J. Child Lang. **33** (2006), 179–190. © 2006 Cambridge University Press
doi:10.1017/S0305000905007294 Printed in the United Kingdom

The Phonological Mean Length of Utterance: methodological challenges from a crosslinguistic perspective*

KATRI SAARISTO-HELIN
University of Helsinki

TUULA SAVINAINEN-MAKKONEN
University of Helsinki

AND

SARI KUNNARI
University of Oulu

(*Received* 2 *November* 2004. *Revised* 3 *October* 2005)

ABSTRACT

The present study assesses the phonological development of 17 children acquiring Finnish at the developmental point of 25 words (ages 1;2–2;0). The analysis is made using the PHONOLOGICAL MEAN LENGTH OF UTTERANCE (PMLU) method (Ingram & Ingram, 2001; Ingram, 2002), which focuses on the children's whole-word productions. Two separate analyses are carried out: the first analysis concentrates on consonants and follows the procedure devised by Ingram and Ingram (2001), and the second analysis also scores the correctness of vowels. The PMLU results of both analyses are found to be much higher than those reported for children acquiring English. The results show the apparent need for more language-specific research in order to develop the PMLU method suitable for various language environments.

INTRODUCTION

The evaluation of children's early word production is a theme that seems to be motivated particularly by clinical demands. Considering the growing

[*] This research and the preparation of the manuscript were supported by grants from the Emil Aaltonen Foundation received by the first and second authors and by the University of Oulu. The writers would like to thank Professor Antti Iivonen and the anonymous reviewers for their helpful comments on an earlier version of this paper. Address for correspondence: Katri Saaristo-Helin, Department of Speech Sciences, P.O. Box 9 (Siltavuorenpenger 20 A), FI-00014 University of Helsinki, Finland. e-mail: Katri.Saaristo@helsinki.fi

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

challenges that clinical speech and language pathologists face, the development of new methods of evaluating early word production is indeed essential: detailed analysis of the state of a child's speech and language development is often required, and the clinician should be able to recognize possible signs of delayed or deviant development early enough to ensure proper rehabilitation measures.

In the past few decades the study of child language has seen an interesting shift from claims of universality (Jakobson, 1941/1968) to an emphasis on individual strategies (Ferguson & Farwell, 1975), and most recently towards the acknowledgement of language-specific processes (e.g. Boysson-Bardies & Vihman, 1991). It is now widely accepted that in the course of phonological development there are processes which are both universal and language-specific and that individual strategies of avoidance or preferences for certain sounds and patterns also play a role in the formulation of a child's first phonology.

During the first six months of the infant's life, development seems to be guided by biological and neural maturation, i.e. the universal processes of language development. However, researchers have reported cross-linguistic differences in the use of consonants and vowels as early as in the babbling stage (Boysson-Bardies, Halle, Sagart & Durand, 1989; Boysson-Bardies & Vihman, 1991). The language acquired can be found to affect both the structure (the number and type of syllables in a word) as well as the segments present in the first words arising from the phonetic patterns of the ambient language (Stoel-Gammon, 1985; Warren, 2001; Kunnari, 2003).

The influence of the ambient language environment has also been verified in research on children acquiring Finnish (Savinainen-Makkonen, 1998, 2000a, b, 2001; Kunnari, 2000, 2002, 2003; Lyakso & Silvén, 2002). It is therefore necessary to consider some aspects of the Finnish language which affect the acquisition of phonology in Finnish children. In contrast to English, Finnish has few monosyllables (Karlsson, 1983: 217). Bisyllables are the most frequent words in Finnish (Karlsson, 1983: 217), but long words with three or more syllables are also common and are used in everyday situations. Finnish has a very rich morphophonology. The basic principle of word formation is the addition of suffixes to the stems. However, there are several kinds of vowel and consonant changes triggered by the addition of suffixes to the stem, so that a word may be represented by different allomorphs of the stem depending upon which suffixes it is followed by (Karlsson, 1999). The Finnish consonant paradigm is quite restricted, consisting of 13 singleton consonants /p, t, d, k, n, m, ŋ, l, r, s, h, ʋ, j/ (Sulkala & Karjalainen, 1992). All vowels (/i, y, e, ø, æ, u, o, ɑ/) and consonants (with the exception of /d, h, j, ʋ/) can occur as geminates in a word

