Title page

Does introducing the letters faster boost the development of children's letter knowledge, word reading and spelling in the first year of school?

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Abstract

Learning the relationships between letters and sounds is a key component of early literacy development and a central aim during the first year of school. Introducing one new letter a week is the most common approach in many countries, but little is known about how the pace of letter instruction contributes to the development of early literacy skills. This study used a natural experiment to investigate how a faster pace of letter instruction influences the development of letter knowledge, word reading and spelling during the first year of school. Regression analysis showed that a faster pace yielded significantly better results for all outcome measures, and logistic-regression models showed that the lowest-performing children benefited more than the highest-performing one from a faster pace. The study concludes with a discussion of those novel findings and suggestions about their implications for teaching practice.

(140 words)

Keywords: letter instruction; letter learning; early literacy instruction; pace of letter instruction

Introduction

Children's success in learning to read and write during the first school years is a strong predictor of later success in school and learning (Cunningham & Stanovich, 1997; Juel, 1988). Hence it is vital to provide first-year pupils with the best possible literacy instruction. For alphabetic writing systems, learning the letter symbols, their names and the sounds they represent is one of the most important goals that children should attain during their first year of school. However, the teaching of letters tends to be based on tradition rather than research (see e.g. Justice, Pence, Bowles, & Wiggins, 2006); in Norway, as in other countries, the most common approach has been to introduce first-year pupils to one new letter a week (Morrow, Tracey, & Del Nero, 2011; Rasmussen, 2013; Treiman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998). Against this background, there have been calls for empirical research into what constitutes effective instruction in letter knowledge, and in particular into the issue of the pace of letter introduction (National Institute of Child Health and Human Development, 2000; Piasta & Wagner, 2010a).

To our knowledge, only one previous study directly investigated how the pace of letter instruction affects the development of children's letter knowledge. In a two-year quasi-experimental study, Jones and Reutzel (2012) found that children who were exposed to one new letter a day and went through several cycles of letter instruction over the course of a year were more successful in acquiring letter knowledge than children following a more traditional approach. However, they did not investigate the children's reading and spelling development.

Hence the aim of the present study is to investigate how the pace of letter instruction relates to the development of both letter knowledge and literacy skills in the first year of school. More specifically, we study the relationship between the month in which the teacher had first introduced all letters (September–June) and children's development of letter knowledge, word reading and spelling. Further, we investigate whether pace of letter

instruction have different effects on children's performance in the two tail ends of the distributions.

Letter Instruction

Letter knowledge and phonemic awareness are key contributors to children's understanding of the alphabetic principle and its application to the decoding and spelling of single words (Linnea C. Ehri, 2005; National Institute of Child Health and Human Development, 2000; Vellutino, Fletcher, Snowling, & Scanlon, 2004). In fact, both cross-sectional and longitudinal studies have established clearly that children's knowledge of letter sounds and/or names in kindergarten is a strong predictor of their later reading and spelling skills across all alphabetic orthographies studied to date (see e.g. H. Catts, Herrera, Nielsen, & Bridges, 2015; Leppanen, Aunola, Niemi, & Nurmi, 2008; National Early Literacy Panel, 2008; Schatschneider et al., 2004). Research has also shown a clear link between inadequate letter knowledge at school entry and later reading difficulties (Torppa et al., 2006).

It is clear from existing research that children benefit from a systematic approach to letter instruction and 'phonics' – a method of reading instruction where children are explicitly taught about the connections between speech sounds (phonemes) and printed letters or groups of letters (graphemes) (National Institute of Child Health and Human Development, 2000). Further, children who start school with weak decoding skills (i.e., poor letter recognition, letter knowledge and word reading) benefit more from systematic and explicit phonics-based instruction than children with stronger skills (Connor, Morrison, & Katch, 2004). As children with weak decoding skills often struggle to identify the connections between graphemes and phonemes during basic decoding and spelling, and to recognise words when reading (Adams, 1990; Blaiklock, 2004; Piasta & Wagner, 2010a; Vellutino et al., 2004), letter instruction should help them automatise those connections by providing sufficient opportunities for repetition (Jones, Clark, & Reutzel, 2013; Treiman, Levin, & Kessler, 2007).

