

The Literacy Profiles of Czech Precocious Readers

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Abstract

This study examines whether nine Czech precocious readers' performance of a set of pre-literacy, early reading, and spelling tasks from kindergarten through the first two grades of primary school was different from that of nine non-precocious readers selected as matched according to school, age, and gender. The profiles of Czech precocious readers for literacy and literacy-related language skills are reported and discussed in line with the international literature. The data analyses showed that compared with their matched peers, Czech precocious readers show superior performance on knowledge of letter sounds and letter names, phoneme awareness, reading fluency (decoding), and spelling in kindergarten and also in the first grade. In the second grade, the two groups of children do not differ in terms of phoneme awareness and reading comprehension performance, while significantly better scores are reported for reading accuracy, fluency, and writing for precocious readers.

Key words: precocious readers, phoneme awareness, letter knowledge, reading fluency, reading comprehension

Research on early reading and spelling skills and their relationship to language development in what is termed the psycholinguistic approach to studying literacy has opened up a space for the systematic description of the pathways of the typical development of reading and spelling. Of course, a large body of research has been conducted on children's various reading and spelling difficulties. However, less attention has been paid, and significantly less research is available, on children who were able to show functional reading skills well

before they entered any formal system of literacy teaching.

What are termed precocious readers show a mastery of fluent or almost fluent reading before beginning the first grade of primary school or before any formal literacy training. As is the case for many other areas in reading research, here too most of the available information on precocious readers comes from English-speaking backgrounds. Notable studies on precocious readers in international research seem to span more than 50 years and today also include know-

ledge from other European languages (classics from Durkin 1966 and Clark 1976 – papers in international journals: Anbar 1986; Tafa & Manolitsis 2008; Olson, Evans, & Keckler 2006; Silván, Proskiparta, & Niemi 2004).

A typical characteristic of precocious readers is that they had no formal instruction in mastering decoding or reading skills and, according to the available knowledge from international research, these children do not seem to be primarily influenced by exceptional intellectual ability or specific socioeconomic status (Olson et al. 2006). Of course, as is the case for many other phenomena in the psychology of reading acquisition, the definition of a precocious reader is a matter of variability at the level of key aspects of the definition of a precocious reader. In their review, Olson et al. (2006) attempted to analyse concrete content presented in definitions of precocious readers in the currently available research and proposed three key features of the definitions of precocious readers (Olson et al. 2006, pp. 206-207). A precociously reading child:

- demonstrates the ability to decode words
- demonstrates comprehension of written material (ruling out hyperlexia, that is, decoding without comprehension); very often, norm-referenced information identifies precocious readers as decoding and comprehending at or above second-grade level while still of preschool age
- had some, albeit “non-formal”,

instruction in reading acquisition – such as spontaneous, intuitive, or unplanned instruction provided by parents, caregivers, or siblings. In other words, precocious readers typically do not participate in any “formal” or systematic reading instruction to become readers.

According to Olson et al. (2006), approximately 1% of children entering school are precocious readers.

Studies on precocious readers in the Czech research literature are rare. Probably the only psychological study of this kind to have been published so far comes from Matějček (1979, 1997, and 1999), the founder of reading research in the Czech Republic. In his research and practice Matejček concentrated on dyslexia or various reading difficulties. As a part of his screening studies on preschool children, he tried to identify “early readers” or, as he called them, “hyperlectic” children and provide a rough picture of the early reading skills these children show before they enter the first grade. He was especially interested in the description of the family background of these children. His study from 1997 thus presents comments on the family context related to the early reading behaviour of precocious readers. This report study is based on clinical samples Matejček collected through approx. 20 years of his clinical practice in Prague, specifically the notes about 76 families Matejček worked with. The results of this study report that most of the parents of early readers were col-

lege- or university-educated. The children were reported as going through rapid language development in their early years, reaching “rich and mature speech at the age of two and showing spontaneous interest in letters and digits at the same time (around the age of two). Blending sounds into syllables was typically reported by parents at the age of three and a half. Soon after that fluent reading appeared – Matejček linked these early reading skills with exceptional phonemic awareness skills in precocious readers. Matejček stresses the fact that the sample of precocious readers was balanced from the gender point of view.

His 1999 screening study was then more concentrated on general descriptive information related to the sample of precocious readers. Out of the sample of 85 children reported by the kindergarten teachers as precocious readers, Matejček selected those children reading at least 50 words per minute (the criterion is not explained in detail, so it is not obvious why this reading level was applied). The children selected for the study were children from kindergarten classes from Prague (the capital) and two more medium-sized cities in the Czech Republic throughout the spring months (the second part of the preschool year) before they entered the first grade of primary school. Out of this sample, precocious readers created a group of 12 (14% of the sample). All of the children in this group of precocious readers were boys (p. 41); both parents of these 12 boys were college- or university-educated and

none of their families had only the lower, compulsory education. In his conclusions in both studies (1995 and 1999), Matejček repeatedly stresses the importance of interaction between exceptional or accelerated speech development and with a supportive and generally pro-reading mobilizing family background.

Various studies from English and non-English-language backgrounds seem, according to Olson et al., to relate in their structure and aims to the pioneering work of Durking (1966). In other words, three areas are typically studied intensively in relation to precocious reading: 1) the personal and environmental correlates of very early readers (such as intellectual skills, parental and caregiver’s behaviour, typical activities while of preschool age, exposure to reading material, etc.); 2) the process of the development of very early reading, and 3) the academic skills of precocious readers. The primary interest of this study lies between the second and third areas; specifically, our aim is to study precocious readers’ performance in various pre-literacy, language, and literacy tasks and compare their performance to that of their age-matched peers.

