Morphological Awareness and Reading Comprehension

Preschool Morphological Awareness as a Longitudinal Predictor of Reading Comprehension in Later School Years

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Abstract

Background and Rationale

Reading comprehension is the ability to extract meaning from the text. Multidimensional in nature, reading comprehension consists of several underlying subcomponents related to decoding and language comprehension. In order to comprehend text, both linguistic and metalinguistic processes must be involved. Morphological awareness is a metalinguistic ability that is closely related to linguistic skills, such as vocabulary knowledge. Developmental trajectories of morphological awareness range from early childhood to well after the beginning of formal education. Hence, it is relevant to examine whether morphological awareness as early as preschool can predict reading comprehension beyond other linguistic and metalinguistic components of reading comprehension. In light of this rationale, the present study aims to answer the following research question:

"To what extent does preschool morphological awareness predict reading comprehension in third-grade Norwegian students when controlled for phonological awareness, vocabulary, and non-verbal intelligence?"

Method

The present study was designed to follow Norwegian-speaking children (N = 215) from preschool to 3rd grade of elementary school, assessing their performance on morphological awareness, phonological awareness, vocabulary and nonverbal intelligence in preschool, and reading comprehension ability in 3rd grade. Thus, this study utilizes a non-experimental longitudinal design in order to answer the research question. The present study is conducted in conjunction with the NumLit, a project of the Institute of Special Needs Education at the University of Oslo.

Analysis

Prior to the use of bivariate correlations and hierarchical multiple regression, descriptive statistics were employed. In the hierarchical model, there are four blocks. The first block includes measures of nonverbal intelligence, the second block includes phonological awareness measures, the third block includes measures of receptive vocabulary, and finally,

the fourth block contains measures of morphological awareness. The analyses were performed using Jamovi statistical spreadsheet, version 1.6 (The Jamovi Project, 2020).

Results

The bivariate correlations revealed that morphological awareness significantly correlated with reading comprehension ($p < .001$), as well as phonological awareness ($p < .01$ and $p < .001$) and vocabulary knowledge ($p < .001$). Furthermore, hierarchical regression analyses showed that morphological awareness is a significant predictor of reading comprehension, explaining approximately 7,9% ($\Delta R2 = .079$, $p < .001$) of its variance, beyond effects of nonverbal intelligence, phonological awareness, and receptive vocabulary. Phonological awareness entered in the second block of the hierarchical regression analysis showed a significant contribution of approximately 5,2 % ($\Delta R2 = .052$, $p = .003$) of the total variance in reading comprehension, while vocabulary entered in the third block accounted for 9,5% ($\Delta R2 = .095$, $p < .001$) of the improvement in the variance of reading comprehension.

Conclusion

Even after controlling for aspects of linguistics, metalinguistics, and nonverbal reasoning, morphological awareness remains a significant, long-term independent predictor of reading comprehension. In addition to contributing to reading comprehension, the present study shows that morphological awareness was significantly associated with both phonological awareness and receptive vocabulary, both of which contributed to reading comprehension. The close relationship between morphological awareness and a construct of reading comprehension, as well as two other previously mentioned significant predictors, places morphological awareness at the heart of reading comprehension research.

Preface

Firstly, I wish to express my sincere gratitude to the NumLit research team for allowing me to participate in the project that inspired me to write about this topic. As I reflect on my study period, I consider this one of the most valuable experiences. Moreover, I would like to thank those who collected data despite the Covid-19 crisis and generously shared them with me.

Thank you to my supervisors, Vasiliki Diamanti and Athanasios Protopapas, for guiding me throughout writing my master's thesis and inspiring me more each and every time we met.

I would also like to thank my study friends Adise, Farida, and Simmi for your unconditional support during this very intense academic year.
Last but not least, I would like to thank my family, my boyfriend, and my friends for always being by my side, no matter what. I am looking forward to spending more time with all of you!

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1 Introduction

1.1 Background and rationale

The rapid development of technology has changed people's reading habits, while at the same time, it is expected that the future job market will put more demands on higher education (SSB, 2020). In light of the changes in reading practices and skills required in modern society, educational science has been under increased pressure to develop more effective methods of literacy acquisition, one of the essential skills for success in learning and, hence, for employment. The ultimate goal of reading instruction in school is to ensure that students understand what they read (Snow, 2002) and gain new knowledge that will assist them in their future academic and professional careers. Hence, reading comprehension is considered the ultimate goal of reading and a primary tool in learning.

Early reading interventions designed to increase reading comprehension require examining specific subcomponent skills in young readers (Solari, Grimm, McIntyre & Denton, 2018). Reading comprehension comprises many subcomponents, including morphological awareness, which entails the ability to identify and manipulate the smallest meaningful elements within words (Carlisle, 1995). Numerous studies have demonstrated the relationship between morphological awareness and reading comprehension that extends beyond the scope of substantive control measures (e.g., Deacon & Kirby, 2004; Kuo & Anderson, 2006). Given the complexity of both constructs, the relationship between morphological awareness and reading comprehension is not fully understood.

Furthermore, empirical evidence indicates that phonological awareness is crucial to the development of early reading ability and, subsequently, reading comprehension (Melby-Lervåg, Lyster & Hulme, 2012). The relationship between phonological awareness and morphological awareness is not surprising since they share the same metalinguistic awareness. Thus, it is expected that these constructs are interrelated. Moreover, Perfetti and Hart (2001) state that reading comprehension relies on the precise knowledge of words across the three levels of representation (orthographic, phonological, and semantic). Children's vocabulary is a good predictor of their reading comprehension, both concurrently and in the long run (Nation & Snowling, 2004). Since morphemes are the units that carry meaning in the word, Kuo and Anderson (2006) argue that children with advanced morphological awareness may be more successful at learning and retaining morphologically complex words within their vocabulary.

Hence, morphological awareness is closely associated with other aspects of metalinguistic awareness and linguistic ability, such as phonological awareness and vocabulary knowledge. Accordingly, when phonological awareness and vocabulary are controlled, morphological awareness tends to be a limited predictor of reading development (Kuo & Anderson, 2006). The reader employs several sources of knowledge and skills in order to comprehend text; thus, it is important to acknowledge the effects of morphological awareness beyond the other components of comprehension. Hence, the purpose of this study is to examine whether morphological awareness predicts long-term reading comprehension after controlling for other component skills.

This study is associated with the research project "NumLit – Development of Numeracy and Literacy in Children" from The Department of Special Needs Education at the University of Oslo. The aim of the NumLit longitudinal study is to provide a better understanding of the interrelationship between numeracy and literacy, and their related precursor skills, in order to early identify and support children who are at risk for learning disabilities.

1.1.1 Research Question

Based on the background and rationale listed above, the following research question has emerged:

"To what extent does preschool morphological awareness predict reading comprehension in third-grade Norwegian students, when controlled for phonological awareness, vocabulary, and non-verbal intelligence?"

1.2 Structure of the Thesis

In Chapter 1 of this thesis, the reader gets an insight into the background and rationale of the present study, followed by the research question.
In Chapter 2, the theoretical and empirical background for reading comprehension is presented, beginning with the nature of reading comprehension, followed by the presentation of two influential models. Finally, integral parts of reading comprehension, subcomponents of word reading, and language comprehension are discussed.

In Chapter 3, the theoretical and empirical background for morphological awareness are presented. Moreover, domains of morphological processing and morphological awareness development accompanied by measurement challenges are discussed. The chapter concludes with a description of the 'The Morphological Pathway Framework'.

Chapter 4 highlights existing research regarding the relationship between morphological awareness and reading comprehension and its close relationship with vocabulary knowledge. At the end of this chapter, the rationale for the present study is discussed.

Chapter 5 discusses the method, design, sample, procedures, and analysis of the current study. Furthermore, a description of the tests used to measure the variables is provided. Moreover, a theoretical background is provided for assessing the study's validity and reliability. Lastly, ethical considerations in relation to the present study are discussed.

The results of the statistical analysis are presented in Chapter 6.

In Chapter 7, the results are discussed in light of the relevant theoretical and empirical background, as well as in light of the study's validity and reliability.

Lastly, Chapter 8 discusses the conclusions, implications, limitations, and future directions of the present study.

2 Theoretical and Empirical Background: Reading Comprehension

2.1 The nature of Reading Comprehension

Due to its importance in people's working and social lives, reading comprehension has been the subject of interest in the large body of research over a long time period. Thus, reading comprehension is a crucial literacy skill a child needs to acquire at school age.

In the broad view, reading comprehension involves three elements: a reader, a text, and the interaction between them, which results in comprehension (Enright, Grabe, Coda, Mosenthal, Mulcahy-Ernt & Schedl, 2000). To understand the text, the reader must be able to identify and access the meaning of individual words. Once this is achieved, the words must be combined into meaningful clauses and sentences. Besides making sense of individual sentences, the reader needs to integrate the ideas presented in the following sentences and give meaning to the text as a whole (Cain, 2010). This indicates that the reader needs to engage a range of different skills, processes, and types of knowledge in order to extract meaning from the text. Thus, in order to understand read text, the reader needs to understand single words, sentences, and finally the whole text, but also by applying prior knowledge of the subject and inference making to put the read text into a larger context and finally make a mental model of the text (Cain, 2010; Johnson-Laird, 1983; Kintsch, 1998).

Conclusively, reading comprehension is a multidimensional process where the reader extracts meaning from the text while activating several underlying subcomponent skills. A better understanding of the development of these underlying skills is necessary to meet beginner readers' individual needs (Solari et al., 2018). In the following chapter, two influential models of reading comprehension will be presented, accompanied by an elaboration of essential underlying components of reading comprehension.

2.2 Models of Reading Comprehension

2.2.1 The Simple View of Reading

Several influential theories and models have been developed over time, and still, the complete understanding of reading comprehension is not accessible. One of the most influential models is the Simple View of Reading by Gough and Tunmer (1986), which refers to individual differences in reading comprehension as a product of two subcomponent skills: decoding (word reading) and listening (language) comprehension. It is often illustrated through the equation:

$$RC = D \times LC$$

Decoding refers to the efficient recognition of written words and the rapid retrieval of semantic information from the mental lexicon. Linguistic comprehension refers to the ability to take that lexical information of the word in the context of sentence and discourse interpretations (Hoover & Gough, 1990). Simply put, a child applies acquired letter-sound knowledge in order to extract the sound of the word and access its meaning. Next, a child needs to interpret understood words in the context of the sentence and make a mental representation of the text as a whole. Thus, a child has to master both decoding and language comprehension in order to comprehend the text.

