Article:

Fricke, S., Szczerbinski, M., Fox-Boyer, A. et al. (1 more author) (2015) Preschool Predictors of Early Literacy Acquisition in German-speaking Children. Reading Research Quarterly, 1 (51). pp. 29-53. ISSN 1936-2722

https://doi.org/10.1002/rrq.116

Preschool Predictors of Early Literacy Acquisition in German-speaking Children

Silke Fricke[1], Marcin Szczerbinski[2], Annette Fox-Boyer[3], and Joy Stackhouse[1]

[1]University of Sheffield, Sheffield, UK

[2]University College Cork, Cork, Republic of Ireland

[3] European University of Applied Sciences Rostock, Rostock, Germany

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Abstract

Phonological awareness, rapid automatized naming (RAN), letter knowledge, and oral language are all significant predictors of successful literacy acquisition in several languages. However, their relative importance is less clear and depends on language characteristics, the specific aspect of literacy assessed, and the phase of literacy acquisition. This study therefore aimed to examine the development of these predictors and their relationship with literacy acquisition through a longitudinal investigation of German-speaking children.

Seventy-eight children growing up monolingual German were assessed three times: a few months before starting school (M_{age} 5;11), in Grade 1 (M_{age} 6;11), and in Grade 2 (M_{age} 7;10). Cognitive predictors were measured at preschool, and literacy outcomes (reading accuracy, speed, comprehension, and spelling) were measured in Grades 1 and 2.

Correlational and path analyses revealed a complex pattern of relationships between cognitive and literacy skills dependent on the aspect of literacy being measured and the time point. Overall, the most important predictor of literacy skill in Grade 2 was earlier literacy skills, followed by letter knowledge and RAN. Phonological awareness was less important than RAN, and oral language skills (i.e., vocabulary and grammar comprehension) were least important. The implications of these findings for the understanding of cognitive mechanisms of literacy acquisition and for early detection of literacy difficulties are discussed.

Keywords: cognitive predictors, early literacy development, German, longitudinal, preschool

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Predictors of Literacy

During the last few decades there has been considerable progress in understanding the cognitive predictors of individual differences in literacy development. Although the majority of studies have been conducted with English-speaking participants, a growing body of research in other writing systems has shown that useful insights can be gained by cross-linguistic comparisons (e.g., Caravolas et al., 2012; Landerl et al., 2013). Alphabetic writing systems, for example, differ in terms of their consistency of mapping graphemes onto phonemes, and vice versa (Caravolas, 2004; Seymour, 2005). Relatively consistent orthographies (e.g., Finnish, German, Greek, Italian and Turkish) have more consistent and predictable relationships between letters or letter groups and the same sound in different words than relatively inconsistent orthographies such as Danish or English. With regard to literacy development, word reading accuracy and speed, and spelling accuracy are generally acquired easier and faster in more consistent orthographies, mainly because graphemes that map reliably and consistently onto phonemes assist children in learning grapheme-to-phoneme-correspondences (Aro & Wimmer, 2003; Seymour, Aro, & Erskine, 2003). This in turn boosts both their decoding (reading) and encoding (spelling) skills. However, even if reading and spelling are considered as “two sides of a coin” (Ehri, 2000) with similar developmental sequence and foundation skills (Ritchey, 2008), they do not develop completely in parallel but rather interact (Frith, 1985). This interaction is further complicated in orthographies like French or German, where the much less consistent phoneme-to-grapheme correspondences (spelling) than grapheme-to-phoneme correspondences (reading) are seen as a reason why reading develops faster than spelling (Bergmann & Wimmer, 2008; Landerl, 2006).

Established frameworks of reading and spelling suggest that alphabetic knowledge, phonological and oral language skills are universally important for literacy development

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

(Gough & Tunmer, 1986; Perfetti, Landi, & Oakhill, 2005; Seymour, 2005). The current study focuses on phonological awareness (PA), rapid automatized naming (RAN), letter knowledge (LK), and oral language (OL) as a number of studies have confirmed their importance in predicting literacy achievement (for review see Bowey, 2005; Lonigan, Schatschneider, & Westberg, 2008). These predictors are investigated from preschool age as individual differences in literacy acquisition are already detectable before school enrollment and could thus be used to identify children at risk of developing literacy difficulties (Puolakanaho et al., 2008; von Goldammer, Mähler, Bockmann, & Hasselhorn, 2010). Further, we examine four literacy components (reading accuracy, speed, comprehension, and spelling) since previous studies have not agreed on their role as predictors (e.g., Fraser & Conti-Ramsden, 2008; Muter, Hulme, Snowling, & Stevenson, 2004), or been criticized for measuring too few literacy components (e.g., Oakhill & Cain, 2012). For example, whilst studies of more consistent orthographies have typically focused on reading fluency or speed (e.g., Dutch: de Jong & van der Leij, 1999; German: Landerl & Wimmer, 2008), studies of English have attended more to reading accuracy (e.g., Muter & Snowling, 1998) with only recent studies also looking at reading fluency and speed as literacy outcomes. While the development of reading accuracy and speed received extensive scrutiny, less attention has been paid to the development of reading comprehension (Fraser & Conti-Ramsden, 2008; Perfetti et al., 2005) and spelling (Caravolas, 2006; Caravolas, Hulme, & Snowling, 2001). Consequently, the relative importance of different cognitive predictors across different literacy components and orthographies remains inconclusive and warrants further investigation.

Phonological Awareness

PA refers to the ability to reflect on and manipulate the phonological structure of words. It is a complex construct that can be categorized along at least two dimensions: size of

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

linguistic unit (syllables, onset-rhymes and phonemes), and level of explicitness: from tacit identification, through segmentation, and blending to more conscious manipulation (Stackhouse & Wells, 1997). In all languages studied so far, PA of larger units (syllables, onsets and rhymes) is well-developed and reliably measurable at the preschool stage and before the acquisition of literacy competence (except for highly explicit tasks such as manipulation). In contrast, preschool children are often not aware of phonemes (Aidinis & Nunes, 2001; Carroll, Snowling, Hulme, & Stevenson, 2003), and some authors suggest that children only develop phonemic awareness as a by-product of literacy instruction (Castles & Coltheart, 2004; Goswami & Bryant, 1990). However, studies in a variety of languages contradict this and show that PA skills at phonemic level do develop to a certain degree before the beginning of formal literacy instruction (e.g., Hulme, Caravolas, Malkova, & Birgstocke, 2005; van Bon & van Leeuwe, 2003). Controversies notwithstanding, the majority of researchers believe in a reciprocal relationship between PA and literacy development, particularly between phonemic awareness and letter knowledge in alphabetic orthographies.

Given the complexity of the PA construct, it is not surprising that several tasks have been developed to measure PA. These involve different linguistic units and levels of explicitness (e.g., syllable segmentation or deletion; phoneme identification or segmentation), as well as varying stimuli (e.g., whether or not pictures are used to aid memory) and response demands (e.g., if a spoken response is required). It is these task-specific demands that may be responsible for different results in different studies (Caravolas, 2004; Stackhouse & Wells 1997).

Different mechanisms for how PA may support literacy have also been suggested. The awareness of the phonological structure of words gives children insight into the symbolic nature of the associated print, and enables their further learning. Moreover, PA is important

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

for literacy acquisition because it provides children with a firm foundation for creating mappings between phonological representations of the spoken language and orthographic representations of the written language (Ziegler & Goswami, 2005). Indeed, many studies of English speakers conclude that the influence and predictive value of PA on reading and spelling accuracy is unquestionable (e.g., Fraser & Conti-Ramsden, 2008). However, findings from more consistent orthographies such as Dutch, Finnish, or German are less clear (Aarnoutse, van Leeuwe, & Verhoeven, 2005; Holopainen, Ahonen, & Lyytinen, 2001; Landerl & Wimmer, 2000). Furthermore, studies from alphabetic writing systems like English as well as more consistent orthographies (e.g., Czech) found that the awareness of phonemes measured at preschool or early school age tends to be a better predictor of early literacy than the awareness of syllables or onsets and rhymes (Caravolas, Volín, & Hulme, 2005; Muter et al., 2004), though some disagreement remains (Goswami, 2001). Thus, the issue of the predictive power of PA is complex as it does not only depend on the language involved, but also on the aspect of literacy, the level of PA being measured, and the phase of literacy acquisition when measurements are taken.

In inconsistent orthographies like English and Danish, PA measured at preschool or early school age is not only predictive of reading accuracy and spelling (Frost, Madsbjerg, Niedersøe, Olofsson, & Møller Sørensen, 2005; Lonigan, Burgess, & Anthony, 2000), but also of reading speed (Wagner & Torgesen, 1987). These early differences in PA skills are predictive of literacy skills throughout primary school years. Furthermore, PA also predicts reading comprehension, but this relationship may be indirect and result from the association of PA with word decoding (Muter et al., 2004; Savage et al., 2005). In more consistent orthographies the predictive power of PA for reading accuracy tends to be weaker and restricted to the early stages of literacy acquisition (Landerl & Wimmer, 2000; Wimmer, Mayringer, & Landerl, 2000), especially once letter knowledge or earlier literacy skills are

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

controlled (Verhagen, Aarnoutse, & van Leeuwe, 2008). However it is still important, particularly as a predictor of spelling (e.g., Babayiğit & Stainthorp, 2011; Wimmer et al., 2000). Although no unique link has been found so far between PA and reading speed in German, it has been found in other consistent orthographies such as Dutch (de Jong & van der Leij, 1999), Czech (Caravolas et al., 2005) and Greek (Constantinidou & Stainthorp, 2009). A unique contribution of PA for reading comprehension in a consistent orthography has been found for Czech (Caravolas et al., 2005). The claim that PA is a weaker and more transient predictor of literacy development in consistent orthographies (compared with inconsistent ones) has been tested directly with several cross-linguistic studies, both longitudinal and cross-sectional, but with contradictory results. While Georgiou, Torppa, Manolitsis, Lyytinen, and Parrila (2012) reported limited predictive power of PA for nonword decoding, text-reading fluency and spelling in Greek and Finnish compared to English, PA emerged as an important predictor of reading accuracy and speed in Finnish, Hungarian, Dutch, Portuguese, and French (Ziegler et al., 2010); of reading fluency in Hungarian, Dutch, and Portuguese (Vaessen et al., 2010); and of reading (measured by speeded reading tests) and spelling in English, Spanish, Czech and Slovak (Caravolas et al., 2012).

Rapid Automatized Naming (RAN)

RAN is defined as the speed with which an individual names a series of highly familiar visual stimuli such as drawings of common objects, patches of color, letters or numbers (Denckla & Rudel, 1976). Despite the apparent simplicity of the RAN tasks, controversy exists about what they actually measure and why success on such tasks is associated with literacy achievement. Some authors (e.g., Wagner & Torgesen, 1987) claim that RAN and literacy skills are associated because they are both phonological tasks; specifically they both require efficient retrieval of phonological codes from long-term memory. Compatible with this view, Lervåg and Hulme (2009) suggested that RAN measures

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

the reliability of neural circuits devoted to object identification and naming which also play an important role in the development of the visual word recognition. Others argue that RAN and literacy are associated because both require either precise temporal coordination of information from various modalities (e.g., Wolf, Bowers, & Biddle, 2000) or high speed of information processing generally (e.g., Catts, Gillispie, Leonard, Kail, & Miller, 2002). These in turn are necessary for the efficient fusion of phonological and visual information into orthographic codes for a quick recognition and processing of familiar and frequent units or symbols (e.g., Bowers, 1995, Powell, Stainthorp, Stuart, Garwood, & Quinlan, 2007). Despite the uncertain nature of RAN tasks, it is generally acknowledged that PA and RAN involve related as well as separate processing subskills that underlie literacy development (Powell et al., 2007). RAN has become an auspicious variable in literacy research, often explaining individual variance in literacy skills over and above PA (Parrila, Kirby, & McQuarrie, 2004).

Performance on RAN tasks has consistently predicted reading speed in various languages such as Dutch, English, Finnish, German, Greek and Turkish (Babayiğit & Stainthorp, 2010; de Jong & van der Leij, 1999; Georgiou, Parrila, & Liao, 2008; Holopainen et al., 2001; Landerl & Wimmer, 2008; Vaessen et al., 2010). Evidence for RAN being an important predictor of spelling is more limited, though available (e.g., Caravolas et al., 2012; Landerl & Wimmer, 2008; Savage, Pillay, & Melidona, 2008). The predictive power of RAN for reading accuracy is reported even more rarely and RAN is a stronger predictor of reading speed than accuracy (Kirby, Parrila, & Pfeiffer, 2003; Swanson, Trainin, Necoechea, & Hammill, 2003). Although Wolf and Bowers (1999) suggested that RAN would play a role in reading comprehension, the few studies carried out have not always confirmed this (Compton, Defries, & Olson, 2001; Savage & Frederickson, 2005). In consistent orthographies with rather rapid word reading accuracy development there might be another,

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

indirect link between RAN and reading comprehension via reading speed. However, Babayiğit and Stainthorp's (2011) longitudinal path models did not confirm this for Turkish.

Letter Knowledge

In alphabetic writing systems, letters represent the phonemes of the spoken language. Studies have frequently combined measures of both letter names and letter sounds into a composite index of letter knowledge (e.g., Duncan & Seymour, 2000; Gallagher, Frith, & Snowling, 2000), and McBride-Chang (1999) suggests that including an examination of both upper and lower case letters provides a more comprehensive assessment of letter knowledge (LK). Examining if children either know a letter's name or its sound is particularly important at the preschool stage (Foulin, 2005) or in consistent orthographies with unequivocal relationships between letter names and sounds (e.g., Schneider, Roth, & Ennemoser, 2000).

Cross-linguistic studies have typically shown an impact of the educational system (i.e., age of onset of formal literacy instruction) on LK development. For example English-speaking children show relatively good LK because of the greater emphasis put on letters and literacy activities in children's homes and preschool settings (Caravolas, 2004; Mann & Wimmer, 2002). However, once children enter more formal schooling, whether at the age of 4 or 6 years, within a few months they achieve a similarly high level of LK independent of language structure and orthographic consistency (Seymour et al., 2003).

It seems inevitable that LK is an essential prerequisite of literacy acquisition in an alphabetic writing system. Since letters generally represent phonemes, the knowledge of letters is necessary to break this cipher and develop the ability to decode written words into speech (reading), and encode speech into written words (spelling). Thus, it is not surprising that in many studies LK has predicted early literacy skills, which in turn have predicted later literacy skills. However, less obvious long-lasting direct effects of early LK on later literacy skills have also been reported (e.g., Leppänen, Aunola, Niemi, & Nurmi, 2008). A reason for

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

this relationship between LK and later literacy might be paired-associate learning (Hulme, Goetz, Gooch, Adams, & Snowling, 2007; Warmington & Hulme, 2012). Furthermore, LK may affect literacy skills via its reciprocal relationship with PA (Muter, Hulme, Snowling, & Taylor, 1998).

Research on both consistent and inconsistent orthographies has repeatedly identified LK, measured before or around school enrolment, as a robust and unique predictor of early literacy (for review see Bowey, 2005; Lonigan et al., 2008). This is true for reading accuracy as well as spelling (e.g., Caravolas, Kessler, Hulme, & Snowling, 2005; Näslund & Schneider, 1996). In more consistent orthographies significant correlations have also been reported between LK and reading speed (e.g., Leppänen et al., 2008; Vaessen et al., 2010; Wimmer, Landerl, Linortner, & Hummer, 1991). Reading comprehension appears generally only indirectly affected by LK via word decoding (Foulin, 2005), though kindergarten LK (M_{age} 6;3) emerged as an important predictor of 4th Grade reading comprehension in Finnish children, even after controlling for early reading skills (Leppänen et al., 2008).