Studies with a similar target have also been conducted in other European languages. Stainthorp and Hughes (1999) conducted a study with English-speaking children comparing the performance of various literacy and phonological tasks of precocious and normally developing readers at the age of five (before entering primary school). These authors also

followed the same group of 61 children up to the age of 11. The precocious readers showed, according to this study, the same developmental pattern as the normally developing children; however, they also generally proved to perform all the tasks that were assessed much better than the control group of typically developing children. More than that, the precociously reading children continued to achieve better scores in reading accuracy, reading rate (speed), reading comprehension, and also in phoneme awareness up to the age of 11.

Finnish-speaking precocious readers were compared to their typically developing age-mates as a part of a longitudinal study reported by Silven, Poskiparta, and Niemi (2004). The authors followed children between the ages of one and approx. seven years, assessing various language and literacy tasks. Their analyses of the performance of the subgroup of precocious readers in phonemic awareness tasks showed that these children - in contrast to the typically developing readers - had superior skills at various levels of phonological awareness as early as at the age of four. Actually, three years before they become readers, they outperformed their age-mates on phoneme awareness tasks and oral language tasks (such as vocabulary, word inflections, and morphology). The superior phoneme awareness of the precocious readers was still present even at the age of six, at the time when the non-precocious readers were just starting to read. The authors interpret this observed

“spurt” in phoneme awareness in precocious readers as a consequence of the spurt in their reading acquisition.

Tafa and Manolitis (2008) compared the development of thirteen precocious and twelve non-precocious Greek readers from kindergarten to the fourth grade of primary school. As reported in this study, the Greek precocious readers also showed superior phoneme awareness in contrast to the age-matched control group; however, this applied only to the kindergarten and first-grade data collection points. Reading fluency was maintained as better in the precocious readers till the fourth grade. The advantage the precociously reading children had in spelling and reading comprehension was maintained till the end of the second grade.

Previous studies reported for English and also for more transparent orthographies such as Finnish or Greek agree on the superiority of phoneme awareness, reading accuracy, reading comprehension, and spelling of precocious readers from kindergarten till (at least) the end of the second grade. The aim of this study is to add more information on the development of precocious children by monitoring Czech precocious readers and the age-matched controls in their class from kindergarten up to the beginning of the second grade. Phoneme awareness and reading and spelling performance will be reported. More details (in comparison to the studies mentioned previously) will be provided on the orthographic skills of these children. Our aim is to construct

literacy skills (specifically, literacy, pre-literacy, and literacy-related language skills) profiles of Czech precocious readers for three educational levels – kindergarten and the first and second grades. The literacy profiles of precocious readers will be compared and contrasted to the profiles of non-precocious readers of the same age, gender, and school. We expect the results for Czech precocious readers concerning reading, spelling, and phonemic awareness to more or less follow the results reported in Tafa and Manolitis (2008) or in Silven et al. (2004) because of the similar levels of orthographic consistency in Czech and Greek and Finnish orthography. This study is specifically important for the Czech research and professional readership as it provides the first detailed description of precocious readers' development in literacy-related and early literacy skills.

Literacy instruction in Czech kindergartens and schools

Formal literacy education typically starts in primary schools in the Czech Republic at the age of six. Therefore the kindergarten curriculum does not include an obligatory system for the teaching of the alphabet, phonics, or reading skills. Children are, however, exposed to some letter-sound knowledge or phonemic awareness training activities (for example, identification of the first sound in a word, recognizing the uppercase versi-

ons of some letters, recognizing the letter at the beginning of the child's name, or even writing the child's name.) These pre-literacy activities are closely tied to the teaching strategies and activities within the development of language and oral language skills. The preschool curriculum in the Czech Republic is based on the idea of key competencies creating prerequisites for lifelong learning. Pre/literacy skills are included as a part of the language and oral skills curriculum content area (Splavcová, Šmelová, Kropáčková, & Syslová 2016), and do not stand as an independent area in the curriculum. Kindergartens have relatively great freedom to choose teaching strategies, programmes, materials, or activities to promote pre-literacy skills or phonological awareness skills. This results in a certain variability between kindergartens; on the other hand, preschool teacher professional training and the associated community generally prefer to support the development of phoneme awareness and letter/sound knowledge within the broader area of oral language skills and game-like training. Work in classes focuses more on oral language skills, including phonology, and there is no systematic teaching of the knowledge of letters. Children are exposed to print in the classroom (books, signs), but there is no formal instruction about print. Children in the Czech Republic typically enter the first grade of primary school at the age of six; specifically, children should reach the age of six before entering the first grade. The

current educational policy in the Czech Republic provides space for variable approaches to delivering reading and spelling instruction. Literacy instruction is traditionally rooted in “phonics” methods of teaching literacy.

Method

Design of the study

This study was developed as a part of the ELDEL longitudinal project “Establishing the Foundations of Literacy in European Languages” (www.eldel.eu). This longitudinal project was aimed at studying the pathways of the development of literacy in selected European languages, including Czech. Six data collection rounds were conducted with the Czech sample, measuring literacy, pre-literacy, and language or cognitive skills before preschool age and throughout the first two years of primary school attendance. Two data collection rounds were conducted in each school year.