When children first start school, their letter knowledge varies greatly, both in terms of which letters they know and how many (Justice et al., 2006; Piasta, 2014; Sigmundsson, Eriksen, Ofteland, & Haga, 2017). There is also a gender difference in letter knowledge favouring girls, both at school entry and at the end of the first year (Sigmundsson, Dybfest Eriksen, Ofteland, & Haga, 2018). The heterogeneity of classes represents a challenge to teachers when it comes to meeting the children's individual needs (Justice et al., 2006; Piasta, 2014). In fact, the traditional one-letter-a-week approach to letter instruction may be based on the assumption that such a slow pace will leave no child behind. Paradoxically, as will be seen later, the same heterogeneity can be used as a key argument in favour of a faster pace of letter instruction.

Potential Benefits of a Faster Pace of Letter Instruction

Research into what constitutes the best pace of letter instruction is scarce. However, Jones et al. (2013) suggest a number of potential benefits of introducing the letters at a faster pace than one a week. First, as also pointed out by Stahl (2014) and Treiman et al. (1998), for children who already know several letters when entering school, devoting a week to 'learning' a letter they are familiar with represents an inefficient use of time. If the letters are first introduced over a shorter period of time, those children who already know the letters, or learn them after this first round, can be given other kinds of literacy instruction and activities to further develop their literacy skills (Jones & Reutzel, 2012).

Second, for children who know few letters when they start school, it will be a long time before they have been introduced to all the letters and it may take several months before they have encountered all of the letters that they need to read and write common words. Explicit letter instruction seems to be particularly important for children with weaker phonological ability, as they tend not to extract letter-sound information on their own (Piasta & Wagner, 2010b). If the pace of letter instruction is slow, the letters introduced early will be

repeated much more often than the letters introduced later. By contrast, a faster pace of letter instruction entails that the children will have been exposed to all letters sooner and that there will be more time for frequent repetition and practice of *all* letters (Jones et al., 2013; Jones & Reutzel, 2012). When children have been introduced to some letters, they should practise using them in daily reading and writing activities (Linnea C Ehri, 2004; National Institute of Child Health and Human Development, 2000), and faster access to all of the letters enables children to use a wider range of letters in reading and writing at an earlier stage (Jones et al., 2013; Jones & Reutzel, 2012).

Such frequent encounters with individual letters through reading and writing will not only further develop children's knowledge and understanding of individual letters, but also extend their knowledge about words and spelling patterns at a more abstract level. In addition, a faster pace gives the teacher better opportunities to differentiate instruction to accommodate the variation in children's early literacy skills throughout the first year. This corresponds to a hermeneutic understanding of learning to read, as proposed by Tønnessen and Uppstad (2015). Hermeneutics is originally a method to interpret texts, based on the principle that 'a new understanding of the whole forms the basis for new readings and new ways of understanding the details, which, in turn, will change the understanding of the whole again' (Tønnessen & Uppstad, 2015, p. 79).

The Present Study

The present study is conducted in Norway. According to Seymour, Aro, and Erskine (2003), Norwegian is considered a semi-transparent orthography, i.e. more transparent than English, but less transparent than Finnish. Over the past few years, Norwegian school have undergone a rapid shift towards that more and more teachers introduce two or more letters a week (Norwegian Reading Centre, 2017; Rasmussen, 2013), following recommendations made from researchers at the Norwegian Reading Centre (Lundetræ & Uppstad, 2016; Lundetræ &

Walgermo, 2014). However, whether pace of letter instruction is associated with better literacy skills has not yet been tested empirically. Therefore, in this study, we investigated whether a faster pace of letter instruction is associated with a better development of children's letter knowledge, word reading and spelling during the first year of school. Two different approaches were taken to investigate questions of considerable theoretical and practical importance.