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

medial position.[1] Studies on children acquiring Finnish have shown that children already target long words at the one-word stage, although they are often truncated to words with one or two syllables (Kunnari, 2000, 2002; Savinainen-Makkonen, 2000a). What is more, the reduction of disyllable words seems to be very uncommon (Savinainen-Makkonen, 2001; Kunnari, 2002). Word-initial consonant omissions are frequent and can be seen as a developmental process in children acquiring Finnish (Savinainen-Makkonen, 2000a). The sizes of early phonetic inventories are typically smaller than those reported for children acquiring English (Kunnari, 2000, 2002), which relates to the restricted consonant system of the Finnish language. The Finnish quantity distinction is acquired very early. Richardson (1998) showed that typically developing Finnish infants are able to distinguish between short and long opposites (/ɑt̲ɑ/ versus /ɑt̲t̲ɑ/) as early as at the age of six months. Furthermore, recent studies suggest that the quantity distinction may begin to be made early in the production of Finnish (Vihman & Velleman, 2000; Kunnari, Nakai & Vihman, 2001). Vihman and Velleman (2000) suggest that as early as the 25-word point (defined as the first 30-minute recording session in which 25 different identifiable word types were used spontaneously, see Vihman & Miller, 1988), when the cumulative lexicon is about 50 words, Finnish children's production is sharply distinguishable from that of children acquiring languages such as French and English which have no phonological quantity contrast.

The individuality of phonological development has placed some methodological challenges on the study of child language. In response to the fact that children at the same age can be in very different stages of development, Vihman & Miller developed the concept of the LEXICAL WORD-POINT (1988), which makes it possible to compare children of different ages who are at the same stage of development. In 1994, Vihman & McCune answered the question 'When is a word a word?' and set criteria for defining the concept of a word. These methodological tools enable the comparison of crosslinguistic and intralinguistic data in spite of differences in age and the language acquired.

Detailed qualitative analysis is possible in the case of restricted amounts of data, and for purposes of formulating phonological theory such qualitative analysis has been highly informative. However, in clinical practice a simple and practical method is being sought which can be used as a reliable assessment tool of a child's phonological skills. So far the methods of analysing children's early phonological skills have made extensive use of formal articulation tests, and the focus has been on segments and measures

[1] Consonants and vowels have two phonological lengths in Finnish: short (single) and long (geminate), and the quantity of a sound changes the meaning of the word (e.g. [mɑt̲o] 'worm' vs. [mɑt̲t̲o] 'carpet', [t̲uli] 'fire' vs. [t̲uuli] 'wind').

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

of correctness (see the review by Ingram, 2002). The idea of the word (vs. the segment) being the basic unit of analysis was developed further when Ingram and Ingram (2001) introduced the Phonological Mean Length of Utterance (PMLU) measure as a new tool for assessing word forms. The PMLU measure draws attention from the segments to the word as a whole and defines three varying dimensions of children's productions: correctness, complexity and variability. The central assessment tool is the Phonological Mean Length of Utterance (PMLU), which measures the whole-word complexity for both child and target words. Words are assigned points for both segments in the word (1 point per segment) and the number of correct consonants in the word (1 point per correct consonant). By comparing the child's PMLU to the PMLU of the target word it is possible to define the PROPORTION OF WHOLE-WORD PROXIMITY (PWP), i.e. the degree of accuracy in producing the words. According to Ingram this measure 'can also be seen as at least an indirect measure of the child's intelligibility' (2002). The third measure, the PROPORTION OF WHOLE-WORD CORRECTNESS (PWC) defines the percentage of the words produced correctly as related to the entire sample. The PROPORTION OF WHOLE-WORD VARIABILITY (PWV) measures the degree of variation (different phonological shapes) in the child's word productions. Preliminary results on monolingual children acquiring English showed (Ingram, 2002) that the PMLU measure could also be used e.g. to identify a child's stage of phonological acquisition.