Oral Language

Oral language (OL) skills such as vocabulary knowledge and grammatical competence have received less attention in the context of literacy acquisition than PA, RAN, and LK. Despite this scarcity of research, the importance of OL seems obvious, at least for reading comprehension. In order to understand what they read, children need not only to decode words, but also to understand their meaning and parse the sentences (Perfetti et al., 2005). This insight has been formalized for example within the Simple View of Reading framework (Gough & Tunmer, 1986; Kendeou, Savage, & van den Broek, 2009), which explains reading comprehension as a product of linguistic comprehension and word decoding skills. However, OL may also influence other aspects of literacy beyond reading comprehension. Vocabulary knowledge appears to affect other predictors like PA and RAN

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

of objects (Carroll et al., 2003; Metsala & Walley, 1998). Vocabulary knowledge together with grammatical competence may bootstrap printed word decoding and support the establishment of reliable orthographic representations and the acquisition of procedural knowledge of orthographic rules (Bryant, Deacon, & Nunes, 2006; Muter et al., 2004; Muter & Snowling, 1997; Nation, Snowling, & Clarke, 2007). Cross-linguistic research suggests that grammatical skills play a larger role in learning to read and write languages that are highly inflected (e.g., French, Greek, German and Turkish) compared to those that are weakly inflected (e.g., English), although not all studies have confirmed this (Babayiğit & Stainthorp, 2010; Rispens, McBride-Chang, & Reitsma, 2008). Overall, OL may be less important in the earlier stages of literacy development when decoding skills play the key role (Caravolas et al., 2012), but it becomes more important later, when reading comprehension is the ultimate goal (Muter & Snowling, 1998).

Numerous studies in different languages and orthographies have confirmed that OL and reading comprehension are linked (e.g., Deacon & Kirby, 2004; Frost et al., 2005; Oakhill, Cain, & Bryant, 2003), often in a complex and multifaceted way (for review see Wagner, Muse, & Tannenbaum, 2007). The role of OL for reading accuracy and speed may be more important in inconsistent than consistent orthographies. To become an accurate and fast reader in an inconsistent orthography children may use OL skills to semantically bootstrap words which they can only partially phonologically decode (Nation & Snowling, 2004; Ouellette, 2006). However, even in consistent orthographies children must eventually switch from slow, serial activation of individual grapheme-phoneme correspondences to fast, parallel mapping of longer letter strings onto phonology if they are to become fluent readers (Wimmer, 2006). This hypothesis is supported by studies reporting predictive value of grammatical competence on reading accuracy or speed in languages other than English (Casalis & Louis-Alexandre, 2000; Jongejan, Verhoeven, & Siegel, 2007). With regards to

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

spelling, a small number of studies showed its relationship with morphological skills (Muter & Snowling, 1997; Rispens et al., 2008). However, grammatical competence or vocabulary often fail to make a unique contribution to the prediction of spelling after other language skills, background factors or earlier spelling skills (Babayiğit & Stainthorp, 2010; Caravolas et al., 2012; Speece, Ritchey, Cooper, Roth, & Schatschneider, 2004).

In summary, the power of the different predictors of literacy development reviewed here depends on many factors, such as the phase of literacy acquisition, and properties of the orthography as well as the languages involved. In German, which is the focus of this paper, several studies have explored the link between a limited number of cognitive skills and literacy components, or they have focused on different age groups (Duzy, Ehm, Souvignier, Schneider, & Gold, 2013; Knievel, Daseking, & Petermann, 2010; Moll, Wallner, & Landerl, 2012; von Goldammer et al., 2010). However, there has been little examination of the development of a wider range of cognitive skills from preschool age and their relationships with early acquisition of the literacy components reading accuracy, speed, comprehension, and spelling.

Research Aims and Hypotheses

The present study aimed to investigate the power of PA, RAN, LK, and OL in order to predict individual differences in early literacy acquisition in German. We hoped to add to the literature on languages other than English and in particular previous German language studies of literacy acquisition by starting earlier (before formal literacy instruction in kindergarten), including a wider range of potential predictors, and also a wider range of literacy outcomes. This allowed us to compare the relative importance of different predictors and to identify unique predictors.

Based on the literature reviewed, we made several predictions. Two of them were general in nature: The most powerful predictor of literacy skills measured later will be the

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

autoregressor (i.e., the same literacy skills measured earlier). This is because early individual differences in literacy are fairly stable (Lonigan et al., 2008; Swanson et al., 2003). Furthermore, whatever cognitive skills emerge as significant predictors of reading accuracy and speed should also predict reading comprehension, since at this early stage of development word reading skills are the main limiting factor on reading comprehension (Perfetti et al., 2005).

The more specific predictions concerning individual predictors were as follows: Firstly, we expected the predictive power of PA to be smaller than in less consistent orthographies such as English, as well as limited to the early, alphabetic phase (Frith, 1985) of literacy development. Secondly, RAN was anticipated to be a powerful predictor of automaticity of single word processing (measured by word reading speed) and orthographic processing skills which contribute to reading accuracy and spelling. Thirdly, we expected LK to uniquely predict all aspects of literacy, which might be indirect for reading comprehension. Finally, we anticipated OL to be uniquely important for reading comprehension, over and above other predictors.

Method

A longitudinal design was adopted. Participating children were assessed during the last term of nursery before they entered school (t1), in Grade 1 (t2), and in Grade 2 (t3). All children received a comprehensive battery of tests which included: predictor skills and nonverbal reasoning at t1, literacy skills at t2, and literacy skills at t3. An overview of assessments is given in Figure 1. A longitudinal design starting at preschool age made it possible to investigate the causal influences of the selected predictor skills on literacy prior to formal literacy instruction (McBride-Chang, Wagner, & Chang, 1997; Muter et al., 2004).

- Insert Figure 1 here -

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Participants

Participants were recruited via mainstream nurseries in three cities of varying size in the Federal State of Hesse in Germany. All nurseries were initially contacted via phone to explain the project and, if necessary, consent was also asked from the nursery's responsible body. Nurseries that agreed to participate in the study were provided with parent/carer information sheets and consent forms, and asked to distribute these among parents/carers whose children met the following criteria: growing up either monolingual German or being a successive bilingual child learner of German; no history of hearing loss, or developmental, medical or neurological disorders in general; attending nurseries at t1 and enrolling at school (Grade 1) in the autumn directly after t1. Prior to the first wave of data collection, consent for participation was received for 136 children from 19 different nurseries. Only the 78 monolingual German-speakers (37 girls and 41 boys; M_{age} 5;11 at t1/last term in nursery) are included in the sample presented here. They attended 18 of the nurseries and none of them had received any formal literacy or structured letter instruction by then. Of the remaining children, 44 were excluded because they grew up bilingual, four were not available for testing during t1, and 10 more did not enter Grade 1 of primary school as expected. Nursery and parent/carer questionnaires confirmed considerable variability in socio-economic status (e.g., neighborhood characteristics, educational and employment levels) in the sample population. At t2 (Grade 1; M_{age} 6;11) and t3 (Grade 2; M_{age} 7;10), the monolingual participants were spread over 24 primary schools, between one and 14 children per school.

Materials

Phonological awareness. The 11 PA subtests from the Test für Phonologische Bewusstheitsfähigkeiten (TPB; Fricke & Schäfer, 2011) administered in this study covered the three linguistic units (i.e., syllable, onset-rhyme and phoneme) and different explicitness levels (i.e., identification, segmentation, blending and manipulation) of PA and thus, tapped

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

both dimensions of PA: size of linguistic unit and explicitness. Furthermore, each subtest except for one (Syllable-segmentation) consisted of an input and an output version to differentiate between the two sides of the speech processing model (i.e., speech perception and production) as recommended by Stackhouse and Wells (1997). The output subtests required spoken answers from the participants, whereas the input versions could be answered by a nonverbal response such as pointing. All PA subtests contained three practice and 12 test items. Apart from two subtests (Onset-rhyme-blending-output and Sound-blending-output), where pictures were inappropriate for the task structure, stimuli were presented as colored pictures. To ensure that children knew the vocabulary required by the test and used the desired labels they were asked to name all the pictures prior to the administration of the first subtest. In case of naming failure circumlocutory sentences, alternative questions, and finally imitations were used to elicit the target word. If a child still failed to name the picture correctly, the intended name was provided by the examiner. Responses were scored as correct (1) or incorrect (0). All subtests had a maximum score of 12 except for Rhyme-production-output that did not have a maximum score due to its open-ended structure. A brief description of the subtests follows (for further details of task and stimuli design see Schaefer et al., 2009).

Syllable-segmentation-output (SylSegout). The task required the child to look at a picture and segment the depicted noun into syllables.

Rhyme-production-output (RhymeProdout). The child was asked to look at a picture and produce as many words or nonwords that rhymed with the depicted noun as possible in 15 seconds.

Rhyme-identification-input (RhymeIDin). Each test item consisted of four pictures, one at the top and three at the bottom of a page. The child was asked to point to the word

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

depicted at the bottom that rhymed with the word depicted at the top. Apart from the correct rhyming word, a phonological distractor and a semantic distractor were presented.

Onset-rhyme-blending-output (OnsetRhymeBlendout). The child was instructed to say the word that resulted from blending the onset and rhyme pronounced by the examiner. Onsets were a single consonant or a consonant cluster.

Onset-rhyme-blending-input (OnsetRhymeBlendin). The child had to point to the picture that represented a word resulting from blending the onset and rhyme produced by the examiner. Apart from the target word, two distractors were presented: one shared the onset with the target word, the other shared the rhyme. Onsets were a single consonant or a consonant cluster.

Sound-identification-beginning-output (SoundIDout). For each item, pictures of two nouns were presented. They always shared the same beginning, either a single consonant (C), the whole consonant cluster (CC) or the first consonant of a consonant cluster (<u>C</u>C). The child was asked to pronounce the 'sound' the two words shared at the beginning.

Sound-identification-beginning-input (SoundIDin). Each test item consisted of four pictures, one at the top and three at the bottom of a page (i.e., target word, a phonological distractor and a semantic distractor). The child was asked to point to the word depicted at the bottom that began with the same sound as the word depicted at the top. The stimuli had the same C, CC and <u>C</u>C item structure as in the output task above.

Sound-blending-output (SoundBlendout). The child was instructed to say the word that resulted from blending the phonemes pronounced by the examiner.

Sound-blending-input (SoundBlendin). The child was asked to point to the picture out of a choice of three that resulted from blending the sounds spoken by the examiner. In addition to a picture of the target word, there was a picture of a word with an onset distractor and a picture of a word with a final sound distractor.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Sound-deletion-output (SoundDelout). The child had to pronounce the nonword that resulted from deleting the beginning of the depicted word. The examiner named only the part that had to be dropped (either a single consonant (C), a whole consonant cluster (CC), or the first consonant of a consonant cluster (<u>C</u>C)).

Sound-deletion-input (SoundDelin). The examiner first pronounced the whole word, and then its part (C, CC, or <u>C</u>C) to be deleted. The child then saw three pictures (i.e., target word, phonological distractor, and semantic distractor) and was asked to point to the picture of the word that resulted from the deletion.

Rapid automatized naming. The RAN tasks used were an adaptation of the procedure originally developed by Denckla and Rudel (1976). The child was asked to name, as fast as they could, five highly familiar visual stimuli, presented repeatedly in a random sequence on a sheet of paper (54 stimuli in total). The score was the number of items named correctly within the time limit of 15 seconds. Three RAN tasks were used: RAN of objects, RAN of colors, and RAN mixed (stimuli used in the previous two RAN tasks were intermixed on the same sheet). To ensure familiarity with the colors and objects used, children were presented with a practice sheet showing the respective stimuli at the beginning of each RAN task. The tasks were discontinued (i.e., the test sheets were not presented) if children had difficulties naming these stimuli. No alphanumeric stimuli (letters or digits) were used as letter and digit knowledge could not be assumed in the preschool-age children taking part in this study.

Letter knowledge. Each child was asked to name the 26 upper case and 26 lower case letters of the Latin alphabet presented in random order. Responding with either the correct name or sound of a letter was accepted as correct. The maximum score was 52.

Oral Language: Expressive vocabulary. The expressive part of the test for Naming and understanding nouns and verbs by Kauschke (2007) was administered as per the test

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

instructions (norms available for German children aged 2;6-8;0). The child had to name 72 line drawings (36 nouns and 36 verbs, each preceded by two practice items). The maximum score was 36 for nouns and verbs respectively.

Oral Language: Reception of grammar (TROG-D). The German version of the Test for Reception of Grammar (TROG; Bishop, 2003) was used as a measure of grammatical comprehension (Test for Reception of Grammar – German; TROG-D; Fox, 2006; normed for German children aged 3;0-9;11). The TROG-D assesses the understanding of 21 grammatical constructs, each tested with four items. In line with the test manual, the child was shown four pictures for each item and asked to select the one that matched a statement given by the examiner (max. score = 21).

Nonverbal reasoning ability. A nonverbal reasoning (NVR) measure was applied to ensure that all children included in the final study sample showed reasoning skills within the typical range, and also because statistically controlling for individual differences in IQ has been claimed to significantly influence the results of literacy studies because of the overlap between IQ and language measures (e.g., Catts, Fey, Zhang, & Tomblin, 1999). The booklet version of *Raven's* Colored Progressive Matrices (Raven, Bulheller, & Häcker, 2002) was administered as per the test manual at t1 to assess the participants' NVR abilities (German norms available for children aged 3;9-11;8). Children needed to select a missing piece (out of six) that completed a pattern for 36 items.

Early spelling. The Hamburger Schreibprobe 1+ (Hamburg writing sample for 1st Graders; HSP1+; May, 2002) measures orthographic knowledge and early spelling strategies in children in middle of Grade 1 and was administered in the first part of t2. In accordance with the test manual, children were asked to write four words and a short sentence. The results were scored as prescribed in the test manual: the number of correctly spelled words (max. 10) and correctly spelled graphemes (max. 40) were calculated.

Reading accuracy, speed, and spelling. The Salzburger Lese- und Rechtschreibtest (Salzburg reading and spelling test; SLRT; Landerl, Wimmer, & Moser, 2001) is a diagnostic tool for developmental reading and spelling difficulties in German-speaking 1st to 4th Graders. It measures reading accuracy, speed, and spelling. The spelling subtest can be administered to groups or individuals, whereas the reading subtest can only be administered individually.

The following reading tasks were administered in January to May of Grade 1 (first part of t2): 30 frequent words and 24 legal pseudowords dissimilar to real words. At t3, the following subtests were administered: 30 frequent words, a short text of 30 words, 24 legal pseudowords dissimilar to real words, and 30 legal pseudowords similar to real words. The tasks were administered as per the test manual. Following practice items (8 frequent words and 6 pseudowords) demonstrating the test format and combination of reading speed and accuracy, each child was asked to read all test items as fast as possible. Time (in seconds) and number of correctly read words (max. 24-30, depending on the task) were measured. If a child could not read a word or hesitated for more than 5 seconds the examiner pointed to the next word and prompted them to move on.