Empirical evidence shows that both decoding and listening comprehension contributes to a large variance in reading comprehension (Foorman, Koon, Petscher, Mitchell & Truckenmiller 2015, Hoover & Gough, 1990, for a review, see Hjetland, Brinchmann, Scherer & Melby-Lervåg, 2017, Protopapas, Simos, Sideridis & Mouzaki, 2012), and the relationship between these variables changes with time (Gough, Hoover, & Peterson, 1996; García & Cain, 2014). More precise, decoding skills are predominant in reading comprehension in the early grades, while the importance of listening comprehension increases in the later school grades.

Protopapas et al. (2012) conducted a confirmatory factor analysis to assess the Simple View of Reading and its proposed components: print-dependent components related to decoding and print-independent related to oral language comprehension. Findings provide strong support for the proposed model by The Simple View of Reading and show significant correlations between print-dependent and print-independent components.

In line with the previous study, the findings of a systematic review of 42 studies examine reading comprehension and the development of its precursors from preschool and into elementary school. The results were consistent with The Simple View's two-factor model of reading comprehension. They showed two distinct pathways from preschool to later reading comprehension: one from language comprehension, based on vocabulary and grammar, and the second from decoding, based on phoneme awareness and letter knowledge, to reading comprehension. Overall, the model explained 60% of the variance in reading comprehension (Hjetland et al., 2017).

Although the Simple View of Reading is widely supported, some critics argue that this model is too simple and cannot explain the full complexity of reading comprehension (Conners, 2009). However, the Simple View of Reading does not deny the importance of the constructs such as phonological awareness, morphological awareness, or vocabulary knowledge. Instead, it suggests that decoding and/or linguistic comprehension encompass those constructs (Conners, 2009).

2.2.2 The Reading Systems Framework

The Reading Systems Framework provides a valuable insight into the underlying constructs of reading comprehension, as illustrated in Figure 1 (Perfetti & Stafura, 2014).

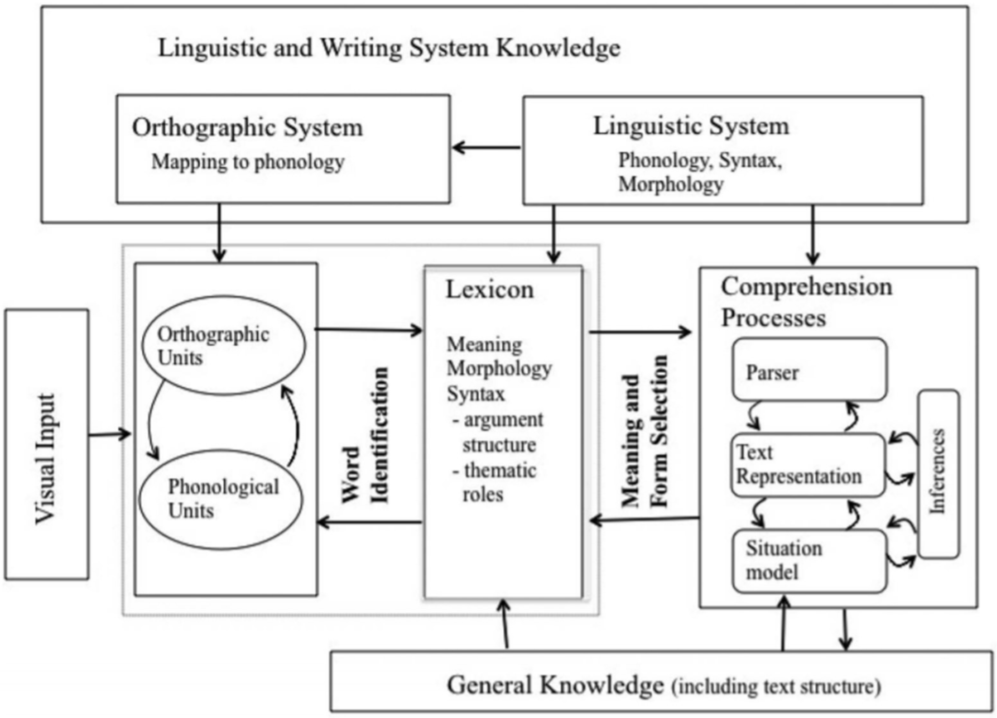

Figure 1 The Reading Systems Framework (Perfetti & Stafura, 2014, p. 24)

This framework gives a broader explanation of reading comprehension by adding the word-level processes to the higher-level comprehension processes. Thus, the Reading Systems Framework consists of word identification, linguistic knowledge, comprehension processes, and general knowledge. This framework emphasizes the knowledge sources (linguistic, orthographic, and general knowledge) and language processes that take place within a cognitive system and further underlines the interactions between them (Perfetti & Stafura, 2014).

A central part of this framework is the lexicon, which has a mediating role between decoding and reading comprehension while integrating general knowledge and language knowledge with comprehension processes (Perfetti & Stafura, 2014, based on Perfetti, 1999).

As can be observed from Figure 1, morphology emerges in the linguistic system and the lexicon. This framework postulates that morphology plays a dual role in reading comprehension. In the first place, as part of the linguistic systems, morphology affects reading comprehension directly by influencing meaning processes across spoken and written language. In the second place, as part of the lexical system, morphology indirectly contributes to reading comprehension by supporting the processing of the lexical representations (Perfetti & Stafura, 2014; Perfetti, Landi, Oakhill, 2005). The role of morphology in this framework will be addressed in more detail in the chapter 3.

2.3 Subcomponent skills development of Reading Comprehension

This chapter will elaborate on the underlying subcomponent skills of reading comprehension. According to the research question of this study, the weight will be put on the print-independent components of reading comprehension.

2.3.1 Word reading

The ability to decode written text into meaningful language units is essential for reading. Decoding is a process of connecting sounds of the language to the print, also known as phoneme-grapheme correspondence, where phoneme represents the smallest unit of the sound that affects the word's meaning. Thus, in the word "cat," if the phoneme "a" is replaced by phoneme "u," the word changes its orthographic and semantic form - "cut." Thus, the first step of successful reading is to connect sounds of the word with the print and to access the semantic, orthographic, and phonological aspects of word representations.

Phonological awareness skills have been identified as the main predictor of successful decoding and critical predictors of early reading ability (for the review, see, Melby-Lervåg et al., 2012). These skills are essential for beginning readers. Given that successful decoding leads to accurate reading fluency, Solari et al. (2018) postulate at least indirect relations between phonological awareness and reading fluency in terms of early reading development and reading comprehension prediction.

A large body of empirical evidence is supporting the importance of phonological awareness in early reading development. Melby-Lervåg et al. (2012) conducted a meta-analysis of 235 studies on phonological awareness and its role in children's reading skills. The review included group comparisons of poor and typically developing children and correlational studies with unselected samples. In contrast to typically developed readers, the poor readers showed a large deficit on phonological awareness tasks (pooled effect size estimated = -.37), and when matched on reading level (pooled effect size estimated = -0.57). Studies of unselected samples showed that phonological awareness has the strongest correlation with individual differences in word reading ability when controlled for verbal short-term memory and rime awareness. Thus, phonological awareness can be seen as a predictor of individual differences in reading development.

Further, the results from the longitudinal study conducted by Clayton, West, Sears, Hulme and Lervåg (2019) indicate a close bi-directional relationship between phonological awareness and reading accuracy. Thus, greater phonological awareness skills lead to higher reading accuracy that in return leads to better phonological awareness.

Over time there have been developed several theories of how children reading. One of the most influential theories is Ehri's (2005) phases of word-reading development. It recognizes four phases of word reading development: pre-alphabetic, partial alphabetic, full alphabetic, and consolidated alphabetic phase. Thus, the reader progress from having no knowledge of print-sound correspondence and eventually becoming a skilled sight word reader. A sight word reader has frequently engaged with words and spelling patterns to recognize words and their spelling rapidly from memory (Cain, 2010). Consequently, the reader enhances the fast and accurate representation of the word and can establish a sight words vocabulary in memory (known as a lexicon; Perfetti, 2007).

Hence, according to the lexical quality hypothesis (Perfetti, 2007), variation in word representations' quality has consequences for reading skills. Thus, high lexical quality emphasizes the interrelations between various aspects of word knowledge (orthography, phonology, morphology, semantics, syntax). Their mutual supportive nature is critical for successful reading. The idea behind high lexical quality is that the more one knows about a word, the more efficient is word decoding, retrieval, and comprehension. On the other hand, low-quality representations of reading words contribute to problems in developing reading comprehension.

2.3.2 Language Comprehension

Language comprehension is the ability to understand words, sentences, and text (Oakhill, Cain & Elbro, 2019). Although it is widely accepted that reading comprehension is the product of decoding and language comprehension, the contribution to the variance in reading comprehension of these two components changes over time. The findings from a meta-analysis conducted by García and Cain (2014) showed that the contribution of language comprehension to reading comprehension increases with age; consequently, the contribution of the decoding decreases. In other words, language comprehension becomes a better predictor of reading comprehension as a child becomes a more experienced reader (Hjetland et al., 2017).

Hoover and Gogh (1990) found that language comprehension is the main predictor of reading comprehension in English-speaking 4th graders. Given that English is a highly inconsistent language, it is expected that automatization of decoding followed with less predictable ability appears earlier in more constrain languages like Norwegian (Cain, 2010).

Although language comprehension appears to be a crucial component of reading comprehension (Hoover & Gough, 1990), Lervåg, Humle and Melby-Lervåg (2018) underlined that the nature of the oral language skills that provide the foundations for listening comprehension needs to be clarified. Oral language is the ability to comprehend spoken language (National Early Literacy Panel, 2008). It is often considered a construct consisting of various skills, such as vocabulary knowledge, morphology, grammar, syntax, pragmatics. Further, oral language skills influence reading comprehension both directly (through the understanding of the words presented in a text) and indirectly (through other literacy-related skills such as phonological awareness) (Spencer & Wagner, 2018).

Oral language is an unconstrained skill that develops over time and acquires naturally from the environment. Hjetland, Lervåg, Hagtvet, Hulme and Melby-Lervåg (2019) conducted a six-year longitudinal study starting before children have started formal education (at 4 years) and followed them beyond the early stages of reading development, examining reading comprehension pathways. Their study showed that oral language is a crucial component for the development of decoding and reading comprehension. Furthermore, this study showed that oral language skills have high stability over time. In summary, early oral language skills play an essential role in both decoding and reading comprehension.