In this study we make the first attempt to apply the PMLU measurement to Finnish data. Our primary goal is to study the variation in the results of the Finnish children at the end of the one-word stage. Secondly, we are interested in discovering to what extent these results are consistent with the earlier results reported for English children and how they reflect the characteristics of the ambient language.

METHOD

This study examines the early word productions of 17 normally developing Finnish children (9 girls, 8 boys). All children came from monolingual Finnish-speaking homes and had normal developmental histories. The parents' education was classified into six categories based on the ISCED (UNESCO International Standard Classification of Education, 1997). Of the parents, 62 percent had completed the first stage of tertiary education (stage 5), 29 percent had completed post-secondary non-tertiary education (stage 4), 6 percent of the parents had completed the second stage of tertiary education (stage 6) and 3 percent had completed upper secondary education (stage 3). Our data originates from three sources: from two previously reported doctoral dissertations by Kunnari (2000, 6 children) and Savinainen-Makkonen (2001, 6 children) and one unpublished, ongoing

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

longitudinal study of phonological development (5 children). The existing data was collected on a weekly, bi-weekly or monthly basis and is comprised of half-hour audio- or videotapes of the everyday interactions (e.g. conversation, play interactions) of children with their parents in their home environments. Written consent for the children's participation was obtained from all the parents. Pseudonyms will be used in referring to individual participants in any reporting of this study. The data was transcribed phonetically using the International Phonetic Alphabet (IPA), and meaningful words produced by the children were identified following a procedure devised by Vihman & McCune (1994). The criteria are based on both formal (phonetic) and functional (or pragmatic-semantic) considerations, such as the degree of segmental match with the adult target, use in a clearly determinative context, and identification by the mother. Each word candidate was rated for the presence or absence of each type of evidence (see Vihman & McCune, 1994 for further details). Interrater reliability was checked: in Kunnari's study the agreement for consonant transcription (2000) was 87 percent. In our study of five children (unpublished study of phonological development), the agreement for consonant transcription was 94 percent. In Savinainen-Makkonen's study (2001), the data was transcribed by two or three people listening together. Analysis was restricted to meaningful word productions at the developmental point of 25 words. The children who had reached the 25-word developmental point were at the ages of 1;2–2;0, with the mean age being 1;8.

The words were accepted for analysis according to the rules suggested by Ingram and Ingram (2001, see also Ingram, 2002). As Ingram and Ingram (2001) recommend, onomatopoeic target words, fillers, interjections and reduplicative target words (e.g. *pipi* 'a hurt') were excluded from the analysis. In addition, only spontaneously produced words were accepted for the analysis, and imitations were excluded. The number of words accepted for analysis ranged from 25 to 35 per child. In order to make reasonable crosslinguistic comparisons, the children's ability to produce the quantity distinction was not taken into account when assigning points for the PMLU. This matter will be dealt with in a separate qualitative analysis.

Two separate PMLU analyses were carried out. The first analysis was done following the count suggested by Ingram and Ingram (2001), focusing on the length of the child's word and the number of correct consonants. The second analysis also scored the correctness of vowels.

RESULTS

Table 1 shows the results for the Finnish children in the first analysis, which dealt with consonants only. The PMLU scores for the target words ranged from 5·27 to 8·43 with the mean target PMLU score being 6·52. The

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

TABLE 1. *Analysis* 1 (*consonants*)*: summary of PMLU, PWP and PWC scores for* 17 *Finnish children at the* 25*-word point*

Child	Age	Target PMLU	Child PMLU	PWP	PWC
Venla	1;2	7·14	5·11	0·72	0·14
Atte	1;8	6·40	4·60	0·72	0·12
Sara	1;8	6·88	5·00	0·73	0·08
Helmi	1;9	6·69	4·90	0·73	0·24
Vinsu	1;6	5·62	4·15	0·74	0·23
Matti	1;6	6·82	5·07	0·74	0·25
Antti	1;5	6·66	5·03	0·76	0·21
Mauri	2;0	8·43	6·43	0·76	0·19
Eelis	1;10	5·27	4·04	0·77	0·38
Mira	1;5	6·61	5·18	0·78	0·18
Melina	1;7	6·45	5·14	0·80	0·14
Pyry	1;10	6·45	5·14	0·80	0·17
Saini	1;4	6·40	5·17	0·81	0·26
Nuppu	1;7	6·65	5·38	0·81	0·27
Juha	1;11	6·45	5·34	0·83	0·45
Annika	1;6	6·07	5·11	0·84	0·25
Vilma	1;8	5·93	5·17	0·87	0·31
Means		6·52	5·06	0·78	0·23