This study uses data from only three selected testing rounds: one at each school level. The first one (T1) was conducted in February/March of the kindergarten school year, then T2 approx. 10 months later, in the middle of the first grade of primary school. T3 concerns children in the middle of the second grade of primary school.

Participants

For the purpose of this study we only

use data from a selected group of precocious readers and the group of their normally developing schoolmates. The original longitudinal sample consisted of 153 Czech monolingual children with no neuro-cognitive deficits or diagnosed learning or language difficulties at preschool age (mean age approx. 72 months, ranging from 64 to 85 months – for details see Caravolas et al. 2012, p. 681). The children were recruited from kindergartens in Prague, a suburb of Prague, and also in three more medium-sized Czech cities on the basis of parents’ consent forms.

A group of precocious readers was selected from the whole longitudinal sample according to their performance in a reading fluency task, one-minute reading, during the T1 testing. We consider a precocious reader to be a child showing a reading performance 1 SD above the mean of the whole longitudinal sample: $M = 3,76$, $SD = 10.41$ (Caravolas et al. 2012, online appendices), which means reading 15 or more words in the one-minute reading task. The mean age of the group of precocious readers was 72.67 months ($SD = 3.76$, ranging from 67–77 months).

The nine precocious readers were then paired with a comparison group of nine non-precocious readers selected from the longitudinal sample. We paired the control group according to age, gender, kindergarten type, and the region (the city placement). The control group contained nine children (four boys and five girls) with a mean age of 72.90 months

(SD = 3.10, ranging from 69-77 months). The children for the control group were selected primarily according to gender, age (the same age or a maximum of two months' difference), and school, meaning taken from the same kindergarten (to ensure similar teaching experience). If that was not possible then the pair was selected from kindergartens in the same city region and from schools of similar type and size (suburb of the city - inner-city parts, small kindergartens - larger schools).

Measures and Procedures

Both selected groups were first compared at the level of verbal skills and non-verbal IQ. We consider these two measures as rough indicators of the level of general cognitive skills and of the socio-cultural background.

Vocabulary task

As a general measure of the vocabulary knowledge of the children from both groups, the vocabulary subtest of the third United Kingdom edition of the Wechsler Preschool and Primary Scale of Intelligence for Children (WPPSI-IIIUK; Wechsler 2003) was adapted into the Czech language. Standard scores for this subtest are not available for the Czech preschool children, so the raw scores are reported in Table 1.

Non-verbal IQ tasks

The block design subtest from the third United Kingdom edition of the Wechs-

ler Preschool and Primary Scale of Intelligence for Children (WPPSI-IIIUK; Wechsler, 2003) was used to measure non-verbal IQ. The norms and standard scores of this subtest are not available for the Czech children, so the raw scores are reported in Table 1.

We think that possible differences at the level of vocabulary and non-verbal IQ could indicate important factors (both at social and individual level) with a possible influence on the development of literacy and pre-literacy skills. Table 1 shows descriptive statistics for these control variables. The precocious readers generally show higher scores in the lexical task and non-verbal IQ task. The difference is greater for lexical skills. It may reflect a generally more pro-reading-oriented family background, and may also be a result of the active use of reading and, as a result of that, access to new lexical knowledge. At the same time, the difference is not significant, so we could conclude that the children from both the target and control groups do not differ significantly from each other at the level of vocabulary skills and non-verbal IQ skills at the beginning of the study (to be precise, in the middle of their kindergarten attendance).

To monitor the children's progress in reading and spelling, a set of tasks was selected from the large test battery used in the longitudinal study. As the aim of this study is to describe possible differences between precocious and non-precocious readers at the level of literacy skills, we selected all the measures

Table 1. Descriptive statistics of control measures (productive vocabulary and non-verbal IQ).

Tests	Groups				Comparison
	Precocious readers		Non-precocious readers		
	Median /Mean	SD (Range)	Median /Mean	SD (Range)	
Vocabulary (WPPSI)	24/23.67	4.56;17-29	18.75/18.5	6.23;9-27	17.5/0.074
Block design (NVIQ)	28/28.56	5.64; 22-37	30/30.13	3.73;26-34	37/0.796

available in the original study for which we could report some reading and spelling performance. As the data reported in this study covers three years of the development of reading and spelling, we were able to include both measures of decoding, fluency and comprehension. The reading comprehension tasks were only administered in the second grade. According to Caravolas et al. (2012 and 2013), phonemic awareness, letter knowledge, and rapid naming tasks seem to be particularly important as indicators of variability in the development of early reading and spelling. We report these measures for the first two data collection points, where these measures seem to be the most sensitive (Seidlova Malkova & Caravolas 2013; Caravolas et al. 2012; Hulme et al. 2005).

Reading tasks

One-minute reading task As a measure of decoding and reading fluency the one-minute reading task from the battery for the assessment of literacy skills for pri-

mary school children (Caravolas & Volín 2004), which is widely used in the Czech psycho-educational counselling system, was used. Standardized scores are, however, only available for the second-grade children. The kindergarten and the first-grade scores are then reported as raw scores.