Evidence shows that vocabulary knowledge is the part of oral language that critically influences listening comprehension (Perfetti, 2007; Perfetti & Stafura, 2014; Protopapas et al., 2012; Quinn, Wagner, Petscher, & Lopez, 2015). Nagy and Scott (2000) estimate that one needs to know about 90% of the words in order to understand a text. However, the meanings of the unknown words can be determined rom the context, and one can enrich vocabulary knowledge through reading activity. Thus, after becoming a fluent reader, a child is extending vocabulary knowledge mainly through interaction with written text (Nagy & Scott, 2000).

The relationship between vocabulary knowledge and reading comprehension is reciprocal. That is, children who have limited vocabulary knowledge have difficulties understanding text and consequently learn fewer new words. Conversely, children with well-developed vocabulary knowledge better understand the text and learn a lot more from the same text (Nagy, 2005; Stanovich,1986).

Quinn et al. (2015) conducted a longitudinal study following the sample of 316 children from 1st through 4th grade, intending to examine the co-development of reading comprehension and vocabulary knowledge as a construct. Findings from latent change modeling showed the constant growth in both variables. However, the rate of growth had a negative proportional change. In other words, the skills of better-performing children in 1st grade were growing faster than in the lower performing children. Further, findings showed that growth in vocabulary knowledge influenced reading comprehension at a one-time point. In conclusion, their findings are in line with the idea that growth in reading comprehension depends partly on vocabulary knowledge.

3 Theoretical and Empirical Background: Morphological Awareness

3.1 Nature of Morphology

The words in European languages can be broken down into smaller sound units (phonemes) and units of meaning (morphemes). Where phonemes are defined as the smallest units of sound to make a meaningful difference to a word, e.g., the word rat contains three phonemes /r/-/a/-/t/. Thereby, a metacognitive ability to reflect on and manipulate phonemes is known as phonological awareness. While morphemes are the smallest meaningful units of the word, e.g., the word housekeeper contains three morphemes –house –keep, and –er. Consequently, a metacognitive ability to reflect on and manipulate morphemes is known as morphological awareness.

Morphology is studying the inner structure of words and underlying processes that govern the integration of morphemes into word formation (Berthiaume, Daigle & Desrochers, 2018). Gonnerman (2018) highlighted several types of morphemes used in linguistic and psycholinguistic research. Firstly, depending on whether a morpheme can stand alone and form a meaningful word or not, we make the distinction between a bound and a free morpheme. In the sentence "Du er den snilleste av alle." the word "snilleste" is formed from morphemes snill (free morpheme), -est (bound morpheme, express superlative), and –e (bound morpheme, expresses definite form). As shown in this example, free morphemes can stand alone, while bound morphemes must be attached to other morphemes.

A second important distinction is between a stem morpheme and affixes. A stem morpheme is used as a base of the word that can be used to create other words by adding affixes to it. Like in a previous example, snill is a stem word, while -est and -e function as an affix. Affixes attached before stem morpheme are referred to as prefixes, and one attached after the stem morpheme are referred to as suffixes (Gonnerman, 2018, Kulbrandstad & Kinn, 2016).

The last important distinction often made in the literature is between inflectional and derivational morphemes. When added to a stem word, inflectional morphemes change tense or another grammatical dimension of the word. Thus, inflectional morphemes are used to make a different form of the same word, like -t, -e, -ere, and -est-e in words snilt, snille, snillere, snilleste. On the other hand, when added to a stem, derivational morphemes form a new word. Usually, they change the original grammatical category of the stem, such as adding -het to adjective snill to derive a noun snillhet (Gonnerman, 2018, Kulbrandstad & Kinn, 2016).

Most psycholinguistic studies on the development of morphological awareness in children focus on three types of morphology and its development: infections, derivations, and compounds. The present study concerns the different domains of morphological processes of inflectional and derivational morphology, and therefore they will be presented in more detail in the following section.

3.2 Domains of Morphological processing

Children acquire knowledge about morphology already in their first years of language acquisition, and evidence shows that morphological awareness has a reasonably predictable developmental path (Kuo & Anderson, 2006).

Inflectional morphology conveys grammatical information by adding morphemes on stem morpheme (Kuo & Anderson, 2006; Maynard, Brissaud, & Armand, 2018). In this process, the lexical meaning is unaltered, which means that even the word is changed, it still has the same semantic content (Gonnerman, 2018). Thus, change of tense, number, aspect or other grammatical elements does not interfere with the word meaning. For example, the Norwegian language recognizes three noun genders: masculine, feminine, and neuter (e.g., hesten; boka; huset). Further, nouns express numbers by adding a suffix -er for indefinite and -ene for definite form (hester/hestene). Furthermore, the adverbs and the adjectives in the Norwegian language have to comply with the gender of the noun (e.g., en fin hest, ei fin bok, et fint hus) (Lieber, 2016). The verb's tense in Norwegian is defined by adding the suffix -ed for the regular verbs in the past tense (hoste/hostet). Studies across different languages show that inflectional morphology appears to be the first developed morphological domain (Berko, 1958; Kuo & Anderson, 2006; Diamanti, Mouzaki, Ralli, Antoniou, Papaioannou, & Protopapas 2017). Thus, inflectional morphology must be considered when assessing children at a young age.

Derivational morphology conveys the different meaning or the class of the word (or both) through adding prefixes or suffixes to the stem morpheme (Feldman & Milin, 2018; Kuo & Anderson, 2006; Kulbrandstad & Kinn, 2016). In other words, by adding prefixes and suffixes to a base, the word changes semantic properties. For example, when added prefix -u in Norwegian, it changes a word meaning into the opposite (venn - friend; uvenn - enemy), or when added suffix -lig a word change words class from noun to adjective (vennlig). Acquisition of derivational morphology appears later in development than inflectional morphology (Berko, 1958; Diamanti, Benaki, Mouzaki, Ralli, Antoniou, Papaioannou, & Protopapas, 2018; Kuo & Anderson, 2006), and the developmental trajectory seems to be longer (Casalis & Louis-Alexandre, 2000). It seems natural since derivational morphology is more present in complex words that children get exposed throughout later grades.

Compound morphology is a word-formation process where two or more stem morphemes or words create a new word with new semantic properties (Fejzo, Desrochers, & Deacon, 2018). The meaning of the compound word may be similar to or deviate from the original meaning of its stem/s. The Norwegian language is rich with compound words consisting of 2, 3, 4 or even more words, often written as one long word. For example, the words hus (house) and eier (owner) are compounds into the word huseier (a house owner), or the word skolehelsetjenesten consists of 4 morphemes (the school health care service). Therefore, it is crucial for Norwegian children to be able to "see the words in the word" and to extract meaning from their compound form (Lyster, 2010). The developmental trajectory of compound words shows growth already in the first school years. Overall, it seems that the development of compound morphology appears at an earlier stage than derivative morphology (Kuo & Anderson, 2006).

3.3 Development of morphological awareness and measurement challenges

Given the complexity of the different morphology domains and their different developmental trajectories, it is challenging for the researchers to construct a valid assessment measure for early morphological development.

Firstly, they have to distinguish between an implicit knowledge of the morphological structure and the cognitive ability to manipulate the different elements. In the literature, the first one is often referred to as morphological knowledge, while the second one is morphological awareness (Kuo & Anderson, 2006). In this thesis, morphological awareness is recognized as a metalinguistic ability that goes beyond implicit knowledge of the morphological rules to more explicit conscious levels of identifying and manipulating the smallest meaningful parts (Carlisle, 1995). However, there is no dichotomous distinction between implicit knowledge and the conscious awareness of the morphology (Diamanti et al., 2018). This leads to the assessment issues since it is unclear whether the detected differences reflect differences in metalinguistic awareness or implicit morphological knowledge (Diamanti et al., 2018, Nagy, Carlisle & Goodwin 2014).

Empirical evidence suggests that children master different morphological processes at different points in their development (Kuo & Anderson, 2006). Gombert's model of the acquisition of linguistic awareness from 1992 is widely used to illustrate the development of metalinguistic awareness. The model has four successive phases or levels: (a) the acquisition of the first linguistic skills; (b) the acquisition of epilinguistic control; (c) the acquisition of metalinguistic awareness and (d) the automation of the metaprocesses. The model begins with the compulsory acquisition of linguistic knowledge in the two first phases, becoming a more conscious activity in the last two phases.

Children acquire their native language through interaction with adult role models. In the first phase of children's linguistic acquisition, adults play a crucial role by reinforcing correct language processing in language production and comprehension. This interaction helps children make memory storage of the correct linguistic forms. At the end of the first stage, children seem to be able to use language correctly, but without full awareness and ability to give an explanation about it. In the second phase of metalinguistic awareness development, children's knowledge becomes more organized and stable through the reorganization of implicit knowledge gained during the initial phase. Although the children's knowledge gets extended and they gain more practical use of the rules, it remains un-reflected. Gombert (1992) considers the first two linguistic awareness levels as a foundation for the next two phases. Typical for the first two phases is the overgeneralizations of the rules, such as "buyed" (instead of "bought"), which suggests a gradual progression in the understanding of the rules of inflectional morphology (Diamanti et al., 2018).

In the third phase, children move from a functional use of the language rules to an upper level where they have conscious control of various aspects of the language. Before achieving this level of metalinguistic awareness, children must have developed a functional level of epilinguistic control. When children acquire metalinguistic awareness, they can consciously apply linguistic rules to the various linguistic forms. This level of awareness can only be achieved if provoked by external factors, such as reading and writing. The final phase of the development of metalinguistic processes is automated, where children do not have to engage in an energy-consuming process of conscious linguistic control. This phase concerns two processes: the epilinguistic processes and the automated processes. The automated processes can be optionally replaced by meta-processes whenever children face the obstacle, whereas epilinguistic processes cannot be replaced (Gombert, 1992).

According to Gombert (1992), stable epilinguistic control is established at the end of the fifth year, while the first metalinguistic awareness is identified around 6-7 years old. Hence, although preschool children demonstrate a mastery of inflectional morphological awareness, their knowledge often remains relatively implicit (Carlisle, 1995). This may explain why younger children often perform unevenly on different morphological awareness tasks (Spencer et al., 2015).