The spelling subtest was administered in June of Grade 1 (second part of t2) and in the middle of Grade 2 (t3). The child had to write the missing word in 25 gap sentences after hearing the whole sentence and the missing word on its own spoken by the examiner. Orthographic and phonological spelling accuracy was scored according to the manual to calculate the number of correctly written words (max. 25).

Reading comprehension. The paper version of the Leseverständnistest für Erst- bis Sechstklässler (Reading comprehension test for 1st to 6th Graders; ELFE1-6; Lenhard & Schneider, 2006) was administered according to the test manual at t2 and t3 to assess reading comprehension on word, sentence, and text level. In the word level subtest, children were asked to select and underline the printed word (out of four) that matched the picture. The

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

number of correct matches achieved within the time limit of 3 minutes (max. 72) was scored. In the sentence level subtest, the word (or words) that completed the sentence had to be selected and underlined (max. 28 within time limit of 3 minutes). The text level subtest comprised 13 short texts; each followed by 1-3 multiple choice questions (max. 20 with time limit of 7 minutes).

Procedure

At t1, children were assessed individually over two, or if necessary three, 30-40 minute sessions during normal nursery hours in a quiet room at the child's nursery. T2 data collections took place in a quiet room at the child's school, after-school-club, or at home. The first part of t2 (Grade 1: January-May) was carried out individually in one or two sessions. In the second part of t2 (Grade 1: June) and at t3 (Grade 2: December–February) literacy tests were administered either to small groups of children or individually, depending on the venue and number of participants attending. Whenever tests were group administered, children were asked to sit at separate tables which were placed at least two arms'-length away from each other to prevent children from copying the answers from one another. As commonly done in predictive longitudinal studies (e.g., Muter et al., 2004), assessments were administered in a fixed order to all children. This procedure was further justified by pilot studies in which tests or subtests were administered in randomized order not showing any significant effects of order of task administration on children's performance (e.g., Fricke, 2007).

The same examiner (first author) administered all assessments. All sessions were recorded via a digital voice recorder and simultaneously recorded in writing. The examiner used the digital recordings to complete and verify the written record of assessments within a month following the testing.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Results

Potential gender differences were examined using Mann-Whitney tests. Although there was a trend for girls to perform better than boys, significant differences were limited to the following tasks: t1 Rhyme-identification-input (U = 564.50, p = .015, r = -.27), t1 Syllable-segmentation-output (U = 560.500, p = .043, r = -.23), and t1 naming 36 nouns (U = 562.50, p = .047, r = -.23).[1]

Nonparametric correlations (Spearman's r_s) between chronological age and cognitive predictors and literacy measures revealed mainly weak relationships. Chronological age at t1 did not correlate significantly with performance on any t1 measures (all ps > .05), except for t1 NVR (r_s = .241). No t2 literacy measure was significantly correlated with chronological age at t2; neither were t3 literacy measures with chronological age at t3. Given this pattern of relationships, chronological age and gender were not controlled for in subsequent analyses.

Table 1 shows reliabilities and descriptive statistics for raw scores on predictor measures at t1 (last term of nursery), table 2 on literacy measures at t2 (Grade 1) and t3 (Grade 2). For published tests, the reliabilities stated in the manuals are reported if available. For predictor measures, reliabilities were also calculated for the study sample as some of them were designed or revised for this study[2].

Table 1 suggests some interesting differences in task difficulties. In general, children scored higher on PA input than output measures. This may be explained by task structure as only input measures allowed for guessing. Moreover, syllable and onset-rhyme tasks were generally easier than phonemic tasks (though there were some exceptions). This is in line

[1] Following the recommendations of Rosenthal (1991 in Field, 2009, p. 550) r coefficient was computed to express effect sizes of observed differences; where r > .3 and r > .5 are deemed to represent medium and large effects, respectively.
[2] Reliabilities above.70 are generally desired if a test is to be used as a research tool, while reliabilities above .90 are sought-after for diagnostic and job selection purposes (e.g., Hammond, 2006). However, a minimum requirement of .55 is also often cited as appropriate for assessments administered in experimental group studies (e.g., Rost, 2007).

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

with the large-to-small unit progression in the development of PA at preschool age. However, comparing task difficulties in predictor measures or analyzing PA development is not the focus here and will therefore not be investigated further.

- Insert Table 1 here -

Table 2 suggests general improvement in literacy performance over time; the gains were particularly large for reading speed. It is notable that children's spelling, while prone to orthographic errors, was very accurate phonologically. On top of these average trends, large individual differences in literacy performance were apparent. The percentile rank norms available for some of the literacy measures made it possible to compare the performance of the study sample against the population of German-speaking children of the same age. The results were inconsistent. At t2, mean spelling scores of the study sample appeared well above the population average according to the HSP1+, but well below that average according to the SLRT. T2 reading comprehension results (ELFE) were close to the population average. At t3, mean percentile ranks were more consistent, all falling reasonably close to the population average for reading speed (SLRT), reading comprehension (ELFE), and spelling (SLRT), though spelling performance was relatively worse than reading.

- Insert Table 2 here -

Predictors of Individual Differences in Literacy

The relationship between cognitive skills investigated at t1 and different aspects of literacy development measured at t2 and t3 was examined using Pearson's correlations and path analysis.

Data preparation. Missing data occurred because some children were not able to attend all of their assessment sessions (e.g., due to illness). These randomly missing data points were substituted using the expectation maximization (EM) method (Tabachnick & Fidell, 2001). The EM procedure included all cognitive as well as literacy variables measured

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

in the study. Only 0–3 data points (0-3.8% of potentially obtainable data) were missing from each variable. The distribution of all variables was then normalized (using Blom's proportion estimation formula) to make the data amenable for parametric statistical analyses. For the ease of interpreting the results, the time children needed to complete the SLRT reading tasks was reversed so that on all measures better performance corresponded to higher scores.

Correlations between predictor and literacy variables. Pearson's correlations between individual predictor measures and literacy composites are reported in Table 3. The patterns of correlations can be summarized as follows. Predictor skills at t1 tended to show stronger relationship with literacy skills in Grade 1 (t2) than in Grade 2 (t3). The most consistent predictor of literacy was LK followed by RAN and PA. Only some measures of PA appeared to be important predictors. Linguistic unit size appears a crucial modulating variable; while measures of phonemic and onset-rhyme awareness tended to correlate significantly with literacy, correlations involving syllabic awareness were mostly weak or negligible. The relationship between OL and literacy skills appeared to be inconsistent, depending on the measure and the aspect of literacy measured. Whereas naming 36 verbs did not correlate significantly with any literacy component, naming 36 nouns and grammar comprehension were correlated with a number of literacy outcomes. The predictive power of NVR was generally significant and of weak to moderate strength.

The correlational analyses described above confirmed that several predictor variables measured before children entered school could be used to predict individual differences in literacy development measured one or two years later. Since the pattern of correlations was complex, a series of path analyses were conducted in order to evaluate the unique contributions of the predictor skills.

- Insert Table 3 here -

Further data preparation. Principal components analyses were conducted on the individual measures of PA, RAN, OL, reading accuracy, speed, comprehension, and spelling to produce and save theoretically plausible and empirically justified component scores. This procedure aimed to enhance reliability, reduce the number of variables, and thus improve statistical power and the ratio of participants to parameters to estimate in the subsequent path analyses. Path analysis can be considered a special case of structural equation modeling (SEM), in which only observed variables (versus latent variables in SEM) are used and which therefore consist of the structural model of SEM but not the measurement model. Thus, path models are noticeably simpler and considered a more conservative statistical approach than SEM (e.g., Norman & Streiner, 2003) and were therefore preferred given the study's sample size. Single, observed variables remained where composites could not be computed, that is for t1 LK, t1 NVR, and t3 Spelling (i.e., SLRT words spelled correctly). For the other variables, the following composites were created and their validity was checked by analyzing their reliability (Cronbach's alpha).

PA. t1 - All PA tasks apart from Syllable-segmentation-output and Rhyme-production-output. The latter two were excluded as they loaded on a different, second component. Moreover, the anti-image correlation matrix diagonal values for those two variables were below .50, indicating they were only weakly related to other variables. Finally, the principal components statistics revealed improved internal consistency (Cronbach's Alpha) of the PA composite if these two variables were deleted (α =.887).

RAN. t1 - RAN objects, colors and mixed (α=.739).

OL. t1 - Vocabulary (36 nouns and 36 verbs) and TROG (α=.650).

Reading accuracy. t2 - SLRT words and pseudowords read correctly (α=.752); t3 - SLRT words, text, pseudowords and word-similar pseudowords read correctly (α=.689).

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Reading speed. t2 - SLRT time of reading words and pseudowords (α=.949); t3 - SLRT time of reading words, text, pseudowords and word-similar pseudowords (α=.933).

Reading comprehension. t2 and t3 - ELFE scores for words, sentences and texts (α=.946 and α=.950).

Spelling. T2: HSP 1+ words and graphemes spelled correctly and SLRT words spelled correctly (α=.865).

Predictors of reading and spelling ability. Path models with maximum likelihood estimation method were used to analyze the relations between the t1 predictors and the different literacy outcomes at t3. We were also interested in examining the predictive value of the preschool skills for t3 literacy skills over and above the respective literacy skill at t2 (i.e., the autoregressor). Therefore, separate path models were constructed that included the autoregressor. All path analyses were carried out using AMOS 20.0 software.

It seems important to acknowledge that SEM is generally considered a large sample technique requiring at least 100 participants (e.g., Norman & Streiner, 2003). However, the sample size required to provide accurate estimates and model fit information depends on features such as the complexity of the model and characteristics of the variables. Larger, more complex models containing a larger number of model parameters or models including non-normally distributed or otherwise flawed data demand larger sample sizes. It is considered possible to use smaller sampler sizes with simpler models, models with no latent variables, and good data characteristics (e.g., normally distributed, reliable, no missing data or outliers; e.g., Ullman, 2006), in which case a ratio of five cases per parameter estimate is suggested as a minimum (e.g., Bentler & Chou, 1987). Given that a) the data set used for the path analyses included variables with normalized distributions, no missing data, and component scores instead of individual variables whenever possible; b) it was ensured that all models were kept as simple as possible and did not violate the five times the number of

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

parameters to be estimated guideline; and c) path models instead of SEM were used, the present sample size was considered small but acceptable for this statistical approach.

At first, models were fitted to the data that included all possible paths from the predictor variables (i.e., t1 PA component, t1 RAN component, t1 LK, t1 OL component, t1 NVR) to one of the t3 literacy outcome variables and all significant correlations between the predictors (see Table 4). Initial models that included the t2 autoregressor were fitted to the data with all possible paths from the t1 predictor variables to the t2 autoregressor. Subsequently, paths from the t1 predictor variables to the t3 literacy variable were added to investigate additional direct effects of the preschool skills on later literacy. Non-significant correlations and paths were dropped successively while observing changes in fit indices to obtain simplified models in which all remaining correlations and paths were statistically significant. Figures 2-5 show the resulting simplified models (standardized estimates) for the different literacy outcomes. Double-headed arrows represent statistically significant correlations and single-headed arrows statistically significant paths and their coefficients (standardized regression weights). The number above the dependent variable represents the proportion of variance in the literacy outcome variable accounted for by the predictors in the model (R^2).

- Insert Table 4 here -

Reading accuracy. The resulting simplified models for the reading accuracy component providing a good fit to the data[3] are shown in Figure 2. Preschool PA and RAN were significant predictors of variations in 2nd Grade reading accuracy, accounting for 25% of variance in the ability to read accurately. The variance accounted for increased to 29% in the model including t2 reading accuracy. As can be seen from Figure 2B, the only significant

[3] A good model fit is judged based on joint criteria: Chi-square statistic <.05, CMIN/DF near 1 (<2 for a fair fit), CFI close to .95, RMSEA <.08 (Hu & Bentler, 1999) with RMSEA and CFI being considered more sensitive fit indices with small sample sizes (Fan, Thompson, & Wang, 1999).

direct t1 predictor of t3 reading accuracy, over and above the autoregressor, was RAN. LK, OL, and NVR influenced the t3 outcome measure indirectly via reading accuracy at t2. In this analysis including the autoregressor, PA is not a significant predictor for either reading accuracy at t2 or t3 (path weights in initial model were .20, p = .098 from t1 PA to t2 reading accuracy, and .20, p = .108 from t1 PA to t3 reading accuracy).

- Insert Figure 2 here -

Reading speed. Figure 3 shows the simplified models for the reading speed component. Both models give a good fit to the data and account for 19% and 51% of the variance in t3 reading speed. Without the autoregressor, preschool RAN and LK were significant predictors of variations in 2nd Grade reading speed. However, in the model including t2 reading speed, only t1 RAN remained as a significant direct predictor of t3 reading speed, over and above the autoregressor. In addition, t1 RAN and t1 LK fed into t3 reading speed indirectly though their significant influence on t2 reading speed.

- Insert Figure 3 here -

Reading comprehension. The simplified models for reading comprehension are shown in Figure 4. Overall, the models give a good fit to the data accounting for 30% (Figure 4A) and 74% (Figure 4B) of variance in the t3 reading comprehension component. Without the autoregressor, three significant preschool predictors emerged for reading comprehension in Grade 2: RAN, LK, and NVR. This predictor pattern changed however when constructing a model that included the t2 reading comprehension component. Over and above the autoregressor, OL (path weight .12, p = .029) emerged as the only significant direct t1 predictor of t3 reading comprehension. RAN, LK, and NVR continued to predict the t3 outcome measure indirectly through their influence on reading comprehension at t2.

- Insert Figure 4 here -

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Spelling. Figure 5A shows the simplified model for the spelling outcome measure without autoregressor. This model gives a fair fit to the data and accounts for 24% of the variance in t3 spelling. RAN and LK were the only significant preschool predictors of t3 spelling. The simplified model including the autoregressor was a good fit to the data accounting for 26% of variance in spelling. As can be seen from Figure 5B, the only significant direct (over and above the autoregressor) t1 predictor of t3 spelling was LK. Additionally, PA, RAN and LK influenced t3 spelling indirectly via the t2 spelling component.

- Insert Figure 5 here -

To sum up, despite the range of predictor variables used and the overall good fit indices of the simplified models, only a relatively small percentage of variance in reading and spelling skills was explained (depending on the literacy component 19 to 30% without t2 autoregressor, and 26 to 74% with t2 autoregressor). However, while the prediction was far from perfect, several significant predictors were identified. The importance of RAN and LK for explaining variance in literacy outcomes was highlighted in numerous cases. PA appeared to be a less important predictor but still contributed to the prediction of variation in reading accuracy and spelling. The predictive power of OL and NVR seemed limited to reading accuracy and comprehension. One of the most interesting findings of these longitudinal models might be the unique contributions of some preschool skills to the prediction of later literacy development (t3) over and above earlier literacy measures (t2). RAN explained unique variance in t3 reading accuracy and speed, LK in t3 spelling, and OL in t3 reading comprehension after controlling for autoregressive effects of the respective t2 literacy skill.

Discussion

A growing body of research indicates that literacy acquisition begins before the onset of formal literacy instruction. Several cognitive skills that start to develop in early childhood

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

are prerequisites, predictors or correlates of later literacy. The present study set out to explore the power of PA, RAN, LK and OL to predict individual differences in early literacy acquisition in German.