First, we investigated whether a faster pace of letter instruction is related to children's scores on letter knowledge, word-reading accuracy, sight word efficiency and spelling at the end of the first year. We hypothesised that a faster introduction of the letters would contribute positively to development on all measures, as children are then exposed to all the letters earlier on, meaning that there is more time for repetition and use of all the letters through reading and spelling, which in turn will contribute positively to the development of both letter knowledge, word reading and spelling.

Second, to explore possible differential effects of a faster pace of letter instruction on children's early literacy development, we investigated the effect of the pace of letter instruction on children's performance in different parts of the distributions. We hypothesised that a faster pace of letter instruction would reduce the likelihood of scoring low for letter knowledge, word-reading accuracy, sight word efficiency and spelling, as introducing the letters at a faster pace means that children who have limited letter knowledge at school entry and/or who need more repetitions in order to automatise the links between graphemes and phonemes will gain access to all of the letters earlier on, meaning that they will have more opportunities for repeated encounters with the letters throughout the first year. In line with this reasoning, we hypothesised that the highest-performing children would also benefit from a faster pace of letter instruction, as less time would be spent on letter instruction for all and there would be more time for reading and writing to further develop their skills.

Method

In Norway, children start school in August of the calendar year in which they turn six. While as many as 96.8% of Norwegian 3–5-year-olds attend 'kindergarten' (Statistics Norway, 2017), no formal literacy instruction is provided there (Norwegian Directorate for Education and Training, 2017a). All children have a statuary right to attend their neighbourhood school and as much as 96.7% of children are enrolled in public (i.e. non-private) schools, and only 0.5% attend special-education schools (Norwegian Directorate for Education and Training, 2018). Norwegian teachers have the autonomy to choose teaching methods and progression of instruction as long as they direct their teaching towards the competence goals in the curriculum 'the Knowledge promotion reform' (Norwegian Directorate for Education and Training, 2017b).

Participants

The sample consists of 952 typically developing children. Mean age at school entry was 6.53 years and 46.2% were girls. The children were from 51 control classes (M = 20.82 children in each class) at 51 schools which were randomised as "business as usual" controls in a large RCT study ('Two Teachers') (Solheim, Rege, & McTigue, 2017). Informed consent was obtained from the parents prior to their child's participation (the rate of consent was 93.3% for the present study), and the children gave verbal consent. Only children unable to participate in the individual testing due to severe disabilities were excluded from the study (Solheim et al., 2017). The third party ethical oversight agency in Norway, Norwegian Social Science Data Service, has approved the study. Furthermore, the project follows the ethical guidelines provided by the National Committee for Research Ethics in the Social Sciences and Humanities.

Those 51 classes are from 28 municipalities in eight counties in southern Norway, and represent both urban and rural areas with an average of 83.3% (ranging from 44.5% to 98.7%)

living in urban areas, which mirror the demography in Norway (Statistics Norway, 2018). According to registry data, 15.2% of the children had both parents born in a non-Scandinavian country, while 11.1% had one parent born in a non-Scandinavian country.

In a few cases, data are missing from T0 and T1 due to illness/absence (T0: 6 children, T1: 13 children) and temporary challenges in the test situation (T0: 11 children, T1: 3 children). Missing data was handled using listwise deletion in all analyses. The total numbers of children included in the analysis were 922 for letter knowledge and word-reading accuracy, 923 for sight word efficiency and 921 for spelling.

Procedure

The tests were conducted on two occasions during the first year: within the first four weeks after school entry (T0) and during the last weeks of the academic year (T1). They were part of a larger testing battery which was individually administered and took about 30–45 minutes per child. The testing was carried out at the school, in a quiet room near the classroom. The entire test battery was administered on an iPad Air2. Most of the tests were completed on the iPad, the remaining ones on paper, and all test results were recorded on the iPad.

All testers had begun or completed a teaching or psychology degree and were trained and certified before testing the children. Their training consisted of a six-hour course on how to use the instrument and how to manage the test situation. It was followed by pairwise certification, where the testers carried out the entire test battery on each other under the supervision of a representative of the ‘Two Teachers’ project. At each school, a team of two testers tested all children.

