Paper presented at DiSS 2015, Disfluency in Spontaneous Speech,
Edinburgh University, Edinburgh, Scotland, 8-9 August 2015.
(Proceedings pending.)

Disfluency incidence in 6-year old Swedish boys and girls with typical language development

Clara Hedenqvist[1], Frida Persson[1], Robert Eklund[2]

[1] Department of Clinical and Experimental Medicine, Division of Speech and Language Pathology, Linköping University, Linköping, Sweden
[2] Department of Culture and Communication, Division of Language and Culture, Linköping University, Linköping, Sweden
clara.hedenqvist@rjl.se, frida.persson@edu.norrkoping.se, robert.eklund@liu.se

ABSTRACT

This paper reports the prevalence of disfluencies in a group of 55 (25F/30M) Swedish children with typical speech development, and within the age range 6;0 and 6;11. All children had Swedish as their mother tongue. Speech was elicited using an "event picture" which the children described in their own, spontaneously produced, words. The data were analysed with regard to sex differences and lexical ability, including size of vocabulary and word retrieval, which was assessed using the two tests *Peabody Picture Vocabulary Test* and *Ordracet*. Results showed that girls produced significantly more unfilled pauses, prolongations and sound repetitions, while boys produced more word repetitions. However, no correlation with lexical development was found. The results are of interest to speech pathologists who study early speech development in search for potential early predictors of speech pathologies.

Keywords: Speech disfluency, children, lexical development, sex differences

1. INTRODUCTION

Disfluency is a naturally occurring phenomenon that occurs in with some degree of individual variation in all speakers. While disfluency in adult speech has been devoted a numbers of studies over the past decades, the speech of children have not been subject to a similar number of studies, and in most cases research on non-pathological child speech mainly occurs in control groups in studies of stuttering and other pathologies. The development of speech disfluency in children is to a large extent unknown, and several theories have been forwarded, focusing on different aspects of language acquisition.

2. PREVIOUS RESEARCH

As was pointed out in the previous paragraph, disfluency in adult speech has been thoroughly studied over the past decades, partly from a speech technological perspective. Disfluency research on child speech looks a little different. While it could be argued that disfluency studies in the speech of children commenced already in the seminal papers by Davis (1939, 1940), later studies have appeared at intermittent intervals, using different test and control groups, and to complicate matters further present the reader with the problem of the fast and complicated language and speech development in the young child; comparing a three-year-old with a five-year-old does not amount to the same thing. Or, to use the words of Bornstein, Hahn and Haynes (2004: 268): "At virtually every age, children vary dramatically in terms of individual differences in their language abilities".

Moreover, many previous studies have focused on stuttering, and children with typical, or non-pathological, speech development have quite often been included mainly as control groups. Thus, it could be argued that even after 75 years of studies, the development of speech disfluency in children is still to a large extent unknown.

Studies of disfluency rates in adult speech have established that around 6% of spontaneously produced speech exhibits some kind of disfluency (Fox Tree, 1995; Oviatt, 1995; Brennan & Schober, 2001; Bortfeld et al., 2001; Eklund, 2004). Studies of general disfluency rates in children have presented similar figures, e.g. Guitar (2013) who reported that preschool children were observed to produce around seven disfluencies per one hundred words, although the percentage of disfluencies in children vary more. It has also been reported that disfluency rates are higher as a function of age, with younger children being more disfluent than older children (Gordon & Luper, 1989).

Levin and Silverman (1965) compared fluency and hesitation in 48 children who told two stories and two different situations: to an audience and to a microphone when no one was present. Using the schemata developed by Trager (1958) and Mahl (1956) they found that speech production was consistent over the different conditions, but that stressful hesitations were responsive to whether the children were speaking in public or privately.

Levin, Silverman and Ford (1967) compared speech disfluency in 24 children, six each from

kindergarten, second, fourth and sixth grade. The children were shown simple physical demonstrations and were then asked to provide descriptions and explanations of these demonstrations. For children of all ages, explanations exhibited more words, more pauses and hesitations, lower speech rate and also longer pauses.

Speech disfluency in children has also been examined from a syntax perspective. Westby (1974) found that highly "dysfluent" children made significantly more grammatical errors than fluent children, irrespective of whether or not the children exhibited stuttering or typical development. Likewise, Haynes and Hood (1978:79), studying 5year-olds, found "a significant relationship between linguistic complexity and disfluency in children". On the other hand, Muma (1971) reported no significant relation between disfluency and syntax in a group of highly fluent and highly disfluent 4-year-olds. Pearl and Bernthal (1980), studying 3- and 4-year-olds, reported significantly more disfluencies in passive sentences than in any other sentence type. Similar results, this time for 5-year-olds, were reported by McLaughlin and Cullinan (1989). It has also been shown that speech disfluency in children has a tendency to be subject to clustering (Sawyer & Yairi, 2010; Colburn, 1985) and especially frequent when language development begins and reaches a level where (rudimentary) sentences are being produced (Colburn, 1985).