Picture-word matching task To assess general reading ability in its beginning phases, we administered a picture-word matching task. In this task the children work with paper-and-pencil worksheets containing a list of approx. 50-60 words (the shorter version for younger children, the longer one for the older ones) sourced from the frequency corpora of graded school reading materials currently used in the Czech Republic (Kessler & Caravolas 2011). On the worksheets words are represented by a simple black-and-white drawing accompanied by a set of four printed versions of the target word. The printed words include the target word, two distractors - one “phonographic”, with a similar spelling, and one “seman-

tic", with a similar meaning), and one unrelated word. The order of the target word and the distractors was counter-balanced; all the children used the same worksheets. The picture-word matching task is a silent reading task. For the purpose of the testing, the children were divided into small groups (three to five children), in which they worked individually to fill in the worksheets. The test is time-limited; the children work with the pictures and related words to choose the one printed word corresponding with the target picture for three minutes. Further details on the construction of this task are available as a part of the study of Caravolas et al. (2013). No norms for this test are available yet. We report the raw scores of correctly matched pictures and words. Each picture correctly matched with its printed version was awarded one point.

Reading comprehension task As an indicator of general reading ability and reading comprehension, a timed cloze reading comprehension test from Caravolas and Volín (2004) was used. This task was modelled on the Gates Basic Reading Test, Type LC, Form 3 (Gates 1958). Children read short passages and fill blank spaces with words that are accessible to choose from. The test includes a total of 23 short texts (7-45 words) on various culturally suitable topics. The passages are graded for difficulty in terms of length, vocabulary, and general world knowledge. Two words are deleted from each passage and blanks labelled A and B are left in their place.

The children choose from the two series of five words provided under each text, headed by a capital A and a capital B, respectively. One word from each series fits the corresponding blank in the text; the remaining four words are phonological or semantic distractors. The children worked for seven minutes only, reading passages and choosing the words that fit each sentence item best. One point was awarded for each correctly filled word. Norms for second-grade Czech children are available; we report the general score for reading comprehension, where fluency and reading speed might also influence the quality of the child's performance. The reading comprehension accuracy score assesses reading comprehension skills more precisely by calculating the ratio of items filled correctly and the total number of items filled. This task was only administered in the second grade of primary school (T3).

Spelling (Writing) tasks

Encoding skills were examined by means of two different spelling tasks: letter writing and word writing. To accommodate early spelling skills measures to the developmental level of the children who were being assessed, we provided different versions of these tasks in T1, T2, and T3.

Letter writing of 15 letters (five vowels, five consonants with relatively consistent sound-letter mappings, and five consonants with relatively inconsistent sound-letter mappings) from the Czech alphabet was administered to kindergar-

ten and first-grade children (T1 and T2).

The *word writing (dictation)* task had two different versions in T1 and T2. A set of seven frequently-occurring and familiar words, along with the task of writing their names, was administered to kindergarten children during T1. The first-grade children wrote the same set of seven primer words and also a set of 30 words representing graphotactic, lexical, and morphological knowledge relevant to Czech orthography. The procedure for the administration of this task was inspired by a spelling (dictation) task included in a Czech reading and spelling test battery by Caravolas and Volín (2004). The children write single words; to write a word they hear the word three times, first in isolation, then in a short sentence or phrase to provide the necessary orthography-related context, and finally, again in an isolated position. The T3 version of the word writing task was an elaborated version of the T2 task, consisting of a set of seven primer words and a set of 34 target words to be dictated. Thus the maximum score in the letter writing task for the kindergarten children was seven, for the first-grade children 37, and for the second-grade pupils 41 points.

Phoneme awareness tasks

Three different tasks across all the data collection rows were used to measure phonemic awareness: phoneme isolation, phoneme blending, and phoneme deletion. All the phonemic awareness tasks used map “explicit” phonemic awareness skills, that is, they require reflection

upon or manipulation of, speech sounds in words. Explicit phonemic awareness is known to have a stronger relationship to reading than what are termed implicit phoneme awareness skills (automatically engaged when working with speech units; Hulme & Snowling 2010, p. 42).

A *phoneme isolation* task was administered to the kindergarten children during T1 and in the first grade (T2). This task had previously been shown to be very sensitive at preschool age at the onset of the first grade of primary school, at the age of five to seven (Hulme, Caravolas, Brigstocke, & Malkova 2005; Seidlova Malkova & Caravolas 2013). This task was assessed in two different parts, the first one assessing the ability to isolate and pronounce the initial phoneme in a one-syllable word and the second part requiring the isolation of the final phoneme, again in a one-syllable word. Each part consisted of two different blocks varying in difficulty from the point of view of their phonemic structure. In the first block of each part, the children isolated and pronounced the target phoneme from a simple consonant-vowel-consonant word (CVC). In the second block of each part, the children isolated it from a consonant-consonant-vowel-consonant word (CCVC), specifically from consonant-vowel-consonant-consonant (CVCC) words when isolating the final phoneme. This task was developed according to the task used in a study by Hulme et al. (2005). For this task, there are no norms available; we report the raw scores. Each correctly isolated and pronounced word

was awarded one point. The maximum points for each part were 16 (8 items for each block); for the whole test the children could receive a maximum of 32 points.

A *phoneme blending* task requires children to blend aurally presented phonemic sequences into target words. We used the version of this task that is now available as a part of the test battery of Seidlova Malkova and Caravolas (2013). The test consists of a list of 24 one-to-two-syllable words varying in their phonological structure and complexity. The task was assessed in both T1 and T2, again showing very good sensitivity at this age (Seidlova Malkova & Caravolas 2013). The target words were presented in a fixed order organized according to increasing complexity of the syllabic structures of the words (VC, VCV, CV, CVC, CCVC, CVCV). The maximum score for this task was 24. Norms are not available for this task; we report raw scores.