Measures

Measures From the Teacher Questionnaire.

For the variable indicating the pace of letter instruction (*Letter instruction (month)*), we collated teachers' (N = 51; 50 females) answers from two questionnaires distributed in December and in June respectively. Information from the December questionnaire was used for the teachers who reported that they had introduced all letters within this month, while information from the June questionnaire were used for the remaining teachers. The relevant question was, 'By the end of which month did you complete the first introduction of the letters?' September was coded as 0, and the following months were coded continuously up to 9 (June). Teacher's responses within the same school differed with 0.41 months on average, which can be expected due to Norwegian teacher's strong autonomy. Descriptive statistics for this variable are presented in Table 1.

Information on teacher and class characteristics was retrieved from relevant questionnaires distributed from the 'Two Teachers' project. The teachers' work experience (in years, including the present year) was entered in the analyses as a continuous variable (1–35 years). Values for this item are missing for three teachers; they were replaced with the average score. To add information on teachers' relevant study subjects in the analyses, we collated the teachers' answers to the following two questions into the variable 'Teacher education'; 'Are any of these subjects part of your education? A. Early literacy instruction B. Reading instruction'. The teachers responded on a three-point scale; 'not at all', 'introduction to the subject' or 'in-depth study subject'. Values missing for two teachers were replaced by the median. Information on number of children and teachers in the classes was collected from the questionnaires. As regards educational level, 7.1% of the teachers had a master's degree while the remaining 92.9% had a three- or four-year teaching degree. The variables of educational level and teacher's gender were not included in the analyses.

[Insert Table 1 about here]

Measures at T0.

Tests of letter knowledge, phonological awareness, RAN, vocabulary, verbal short term memory, and early mathematical skills is typically found to predict children's literacy development (Caravolas et al., 2012; H. W. Catts, 2003; Duncan et al., 2007; Melby-Lervåg, Lyster, & Hulme, 2012), and were therefore included as control variables in the current study.

Letter-sound recognition, previously used in the 'On Track' project (Solheim, Frijters, Lundetræ, & Uppstad, 2018), was measured using 24 multiple-choice items (the Norwegian alphabet has 29 letters, but *Q, Z, C, W* and *X* are rarely used and were not included). A pre-recorded letter sound was presented on the iPad along with four upper-case letters, and the children were to press the letter corresponding to the sound. Reliability (Crohnbach's alpha) was .90.

Phoneme isolation, previously used in the 'On Track' project (Solheim et al., 2018), was measured using a 10-item test where the child was asked to isolate and pronounce the first sound of 10 monosyllabic words representing common objects. The tester named an object and then asked the child to say the first sound in the word, using the following script: 'This is a ball. What is the first sound in *ball*?' Corrective feedback was given during two training items before the test began. The test was terminated after two subsequent errors. Reliability (Crohnbach's alpha) was .93.

Rapid automatised naming (RAN), previously used in the 'On Track' project (Solheim et al., 2018), was measured as the ability to name familiar objects presented simultaneously in random order in a left-to-right serial fashion. The objects were presented in a matrix on the iPad with four rows of five pictures. Before administering the test, the tester made sure that

the child knew the words for the objects and understood the task. The objects were *sun*, *car*, *plane*, *house*, *fish* and *ball*, all of which are represented by monosyllabic words in Norwegian.

Vocabulary was measured using the Norwegian Vocabulary Test (NVT), which is designed for children aged 5–6 (Ingunn Størksen, Ellingsen, Tvedt, & Idsøe, 2013). An abridged version including 20 of the 40 items was used; this subset has been shown to have satisfactory reliability (Lundetræ, Solheim, Schwippert, & Uppstad, 2017). The children were asked to name pictures that appeared on the iPad. The easiest, at 98.7% correct answers, was *nøkkel* 'key' and the hardest was *trekkspill* 'accordion' at 17.5%. Reliability (Crohnbach's alpha) was .81.