PMLU scores for the children's productions ranged from 4·04 to 6·43 with the mean PMLU score being 5·06. The accuracy of the children's productions can be seen in the WHOLE-WORD PROXIMITY scores (PWP), which ranged from 0·72 to 0·87. The mean PWP score in this analysis was 0·78. The number of whole words produced correctly was calculated to obtain the WHOLE-WORD CORRECTNESS score (PWC) (see Table 1). The PWC range is extremely broad, from 0·08 to 0·45. The mean PWC score, 0·23, indicates that as much as a quarter of the words were produced entirely correctly.

Table 2 shows the scores for the Finnish children in the second analysis, where the correctness of vowels was also scored. Due to the addition of points for the vowels, both target PMLU values and children's PMLU values were higher than those in the first analysis. The PMLU scores for the target words ranged from 7·15 to 11·33 (mean 8·81), and the PMLU scores for the children's productions ranged from 5·73 to 8·43 (mean 6·73) for the second analysis. The PWP score varied in this analysis from 0·70 to 0·84 with the mean PWP score being 0·76.

If we examine our results from a crosslinguistic perspective, the most prominent finding seems to be the relatively high PMLU values for the Finnish children when compared with English data (see Table 3). Reflecting the fact that in Finnish words are long, both the target PMLUs and the children's PMLUs in the first analysis were more than 2·5 points higher than the results reported for the children acquiring English (Ingram, 2002,

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

TABLE 2. *Analysis 2 (consonants and vowels): summary of the PMLU and PWP scores of 17 Finnish children at the 25-word point*

Child	Age	Target PMLU	Child PMLU	PWP
Matti	1;6	9·21	6·43	0·70
Sara	1;8	9·31	6·73	0·72
Helmi	1;9	8·90	6·41	0·72
Antti	1;5	8·90	6·52	0·73
Venla	1;2	9·49	7·03	0·74
Mauri	2;0	11·33	8·43	0·74
Vinsu	1;6	7·77	5·92	0·76
Nuppu	1;7	9·00	6·88	0·76
Atte	1;8	8·80	6·68	0·76
Mira	1;5	8·71	6·71	0·77
Melina	1;7	8·69	6·72	0·77
Juha	1;11	8·69	6·72	0·77
Saini	1;4	8·63	6·86	0·79
Annika	1;6	8·21	6·61	0·80
Eelis	1;10	7·15	5·73	0·80
Pyry	1;10	8·76	7·10	0·81
Vilma	1;8	8·14	6·86	0·84
Means		8·81	6·73	0·76

TABLE 3. *Cross-linguistic comparisons of the PMLU, PWP and PWC values*

	Ages	Target PMLU	Child PMLU	PWP	PWC
17 children acquiring Finnish	1;2–2;0	6·52	5·06	0·78	0·23
5 children acquiring English*	0;11–1;10	4·94	3·18	0·64	0·12
5 children acquiring Spanish**	2;2–2;11	7·6	6·3	0·82	

* Ingram (2002: 720), citing Velten (1943), Ingram (1985) and Stoel-Gammon (1985).
** Ingram (2002: 725), citing Loatman (2001).

see Table 3 for a review). Finnish children already target multisyllabic words at the one-word stage, as has been noted in previous studies of children acquiring Finnish (Kunnari, 2000; Savinainen-Makkonen, 2001). In this study a clear majority (79 percent) of the words targeted by the Finnish children were disyllabic, 13 percent were multisyllabic, and only 8 percent were monosyllabic, whereas English children usually target only mono- or disyllabic words at the early stages of language development (e.g. Ingram, 1989). A more detailed analysis of the words produced by the Finnish children revealed that as much as 96 percent of the disyllabic words were produced as disyllables, whereas 58 percent of the words with three syllables were reduced to disyllabic productions. Nevertheless, this analysis revealed that nearly 89 percent of all the words produced by the children were di- or polysyllabic, relating obviously to the high PMLUs for the children. In addition to the high PMLU values, both the PWP and PWC values for

