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Chapter 5

5 Predicting Reading Literacy in Primary School: The Contribution of Various Language Indicators in Preschool

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Summary

Although children's language competencies in preschool are known to be important predictors of reading literacy, the nature of the relation between early language and later reading literacy is still under debate. This is presumably due to the multicomponential nature of language as well as of reading literacy. In this chapter, we begin with a brief overview of theoretical assumptions and empirical results regarding how various facets of language are connected to reading literacy. However, the majority of the existing empirical studies do not clearly differentiate between various aspects of the individual's language and reading literacy and often consider only single aspects of language and/or reading. Therefore, data from the longitudinal BiKS-3-10 study were used to more directly compare the impacts of various indicators of early language competencies on different aspects of reading literacy. Specifically, we considered the importance of (a) phonological information processing skills (phonological working memory, speed of access to long-term

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memory) and (b) linguistic abilities in the sense of language components (vocabulary, grammar) as well as more integrative language competencies (story reproduction and comprehension, sentence reproduction) in preschool on (c) rather basic reading skills and (d) reading comprehension in the second year of primary school. In contrast to many other studies, the BIKS-3-10 study assessed various potentially relevant language predictors of reading, and in addition, this assessment was conducted at an early age of about 4 years. In particular, we examined whether early linguistic abilities in the sense of vocabulary and grammar would be – as often assumed – more strongly associated with reading comprehension, whereas early phonological processing skills would be more strongly associated with more basic aspects of reading development such as reading speed. Additionally, we asked whether integrative language competencies (story reproduction and comprehension, sentence reproduction) would be more predictive of early reading comprehension than measures of linguistic abilities in the sense of language components (i.e., vocabulary, grammar). The results of the BiKS-3-10 study are discussed with regard to different theories and assumptions about the ways in which language is predictive of reading literacy development.

Reading literacy is – undoubtedly – a key competence in modern societies. Interindividual differences and individual deficits in reading abilities tend to show up rather early in school and have been found to be highly stable across grades (e.g., Cunningham & Stanovich, 1997; Nation & Snowling, 2004). Thus, predicting reading development and fostering precursors of reading proficiency are important for individual children as well as for modern societies as a whole. When considering preschool-age children's skills and abilities that may be most predictive of the development of individual differences in reading literacy, language competencies in particular have been found to be significantly associated with later attainment and success in reading literacy (e.g., Lervåg, Bråten, & Hulme, 2009; NICHD Early Child Care Research Network, 2005; Reese, Suggate, Long, & Schaughency, 2010). However, language competencies encompass a variety of – by no means homogeneous – abilities and skills. One distinction relevant to the prediction of later reading literacy is the

differentiation between *phonological information processing skills* on the one hand and *linguistic abilities or more integrative language competencies*[1] on the other.

Reading-related *phonological processing skills* are often further subdivided into (a) phonological awareness skills (i.e., the sensitivity and ability to segment words into smaller units and to reflect on the structure of the sound of oral language), (b) phonological (working) memory (i.e., the individually different capacity to represent phonological information in working memory), and (c) fast access to phonological information in long-term memory, also known as rapid automatized naming (RAN) (see Torgesen, Wagner, & Rashotte, 1994).

Unlike phonological processing skills *linguistic abilities* refer more strongly to lexical knowledge (i.e., receptive and productive vocabulary and the structure of the lexicon) as well as to morphosyntactic knowledge (i.e., implicit knowledge of grammatical regularities). Closely related to these linguistic abilities or language components, more *integrative, functional language competencies* have to be considered. These require the mastery and integration of various language facets and come with higher ecological validity as they are closer to the everyday affordances of language that children are exposed to. Examples of such competencies are narrative discourse (e.g., the telling and retelling of a story), story comprehension, and sentence reproduction. They draw on various language facets including the child's lexical-semantic and grammatical knowledge as well as his or her phonological information processing skills.

However, although there is substantial research that has documented a close relation between language and reading, many questions concerning the specific and possibly different impacts of various language facets on reading literacy remain unresolved. This is presumably due to the complex multicomponential nature of language. In fact,

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[1] In linguistics and the psychology of language, phonology is conceptualized as a subcomponent of linguistic knowledge (see Weinert & Grimm, 2008, 2012). However, in this article we use the term *linguistic abilities* to refer predominantly to vocabulary and grammar, thus differentiating *linguistic* knowledge from *phonological* processing skills. Furthermore, *integrative language competencies* refer to more comprehensive language measures that tap both, linguistic knowledge and phonological processing skills, and/or are closer to everyday language affordances (e.g. oral text comprehension, narrative discourse measures, sentence reproduction). Some authors use the term *oral language* (e.g., Muter, et al., 2004; Senechal, et al., 2006) to describe linguistic abilities in the above-mentioned sense as well as more integrative language competencies. However, because our aim is to differentiate between various aspects of oral language competencies (phonological processing, vocabulary and grammar, integrative language measures) we use the term *linguistic abilities* and *integrative language competencies* to refer to the respective aspect of oral language processing.

most studies have focused on only some of the potentially relevant facets of language in preschool-age children (e.g., vocabulary, phonological awareness) and have not taken into account the relative importance of these facets in the prediction of reading literacy. In addition, significant distinctions have to be made with regard to the outcome measure. Thus, the various aspects of language competencies are to be pitted against at least two different facets of reading literacy: the ability to decode written language (including measures of reading fluency) and the ability to comprehend (written) texts (Cain, 2010). When children begin learning to read, their initial task is to figure out how letters and written words map onto their phonological form. Thus, children have to discern the more or less regular grapheme-phoneme correspondence rules and to defragment them into phonological word forms. It is not until they have mastered this task that they can begin to read for meaning. Thus, children first have to master basic decoding processes before higher comprehension processes can take place. This holds true, and is even more pronounced, at the levels of sentences and texts.

Basic reading skills and improvements in decoding are often assessed by measures of reading accuracy. Whereas this is reasonable in orthographically inconsistent languages such as English, this is not the case in more consistent orthographies such as German. Here, a high level of reading accuracy is achieved very early in reading development, and the developmental progress in basic reading skills is better described as an improvement in fast and fluent reading as indicated by measures of reading fluency (Wimmer, 2006).

According to the simple view of reading, reading literacy is defined as a product of the processes of decoding and comprehension (Hoover & Gough, 1990). However, from a resource-allocation point of view, it is not only a person's decoding ability per se but, in particular, that person's ease and fluency of decoding (reading fluency) that seems to provide an important foundation for reading comprehension. Fluent readers probably need fewer resources for basic reading processes and thus they have more residual cognitive resources for processing and elaborating the information given in a text (e.g., Perfetti, 1985). In line with this assumption, reading fluency was shown to be a highly reliable predictor of reading comprehension (Kim, Wagner, & Foster, 2011).

Irrespective of this interrelation, the two facets of reading literacy (i.e., basic reading skills and reading comprehension) should be influenced differently by individual phonological processing skills and linguistic abilities or integrative language competencies. Acquiring basic reading skills affords the analysis and synthesis of strings of phonemes (i.e., phonological awareness), a comparison of the decoded phonemes with information stored in long-term memory (fast access to long-term memory), and the maintenance of the decoded phonemes in working memory. Thus, as far as basic reading skills are concerned, individual phonological information processing skills most likely play a major functional role. However, this might be different when reading comprehension is considered. In order to comprehend words, sentences, and texts, the reader has to draw on lexical knowledge (vocabulary), morphosyntactic knowledge (grammar), as well as text-specific formal and content-related knowledge. Obviously, when children begin to develop reading competencies, the written words, sentences, and texts presented to them tend to be very easy and thus might be understood with rather basic linguistic abilities; however, as decoding and reading fluency improve and children grow up, they begin to encounter and read more complex texts. At that time, advanced linguistic abilities should become more important for text comprehension. Yet, because reading comprehension affords a minimum of basic reading skills and is facilitated – via reduced cognitive load – by advanced basic reading skills, phonological processing skills may still have an (indirect) impact on reading comprehension.

In sum, when predicting reading literacy in school-age children from their language competencies in preschool, it is important to consider various language indicators as predictors; at the same time, different aspects of reading literacy should be taken into account as outcome criteria. However, studies differ in the language competencies that are assessed as well as in the reading outcomes measured in school-age children (e.g., decoding skills, reading fluency, reading accuracy, reading comprehension). Furthermore, these studies often refer to only some aspects of language and/or reading literacy. Thus, after a brief overview of empirical results regarding the predictive power of various facets of language for reading literacy in elementary-school-age children, we use data from the longitudinal BiKS-3-10 study to analyze the impact

of various indicators of early language competencies on different facets of reading literacy in more detail.

Language Competencies as Predictors of Reading Literacy

The Role of Phonological Information Processing Skills in Learning to Read

A large amount of research has established the idea that phonological information processing skills are important predictors of individual differences in learning to read (e.g., Bryant, MacLean, Bradley, & Crosslan, 1990; Castles & Coltheart, 2004; Ehri, et al., 2001; Lonigan, et al., 2009; Muter, Hulme, Snowling, & Stevenson, 2004). To discern the more or less regular grapheme-phoneme rules of correspondence of the child's respective language, phonological awareness helps the child to find out how the sound structure of words maps onto the written words. Phonological awareness refers to "the ability to identify and manipulate the sound structure of words" (Cain, 2010, p. 76). Besides mapping the sound structure to written words, in order to read fluently, the child has to process phonological information in working memory and to quickly gain access to the phonological word forms stored in long-term memory in order to retrieve the respective word meaning. Thus, phonological information processing skills that are relevant for learning to read can be differentiated into phonological awareness, speed of access to verbal information in long-term memory, and phonological working memory capacity (Torgesen, et al., 1994; Wagner & Torgesen, 1987; see also Cain, 2010). However, although these facets are related, they are not identical and may have different impacts on reading development.

Phonological awareness. Phonological awareness comprises the sensitivity and ability to reflect on and be aware of the sound structure of language. To assess phonological awareness, children are usually asked to delete, count, or substitute sound units (analysis tasks), to combine sounds (synthesis tasks), to match sounds within words (identity tasks), or to respond to rhyming tasks (produce a word that rhymes or judge whether pairs of words or nonwords rhyme or not; Shanahan & Lonigan, 2010). Intervention studies in different countries have shown that children trained in phonological awareness skills such as rhyming or segmenting words into phonemes outperform untrained children on measures of phonological awareness as well as in

later reading and writing (e.g., Bradley & Bryant, 1985; Lundberg, Frost, & Peterson, 1988). Training effects have also been found for at-risk children who show poor phonological awareness or language skills (e.g., Berendes, 2011; Schneider, Ennemoser, Roth, & Küspert, 1999), have immigration backgrounds (Souvignier, Duzy, Glück, Pröscholdt, & Schneider, 2012), or come from families with low socioeconomic status (Ehri, et al., 2001; Lundberg, Larsman, & Strid, 2012).