Digit span was measured using the Digit Span Forward test from the third edition of the Wechsler Intelligence Scales for Children (WISC) (Wechsler, 1991). A number of digits (starting with two) were read aloud by the tester, at a rate of one digit per second. The child was then asked to repeat the series in the same chronological order. The test was automatically discontinued after two subsequent errors. Raw scores were used in the analyses.

Early mathematical skill was measured using an abridged version of the Ani Banani test (I Størksen & Mosvold, 2013). The child was asked to help a recurring monkey figure called Ani Banani to solve different tasks on the iPad, e.g. 'Today Ani Banani is very thirsty. Can you give him the largest milkshake?' and 'Ani Banani has some bananas in one of his baskets. Can you put as many apples in his other basket?' The child was also asked to count different objects and to count forwards and backwards from different starting points. Reliability (Crohnbach's alpha) was .71.

Measures at T1.

Letter-sound knowledge was measured using a test developed for the 'Two Teachers' project (Solheim et al., 2017) where 24 lower-case letters (*q*, *z*, *c*, *w* and *x* were not included)

were presented one at a time on the iPad and the child was asked to say the corresponding letter sound. If the child answered by saying the letter name instead of the letter sound, this was noted and the child was asked again if he or she knew the letter sound. A correct answer on the first attempt yielded 1 point while a correct answer when asked again yielded 0.5 points. Reliability (Crohnbach's alpha) was .90.

Word-reading accuracy was measured using 36 high-frequency words (the same set of words that was used by Seymour et al. (2003) in their study). The first 18 words were content words (e.g. *bok* 'book', *skole* 'school', *kake* 'cake') and the last 18 were function words (e.g. *ut* 'out', *eller* 'or', *fra* 'from') which represented a variety of letters and letter structures (CV, VC, CVC, CCV, VCC, CVCV, CCVC, VCCV, CVCC, CVCCV, CCVCV, VCCVC) common in Norwegian. The words were shown one at a time on the iPad. All children were presented to all 36 words as they had an approximately even level of difficulty. Reliability (Crohnbach's alpha) was .96.

Sight word efficiency (or word recognition) was measured using the Test of Word Reading Efficiency (TOWRE) (Torgesen, Wagner, & Rashotte, 1999), which has previously been translated into Norwegian and adapted for use with Norwegian children (Furnes & Samuelsson, 2011). In the present study, only form A for sight word efficiency was included, which contains 104 increasingly longer and more complex words (easy word; *du 'you',* difficult word; *nødvendig 'necessary'*). The task was to read as many words as possible within 45 seconds. Raw scores were used in the analyses.

Spelling was measured using a 15-item test containing selected words from 'Staveprøven' (Norwegian Reading Centre, 2013; Solheim et al., 2018) ranging from two to six letters in length, and representing varied letter structures (CV, VCC, CVC, CVCV, CVCC, CVCVC, CCVCV, CCVCC, CVCCV, CVVVC, CVCCC, CCVVVC) common in

Norwegian. The target word was presented in a sentence: e.g. ‘A tiger has stripes. Write *tiger*’. The number of orthographic correct spellings was measured. Reliability (Crohnbach’s alpha) was .74.

Data Analysis

All analyses were conducted using Mplus 8.0 (Muthén & Muthén, 1998-2017), and clustering within schools was taken into account. Two different approaches were taken to analyse the possible effects of faster letter instruction. First, four linear regression analyses were conducted to investigate whether the pace of letter instruction predicted letter sound knowledge, word-reading accuracy, sight word efficiency and spelling at the end of the first year. Second, logistic regression analyses were performed to investigate whether children in classrooms with a faster pace of letter instruction were more or less likely to perform in the tail ends of the distribution. For the lower end of the distribution, the cut-off for the dependent variables was set as close as possible to the 10th and 20th percentiles for all outcome measures. The 20th-percentile cut-off is in line with the mandatory Norwegian screening battery for the first year, which is designed to identify children at risk of reading difficulties (Norwegian Directorate for Education and training, 2015). The 10th-percentile cut-off was added to further investigate the effect on the lowest-performing children. For the higher end of the distribution, the cut-off was set as close as possible to the 80th percentile. However, because of ceiling effects, the cut-offs had to be on the 68.5th percentile for letter-sound knowledge and on the 72.6th percentile for word-reading accuracy. Scores in the lower- and higher-performing groups were coded as (1) while the remaining scores was coded as (0).

