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Screening language skills at 2;0

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ABSTRACT

Early screening of children at risk for language difficulties is challenging. This study aimed to analyze the specificity and sensitivity of two screening methods at 2;0 years of age. In addition, the matter of what kind of information the use of word combinations and parental concern provide for screening was analyzed. The subjects were 78 children. The screening methods used were the Finnish versions of the short-form version of the MacArthur Communicative Development Inventories (FinCDI-SF) and the Communication and Symbolic Behavior Scales, Developmental Profile, Infant-Toddler Checklist (FinCSBS). The specificity and sensitivity of the screening methods were analyzed based on result of the Reynell Developmental Language Scales III. Both screening methods had high specificity but only moderate sensitivity. **The use of word combinations and parental concern provided relevant information on early language development.** The results imply that it is important to take into consideration receptive language development in early screening.

1. Introduction

The effect of language difficulties is far reaching and affects various aspects of life, such as learning and the quality of relationships (Durkin & Conti-Ramsden, 2007; Lyytinen, Eklund & Lyytinen, 2005; Rescorla, 2009). Screening for children who are at risk of language difficulties helps with early identification and provides them the support they need. Early intervention is cost-efficient if compared to later intervention (Chowdry & Oppenheim, 2015) and it also diminishes parental concern. The question is how to clinically identify those children, who are at risk for persistent language difficulties, in the best and most economical way. This study compares two screening methods and evaluates their sensitivity and specificity in identifying children with weak language skills (WLS), when measured using a standardized language test at 2;0 years of age.

Expressive lexicon size at 2;0 years is a strong predictor of language skills at 3;0, and even at 5;0 years of age, especially in high-risk children (Korpilahti, Kaljonen & Jansson-Verkasalo, 2016; Lee, 2011; Stolt, Matomäki, Lapinleimu, Haataja & Lehtonen, 2014). At two years of age, children have typically acquired approximately 300 words in their expressive lexicons (Fenson et al., 2007; In Finnish, Lyytinen, 1999; Stolt et al., 2008). Children with small expressive lexicons, in the absence of other neurological pathologies, at 2;0 years of age, are called late talkers (Rescorla, 1989; Rescorla & Dale, 2013). Their prevalence varies between 13% and 20% of 2-year-old children (Reilly et al., 2007; Rescorla, 1989; Zubrick et al., 2007). Although most late-talkers, especially those with no difficulties in receptive language skills, catch up with their peers between the ages of 3;6 and the age of entering school, being a late talker is a risk factor for persistent language difficulties (Lyytinen et al., 2005; Lyytinen, Poikkeus, Laakso, Eklund & Lyytinen, 2001; Rescorla, 2011; Rescorla & Dale, 2013).

The emergence of word combinations can be regarded as a significant developmental milestone for syntactic and semantic

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development (Bates, Bretherton & Snyder, 1988; Bates, Dale & Thal, 1995). Word combinations typically emerge between 1;6 and 2;0 years of age usually after the child has acquired a sufficient number of words in their expressive vocabulary (Fenson et al., 2007; Fenson et al., 2000; Rhea and Norbury, 2012; Stolt, Haataja, Lapinleimu & Lehtonen, 2009). At 2;0, roughly 90% of children use word combinations (Fenson et al., 2000; Stolt et al., 2009). The clinical importance of the emergence of word combinations was noted by Rescorla (1989) when she examined several different screening thresholds for late talkers. If the child had not yet started using word combinations or had 50 or less words when measured using the Language Development Survey, a parental-based word checklist, at 2;0, he/she was identified as a late talker (Delay 3 criterion). Failure to use word combinations at 2;0 roughly corresponds to the clinically significant weakest 10% performance in expressive lexicon size at 2;0 (Bates et al., 1995; Stolt et al., 2009).

The challenge with screening is to identify as accurately as possible the true positives and true negatives, and thus, obtain good sensitivity and specificity numbers. Regarding language development, true positives include children with delayed or atypical language skills and true negatives are those with no difficulties in language skills. Klee, Pearce and Carson (2000) conducted further studies on how to reduce the number of those children who were identified as late talkers but were actually typically developing children (a.k.a. false positives) by revising the Delay 3 (Rescorla, 1989) criterion. By adding parental concerns about a child's language development or if the child had experienced six or more ear infections by the age of two years to the Delay 3 criterion (Delay 3+ criterion), the probability of identifying those children with WLS improved. The value of parental concern has also been examined in other studies and it has been shown to correlate with weak language test results, especially weak expressive language skills (Hayiou-Thomas, Dale & Plomin, 2014; Korpilahti et al., 2016; McLeod & Harrison, 2009).