Some researchers argue that phonological awareness is less important in languages with regular or more consistent orthographies compared to orthographically less consistent languages. In line with this argument, training programs as well as longitudinal studies conducted in countries with a regular orthography such as Finland, Germany, the Netherlands, or Norway have shown that phonological awareness has an effect on the early stages of reading in particular (e.g., de Jong & van der Leij, 1999; Lervåg, et al., 2009), whereas in English-speaking countries, effects have been demonstrated for longer periods in reading development (e.g., Byrne & Fielding-Barnsley, 1995; Muter, et al., 2004; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). These results suggest that phonological awareness is more closely related to basic reading skills than to reading comprehension.

Fast access to phonological information in long-term memory. The ability to quickly access phonological information stored in long-term memory is thought to facilitate reading because the child has to match written words with sounds stored in long-term memory. Indeed, children who exhibit poor reading skills often show deficits in the ability to access phonological information in long-term memory (Morris, et al., 1998; Stanovich & Siegel, 1994). In the same vein, individual differences in the ability to quickly access phonological information are correlated with differences in reading acquisition (Torgesen, et al., 1999).

To assess how rapidly children are able to access phonological information in long-term memory, they are usually asked to name well-known objects, letters, or digits as quickly as possible (RAN (rapid automatized naming) tasks). These rapid-naming measures have been shown to impact early reading literacy even when other measures of phonological processing are statistically controlled (Kirby, Parrila, & Pfeiffer, 2003; Lervåg, et al., 2009; Schatschneider, et al., 2004). Thus, there is empirical evidence indicating that rapid automatized naming is a reliable predictor of reading literacy. In

particular, in more orthographically consistent languages such as German or Greek, rapid automatized naming seems to be more important for basic reading processes than phonological awareness (Georgiou, Rauno, & Papadopoulus, 2008; Wimmer, Mayringer, & Landerl, 1998).

Phonological working memory. Besides phonological awareness and the ability to quickly access long-term memory, phonological working memory has been discussed as being important for reading development (e.g., Lonigan, et al., 2009; Wagner, et al., 1997). The capacity of phonological working memory is usually assessed through digit or word-span tasks or by using nonword repetition tasks. In these tasks, the child has to immediately repeat orally presented material that differs in length and/or complexity.

Torgesen et al. (1994) among others have reported medium to high correlations between phonological working memory performance in preschool and later reading ability. In the same vein, Ennemoser, Marx, Weber, and Schneider (2012) found almost identical correlations between measures of phonological working memory and various facets of reading literacy on the one hand and between phonological awareness tasks and these reading outcomes on the other. However, because the various aspects of phonological processing seem to share a large amount of common variance, measures of phonological working memory do not seem to account for unique variance in basic reading skills as assessed by measures of reading accuracy when other indicators of phonological processing are statistically controlled (Lervåg, et al., 2009; Torgesen, et al., 1994).

Phonological working memory may also have an *indirect* effect on later reading literacy mediated through linguistic abilities. In fact, it has been documented that early lexical learning is significantly influenced by phonological working memory capacity (e.g., Ebert, et al., 2013; Gathercole & Baddley, 1989; Weinert, Ebert, Lockl, & Kuger, 2012). Because lexical learning is expected to be important for later measures of reading development, studies that focus on the early stages of reading instruction may miss this effect.

In sum, it is well documented that phonological processing skills are significantly, although partially redundantly, associated with learning to read. However, the impact

of the various indicators of phonological information processing seems to vary – at least partially – according to the orthographic consistency or inconsistency of the language (Georgiou, et al., 2008). For instance, in a study comparing German- and English-speaking children, Mann and Wimmer (2002, cited in Georgiou, et al., 2008) showed that phonological awareness was the only significant predictor of reading fluency in English-speaking children, whereas for German-speaking children, only RAN measures turned out to be predictive Georgiou et al. (2008) demonstrated that phonological awareness was a better predictor of decoding skills in English than in Greek children.

In theory, phonological processing skills should be associated with decoding processes in particular (see Cain, 2010). Therefore, studies that have investigated the impact of phonological processing skills have predominantly focused on decoding and basic reading skills such as reading accuracy and reading fluency or reading speed. At the same time, phonological processing skills are interconnected with linguistic abilities and thus may have an additional indirect effect on later reading literacy, especially on reading comprehension. As argued in more detail in the next section, linguistic abilities are also correlated with reading literacy and with reading comprehension in particular.

The Role of Linguistic Abilities and More Integrative Language Competencies in Reading Development

Linguistic abilities and more integrative language competencies are important for later reading literacy for various reasons (e.g., Dickinson, McCabe, Anastasopoulus, Peisner-Feinberg, & Poe, 2003; Muter, et al., 2004; Reese, et al., 2010). Obviously, (written) text comprehension presupposes lexical and semantic as well as morphosyntactic knowledge to enable a person to understand (written) words and sentences and the meaning of texts. Grammatical and semantic knowledge also help a person to unravel unknown words and to infer the exact interrelations between propositions. The more complex a written text is (e.g., including challenging vocabulary and sentence structures), the more linguistic knowledge is required to decipher its meaning. Besides vocabulary and grammatical knowledge (i.e., language components), more integrative and functional language competencies may be of

special relevance to (written) text comprehension. In particular, children's narrative skills and comprehension skills for oral texts may play important roles. However, most studies that have predicted reading literacy not only through phonological processing skills have focused on vocabulary or syntactic abilities, whereas only a few have examined functional, more integrative language competencies such as oral text and discourse comprehension (listening comprehension of orally presented texts/discourses) (Cain, 2010).

Studies that have taken *vocabulary* into account have often demonstrated that it has a significant relation to later reading literacy (e.g., de Jong & Leseman, 2001; de Jong & van der Leij, 2002; Muter, et al., 2004; NICHD Early Child Care Research Network, 2005). Correlations have been found between vocabulary and early basic reading skills (e.g., NICHD Early Child Care Research Network, 2005) as well as early reading comprehension (e.g., Roth, Speece, & Cooper, 2002). The strongest effects, however, have been documented between vocabulary and later reading – specifically for later reading comprehension (e.g., de Jong & van der Leij, 2002; Sénéchal & LeFevre, 2002). De Jong and van der Leij (2002), for example, documented an effect of individual differences in vocabulary on later reading comprehension at the age of 10, even when controlling for reading comprehension at the age of 7. Thus, their study was able to demonstrate that vocabulary is correlated not only with later reading comprehension, but has an effect on its growth as well.

Interestingly, Ouellette (2006) showed – based on a study of 60 children from the fourth grade – that receptive vocabulary (breadth of vocabulary) is specifically relevant for decoding, whereas depth of lexical knowledge (select synonyms, providing definitions) impacts reading comprehension. Similarly, Roth et al. (2002) reported comparatively higher correlations between tasks requiring oral word definitions and reading comprehension compared to those between receptive vocabulary and reading comprehension. These results suggest that vocabulary (and specific aspects of lexical knowledge) may have differential and various effects on reading literacy.

Some studies have considered not only vocabulary but also additional linguistic abilities. However, they frequently distinguished only between vocabulary and a broad language measure, which comprises different language measures such as oral text comprehension and expressive language skills. For example, in a longitudinal study

following more than 600 children from preschool to grade 4, Storch and Whitehurst (2002) found a direct effect of receptive vocabulary on concurrent reading comprehension (Grade 3 & 4) and an indirect effect of a broad language measure (including oral text comprehension) assessed in preschool on word reading measured in Grade 1 and Grade 2 mediated by code-related skills (phonological awareness, letter knowledge). Their study thus demonstrated direct and indirect effects of linguistic measures on reading literacy. However, their study did not address which of the various language aspects was most important for reading literacy.

Direct and indirect influences of linguistic abilities or broad language measures on early reading literacy were also demonstrated by another comprehensive study conducted by the NICHD Early Child Care Research Network (2005). Interestingly enough, early vocabulary and a broad language measure (including various language indicators such as measures for syntax, oral text comprehension, and expressive language) were found to covary with decoding to nearly the same extent in the first grade; but when both measures were included in the model, only the broad language measure predicted decoding in the first grade and thus played the more prominent role. Specifically, the study found that the broad language measure at the age of 4 was directly associated with decoding skills in the first grade. Furthermore, the study identified significant indirect paths from the broad language measure at the age of 3 as well as from the age of 4. In contrast to the prediction of first graders' decoding skills, when predicting reading comprehension, not only did the earlier broad language measure provide a direct path, but also vocabulary. However, reading comprehension was measured in the third grade and more basic reading skills were measured in the first grade. Thus, it was not possible to judge the effect of the various oral language measures on reading comprehension compared to more basic reading skills at the same developmental time point.

Besides broad language measures, which comprise various indicators of receptive and productive language facets and competencies, some studies have focused more specifically on functional or integrative language measures (i.e., narrative skills or oral text comprehension) that are ecologically valid and/or conceptually connected to reading comprehension. However, results concerning the impact of these more integrative measures on reading literacy are heterogeneous. For example, a study by de

Jong and Leseman (2001) revealed that vocabulary and listening comprehension (i.e., oral text comprehension) in Grade 1, when considered separately, were significant predictors of reading comprehension in Grade 3 when controlling for early reading comprehension and word decoding as well as for home literacy and problem solving. However, when accounting for both language indicators simultaneously, only vocabulary had a significant effect. By contrast, de Jong and van der Leij (2002) did not find that vocabulary in Grade 1 accounted for additional variance in reading comprehension in Grade 3 when controlling for listening comprehension (i.e., oral text comprehension) and reading comprehension in Grade 1. This may be due to the fact that more integrative language skills such as oral text comprehension become more and more important as reading skills continue to develop. Reese et al. (2010), for example, found that after 1 year of reading instruction, children's narrative skills did not predict their concurrent reading skills (i.e., reading fluency) when differences in early decoding skills were accounted for. In a second study, however, they showed that after 2 years of reading instruction, the quality of children's narratives predicted their concurrent reading skills as well as reading skills 1 year later, even after controlling for vocabulary and early decoding skills.

In addition to measures of narrative discourse and oral text comprehension, which are accepted as functional and conceptually relevant to reading comprehension, another integrative language measure (i.e., sentence reproduction) has been found to be highly predictive of reading literacy as well. In a German longitudinal study that included 53 children, sentence reproduction in the last year of preschool attendance (i.e., at age 5) was found to be the best predictor of children's basic reading skills in the second year of formal reading instruction compared to other language measures including phonological awareness (Goldammer, Mähler, Bockmann, & Hasselhorn, 2010). However, the theoretical status of sentence reproduction tasks is controversial. Sometimes these tasks are classified as memory tasks, sometimes as integrative measures of vocabulary and phonological processing, and sometimes as indicators of grammatical knowledge (especially when vocabulary is rather easy and the sentence exceeds memory span, which is normally the case in these tasks; see Weinert, 2010b). The ambiguous theoretical status is due to the fact that sentence reproduction tasks tap various language skills. Although sentence reproduction tasks are less ecologically

valid, they draw from available lexical-semantic and grammatical knowledge that help the child to process, represent, and recall/reconstruct the content and structure of a given sentence and to hold it in short-term memory even when the number of words exceeds capacity restrictions. At the same time, because working memory is involved in this task to a large degree, the task also taps phonological processing skills. This may explain the strong impact of sentence reproduction on basic reading skills. However, the impact on reading comprehension remains an open question. Furthermore, it is not clear whether this kind of measure is a better predictor of reading literacy than more ecologically valid measures such as oral text comprehension.