As the data have a hierarchical structure, with children nested in 51 different classes from 51 different schools, we calculated intra-class coefficients (ICC) for the outcome measures. The ICC was .045 for letter sound knowledge, .089 for word-reading accuracy, .064 for sight word efficiency and .047 for spelling. As the ICC values indicated that some of

the variation on these measures was due to differences between classes, clustering should be taken into account (Geiser, 2013; Peugh, 2010). Modelling the data without clustering could entail a risk of underestimating the standard error of the estimates, potentially causing a type 1 error. Both the linear-regression and logistic-regression models were therefore conducted with robust (Huber–White) standard errors, using the COMPLEX command in Mplus (Muthén & Muthén, 1998-2017).

Results

Descriptive Statistics

Descriptive statistics for literacy-related measures at school entry, teacher characteristics, child-teacher ratio and outcome measures are shown in Tables 2 and 3. As can be seen in Table 3, the results for letter-sound knowledge and word-reading accuracy are substantially skewed. Letter-sound knowledge was not expected to be normally distributed, as this would require the children to have a partial mastery of the alphabet (Paris, 2011) and also because at the end of the first year, most children know all letter–sound associations. As for word-reading accuracy, the facts that all items were at about the same level of difficulty and that there was no time limit yielded little variability and high scores for most children (ibid.). Because of the skewedness, the MLR estimator, which is robust to non-normal distributions, was applied (Muthén & Muthén, 1998-2017). A few children scored more than 3 standard deviations above the mean on sight word efficiency (8 children) and spelling (5 children). To avoid possible implications on the correlations and regression estimates, these children were moved to the higher tail end of the distribution (similar to Puglisi, Hulme, Hamilton, & Snowling, 2017; Torppa, Eklund, Sulkunen, Niemi, & Ahonen, 2018). However, several children fell below 3 standard deviations from the mean on letter-sound knowledge (21 children) and word-reading accuracy (43 children) because of the ceiling effect, and were not

moved to the lower tail end of the distributions. Hence analyses involving these variables should be treated with caution.

Correlations between literacy-related measures and 'letter instruction (month)'

Correlational analyses showed no significant correlations between 'letter instruction (month)' and literacy related measures at T0, implying that children's skills at school start is not decisive for letter instruction speed.

[Insert Tables 2, 3, 4 and 5 about here]

Results of Regression Analyses

Results from the linear regression analyses are shown in Table 5. The results indicated that a faster pace of letter instruction contributed positively to development for all dependent variables – letter sound knowledge (β = -0.09, $p < .05$), word-reading accuracy (β = -0.12, $p < .01$), sight word efficiency (β = -0.10, $p < .01$) and spelling (β = -0.08, $p < .05$) – after controlling for literacy-related skills at school entry, teacher characteristics and child-teacher ratio.

[Insert Table 6 about here]

Results of Logistic Regression Analyses

The results from the logistic regression analyses are displayed in Tables 7–10. The analysis for letter knowledge (Table 7) showed that both for the lowest 8.4% and the lowest 24.2%, the odds ratio was significantly higher than 1, indicating that a faster pace of letter instruction reduces the likelihood of scoring among the lowest-performing pupils. Similarly, a faster pace of letter instruction was associated with a reduced likelihood of scoring among the lowest 9.5% of the distribution for word-reading accuracy (Table 8); for the lowest 21.5%, however, the β value was positive but the result was non-significant. Further, a faster pace of letter instruction was significantly associated with a reduced likelihood of scoring among the

lowest 10.2% and 19.7% for sight word efficiency (Table 9). The same pattern was also found in the analysis for spelling (Table 10); for both the lowest 11% and the lowest 19.2%, the β value was positive and the odds ratio was above 1 and statistically significant.