The predictor skills were assessed in the last term of nursery before children entered school (t1). Thus, at that point in time none of the children had received any formal literacy instruction though they did have some emergent literacy skills as evidenced by their letter knowledge at t1. Given that PA is a complex construct that was measured on all three sizes of linguistic units and different levels of explicitness in nursery, PA is often assumed to have a reciprocal relationship with literacy (e.g., Hulme et al., 2005; Muter et al., 2004), and the relationship between phonemic awareness in particular and literacy competence has been frequently debated (e.g., Castles & Coltheart, 2004; Hulme et al., 2005), findings from the PA tasks measured in this developmentally important preschool period will be discussed briefly. The relative difficulty of PA tasks generally confirmed the hypothesis about PA skills developing from larger to smaller linguistic units and from implicit to more explicit awareness (Stackhouse & Wells, 1997). The results are consistent with the view that phonemic awareness develops to a certain degree before the onset of formal literacy instruction (e.g., Schneider & Näslund, 1997; van Bon & van Leeuwe, 2003). The task that children found the hardest was the explicit phonemic PA task without the support of pictures (i.e., Sound-deletion-output). This could be because more advanced phonemic skills that necessitate conscious manipulation of phonemes require a certain amount of literacy competence (Mann & Wimmer, 2002). However, preschool children could solve less explicit PA tasks, not only those involving syllables and onset-rhymes, but also those involving phonemes. For a more detailed exploration of early PA skills in German children and task difficulty see Schaefer et al. (2009).

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Children's literacy skills were assessed for the first time in Grade 1 (t2) and again in Grade 2 (t3). Children showed improvements in all their literacy skills between first and second assessment, which was expected given the literacy instruction they received. While considerable individual differences were observed in reading speed, comprehension, and spelling, individual differences in accuracy were rather small (particularly at t3), since most children made few word reading errors. This makes accuracy measures relatively problematic for the study of predictors of literacy acquisition in consistent orthographies like German – a point others have also made (e.g., Georgiou et al., 2012; Wimmer & Goswami, 1994).

Predictors of Individual Differences in Literacy

The correlational and path analyses confirmed that, for German-speaking children, individual differences in literacy acquisition can be predicted not only by earlier literacy skills themselves but also by other cognitive skills measured before school entry (e.g., Georgiou et al., 2012; Lonigan et al., 2000; Schneider & Näslund, 1997). One important message that can be extracted from the analyses is that the developmental relationships between literacy and other cognitive skills are manifold and complex. Thus, success at literacy depends on many factors, which confirms Hammill's (2004) conclusion that "in all probability, no single ability [...] will accurately predict those who are and who are not poor readers as well as who will and who will not become poor readers" (p. 464). Secondly, the noticeably improved prediction of variance in 2nd Grade literacy skills through inclusion of the autoregressor in 1st Grade (in particular for reading speed and comprehension) confirms that nothing predicts literacy better than literacy itself.

However, even if early literacy itself emerged as a powerful predictor of later literacy, the predictor skills measured even earlier (at end of nursery) also showed several longitudinal relationships with 2nd Grade literacy measures; either indirectly through their influence on 1st Grade literacy skills or through unique and direct contributions to the prediction of 2nd Grade

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

literacy skills. The finding that preschool predictor skills influenced 1st Grade reading and spelling skills which then impact on 2nd Grade literacy skills highlights the educational importance of achieving appropriate literacy competence in the first year of formal literacy instruction to support successful literacy development in more advanced, later phases. Some preschool skills also accounted for unique variance in later literacy even after individual differences in the respective Grade 1 literacy skill had been controlled for. Thus, both findings confirm the importance of the preschool period for acquiring the foundation skills for later literacy development for the German home and educational environment, in which formal literacy instruction only starts in 1st Grade and not much importance is placed on literacy in children's homes.

Phonological awareness. The correlational analyses confirmed that the importance of PA skills is dependent on the linguistic unit, the level of explicitness, and the literacy aspect assessed (Geva & Wang, 2001; Muter et al., 2004; Ziegler & Goswami, 2005). In line with earlier studies (e.g., Caravolas et al., 2005; Muter et al., 1998), awareness of phonemes was confirmed to have the strongest relationship with literacy among PA tasks. It was followed by onset-rhyme awareness, whereas the relationships between syllable awareness and literacy were generally very weak (see Babayiğit & Stainthorp, 2007; Wimmer, Landerl, & Schneider, 1994 for similar findings). While it would have been interesting to investigate further the importance of different PA linguistic unit sizes or task formats (e.g., input versus output) for different literacy components at different stages of literacy acquisition in the path analyses, it was considered more appropriate given the study's sample size to use a theoretically plausible and empirically justified component score.

As anticipated, PA accounted for less variance in literacy performance than typically found in English-language studies. This finding is in agreement with earlier German-language studies (e.g., Landerl & Wimmer, 2000; Wimmer et al., 2000) and with one of the

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

more recent cross-linguistic studies of reading and spelling predictors (Georgiou et al., 2012). It also supports arguments that more consistent orthographies such as German ease the demands on PA for literacy development (e.g., Mann & Wimmer, 2002). Reasons for PA playing a less important role in the present German-language study than in some other recent cross-linguistic studies (Caravolas et al., 2012; Ziegler et al., 2010) might be related to the PA tasks used and the time points when PA and literacy skills were assessed. In this and Georgiou at al.'s (2012) study predictor skills were assessed in the last term of nursery and used to predict literacy skills in Grade 2 (i.e., roughly 2 years later). PA might be more predictive of literacy if both are measured within a shorter period of time (e.g., 10 months: Caravolas et al., 2012; concurrently: Ziegler et al., 2010). Another reason might be that in the present study PA was assessed comprehensively and tasks were designed to measure PA relatively unconfounded by working memory demands (Schaefer et al., 2009). PA might emerge as a more important predictor if it is assessed by phoneme level tasks only (e.g., phoneme isolation and blending: Caravolas et al., 2012) instead of a comprehensive PA battery or one blending task with items tapping different linguistic unit sizes (Georgiou et al., 2012).

As anticipated and in line with other studies of inconsistent as well as consistent orthographies (Aidinis & Nunes, 2001; Babayiğit & Stainthorp, 2007; Lonigan et al., 2000; Wimmer et al., 1991) a unique contribution of PA to early spelling development (Grade 1) emerged. Thus, PA influences later (orthographic) spelling in German indirectly via its impact on earlier (alphabetic) spelling. In line with our expectations, PA contributed significantly to the prediction of reading accuracy but not reading speed. Given that no unique link has been reported between PA and reading speed for the German language so far (Landerl & Wimmer, 2008), the unimportance of PA for reading speed was not surprising. The finding that PA predicted reading accuracy in Grade 2 corresponds to previous studies

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

concluding that the effect of PA on reading in consistent orthographies is restricted to the first or at the latest the second year of formal schooling (de Jong & van der Leij, 1999; Landerl & Thaler, 2006). However, given that the importance of PA for literacy in consistent orthographies is seen as time-limited to the early alphabetic literacy phases, the finding that preschool PA was more important for reading accuracy in 2nd Grade (t3, without controlling for Grade 1 reading) than in 1st Grade (t2) was unexpected. It may be attributed to the reading accuracy tasks used at the different testing points. The orthographic consistency of German combined with the widespread use of a systematic phonics teaching approach might have permitted all children to master alphabetic reading skills well enough to decode the frequent words and dissimilar pseudowords in Grade 1 independently of their preschool PA skills (see Landerl & Thaler, 2006 for a similar argument). This was no longer the case in Grade 2 when the reading accuracy assessment was extended to include a short text and pseudowords that were similar to real words.

Although overall PA was, as expected, found to be less important for predicting literacy in German than in less consistent orthographies, its foundational role as a direct or indirect predictor for literacy acquisition has nevertheless been confirmed and should be taken into account when designing preschool training programs and compiling test batteries for the early identification of children at risk of literacy difficulties.

Rapid automatized naming. RAN emerged as a very important predictive variable accounting for variance in literacy skills independent of PA, a finding corresponding to our expectations on the basis of the literature (e.g., Caravolas et al., 2012; de Jong & van der Leij, 1999; Parrila et al., 2004). In line with findings from studies across several languages and that both tasks shared a speed component, RAN was a unique predictor of reading speed (e.g., Babayiğit & Stainthorp, 2011; Georgiou et al., 2012; Holopainen et al., 2001; Landerl & Wimmer, 2008). The unique longitudinal relationships between RAN and reading accuracy

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

were stronger than expected given that other studies have found that RAN contributed considerably less to reading accuracy than to reading speed (Georgiou, Parrila, & Papadopoulos, 2008; Kirby et al., 2003; Swanson et al., 2003). However, the German orthography is very consistent for reading (i.e., grapheme-to-phoneme-correspondences) and such consistency facilitates the transition from alphabetic to orthographic reading early on (e.g., Aro & Wimmer, 2003). Since we expected RAN to be related to orthographic processing this finding fits our expectations. Furthermore, the tasks used to measure reading accuracy encouraged fast responses and thus, may have conflated accuracy and speed resulting in an intensified association between RAN and reading accuracy (Babayiğit & Stainthorp, 2010). The present result that RAN is predictive of reading comprehension in German is in line with Compton et al. (2001) and supports Wolf and Bowers' (1999) suggestion that RAN has a role in reading comprehension. It also corresponds to our expectations that skills important for word reading would impact on reading comprehension given that reading comprehension is often described as a product of word recognition and OL skills (Kendou et al., 2009) and limited by word recognition skills in the early stages of its development (Perfetti et al., 2005). Another explanation might again be an intensified association between RAN and the reading outcome due to task demands. Reading comprehension was measured with a task that encouraged fast responses and RAN has been found to have the biggest impact on reading comprehension measures that require 'speeded/fluent responses' (Compton et al., 2001). The importance of RAN for spelling in the present study generally meets our expectations and confirms earlier findings (Babayiğit & Stainthorp, 2011; Georgiou et al., 2012), though the link appears weaker than reported by some studies that found such a relationship (e.g., Landerl & Wimmer, 2008; Savage et al., 2008). This may be related to differences in the age of the children when tested and in the spelling assessment used. Lander and Wimmer (2008) assessed their predictor measures in

115 German-speaking children at the beginning of 1st Grade and chose the outcome measure for their predictor analysis to be their orthographic spelling measure in Grades 4 and 8 rather than their phonological spelling measure from the end of Grade 1. Thus, their children were older and spelling skills were measured at a later developmental stage. We anticipated RAN to be a more powerful predictor of later orthographic spelling than earlier alphabetic spelling. Thus, the weaker but still significant contribution of RAN to spelling in the current study might reflect that children had only just started to make the transition from alphabetic to orthographic spelling by Grade 2 and that our outcome measure combined phonological and orthographic spelling errors. Furthermore, the words used in the SLRT spelling subtest were short (1-2 syllables) and had rather simple phonological structures, thus did not challenge phonological encoding or orthographic processing skills. A phonologically more sensitive spelling measure that included longer words, or words and pseudowords with more complex phonological structures could have shown a greater number of spelling errors that might have been more likely to be linked to RAN (see Klicpera & Gasteiger-Klicpera, 2000).

Given that the findings confirmed preschool RAN as a unique predictor of early reading and spelling in German, it seems desirable to include RAN in testing procedures for the early identification of at-risk children even if it is not yet clear how slow RAN can be remediated (Kirby et al., 2010).

Letter knowledge. As was expected, the findings confirmed LK as the strongest preschool predictor of literacy skills with predictive value for all literacy components (Georgiou et al., 2012; Lonigan et al., 2008). More specifically, they support the conclusion of Hammill's meta-analysis (2004) that the likelihood of a task predicting literacy increases as the task looks more like actual reading and thus involves print. Given that none of the participants had received any formal letter or literacy instruction when tested in nursery, it is also reasonable to assume that LK was a proxy measure of any emergent literacy skills that

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

children are likely to exhibit at this early stage (e.g., Lonigan et al., 2000) although reading and writing as such was not measured at t1. Since nursery (t1) LK was a unique predictor of reading accuracy, speed, comprehension, and spelling at Grade 1 (t2), which in turn predicted variance in literacy skills in Grade 2, the present results support proposals that preschool LK has indirect effects on later literacy skills that are mediated by earlier reading and spelling skills (Leppänen et al., 2008; Muter & Snowling, 1998; Schneider & Näslund, 1997). Perhaps surprisingly, a direct unique contribution of LK to spelling in 2nd Grade, after controlling for 1st Grade spelling, was also found. This may be because knowing many letters at preschool in countries without formal letter instruction in nurseries indicates a literacy friendly and supportive environment or because learning letter names and sounds requires the same cognitive skills as spelling itself (Foulin, 2005; Leppänen et al., 2008). These two explanations are not mutually exclusive. Another explanation might be that spelling remains alphabetic for longer than reading due to the suggested interaction between the two skills (Frith, 1985) and German being less consistent in the spelling than reading direction. Thus, LK as an essential prerequisite for alphabetic decoding and encoding still impacts uniquely on spelling in Grade 2 but not on reading.

Overall, the vital role of early LK for reading and spelling acquisition found in this study has important educational implications for the German-speaking educational context, which are in line with conclusions drawn for other languages and orthographies (e.g., Georgiou et al., 2012; Puolakanaho et al., 2007). Training of LK in the early stages of formal literacy instruction and in children at risk of literacy difficulties should be emphasized, and LK should be included in assessment procedures aiming to identify children at risk of literacy difficulties.

Oral language. The study shows that OL skills (i.e., vocabulary knowledge and grammar comprehension) contribute to literacy development over and above phonological

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

skills such as PA and RAN, although their unique contribution appeared relatively small. This replicates several previous studies (Deacon & Kirby, 2004; Fraser & Conti-Ramsden, 2008; Frost et al., 2005; Nation & Snowling, 2004; Perfetti et al., 2005). However, the unique contribution of preschool OL to the prediction of 2nd Grade reading comprehension over and above the autoregressor highlights the importance of OL for reading comprehension and is in line with our expectations and, for example the Simple View of Reading. Generally, it is possible that the present results underestimate the importance of OL skills in German. The contribution of OL skills may not be substantial until Grade 3 or 4 when fluent word recognition skills have been acquired, and the challenge shifts to reading comprehension and the mastery of complex, morphology-informed spellings (e.g., Muter & Snowling, 1998; Nation & Snowling, 2004). Also, in the present study, OL was assessed using an expressive vocabulary naming task and a grammar comprehension task only. Linguistic comprehension depends on complex interrelationships between various skills involved in constructing coherent mental representations and the strength of OL-literacy relationships has been shown to differ depending on the measure (e.g., Oakhill et al., 2003; Perfetti et al., 2005). Thus, future studies may want to include a wider range of OL measures (e.g., different vocabulary measures, listening comprehension, inferencing, morphological knowledge: Babayiğit & Stainthorp, 2011; Oakhill & Cain, 2012; Ouellette, 2006) to capture children's overall linguistic competence. Furthermore, although reading comprehension was measured by three different tasks, these were all subtests of one standardized assessment. Given that performance on reading comprehension tests is determined at least in part by the material presented as well as the format used for assessing reading comprehension (e.g., Bowyer-Crane & Snowling, 2005) future studies may want to develop a more comprehensive assessment of early reading comprehension in German-speaking primary school children.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Finally, NVR turned out to be a unique predictor of literacy only in the context of reading accuracy and comprehension. This replicates other studies of literacy development which have found the predictive value of IQ is very much reduced when measured simultaneously with predictors more specifically related to processes involved in reading and spelling (e.g., Caravolas et al., 2005; Fraser & Conti-Ramsden, 2008; Ziegler et al., 2010).