Also emotions, gaze, non-verbal communication, receptive lexical skills and the use of objects have been found to be associated with concurrent and later language skills (Laakso, Eklund & Poikkeus, 2011; Lyytinen et al., 2005; Stolt et al., 2016; Stolt, Mäkilä et al., 2014; Watt, Wetherby & Shumway, 2006; Wetherby & Prizant, 2002). These skills provide important information on very early language and communication and can be used for screening purposes (Laakso et al., 2011; Wetherby & Prizant, 2002).

The main aim of this study was to analyze the specificity and sensitivity of two screening methods: the short form version of the MacArthur Communicative Development Inventories (Fenson et al., 2000); Finnish version: FinCDI-SF, Stolt & Vehkavuori, in press) and the Communication and Symbolic Behavior Scales, Developmental Profile, Infant-Toddler Checklist (Wetherby & Prizant, 2002; Finnish version: Esikko method, FinCSBS, Laakso et al., 2011) at 2;0. The exact study questions were: 1) How specific and sensitive is the FinCDI-SF in identifying children with WLS at 2;0?, 2) How specific and sensitive is the FinCSBS in identifying WLS at 2;0? and 3) Does the use of word combinations and/or parental concern about their child's language development provide relevant information for screening at 2;0?

This study is part of the ongoing norming study of the FinCDI-SF (Project Leader Dr. Stolt). Permission to adapt the short-form version of the CDI in Finnish was received from the CDI Advisory Board in September 2010. The Ethics Committee of the University of Turku approved the procedure of the FinCDI-SF norming study, in December 2010. Permission to recruit the participants to the norming study, from child welfare clinics in the Turku area, was granted by Turku Health Services, in March 2011. Parents received written feedback from the test results. If the child's skills were delayed, parents were advised to contact their local child welfare clinic.

2. Participants and methods

2.1. Participants

The participants were 78 healthy, full-term children from monolingual Finnish families (35 boys, 45%; 43 girls, 55%). Parents were not known to have any problems with alcohol consumption, drug uses or mental health issues, when the study began. All parents had finished at least nine years of compulsory schooling. Seven mothers (9%) had finished high school (12 years of basic education) and 71 (91%) had studied further (more than 12 years of basic education). Three fathers (4%) had finished compulsory schooling, 14 (18%) had finished high school and 59 (76%) had studied further. The education level of the parents in this study is parallel to the education levels of young adults in Finland (Official Statistics of Finland, 2014).

2.2. Measures and procedure

The original versions of the screening methods used in the present study are well known. Both methods are also rather new and there is a need for research on what kind of information they provide for the clinicians. Both the short form version of the CDI and the CSBS, developmental profile, have been validated in the Finnish population (Laakso et al., 2011; Stolt & Vehkavuori, in press).

The FinCDI-SF and the FinCSBS consist of checklists and are filled out by parents. The short form version of the FinCDI includes two versions, one for the age period 0;9–1;6 and one for the age period 1;6–2;0. The latter one was used in the present study. It is possible to obtain information on the expressive lexicon and on the use of word combinations by using it. The *number of words* in the checklist is 100 (one word = one point) parallel to Fenson et al. (2000). The words in the checklist represent different semantic lexical categories (early social terms, nouns, verbs, adjectives, words about time and closed class words) parallel to Fenson et al. (2000). Only the expressive lexicon can be measured with the toddler version of the FinCDI-SF. The method also includes one question on the use of *word combinations* (Does not use = 0, Uses sometimes = 1, Uses often = 2 points). Thus, the possible *total score* is 102 points. The 10th percentile values (number of words < 16, total score < 17 points) of the FinCDI-SF were used as a marker for WLS. The validity of the FinCDI-SF is good especially at the end of the second year (Stolt & Vehkavuori, in press). The simultaneous Spearman's correlation co-efficient values between the total number of words measured using the FinCDI-SF and other measures are

high and significant at 2;0 (the Finnish long form version of the CDI $r = 0.92$, $p < .001$; expressive language score of the Bayley Scales of Infant Development III (Bayley, 2006) $r = 0.74$, $p < .001$).