Comparing Phonological Information Processing Skills and Linguistic Abilities or Integrative Language Competencies as Predictors of Reading Literacy

The studies summarized so far demonstrate that both phonological information processing skills and linguistic abilities in the sense of vocabulary and/or grammar but also more integrative language measures are reliable predictors of later reading literacy. Thus, the question arises whether phonological information processing or linguistic as well as more integrative language measures are more important to the development of reading literacy.

An extensive meta-analysis of about 300 published articles carried out by the National Early Literacy Panel (NELP; see Shanahan & Lonigan, 2010) indicated that specifically phonological awareness and rapid automatized naming of letters/digits/objects/colors showed moderate to large effects in predicting later basic reading skills (decoding) and reading comprehension. Somewhat smaller but still moderate were the effects of phonological memory in predicting basic reading skills (decoding) and reading comprehension. The covariation of reading literacy and phonological processing variables was maintained when differences in other variables, such as IQ or socioeconomic status, were accounted for. By contrast, the ability to produce and comprehend oral language did not always preserve its predictive power when other variables were controlled, although this ability was also moderately to highly correlated with later basic reading skills (i.e., decoding) and reading comprehension. Furthermore, the results suggest that linguistic abilities are more important when

more complex or broad measures instead of simple vocabulary measures are considered. Moreover, complex integrative or broad language measures were more strongly associated with reading comprehension (about $r = .70$) than with basic reading skills (i.e., decoding; about $r = .58$). For vocabulary measures, this difference in predictive power was not observed (Shanahan & Lonigan, 2010). These are important results as studies often assess only vocabulary and therefore may underestimate the effect of linguistic abilities and more integrative language measures (see also Dickinson, Golinkoff, & Hirsh-Pasek, 2010).

In sum, the meta-analysis suggested that there are effects of phonological information processing skills as well as of linguistic abilities and more integrative language measures on later reading achievement, although the correlations between phonological information processing skills and reading literacy seemed to be more robust across studies and less affected by methodological variations. However, Dickinson et al. (2010) criticized this NELP report as failing to adequately recognize the role of linguistic abilities and more integrative language competencies. They argued that the meta-analysis failed to consider indirect effects of these measures on later reading literacy. For example, Sénéchal, Ouellette, and Rodney (2006) demonstrated an effect of vocabulary on gains in phonological awareness, which was found to be one of the strongest predictors in the above-cited meta-analysis. Furthermore, Dickinson et al. (2010) argued that linguistic abilities and more integrative language competencies, in contrast to phonological abilities, develop over an extended period of time and therefore have longer lasting effects that were not considered in the time period included in the meta-analysis. In this vein, a Finnish study revealed the strongest (indirect) predictive links between linguistic abilities in preschool and reading fluency and accuracy at 9 years of age for receptive and expressive language via measures of letter naming, morphology, and phonological awareness. However, direct links were stronger for phonological information processing skills such as rapid naming and phonological sensitivity (Torppa, Lyytinen, Erskine, Eklund, & Lyytinen, 2010). Moreover, most studies that have considered both phonological information processing skills and linguistic abilities have shown that phonological awareness had a stronger effect on early reading literacy, whereas linguistic abilities had more impact on later reading literacy, especially reading comprehension (e.g., NICHD Early Child

Care Research Network, 2005; Sénéchal & LeFevre, 2002; Sénéchal, et al., 2006; Wagner, et al., 1997). A recent German study enhanced these conclusions by comparing the results of two German longitudinal studies that both included measures of reading fluency and reading comprehension. Both studies showed that linguistic abilities were more strongly connected to later reading and, in particular, to reading comprehension, whereas phonological processing turned out to be more strongly connected to early reading achievement (reading fluency as well as reading comprehension; Ennemoser, et al., 2012). Moreover, Sénéchal et al. (2006) demonstrated that vocabulary and oral text comprehension explained a unique proportion of variance in reading comprehension in Grade 3 but not in Grade 1 (when accounting for parents' education, earlier reading comprehension, early literacy, and phonological awareness in kindergarten). On the other hand, phonological awareness was found to be a stronger predictor of reading comprehension in Grade 1 than in Grade 3. In a second study, Sénéchal et al. (2006) showed similar results for French-speaking children. Results revealed that receptive vocabulary measured in kindergarten had an effect on reading comprehension in Grade 4 after accounting for various variables such as word reading in Grade 1 and reading fluency in Grade 4, but not on reading fluency after accounting for reading comprehension, parents' education and literacy, early literacy, and phonological awareness.

In sum, the literature suggests that phonological information processing skills are especially important for early reading development, particularly when basic reading skills such as decoding and reading fluency are concerned; linguistic abilities and more integrative language competencies, however, seem to play a major role in later reading development, particularly in reading comprehension. Although this seems to be a straightforward suggestion when considering models of learning to read, the issue is actually more complicated because linguistic abilities themselves build upon phonological information processing and vice versa. Specifically, early lexical learning and vocabulary acquisition draw heavily on phonological knowledge as well as on phonological working memory capacity, i.e., phonological working memory is an important predictor of early vocabulary growth (Weinert, 2010a; see also Ebert, et al., 2013; Weinert, et al., 2012). However, from the age of 6 onwards (or even earlier), vocabulary has been shown to be predictive of the growth of phonological working

memory (Gathercole, et al., 1992). Furthermore, integrative language measures (e.g., oral text comprehension) draw on linguistic abilities such as vocabulary and grammar as well as on phonological processing skills. In addition, the phonological sensitivity approach states that vocabulary provides the foundation for phonological sensitivity and awareness, which in turn support early reading development and decoding skills (see Dickinson, et al., 2003; Sénéchal, et al., 2006). Thus, the various language skills and measures seem to be highly interconnected in the preschool years and appear to influence each other. Accordingly, Dickinson et al. (2003) foster a comprehensive language approach suggesting that various language abilities and skills, such as phonological information processing and linguistic abilities including integrative oral language competencies, are interrelated during the preschool years and that these relationships persist in later reading development.

Taken together, phonological information processing skills and specifically phonological awareness (at least in orthographically more inconsistent languages such as English) seem to have a comparatively strong impact on reading literacy. By contrast, the influence of linguistic abilities and integrative language competencies is more diversified. These become more strongly related to reading literacy during the course of reading acquisition in the early school years and their effects are not only direct but also indirect through phonological information processing and thus probably through basic reading skills as well. Furthermore, linguistic abilities (vocabulary, grammar) and more integrative language competencies seem especially important for reading comprehension, whereas phonological processing skills are more important for basic reading processes such as decoding or reading fluency. However, the results are not totally clear. Some studies have also revealed that linguistic abilities and more integrative language measures are correlated with basic reading skills, whereas phonological processing skills are correlated with reading comprehension. As outlined, an explanation for these findings might be that phonological processing and linguistic abilities are strongly interconnected. Phonological working memory, for example, is predictive of early vocabulary development, whereas later, vocabulary is itself predictive of the growth of phonological working memory (Gathercole, et al., 1992) and phonological awareness (Sénéchal, et al., 2006). Furthermore, integrative language measures tap not only

linguistic abilities but also phonological information processing skills. Thus, the question is whether phonological processing skills and linguistic abilities are separable at all in the early years or whether they represent a single construct of global language competencies in general.

In summary, various studies have stressed the importance of language competencies in the development of reading literacy. Some researchers have more strongly referred to phonological information processing as an important predictor of later reading literacy, whereas others have emphasized linguistic abilities (vocabulary, grammar), more integrative language measures, or broad language measures (summing across various indicators and facets). The literature suggests that both phonological information processing skills and linguistic abilities or more integrative language measures are of relevance to reading development but seem to influence reading literacy in different ways and at different time points in development. Phonological processing has been found to be more relevant to basic reading skills such as decoding and reading fluency and in early phases of reading development, whereas linguistic abilities and integrative language measures have demonstrated a stronger impact on reading comprehension and on later reading development.

However, studies differ in the language competencies that are assessed as well as in the reading outcomes measured in school-age children (e.g., decoding skills, reading fluency, reading accuracy, reading comprehension). Furthermore, these studies often refer to only some aspects of language and/or reading literacy. Thus, empirical results concerning the impact of various language skills for reading literacy are heterogeneous and ambiguous. The present study considers phonological processing skills and linguistic abilities in early preschool-age children and tests for their predictive effects on (a) more basic reading skills (reading fluency) and (b) reading comprehension. Furthermore, although much is known about the impact of phonological processing skills on reading literacy and on basic reading skills in particular, less is known about the relative impact of lexical, grammatical, and/or more functional and integrative language competencies on more advanced reading competencies such as reading comprehension. This may be due to the fact that only a few studies to date have considered and systematically differentiated various linguistic abilities and language measures. Thus, the present study addresses this issue in depth by analyzing the

contributions of lexical-semantic, grammatical, and more integrative, functional language measures on reading comprehension. Moreover, most studies have assessed these early predictors of reading in the last year before school entrance. Thus, we know little about the impact of early language skills on later reading literacy, but this link is especially important to uncover because phonological processing skills and linguistic abilities are strongly interrelated and influence each other over the course of development.

Therefore, we (1) analyzed whether phonological processing skills and linguistic abilities could be separated in early preschool-age children and – if so – (2) tried to replicate the finding that linguistic abilities are especially relevant to reading comprehension, whereas phonological processing skills are more predictive of basic reading skills. In this vein, we investigated whether this would even be true when language competencies were assessed early in the preschool years and for early reading comprehension in Grade 2 when reading literacy is just beginning.

Because less is known about the relative impact of various indicators of linguistic abilities and more integrative language competencies for reading literacy, we (3) further focused on reading comprehension and its prediction through various linguistic abilities and integrative language measures. (a) First, we asked which linguistic component – vocabulary (assessed in most studies) or grammar (often not assessed as a separable linguistic component) – would have a comparatively stronger impact on early reading comprehension. (b) Additionally, we investigated whether integrative and functional measures of early language competencies would explain additional variance over and above linguistic abilities in the sense of language components such as vocabulary and grammar.