As for lexical factors, the literature presents inconsistent findings. While some studies on have reported that disfluencies predominantly are related to content words (Juste et al., 2012), the opposite observation has also been made, relating early disfluency primarily to function words (Silverman, 1974). Moreover, Westby (1974) reported that children with atypical lexical development had a higher incidence of disfluency than children with normal lexical development, while e.g. DeJoy and Gregory (1983) reported no significant effect for either vocabulary or syntax.

While sex differences in adult speech disfluency (males being more disfluent), has been reported for e.g. American English (e.g. Shriberg, 1994), no sex differences between the sexes was found in studies of Swedish adult speech (Eklund, 2004; Bell, Gustafson & Eklund, 2000). In a study on speech disfluency in English 7-year-old children (Kools & Berryman, 1971), no differences between the sexes were observed. Likewise, Yairi (1981) found no sex differences in the speech of 2-year-olds.

Finally, looking at disfluency as a function of age, Haynes and Hood (1977) studied speech disfluency in 4- and 8-year-olds and reported only very small, non-significant, differences. DeJoy and Gregory (1978) studied 3.5- and 5-year-olds and reported both similarities (ungrammatical pauses, revisions) and differences (the younger children produced more phrase repetitions, dysrhythmic phonations etc; the older children produced more grammatical pauses). Wexler and Mysak (1982) reported similar disfluency patterns in 2-, 4- and 6-year-old nonstuttering children.

Summing up, it should be obvious from the previous passages that the situation is far from clear when it comes to speech (dis)fluency in children. Whatever factor one looks at, results seem to have a tendency to "point both ways", and individual variation seems to play a very large role, as pointed out by Bornstein, Hahn and Haynes (quote above). However, this does not mean that the results are "pointless". From a clinical perspective, any piece of information available to the clinician might be valuable in that it provides the basis to more careful diagnosis and makes the acting clinician more aware of what potential factors and the degree and type of variation present in the developing child. Consequently, all the previous as well as future studies help shed a little light on what apparently is a very complex phenomenon.

3. THE PRESENT STUDY

The present study focused on speech disfluency in a group of 6-year-old children without any diagnosed speech pathology, with focus on three parameters: (1) a general mapping of disfluency in 6-year-old girls and boys; (2) sex differences with regard to disfluency production; and (3) possible correlation with lexical development, including an analysis of vocabulary size and lexical retrieval.

4. METHOD AND ANALYSIS

The study included 55 children, 25 girls and 30 boys between 6;0–6;11 years old. All children had Swedish as their mother tongue. To elicit speech an event picture was used, taken from a neurolinguistic aphasia examination package described in Lindström & Werner (2006). Lexical ability was examined using the two tests *Peabody Picture Vocabulary Test* (PPTV) (Dunn & Dunn, 1997) and "Ordracet" (Eklund, 1996). The speech data were recorded using a discreet iPhone iOS7 and the sounds files were later converted into wave format and analysed in Praat (www.praat.org). Statistics were calculated using SPSS 22 (www.spss.com).

Interlabeller reliability was tested both between the two main investigators (CH, FP) and an outside speech therapist (MK) and was found to be .94.

Table 1. Summary statistics for all disfluencies broken down for type, number, proportion/percentage and position in sentence/word. All disfluency figures are given as disfluencies/words. Girls and boys are presented in separate columns. Statistical significance is calculated performing *Z* test-of-proportions, two-tailed. In cases where the difference is significant, the more disfluent group is specified using ♀ for girls and ♂ for boys.