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

the Finnish children were also considerably higher than those reported for the children acquiring English. The PMLU and PWP values of the Finnish children were closer to the scores attained from five children acquiring Spanish (see Table 3). In Spanish, like in Finnish, words are much longer than in English. However, direct comparisons between Finnish and Spanish data are problematic, as the Spanish children in Loatman's study were older (between 2;2 and 2;11) than the Finnish children (between 1;2 and 2;0).

The high PMLU values of the children's productions indicate that Finnish children are in fact managing relatively well in producing their targets. The child's PMLU score can also be seen as an indicator of the child's ability to perceive and produce certain segments or entities. Ingram (2002) has suggested some preliminary stages for the PMLU and has hypothesized that the first 50 words of normally developing children will fall between 2·5 and 3·5 (stage I). Ingram based his suggestion on the initial PMLU counts of children acquiring English. In our first analysis the PMLU values for the word productions of the Finnish children fall between 4·04 and 6·43. It is clear that in order to make reasonable comparisons between children we would have to determine our own stages of language acquisition for Finnish children. A comparable finding was also made in studying the phonological development of Mexican-American children (Ingram, 2002 citing Loatman, 2001).

Our second analysis scored not only the correctness of consonants, but also the correctness of vowels. The second scoring seemed to be a slightly stricter measure than the first, since a small discrepancy could be found in the mean PWP values (0·78 vs. 0·76). The PWP values of 12 children (71 percent) were lower in the second analysis than in the first. When taking into account the impact of vowel errors on the child's intelligibility, these findings are indeed noteworthy and raise the question of whether correct vowels should be scored as well as correct consonants, at least when early words are in focus.

DISCUSSION

The preliminary results acquired with the PMLU measurement challenge us to study the facts related to language-based differences. A closer examination of the words produced by the Finnish children revealed that the consonants used in early word productions were mostly stops and nasals. Compared with other languages, Finnish has in fact a relatively small consonant inventory (e.g. 13 consonants compared to 24 in English), and thus there is also less challenge and more variation allowed in the pronunciation of the segments. This might be one factor that explains the relatively high PMLU and PWP results for the Finnish children in the early stages of phonological development. An examination of the PWC scores

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

revealed that correctly produced words were mostly cases of modelling the simple input words, which were mono- or disyllabic words that consisted mostly of only one consonant type and one or two vowels (e.g. *puu* 'tree', *tutti* 'pacifier'). The five children who received the best PWC scores (over 0·25) had correspondingly relatively low target PMLU values in both analyses. By targeting words with simple structures the children achieve high overall word correctness scores.

An issue that is worth closer attention is the production of the consonant geminates of the Finnish words. A detailed examination of the targeted words revealed that as many as 202 (41·4 percent) of the 487 words included a geminate within the word (e.g. *heppa* 'horsie', *kukka* 'flower', *kello* 'clock'). Finnish children lengthened the consonant correctly in 157 of 202 words. This means that in more than three quarters (77·7 percent) of the cases the children were able to make the correct quantity distinction between the short and long consonants. This data is in line with previous findings of Finnish children's ability not only to detect but also to produce the quantity distinction already at the early stages of development (Richardson, 1998; Vihman & Velleman, 2000; Kunnari *et al.*, 2001). Despite the ability to produce the geminate structures, consonant sequences and clusters were still problematic for Finnish children: consonant sequences and clusters were produced correctly in only 16 percent of the cases.

One possible source of the language-based differences between the PMLU values of the Finnish and English children could also be the fact that in Finnish, words usually end with a vowel, whereas in English, word final consonants are frequent. There were very few words ending with a consonant targeted by the Finnish children, and thus there was a very small chance for the children to fail in the production of these kinds of words. As such, the production restriction due to word final consonants has also been noted in previous studies in children acquiring Finnish (Savinainen-Makkonen, 2001; Kunnari, 2002). It is possible that the same restriction diminishes the PMLU values of the children acquiring English.