Method

Procedure and Sample

Data were drawn from the German BiKS-3-10 study (see for more information about BiKS-3-10 Lorenz, Schmitt, Lehrl, Mudiappa, & Rossbach, chapter 2, this volume). The

sample in the present study was comprised of children who had been participating in the BiKS-3-10 study since they were about 3 years old (N = 554).[2] At this age, most of the children had just started preschool. In this study, we focused on children's language competencies in the first and second year of preschool (measurement points 2 and 3 of the BiKS-3-10 study) as well as on their reading literacy in Grade 2 (about 3 years later). At measurement point 3, when most of the language tests relevant for this study were administered, children were about 4;8 years old (SD = 4.47 months). Their families' highest international socioeconomic status (HISEI; see Ganzeboom, de Graaf, & Treiman, 1992, for further information) was on average 52.2 (SD = 16.3). With regard to parents' mother tongue, 12.1% of the children had parents who both spoke a different first language than the lingua franca of society (German), whereas 9.7% lived in families with one parent who had a mother tongue other than German.

Preschool-age children were tested individually in separate rooms at their preschools. After entry into the formal school system, testing took place in small groups in school or individually at home depending on the measure assessed. All assessments were conducted by extensively trained students using – as much as possible – standardized tests with approved quality.

Measures

For preschool-age children, various language measures were assessed. At measurement point 3 of the BiKS-3-10 study (age: 4;8 years), children completed two tests measuring phonological processing skills (phonological working memory; rapid naming) and two tests assessing linguistic competencies (receptive vocabulary; receptive grammar). A subgroup of 128 children[3] received two additional tests measuring integrative (functional) language competencies (reproduction and comprehension of an orally presented story; sentence reproduction). Sentence

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[2] Seven of these children entered the study at a later time point because they started preschool after our first measurement point, but like the other children in our study, they were expected to enter school in autumn 2008.

[3] At measurement point 3 of the BiKS-3-10 study, this subgroup of children was 4;9 years old (M = 57.02 months, SD = 2.06). About 7.0% of these children had parents who both spoke a mother tongue other than German, and about 4.7% had one parent with a mother tongue other than German. The mean HISEI of this subsample was 52.3 (SD = 14.9).

reproduction was assessed at measurement point 3, whereas story reproduction and comprehension were assessed at measurement point 2, about half a year earlier.

Phonological processing skills

Phonological working memory. Children completed a digit span task taken from the German Version of the Kaufman Assessment Battery for Children (K-ABC; Melchers & Preuss, 2003). Children had to reproduce sequences of digits ordered in sets of increasing length. Each set consists of three items made up of the same number of digits. Testing ends when children fail to correctly reproduce a single item in a set. For each correctly recalled item, children receive 1 point. The number of correctly recalled items was used in the analyses.

Rapid naming. To assess children's fast access to phonological information stored in long-term memory, a rapid naming task was administered. Children had to name five familiar objects: Eis (ice), Ball (ball), Hund (dog), Baum (tree), Fisch (fish) as fast as possible. These objects were presented on a picture card and the pictures were repeatedly presented in a random order in five rows. The time the child needed to name all objects on the sheet was used for the analyses.

Linguistic measures

Vocabulary. Receptive vocabulary was assessed by an unpublished German Research Version of the Peabody Picture Vocabulary Test - Revised (PPVT-R; Dunn & Dunn, 1981; Research Version: Roßbach, Tietze, & Weinert, 2005). Children were presented individual words accompanied by four black-and-white pictures per item. The test consists of 175 items clustered in sets of 12 items (last set 7 items). The children's task is to point to the picture that depicts the meaning of the orally presented word. Testing ends when children answer six or more items per set incorrectly. The total number of correct items was used in the analyses.

Grammar. To assess children's receptive grammar, a short version of the German Version of the Test for the Reception of Grammar (TROG; Bishop, 1983/1989; German Version: TROG-D; Fox, 2006) was implemented. Children are orally presented with sentences accompanied by four colored pictures per sentence. Their task is to select the picture that corresponds to the stimulus sentence. Items are grouped in sets.

The first three sets control for vocabulary. The 18 sets that follow are comprised of sentences of increasing grammatical complexity with two items per sentence structure. Testing ends when children answer five succeeding sets incorrectly; a set is counted as failed when at least one item is answered incorrectly. Each correct answer was scored as 1 point, and a maximum of 48 points could be received.

Integrative language measures

Story reproduction and comprehension. To assess children's story reproduction and comprehension, we used a version of a Scottish fairy tale employed in a number of psychological studies (e.g., Wimmer, 1982). In this fairy tale, a farmer wants to bring his donkey into the barn, but the donkey doesn't want to go. So the farmer asks his dog to bark so that the donkey will get frightened and run into the barn. The story ends with the dog barking and the donkey running into the barn. After a short delay, children were asked to reproduce the story. For motivation, a teddy bear was introduced to listen to the child's reproduction. Subjects were prompted to tell as much about the story as they could remember. If they did not begin to retell the story, up to three general prompts were provided (e.g., "What happened in the story?"). If children stopped during their retelling of the story, again, general prompts were given (e.g., "Tell me more"; "What happened then?"). As a first measure of the children's story reproduction, the number of propositions (content units) recalled was counted. Children could receive up to 11 points. After finishing their free recall, children were asked specific questions about the story. These questions consisted of three "What questions" and three "Why questions" (e.g., "What should the dog do?"; "Why did the farmer want the dog to bark?"). Each correct answer was scored as 1 point. Thus, children could receive a maximum of 6 points.

Sentence reproduction. As another integrative measure of early oral language competencies that draws on lexical and grammatical knowledge as well as on phonological processing skills, the subtest "Sentence Memory" of a German language battery for children (SETK 3-5: Sprachentwicklungstest für drei- bis fünfjährige Kinder; Grimm, 2001) was administered. In this task, the children were presented with 15 sentences of increasing grammatical complexity and length, and they were asked to immediately reproduce each sentence. About half of the sentences were semantically

incongruent (i.e., nonsense sentences, e.g., “The stupid parrot knits on the bottle”). Thus, some of the sentences drew on linguistic knowledge as well as on world knowledge whereas others drew specifically on linguistic knowledge (grammar, vocabulary). Each sentence reproduction was scored according to the number of words correctly recalled. In total, the children could receive 119 points.

Reading literacy

All children who still took part in the BiKS-3-10 study in Grade 2 of primary school were administered two tests of reading literacy, one of them assessing basic reading skills (reading fluency/speed) and the other reading comprehension.

Basic reading skills (reading fluency/speed). As a measure of the children’s basic reading skills, the SLS 1-4 (Salzburger Lese-Screening für die Klassenstufen 1-4; Mayringer & Wimmer, 2003) was administered. Children are instructed to read as quickly as possible a series of simple sentences with increasing length. The child has to evaluate whether the content of the sentence he or she just read is true or false. Because each statement (sentence) is very obviously true or false, the evaluation of its truth should be easy (e.g., “Bananas are blue”). The number of sentences judged correctly within 3 min is assessed. According to the authors, this test measures basic reading skills in a natural reading context with a focus on reading speed.

Reading comprehension. For assessing reading comprehension, the subtest “text comprehension” of a German reading literacy test for first to sixth graders (ELFE 1-6: Ein Leseverständnistest für Erst- bis Sechstklässler; Lenhard & Schneider, 2006) was implemented. Children had to read short passages and to answer one to three multiple-choice questions about each passage. Each multiple-choice question provided four alternative answers. The questions tapped either information given explicitly in the text or they required the child to extract meaning or to draw inferences from the text. Children received 1 point for each correctly answered multiple-choice question with a maximum of 20 points.

Statistical Analyses

Subsamples considered in the analyses. When focusing on reading literacy, children who were enrolled in school at time points that differed from the main sample ($N = 54$)

had to be excluded from the analyses because of different levels of formal reading instruction. Furthermore, not all children of the cohort sampled in preschool could be followed until they were school age. Thus, only those children who were tested for reading literacy in Grade 2 ($N = 293$) were included in these analyses.

According to the study design, language measures testing for integrative, functional language competencies were assessed only in a subgroup of 128 children. Thus, analyses of these measures refer to this subgroup of children. Again, children were excluded from analyses concerning reading literacy in school if they were enrolled in school at time points that differed from the main sample ($N = 7$), and only those children who were tested for reading literacy in Grade 2 were included in the analyses ($N = 74$).

Procedure. In the following, we first refer to descriptive statistics for the two subsamples before evaluating two alternative models (a one- and a two-factor model) of children's language competencies in preschool using confirmatory factor analyses. Based on these results, reading literacy was predicted by children's language competencies. For these analyses, the full-information-maximum-likelihood (FIML) approach (e.g., Arbuckle, 1996) implemented in Mplus Version 6.0 (Muthén & Muthén, 2010) was adopted to deal with missing data. This approach includes valid information of all observations to estimate model parameters.

In a second step, more specific analyses were conducted to determine the relative impact of vocabulary and grammar when predicting reading literacy by using hierarchical regression analyses. The uniquely explained variance was estimated by entering the corresponding variable (vocabulary or grammar, respectively) in the last step to test for the specific proportion of variance explained by these predictors.

Finally, in a third step, we focused on the role of integrative, functional measures of early (oral) language competencies and their abilities to predict reading literacy after controlling for vocabulary and grammar. Again, hierarchical regression analyses were used to test for the specific contribution of these language measures to later reading literacy.

Results

Descriptive Statistics

Table 1 shows the descriptive statistics for language measures in preschool and for reading literacy in Grade 2 relevant for the present study. Statistics are presented separately for the whole sample and the subgroup of children who were given additional tests on integrative language competencies.

Table 1. Descriptive Statistics for the Total Sample and a Subgroup of Children who were Additionally Tested on their Integrative and Functional Language Competencies

	Total Sample			Subgroup		
Measures	*N*	*M*	*SD*	*N*	*M*	*SD*
Age, time 3 (preschool)	519	55.7	4.5	117	57.1	2.1
Age, Grade 2	298	97.8	4.0	78	100.0	2.3
Phonological Processing Skills						
Phonological Working Memory						
Digit Span (ZN, K-ABC), time 3	519	5.7	2.3	117	6.3	2.0
Access to long-term memory						
Rapid Naming, time 3	495	32.3	10.0	111	30.2	9.0
Linguistic Abilities						
Vocabulary						
PPVT, time 3	504	56.0	21.7	114	59.7	18.8
Grammar						
TROG, time 3	518	30.6	7.1	117	32.1	6.4
Integrative Language Competencies						
Sentence Reproduction						
Sentence Memory (SETK 3-5), time 3				106	80.3	20.6
Story Reproduction & Comprehension						
Story Reproduction, time 2				123	2.2	2.7
Story Comprehension, time 2				122	3.8	1.9
Reading Literacy						
Reading Speed (SLS 1-4), Grade 2	296	31.6	10.0	76	33.1	10.4
Reading Comprehension (ELFE 1-6), Grade 2	248	10.0	4.3	64	11.1	4.6

Note. ZN = Zahlennachsprechen (digit span); K-ABC = Kaufman Assessment Battery for Children; PPVT = Peabody Picture Vocabulary Test; TROG = Test for the Reception of Grammar; SETK 3-5 = Sprachentwicklungstest für 3-5jährige Kinder (language test battery); SLS 1-4 = Salzburger Lesescreening für die Klassenstufen 1-4 (reading speed); ELFE 1-6 = Ein Leseverständnistest für Erst- bis Sechstklässler (reading comprehension).