	Girls ***N*** **= 25**	**Boys** ***N*** **= 30**	**Statistical Significance**
Total number of words	**3377**	**4600**	**–**
Total number of disfluencies	**575 (17.0 %)**	**670 (14.6 %)**	**–**
Unfilled Pauses	**328 (57%)**	**360 (53.7%)**	***p*** **< 0.01** (♀)
Filled Pauses – All Positions	**113 (19.6%)**	**153 (22.8%)**	**n.s.**
Filled Pauses – initial	58 (10%)	75 (11.2%)	n.s.
Filled Pauses – medial	55 (9.6%)	78 (11.6%)	n.s.
Filled Pauses – final	0 (0%)	0 (0%)	-
Segment Prolongations – All Positions	**81 (14.1%)**	**49 (7.3%)**	*p* < 0.01 (♀)
Segment Prolongations – initial	26 (4.5%)	12 (1.8%)	*p* < 0.01 (♀)
Segment Prolongations – medial	32 (5.6%)	13 (1.9%)	*p* < 0.05 (♀)
Segment Prolongations – final	23 (4%)	24 (3.6%)	n.s.
Sound Repetitions – All positions	**5 (0.9%)**	**6 (0.9%)**	**n.s.**
Sound Repetitions – initial	2 (0.4%)	6 (0.9%)	n.s.
Sound Repetitions – medial	3 (0.5%)	0 (0%)	*p* < 0.05 (♀)
Sound Repetitions – final	0 (0%)	0 (0%)	-
Syllable Repetitions – All positions	**6 (1%)**	**12 (1.8%)**	**n.s.**
Syllable Repetitions – initial	6 (1%)	12 (1.8%)	n.s.
Syllable Repetitions – medial	0 (0%)	0 (0%)	-
Syllable Repetitions – final	0 (0%)	0 (0%)	-
Word Repetitions	**23 (4%)**	**56 (8.4%)**	*p* < 0.05 (♂)
Truncations	**19 (3.4%)**	**34 (5.1%)**	**n.s.**

5. RESULTS

The results are summarized in Table 1 above.

As for general frequency, we found that the 6-year-olds in this study on average produced 15.6 disfluencies per 100 spoken words, a result that is different from what is reported in Guitar (2013), who presented adult-like figures in child disfluency. We also observed considerable individual variation was also observed, similar to what has previously been reported in the literature for adult speech (e.g. Oviatt, 1995; Bell, Eklund & Gustafson, 2000).

As for differences between the two sexes, we found that girls produced significantly more unfilled pauses, prolongations, sound repetitions in medial position and word repetitions, while boys exhibited more word repetitions. This observation replicates the results presented by Kools & Berryman (1971) for 7-year-olds, and Yairi (1981) for 2-year-olds.

We did not observe any correlation between the amount of disfluencies produces and lexical ability, including vocabulary size and word retrieval, which runs counter to Westby's (1974) observations.

6. DISCUSSION AND CONCLUSIONS

As has already been pointed out, there is an obvious lack of consistency in the results reported in the literature, across most variables. Although it must be borne in minds that given the very fast and complex development of language and speech in young children, comparisons between different and across studies are cumbersome, for obvious reasons. Comparing our results with previously reported studies highlights this phenomenon in that we both replicate results and present results that run counter to previous studies. It is our belief, and a limitation of the present study, that disfluency in young children must be studied in a way that is solidly based in general theories on child language acquisition. Similar to many previous studies, the present study included a small group of children with a given, and our results need to be corroborated or contested and future studies of children of the same or similar ages. We do hope, however, that the present study helps shed a little bit more light on disfluency incidence in young children.

7. REFERENCES

Bell, L., Eklund, R., Gustafson, J. 2000. A Comparison of Disfluency Distribution in a Unimodal and a Multimodal Human–Machine Interface. *Proceedings of ICSLP '00*, Beijing, 16–20 October 2000, 626–629.

Bornstein, M.H., Hahn, C-S., Haynes, O.M. 2004. Specific and general language performance across early childhood: Stability and gender considerations. *First Language* 24(3), 267–304.

Bortfeld, H., Leon, S.D., Bloom, J. E., Schober, M.F., Brennan, S.E. 2001. Disfluency Rates in Conversation: Effects of Age, Relationship, Topic, Role, and Gender. *Language and Speech* 44(2), 123–147.

Brennan, S.E., Schober, M.F. 2001. How Listeners Compensate for Disfluencies in Spontaneous Speech. *Journal of Memory and Language* 44, 274–296.

Colburn, N. 1985. Clustering of Disfluency in Nonstuttering Children's Early Utterances. *Journal of Fluency Disorders* 10(1), 51–58.

Davis, D.M. 1939. The Relation of Repetitions in the Speech of Young Children to Certain Measures of Language Maturity and Situational Factors: Part I. *Journal of Speech Disorders* 4(4), 303–318.

Davis, D.M. 1940. The Relation of Repetitions in the Speech of Young Children to Certain Measures of Language Maturity and Situational Factors: Part I. *Journal of Speech Disorders* 5(3), 193–288.

DeJoy, D.A., Gregory, H.H. 1973. The relationship of children's disfluency to the syntax, length, and vocabulary of their sentences. Paper presented at the Annual Convention of the American Speech and Hearing Association, Washington, D.C., 1973. Cited (p. 152) in: Gordon, P.A., Luper, H.L., Peterson, H.A. 1986. The effects of syntactic complexity on the occurrence of disfluencies in 5 year old nonstutterers. *Journal of Fluency Disorders* 11, 151–164.