The correctness of vowels was scored in the second analysis. The transcription of vowels is widely agreed to be more difficult than the transcription of consonants (see e.g. Stoel-Gammon & Herrington, 1990; Ladefoged, 1993; Ingram, 2002), and this assumption has also been the primary motive for scoring only the correct consonants in the PMLU count. However, as the impact of vowels in early phonological development seems to be far from unambiguous (see Pollock & Berni, 2001 for a thorough review), we are challenged to take vowels into account when evaluating early phonological development. Although the differences between our two analyses were not considerable, the second analysis did detect which children were quite accurate in their consonant productions but had notable vowel errors that clearly affected their intelligibility.

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

Longitudinal data and the word-point method (Vihman & Miller, 1988) made it possible for us to compare the children who were at the same stages of development despite differences in age. However, there were some challenges in applying the PMLU method to our data. First of all, the sample-size rule advises us to select at least 25 words, but preferably 50 words for analysis (Ingram, 2002). According to Vihman's and Miller's 25-word point criteria, children should produce at least 25 different words in the word point recording session. However, children produce many onomatopoeic expressions, reduplicative child words etc. which do not meet the criteria for the PMLU analysis set by Ingram & Ingram (2001) (e.g. 'include only words that are used in normal conversation between adults'). Thus, we had to 'move forward' to the next recording session and finally to the first half-hour session from which we were able to detect the minimum of 25 words for the analysis after applying all the rules. We must also bear in mind that by excluding all onomatopoeic expressions and reduplicative child words from the analysis we inescapably leave something essential behind. These child words and onomatopoeic words are usually the ones at which children are good at, and they are the ones that the children first try to target at the early stages of language development.

The application of the rules for the calculation of the PMLU has also raised other questions, which have recently been discussed in other contexts as well (see Taelman, Durieux & Gillis, 2005 and Bónová, Slančová & Mikulajová, 2005). Several improvements have been suggested, including e.g. minimal sample sizes (Taelman *et al.*, 2005) and a new 'positional rule' for the treatment of metathesis in the children's productions (see Bónová *et al.*, 2005). Taelman *et al.* (2005) suggest that all available tokens should be analysed. It is true that by counting only one token of each word we do not obtain any information about the variation in the children's productions. This, in line with the other themes, is a matter in need of more discussion.

Due to the qualitative nature of this study it is clear that the results presented here are preliminary, as this has been the first effort to apply the PMLU measurement to data from Finnish children. The results cannot be generalized to represent all children acquiring Finnish, but they reveal a fragment of the variation which will most probably be represented in the results for Finnish children. Further, the results show the immense need for more language-specific research in order to develop the PMLU method suitable for clinical use in various language environments.

REFERENCES

Bónová, I., Slančová, D. & Mikulajová, M. (2005). The measurement of phonological acquisition in Slovak. Poster presented at the *X. International Congress for the Study of Child Language*. Berlin, Germany.

