be involved in regular language production.

Purpose

Our two main research questions were:

1. Does the frequency of disfluencies differ between children with typical language development and children with language difficulties in both receptive and expressive language domains?

2. Do the types of disfluencies used differ between children with typical language development and children with language difficulties in both receptive and expressive language domains?

Relevant aspects not covered in this study

Due to the limited size of this study, and with regard to amount and type of data collected, we have chosen not to include analyses of syntactic placement of disfluencies or frequency and type of disfluency in relation to word classes, utterance length or linguistic complexity of utterances.

We have also chosen not to include different types of language deficits but limited ourselves to mixed receptive-expressive language disorder.

Method

Data were collected by letting the participants talk freely about a thematic picture (Lindström & Werner, 1995) and various toys. The participants were recruited by e-mail communication with four pre-schools, two of which were specialized in children with speech and language difficulties. Inclusion criteria were that the participants were to be between three and five years of age and native speakers of Swedish. The participants had either a typical language development or a diagnosed language disorder affecting both expressive and receptive language processing. The participants' parents were informed of the study and signed a letter of consent.

The data were recorded with a dictaphone by the brand Olympus, model VN-8500PC.

The data were transcribed orthographically and disfluencies per words were calculated for every child by dividing the total number of uttered words by 50, and then multiplying this by the number of disfluencies uttered. This process was divided evenly between the first two authors. Every transcription and analysis was then checked for errors or uncertainties by the other writer. The two test groups were then analysed individually and statistically compared with Mann Whitney *U*-tests using SPSS version 24. The disfluencies were classified using Johnson and Associates' (1959) taxonomy, which divides disfluencies into the categories interjections, sound and syllable repetitions, word repetitions, phrase repetitions, revisions, incomplete phrases, broken words and prolonged sounds.

The groups were not compared by age or sex because of the previously mentioned studies by Haynes and Hood (1977) and Yairi and Clifton (1972) since the focus of this study was comparing the children with typical language development and children with mixed receptive-expressive language disorder.

Results

A total of 10 children with language impairment and 6 children with typical language development (N=16) were recorded. Type (and total amount) of disfluency for every 50 words in the language impairment group is illustrated in Table 1 and Table 2 for the typical language development group. In the language impairment group (n = 10) the mean for total uttered words was 103.8 (min = 48; max = 158) with a 95% confidence interval, upper value = 129.2 and lower value = 78.4 In the typical language development group (n = 6) the mean for total uttered words was 204.2 (min = 89; max = 397) with a 95% confidence interval, upper value = 320.1 and lower value = 8.22.

Comparison

Statistically significant differences were found between the groups in the disfluency types *sound and syllable repetitions* $U = 7.5$ $p = 0.014$, *broken words* $U = 6.0$; $p = 0.009$, *prolonged sounds* $U = 3.12$ $p = 0.007$ with one-tail significance measure since zero prolongations occurred in the typical development group. Total amount of disfluencies produced over all $U = 0$; $p = 0.0288$.

Table 1. Each disfluency type for each child in the language impairment group per 50 words. C = Child.

Type of disfluency	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	% total	m/sd
Interjections	0.66	1.72	3.25	1.26	0	1.84	0	1.72	1.03	5	20	1.65 1.44(sd)
Sound and syllable repetitions	0.66	1.72	1.3	0.31	1.0	0	1.13	0.34	1.03	0.83	11.8	0.832 0.49(sd)
Word repetitions	0.66	0.57	2.6	0.95	0	0	1.13	0.69	0.52	1.25	11.9	0.837 0.70(sd)
Phrase repetitions	0	0	0.65	0.31	0	0	0	0	0	0.42	2	0.138 0.22(sd)
Revisions	0.66	0	0	0.31	0	0.37	0.57	0.7	0	0.42	4.3	0.303 0.27(sd)
Incomplete phrases	0	0	1.3	0.95	1.0	0.73	0	1.72	1.55	0	10.3	0.725 0.65(sd)
Broken Words	1.97	2.82	1.94	1.9	2.1	0.37	1.13	1.0	1.03	0.42	20.9	1.468 0.76(sd)
Prolonged sounds	0	1.72	1.94	0.63	1.0	1.1	0.57	0.69	2.56	0	14.15	1.02 0.79(sd)
Total	5.2	8.6	13.0	6.7	5.2	4.4	4.5	6.9	7.7	7.9	100	7.02 2.43(sd)

Table 2. Each disfluency type for each child in the typical language development group per 50 words. C = Child.