DeJoy, D.A., Gregory, H.H. 1985. The relationship between age and frequency of disfluency in preschool children. *Journal of Fluency Disorders* 10, 107–122.

Dunn, L. M., Dunn, D. M. 1997 (third edition). *Peabody Picture Vocabulary Test*. Circle Pines, Minnesota: American Guidance Service.

Eklund, H. 1996. *Ordracet.* Hargdata AB.

Eklund, R. 2004. Disfluency in Swedish human–human and human–machine travel booking dialogues. PhD thesis, Linköping Studies in Science and Technology, Dissertation No. 882, Department of Computer and Information Science, Linköping University, Sweden.

Fox Tree, J.E. 1995. The Effects of False Starts and Repetitions on the Processing of Subsequent Words in Spontaneous Speech. *Journal of Memory and Language* 34, 709–738.

Gordon, P.A., Luper, H.L. 1989. Speech disfluencies in nonstutterers: Syntactic complexity and production task effects. *Journal of Fluency Disorders* 14(6), 429–445.

Guitar, B. (ed.). 2013. *Stuttering: An integrated approach to its nature and treatment* (4th Ed.). Lippincott, William & Wilkins.

Haynes, W.O., Hood, S.B. 1977. Language and Disfluency Variables in Normal Speaking Children from Discrete Chronological Age Groups. *Journal of Fluency Disorders* 2, 57–74.

Haynes, W.O., Hood, S.B. 1978. Disfluency changes in children as a function of the systematic modification of linguistic complexity. *Journal of Communication Disorders* 11, 79–93.

Juste, F.S., Sassi, F.C., de Andrade. C.R. 2012. Exchange of disfluency with age from function to content words in Brazilian Portuguese speakers who do and do not stutter. *Clinical Linguistics & Phonetics* 26, 11–12.

Kools, J.A., Berryman, J.D. 1971. Differences in disfluency behavior between male and female nonstuttering children. *Journal of Speech and Hearing Research* 14(1), 125–30.

Levin, H., Silverman, I., Ford, B.L. 1967. Hesitations in Children's Speech During Explanation and Description. *Journal of Verbal Learning and Verbal Behavior* 6, 560–564.

Levin, H, Silverman, I. 1965. Hesitation Phenomena in Children's Speech. *Language and Speech* 8(2), 67–85.

Lindström, E., Werner, C. 2006. *A-ning. Neurolingvistisk Afasiundersökning,* Standardisering. Stockholm: Ersta.

Mahl, G.F. 1956. Disturbances and silences in the patient's speech in psychotherapy. *Journal of Abnormal and Social Psychology* 53, 1–15.

McLaughlin, S.F., Cullinan, W.L. 1989. Disfluencies, utterance length, and linguistic complexity in nonstuttering children. *Journal of Fluency Disorders* 13, 17–36.

Muma, J.R. 1971. Syntax of Preschool Fluent and Disfluent Speech: A Transformational *Analysis.* Journal of Speech, Language, and Hearing Research 14(2), 428–441.

Oviatt, S. (1995). Predicting spoken disfluencies during human-computer interaction. *Computer Speech and Language* 9(1), 19.

Pearl, S.Z., Bernthal, J.E. 1980. The Effect of Grammatical Complexity Upon Disfluency Behavior of Nonstuttering Children. *Journal of Fluency Disorders* 5, 55–68.

Sawyer, J., Yairi, E. 2010. Characteristics of Disfluency Clusters Over Time in Preschool Children Who Stutter. *Journal of Speech, Language, and Hearing Research* 53, 1191–1205

Shriberg, E.E. 1994. *Preliminaries to a Theory of Speech Disfluencies*. PhD thesis, University of California, Berkeley.

Silverman, E.M. 1974. Word Position and Grammatical Function in Relation to Preschoolers' Speech Disfluency. *Perceptual and Motor Skills* 39(1), 267–272.

Trager, G.L. 1958. Paralanguage: a first approximation. *Studies in Linguistics*, 13(1–2), 1–13.

Westby, C.E. 1974. Language performance of stuttering and nonstuttering children. *Journal of Communications Disorders* 12(2), 133–145.

Wexler, K.B., Mysak, E.D. 1982. Disfluency Characteristics of 2-, 4-, and 6-Yr-Old Males. *Journal of Disfluency Disorders* 7, 37–446.

Yairi, E. 1981. Disfluencies of normally speaking two-year-old children. *Journal of Speech, Language, and Hearing Research* 24, 490–495.