The FinCSBS includes 24 questions which are divided into the following variables: *social composite* (SoC: sum of emotion and eye gaze, communication, and gestures; 13 questions), *speech composite* (SpC: sum of sounds and expressive words; 5 questions) and *symbolic composite* (SyC: sum of understanding and object use; 6 questions). The points for each question are given by using either categorization values (such as language usage, with 0 points for answer not yet, 1 point for sometimes and 2 points for often) or a numeric value (0–4 points for questions formulated as “How many...?”) scale. The maximum scores for the composite variables SoC, SpC and SyC are 26, 14 and 17 points, respectively. The maximum *total score* is 57 points. The 10th percentile values of the FinCSBS, derived from the Finnish norms, are as follows: 21 points for the SoC, 12 for the SpC, 15 for the SyC and a total score of 49. The validity of the FinCSBS is good (Laakso et al., 2011).

Parents filled in the two screening methods and returned them at the assessment, within two weeks after their child's 2-year birthday. The Reynell Developmental Language Scales III (RDLS III, Edwards et al., 1997; Finnish version, Korttesmaa et al., 2001) was conducted at the assessment. The RDLS III is a structured, formal test that has been standardized in Finnish and has Finnish normative data. Both receptive and expressive language skills were tested. The *total score* is the sum of the points derived from the *receptive* and *expressive scores*. Standard scores were used in the present study (mean standard score SSc 100; ± 1 standard deviations; SD 15 SSc).

Parents' concern (yes/no) about their child's language skills was collected via an interview at 2;0 years of age, before conducting the RDLS III test. At the assessment, parents of six participants (8%) were concerned about their child's skills.

2.3. Data analysis

Inter-correlations between the methods were calculated using Spearman's correlation co-efficient r . The cut-off value of the lowest 10th percentile was used for the FinCDI-SF (number of words, total score) and FinCSBS variables (SoC, SpC, SyC, total score) when calculating the specificity and sensitivity of the methods. Specificity and sensitivity calculations were based on the variables of the RDLS III. A standard score of 85 was set as a cut-off value for the specificity and sensitivity analysis as a marker of WLS in all three scores. A standard score of < 85 means that the child is performing at least 1 SD weaker (-1 SD) than the mean (100 SSc).

An independent samples t -test was used to analyze if the language skills measured using RDLS III in those children with no word combinations differed from the language skills of those children with word combinations. A comparable procedure was used with the parental concern variable.

3. Results

3.1. Data description

The descriptive statistics for the FinCDI-SF, FinCSBS and RDLS-III are presented in Table 1. Regarding the FinCDI-SF, all children had at least a few words in their lexicon. The mean number of words was 57 words (SD 26). Seven children (9%) fell below the 10th percentile limit on the Fin-CDI-SF words and FinCDI-SF total score. Nine children (12%) had not started using word combinations, eight (10%) used them sometimes and 61 (78%) used them often.

The mean value of the FinCSBS was 52 (SD 3). A ceiling effect was found, in this method, at 2;0 (maximum total score 57 points). The numbers of children performing in the weakest 10th percentile group, when measured using the FinCSBS, were as follows: 19 (24%) for SoC, 9 (12%) for SpC, none (0%) for SyC and 11 (14%) for total score.

The mean RDLS III total score was 104 (SD 15). The numbers of children performing < 85 SSc, when measured using the RDLS III method, were as follows: 7 (9%) for receptive, 17 (22%) for expressive and 6 (8%) for the total score.

The correlations between the variables are presented in Table 2. The correlation co-efficient values between the FinCDI-SF total score, and the expressive and total score of the RDLS III were clear and significant. The correlation co-efficient value, between the

Table 1

The descriptive statistics for the Finnish versions of the short form version of the Communicative Development Inventories (FinCDI-SF), the Communication and Symbolic Behavior Scales, Developmental Profile, Infant-Toddler checklist (FinCSBS) and the Reynell Developmental Language Scales III (RDLS III) at 2;0 years of age.

Method	Variable	Mean	SD	Mdn	Range
FinCDI-SF	Number of words	57	26	59	4–100
	Total score	58	27	61	4–102
FinCSBS	SoC	22	3	23	16–26
	SpC	13	1	14	8–14
	SyC	17	1	17	15–17
	Total score	52	3	52	44–57
RDLS III	Receptive	107	16	107	73–143
	Expressive	100	15	103	77–133
	Total score	104	15	105	71–133

Note. SoC = FinCSBS Social composite, SpC = FinCSBS Speech composite, SyC = FinCSBS Symbolic composite.