A *phoneme deletion* task was administered in the first (T2) and second grades (T3). This task requires a child to delete the first or final phoneme of a short word and to say the resulting word aloud when the specified part is not sounded. In the first-grade version, the children were asked to delete the first phoneme of 10 target words with a simple syllable structure: consonant-vowel-consonant (CVC). The task for the second-grade children consisted of 20 one-syllable words. For the first 10 items, five with a CVC and five with a CCVC structure, the children

were asked to delete the initial phoneme and provide the resulting word. For the next set of 10 words (five CVC and five CVCC), the children were instructed to delete the final phoneme and again to say the resulting word. The maximum score for the first grade was 10, for the second grade 20. There are no norms available for this specific version of the phoneme deletion task in the Czech literature, and therefore we report the raw scores.

Rapid Automatized Naming (RAN) is considered to be an important predictor of early reading and spelling (Caravolas et al. 2012). The task is widely used for assessing phonological processes influencing the development of literacy. A RAN objects task was used in this study. The children named a set of five picture items sequentially, as fast as they could. The items were placed on a landscape A4 card and organized into lines. The whole card contained five lines with eight items on each line. The scores for this test were estimated from the average time taken to name 40 picture items across two trials. The accuracy score was constructed as the average error for two trials. Error rates tend to be low in typically developing children, and this was also the case with our children. Rapid naming was administered across all the testing points (T1, T2, and T3).

Letter knowledge

Letter knowledge was assessed by a *letter recognition task*. The children were asked to supply the names and the sou-

nds of letters presented on cards. Separate cards for upper- and lowercase letters were provided. The 34 letters of the Czech alphabet were presented in a fixed, but not in an alphabetical order, separately for upper- and lowercase. One point was awarded for each correctly named sound and name. We report the scores for sounds and names separately. The maximum score for the letter recognition task for sounds or names is 68 (covering lower- and uppercase letters). Raw scores are reported for this task as there are no age norms available for this task in Czech. Letter knowledge was assessed in kindergarten (T1) and in the first grade of primary school (T2). We understand knowledge of the names of letters as being more related to some form of the explicit and formalized teaching provided by adults or in the formal schooling context – as this is knowledge of the names of the letters as they appear in the alphabet. Letter sound knowledge, on the other hand, is more open to the implicit, spontaneous forms of learning as it is related more to the sounds appearing in words.

Reliability scores for the measures used in this study were calculated on the basis of the data from the whole longitudinal sample, as this gives more accurate information. All the measures reported for kindergarten and most of the measures reported in primary school children, including their reliability, were described in detail in our previous study, Caravolas et al. (2012). Internal consistency reaching middle to high scores

for the Cronbach's alpha was reported for the One-minute Reading task (.91), both spelling tasks (.82, .92), phonemic awareness (.96, .95), and letter knowledge tasks (.95, .98); test-retest reliability was reported for the picture-word matching task (.92) and rapid naming tasks (.79; Caravolas et al. 2012, Table 1 and Table 2, online appendices). The reliability of the reading comprehension task is reported by its authors as being valid and reliable for use in the second grade (Caravolas & Volín 2004, p. 14). For the phoneme deletion task, its reliability was calculated on the basis of the whole longitudinal sample; the internal reliability of this task at T2 is .85 and at T3 0.92.

Procedure

During the three years of the original study all the sample children were given a set of tasks administered – in most cases – individually at a total of six data collection points. The picture-word matching task and word writing task in T2 and T3 and the reading comprehension task in T3 were administered in small groups of four or five children to make the data collection more effective. All three of these tasks require some individual production by a child by filling in simple prepared sheets of paper in pencil.

At all the data collection points, the tests were administered to each participant in a fixed order. For this study we only selected three data collection points representing different educatio-

Table 2. Mean scores, standard deviations, and medians for all measures administered in kindergarten (T1)

Measures	<i>Precocious</i>			<i>Non-precocious</i>		
	M (SD)	Median	Min-Max	M (SD)	Median	Min-Max
Letter recognition - sounds	56.7 (4.2)	57.0	51-63	15.3 (16.0)	15.0	0-46
Letter recognition - names	30.4 (14.5)	32.0	5-45	5.4 (8.8)	1.0	0-24
Letter writing	27.3 (4.4)	28.0	16-30	16.2 (9.5)	14.0	4-30
Phoneme isolation	61.1 (2.6)	61.0	57-64	28.3 (22.3)	28.0	0-58
Phoneme blending	10.1 (0.92)	10.0	9-11	0.78 (1.2)	0.0	0-3
RAN objects - time	40.4 (8.2)	37.5	30.5-56.5	52.4 (13.7)	53.5	31.5-70
One-minute reading	35.6 (27.4)	25.0	15-87	1.1 (1.2)	1.0	0-3
Picture-word matching - accuracy	1.7 (3.0)	0.0	0-9	4.4 (3.3)	3.0	1-10
Picture-word matching - errors	2.67(2.83)	2.0	0-8	12.78 (9.39)	10.0	3-34
Word writing	5.4 (1.6)	5.0	2-7	1.3 (1.1)	1.0	0-3

nal grades. All the data collection points were administered in the middle of the respective school year.

Letter knowledge tasks and phoneme isolation and phoneme blending tasks were only administered at the T1 and T2 levels. Phoneme deletion was not administered at T1 as the task would be too difficult for normally developing children. The reading comprehension task was only administered at T3. The rapid naming, reading, and writing tasks (rapid naming of objects, one-minute reading, picture-word matching, and word writing) were administered throughout all the three data collection points.