Due to the study design, this subsample was more homogenous in age and was on average 1.5 - 2 months older. Therefore, these children scored somewhat higher on all language measures than the total sample. For both samples, the number of children varied with respect to the measures assessed. This was mainly due to absences on the day of testing because testing took place on up to 4 days per measurement point. Concerning reading literacy in Grade 2, differences in sample sizes were due to the fact that ELFE (reading comprehension) was assessed in school, whereas SLS (reading fluency/speed) was tested at home. Although some schools refused to take part in the study, we were able to test children at home. Despite rather high stability in the sample, some children were lost because their families removed, they ended up attending special schools (e.g., Waldorf), their families lost interest in taking part in the longitudinal BiKS study, or for other reasons. However, in Grade 2, there were still 326 children who were tested for basic reading skills (SLS 1-4) and 263 children for reading comprehension (ELFE 1-6).

Table 2 shows moderate to high correlations between phonological processing measures, linguistic measures, and reading literacy for the whole sample. As predicted, all language measures were significantly correlated, although their covariations with rapid naming were only moderate. The intercorrelations between digit span as an indicator of phonological memory and the other measures were somewhat higher, whereas those between vocabulary or grammar and the others were quite similar. The highest correlation was found between the linguistic variables (i.e., vocabulary and grammar).

Table 2. Correlations between Measures of Phonological Processing, Linguistic Abilities, and Reading Comprehension for the Total Sample

	1	2	3	4	5
1. Digit Span, time 3					
2. Rapid Naming, time 3	-.26**				
3. Vocabulary, time 3	.43**	-.26**			
4. Grammar, time 3	.45**	-.22**	.63**		
5. Reading Comprehension, Grade 2	.30**	-.20**	.34**	.26**	
6. Reading Speed, Grade 2	.29**	-.33**	.18**	.18**	.80**

Note. Correlations between rapid naming and the other measures are negative because the score on the measure is the time needed to complete the task.
** $p < .01$

Furthermore, Table 2 shows that basic reading skills (reading speed) and reading comprehension were highly interrelated (r = .80). Measures of grammar and vocabulary were more strongly associated with reading comprehension than with basic reading skills, whereas phonological processing skills (digit span, rapid naming) were correlated with both basic reading skills and reading comprehension, although the correlations with basic reading skills were slightly higher.

Focus 1: Early Phonological Processing Skills and Linguistic Abilities

Are early phonological processing skills and linguistic abilities two distinguishable facets of language in preschool? Concerning our first research question (i.e., the separability of phonological processing skills and linguistic abilities in early preschool-age children), confirmatory factor analyses (CFA) were conducted. Two alternative models, a one-factor and a two-factor model, were evaluated and compared. Thus, we analyzed whether it would be statistically possible to differentiate phonological processing skills and linguistic abilities as two distinct though correlated dimensions of language processing at the age of 4 years or whether these facets are better described as indicators of one global dimension of language competence. The one-factor model combined all language measures, that is, vocabulary (PPVT), grammar (TROG), rapid naming, and phonological memory (digit span), as indicators of one global factor. The two-factor model consisted of two different factors, one for *Phonological Processing* and one for *Linguistic Abilities*. The factor *Phonological Processing* was indicated by the measure of phonological memory (digit span) and by the measure of the ability to quickly access phonological representations in long-term memory (rapid naming). The factor *Linguistic Abilities* was indicated by children's vocabulary (PPVT) and grammar (TROG). Models were evaluated using the statistical software Mplus version 6.0 (Muthén & Muthén, 2010). The full-information-maximum-likelihood (FIML) approach implemented in Mplus was used to adjust for missing data.

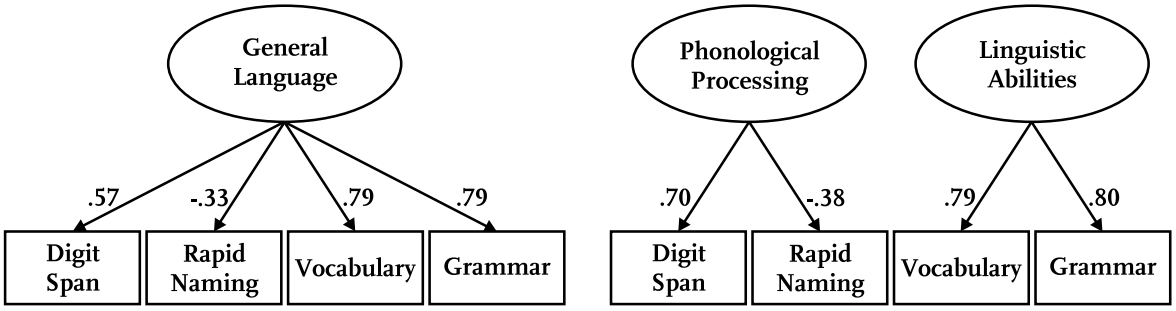

Figure 1. One-factor and two-factor models depicting factor loadings and correlations between factors at measurement point 3 (4;8 years). Circles represent latent variables and rectangles represent observed variables. All values can be interpreted as standardized coefficients.

Figure 1 illustrates both the one-factor and two-factor models, indicating the loadings on the latent factors. Model fit was estimated using various goodness-of-fit indices (see Table 3). A nonsignificant χ^2 value suggests a good model fit. Furthermore, the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA) were consulted. Values of CFI > .95 and RMSEA < .08 indicate close fit for small sample sizes (N < 250). Furthermore, a smaller Akaike Information Criterion (AIC) indicates which of the two models, which differed in complexity, fit the data better (see Bühner, 2008, for information about model fit). Table 3 compares the model fit of the two models under study.

Table 3. Fit Indices for the One-Factor and Two-Factor Models concerning Children's Phonological Processing Skills and Linguistic Abilities

	One-factor model	Two-factor model
χ^2 (df)	7.73 (2)	1.23 (1)
p (X^2)	.02	.27
CFI	.987	.999
RMSEA	.07	.02
AIC	13643.68	13639.18

As indicated by the χ^2, RMSEA, and CFI as well as by AIC, the two-factor model showed a better fit compared to a simple one-factor model. In addition, a χ^2 difference test favored the two-factor model ($\Delta\chi^2 = 6.5$, $\Delta df = 1$, $p < .05$). This result suggests that

the two-factor model, which differentiates phonological processing skills from linguistic abilities, is comparatively more compatible with the data structure than a global model of language competence. Thus, our data support the assumption that phonological processing skills and linguistic abilities are separable in early preschool-age children. However, as hypothesized, the two latent factors were highly correlated (r = .80), thus reflecting the high correlative association between phonological memory and the linguistic measures of vocabulary and grammar (see Table 2).

How is reading literacy in Grade 2 predicted by early phonological processing skills and linguistic abilities? In a next step, we analyzed whether early indicators of phonological processing skills would indeed be more strongly associated with later basic reading skills, whereas linguistic abilities (grammatical and lexical knowledge) would have a stronger impact on reading comprehension. Although linguistic abilities and phonological processing skills were found to be better described as two separable dimensions than a global dimension of general language competence, when trying to specify a model to predict reading literacy through the factors of Linguistic Abilities and Phonological Processing within a single model, suppression effects were found. This is probably due to the fact that the two factors were highly correlated. Thus, we tested single models to compare the impact of linguistic abilities and phonological processing on later reading literacy. Specifically, we hypothesized that linguistic abilities and phonological processing skills would differ with respect to their impact on later reading literacy.

The correlations already presented in Table 2 show that basic reading skills, specifically reading speed and reading comprehension, are highly correlated in Grade 2. This is expected because – at least in the early school years – basic reading skills are a necessary precondition for reading comprehension. Thus, restrictions in basic reading skills may hinder children's reading comprehension. Therefore, we specified two models, one for phonological processing skills and a second model for linguistic abilities in which basic reading skills were accounted for when predicting reading comprehension. With respect to phonological processing skills and linguistic abilities, latent variables were modeled as in the CFA reported above. From these latent factors, a direct path to basic reading skills (SLS; reading speed) and to reading comprehension (ELFE; text comprehension) was indicated (see Figure 2). Again, missing data were

adjusted with the full-information-maximum-likelihood (FIML) approach. Figure 2 illustrates the four models with standardized beta weights. Both models show good to very good model fit (for linguistic abilities: χ^2 = 2.91, *df* =1, *p* = .09; CFI = 1.0; RMSEA = .06; for phonological processing: χ^2 = 1.16, *df* =1, *p* = .28; CFI = 1.0; RMSEA = .02).

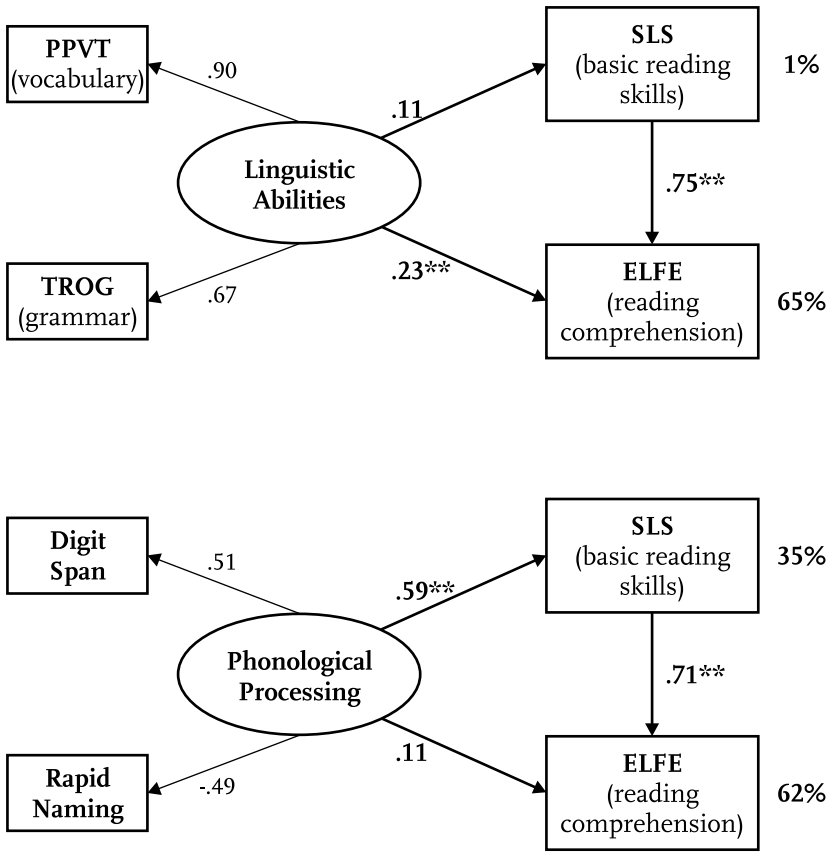

Figure 2. Predicting reading literacy (Grade 2) through phonological processing skills (Model 1) and linguistic abilities (Model 2). Circles represent latent variables and rectangles represent observed variables. All values can be interpreted as standardized coefficients.
$^{**}p < .01$.