Study Limitations

There are some general limitations of the study that need to be acknowledged. Firstly and inevitably, the specific findings and pattern of relationships are limited to the specific measures used and the timing of the testing points. It was for example not possible to extend the study beyond Grade 2 in the given time frame in order take into account more advanced aspects of reading comprehension, written expression, and orthographic spelling skills that become increasingly important for academic success as children get older. It was also not possible to measure all skills as comprehensively as desirable due to time and resource limitations as well as ethical considerations regarding the length of testing sessions. Secondly, the statistical power of the study was limited by the sample size and the number of predictors (see Lonigan et al., 2000 for a similar acknowledgement) and although this paper presents models that are most parsimonious for the data collected, other models could have been considered. Lastly, despite including a number of predictor skills and the respective autoregressors, most models accounted only for a small to moderate amount of variance. Although this seems in line with previously reported findings (Georgiou et al., 2012), other factors not measured here may also play a significant role in determining literacy outcomes. These may include other cognitive skills (e.g., short-term memory: Georgiou et al., 2008; Vaessen et al., 2010) or environmental and family factors (e.g., socio-economic status, parents' phonological awareness, and family history: Heath et al., 2014).

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Summary and Conclusions

The present study adds to the literature on the prediction of literacy acquisition in young German-speaking children in a number of ways. It measured potential predictors a few months before children enrolled at school, included four key predictors (PA, RAN, LK, OL) as well as NVR in a single study, and applied a longitudinal design in which four outcome measures (reading accuracy, speed, comprehension, and spelling) were assessed in Grade 1 and 2. This allowed not only the inclusion of the autoregressive effect important for evaluating causal relationships but also the comparison of the relative importance of different predictor skills for predicting literacy longitudinally.

The present findings confirm that a number of cognitive and literacy skills need to be assessed in order to predict early literacy development with a reasonable degree of precision in German-speaking children. The correlation and path analyses replicated previous studies in other languages which found that several predictor skills measured a few months before or after school entry can explain later differences in literacy acquisition. Although literacy skills themselves were confirmed as crucial predictors of reading and spelling at later points in time, the study also identified a number of other cognitive skills that made a unique contribution to predicting literacy development. The results point to LK as being the most important of such measures, followed by RAN. Despite accounting for less unique variance than RAN and LK, PA also emerged as important for predicting early literacy, followed by OL. In some cases, the predictor skills accounted for unique variance in a literacy outcome over and above that literacy skill at an earlier point in time. In other cases, the long-term effect of the preschool predictor skills was indirect via earlier literacy skills. In both cases and due to the longitudinal nature of the data, it is almost certain that these influences of predictors are causal in German.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Increasing emphasis is being put on preventing difficulties in literacy acquisition by identifying children at risk for literacy difficulties and delivering early targeted support. Teachers and other practitioners (e.g., speech-language pathologists, psychologists) are in need of reliable procedures that enable them not only to identify children at risk for literacy difficulties, but also to monitor children's literacy development from nursery to school age. The present findings identify skills (i.e., LK, RAN, PA and OL) that could be examined and monitored when working with German-speaking children (see Babayiğit & Stainthorp, 2011; Georgiou et al., 2012; Kirby et al., 2010; Oakhill & Cain, 2012 for similar conclusions regarding other languages). Since these predictor skills can be measured by practitioners, the findings could contribute to practice guidelines for the identification of children at risk for literacy difficulties. Although our study cannot offer any direct guidelines for literacy teaching, available training studies have suggested that three sets of skills that we identified as significant predictors – PA, LK and OL – should be taught explicitly as part of early literacy instruction and support (e.g., Fricke, Bowyer-Crane, Haley, Hulme, & Snowling, 2013; Hatcher, Hulme, & Snowling, 2004; Hulme, Bowyer-Crane, Carroll, Duff, & Snowling, 2012; Roth & Schneider, 2002; Schneider et al., 2000). Further experimental training studies are needed to develop evidence-based teaching and support programs for use in preschool settings and schools.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

References

Aarnoutse, C., van Leeuwe, J., & Verhoeven, L. (2005). Early literacy from a longitudinal perspective. Educational Research and Evaluation, 11(3), 253-275.

Aidinis, A., & Nunes, T. (2001). The role of different levels of phonological awareness in the development of reading and spelling in Greek. Reading and Writing, 14(1-2), 145-177.

Aro, M., & Wimmer, H. (2003). Learning to read: English in comparison to six more regular orthographies. Applied Psycholinguistics, 24(4), 621-635.

Babayiğit, S., & Stainthorp, R. (2007). Preliterate phonological awareness and early literacy skills in Turkish. Journal of Research in Reading, 30(4), 394-413.

Babayiğit, S., & Stainthorp, R. (2010). Component processes of early reading, spelling, and narrative writing skills in Turkish: A longitudinal study. Reading and Writing, 23(5), 539-568.

Babayiğit, S., & Stainthorp, R. (2011). Modeling the relationships between cognitive–linguistic skills and literacy skills: New insights from a transparent orthography. Journal of Educational Psychology, 103(1), 169-189.

Bentler, P.M., & Chou, C.P. (1987). Practical issues in structural modeling. Sociological Methods & Research, 16(1), 78-117.

Bergmann, J., & Wimmer, H. (2008). A dual-route perspective on poor reading in a regular orthography: Evidence from phonological and orthographic lexical decisions. Cognitive Neuropsychology, 25(5), 653-676.

Bishop, D.V.M. (2003). Test for Reception of Grammar (TROG-2). London: Harcourt Assessment.

Bowers, P.G. (1995). Tracing symbol naming speed's unique contributions to reading disabilities over time. Reading and Writing, 7(2), 189-216.

Bowey, J.A. (2005). Predicting individual differences in early reading ability. In M.J. Snowling & C. Hulme (Eds.), The science of reading: A handbook (pp. 155-172). Oxford: Blackwells.

Bowyer-Crane, C., & Snowling, M.J. (2005). Assessing children's inference generation: What do tests of reading comprehension measure? British Journal of Educational Psychology, 75(2), 189-201.

Bryant, P., Deacon, S.H., & Nunes, T. (2006). Morphology and spelling: What have morphemes to do with spelling? In R. Malatesha Joshi & P.G. Aaron (Eds.), Handbook of orthography and literacy (pp. 601-616). Mahwah, NJ: Lawrence Erlbaum.

Caravolas, M. (2004). Spelling development in alphabetic writing systems: A cross-linguistic perspective. European Psychologist, 9(1), 3-14.

Caravolas, M. (2006). Learning to spell in different languages: How orthographic variables affect early literacy. In R. Malatesha Joshi & P.G. Aaron (Eds.), Handbook of orthography and literacy (pp. 497-511). Mahwah, NJ: Lawrence Erlbaum.

Caravolas, M., Hulme, C., & Snowling, M.J. (2001). The foundations of spelling ability: Evidence from a 3-year longitudinal study. Journal of Memory and Language, 45(4), 751-774.

Caravolas, M., Kessler, B., Hulme, C., & Snowling, M. (2005). Effects of orthographic consistency, frequency, and letter knowledge on children's vowel spelling development. Journal of Experimental Child Psychology, 92(4), 307-321.

Caravolas, M., Lervåg, A., Mousikou, P., Efrim, C., Litavský, M., Onochie-Quintanilla, E., ... Hulme, C. (2012). Common patterns of prediction of literacy development in different alphabetic orthographies. Psychological Science, 23(6), 678-686.

Caravolas, M., Volín, J., & Hulme, C. (2005). Phoneme awareness is a key component of alphabetic literacy skills in consistent and inconsistent orthographies: Evidence from Czech and English children. Journal of Experimental Child Psychology, 92(2), 107-139.

Carroll, J.M., Snowling, M.J., Hulme, C., & Stevenson, J. (2003). The development of phonological awareness in preschool children. Developmental Psychology, 39(5), 913-923.

Casalis, S., & Louis-Alexandre, M.F. (2000). Morphological analysis, phonological analysis and learning to read French: A longitudinal study. Reading and Writing, 12(3-4), 303-335.

Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? Cognition, 91(1), 77-111.

Catts, H.W., Fey, M.E., Zhang, X., & Tomblin, J.B. (1999). Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. Scientific Studies of Reading, 3(4), 331-361.

Catts, H.W., Gillispie, M., Leonard, L.B., Kail, R.V., & Miller, C.A. (2002). The role of speed of processing, rapid naming, and phonological awareness in reading achievement. Journal of Learning Disabilities, 35(6), 509-524.

Compton, D.L., Defries, J.C., & Olson, R.K. (2001). Are RAN and phonological awareness deficits additive in children with reading disabilities? Dyslexia, 7(3), 125-149.

Constantinidou, M., & Stainthorp, R. (2009). Phonological awareness and reading speed deficits in reading disabled Greek-speaking children. Educational Psychology, 29(2), 171-186.

De Jong, P.F., & van der Leij, A. (1999). Specific contributions of phonological abilities to early reading acquisition: Results from a Dutch latent variable longitudinal study. Journal of Educational Psychology, 91(3), 450-476.

Deacon, S.H., & Kirby, J.R. (2004). Morphological awareness: Just "more phonological"'? The roles of morphological and phonological awareness in reading development. Applied Psycholinguistics, 25(2), 223-238.

Denckla, M.B., & Rudel, R.G. (1976). Naming of objects by dyslexic and other learning-disabled children. Brain and Language, 3, 1-15.

Duncan, L.G., & Seymour, P.H. (2000). Socio-economic differences in foundation-level literacy. British Journal of Psychology, 91(2), 145-166.

Duzy, D., Ehm, J.H., Souvignier, E., Schneider, W., & Gold, A. (2013). Prädiktoren der Lesekompetenz bei Kindern mit Deutsch als Zweitsprache. Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 45(4), 173-190.

Ehri, L.C. (2000). Learning to read and learning to spell: Two sides of a coin. Topics in Language Disorders, 20(3), 19-36.

Fan, X., Thompson, B., & Wang, L. (1999). Effects of sample size, estimation methods, and model specification on structural equation modeling fit indexes. Structural Equation Modeling: A Multidisciplinary Journal, 6(1), 56-83.

Field, A. (2009). Discovering Statistics Using SPSS (3rd ed.). London: Sage.

Foulin, J.N. (2005). Why is letter-name knowledge such a good predictor of learning to read? Reading and Writing, 18(2), 129-155.

Fox, A.V. (2006). TROG-D (Test for Reception of Grammar-German). Idstein: Schulz-Kirchner.

Fraser, J., & Conti-Ramsden, G. (2008). Contribution of phonological and broader language skills to literacy. International Journal of Language & Communication Disorders, 43(5), 552-569.

Fricke, S. (2007). Phonological awareness skills in German-speaking preschool children. Idstein: Schulz-Kirchner.

Fricke, S., & Schäfer, B. (2011). Test für Phonologische Bewusstheitsfähigkeiten (TPB, 2nd ed.). Idstein: Schulz-Kirchner.

Fricke, S., Bowyer-Crane, C., Haley, A.J., Hulme, C., & Snowling, M.J. (2013). Efficacy of language intervention in the early years. Journal of Child Psychology and Psychiatry, 54(3), 280-290.

Frith, U. (1985). Beneath the surface of developmental dyslexia. In K. Patterson, J. Marshall & M. Coltheart (Eds.), Surface dyslexia, neuropsychological and cognitive studies of phonological reading (pp. 301-330). London: Erlbaum.

Frost, J., Madsbjerg, S., Niedersøe, J., Olofsson, A., & Møller Sørensen, P. (2005). Semantic and phonological skills in predicting reading development: from 3-16 years of age. Dyslexia, 11(4), 79-92.

Gallagher, A., Frith, U., & Snowling, M. (2000). Precursors of literacy delay among children at genetic risk of dyslexia. Journal of Child Psychology and Psychiatry, 41(2), 203-213.

Georgiou, G.K., Parrila, R., & Liao, C.H. (2008). Rapid naming speed and reading across languages that vary in orthographic consistency. Reading and Writing, 21(9), 885-903.

Georgiou, G.K., Parrila, R., & Papadopoulos, T.C. (2008). Predictors of word decoding and reading fluency across languages varying in orthographic consistency. Journal of Educational Psychology, 100(3), 566-580.

Georgiou, G.K., Torppa, M., Manolitsis, G., Lyytinen, H., & Parrila, R. (2012). Longitudinal predictors of reading and spelling across languages varying in orthographic consistency. Reading and Writing, 25(2), 321-346.

Geva, E., & Wang, M. (2001). The development of basic reading skills in children: A cross-language perspective. Annual Review of Applied Linguistics, 21(1), 182-204.

Goswami, U. (2001). Rhymes are important: A comment on Savage. Journal of Research in Reading, 24(1), 19-29.

Goswami, U., & Bryant, P. (1990). Phonological skills and learning to read. Hove: Lawrence Erlbaum.

Gough, P.B., & Tunmer, W.E. (1986). Decoding, reading, and reading disability. Remedial and Special Education, 7(1), 6-10.

Hammill, D.D. (2004). What we know about correlates of reading. Exceptional Children, 70(4), 453-468.

Hammond, S. (2006). Using psychometric tests. In G.M. Breakwell, S. Hammond, C. Fife-Schaw & J.A. Smith (Eds.), Research methods in psychology (3rd ed., pp. 182-209). London: Sage.

Hatcher, P.J., Hulme, C., & Snowling, M.J. (2004). Explicit phoneme training combined with phonic reading instruction helps young children at risk of reading failure. Journal of Child Psychology and Psychiatry, 45(2), 338-358.

Heath, S.M., Bishop, D.V., Bloor, K.E., Boyle, G.L., Fletcher, J., Hogben, J.H., ...Yeong, S. H. (2014). A spotlight on preschool: The influence of family factors on children's early literacy skills. PloS one, 9(4), e95255.

Holopainen, L., Ahonen, T., & Lyytinen, H. (2001). Predicting delay in reading achievement in a highly transparent language. Journal of Learning Disabilities, 34(5), 401-413.

Hu, L.T., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal, 6(1), 1-55.

Hulme, C., Caravolas, M., Malkova, M., & Birgstocke, S. (2005). Phoneme isolation ability is not simply a consequence of letter-sound knowledge. Cognition, 97(1), B1-B11.

Hulme, C., Goetz, K., Gooch, D., Adams, J., & Snowling, M.J. (2007). Paired-associate learning, phoneme awareness, and learning to read. Journal of Experimental Child Psychology, 96(2), 150-166.

Hulme, C., Bowyer-Crane, C., Carroll, J.M., Duff, F.J., & Snowling, M.J. (2012). The causal role of phoneme awareness and letter-sound knowledge in learning to read: Combining intervention studies with mediation analyses. Psychological Science, 23(6), 572-577.

Jongejan, W., Verhoeven, L., & Siegel, L.S. (2007). Predictors of reading and spelling abilities in first- and second-language learners. Journal of Educational Psychology, 99(4), 835-851.

Kauschke, C. (2007). Erwerb und Verarbeitung von Nomen und Verben (Reihe Linguistische Arbeiten Band 511). Tübingen: Niemeyer.

Kendeou, P., Savage, R., & van den Broek, P. (2009). Revisiting the simple view of reading. British Journal of Educational Psychology, 79(2), 353-370.