Type of disfluency	C1	C2	C3	C4	C5	C6	% total	m/sd
Interjections	0.76	0.56	0.58	1.42	1.28	1.03	33.5	0.94 0.36(sd)
Sound and Syllable repetitions	0.13	0	0.19	0	0.77	0	6.5	0.18 0.29(sd)
Word repetitions	0.25	0	0.58	0.36	0.25	0.34	10.5	0.3 0.14(sd)
Phrase repetitions	0.38	0	0.58	0.36	0.25	0.69	13.4	0.38 0.24(sd)
Revisions	0.5	0.56	0.19	0	0.77	0.34	11	0.39 0.27(sd)
Incomplete phrases	0	0.56	0.19	0	0.25	0.34	8	0.22 0.21(sd)
Broken words	0.25	1.1	0.19	0.71	0.25	0.34	16.9	0.47 0.36(sd)
Prolonged sounds	0	0	0	0	0	0	0	0
Total	2.3	2.2	2.5	2.9	3.8	3.1	100	2.8 0.6(sd)

Discussion

As for research question 1, our results show a significant difference in the general frequency of disfluencies produced between children with language impairment that affects both receptive and expressive language domains and children with typically developed language.

The results regarding a generally higher disfluency production in children with language impairment compared to their peers with typical language development confirm what Befi-Lopes et al. (2014) and Guo, Tomblin and Samelson (2008) found.

One way to explain the difference is to look at McLaughlin and Cullinan (1989) who stated that one specific sentence or utterance can have different linguistic complexity for two different individuals if put in relation to their respective linguistic abilities. Since children with language impairment are on a lower level regarding linguistic abilities one could possibly assume that the same utterance for a child with language impairment and a child with typically developed language could differ in fluency.

Another question is why disfluencies appear at all. Alm (2005) explains fluctuations of fluency as an interruption anywhere in what he calls the *medial premotor system*. Since these neurological structures are largely the same as Ullman and Pierpoint (2005) point out as divergent in children with language disorders there might be an etiological link between language disorders and high disfluency rate. It would be interesting if future studies would compare children with language disorder and language matched children who stutter. However, there are other perspectives on disfluencies. Allwood, Nivre and Ahlsén (1990) for example, suggest that disfluencies rather are a communicative tool.

As for research question 2, our results show there are differences in sound and syllable repetitions, broken words and prolonged sounds. Regarding prolonged sounds and broken words one possible explanation might be that it is the result of either an incomplete or slow semantic retrieval of a word and therefore, in line with Levelt (1989) and Westby (1974), could be a consequence of an exceeded linguistic demand for the child in relation to its unique linguistic abilities.

Yairi and Clifton (1972) discussed a possible link between pragmatic development and disfluency production. This was studied further by Haynes and Hood (1977) who linked decreases in specific disfluency types to pragmatic maturation. Since the terminology of linguistic pragmatics is not completely clear-cut, we have refrained from making any strong assumptions in this study. It would, however, with no doubt be interesting to look closer at possible correlations between specific pragmatic abilities and disfluencies since disfluencies seem to be affected by pragmatic development.

The present study is clearly rather limited in size and it is consequently difficult to draw strong conclusions as to how and why specific phenomenon seem to appear. However, we argue that the present study might reinforce the conclusions reported in previous studies in the same area, and hopefully thoughts about further research that can be made in purpose to contribute to what possibly could give disfluency analysis a role of a diagnostic tool in assessing risk factors in children developing a language disorder.

Conclusions and future research

In this study we found that children with mixed receptive–expressive language disorder produced a significantly higher rate of total disfluency than children with typical language development. Furthermore we have found that children with

language disorders produce higher numbers of prolongations, sound and syllable repetitions and broken words. In relation to prior research this might be explained from pragmatic, neurologic and linguistic perspectives.

The present study focused on comparison between children with language disorder children with typical language development. To further examine the linguistic components of disfluencies it would be interesting to use language-matched children with typical language development. It would also be interesting to further explore the similarities and differences between disfluency behavior in children with a language disorder and children who stutter, both age-matched and language-matched.

Finally, as was mentioned in the discussion, further studies on similarities and differences in disfluency behavior in children with language disorder, typical development and pragmatic deficits such as autism spectrum disorder could be of great worth for exploring the possible pragmatic components of disfluency.

Acknowledgements

We would like to thank all our participants.

References

Allwood, J., J. Nivre & E. Ahlsén. 1990. Speech Management: on the Non-Written Life of Speech. *Nordic Journal of Linguistics* 13(1):3–48

Alm, A. P. 2005. *On the Causal Mechanisms of Stuttering*. Diss., Lund University.

Befi-Lopes, D. M., A. M. Cáceres-Assenço., S. F., Marques & M., Vieira. 2014. School-age children with specific language impairment produce more speech disfluencies than their peers. *CODAS* 26(6):439–443.

Bishop, D. 1997. *Uncommon Understanding: Development and Disorders of Language Comprehension In Children*. Hove: Psychology Press Ltd.

Bortfeld, H., S. Leon, J. Bloom, M. Schober & S. Brennan. 2009. Disfluency Rates in Conversation: Effects of Age, Relationship, Topic, Role, and Gender. *Language And Speech* 44(2): 123–147.