In many cases it is not clear whether differences in measures of morphological awareness reflect differences in metalinguistic awareness or in implicit morphological knowledge (Nagy et al.,2014). Many studies use operationalization of Carlisle (1995) who uses a judgment task of the spoken words to tap epilinguistic awareness and a production task to tap metalinguistic awareness. In line with Carlisle's operationalization, Diamanti et al. (2017) designed a morphological awareness tasks that account for both implicit and explicit knowledge, as well as metalinguistic levels of morphological awareness across inflectional and derivational domain. Present study uses adopted version of the morphological awareness tasks developed by Diamanti et al. (2017).

3.4 The Morphological Pathway Framework

There is longstanding evidence of empirical research highlighting the importance of morphology in children's literacy development; still, the morphology is underrepresented in reading and spelling development models (see Carlisle, 2010; Ehri, 2005; Kuo & Anderson, 2006). The most influential, the simple view of reading, acknowledges only listening comprehension as a single linguistic factor for successful reading comprehension (Hoover & Gough, 1990). Whereas the reading systems framework explicitly acknowledges the influence of morphology on reading comprehension (Perfetti, Landi, & Oakhill, 2005; Perfetti & Stafura, 2014). A general idea behind this framework is that reading systems must take into consideration word-level processes, in addition to already considered higher-level processes (Perfetti & Stafura, 2014).

Levesque, Breadmore and Deacon (2021) have summarized increasing research on the importance of morphological awareness on literacy outcomes such as word reading, spelling, and reading comprehension through theoretical model – The Morphological Pathway Framework. This model highlights the multidimensional character of morphology in its support of literacy development in the English language. This framework aims to clarify and specify how the multiple roles of morphology support the development of children's literacy skills.

The Morphological Pathway Framework builds on the Reading Systems Framework (Perfetti et al., 2005; Perfetti & Stafura, 2014) since it sets the foundation for multiple roles of morphology in reading comprehension. Its broad set of different knowledge sources (Linguistic and Writing Systems, General Knowledge) interacting within a cognitive system to support reading comprehension processes was crucial to its use as a basis for this framework.

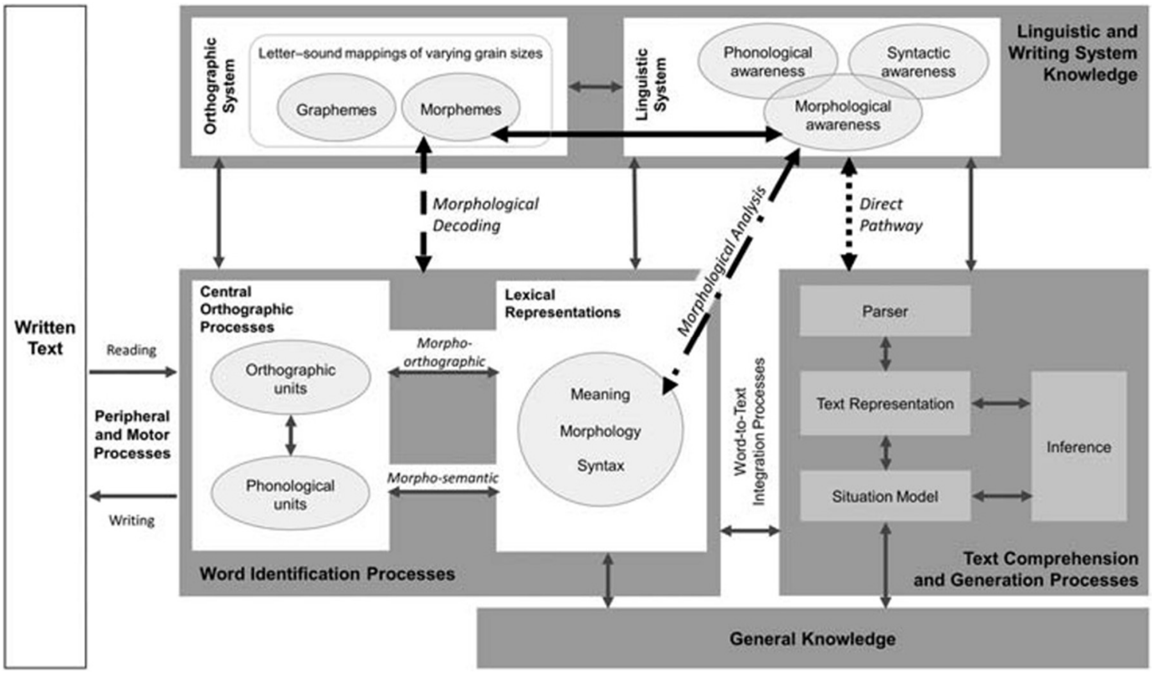

Figure 2. The Morphological Pathway Framework *(Levesque et al., 2021, p. 12)*

Within the Reading Systems Framework, morphology emerges in two distinct systems: the linguistic and lexicon systems (Perfetti & Stafura, 2014). The linguistic system contains morphological, phonological, and syntactic awareness, making a direct pathway between morphology and reading comprehension. Further, the linguistic system supports other components of the framework and provides an indirect morphological pathway through the role of morphology in word reading and its influence on reading comprehension. Furthermore, Reading Systems Framework includes morphology in the linguistic system as a part of the lexicon. This role of morphology illustrates another indirect pathway through which morphology contributes to reading comprehension. Levesque et al. (2021) propose that these three distinct pathways support empirical shreds of evidence of distinguishing dimensions of morphology and its independent contributions to reading comprehension (Goodwin, Carlisle, Petscher & Mitchell 2017; Levesque, Kieffer, & Deacon, 2017, 2019).

The Morphological Pathway Framework suggests that morphological awareness supports readers' comprehension through morphological decoding and morphological analysis during the reading process. The process of morphological decoding occurs at the level of word form, connecting morphological knowledge to the decomposition of morphologically complex words. Whereas morphological analysis acts at the level of word meaning, enabling morphemes to convey meaning in morphologically complex words (Carlisle, 2007, Levesque et al., 2021).

Morphological decoding is considered as the first indirect morphological pathway. This is supported in the empirical evidence of Deacon, Tong and Francis (2017), where morphological decoding accounts for unique variance in reading comprehension in the mid-to-late elementary English graders. The second indirect morphological pathway to reading comprehension is the morphological analysis, which it refers to the underlying mechanism that supports multimorphemic word comprehension. The empirical evidence provided by Levesque et al. (2017, 2019) showed that morphological analysis entirely mediated the contribution of morphological awareness to gains in reading comprehension over time. This illustrates an indirect pathway of morphological awareness through the lexicon where morphological analysis evokes meaning in lexical representations, which in turn supports reading comprehension.

Taken together, Levesque et al. (2021) propose that mechanisms of morphological decoding and morphological analysis have a central role in the process of reading comprehension.

Simultaneously, considering morphological awareness as a broader metalinguistic skill that serves as the foundation for operationalizing those mechanisms. In other words, the developmental level of a child's morphological awareness determines the extent to which morphological decoding and morphological analysis can facilitate reading comprehension of complex words. Further, the authors concluded that future research should focus on a better understanding of these mechanisms' contribution and the development of reading comprehension.

This framework focuses on the role of morphology in word spelling and text generation due to missing empirical evidence on the contribution of morphological awareness to writing composition. The authors highlight that morphology contributes to text generation through the same three pathways as reading comprehension, only acting in reverse.

To sum up, the authors conclude that the Morphological Pathways Framework "specifies key morphological mechanisms that operate bi-directionally and in parallel to support children's literacy development."

4 Morphological Awareness and Reading Comprehension

4.1 Morphological awareness and reading comprehension

Since the meaning of the words can be extracted by analyzing the morphological structure of the words, it is reasonable to assume that morphological awareness can be a helpful tool for readers when they get exposed to unfamiliar words. A large body of empirical evidence indicates a strong relationship between morphological awareness and reading comprehension that has survived beyond several control measures such as general cognitive abilities, phonological awareness, phonological short-term memory, vocabulary knowledge (e.g., Carlisle, 1995; Deacon & Kirby, 2004; James, Currie, Tong & Cain, 2021; Levesque et al., 2017). This relationship is fairly consistent across different orthographies (Casalis & Louis-Alexandre, 2000; Diamanti et al., 2017; Lyster, Snowling, Hulme & Lervåg, 2021).

In a comprehensive longitudinal study, Diamanti et al. (2017) have investigated a prediction of reading and spelling skills of children at the end of the 1st grade by a broad set of preschool measurements of morphological awareness. They found that morphological awareness had a significant unique contribution to almost all outcome variables. Importantly, they found that preschool morphological awareness stands for 9,1% of unique variance in reading comprehension at the end of the 1st grade.

A longitudinal study conducted by Casalis and Louis-Alexandre (2000) was one of the first studies following French-speaking children before formal reading instruction in preschool and throughout 2nd grade with the aim to investigate the development of morphological awareness and its predicting ability of later reading comprehension. Findings show that morphological awareness is a significant predictor of later reading comprehension with improved performance on all morphological tasks across the study.

Deacon and Kirby (2004) conducted a four-year longitudinal study on the contribution of morphological awareness from 2nd grade to reading comprehension throughout 5th grade after controlling for prior measures of reading comprehension, verbal and nonverbal intelligence, and phonological awareness. Performance on an inflectional morphological awareness task at Grade 2 contributed significantly to reading comprehension at both 4th and 5th grade but showed no unique prediction to reading comprehension in 3rd grade. Findings from this study imply that morphological awareness contributes to reading comprehension to a greater extent in later grades in English-speaking children due to exposure to the increasing number of complex words.

Lyster, Lervåg and Hulme (2016) have investigated the long-term effect of morphological awareness training delivered in the preschool children on reading skills measured at the end of the 1st and 6th grades Norwegian-speaking children. They compared the results of two experimental groups who got training in morphological and phonological awareness, respectively, and the control group followed the ordinary preschool curriculum. The morphological training involved activities with identification and manipulation of suffixes and prefixes in the words, as well as extraction of component words in compound words. The results showed that the group who received the morphological training scored significantly better on reading comprehension than in the control group at Grade 1 as well as Grade 6. In contrast, the phonological awareness intervention showed no long-lasting effects on reading comprehension over a 6-year period.