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

Boysson-Bardies, B. de, Halle, P., Sagart, L. & Durand, C. (1989). A crosslinguistic investigation of vowel formants in babbling. *Journal of Child Language* **16**, 1–17.
Boysson-Bardies, B. de & Vihman, M. M. (1991). Adaptation to language: evidence from babbling and first words in four languages. *Language* **67**, 297–319.
Ferguson, C. A. & Farwell, C. B. (1975). Words and sounds in early language acquisition. *Language* **51**, 419–39.
Ingram, D. (1985). On children's homonyms. *Journal of Child Language* **12**, 671–80.
Ingram, D. (1989). *Phonological Disability in Children*. Second edition. London, Jersey City: Whurr Publishers.
Ingram, D. & Ingram, K. D. (2001). A whole-word approach to phonological analysis and intervention. *Language, Speech and Hearing Services in Schools* **32**, 271–83.
Ingram, D. (2002). The measurement of whole-word productions. *Journal of Child Language* **29**, 713–33.
Jakobson, R. (1941). *Kindersprache, Aphasie und allgemeine Lautgesetze*. Uppsala: Almquist & Wiksell.
Jakobson, R. (1968). *Child language, aphasia and phonological universals*. The Hague, Paris: Mouton.
Karlsson, F. (1983). *Suomen kielen äänne- ja muotorakenne*. Porvoo, Helsinki, Juva: WSOY.
Karlsson, F. (1999). Finnish: an essential grammar. London, New York: Routledge.
Kunnari, S. (2000). *Characteristics of early lexical and phonological development in children acquiring Finnish*. Acta Universitatis Ouluensis. Oulu: Oulu University Press.
Kunnari, S. (2002). Word length in syllables: evidence from early word production in Finnish. *First Language* **22**, 119–35.
Kunnari, S. (2003). Consonant inventories: a longitudinal study of Finnish-speaking children. *Journal of multilingual communication disorders* **2**, 124–31.
Kunnari, S., Nakai, S. & Vihman, M. M. (2001). Crosslinguistic evidence for acquisition of geminates. *Psychology of Language and Communication* **5**, 13–24.
Ladefoged, P. (1993). *A course in phonetics*. Third edition. New York: Harcourt, Brace, Jovanovich.
Loatman, C. (2001). Phonological patterns of two-year-old monolingual Mexican-American Spanish speakers. Unpublished Masters Thesis, Arizona State University.
Lyakso, E. E. & Silvén, S. A. M. (2002). Comparative characteristics of early vocalizations in Finnish and Russian infants. *Journal of Sensory System* **16**, 65–74.
Pollock, K. E. & Berni, M. C. (2001). Transcription of vowels. *Topics in Language Disorders* **4**, 22–40.
Richardson, U. (1998). *Familial dyslexia and sound duration in the quantity distinctions of Finnish infants and adults*. Studia Philologica Jyväskyläensia **44**.
Savinainen-Makkonen, T. (1998). Ensisanojen kauden fonologiaa: tapaustutkimus. In M. Karjalainen (ed.), *Kielen ituja. Suomen ja saamen kielen ja logopedian laitoksen julkaisuja* **10**, 44–83. Oulu: Yliopistopaino.
Savinainen-Makkonen, T. (2000a). Word-initial consonant omissions – a developmental process in children learning Finnish. *First Language* **20**, 161–85.
Savinainen-Makkonen, T. (2000b). Learning long words – a typological perspective. *Language and Speech* **43**, 202–25.
Savinainen-Makkonen, T. (2001). *Suomalainen lapsi fonologiaa omaksumassa*. Helsingin yliopiston fonetiikan laitoksen julkaisuja **42**. Helsinki: Hakapaino Oy.
Stoel-Gammon, C. (1985). Phonetic inventories, 15–24 months: a longitudinal study. *Journal of Speech and Hearing Research* **28**, 505–12.
Stoel-Gammon, C. & Herrington, P. (1990). Vowel systems of normally developing and phonologically disordered children. *Clinical Linguistics and Phonetics* **4**, 145–60.
Sulkala, H. & Karjalainen, M. (1992). *Finnish*. London: Routledge.
Taelman, H., Durieux, G. & Gillis, S. (2005). Notes on Ingram's whole-word measures for phonological development. *Journal of Child Language* **32**, 391–405.

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press

UNESCO (1997). International Standard Classification of Education, ISCED 1997. http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm

Velten, H. (1943). The growth of phonemic and lexical patterns in infant language. *Language* **19**, 281–92.

Vihman, M. M. & McCune, L. (1994). When is a word a word? *Journal of Child Language* **21**, 517–42.

Vihman, M. M. & Miller, R. (1988). Words and babble at the threshold of language acquisition. In M. D. Smith & J. L. Locke (eds), *The emergent lexicon: the child's development of a linguistic vocabulary*, 151–83. New York: Academic Press.

Vihman, M. M. & Velleman, S. L. (2000). The construction of a first phonology. *Phonetica* **57**, 255–66.

Warren, S. (2001). *Phonological acquisition and ambient language: a corpus based crosslinguistic exploration*. PhD Thesis, University of Hertfordshire, UK.

https://doi.org/10.1017/S0305000905007294 Published online by Cambridge University Press