By contrast, for the highest-performing children (meaning, for letter knowledge, the top 31.5%, for word-reading accuracy, the top 27.4%, for sight word efficiency, the top 20.5%, and for spelling, the top 21.2%), the results were only significant for word-reading accuracy and non-significant for all other dependent variables. Word-reading accuracy was heavily at ceiling and these results should be treated with caution. Taken together, pace of letter instruction had minimal effect in the higher end of the distributions.

[Insert Tables 7-10 about here]

Discussion

This study was designed to find out whether a faster pace of letter instruction contributes to the development of letter knowledge, word reading and spelling skills in the first year of school, and whether a faster pace of letter instruction reduces or increases the probability of very low or very high scores on literacy measures. In general, the findings from the present study were in line with the hypotheses put forward. More specifically, children in classes with faster letter instruction performed significantly better on all outcome measures and were less likely to score among the lowest 10% and 20%. Also, a faster pace of letter instruction was significantly associated with word-reading accuracy in the higher end of the distribution. These findings are in line with that of Jones and Reutzel (2012) that a faster pace of letter instruction affects children's development in letter knowledge. The present study adds to the existing literature by showing that outcomes in word reading and spelling are also associated with the pace of letter instruction.

Effect of Letter-instruction Pace on the Development of Letter Knowledge, Word Reading and Spelling

The observed effect of letter-instruction pace on letter knowledge supports the hypothesis that a faster pace gives children better opportunities for sufficient repetition and practice of the letters (Jones et al., 2013). Hence it is reasonable to assume that the effect of letter-instruction pace on children's word-reading accuracy and sight word efficiency is due to the fact that children in classes with faster letter instruction have automatised more letters, which helps them to decode different words. In addition, especially for sight word efficiency, obtaining a high score requires keeping representations of several words in one's memory, and the ability to do this is best acquired through multiple encounters with words, through both reading and writing (Adams, 1990).

The explanation for the significant effect seen for spelling seems to follow the same line of reasoning as for word reading. Young children typically read words better than they spell them, as spelling requires grapheme retrieval and is more dependent on memory and ample practice while word reading requires only grapheme recognition (Perfetti, 1997). Still, a faster pace of letter instruction seems to provide children with better opportunities to develop their spelling skills as well, possibly as a result of both better knowledge of the letters and more time to practise. Norwegian has a semi-transparent orthography (Seymour et al., 2003) and knowledge of more complex orthographic conventions was required to find the correct spelling of eight of the fifteen words included in our outcome measure of spelling. Here it should be noted that we did not count phonologically accurate but formally incorrect spellings as correct answers. In the age group concerned, such spellings are normally encouraged by teachers. Hence our study may have underestimated the association between letter-instruction pace and spelling.

Letter-instruction Pace and the Likelihood of Tail-end Scores for Letter Knowledge, Word Reading and Spelling

Children who first start school are typically a very heterogeneous group in terms of literacy, ranging from children who know only some of the letters to children who are already fluent readers and writers (Justice et al., 2006; Piasta, 2014; Sigmundsson et al., 2017). Letter knowledge at school entry is known to be a strong predictor of the development of reading skill (H. Catts, Fey, Tomblin, & Zhang, 2002; Leppanen et al., 2008; National Early Literacy Panel, 2008; Schatschneider et al., 2004), and if children who know few letters at school entry have to wait, say, 19 weeks before they are introduced to a letter that they need in order to read and spell, this will delay their ability to read and write many words. Our findings indicate that contrary to the highest performing children, the lowest performing children benefit from a faster introduction of the letters on all outcome measures. These results partly contradictes the

results by Connor et al. (2004) to the effect that the level of literacy skills (letter recognition, letter knowledge and word reading) at school entry is a stronger predictor of literacy development than classroom instruction.