In a recent longitudinal study conducted by Lyster et al. (2021), 323 Norwegian-speaking typically developed children were followed from preschool to 9th grade detecting language-related predictors of reading comprehension. The study is unique in the length, a number of predictors (including morphological awareness), and the use of reliable measures. The research question addressed whether the morphological awareness effect is distinct from phonological awareness and the extent to which morphological awareness correlates with other language abilities. Further, they found that preschool measures of phonological, morphological, and semantic skills form a single language factor that best predicts reading comprehension in late elementary school. Furthermore, the findings confirmed that preschool language skills are direct predictors of reading comprehension outcomes in later grades.

Despite the strong findings of relationship between morphological awareness and reading comprehension, the nature of its relationship is still unclear. Perfetti et al. (2005) propose two roles of morphology in reading comprehension. In addition to its independent contribution to reading comprehension, morphology supports word reading skills through impact on lexical representation of the word and in return contributes to reading comprehension.

Deacon, Kieffer and Laroche (2014) conducted a longitudinal study of children from 3rd to 4th grade, where they investigated two key questions on the relationship between morphological awareness and reading comprehension, while controlling for phonological awareness, vocabulary and non-verbal intelligence. Firstly, the indirect impact of morphological awareness on reading comprehension through the mediation role of word reading skills. Secondly, they investigated whether morphological awareness cause direct gains in reading comprehension and/or vice versa. Findings suggest that morphological awareness contributes to children understanding of the text both directly and through support of reading individual words, which in turn benefit reading comprehension. Further, findings suggest that morphological awareness contributed to gains in reading comprehension, as well as reading comprehension contributed to gains in morphological awareness.

Levesque et al. (2017) examined the relationship between morphological awareness and reading comprehension in 221 English-speaking children in Grade 3. More closely, they aimed to find different mediating factors in this relation for developing readers. They assessed four intervening variables: word reading, vocabulary, morphological decoding, and morphological analysis while controlling for phonological awareness and non-verbal intelligence. Findings showed two indirect and one direct relation between morphological awareness and reading comprehension. In the first indirect pathway, morphological awareness led to better word reading through morphological decoding, which finally contributed to better reading comprehension. In the second indirect pathway, morphological awareness influenced morphological analysis, which led to better reading comprehension. At last, in a direct pathway, morphological awareness contributed to reading comprehension directly, beyond other measures.

James et al. (2021) conducted a comprehensive cross-sectional study with an aim to understand better whether and how different aspects of morphological awareness predict reading comprehension across three age groups: 6–8, 9–11 and 12–13 years; above and beyond age, vocabulary ability, word reading, phonological awareness and nonverbal reasoning. The administrated morphology tasks measured awareness of compounds, inflections and derivations that required two types of responses (production and judgement). Findings showed a single factor structure of morphological awareness for children aged 6 to 13 years that made a unique significant contribution to reading comprehension beyond controlling variables. Further, they employed quantile regression analyses to evaluate the extent to which morphological awareness predicts performance across the reading comprehension ability range for each age group. Findings confirmed the unique variance of morphological awareness across children's reading comprehension abilities.

4.2 Morphological Awareness & Vocabulary

It is clear from already presented theoretical and empirical perspectives that morphological awareness plays a crucial role in vocabulary knowledge. Past research has demonstrated that morphological awareness explains unique variance in vocabulary and that two constructs are closely related (Anglin, 1993; Bowers & Kirby, 2010; Carlisle & Goodwin, 2014; Spencer et al., 2015). Inferring meaning through morphological problem solving might be a tool for vocabulary growth (Anglin, 1993; Levesque et al., 2019). Carlisle and Goodwin (2014) concluded that there is evident an intense growth of morphological awareness in the late elementary grades. They hypothesized that this might amplify students' use of morphological knowledge when assessing unknown words. Bowers and Kirby (2010) concluded that "the consistent structure of written morphology facilitates the use of problem-solving activities in which learners act as "word detectives". Similarly, Nagy and Anderson (1984) estimated that about 60% of the unknown novel text words could be perceived by problem-solving of the morphological structure of the words and their syntax.

Kieffer and Lesaux (2012a, 2012b) conducted two studies concerning the relationship between morphological awareness and vocabulary. In the first study, Kieffer and Lesaux (2012a) the data were collected longitudinally from 90 Spanish-speaking minority students from 4th till 7th grade. Findings showed that vocabulary growth was positively correlated with growth in morphological knowledge. Their second study looked closely at the relationship between those two concepts (Kieffer & Lesaux, 2012b). Participants included 584 6th graders, one group of language minority students learning English as a second language, and a group of students who learned English as a first language. Reported findings showed that vocabulary was comprised of three highly related but distinct dimensions—breadth, contextual sensitivity, and morphological awareness.

Thus, some researchers argue that morphological knowledge and vocabulary knowledge are so closely related that the two terms are the product of the same construct (Kieffer & Lesaux, 2012b, Wagner et al., 2007). Several studies have found that one construct model where morphological knowledge is an integral part of vocabulary is the best fit for experienced readers (Spencer et al., 2015, Wagner et al., 2007). Spencer et al. (2015) concluded that "morphological awareness is an integral part of vocabulary knowledge and may even be considered an additional facet of an individual's depth of knowledge" p.980. Conflicting findings of whether morphological awareness is a separate construct or part of vocabulary might be explained by the use of different statistical models and the reliability of the measurement tasks. Carlisle and Goodwin (2014) suggests that "morphological awareness and vocabulary knowledge are probably distinct yet highly correlated constructs" p. 273.

Findings from the intervention studies show that it is beneficial to include morphological awareness instruction when teaching broader vocabulary knowledge. Bowers and Kirby (2010) provided evidence that a 20-lesson classroom intervention for 4th and 5th English-speaking graders focusing on teaching morphological analysis knowledge and skills contributed to vocabulary development. Children were able to use acquired knowledge beyond the words they are taught, but not beyond the morphological families they are taught. They concluded that learning many base words with attention to morphological principles would significantly improve vocabulary and potentially influence students' reading comprehension skills.

Similarly, Brinchmann, Hjetland and Lyster (2016) employed a quasi-experimental intervention study with Norwegian-speaking 3rd and 4th-grade poor comprehenders intending to examine the effects of a comprehensive word knowledge intervention on the language and literacy skills. Morphological awareness instruction was one of the focus areas in the instruction. Findings supported the hypothesis that intervention was effective in improving language abilities that underpinned reading comprehension. More importantly, students who scored low on the morpheme knowledge test prior to the intervention showed a highly significant effect on a morphological measure of near transfer. They hypothesized that the effect of the intervention on reading comprehension is in line with the lexical quality hypothesis (Perfetti, 2007), explaining that "an indication of how the quality of different word features and the coherence among them facilitate the retrieval of lexical word identities and their integration into a mental model of the text" (Brinchmann et al., 2016, p. 14). Given this, it is no surprise that morphological awareness has been identified as an essential element of developing reading comprehension skills.

4.3 Rationale of the Present Study

As the presented theory outlines, reading comprehension is a multidimensional process composed of many underlying subcomponents. Solari et al. (2018) suggest that a better understanding of these underlying skills is necessary to give adequate reading instruction to children. One of the most influential models of reading, the Simple View of Reading, suggests that reading comprehension is a product of two subcomponent skills: decoding and language comprehension (Gough & Tunmer, 1986). A more nuanced picture of reading comprehension is provided by the Reading Systems Framework, which gives a more detailed explanation of reading comprehension by adding word-level processes to the higher-level comprehension process.

Extensive evidence has highlighted phonological awareness as a critical predictor of successful decoding and early reading ability in general (see meta-analysis by Melby-Lervåg et al., 2012). While it is generally accepted that reading comprehension is the product of decoding and language comprehension, the relative contributions of these skills may change over time (García & Cain, 2014). Consequently, decoding appears to be the most important predictor for beginning readers, while language comprehension becomes increasingly important as readers become more experienced. Language comprehension relies on oral language (National Early Literacy Panel, 2008), which includes various skills such as those examined in this study, vocabulary, and morphology. According to Nagy and Scott (2000), 90% of the words in a text must be known to the reader to fully comprehend it. Additionally, research suggests that vocabulary knowledge is a critical component of oral language that affects listening comprehension (Perfetti, 2007; Perfetti & Stafura, 2014; Quinn et al. 2015).

Furthermore, morphological awareness can give insight into unfamiliar words by analyzing the morphological structure of the words. As outlined, morphological awareness refers to the ability to identify and reflect upon morphemes, which are the smallest units of meaning in a word (Carlisle, 1995). Therefore, it should not come as a surprise that empirical evidence suggests a close relationship between morphological and vocabulary knowledge (Anglin, 1993; Spencer et al., 2015; Levesque et al., 2019). On the other hand, evidence suggests a strong relationship between morphological awareness and reading comprehension that persists beyond vocabulary knowledge, phonological awareness, and a variety of other control measures (e.g., Carlisle, 1995; Deacon & Kirby, 2004; James et al., 2021; Levesque et al., 2017). This thesis focuses on word-level processing to explore to what extent morphological awareness in preschool predicts reading comprehension in 3rd grade, after controlling for other influential word-level subcomponents, such as phonological awareness and vocabulary knowledge.

As a result of illustrating the various components of reading comprehension and the importance of each for this ability, the current study will address the following research question:

"To what extent does preschool morphological awareness predict reading comprehension in third-grade Norwegian students when controlled for phonological awareness, vocabulary, and non-verbal intelligence."

As a control variable, phonological awareness was included in order to avoid simply measuring metalinguistic abilities. Furthermore, nonverbal reasoning has been included to control for the reasoning skills involved in the performance of tasks that will measure other variables. Finally, vocabulary knowledge has been included to distinguish word knowledge and metacognitive ability to manipulate morphemes.

5 Method

The present study employs a quantitative method to determine whether morphological awareness in preschool can predict reading comprehension skills in Norwegian 3rd-graders. The present study is based on the data collected in the research project "NumLit – Development of Numeracy and Literacy in Children" at the Department of Special Education at the University of Oslo.

5.1 Longitudinal Design

The current study uses a longitudinal design consisting of two measurement points collected over a period of four years. Using the longitudinal design, it is possible to analyze how traits and skills develop over time as well as compare the obtained results within and across individuals (Gall, Gall & Borg, 2007). Therefore, the present study's design enables us to examine the relationship between morphological awareness in preschool and later reading comprehension. Due to the fact that no variables were manipulated but only measured as they emerged naturally, the research design of the current study was also non-experimental (Cozby & Bates, 2015).