For each data collection point included in this study (T1 for kindergarten, T2

for the first grade, and T3 for the second grade), we conducted non-parametric alternatives of the t-test analyses (Mann-Whitney test) to test the differences between the performance of the groups of precocious and non-precocious readers on all the selected metrics. As the set of tasks administered at each data collection point is not identical (to reflect the developmental changes at the level of literacy and literacy related skills), we provide separate comparisons for each grade. This enables us to concentrate on the complete set of literacy and literacy related skills relevant in each grade that was monitored. Only the one-minute reading task and rapid naming task were administered in identical formats at each

data collection point. These measures are constructed in a format that could stay sensitive throughout the whole period of our data collection time.

Results

Tables 2, 3, and 5 report the mean scores, the medians, and the standard deviations for all the measures included at each testing point. The results of the Mann-Whitney test for each testing points are available in Table 4 and Table 6.

Kindergarten literacy profiles of precocious readers

As we can see in Table 2, the precocious readers show generally higher scores for almost all the measures administered at T1. Higher means, reflecting better performance for the group of precocious readers, apply to almost all the measures, except the picture-word matching task. RAN is a timed task, where lower mean scores relate to a better outcome (i.e. faster naming), so as we could expect in fluent readers, RAN would be faster for the precocious readers. The picture-word matching task is also timed; however, we do not report the time but the number of correctly paired pictures and words. We also report the number of errors made in this pairing. As we could see, the precocious readers generally achieve a lower number of correct items; however, at the same time, they also show fewer errors in the items they manage to pair. The performance of the group of precocious readers on the letter recognition (both

sounds and the names of letters from the alphabet), phonemic awareness tasks (both isolation and blending), reading (the fluency assessed by the one-minute reading task), and word writing tests is significantly better in comparison to their non-precocious age- and classmates (see Table 4). So we can conclude that the precocious readers' literacy profiles consist of superior phonemic awareness and orthographic (meaning letter) knowledge performance – the core and essential skills for beginning to acquire the skills of reading. As expected, the precocious readers can use the phone-grapheme correspondences effectively and fluently, so they show superior performance in decoding (early reading fluency). This is what we can interpret as in line with the dual route theory of the foundations of literacy (Hulme et al. 2005; Byrne 1998). The rapid naming speed, however, is not significantly faster in the precocious readers in kindergarten in comparison to the non-readers. The results in the picture-word matching task show that the precocious readers do not differ significantly from the non-precocious readers in terms of the number of correctly solved items. However, they show significantly lower numbers of errors in this task. This may be interpreted as a result of the careful reading these children perform. While trying to solve the picture-word pairing task, they probably spend more time on reading each of the four words to be paired with the picture because they use a phonological reading strategy (typical

Table 3. Mean scores, standard deviations, and medians for all measures administered in first grade (T2)

Measures	<i>Precocious</i>			<i>Non-precocious</i>		
	M (SD)	Median	Min-Max	M (SD)	Median	Min-Max
Letter recognition - sounds	61.9 (3.3)	62	58-68	37.7 (13.2)	35	17-58
Letter recognition - names	49.8 (10.9)	52	27-62	15.7 (16.6)	11	0-44
Letter writing	29.7 (0.7)	30	28-30	25.9 (5.7)	28	14-30
Phoneme blending	23.3 (1.0)	24	21-24	12.6 (6.6)	13	2-23
Phoneme deletion	19.6 (0.7)	20	18-20	5.8 (8.3)	0	0-19
RAN objects (time)	37.0 (6.4)	36.5	27.5-50	42.8 (12.7)	42	25-58
One minute reading	59.0 (25.3)	58	23-100	8.9 (7.5)	7	2-24
Picture-word matching - accuracy	27.0 (9.4)	23	17-45	12.2 (3.5)	11	9-20
Picture-word matching - errors	2.33 (2.60)	2.0	0-7	4.44 (4.85)	3.0	0-15
Word writing	21.3 (5.8)	22	11-29	5.7 (3.6)	5	3-14

of fluent readers). The non-precocious readers probably rely - very effectively - on a non-phonemic reading strategy, for example a whole word reading strategy, relying more on the visual patterns of the written form of words) and this may give them more speed in this task.

First-grade literacy profiles of precocious readers

The performance pattern the precocious readers show in the middle of the first grade seems to be very similar to the kindergarten one (see Table 3), except for the picture-word matching task. Now, the precocious readers show generally

higher accuracy scores in this task than the non-precocious readers; they also keep making fewer errors in this task.

The performance in letter knowledge scores (both the sounds and the names of the letters of the alphabet, phonemic awareness task scores (blending and deletion), reading (number of correctly read words in one minute together with the accuracy and error rates in the picture-word matching task), and writing (both letters and words) is significantly better in the precocious readers in comparison with the non-precocious readers in the middle of the first grade. The pattern of the picture-word reading

Table 4. Mann-Whitney tests comparing the performance of the precocious readers and non-precocious readers on the letter knowledge, phonemic awareness, rapid naming, reading, and spelling tasks in kindergarten (T1) and the middle of grade 1 (T2)

Measures	<i>T1 - kindergarten</i>		<i>T2 - middle of first grade</i>	
	<i>U</i>	<i>p*</i>	<i>U</i>	<i>p*</i>
Letter recognition - sounds	0.00	0.000	5.0	0.000
Letter recognition - names	4.0	0.000	4.0	0.000
Letter writing	12.0	0.011	22.5	0.113
Phoneme isolation	1.5	0.000	11.5	0.008
Phoneme blending	0.0	0.000	2.5	0.000
RAN objects	20.0	0.077	29.0	0.340
One minute reading	0.00	0.000	1.0	0.000
Picture-word matching - accuracy	15.5	0.024	20.	0.000
Picture-word matching - errors	6.0	0.001	29.0	0.340
Word writing	2.5	0.000	1.0	0.000
Phoneme deletion	-	-	2.0	0.000