Table 2

Spearman's correlation (*r*-values) between the Finnish versions of the short form version of the Communicative Development Inventories (FinCDI-SF), the Communication and Symbolic Behavior Scales, Developmental Profile, Infant-Toddler checklist (FinCSBS) and the Reynell Developmental Language Scales III (RDLS III) at 2;0 years of age at 2;0 years of age.

Method	Variable	RDLS III		
		Receptive score	Expressive score	Total score
FinCDI-SF	Number of words	.48***	.72***	.65***
	Total score	.48***	.72***	.65***
FinCSBS	SoC	.10	.06	.10
	SpC	.15	.49***	.31**
	SyC	.23*	.13	.22
	Total score	.22	.27*	.27*

Note. SoC = FinCSBS Social composite, SpC = Speech composite, SyC = Symbolic composite. * = $p < .05$; ** = $p < .01$, *** = $p < .001$.

FinCDI-SF total score and the receptive score of the RDLS III, was weaker but still clear and significant. The correlation co-efficient values between the FinCSBS total score and the RDLS III expressive and total score were only modest but significant. There was no significant correlation between the total score of the FinCSBS and the receptive score of RDLS III.

3.2. The specificity and sensitivity of the screening methods

The FinCDI-SF (total score) identified most of the children (92%) without WLS (Table 3). Hence, its specificity was very good. However, it identified only 33% of those children with WLS if measured using the RDLS III total score. Therefore, its sensitivity was only moderate.

The FinCSBS (total score) identified most (88%) of the children without WLS at 2;0. Therefore, its specificity was reasonably good. Still, it identified only 33% of those WLS at 2;0. Thus, its sensitivity was only moderate.

3.3. Word combinations and parental concern

Children who did not use word combinations performed significantly weaker compared to children who already used word combinations, when measured using the RDLS III expressive score, $t(76) = -4.9, p < .001$, and total score, $t(76) = -3.3, p = .001$. A statistically significant difference was not found when using the RDLS III receptive score, $t(76) = -1.7, p = .09$, although, the mean receptive score was lower for children who had not yet started using word combinations.

The language skills of children whose parents had concerns about their language skills were significantly weaker compared to children whose parents did not have any concerns about their child's language development: the RDLS III receptive score, $t(76) = 3.4, p = .001$, RDLS III expressive score, $t(76) = 3.1, p = .003$, and RDLS III total score, $t(76) = 3.8, p < .001$.

4. Discussion

This study aimed to analyze the specificity and sensitivity of two screening methods, the Finnish versions of the short form version of the MacArthur Communicative Developmental Inventories and the Communication and Symbolic Behavior Scales, Developmental

Table 3

Sensitivity (Sens.) and specificity (Spec.) of the Finnish versions of the short form version of the Communicative Development Inventories (FinCDI-SF), the Communication and Symbolic Behavior Scales, Developmental Profile, Infant-Toddler checklist (FinCSBS) and the Reynell Developmental Language Scales III (RDLS III) at 2;0 years of age.

Method	Variable	RDLS III					
		Receptive		Expressive		Total Score	
		Sens.%	Spec.%	Sens.%	Spec.%	Sens.%	Spec.%
FinCDI-SF	Number of words	14	92	41	100	33	93
	Word combinations	14	89	41	97	16	89
	Total score	14	92	41	100	33	93
FinCSBS	SoC	57	79	29	77	50	78
	SpC	43	92	53	100	50	92
	SyC	0	100	0	100	0	100
	Total score	43	89	29	90	33	88

Note. SoC = FinCSBS Social composite; SpC = FinCSBS Speech composite; SyC = FinCSBS Symbolic composite.

Profile, Infant-Toddler Checklist at 2;0. It also aimed to study if word combinations and parental concern can provide valuable information for screening. The correlations between the FinCDI-SF and the RDLS III variables were clear and significant; whereas, the correlations between the FinCSBS and the RDLS III variables were only modest. Both screening methods, used in the present study, had good specificity but only moderate sensitivity. The additional questions on the use of word combinations and parental concern gave relevant information on early language development.