Buaka, P., N. Ström. & B. Lóránt. 2016. *Förekomsten av disfluenser hos svenska 6-åriga barn med typisk utveckling.* BA thesis, of Clinical and Experimental Medicine, Linköping University.

Guo, L., J. B. Tomblin & V. Samelson. 2008. Speech Disruptions in the Narratives of English-Speaking Children With Specific Language Impairment. *Journal of Speech, Language & Hearing Research* 51(3):722–738.

Haynes, W. & S. Hood. 1977. Language and disfluency variables in normal speaking children from discrete chronological age groups. *Journal of Fluency Disorders.* 2(1):57–74.

Hedenqvist, C. & F. Persson. 2014. *Förekomsten av disfluenser hos svenska 6-åringar med typisk utveckling.* MA thesis, Institute of Clinical and Experimental Medicine, Linköping University.

Johnson, W. & Associates. 1959. *The Onset of Stuttering.* Minneapolis: University of Minnesota Press.

Kools, J. & J. Berryman. 1971. Differences in Disfluency Behaviour Between Male and Female Nonstuttering Children. *Journal of Speech and Hearing* 14(1):125–130.

Lindström, E. & C. Werner. 1995. *A-ning – neurolingvistisk undersökning.* Ersta högskola – Ersta utbildningsinstitut, Stockholm.

Levelt, W. J. M. 1989. *Speaking: From Intention to Articulation.* Cambridge, Massachusetts: MIT Press.

McLaughlin S. & W. Cullinan. 1989. Disfluencies, Utterance Length, and Linguistic Complexity in Nonstuttering Children. *Journal of Fluency Disorders* 14(1):17–36.

Murdoch, B. E. 2010 (2nd edition). *Acquired speech and language disorders: a neuroanatomical and functional neurological approach*. Chichester, West Sussex: Wiley-Blackwell

Ullman, M. & E. Pierpont. 2005. Specific Language Impairment is not Specific to Language: The Procedural Deficit Hypothesis. *Cortex* 41(3):399–433.

Westby C. 1974. Language Performance of Stuttering and Nonstuttering Children. *Journal of Communication Disorders* 12(2): 133–145.

Yairi, E. & N. F. Clifton. 1972. Disfluent Speech Behavior of Preschool Children, High School Seniors, and Geriatric Persons. *Journal of Fluency Disorders.* 15(4):714–219.

Yaruss J., R. Newman & T. Flora. 1999. Language and Disfluency in nonstuttering children's conversational speech. *Journal of Fluency Disorders* 24(3):185–207.

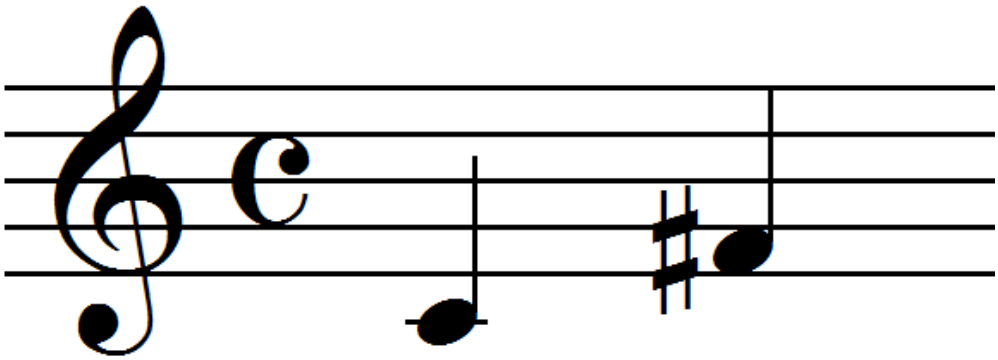
Proceedings of

DiSS 2017

The 8th Workshop on Disfluency in Spontaneous Speech

KTH Royal Institute of Technology
Stockholm, Sweden
18–19 August 2017

TMH-QPSR
Volume 58(1)



Edited by
Robert Eklund & Ralph Rose

Conference website: http://www.diss2017.org
Proceedings also available at: http://roberteklund.info/conferences/diss2017

Cover design by Robert Eklund
Graphics and photographs by Robert Eklund (except ISCA and KTH logotypes)

Proceedings of DiSS 2017, Disfluency in Spontaneous Speech
Workshop held at the Royal Institute of Technology (KTH), Stockholm, Sweden, 18–19 August 2017
TMH-QPSR volume 58(1)
Editors: Robert Eklund & Ralph Rose
Department of Speech, Music and Hearing
Royal Institute of Technology (KTH)
Lindstedtsvägen 24
SE-100 44 Stockholm, Sweden

ISSN 1104-5787
ISRN KTH/CSC/TMH–17/01-SE