Kirby, J.R., Georgiou, G.K., Martinussen, R., Parrila, R., Bowers, P., & Landerl, K. (2010). Naming speed and reading: From prediction to instruction. Reading Research Quarterly, 45(3), 341-362.

Kirby, J.R., Parrila, R.K., & Pfeiffer, S.L. (2003). Naming speed and phonological awareness as predictors of reading development. Journal of Educational Psychology, 95(3), 453-464.

Klicpera, C., & Gasteiger-Klicpera, B. (2000). Sind Rechtschreibschwierigkeiten Ausdruck einer phonologischen Störung? Die Entwicklung des orthographischen Wissens und der phonologischen Rekodierungsfähigkeit bei Schülern der 2. bis 4. Klasse Grundschule. Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie 32(3), 134-142.

Knievel, J., Daseking, M., & Petermann, F. (2010). Kognitive Basiskompetenzen und ihr Einfluss auf die Rechtschreib- und Rechenleistung. Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 42(1), 15-25.

Landerl, K. (2006). Reading acquisition in different orthographies: Evidence from direct comparisons. In R. Malatesha Joshi & P. G. Aaron (Eds.), Handbook of orthography and literacy (pp. 513-530). Mahwah, NJ: Lawrence Erlbaum.

Landerl, K., & Thaler, V. (2006). Reading and spelling acquisition and dyslexia in German. In R. Malatesha Joshi & P. G. Aaron (Eds.), Handbook of orthography and literacy (pp. 121-134). Mahwah, NJ: Lawrence Erlbaum.

Landerl, K., Ramus, F., Moll, K., Lyytinen, H., Leppänen, P.H.T., Lohvansuu, K., ...Schulte-Körne, G. (2013). Predictors of developmental dyslexia in European orthographies with varying complexity. Journal of Child Psychology and Psychiatry, 54(6), 686-694.

Landerl, K., & Wimmer, H. (2000). Deficits in phoneme segmentation are not the core problem of dyslexia: Evidence from German and English children. Applied Psycholinguistics, 21(2), 243-262.

Landerl, K., & Wimmer, H. (2008). Development of word reading fluency and spelling in a consistent orthography: An 8-year follow-up. Journal of Educational Psychology, 100(1), 150-161.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Landerl, K., Wimmer, H., & Moser, E. (2001). Der Salzburger Lese- und Rechtschreibtest (SLRT). Bern: Hans Huber.

Lenhard, W., & Schneider, W. (2006). Ein Leseverständnistest für Erst- bis Sechstklässler (ELFE 1-6). Göttingen: Hogrefe.

Leppänen, U., Aunola, K., Niemi, P., & Nurmi, J.E. (2008). Letter knowledge predicts Grade 4 reading fluency and reading comprehension. Learning and Instruction, 18(6), 548-564.

Lervåg, A., & Hulme, C. (2009). Rapid automatized naming (RAN) taps a mechanism that places constraints on the development of early reading fluency. Psychological Science, 20(8), 1040-1048.

Lonigan, C.F., Burgess, S.R., & Anthony, J.L. (2000). Development of emergent literacy and early reading skills in preschool children from a latent variable longitudinal study. Developmental Psychology, 36(5), 596-613.

Lonigan, C.F., Schatschneider, C., & Westberg, L. (2008). Identifcation of children's skills and abilities linked to later outcomes in reading, writing, and spelling. In NELP (Ed.), Developing early literacy: A scientifc synthesis of early literacy development and implications for intervention (pp. 55-106). Jessup, MD: NIL.

Mann, V., & Wimmer, H. (2002). Phoneme awareness and pathways into literacy: A comparison of German and American children. Reading and Writing, 15(7/8), 653-682.

May, P. (2002). Hamburger Schreibprobe (HSP 1+). Hamburg: VPM.

McBride-Chang, C. (1999). The ABCs of the ABCs: The development of letter-name and letter-sound knowledge. Merrill-Palmer Quarterly, 45(2), 285-309.

McBride-Chang, C., Wagner, R. K., & Chang, L. (1997). Growth modeling of phonological awareness. Journal of Educational Psychology, 89(4), 621-630.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Metsala, J.L., & Walley, A.C. (1998). Spoken vocabulary growth and the segmental restructuring of lexical representations: precursors to phonemic awareness and early reading ability. In J.L. Metsala & L.C. Ehri (Eds.), Word recognition in beginning literacy (pp. 89-120). Mahwah, NJ: Lawrence Erlbaum.

Moll, K., Wallner, R., & Landerl, K. (2012). Kognitive Korrelate der Lese-, Leserechtschreib-und der Rechtschreibstörung. Lernen und Lernstörungen, 1(1), 7-19.

Muter, V., Hulme, C., Snowling, M., & Taylor, S. (1998). Segmentation, not rhyming, predicts early progress in learning to read. Journal of Experimental Child Psychology, 71(1), 3-27.

Muter, V., Hulme, C., Snowling, M.J., & Stevenson, J. (2004). Phonemes, rimes, vocabulary, and grammatical skills as foundations of early reading development: Evidence from a longitudinal study. Developmental Psychology, 40(5), 665-681.

Muter, V., & Snowling, M. (1997). Grammar and phonology predict spelling in middle childhood. Reading and Writing, 9(5-6), 407-425.

Muter, V., & Snowling, M. (1998). Concurrent and longitudinal predictors of reading: The role of metalinguistic and short-term memory skills. Reading Research Quarterly, 33(3), 320-337.

Näslund, J.C., & Schneider, W. (1996). Kindergarten letter knowledge, phonological skills, and memory processes: Relative effects on early literacy. Journal of Experimental Child Psychology, 62(1), 30-59.

Nation, K., & Snowling, M.J. (2004). Beyond phonological skills: Broader language skills contribute to the development of reading. Journal of Research in Reading, 27(4), 342-356.

Nation, K., Snowling, M.J., & Clarke, P. (2007). Dissecting the relationship between language skills and learning to read: Semantic and phonological contributions to new

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

vocabulary learning in children with poor reading comprehension. Advances in Speech-Language Pathology, 9(2), 131-139.

Norman, G.R., & Streiner, D.L. (2003). PDQ statistics (Vol. 1). Shelton, CT: PMPH-USA.

Oakhill, J.V., & Cain, K. (2012). The precursors of reading ability in young readers: Evidence from a four-year longitudinal study. Scientific Studies of Reading, 16(2), 91-121.

Oakhill, J.V., Cain, K., & Bryant, P.E. (2003). The dissociation of word reading and text comprehension: Evidence from component skills. Language and Cognitive Processes, 18(4), 443-468.

Ouellette, G.P. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. Journal of Educational Psychology, 98(3), 554-566.

Parrila, R., Kirby, J.R., & McQuarrie, L. (2004). Articulation rate, naming speed, verbal short-term memory, and phonological awareness: Longitudinal predictors of early reading development? Scientific Studies of Reading, 8(1), 3-26.

Perfetti, C.A., Landi, N., & Oakhill, J. (2005). The acquisition of reading comprehension skill. In M.J. Snowling & C. Hulme (Eds.), The science of reading: A handbook (pp. 227-247). Oxford: Blackwell.

Powell, D., Stainthorp, R., Stuart, M., Garwood, H., & Quinlan, P. (2007). An experimental comparison between rival theories of rapid automatized naming performance and its relationship to reading. Journal of Experimental Child Psychology, 98(1), 46-68.

Puolakanaho, A., Ahonen, T., Aro, M., Eklund, K., Leppanen, P.H.T., Poikkeus, A.M., ...Lyytinen, H. (2008). Developmental links of very early phonological and language skills to second grade reading outcomes: Strong to accuracy but only minor to fluency. Journal of Learning Disabilities, 41(4), 353-370.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Raven, J.C., Bulheller, S., & Häcker, H. (2002). Coloured Progressive Matrices. Göttingen: Hogrefe.

Rispens, J., McBride-Chang, C., & Reitsma, P. (2008). Morphological awareness and early and advanced word recognition and spelling in Dutch. Reading and Writing, 21(6), 587-607.

Ritchey, K.D. (2008). The building blocks of writing: Learning to write letters and spell words. Reading and Writing, 21(1/2), 27-47.

Rost, D.H. (2007). Interpretation und Bewertung pädagogisch-psychologischer Studien-Eine Einführung (2 ed.). Weinheim: Beltz/UTB Wissenschaft.

Roth, E., & Schneider, W. (2002). Langzeiteffekte einer Förderung der phonologischen Bewusstheit und der Buchstabenkenntnis auf den Schriftspracherwerb. Zeitschrift für Pädagogische Psychologie/German Journal of Educational Psychology, 16(2), 99-107.

Savage, R., & Frederickson, N. (2005). Evidence of a highly specific relationship between rapid automatic naming of digits and text-reading speed. Brain and Language, 93(2), 152-159.

Savage, R., Frederickson, N., Goodwin, R., Patni, U., Smith, N., & Tuersley, L. (2005). Relationships among rapid digit naming, phonological processing, motor automaticity, and speech perception in poor, average, and good readers and spellers. Journal of Learning Disabilities, 38(1), 12-28.

Savage, R., Pillay, V., & Melidona, S. (2008). Rapid serial naming is a unique predictor of spelling in children. Journal of Learning Disabilities, 41(3), 235-250.

Schaefer, B., Fricke, S., Szczerbinski, M., Fox-Boyer, A.V., Stackhouse, J., & Wells, B. (2009). Development of a test battery for assessing phonological awareness in German-speaking children. Clinical Linguistics & Phonetics, 23(6), 404-430.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Schneider, W., & Näslund, J.C. (1997). The early prediction of reading and spelling: Evidence from the Munich longitudinal study on the genesis of individual competencies. In C.K. Leong & R.M. Joshi (Eds.), Cross-language studies of learning to read and spell (pp. 139-159). Berlin: Springer.

Schneider, W., Roth, E., & Ennemoser, M. (2000). Training phonological skills and letter knowledge in children at risk for dyslexia: A comparison of three kindergarten intervention programs. Journal of Educational Psychology, 92(2), 284.

Seymour, P.H.K. (2005). Early reading development in European orthographies. In M.J. Snowling & C. Hulme (Eds.), The science of reading: A handbook (pp. 296-315). Oxford: Blackwell.

Seymour, P.H.K., Aro, M., & Erskine, J.M. (2003). Foundation literacy acquisition in European orthographies. British Journal of Psychology, 94(2), 143-174.

Speece, D.L., Ritchey, K.D., Cooper, D.H., Roth, F.P., & Schatschneider, C. (2004). Growth in early reading skills from kindergarten to third grade. Contemporary Educational Psychology, 29(3), 312-332.

Stackhouse, J., & Wells, B. (1997). Children´s speech and literarcy difficulties 1: A psycholinguistic framework. London: Whurr.

Swanson, H.L., Trainin, G., Necoechea, D.M., & Hammill, D.D. (2003). Rapid naming, phonological awareness, and reading: A meta-analysis of the correlation evidence. Review of Educational Research, 73(4), 407-440.

Tabachnick, B.G., & Fidell, L.S. (2001). Using multivariate statistics (4. ed.). Boston: Allyn and Bacon.

Ullman, J.B. (2006). Structural equation modeling: Reviewing the basics and moving forward. Journal of Personality Assessment, 87(1), 35-50.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Vaessen, A., Bertrand, D., Tóth, D., Csépe, V., Faísca, L., Reis, A., & Blomert, L. (2010). Cognitive development of fluent word reading does not qualitatively differ between transparent and opaque orthographies. Journal of Educational Psychology, 102(4), 827– 842.

Van Bon, W.H.J., & van Leeuwe, J.F.J. (2003). Assessing phonemic awareness in kindergarten: The case for the phoneme recognition task. Applied Psycholinguistics, 24(2), 195-219.

Verhagen, W., Aarnoutse, C., & van Leeuwe, J. (2008). Phonological awareness and naming speed in the prediction of dutch children's word recognition. Scientific Studies of Reading, 12(4), 301-324.

Von Goldammer, A., Mähler, C., Bockmann, A.K., & Hasselhorn, M. (2010). Vorhersage früher Schriftsprachleistungen aus vorschulischen Kompetenzen der Sprache und der phonologischen Informationsverarbeitung. Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 42(1), 48-56.

Wagner, R.K., Muse, A.E., & Tannenbaum, K.R. (2007). Vocabulary acquisition: Implications for reading comprehension. New York: Guilford Press.

Wagner, R.K., & Torgesen, J.K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. Psychological Bulletin, 101(2), 192-212.

Warmington, M., & Hulme, C. (2012). Phoneme awareness, visual-verbal paired-associate learning, and rapid automatized naming as predictors of individual differences in reading ability. Scientific Studies of Reading, 16(1), 45-62.

Wimmer, H. (2006). Don't neglect reading fluency! Developmental Science, 9(5), 447-448.

Wimmer, H., & Goswami, U. (1994). The influence of orthographic consistency on reading development: Word recognition in English and German children. Cognition, 51(1), 91-103.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Wimmer, H., Landerl, K., Linortner, R., & Hummer, P. (1991). The relationship of phonemic awareness to reading acquisition: More consequence than precondition but still important. Cognition, 40(3), 219-249.

Wimmer, H., Landerl, K., & Schneider, W. (1994). The role of rhyme awareness in learning to read a regular orthography. British Journal of Developmental Psychology, 12(4), 469-484.

Wimmer, H., Mayringer, H., & Landerl, K. (2000). The double-deficit hypothesis and difficulties in learning to read a regular orthography. Journal of Educational Psychology, 92(4), 668-680.

Wolf, M., & Bowers, P.G. (1999). The Double-Deficit Hypothesis for the developmental dyslexias. Journal of Educational Psychology, 91(3), 415-438.

Wolf, M., Bowers, P.G., & Biddle, K. (2000). Naming-speed processes, timing, and reading: A conceptual review. Journal of Learning Disabilities, 33(4), 387-407.

Ziegler, J.C., Bertrand, D., Tóth, D., Csépe, V., Reis, A., Faísca, L., ...Blomert, L. (2010). Orthographic depth and its impact on universal predictors of reading: A cross-language investigation. Psychological Science, 21(4), 551-559.

Ziegler, J.C., & Goswami, U. (2005). Reading acquisition, developmental dyslexia, and skilled reading across languages: A psycholinguistic grain size theory. Psychological Bulletin, 131(1), 3-29.

Acknowledgements

The research was partly funded by scholarships awarded to Silke Fricke by the Deutschen Akademischen Austauschdienst (German Academic Exchange Service) and the FAZIT Foundation (Frankfurt, Germany). We thank all children, parents, and staff who participated in this project.

Author statements

SILKE FRICKE (corresponding author) is a speech and language therapist and senior lecturer at the Department of Human Communication Sciences, University of Sheffield, UK; S.Fricke@sheffield.ac.uk. Her principal research interests lie in the field of speech, language, literacy development and difficulties in monolingual and multilingual children, as well as the evaluation of intervention approaches.

MARCIN SZCZERBINSKI is a psychologist, a lecturer at the School of Applied Psychology, University College Cork, Ireland; m.szczerbinski@ucc.ie. His principal research interest lies in the field of educational psychology, particularly early detection and remediation of literacy difficulties, as well as other developmental difficulties.