Both FinCDI-SF and FinCSBS had similarly high specificity across the variables but only low to moderate sensitivity. Various reasons may explain this. First, neither of the screening methods gave detailed, if any, information on receptive language/lexical skills. This explains the low sensitivity scores in terms of the RDLS III receptive and total score – the receptive score has a strong impact on the total score. Screening for receptive skills would still be important. Children with only delayed expressive language skills are more likely to catch up to their peers compared to children with difficulties in both receptive and expressive language (Lyytinen et al., 2005; Rescorla, 2011). Second, it can always be debated if a single formal language test is the best method for identifying WLS at 2;0. The co-operation of a 2;0-year-old child may not always be optimal in the clinical testing situation due to shyness, tiredness or hunger. This may sometime lead to an unrepresentative result. It may be that parental based screening methods are in some cases even more informative than the formal tests, at this very early age, because parents have opportunities to observe their child daily when the child performs at their best, and in varying situations. Furthermore, although the total scores of FinCDI and FinCSBS both provided comparable information on sensitivity and specificity, the two screening methods screen different skills, at least partially. Hence, the methods should not be regarded as similar screening tools. Lastly, the results on the sensitivity and specificity of the FinCDI-SF words score and the FinCDI-SF total score were identical. This finding suggests that the question on the use of word combinations in the FinCDI-SF total score may not have enough weight as calculated in the present study.

The correlations between the FinCDI-SF and the RDLS III receptive, expressive and total score were clear and statistically significant. As expected, the strongest correlation was found between the FinCDI-SF and the RDLS-III expressive score. Thus, the FinCDI-SF provided valid information on children's expressive language skills. In contrast, the correlations between the FinCSBS and the RDLS-III were moderate or weak, or even non-significant. This can partly be explained by the ceiling effect found in FinCSBS. Age 2;0 years is the last age point at which this method has norms and is designed to be used at. Weak correlations were also reported in the Finnish norming study of the FinCSBS (Laakso et al., 2011). Furthermore, it may as well be that the correlation co-efficient values between the results of the FinCSBS and RDLS-III were weak because the methods measure slightly different skills.

The finding that children with no word combinations had weaker expressive skills and language skills in general, is parallel to previous studies (Bates et al., 1995; Fenson et al., 2000; Rescorla & Dale, 2013; Stolt et al., 2009), as is the finding that a very high percentage of children had started using word combinations at 2;0. These findings strengthen the knowledge that the majority of children have begun to use word combinations at the end of the second year, and, that the emergence of word combinations is, indeed, associated with the number of expressive words a child has acquired. Thus, the use of word combinations provides relevant information on children's language development at the age of two years. However, when interpreting the value of the use of word combinations variable, it should be taken into consideration that, although this variable seems to identify the true negatives quite reliably, i.e., the children without WLS, it may not be sensitive enough to identify true positives, i.e. the children with WLS. Some children with very small lexicons at 2;0 may have begun to use word combinations. This increases the risk of identifying the child as a false negative. To conclude, even though the question of word combinations provides relevant information on children's language skills, it may not be accurate enough to be used independently in screening without assessing receptive and expressive lexical skills using other methods.

In the present study, children whose parents had concerns about their child's language skills, performed weaker on all the RDLS III variables than children whose parents did not report any concern. Thus, parents can provide important information on their children's language development. Our finding is in accordance with previous findings (Hayiou-Thomas et al., 2014; Korpilähti et al., 2016). On the other hand, parental concern is especially aroused in the cases of a hereditary difficulty and it is more likely to be aroused by speech than by language problems, and only rarely by receptive language difficulties (Hayiou-Thomas et al., 2014). Hence it would be necessary to clarify the different aspects of speech and language skills to parents when asking about their concern.

Clinical implications of the present study are as follows. Although expressive lexicon and the use of word combinations provide important information on early language development of two-year-old children, it would be important to get comprehensive information on the receptive language development as well in the early screening. Present findings underline the need to develop new screening tools that would take into consideration also the receptive language development at this age. Furthermore, our finding, together with earlier findings (e.g. Hayiou-Thomas et al., 2014), proposes that the parental concern should be taken seriously in the clinical work since it provides important information on the language development of the children. A limitation of this study is the relatively small number of participants. A greater number of participants could have included more children with WLS. Also, including children from special populations, such as pre-term children or children with neurological disorders might have led to different results, as the group of children with WLS might have been bigger. It would be beneficial to compare the specificity and sensitivity of these screening methods in special populations, such as toddlers born pre-term.

To conclude, the main aim of this study was to analyze the specificity and sensitivity of the FinCDI-SF and the FinCSBS. Both methods had high specificity but only moderate sensitivity. The use of word combinations and parental concern, both, provided relevant information for screening WLS. Measuring receptive language development in early screening would be most important for identifying children with WLS more accurately.

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