* $p < 0.05$

task now changes in comparison with the kindergarten one: the precocious readers show significantly higher accuracy scores than the non-precocious readers. The error rate, however, is not significantly different in both groups of readers. We can interpret these results as a consequence of the use of a different reading strategy by the non-precocious readers. Children are being taught to read in school at this time. So as beginner readers, the non-precocious readers are also starting to use a phoneme-based reading strategy. This, of course, slows down the speed at which they deal with the picture-word matching task.

Second-grade literacy profiles of precocious readers

As a part of the literacy profile of the precocious readers in the second grade, we report one measure of phonemic awareness, the phoneme deletion task; rapid naming is again assessed by RAN objects. Then various tasks to measure reading and spelling were administered. In contrast to the kindergarten and first-grade data collection points, we now also report on the reading comprehension task. As we can see in Table 5, the precocious readers achieve generally higher (or better in the case of RAN) scores than the non-precocious readers in all

Table 5. Mean scores, standard deviations, and medians for all measures administered in second grade (T3)

Measures	<i>Precocious</i>			<i>Non-precocious</i>		
	M (SD)	Median	Min-Max	M (SD)	Median	Min-Max
Phoneme deletion	34.8 (4.8)	37	28-40	32.2 (6.8)	34	19-40
RAN objects	30.9 (9.6)	30	21-53.5	37.8 (8.9)	41	25-49
One-minute reading	97.2 (20.3)	92	76-135	57.4 (30.0)	45	22-119
Picture-word matching - accuracy	44.9 (7.9)	44	36-61	30.4 (8.2)	29	24-48
Picture-word matching - errors	0.44 (1.01)	0.00	0-3	0.67 (1.00)	0.00	0-3
Word writing	31.3 (4.5)	31	26-39	25.9 (5.0)	27	16-32
Reading comprehension - general	17.4 (1.7)	18	14-20	15 (3.9)	17	10-20
Reading comprehension - accuracy (%)	87.2 (8.7)	90	70-100	75 (19.7)	85	50-100

the tasks measured. Table 6 then shows that the significantly better performance of the precocious readers applies only to the one-minute reading task, the picture-word matching accuracy and word writing task. Their scores for phonemic awareness, RAN, and reading comprehension are not significantly better. The superiority of the precocious readers in the second grade is associated with their higher speed and precision of reading and greater accuracy of word writing. Reading comprehension is probably still quite a difficult task for both reading groups, so it is difficult to differentiate their performance.

Discussion and conclusion

The aim of this longitudinal study was to monitor the development of early precocious readers by contrasting the development of their literacy with the development of their age-, gender-, and class-matched peers. According to the current state of knowledge in the area of the precursors of early literacy, the sets of literacy and literacy-related measures were created to construct literacy profiles applicable to each of kindergarten and the first and second grades.

According to the data available in our

Table 6. Mann-Whitney tests comparing the groups of precocious readers and non-precocious readers on phonemic awareness, rapid naming, reading, and spelling tasks in the middle of grade 2

Measures	<i>T3 - middle of the second grade</i>	
	U	p*
Phoneme deletion	33.0	0.546
RAN objects	23.0	0.236
One-minute reading	11.0	0.008
Picture-word matching - accuracy	9.0	0.004
Picture-word matching - errors	32.5	0.489
Word writing	17.0	0.040
Reading comprehension -general score	28.0	0.297
Reading comprehension -accuracy score	28.0	0.297

*p < 0.05

study, precocious readers of kindergarten age show superior levels of literacy foundation skills: phonemic awareness performance (at various levels of difficulty - isolation, blending) and letter knowledge (obvious at the level of their knowledge of both the sounds and names of letters). As expected, according to the studies available on the early precursors of the development of reading (Caravolas et al. 2012 - this one including a Czech sample; Ziegler et al. 2010), precocious readers use their superior literacy foundation skills to boost their basics in reading - the decoding skills. So, in contrast to their classmates, these children also show a superior level of decoding skills when of kindergarten age. This was observed in the one-minute reading task as a significantly higher number of words read correctly in one minute

and also at the level of the word spelling task (more words spelled correctly). The precocious readers seem to rely more on phonological reading strategies, which brings them less effectiveness in solving the picture-word reading tasks. As already explained, the picture-word matching tasks require the child to choose the appropriate written form of a word presented as a picture - within a certain time limit. As a part of this task, four possible forms of the word are presented and the children have to choose the correct one. For children relying on a phonological ("non-lexical") strategy to read (sounding out each letter in a word), this task could be demanding in terms of the time needed. So children relying more on a "lexical" (sight word) reading strategy (typical of the pre-reading attempts of kindergarten children before the formal

teaching of literacy (Coltheart 2005) or, in relation to Czech early readers, Špačková, Kucharská, & Seidlová Málková (2015) might be more effective for this task.