5.2 Sample

The present study sample is derived from the larger sample of the NumLit-project and consists of 215 children born in 2012. With regard to parents' education and socioeconomic status, the sample is carefully selected to reflect the general population in Norway. as a result, children from four municipalities outside of Oslo were recruited for the study. Children participating in the present study are all native Norwegian speakers with typical development.

5.3 Procedures

Trained research assistants individually assessed the children's abilities at each measurement point. The research assistants were recruited through the University of Oslo, and all had a pedagogical or psychological background. Prior to the assessment period, research assistants received training in administering tests, and if needed, supervisors provided assistance during the assessment period.

The subtests were administered as part of the extensive test battery in the NumLit project, which contains a combination of standardized tests and tests developed specifically for this project. All standardized tests, as well as the tests developed for this project, have been administered according to the manual guidelines. Each year, the tests were conducted between January and the beginning of March. There were three sessions during the first measurement point, and during the second measurement point, there were four sessions. The assessment took place in a quiet room. The duration of each session varied between 45 and 90 minutes, depending on the children's need for a break. During each session, the children were awarded a diploma in order to maintain their motivation.

5.4 Data Analysis

In order to answer the research question, a variety of statistical analyses were conducted using the statistical software Jamovi 1.6 (The Jamovi Project, 2020). In the early stages of the analysis, descriptive analyses were performed to evaluate the properties and distribution of the individual variables. Furthermore, a bivariate correlation analysis was conducted to examine the strength of the association between the included variables. Finally, multiple regression analysis was employed to determine the effect of several predictors on the outcome variable. Therefore, the multiple regression analysis was used to determine the extent to which variation in 3^{rd-}grade reading comprehension can be explained by preschool morphological awareness after controlling for phonological awareness, vocabulary, and nonverbal intelligence.

5.5 The Variables and Their Measurement Tools

Table 1. The Constructs and Their Measurement Tools

Construct	Measures/Variables	Test battery
Morphological awareness	Epi-inflectional Judgment Task Meta-inflectional Production Task Meta-derivational Production Task	
Reading Comprehension	Neale Analysis of Reading Ability (NARA II)	NARA II
Phonological awareness	Phoneme Isolation Phoneme Blending	
Vocabulary	BPVS-II	BPVS-II
Nonverbal-IQ	Raven's CPM	RAVEN

5.5.1 Measures of Morphological Awareness

In the absence of standardized tests, morphological awareness tests were developed by NumLit research group (for review, see García Grande, 2018). The morphological awareness tasks in Greek developed by Diamanti et al. (2018) served as a prototype for those used in the present study. To validate and tailor the morphological awareness tasks for this study, two pilot studies were conducted. The tasks follow Gombert's operationalization of meta-linguistic awareness; thus, one subtest taps into the concept of inflectional morphology, and the other taps into that of derivational morphology.

5.5.2 Epi-inflectional Judgment Task

For the first task, the test leader displays a picture illustrating one action and reads two sentences aloud to the child. Only one sentence describes the illustrated action in a grammatically correct manner. It is important to note that the target word in the second sentence has a correct syntactic structure but with an incorrect inflection (e.g., referring to an action in the plural when the picture illustrates an action in the singular). The child should select the correct sentence. The following is an example of an item of this task: sentence 1: “Skilpadden ser en føls klovn.”, sentence 2: “Skilpadden ser følse klovner.”, accompanied by a picture showing two clowns.

In this task, a child's implicit ability to reflect on inflectional endings in nouns, adjectives, and verbs in non-words is assessed, without the requirement for production on their own. Even though the targeted non-words do not have a semantic meaning, they still display similar syllabic structure and phonological features to real Norwegian words (García Grande, 2018).

5.5.3 Meta-inflectional Awareness Production Task

As part of this task, the test leader presents the child with two pictures showing turtles performing different actions. Furthermore, it is explained to the child that turtles speak an unknown language. Next, the test leader shows the child a second picture, which corresponds to the first picture, and the child is expected to produce an inflection on the targeted non-word that matches the second picture. As an illustration, here is an example of this task: ”Skilpadden bærer faven”, ”Skilpadden bærer...(*favene*)”.

The purpose of this task is to assess the child's explicit awareness of and ability to produce inflectional endings in verbs, nouns, and adjectives (García Grande, 2018).

5.5.4 Meta-derivational Awareness Production Task

In this task, real words are used, and the child is exposed to new pictures. Two sentences accompanied each picture. The targeted word in the first sentence has a stem function for the second sentence, which was designed such that the stem word from the first sentence requires adding a suffix to maintain the correct structure.
In a test situation, the test leader shows an illustrated picture to the child and then reads aloud the corresponding sentence containing the target word. As the test leader begins the second sentence, the child is asked to produce the final word in the sentence producing the derivation of the targeted verb, noun, or adjective from the first sentence. For example, the test leader shows a picture to the child and reads the sentence “Mari skriver i timen.”, then continues the following sentence, “Mari har en time med”, the child is expected to say, “skriving”.

The purpose of this task is to assess the child's explicit derivational awareness through the ability to produce derivations in verbs, nouns, and adjectives by adding suffixes to a targeted stem (García Grande, 2018).

5.5.5 Measure of Reading Comprehension

The reading comprehension test was administered using a Norwegian translation of the NARA-II (Neale, 1999).

5.5.6 Neale Analysis of Reading Ability (NARA II)

The reading comprehension test comprises six narrative texts. Each story is followed by a set of open-ended questions, with four questions following the first story and eight questions following the next five. This test may draw more on comprehension than tests with multiple-choice or closed-ended questions (Cain & Oakhill, 2006). There has been a gradual increase in the complexity of stories, and subsequent questions require more inference making in order to answer correctly.

Prior to reading, the child is presented with an illustration of the story. The child is instructed to read a story and that it will answer questions regarding the story afterward. In the event that a child has difficulty reading a word in the text, the test leader will read the word aloud and ask the child to continue reading. The test was terminated if there were no correct answers to comprehension questions after one story. In this study, only reading comprehension scores were considered, whereas the test also provides scores on reading accuracy and fluency.

5.5.7 Measures of Phonological Awareness

Two subtests of phoneme isolation and blending were used to measure phonological awareness. The research group developed the tests specifically for this project.

5.5.8 Phoneme Isolation

The subtest consists of two blocks. The child is asked to isolate the first phoneme in the first block, and the last phoneme in the second block. There are four items in this task that are accompanied by pictures that illustrate the target words, while the remaining items involve only listening to the first phoneme in the word. For example, the test leader shows a picture to the child and asks, “Which of these begins on /m/: 1. Katt, 2. Mor, 3. Sopp”, or “What is the first sound in / lam /?”.

The second block follows the same format, in which the child is asked to isolate the last phoneme in the targeted word. For example, “Which of these ends in / n /: 1. Gutt, 2. Tann, 3. Bok”, or “What is the last sound in / nål /?”.

Each block is composed of 24 items. A test was interrupted by the test leader in the event of six consecutive errors.

5.5.9 Phoneme Blanding

A test leader presents the child with the phonemes of a targeted word, and the child is instructed to listen to the sounds and draw them together into a single word. As an example, the child is expected to draw the phonemes /b/, /i/, and /l/ into the word /bil/.

There are 24 items of increasing difficulty in this subtest. Upon the occurrence of six consecutive errors, the stopping point was reached.

5.5.10 British Picture Vocabulary Scale II

The Norwegian version of the British Picture Vocabulary Scale (BPVS II) was used to assess receptive vocabulary (Dunn, Dunn, Whetton & Burley, 1997). The test has been developed and standardized for Norwegian conditions by the research group at the Department of Special Education at the University of Oslo (Lyster, Horn & Rygvold, 2010). The test was standardized based on the results of 884 children ranging from 3 to 16 years of age. For practical reasons, a PC-based version of the BPVS II has been developed for this project. The administration and scoring of the PC-based test conformed to the instructions for the original version administered manually.

There are 144 items in the test, divided into 12 blocks. The items have increasing difficulty from high-frequent and concrete to low-frequent and more abstract words. The test leader instructs the child to listen carefully to the recorded spoken word and then point at one of the four pictures that correspond to the recorded word. In the event of eight or more errors within the same block, the test was automatically terminated.

5.5.11 Raven's Colored Progressive Matrices

Raven's CPM was used to assess non-verbal intelligence (Raven, 2004). The target group is the children in the age range 4:0-11:0. For the NumLit project, a computerized version of the standardized test has been developed.
The test leader displays a picture of a pattern with a missing piece on the PC screen and asks the child to complete the pattern by selecting among six alternative solutions to a puzzle with a matching pattern.
Raven’s CPM test consists of a total of 36 tasks in color. The items were organized hierarchically into three series, each consisting of 12 items. There was no stopping criterion in this test, and the scoring was automatic.

5.6 Validity

Studies that follow a quantitative method design draw conclusion about the relationships between variables based on collected numeric data. When conducting any type of research, it is important to adhere to the appropriate methodological principles and guidelines in order to guarantee the quality of the research (Cozby & Bates, 2015). Cook and Campbell (1979) use the term validity to refer to a set of assumptions that are best estimates of the truth, including assumptions about causality. Furthermore, they discuss that a modifier "approximately" is always relevant when referencing validity since one cannot know for sure what is true or what is not.

In this study, the validity is examined according to Cook and Campbell's (1979) classification of the validity into four categories: statistical validity, internal validity, construct validity, and external validity.

5.6.1 Construct Validity

One of the main challenges in educational science is the abstract nature of the variables, which cannot be directly observed (e.g., intelligence, personality traits). Consequently, it relies on measuring properties and concepts observed indirectly by looking at relevant behavior (Befring, 2015). Construct validity refers to the approximate validity of the study method and its operationalization of the higher-order constructs into measurable variables

(Cook & Campbell, 1979). Essentially, it measures how well the variable reflects the higher-order theoretical construct. To ensure construct validity, the researcher makes hypotheses based on the theoretical knowledge of the measured construct to predict the expected behavior of the participants. If the test is a valid measure of the construct, participants will behave as predicted by the theory. Another way to verify construct validity is to examine whether the scores are correlated with scores from other tests measuring the same construct (Cohen & Swerdlik, 2018).

5.6.2 Statistical Validity

Statistical validity refers to the extent to which valid conclusions can be drawn regarding the relationships between examined variables (Lund, 2015). Researchers can draw informed conclusions about whether an effect between two variables is strong enough and statistically significant by applying appropriate statistical methods.