ANNETTE FOX-BOYER is a speech and language therapist and Professor of Speech and Language Pathology at the Department of Speech, European University of Applied Science EUAS Rostock, Germany; a.fox@eufh.de. Her principal research interests lie in the field of speech and literacy development and difficulties in monolingual and multilingual children.

JOY STACKHOUSE is Professor of Human Communication Sciences at the Department of Human Communication Sciences, University of Sheffield, UK; j.stackhouse@sheffield.ac.uk. She is a psychologist/speech and language therapist and her research focuses on the relationship between spoken and written language and on how best to support children with persisting speech difficulties.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Table 1

Descriptive statistics for predictor tasks at t1 (last term of nursery).

Measures (max. possible score)	Reliability	M	SD	Range
Phonological awareness				
SylSegout (12)	.77[1] (.73[1])	9.76	2.31	2 - 12
RhymeProdout	.93[1] (.94[1])	38.85	17.91	3 - 97
RhymeIDin (12)	.61[1] (.90[1])	11.51	.95	7 - 12
OnsetRhymeBlendout (12)	.85[1] (.89[1])	6.87	3.44	0 - 12
OnsetRhymeBlendin (12)	.59[1] (.57[1])	10.00	1.68	5 - 12
SoundIDout (12)	.91[1] (.93[1])	8.23	3.81	0 - 12
SoundIDin (12)	.80[1] (.85[1])	7.79	3.22	2 - 12
SoundBlendout (12)	.90[1] (.93[1])	3.94	3.89	0 - 12
SoundBlendin (12)	.71[1] (.78[1])	9.22	2.61	3 - 12
SoundDelout (12)	.88[1] (.94[1])	1.91	3.05	0 - 12
SoundDelin (12)	.62[1] (.71[1])	7.83	2.31	3 - 12
RAN	.73[1]			
RANobjects		15.78	2.49	10 - 22
RANcolors		16.76	2.80	6 - 24
RANmixed		12.05	2.59	5 - 19
Letter knowledge	.94[2]			
LK (52)		47.67	4.50	22 - 52
Oral Language				
36 nouns (36)	.64[2]	32.86	2.02	28 - 36
36 verbs (36)	.61[2]	29.29	2.66	23 - 36
TROG-D[a] (21)	.74[2]	13.19	2.28	7 - 18
		(56.50)	(7.93)	(33 - 77)
Nonverbal reasoning				
T1 NVR[a]	.85[2] (.67-.93[1])	21.97	3.63	14 - 33
		(65.64)	(20.09)	(16 - 100)

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Note. M = mean; SD = standard deviation; TROG-D = Test for Reception of Grammar – German. [a]TROG-D and NVR raw scores are presented in the upper row, while derived scores (TROG-D: t-scores; NVR: percentile ranks) are presented in the lower row in parentheses. Reliability: Sample reliabilities are presented first while reliabilities reported in the test manuals are given in parentheses if available; [1]Cronbach's alpha; [2]Split-half reliability.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Table 2:

Descriptive statistics for literacy measures at t2 (1st Grade) and t3 (2nd Grade)

Measures		t2			t3		
(max. score)	Reliability	M	SD	Range	M	SD	Range
Reading accuracy and speed							
SLRT words corr. (30)	.60[2]	24.85	5.69	0-30	28.65	1.79	22-30
SLRT time words (sec)	.97[2]	96.74 (32.58)	63.12 (31.24)	13-283 (1-90)	26.74 (69.42)	13.00 (24.59)	8-74 (11-90)
SLRT words corr. (text; 30)	.58[2]				29.45	1.04	24-30
SLRT time text (sec)	.94[2]				22.36 (67.26)	11.35 (24.80)	8-71 (7-90)
SLRT PW corr. (24)	.54[2]	19.03	5.42	3-24	21.21	2.40	14-24
SLRT time PW (sec)	.96[2]	112.49 (35.19)	67.11 (28.48)	33-411 (1-90)	56.13 (67.65)	17.57 (22.67)	27-108 (11.50-90)
SLRT wordsim. PW corr. (30)	.64[2]				27.15	2.70	19-30
SLRT time wordsim. PW (sec)	.96[2]				49.64 (67.28)	18.48 (24.45)	24-112 (6.50-93)
Spelling							
HSP1+ words corr. (10)	.81[1]	5.49 (70.55)	2.10 (24.72)	0-10 (1-100)			
HSP1+ graph. corr. (40)	.92[1]	33.86 (75.69)	4.39 (22.15)	10-40 (5-100)			
SLRT orthographic errors (25)	.89[2]	12.14 (18.38)	4.72 (22.98)	0-21 (1-80)	6.53 (43.79)	4.19 (23.66)	0-19 (1-80)
SLRT phonological errors (25)	.45[2]	1.79	2.30	0-13	.74	.89	0-4
Reading comprehension							

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

ELFE word (72)	.95[1]	20.36	8.22	4-49	31.08	8.40	14-56
		(61.21)	(25.96)	(4.8-100)	(65.90)	(20.08)	(12.7-96)
ELFE sentence (28)	.77[1]	7.26	4.80	0-25	13.40	4.66	4-28
		(56.79)	(28.92)	(4.1-100)	(65.37)	(22.04)	(14.6-100)
ELFE text (20)	.94[1]	4.54	3.52	0-19	8.97	4.29	1-20
		(56.97)	(26.67)	(8.3-100)	(66.06)	(24.10)	(7.3-100)

Note. M = mean; SD = standard deviation; HSP1+ = Hamburger Schreibprobe (Hamburg writing sample for 1st Graders); SLRT = Salzburger Lese- und Rechtschreibtest (Salzburg reading and spelling test); ELFE = Leseverständnistest für Erst- bis Sechstklässler (Reading comprehension test for 1st to 6th Graders); sec = seconds; corr. = correct; PW = pseudowords; wordsim. = similar to real words; graph. = graphemes.Whenever obtainable, percentile ranks are presented in addition to raw scores (upper row) in parenthesis. Reliability: Reliabilities reported in the test manuals are given; [1]Cronbach's alpha; [2]Parallel test forms reliability.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Table 3

Zero-*order correlations (Pearson's r, two*-tailed) between t1 predictor skills and t2/t3 literacy components

	t2				t3			
Measures	read. acc.	read. speed	read. comp.	spell.	read. acc.	read. speed	read. comp.	spell.
t1 PA								
SylSegout	.23*	-.02	.09	.04	.18	.09	.13	.27*
RhymeProdout	.22	.26*	.20	.26*	.25*	.23*	.21	-.01
RhymeIDin	.40**	.19	.36**	.46**	.36**	.23*	.43**	.39**
OnsetRhymeBlendout	.36**	.19	.25*	.39**	.28*	.03	.22	.21
OnsetRhymeBlendin	.21	.09	.21	.29*	.29**	.01	.09	.21
SoundIDout	.53**	.24*	.31**	.42**	.28*	.14	.34**	.37**
SoundIDin	.50**	.21	.30**	.42**	.23*	.11	.30**	.28*
SoundBlendout	.34**	.22	.23*	.33**	.24*	-.00	.21	.30**
SoundBlendin	.11	-.02	.17	.26*	.16	-.12	.09	.18
SoundDelout	.38**	.31**	.37**	.37**	.25*	.14	.32**	.25*
SoundDelin	.32**	.27*	.27*	.25*	.27*	.21	.34**	.36**
t1 RAN								
objects	.25*	.29*	.33**	.22	.35**	.35**	.35**	.24*
colors	.23*	.29*	.33**	.23*	.33**	.34**	.28*	.24*
mixed	.32**	.26*	.36**	.31**	.44**	.31**	.33**	.27*
t1 Letter knowledge								
LK	.44**	.40**	.48**	.44**	.18	.28*	.45**	.46**
t1 Oral Language								
36 nouns	.35**	.12	.09	.24*	.28*	.11	.22	.09
36 verbs	.01	.03	.05	.13	.16	.08	.10	-.10
TROG-D	.41**	.23*	.17	.35**	.25*	.15	.23*	.07
t1 Nonverbal Reasoning								
NVR	.36**	.33**	.38**	.27*	.30**	.27*	.38**	.18

Note. t1 = nursery; t2 = Grade 1; t3 = Grade 2; PA = phonological awareness; RAN = rapid automatized naming; LK = letter knowledge; NVR = nonverbal reasoning; read. acc. =

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

reading accuracy component; read. speed = reading speed component; read. comp. = reading comprehension component; spell. = spelling .Time (in seconds) children needed to complete the SLRT reading tasks was reversed so that on all measures better performances corresponded to higher scores; *p <.05 **p < .01.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

Table 4

Zero-order correlations (Pearson's r, two-tailed) between t1 predictor skills

	t1				
Measures	PA	RAN	LK	OL	NVR
t1 PA component	1.00	.17	**.57****	**.36****	.17
t1 RAN component	.17	1.00	.16	**.28***	**.40****
t1 Letter knowledge (LK)			1.00	.07	.18
t1 Oral Language component (OL)				1.00	.22
t1 Nonverbal Reasoning (NVR)					1.00

Note. t1 = nursery; PA = phonological awareness; RAN = rapid automatized naming; *p <.05 **p < .01; bold = correlations between predictors included in initial path models.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

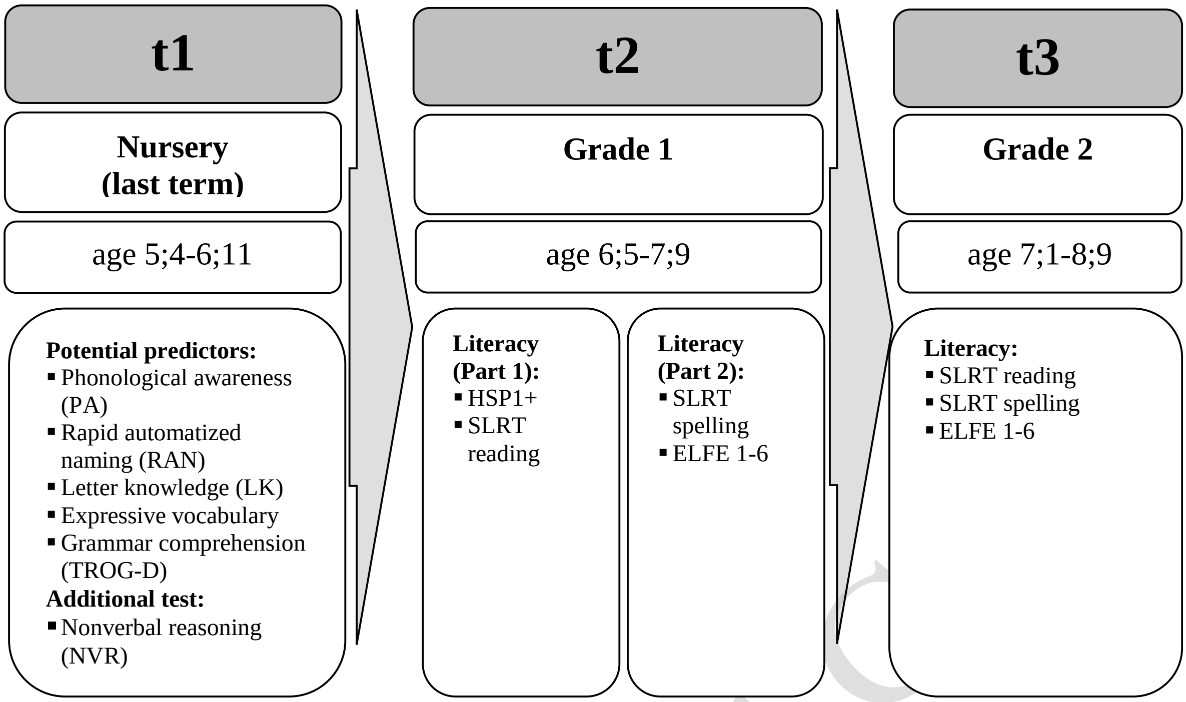

Figure 1. Overall study design showing study timeline and assessments reported here. TROG-D = Test for Reception of Grammar – German; HSP1+ = Hamburger Schreibprobe (Hamburg writing sample for 1st Graders); SLRT = Salzburger Lese- und Rechtschreibtest (Salzburg reading and spelling test); ELFE 1-6 = Leseverständnistest für Erst- bis Sechstklässler (Reading comprehension test for 1st to 6th Graders).

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

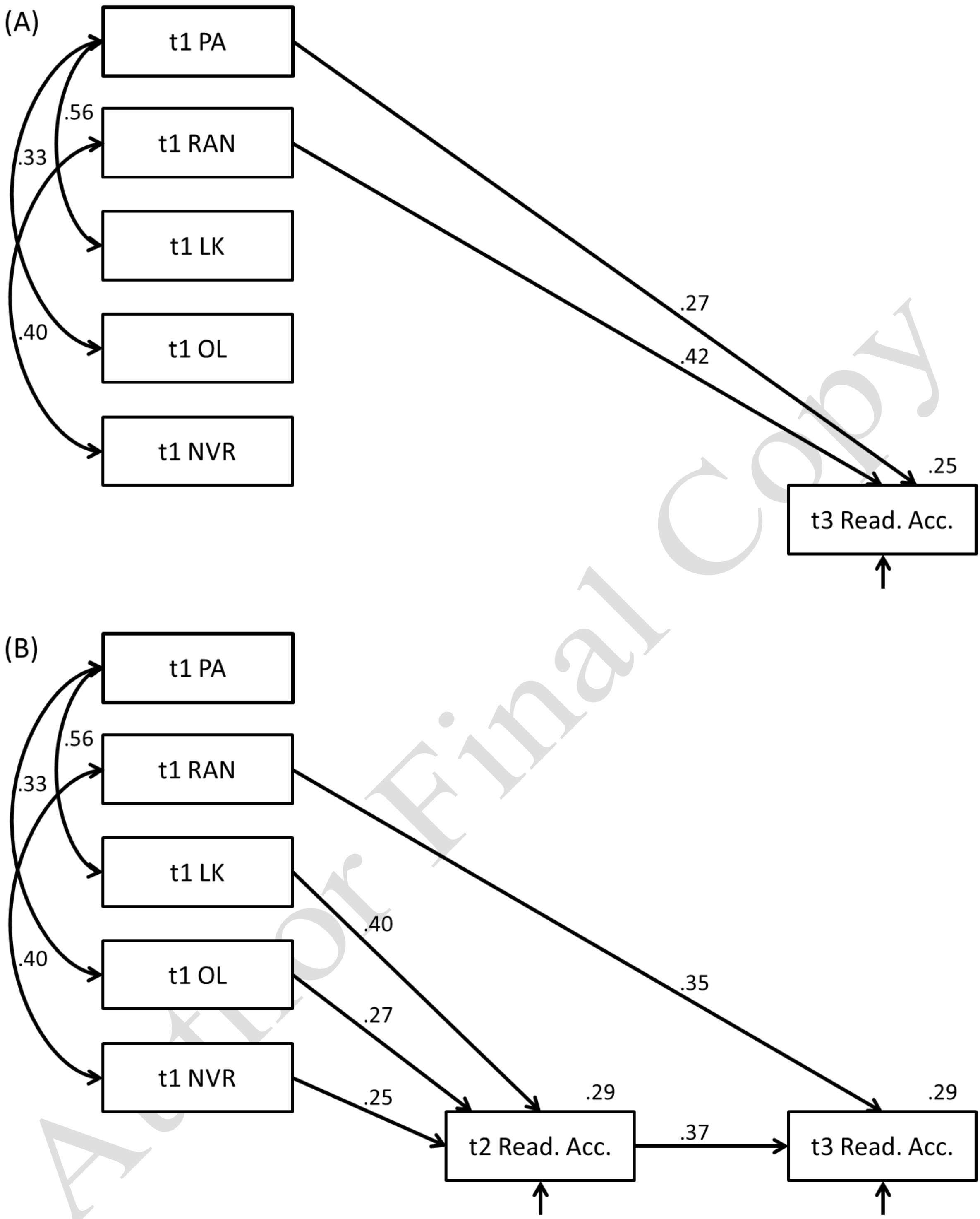

Figure 2. Paths analysis models predicting t3 reading accuracy component from (A) t1 predictor variables and (B) from t1 predictor variables and t2 reading accuracy component (autoregressor). Fit indices are as follows: **(A)** (χ2 (10, N = 78) = 12.933, p = .227, CMIN/DF = 1.293, CFI = .963, RMSEA = .062 (90% CI = .000 - .146); **(B)** (χ2 (13, N = 78) = 18.595, p = .136, CMIN/DF = 1.430, CFI = .953, RMSEA = .075 (90% CI = .000 - .145). PA = phonological awareness component; RAN = rapid automatized naming component; LK =

letter knowledge; OL = oral language component; NVR = nonverbal reasoning; Read. Acc. = reading accuracy component; t1 = nursery; t2 = Grade 1; t3 = Grade 2.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