As Figure 2 shows, linguistic abilities had a significant direct impact on reading comprehension, even when individual differences in basic reading skills were accounted for. In addition, an indirect effect of linguistic abilities on reading comprehension through basic reading skills was found (β = .18, p < .01). A direct link from linguistic abilities to basic reading skills did not appear.

By contrast and as hypothesized, phonological processing skills did not have a significant impact on reading comprehension when basic reading skills were controlled. Instead, phonological processing skills showed a strong impact on basic reading skills. This suggests that linguistic abilities (in the sense of the semantic and grammatical components of language) are specifically relevant for reading comprehension, even in Grade 2, whereas phonological processing skills indexed by phonological memory and the ability to quickly access lexical knowledge are particularly relevant for acquiring basic reading skills. However, phonological processing has an indirect effect on reading comprehension through basic reading skills.

Looking at the proportion of variance explained by the models, most of the variance in reading comprehension was explained by basic reading skills, which in turn were influenced by phonological processing skills.

Focus 2: Linguistic Competencies as Predictors of Later Reading Comprehension

Are there differential effects of early vocabulary and grammar on reading comprehension in Grade 2? As suggested by other studies as well as by our analyses, linguistic abilities that refer to the semantic and grammatical components of language have a specific significant impact on reading comprehension. This is true even with respect to early reading comprehension and when language predictors are assessed early in preschool. In a next step, we analyzed whether receptive vocabulary and grammar would each explain unique proportions of variance in reading comprehension or whether the variance shared between the two components would be relevant for reading comprehension. The goal of these analyses was to provide information about the relative impact of preschool children's early vocabulary and grammar as prerequisites for reading comprehension. Therefore, we conducted hierarchical regression analyses to explain the variance in reading comprehension. To determine the unique contributions of grammar and vocabulary, we conducted two hierarchical regression analyses. In Model A, vocabulary was entered in the first step and grammar in the second step; in Model B, the order was reversed. The increase of explained variance in the second step thus provides information about the unique contribution of the second predictor. The amount of shared variance can be

determined by subtracting the independent contributions of the two predictors from the total explained variance. Furthermore, we controlled for basic reading skills as we did not predict reading comprehension per se but the residual variance of reading comprehension. Table 4 shows the results of the two hierarchical regression analyses.

Table 4. Summary of Hierarchical Regression Analyses Predicting the Residuum of Reading Comprehension (Controlling for Basic Reading Skills) from Vocabulary and Grammar

	β	t	R^2	ΔR^2
Model A				
Step 1				
Vocabulary (PPVT), time 3	.32	4.67	.10	
Step 2				
Grammar (TROG), time 3	.00	0.05	.10	.00
Model B				
Step 1				
Grammar (TROG), time 3	.17	2.33	.03	
Step 2				
Vocabulary (PPVT), time 3	.32	3.98	.10	.07**

Note. N = 193; PPVT = Peabody Picture Vocabulary Test; TROG = Test for the Reception of Grammar.
** $p < .01$

As Table 4 shows, when predicting the residuum of reading comprehension through grammar and vocabulary, only vocabulary explained specific variance. Vocabulary accounted for an additional 7% of the variance over and above the impact of grammar, $\Delta R^2 = .07$; $F_{inc}(1, 190) = 15.86$, $p < .01$. The unique contribution made by grammar to reading comprehension was zero, and even if entered in the first step, the amount of variance explained by grammar was small. Together, vocabulary and grammar at the ages of about 4 to 5 years explained 10% of the residual variance in reading comprehension in the second grade (i.e., more than 3 years later). Because the inclusion of grammar in a second step did not explain any additional variance, the amount of variance shared between grammar and vocabulary when predicting reading comprehension was 3%.

Do integrative language measures explain differences in later reading comprehension better than vocabulary and grammar? To answer our research question regarding whether more functional and integrative measures of language competencies would be able to predict later reading comprehension over and above the impact of vocabulary and grammar, data from the subsample of children who received the tests for story comprehension and reproduction as well as for sentence reproduction were considered. Table 5 shows the correlations between the various language measures and reading literacy (reading comprehension and basic reading skills) for this subsample. As in the whole sample, grammar and vocabulary were more strongly related to reading comprehension than to basic reading skills. Furthermore, story comprehension was significantly correlated with both kinds of linguistic abilities (i.e., grammar and vocabulary), whereas story reproduction was associated only with vocabulary, but not with grammar. For story comprehension and reproduction, their correlations with phonological processing skills (phonological memory and access to long-term memory) were small and even nonsignificant for rapid naming. Sentence reproduction, by contrast, was significantly related to all language measures. Furthermore, sentence reproduction showed higher correlations with phonological memory than any of the other language measures.

Interestingly, although story reproduction and comprehension were associated with the various language measures, significant correlations with either reading comprehension or basic reading skills were not found. By contrast, sentence reproduction was significantly related to both reading comprehension and basic reading skills. Again, as was found for the total sample, the correlation between reading comprehension and basic reading skills was particularly high.

Table 5. Correlations between Measures of Phonological Processing, Linguistic Abilities, and Reading Comprehension for the Subsample that was Tested on Story Reproduction and Comprehensions as well as on Sentence Reproduction

	1	2	3	4	5	6	7	8
1. Digit Span, time 3								
2. Rapid Naming, time 3	-.13							
3. PPVT, time 3	.36**	-.10						
4. TROG, time 3	.26**	-.13	.47**					
5. Story Reproduction, time 2	.23*	.00	.45**	.18				
6. Story Comprehension, time 2	.29**	-.15	.49**	.49**	.44**			
7. Sentence Reproduction, time 3	.45**	-.22*	.49**	.30**	.30**	.49**		
8. ELFE 1-6, Grade 2	.45**	-.19	.33**	.32*	.01	.17	.43**	
9. SLS 1-4, Grade 2	.36**	-.31**	.14	.22	.03	.12	.37**	.82**

Note. Correlations between rapid naming and the other measures are negative because the score on the measure is the time needed to complete the task. PPVT = Peabody Picture Vocabulary Test; TROG = Test for the Reception of Grammar; ELFE = Ein Leseverständnistest für Erst- bis Sechstklässler (reading comprehension); SLS = Salzburger Lesescreening für die Klassenstufen 1-4 (reading speed).
* $p < .05$. ** $p < .01$.

To determine whether integrative language competencies (i.e., more integrative and functional measures of language competencies that require the mastery and interplay of various language components) would explain independent proportions of variance over and above grammar and vocabulary, we again conducted hierarchical regression analyses. In a first step, children's grammatical and vocabulary knowledge were entered into the model. In a second step, measures that assessed integrative language skills were added to determine the specific variance explained by these measures over and above vocabulary and grammar. Again, we predicted the residuum of reading comprehension while controlling for basic reading skills.

Story comprehension and reproduction. Table 6 presents the results for the hierarchical regression analyses predicting the residuum of reading comprehension from individual differences in early vocabulary, grammar, and story comprehension and production.

Table 6. Summary of Hierarchical Regression Analyses Predicting the Residuum of Reading Comprehension (Controlling for Basic Reading Skills) from Vocabulary, Grammar, and Story Reproduction and Comprehension

	β	t	R^2	ΔR^2
Step 1				
Vocabulary (PPVT), time 3	.18	1.20		
Grammar (TROG), time 3	.21	1.43	.10	
Step 2				
Vocabulary (PPVT), time 3	.24	1.47		
Grammar (TROG), time 3	.18	0.98		
Story Reproduction, time 2	-.19	-1.14		
Story Comprehension, time 2	.12	0.67	.13	.03

Note. N = 52; PPVT = Peabody Picture Vocabulary Test; TROG = Test for the Reception of Grammar.

Table 6 shows that the integrative language measures (story reproduction and story comprehension) accounted for only a small amount of additional variance, $\Delta R^2 = .03$; $F_{inc}(1, 47) = 0.71$, *ns*, when individual differences in vocabulary and grammar were controlled. For story reproduction, a nonsignificant negative regression weight was obtained. This may be due to suppression effects as story reproduction was not correlated with reading literacy (cf. Table 5) but was correlated with vocabulary (see Bühner & Ziegler, p. 686). Thus, story reproduction and comprehension, although recognized as ecologically valid integrative language measures, did not explain additional variance over and above measures of language components (vocabulary, grammar) and were, in fact, only weakly associated with reading literacy in Grade 2.

Sentence reproduction. Table 7 presents the results of the hierarchical regression analyses predicting the residuum of reading comprehension from vocabulary, grammar, and sentence reproduction.

Table 7. Summary of Hierarchical Regression Analyses Predicting the Residuum of Reading Comprehension (Controlling for Basic Reading Skills) from Vocabulary, Grammar, and Sentence Reproduction

	β	t	R^2	ΔR^2
Step 1				
Vocabulary (PPVT), time 3	.17	1.09		
Grammar (TROG), time 3	.20	1.32	.10	
Step 2				
Vocabulary (PPVT), time 3	.16	1.05		
Grammar (TROG), time 3	.17	1.04		
Sentence Reproduction, time 3	.08	0.51	.10	.00

Note. N = 49; PPVT = Peabody Picture Vocabulary Test; TROG = Test for the Reception of Grammar.

As can be seen in Table 7, the addition of sentence reproduction in the second step did not improve the amount of variance explained by vocabulary and grammar. Thus, although sentence reproduction is a measure that draws on the child's lexical and grammatical knowledge as well as on his or her phonological information processing skills, it did not explain additional variance in the residuum of reading comprehension over and above measures of language components (vocabulary, grammar).

Thus, both integrative language indicators did not show additional effects on reading comprehension over and above the language components. To further substantiate this result, we conducted two additional analyses. Specifically, we predicted reading comprehension without controlling for basic reading skills (see Table 8).

Table 8. Summary of Hierarchical Regression Analyses Predicting Reading Comprehension in Grade 2 from Language Measures at Time 3 of the BiKS-3-10 Study

	β	t	R^2	ΔR^2
Model: Story Reproduction & Comprehension				
Step 1				
Vocabulary (PPVT), time 3	.24	1.84		
Grammar (TROG), time 3	.24	1.81	.16	
Step 2				
Vocabulary (PPVT), time 3	.37*	2.53		
Grammar (TROG), time 3	.26	1.84		
Story Reproduction, time 2	-.27	-1.80		
Story Comprehension, time 2	.01	0.03	.21	.05
Model: Sentence Reproduction				
Step 1				
Vocabulary (PPVT), time 3	.23	1.67		
Grammar (TROG), time 3	.24	1.78	.15	
Step 2				
Vocabulary (PPVT), time 3	.09	0.59		
Grammar (TROG), time 3	.19	1.42		
Sentence Reproduction, time 3	.32*	2.27	.23	.08*

Note. N = 61/57; PPVT = Peabody Picture Vocabulary Test; TROG = Test for the Reception of Grammar.
*$p < .05$

As Table 8 shows, story reproduction and comprehension did not account for a significant amount of additional variance, $\Delta R^2 = .05$; $F_{inc}(1, 56) = 1.85$, *ns*. Once again, a negative regression weight for story reproduction was obtained. This, once again, is potentially due to suppression effects. Story comprehension and reproduction seem to absorb variance from vocabulary and grammar that is not relevant for reading comprehension (see Bühner & Ziegler, p. 686). Thus, even when reading comprehension was considered instead of the residuum of reading comprehension, story comprehension and reproduction did not explain specific variance over and above the grammatical and lexical components of language.