Furthermore, high statistical validity reduces the risk of error-driven conclusions being drawn from the results by reducing the probability of making Type-I and Type-II errors. Type-I and Type-II errors are closely related to null-hypothesis, which states no association between predictor and outcome variables in the population. Hence, in this study, the null hypothesis postulates no relationship between morphological awareness of preschool children and reading comprehension of 3rd graders. A Type-I error occurs when a true null hypothesis suggesting no relationship between variables is rejected, resulting in a mistaken conclusion of a relationship between variables. This is also referred to as a "false positive" conclusion. On the other hand, Type-II error results from the failure to reject a false null hypothesis, resulting in an incorrect conclusion that there is no relationship between variables. Often referred to as a "false negative" conclusion (Gall et al., 2007, Banerjee, Chitnis, Jadhav, Bhawalkar & Chaudhury, 2009).

Statistical significance testing is performed using the null hypothesis in order to estimate the probability that the observed association between predictors and outcome variables could arise due to chance (Banerjee et al., 2009). The probability of making a Type-I error is determined by the significance level set by the researcher at an arbitrary cut-off point. Typically, two significance levels are used .01 and .05. Significance level indicates the probability of making fail conclusions; the probability is between 1% and 5% for a Type-I error. Note that reducing the risk of making a Type-I error increases the likelihood of making a Type-II error. Additionally, sample size and effect size are important statistical factors influencing the size of type-II errors that exceed significance (alpha) levels in a study (Cozby & Bates, 2015). In this respect, researchers must consider these factors when determining the significance level of the study.

There are two major threats to the validity of statistical results: the small sample size and the sample error (Cook & Campbell, 1979). Research can be improved by increasing the sample size, reducing the probability of errors of type-I and type-II, although these cannot be avoided entirely (Banerjee et al., 2009). Statistical validity is also threatened by effect size, which indicates the strength of a relationship between variables. The sample size must be large enough in order to detect even minimal effects (Cozby & Bates, 2015).

Lastly, validity in any statistical analysis depends in part on the reliability of the measures used in research (Cook & Campbell, 1979). Broadly speaking, reliability refers to the degree to which findings are trustworthy, credible, and accurate. Thus, the reliability of a measuring instrument depends upon how consistently it measures over time and how stable it is (Cozby & Bates, 2015). Test-retest estimates can serve as an indicator of the instrument's reliability. It indicates a consistent pattern of scores for a particular participant across repeated measurements (Cohen & Swerdlik, 2018). Another way to determine the reliability of the test is by assessing the internal consistency of the test items. Inter-item consistency is derived from a single administration of a single test form, and it indicates the degree of correlation between all items across the scale (Cohen & Swerdlik, 2018). The inter-item consistency of the current study is assessed with two coefficients: Cronbach's alpha (α) and McDonald's omega (ω).

5.6.3 Internal Validity

Internal validity refers to the approximate accuracy of inferences about the cause and effect of the relationship between variables (Cook & Campbell, 1979). In a nutshell, the internal validity of a study is how trustworthy its conclusions are regarding cause-and-effect relationships. Moreover, the method used for conducting the study also affects its internal validity (Cozby & Bates, 2015). Studies that are not experimental in nature, like this one, cannot conclusively prove that one variable caused the change in another. Fortunately, proper statistical analysis allows for the improvement of internal validity in non-experimental studies. The present study used hierarchical multiple regression to enhance internal validity since it allows for assessing the predictive value of a variable of interest to the outcome variable while controlling for interference from other variables (Kleven, 2002).

5.6.4 External Validity

The primary objective of qualitative research is to generalize findings from a sample to the targeted population as a whole. External validity refers to the extent to which the presumed causal relationships between variables can be generalized across and within other populations or settings (Cozby & Bates, 2015). An appropriate sampling procedure, a large sample size, and a homogenous sample will ensure high external validity (Cook & Campbell, 1979). This study aims to generalize the obtained results to Norwegian monolingual speakers that follow typical developmental patterns. The external validity of the present study is somewhat lower than studies with randomized samples as the results rely on a convenience sample. In conclusion, the extent to which the sample represents the whole population is crucial to the external validity and generalizability of the results (Cook & Campbell, 1979).

5.7 Ethical Considerations

The present study is a part of NumLit project, which has been approved by the *Norwegian Centre for Research Data* (NSD), an institution that governs the use of personal data, privacy, data collection, and research ethics. The fact that the participants in this study are children should be highlighted since they are vulnerable and therefore need to be protected (NESH, 2016). Parental consent was obtained in advance and parents were informed of their right to withdraw from the project at any time. Furthermore, the children were verbally informed about the project and their voluntary participation. Additionally, the participants were informed that all obtained data will be anonymized and used confidentially until the end of the project when it will be deleted. The data were collected by trained research assistants with backgrounds in education or social science. Overall, the current study fulfilled the formal requirements provided by the *Guidelines for Research Ethics* (NESH, 2016).

6 Results

This chapter presents the results of the statistical analysis. First, the study's sample and missing data will be elaborated on. Further, it will be presented descriptive statistics focusing on the distribution of the variables and the measurements' reliability. Finally, it will be considered results from bivariate correlation and multiple hierarchical regression analysis.

Missing data is one of the most common problems in data analysis of longitudinal studies. The final sample in this study consists of 215 participants with no missing data in chosen variables. The participants in this study are part of the broader sample from the NumLit project. The number of missing data was considered small compared to the sample size and scattered randomly throughout the sample. Therefore, deletion was a practical technique for handling missing data (Tabachnick & Fidell, 2018). Further, three outliers of the score lower than 20 in the variable BPVS-II were observed under the visual inspection of the variable in the descriptive analysis. They were removed due to their impact on the variable's distribution. Finally, one outlier of the score higher than 30 in the variable NARA-II was removed due to the inspection of the scatter plot of the residuals in the hierarchical multiple regression analysis and its influence on the results Shapiro-Wilk test.

6.1 Descriptive Statistics of the Variables

In preparation for adequate statistical analysis, all variables have to be assessed with descriptive statistics since its form and nature determine which statistical analysis will be applied. Descriptive statistics use mathematical techniques for organizing and summarizing the set of numerical data to describe variables and their distribution (Gall et al., 2007). The statistical analyses used in this study assume that the data are evenly distributed around an average value (the mean), so-called a normal distribution. The normal distribution curve is a theoretical concept, and the distribution of the real data set deviates to some extent from it (Gall et al., 2007). Further, the characteristics of the data distribution in this study will be described by measures: skewness and kurtosis. The skewness is a measure that informs about the a/symmetry of the data set. Thus, if the data set has many extreme small values or far many values lower than mean, and not so many extreme large values or far many values greater than mean, we conclude that the data set is negatively skewed and reverse. On the other hand, a distribution with perfect symmetry has a skewness of zero. The negative sign indicates the negatively skewed distribution, and a positive sign indicates a positively skewed distribution (Navarro & Foxcroft, 2019). Distributions of the data set also vary in their kurtosis. Kurtosis refers to the degree to which scores cluster at the ends (tails) of the distribution. It expresses how pointy or flat the distribution is (Field, 2013). Thus, a distribution with positive kurtosis has many scores in the tails and is pointy. In contrast, a distribution with negative kurtosis is relatively thin in the tails and is too flat (Navarro & Foxcroft, 2019). Overall, the more the skewness and kurtosis values differ from zero, the more the distribution of the data deviates from the normal curve (Field, 2013). In addition to the evaluation of skewness and kurtosis, the Shapiro-Wilk test is commonly used to test whether the data distribution differs from the normal distribution (Field, 2013). Ideally, we want our data set to be normally distributed or as close as possible to a normal distribution. Therefore, the data has to be assessed with descriptive statistics before further analysis.

Further, the internal consistency reliability of the tests is assessed with traditionally used Cronbach's alpha (α) and additionally with McDonald's omega (ω). Cronbach's alpha provides a measure of internal consistency among the items in the test. It calculates a coefficient of inter-item correlations by using an average value of all possible split-half reliability coefficients (Cohen, Manion & Morrison, 2018). An alternative for Cronbach's alpha is a measure of internal consistency reliability is a McDonald's omega (ω) which is seen as a more robust measure and in some cases provides a more accurate estimate of the reliability of the scale. Internal consistency reliability of .7 or more is considered sufficient for both coefficients (Navarro & Foxcroft, 2019).

Table 2. Descriptive Statistics of All Variables

Variable	M	Mdn	SD	Range	Skewness	Kurtosis	Sh-W	p	α	ω
Epi-inflectional Task	11.21	11	2.48	5—16	-0.25	-0.47	0.97	<.001	.72	.74
Meta-inflectional Task	7.23	7	4.07	0—16	0.16	-0.76	0.98	<.001	.84	.84
Meta-derivational Task	4.78	5	2.12	1—11	0.45	0.19	0.96	<.001	.65	.66
NARA II	15.53	16	5.08	1—30	-0.15	0.22	0.99	.176	.85	.85
Phoneme Isolation	11.46	10	6.60	2—24	0.50	-1.03	0.91	<.001	.93	.93
Phoneme Blending	4.58	2	6.14	0—23	1.48	1.11	0.75	<.001	.95	.96
BPVS-II	63.90	62	11.71	37—90	0.23	-0.74	0.98	.001	.90	.92
Raven's CPM	17.75	17	4.45	7—35	0.27	0.41	0.99	.027	.73	.73

N = Number of participants; M = mean; Mdn = median; SD = standard deviation; range is from lowest to highest observed value; Sh-W = Shapiro-Wilk; p = p-value; α = Cronbach's alpha; ω = McDonald's omega

6.1.1 Epi-inflectional Awareness Judgment Task (Pre-School)

Epi-inflectional Awareness Judgment Task has 16 items measuring children's implicit ability to reflect on inflectional endings of the words. The mean of 11.21 has a slightly higher value than the median of 11, indicating symmetrical distribution. The skewness of –0.25 indicates a slight deviation to the left, while the kurtosis of –0.47 shows a moderate floor effect. However, the Shapiro-Wilk test of 0.97 with a significant p-value <.001 indicates a violation of normal distribution. Therefore, non-parametric tests will be used in further analysis. The test has a sufficient internal consistency of α = .72 and ω = .74.