Jones et al. (2013) highlights the opportunity to repeat and practise the letters more often during the first year of school as a particular benefit of introducing them faster. Our findings suggest that this is particularly important for children with poor letter knowledge at school entry – who typically need more explicit exposure to letters in order to learn them sufficiently well (Jones et al., 2013; Piasta & Wagner, 2010b; Treiman et al., 2007). In classrooms with a slow instructional pace, children who need such explicit instruction will typically learn those letters that are introduced early on quite well, as they can repeat and use them more often during the academic year. However, because most children will have automatised their letter knowledge during the first year, there tends to be rather less explicit letter instruction in later years. As a result, the children needing such explicit instruction may not have sufficient time to automatise those letters that are introduced towards the end of the first year. Hence children already at risk of reading difficulties are further disadvantaged by a slow pace (Jones et al., 2013). As pointed out earlier in the discussion, letter knowledge represents one of the steps of the early development of literacy skills, and children in classes with faster letter instruction are in fact less likely to perform poorly in word reading and spelling. This is in line with Jones et al. (2013), where it is emphasised that the purpose of letter knowledge is reading and writing and that a slow pace of letter instruction takes up valuable time, leaving children with less time to develop their reading and spelling skills.

Jones et al. (2013) also notes that a slow pace forces children who already know many letters when entering school to devote a disproportionate amount of time to ‘learning’ letters they already know. Given the overall high scores for letter knowledge, it was unlikely that there would be differences among high-performers depending on the pace of letter

introduction in their classes, but there could have been some differences for word reading and spelling. However, it turned out that children in classes with faster letter instruction were only more likely to perform in the higher end of the distribution on the heavily skewed measure of word-reading accuracy. Taken together, the results in the higher end of the distributions show minimal effect of pace of letter instruction. One possible explanation for this finding might be that children who know most of the letters when entering school already have the tools they need to engage with literacy (whereas there is much more potential knowledge for the lowest-performing children to gain from the practice under investigation). Hence, action taken to support the highest-achieving children's literacy development will not involve letter instruction as much as practices related to reading and writing. Even so, a faster pace of letter instruction can provide better opportunities to differentiate literacy instruction for all children. As letter instruction and early reading instruction take up a great deal of the time during the first year of school, teachers should consider to what extent children who already know the letters should take part in the first introduction of the letters and in subsequent repetition, where this takes place in whole-class sessions. Stipek and Chiatovich (2017) found that low-performing children benefit more than high-performing ones from high-quality instruction to develop their reading skills. This can be linked to the findings of the present study, which suggest that a faster pace of letter instruction is a better practice.

Strengths and Limitations of the Study

The present study has several strengths. The sample is large and comes from classes randomised as controls in a large RCT study, 'Two Teachers' (Solheim et al., 2017). The fact that this is a natural experiment implies a limitation in the reduced control of extraneous variables that might bias the results, but it strengthens validity as the observed differences are unlikely to be due to participation in the study. The design also strengthens ecological validity, as differences in letter-instruction pace are studied in a natural setting. Further

strengths are that a variety of literacy skills at school entry, teacher characteristics and child-teacher ratio are controlled for.

However, a note of caution is necessary as this is the first study to investigate the effect of letter-instruction pace beyond the study by Jones and Reutzel (2012). More studies are needed to enable clear conclusions to be drawn on this matter. Further, the present study does not provide any information about the quality or methods of letter instruction in the different classes.

Conclusions

This study was designed to investigate whether a faster pace of letter instruction can contribute to children's development of literacy skills during the first year of school. The general findings show that introducing the letters at a faster pace is positively associated with children's literacy skills, especially for those in the lower tail-end of the distributions. As mentioned, research concerning the pace of letter instruction is scarce. This innovative study therefore contributes significantly to a research field in need of further exploration.

These are promising findings as they indicate that a relatively minor change to instruction practices seems to contribute positively to the development of children's literacy skills. Further, they challenge the notion that a slow pace of letter instruction is required to ensure that all children learn the letters and come off to a good start in their literacy development. In fact, they suggest that a slow pace of letter instruction can actually inhibit this development in the lowest-performing children. Given the importance of letter knowledge for the development of literacy skills, these are important findings with direct implications for how the letters should be taught to first-year children.

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