By contrast, when sentence reproduction was entered in a second step after controlling for differences in vocabulary and grammar (see Table 8; Model Sentence Reproduction), sentence reproduction significantly improved the amount of variance explained in reading comprehension, $\Delta R^2 = .08$; $F_{inc}(1, 53) = 5.14$, $p < .05$.

Furthermore, the regression weights for vocabulary and grammar decreased when sentence reproduction was considered in the same analysis. Thus, sentence reproduction was found to be the comparatively strongest predictor of reading comprehension. This is the case most likely because sentence reproduction draws on both lexical and grammatical knowledge as well as on phonological processing skills. To further analyze the effect of sentence reproduction on reading comprehension, an additional analysis was conducted. We tested whether the effect of sentence reproduction would be mediated through phonological processing skills or whether it would have an effect over and above phonological processing. In this analysis, besides vocabulary and grammar, phonological memory and rapid automatized naming (RAN) were entered in a first step, and sentence reproduction was added in a second step. Table 9 shows the results of this analysis.

Table 9. Summary of Hierarchical Regression Analyses Predicting Reading Comprehension from Vocabulary, Grammar, Digit Span, and Sentence Reproduction

	β	t	R^2	ΔR^2
Step 1				
Vocabulary (PPVT), time 3	.14	1.40		
Grammar (TROG), time 3	.17	1.22		
Rapid Naming, time 3	-.15	-1.18		
Digit Span, time 3	.32	2.42	.23	
Step 2				
Vocabulary (PPVT), time 3	.09	0.63		
Grammar (TROG), time 3	.16	1.13		
Rapid Naming, time 3	-.14	-1.09		
Digit Span, time 3	.25	1.62		
Sentence Reproduction, time 3	.14	0.84	.24	.01

Note. $N = 54$; The obtained β weights for rapid naming are negative because the score on the measure is the time needed to complete the task. PPVT = Peabody Picture Vocabulary Test; TROG = Test for the Reception of Grammar.

As Table 9 shows, the unique variance that sentence reproduction explained was indeed due to the variance shared between sentence reproduction and phonological processing skills. Sentence reproduction did not contribute further to the prediction of reading comprehension when differences in the grammatical and lexical components of language as well as phonological processing skills were statistically controlled, $\Delta R^2 = .01$; $F_{inc}(1, 48) = 0.70$, *ns*.

The results of these analyses also demonstrate that early language measures account for a higher proportion of variance in reading comprehension when basic reading skills are not accounted for. Although reading comprehension was assessed 3 to 4 years later than oral language competencies, language measures explained up to 24% of the variance in reading comprehension in Grade 2.

Discussion

The aim of the present study was to investigate how various language indicators assessed early in preschool would predict reading literacy in the first years of formal reading instruction in primary school. We tested and confirmed that phonological processing skills (phonological working memory, fast access to phonological representations in long-term memory) and linguistic abilities (vocabulary, grammar) are significantly interrelated in preschool-age children but nevertheless contribute in different ways to the development of early reading literacy – that is, to the acquisition of basic reading skills (reading speed) and reading comprehension, respectively. In addition, we analyzed the specific long-term impact of early individual differences in vocabulary, grammar, and integrative language measures (story reproduction and comprehension, sentence reproduction) in preschool on reading comprehension. Our study indicated that when language components (grammar, vocabulary) were considered together with integrative language measures, the latter did not explain an additional or higher amount of variance in early reading comprehension. In the following, the main results of the study will be discussed in more detail and related to other research outcomes.

Based on theoretical models and empirical results concerning precursors and predictors of reading literacy, we first analyzed whether the distinction between phonological processing skills and linguistic abilities as predictors of different facets of reading literacy could be empirically substantiated in the early preschool years. Confirmatory factor analyses demonstrated that a two-factor model that differentiated between phonological processing skills and linguistic abilities fit the data better than a one-factor model that integrated all language measures into one global factor. Thus, the distinction between phonological processing skills and linguistic abilities seems empirically justified. However, it should be kept in mind that the estimated correlation

between the latent factors of phonological processing and linguistic abilities was strong (r = .80), reflecting and substantiating the proposed tight developmental interrelations between various language facets (e.g., vocabulary acquisition and phonological working memory; Ebert, et al., 2013; Gathercole, et al., 1992; Weinert, et al., 2012). In fact, interindividual differences in digit span as an indicator of phonological working memory capacity were even more highly correlated with grammar and vocabulary than with rapid naming as an indicator of the fast access to phonological representations in long-term memory. Thus, correlational analyses showed that digit span and rapid naming as indicators of phonological processing skills are not more strongly interconnected with each other than each of these indicators is related to vocabulary and grammar as indicators of linguistic abilities. However, vocabulary and grammar were more strongly connected to each other than to phonological working memory (i.e., digit span, in this case). This result suggests that the linguistic measures (vocabulary and grammar) may refer to the same underlying construct or have similar developmental determinants, whereas digit span and rapid naming, although related, may be connected to this construct for other developmental reasons.

One might object that we didn't assess measures of phonological awareness as an important facet of phonological information processing, which seems to be one of the most important predictors of reading development (e.g., Shanahan & Lonigan, 2010). Admittedly, as already mentioned, phonological awareness seems to be less important in languages with comparatively more regular orthography (e.g., German). Moreover, the empirical data suggest that measures of phoneme skills (also known as phonological awareness in a narrow sense) show floor effects when assessed at such an early age as in the present study, whereas measures of onset-rime skills (also known as phonological awareness in a broader sense) are often not associated with early reading development and have been shown to be more strongly correlated with vocabulary than with phoneme awareness (Muter, et al., 2004). These results are also in line with findings from the BiKS-3-10 study that are not reported in the results section: For a subgroup of children, a measure of rhyming was assessed at a later time point than the measures reported here. Confirmatory factor analyses (similar to those conducted in the present study) including the rhyming task found rhyming to be more strongly associated with vocabulary than with the other measures of phonological awareness.

Thus, it cannot be argued that a confirmatory factor analysis including additional measures of phonological awareness to represent phonological processing skills would have produced a clearer distinction between phonological processing skills and linguistic abilities. Furthermore, a study conducted by Lonigan et al. (2009) that did not consider linguistic skills but only aspects of phonological processing showed that phonological awareness was more closely related to phonological working memory than to rapid automatized naming. Specifically, a two-factor model combining measures of phonological awareness and phonological memory in one factor and measures of rapid automatized naming in a second factor fitted the data best. Thus, this study also demonstrates an exceptional position of rapid automatized naming, whereas phonological awareness and phonological working memory seem to be more strongly associated. These results may also excuse the fact that we did not consider measures of phonological awareness. Actually, with respect to our second aim, a strength of the present study is that we considered phonological working memory and rapid automatized naming as indicators of phonological processing skills.

The second aim of the present study was to replicate the finding that lexical and grammatical knowledge are especially relevant to reading comprehension, whereas phonological processing skills are more important for basic reading skills. To date, only a few studies have considered various aspects of phonological processing as well as of linguistic abilities within one and the same study (Cain, 2010). Also, if both facets were included, they most often focused on phonological awareness, but not on other measures of phonological information processing (e.g., Muter, et al., 2004; Senechal, et al., 2006). The study by Muter et al. (2004), for example, assessed children's vocabulary and grammar as we did in the present study, whereas phonological processing was indicated by phonological awareness (onset-rime and phoneme awareness); measures of phonological memory and rapid automatized naming were not considered. Thus, the present study was able to provide new information by verifying that aspects of phonological information processing other than phonological awareness show similar effects on later reading and different effects than linguistic abilities. Muter et al. (2004) showed that measures of phoneme awareness (but not of onset-rime) at age 5 were significant predictors of word recognition at age 6 even when word recognition at age 5 and early vocabulary and grammar were controlled for, whereas vocabulary and

grammar failed to predict the growth of word recognition over and above phoneme awareness. With respect to reading comprehension, the pattern was reversed: Vocabulary and grammar showed an effect on reading comprehension but not on phoneme awareness when earlier word recognition was controlled. The results of the present study were pretty much the same, although we used digit span and rapid automatized naming as indicators of phonological processing instead of measures of phoneme awareness and a measure of sentence comprehension for grammar instead of a word-order correction task and a morphological generation task. The present study showed that phonological processing skills assessed at the age of 4 had a significant effect on basic reading skills (reading speed/fluency) in Grade 2 (at the age of about 8 years), whereas no effect of phonological skills on reading comprehension showed up after controlling for basic reading skills. By contrast, linguistic abilities asserted a significant effect on reading comprehension after controlling for basic reading skills, but not on basic reading skills. Thus, the present study demonstrates that, no matter what aspects of phonological processing are assessed and even when phonological awareness is not considered, phonological processing is more important for basic reading skills, whereas linguistic abilities are specifically relevant for reading comprehension. Moreover, the present study further shows that this pattern of results holds (a) when predictors are assessed at a very young age (4 years) and (b) for early reading literacy (i.e., in a developmental phase when reading comprehension may still be dominated and restricted by decoding processes). Indeed, correlations between basic reading skills and reading comprehension are high in children in Grade 2. In this context, a meta-analysis conducted by Gough, Hoover, and Peterson (1996, cited by Muter, et al., 2004) demonstrated that the correlations between decoding and reading comprehension are high in the early grades but decrease later on. Thus, although basic reading skills and reading comprehension are highly redundant indicators of reading literacy in the early years of reading instruction, our results demonstrate that there are already important differences concerning the relevance of various language predictors. This result shows that basic reading skills and reading comprehension have different determinants in development from early on (see also Cain & Oakhill, 2007).

Furthermore, it should be noted that we found significant effects of language predictors on reading literacy over a long time period of 4 years (note that this is half of these children's lifetimes) including the transition from one learning environment (preschool) to a new learning environment (school). Thus, during this time, large environmental influences on reading development are to be expected, and these could have obscured or reduced the impact of variables measured in preschool. Nevertheless, in this study as well as in others, child variables were found to be strong predictors of developmental progress (Ebert, et al., 2013). To be sure, these developing child variables are – in accordance with bioecological models of development (Bronfenbrenner & Morris, 2006) – influenced by each other as well as by environmental factors (Weinert & Ebert, 2013).