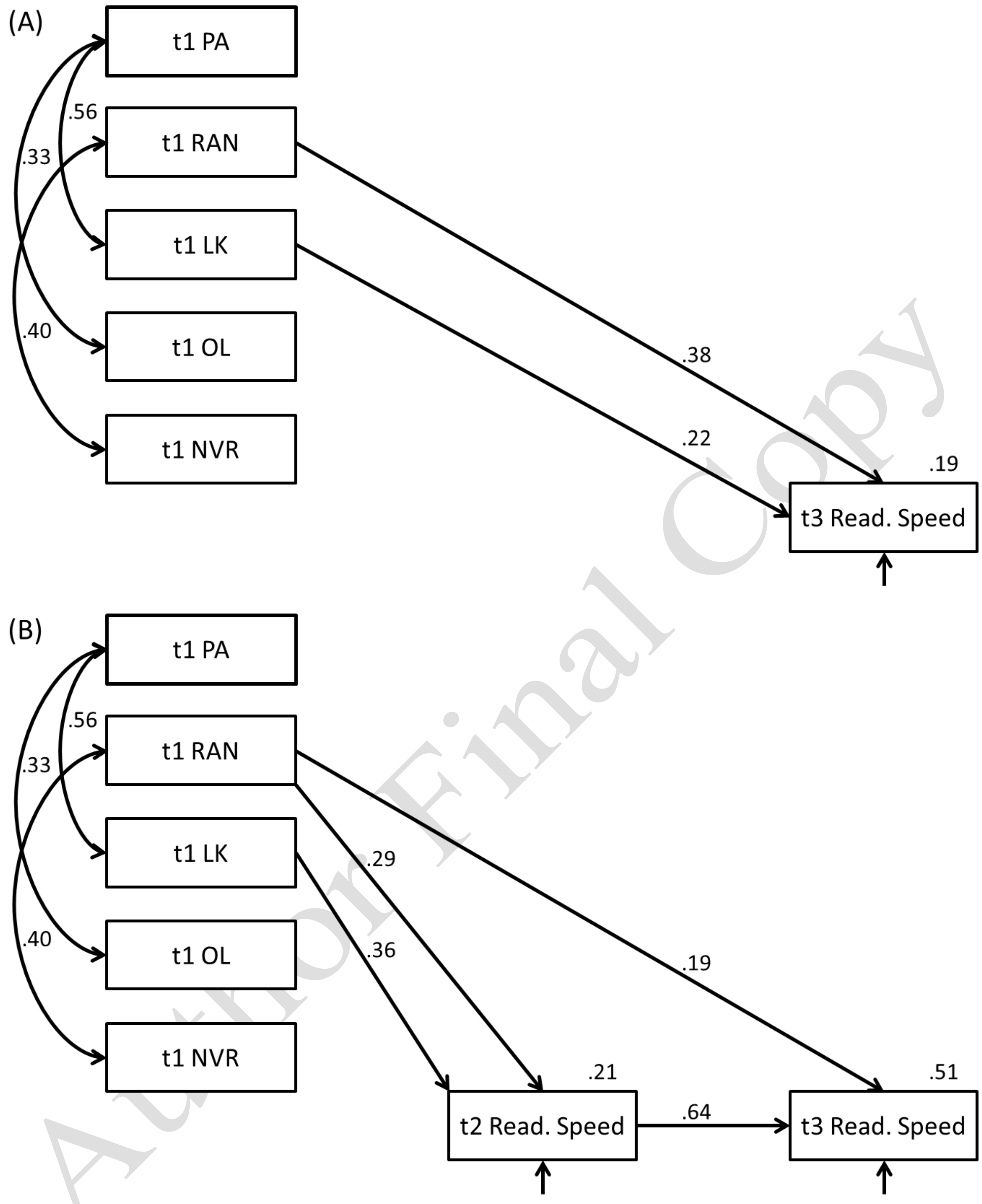

Figure 3. Paths analysis models predicting t3 reading speed component from (A) t1 predictor variables and (B) from t1 predictor variables and t2 reading speed component (autoregressor). Fit indices are as follows: (A) (χ2 (10, N = 78) = 13.713, p = .186, CMIN/DF = 1.371, CFI = .950, RMSEA = .069 (90% CI = .000 - .151); (B) (χ2 (14, N = 78) = 16.458, p = .286, CMIN/DF = 1.176, CFI = .981, RMSEA = .048 (90% CI = .000 - .125). PA = phonological awareness component; RAN = rapid automatized naming component; LK = letter knowledge;

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

OL = oral language component; NVR = nonverbal reasoning; Read. Speed = reading speed component; t1 = nursery; t2 = Grade 1; t3 = Grade 2.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

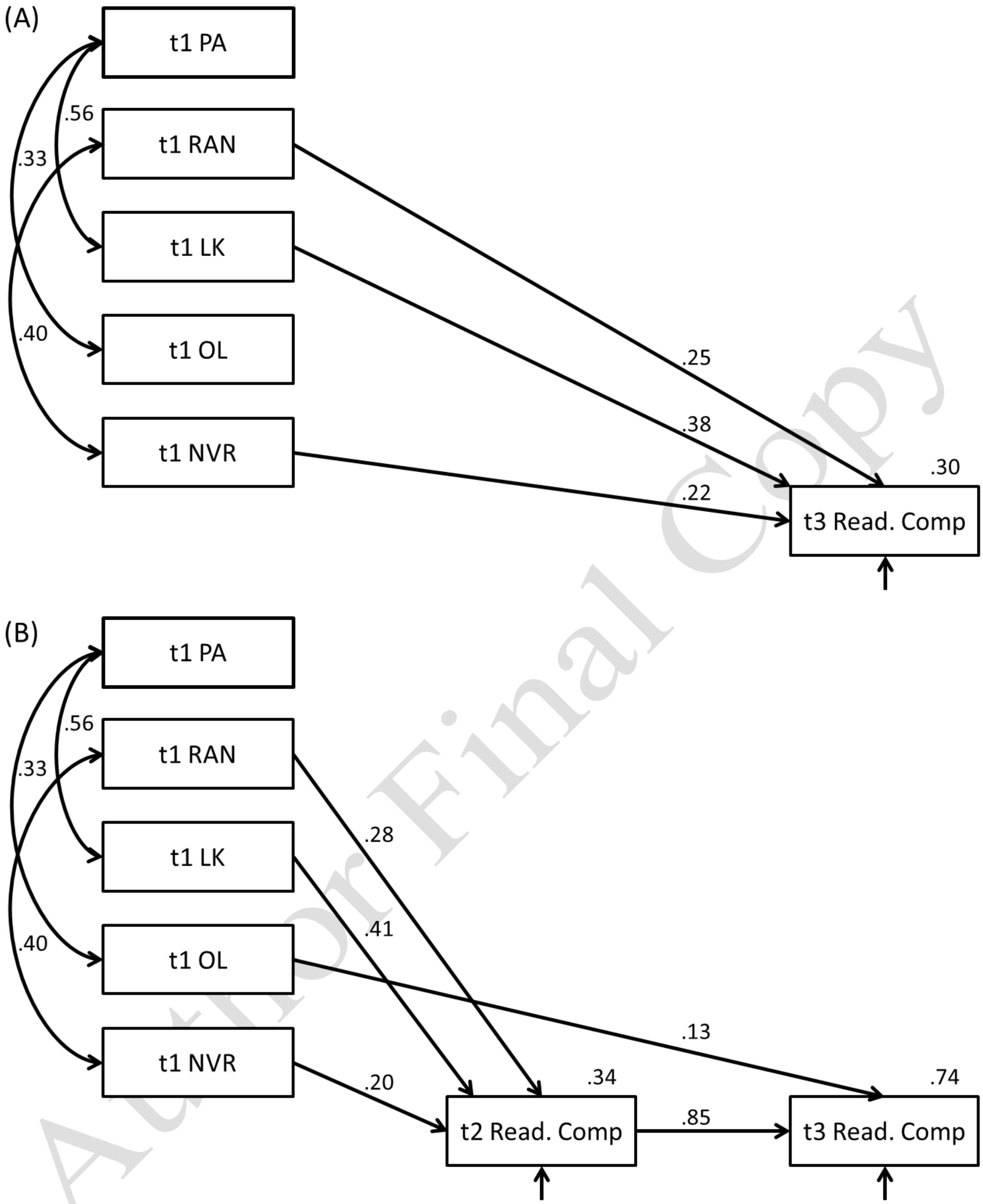

Figure 4. Paths analysis models predicting t3 reading comprehension component from (A) t1 predictor variables and (B) from t1 predictor variables and t2 reading comprehension component (autoregressor). Fit indices are as follows: (A) ($\chi2$ (9, N = 78) = 11.892, p = .219, CMIN/DF = 1.321, CFI = .966, RMSEA = .065 (90% CI = .000 - .152); (B) ($\chi2$ (13, N = 78) = 13.136, p = .437, CMIN/DF = 1.010, CFI = .999, RMSEA = .012 (90% CI = .000 - .114). PA = phonological awareness component; RAN = rapid automatized naming component; LK

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

= letter knowledge; OL = oral language component; NVR = nonverbal reasoning; Read. Comp. = reading comprehension component; t1 = nursery; t2 = Grade 1; t3 = Grade 2.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116

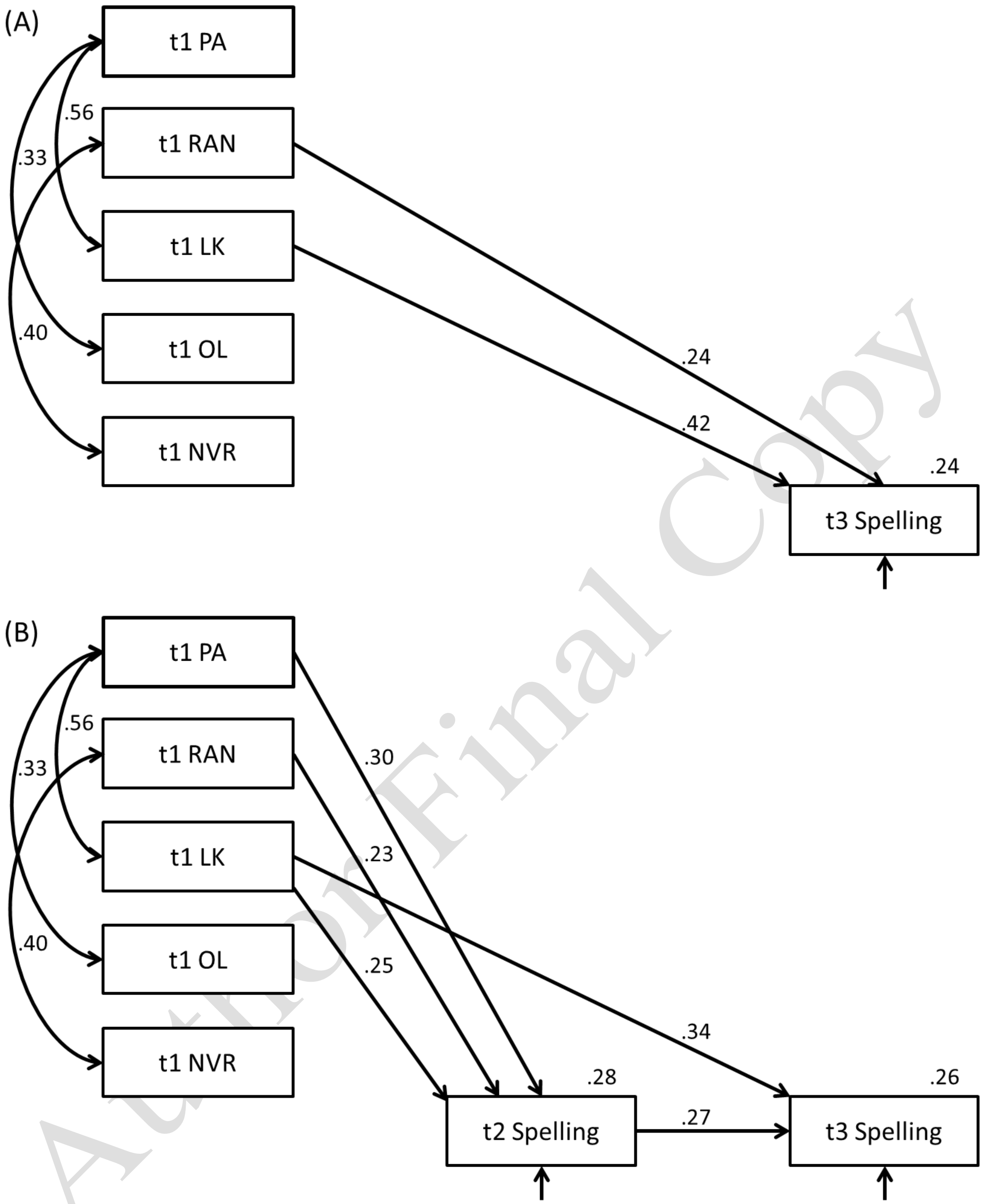

Figure 5. Paths analysis models predicting t3 spelling from (A) t1 predictor variables and (B) from t1 predictor variables and t2 spelling component (autoregressor). Fit indices are as follows: **(A)** ($\chi 2$ (10, N = 78) = 13.744, p = .185, CMIN/DF = 1.374, CFI = .953, RMSEA = .070 (90% CI = .000 - .151); **(B)** ($\chi 2$ (13, N = 78) = 20.453, p = .084, CMIN/DF = 1.573, CFI = .932, RMSEA = .086 (90% CI = .000 - .154). PA = phonological awareness component; RAN = rapid automatized naming component; LK = letter knowledge; OL = oral language component; NVR = nonverbal reasoning; t1 = nursery; t2 = Grade 1; t3 = Grade 2.

Published Article: Fricke, S., Szczerbinski, M., Fox-Boyer, A., & Stackhouse, J. (2016). Preschool Predictors of Early Literacy Acquisition in German-Speaking Children. Reading Research Quarterly, 51(1), 29–53. doi:10.1002/rrq.116