The first-grade literacy profiles of the Czech precocious readers show their superiority in literacy foundation skills: letter knowledge (both the sounds and names of letters) and phonemic awareness. However, the first-grade profile shows that the performance of the precocious readers for phonemic awareness is only superior at the level of the more difficult phoneme task (blending). The phoneme isolation task also becomes feasible for typically developing readers and does not differentiate them from the precocious ones. Reading is significantly better in the precocious readers at all the levels we attempted to describe. The precocious readers read more words accurately in the one-minute reading task, solve significantly more items correctly, and make significantly fewer errors in the picture-word matching task than the non-precocious readers. The average number of words read in the one-minute reading task by the precocious readers in this study applies to the typical performance of typically developing Czech second-grade children (Caravolas & Volín 2004, p. 38). The spelling of letters, similarly to word writing, is much more precise and accurate in the precocious readers when they reach the first grade.

The second-grade literacy profiles of the precocious readers maintain their superior performance at the level of

reading accuracy and writing. As in the first grade, the precocious readers can read significantly more words in the one-minute reading task and can correctly solve more items and make fewer errors in the picture-word matching task than the non-precocious readers. Their word writing performance also maintains its superior level. On the other hand, the phoneme deletion task used to monitor the phonemic awareness performance in the second grade does not differentiate between the precocious and non-precocious readers (probably because this task starts to be easy for the precocious readers). The timed reading comprehension cloze test task did not differentiate the precocious readers from their classmates either.

The structure of the Czech precocious readers' literacy profiles has a few aspects in common with the study of Tafa and Manolitis (2008). To the extent to which we can compare our study with that study (which is not constructed in such a way as to be directly comparable), both Czech and Greek precocious readers show superior phonemic awareness performance in kindergarten and in reading fluency and spelling superior scores throughout the first and second grades. However, a direct cross-linguistic study with a comparable methodology and measures would be needed to provide a reliable cross-linguistic comparison of the development of precocious readers.

The results of the rapid naming (i.e. RAN objects) tasks might look surprising.

The rapid naming speed did not prove to be significantly better in the precocious than the non-precocious readers at any of the data collection points. At the same time, as reported in Tables 3 and 5, in all the data collection rows, the RAN speed was generally faster for the precocious readers than for the non-precocious ones. RAN is, of course, along with letter-sound knowledge and phonemic skills, an important foundation skill for early literacy (Caravolas et al. 2012). Performance on the rapid naming tasks clearly differentiates between good and poor readers (Jones, Ashby, & Branigan 2013) but probably cannot differentiate precocious and typical (non-precocious) readers so clearly. This may relate to the fact that RAN seems to "...tap a separable mechanism that is involved in forming associations between printed words and their pronunciations" (Caravolas et al. 2012, p. 684).

Discussion may arise around the issue of the selection or identification of the precocious readers. The broader data sample we used in this study was not primarily constructed for the assessment of precocious readers. That, of course, brings some limits of this study. First, there is the issue of the criteria for selecting precocious readers. The studies we referred to from the previous research articles typically selected precocious readers according to the judgement of kindergarten teachers (for example Tafa & Manolitis 2008; Matejček 1995, 1999) and these preselected groups of children were then assessed by means of specific

reading tests, either a word reading test (assessing fluency and speed - Matejček 1995, 1999) or more general reading tests assessing reading at the level of fluency, speed, and comprehension (Tafa & Manolitis 2008) or just selected measures from a large assessment battery containing various language (both receptive and expressive) and reading skills (Silvén, Poskiparta, & Niemi 2004). Our research data did not allow us to follow any of these procedures in detail. The original larger sample in our study was a part of a longitudinal study assessing very early literacy skills and only some of the language skills (mainly expressive). Reading comprehension tasks were administered only in the second grade (T3), so we could not use the reading comprehension tasks for the selection procedures. For that reason we could not fully differentiate precocious readers from what are termed hyperlexic children in our sample - see the introductory part of this study: the definition of precocious readers by Olson et al. (2006). The careful combination of both reading fluency and reading comprehension tasks for the purpose of the selection of precocious readers in kindergartens should be a focus of future research. On the basis of our experience and the results of this study, we propose a general three-step screening procedure in kindergartens for selecting precocious readers. As a first step the screening should contain a letter knowledge task (preferably capital letters in Czech), then as a second step a one-minute word reading task, and, in the event of positive

results (above the normal level of the results achieved by their age-mates in standardized measures), to add as a third step a reading comprehension task to differentiate hyperlexic children.

Another issue concerning the selection criteria for the precocious readers used in our study may relate to the fact that the one-minute reading test we used for selecting precocious readers was also used in the study to construct the reading profiles of both precocious and non-precocious readers and to contrast these two groups. Ideally, we would use a different measure of word reading to select precocious readers and to contrast them with non-precocious readers. However, as already mentioned, the set of tasks we were able to use in our study was limited by the original longitudinal study and it was not possible for us to implement another special measure of word reading. At the same time, we wanted to retain the possibility of tracking the development of these word reading skills throughout both the following primary school years. So the differences between precocious and non-precocious readers in word reading at T1 should be viewed with caution (as these are obvious). The important information, however, is that the differences at the level of reading efficiency are also maintained in the first- and second-grade (T2 and T3 data collection time) measures.

The control measures used in this study (lexical skills and non-verbal IQ) also argue for the importance of a more precise description of the socioeconomic and

family background of precocious readers. This study provided a description of the structure of the literacy and, of course, some pre-literacy language-related skills of the precociously reading children. However, our data does not allow us to take into consideration the wider socioeconomic or family background influences. So this study should be considered as a beginning, as baseline material to show the strength of the differences between precociously reading children and their peers. The knowledge provided in this study is therefore of particular importance for the practice of psychological counselling.

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