The third aim of the present study was to investigate in more detail the predictive power of linguistic abilities (vocabulary, grammar) and more integrative language measures on reading comprehension. In comparison to phonological processing and its relevance to more basic reading skills (decoding, reading fluency), relatively less is known about the relative impact of various linguistic abilities on reading comprehension (Cain, 2010; Muter, et al., 2004). First, we analyzed whether vocabulary or grammar would have a comparatively stronger impact on later reading comprehension when considered simultaneously. Whereas most studies have considered just vocabulary and not grammar, a study by Muter et al. (2004) demonstrated that the impact of grammar and vocabulary on reading comprehension was quite similar. By contrast, the present study showed that vocabulary but not grammar (sentence comprehension) at the age of 4 explained additional variance in reading comprehension in Grade 2 after controlling for basic reading skills (reading speed) and grammar or vocabulary respectively. In addition, a study by Roth et al. (2002) showed that semantic abilities assessed in kindergarten more strongly predicted reading comprehension than a test of syntax.

From a theoretical point of view, predictions concerning the relative importance of vocabulary and grammar are not straightforward. Obviously, their relative impacts may depend on features of the written text (complexity of sentence structure and vocabulary), the assessment of text comprehension (e.g., the extent to which it taps one or the other aspect; the extent to which it presupposes specific processes of text

comprehension), as well as on the time point of assessment in language and reading development (When are the linguistic predictors assessed in preschool? When is reading literacy assessed in school?). In order to comprehend (written) texts, the child has to have both lexical and grammatical knowledge; in addition these two language components are interrelated in language development and may interact in text comprehension (see e.g., Weinert, 2006). Emanating from the fact that linguistic skills are relatively stable across time (e.g., Storch & Whitehurst, 2002; Weinert, Ebert, & Dubowy, 2010), reading comprehension may depend on whether texts include complex grammar and/or complex vocabulary. For example, when texts include more complex vocabulary, more sophisticated grammatical abilities may help the reader to construct the meaning of the text even without knowing all the words, whereas if sentence and text structure draw on basic linguistic skills, it may be sufficient to know most of the words to make sense of the text. Thus, the relative impact of vocabulary and grammar in predicting reading may change according to text complexity and/or a child's age. Oakhill, Cain, and Bryant (2003, cited in Cain & Oakhill, 2007), for example, found that syntactic ability did not predict reading comprehension in 7- or 8-year-olds when controlling for differences in vocabulary and IQ, but predicted reading comprehension 1 year later. Thus, the more dominant impact of vocabulary found in our study may be due to the fact that (written) texts are still rather easy in second grade when taking into account the still restricted basic reading competencies of the children. Interestingly, further analyses of our data showed that, at later time points and regarding subgroups of older children, grammar and vocabulary explained a similar amount of specific variance. This result is in line with the above-mentioned study by Muter et al. (2004). This suggests that the relative predictive power of vocabulary and grammar might also change according to children's age. Because one possible explanation for the diverging results traces back to the developmental relation between vocabulary and grammar, future research should consider the developmental pathways between these language variables in more detail.

Besides the issue of the relative importance of specific language components (e.g., vocabulary and grammar) for reading literacy, another aim of the present study was to further investigate whether measures of more integrative and functional language competencies would be better predictors of reading comprehension than measures of

language components. Integrative language measures such as oral text comprehension or sentence reproduction require not only the availability of lexical and grammatical knowledge, but also tap phonological processing skills and are more ecologically valid.

Concerning oral text comprehension (listening comprehension), van den Broek et al. (2005) found strong connections between 4-year-olds' listening comprehension and their reading comprehension in Grade 2. This was true for important causal information that the children remembered in free recall (r = .58) as well as for their scores on complex questions (r = .53). Even after controlling for vocabulary as well as for letter and word identification and phonemic awareness, the predictive power of oral text comprehension in preschool for reading comprehension in the second grade remained significant. These results are in contrast to those of the present study. Story reproduction and story comprehension at the age of about 4 years did not explain additional variance in reading comprehension after controlling for differences in basic reading skills (reading speed), vocabulary, and grammar. Thus, these integrative measures did not show a predictive effect over and above measures of language components. Even the simple correlations between our measures of oral text comprehension and reading literacy were small. With respect to story comprehension, correlations ranged between r = .12 and r = .17; when considering story reproduction, they were almost zero. How can we explain these diverging results? One explanation may be found in our operationalization of oral text comprehension. Van den Broek et al. (2005), for example, differentiate between various types of "comprehension" (e.g., the ability to remember information explicitly given in the text, to apply information conveyed in the text, to recognize the topic or moral of a text, or to provide a critical appraisal of the text). However, according to van den Broek and colleagues, these types of comprehension share core processes that "involve interpretation of the information in the text, the use of prior knowledge to do so and, ultimately, the construction of a coherent representation or picture what the text is about" (van den Broek, et al., 2005, p. 109). Similar to this approach, our comprehension measures included indicators of the information remembered by the child and of the inferences drawn. However, it is possible that our measure is more dependent on memory resources than other measures of oral text comprehension because the presentation of the story and the assessment of story comprehension (story reproduction, comprehension questions)

were separated by a retention interval. Consistent with this explanation, Reese et al. (2010) found that the quality of narratives (in contrast to, e.g., story memory) was most predictive of reading. Unfortunately, we do not know what kind of comprehension questions van den Broek and colleagues used in their study; however, because the children in van den Broek's study listened to an extended orally presented or televised narrative, it is reasonable to assume that they had to answer mainly comprehensive questions about the causal structure of the story. By contrast, in our task, children had to remember a greater number of details from a relatively short story.

However, our results are puzzling because our measures of oral text comprehension were significantly correlated with vocabulary, grammar, and sentence reproduction (except for the low correlation between grammar and story reproduction), but not with reading literacy. Oral text comprehension and other language measures are related to each other and may interact with each other; thus, linguistic skills in the sense of vocabulary or grammar may limit children's comprehension skills. Nevertheless, contrary to our expectations and in contrast to other research results (e.g., de Jong & van der Leij, 2002; van den Broek et, al., 2005), we did not find that oral text comprehension in preschool was an important predictor of later reading comprehension in Grade 2. However, we do not know whether this is due to the measures of oral text comprehension or to the measure of reading comprehension administered in the present study. Thus, our test of reading comprehension may tap more basic rather than linguistically challenging comprehension skills. This is usually the case in the early stages of children's reading development as children are still struggling with basic reading skills. Accordingly, as already mentioned, reading comprehension and basic reading skills were highly correlated in our study (i.e., even after 2 years of reading instruction).

Another important contribution of the present study is that, over and above considering the impact of language components (vocabulary, grammar) as well as of more integrative, functional language measures (story comprehension, story reproduction) on reading comprehension, we also introduced a second measure of integrative language competencies, namely, sentence reproduction. This measure is of specific interest because it is supposed to be a highly reliable predictor of reading development (Goldammer, et al., 2010). Compared to oral text comprehension, it is

conceptually less similar to reading comprehension and not as ecologically valid but easy to assess. In particular, sentence reproduction comprises various language skills known to be predictive of basic reading skills and reading comprehension. On the one hand, sentence reproduction draws on phonological processing skills to verbally store the presented sentence in short-term memory; on the other hand, available lexical and grammatical knowledge support these memory processes as well as the immediate reconstruction of the semantic and grammatical structure of the given sentence. Therefore, we tested whether this measure significantly predicts reading comprehension and outperforms indicators of language components. As an extension of the study by Goldammer et al. (2010), we examined the impact of a sentence reproduction task on reading comprehension instead of on basic reading skills. Contrary to the results of Goldammer et al. (2010), who found sentence reproduction at the age of 5 years to be the strongest predictor of basic reading skills (reading speed at the word and sentence levels) at about 8 years, our results showed that a higher attainment in sentence reproduction at age 4 did not explain unique variance in children's reading comprehension in Grade 2 over and above language components, that is, after controlling for differences in basic reading skills (reading speed at the sentence level), vocabulary, and grammar. However, if we did not control for basic reading skills, sentence reproduction was a stronger predictor than vocabulary and grammar. This seems to be due to the fact that sentence reproduction draws on language components as well as on phonological processing skills, specifically verbal memory. This assumption is supported by the finding that sentence reproduction did not explain additional unique variance in reading comprehension when individual differences in grammar, vocabulary, verbal short-term memory (digit span), and fast access to long-term memory (rapid automatized naming) were statistically controlled. Thus, our results suggest that sentence reproduction is a highly valid predictor of reading comprehension because of its demands on phonological processing and linguistic abilities. Accordingly, we recommend that researchers use sentence reproduction as an economical measure of children's general language competencies. However, this measure does not assess (language) competencies over and above the required language components (i.e., tests of language components). Furthermore, our results suggest that the predictive effect of sentence reproduction on reading comprehension is mediated mainly through its interrelation with basic reading skills.

Thus, sentence reproduction does not account for unique variance (over and above vocabulary and grammar) in reading comprehension when basic reading skills (reading speed) are controlled. This converges with the results of Goldammer and colleagues, who found that sentence reproduction was a strong predictor of basic reading skills.

In sum, our results are in line with the national and international research literature on the impact of phonological processing skills and linguistic abilities on the development of reading literacy. Specifically, we replicated the differential effects in the predictive power of phonological processing skills and linguistic abilities. Whereas phonological processing skills are superior predictors of basic reading skills, linguistic abilities are more important in the prediction of reading comprehension when controlling for basic reading skills that may hinder more complex comprehension processes from taking place (see also Muter, et al., 2004; Senechal, et al., 2006). Thus, phonological processing skills are important for reading comprehension as long as basic reading skills are not accounted for; when basic reading skills are controlled, phonological processing skills no longer account for reading comprehension. In the same vein, linguistic abilities are subordinate when basic reading skills are not controlled. In particular, the present study provides important new information as the differential effects of phonological processing skills and linguistic abilities on reading literacy even hold when predictors are assessed at an early age in preschool and for reading outcomes in early phases of reading development.

Probably the most important contribution of the present study is that it partly disentangles the differential effects of various oral language indicators on early reading comprehension. Specifically, analyses were conducted with respect to the impact of language components (vocabulary, grammar) compared to integrative language competencies (oral text comprehension, sentence reproduction). This is especially important when thinking about the promotion of oral language in preschool. Our results suggest that early in preschool, it is vocabulary in particular that seems to provide the foundation for further language and reading development. However, it is likely that vocabulary influences grammar and integrative language skills such as oral text comprehension, which may become more important in the course of development when children grow older. Concerning integrative language competencies, our results

are somewhat contradictory to studies that found that oral text comprehension, even early in preschool, was a reliable predictor of reading comprehension. It is possible that this difference is due to our measures of oral text comprehension or to our measure of reading comprehension. In fact, there is a deep need for more reliable and valid tests of oral text (and reading) comprehension in young children. Further studies have to gain insight into the developmental interrelations of vocabulary, grammar, and more integrative language measures, which are all subject to social disparities from an early age (e.g., Ebert, et al., 2013; Weinert & Ebert, 2013; Weinert, et al., 2010, 2012). Because individual differences have been shown to be rather stable in the language domain, this might be important not only for reading comprehension but also for school learning in general.

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