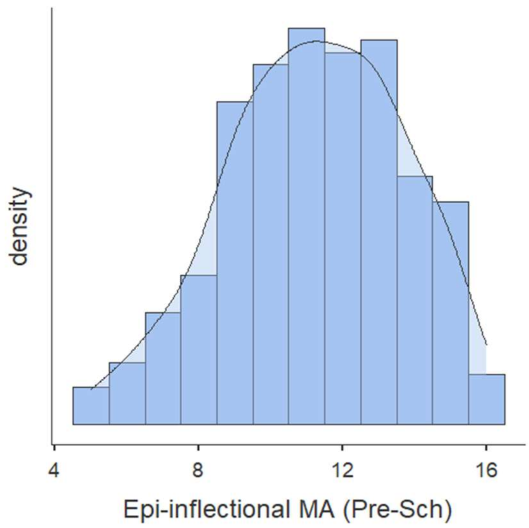

Figure 3. Histogram of Epi-inflectional Awareness Judgment Task (Pre-School)

6.1.2 Meta-inflectional Production Task (Pre-school)

The meta-Inflectional production Task has 16 items measuring a child's ability to produce inflectional endings in words. This variable is approximately normally distributed with somewhat higher values in the tails. Accordingly, kurtosis of –0.76 shows floor effect with moderate deviation, while skewness of 0.16 indicates approximately symmetric distribution around the mean of 7. Significant Shapiro-Wilk with p-value <.001 implies further use of non-parametric statistical analysis. The internal consistency of the test is relatively strong with α = .84 and ω = .84.

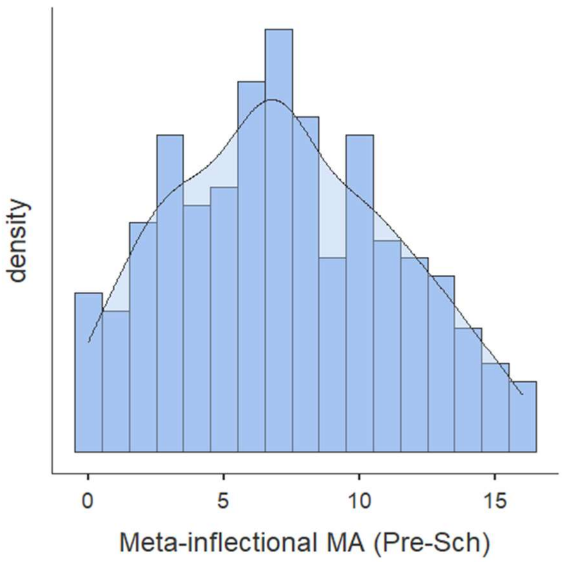

Figure 4. Histogram of Meta-inflectional Production Task (Pre-School)

6.1.3 Meta-derivational Awareness Production Task

Meta-derivational Awareness Production Task contained 14 items measuring children's ability to add a suffix to a targeted stem word and produce a derived word. The histogram of this variable shows an approximately normal distribution with all indices within the corresponding limits. The skewness of 0.45 indicates deviation to the right from the normal distribution. However, Shapiro-Wilk of 0.96 with a significant p-value <.001 indicates deviations from the normal distribution. The reliability coefficients are somewhat weak with $\alpha = .65$, and $\omega = .66$.

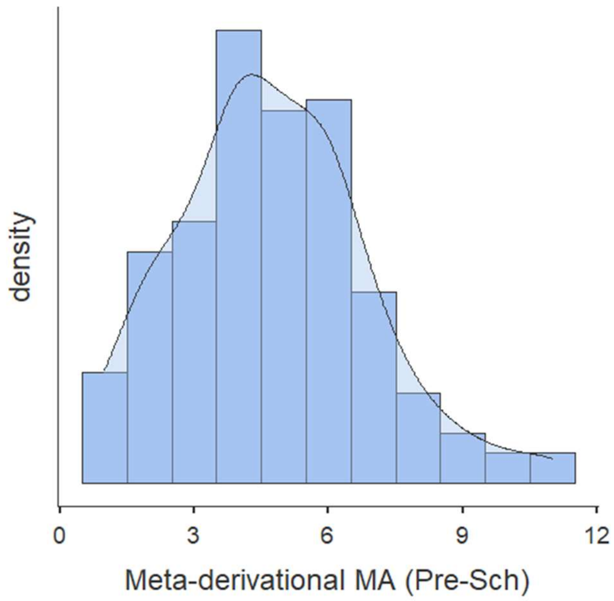

Figure 5. Histogram of Mata-derivational Production Task (Pre-School)

6.1.4 Neale Analysis of Reading Ability (NARA II) comprehension (G03)

Reading comprehension is measured with the NARA-II test. The histogram shows a nearly normal distribution with all indices within the corresponding limits. The mean of 15.53 has a slightly lower value than the median of 16, indicating symmetrical distribution. Overall, a non-significant Shapiro-Wilk score of 0.99 with a p-value of .176 implies no significant deviation from the normal distribution of this variable. The reliability coefficients reasonably high, α = .85, and ω = .85.

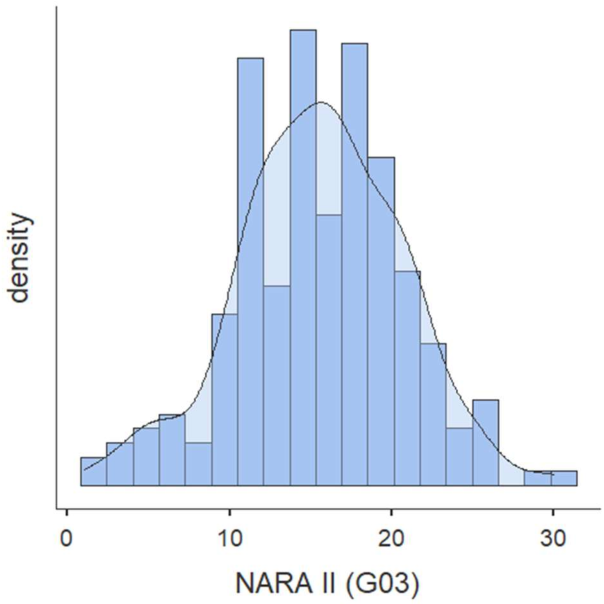

Figure 6. Histogram of Neale Analysis of Reading Ability (NARA II) (3rd grade)

6.1.5 Phoneme Blending

Phoneme Blending Task contained 24 items with increasing difficulty measuring the child's ability to draw a word from presented phonemes. The histogram shows a severe deviation from the normal distribution with a right-skewed peak and skewness of 1.48, accompanied by high values in the left tail and kurtosis of 1.11. Naturally, Shapiro-Wilk of 0.75 with a significant p-value <.001 indicates deviations from the normal distribution. It is apparent that the test did not capture the total variation of this variable and that tasks were too difficult for many children in the sample. The internal consistency of the test is strong, with $\alpha = .95$, and $\omega = .96$.

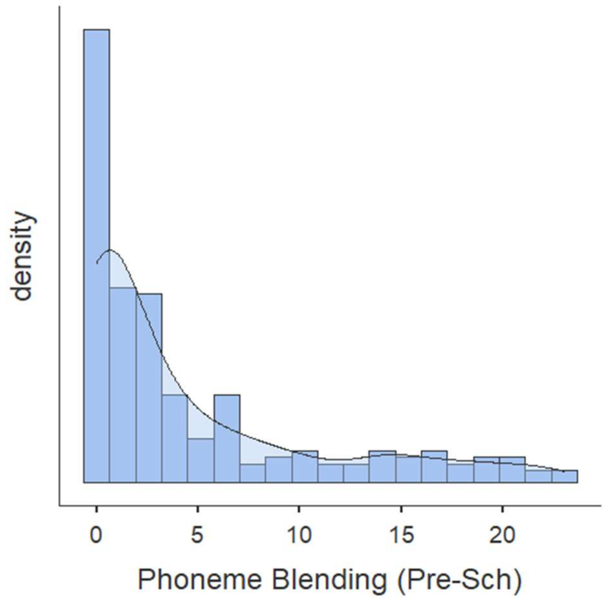

Figure 7. Histogram of Phoneme Blanding (Pre-School)

6.1.6 Phoneme Isolation

Phoneme Isolation Task contained 24 items with increasing difficulty measuring child's ability to isolate a requested phoneme from presented word. The histogram shows a clear deviation from the normal distribution to the right with a skewness of 0.50. Kurtosis of -1.03 shows floor effect indicating tasks weaknesses to capture lower limits of the variation. Naturally, Shapiro-Wilk of 0.91 with a significant p-value <.001 shows deviations from the normal distribution. Phoneme isolation test has strong internal consistency of $\alpha = .93$, and $\omega = .93$.

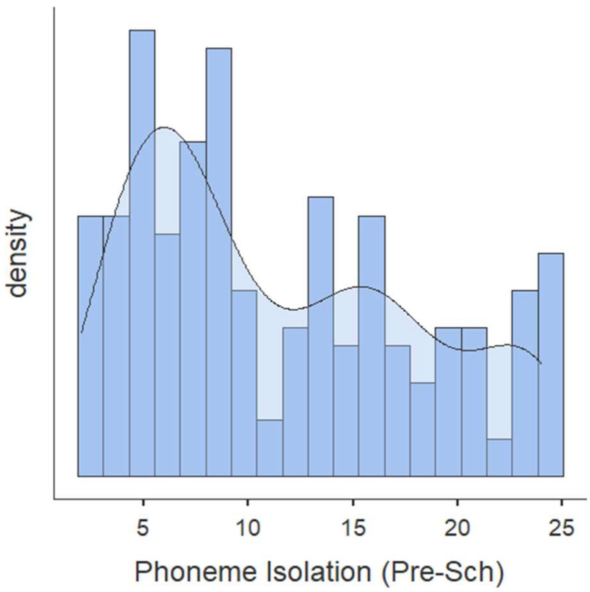

Figure 8. Histogram of Phoneme Isolation (Pre-School)

6.1.7 BPVS-II (Pre-school)

Vocabulary is measured with the BPVS-II test. The histogram shows the approximately normal distribution. The skewness of 0.23 indicates a slight deviation to the right from the normal distribution. Also, a kurtosis of –0.81 indicates a ceiling effect. However, Shapiro-Wilk of 0.98 with a significant p-value of .001 indicates deviations from the normal distribution. The test shows high reliability coefficients; α= .90 and ω = .92.

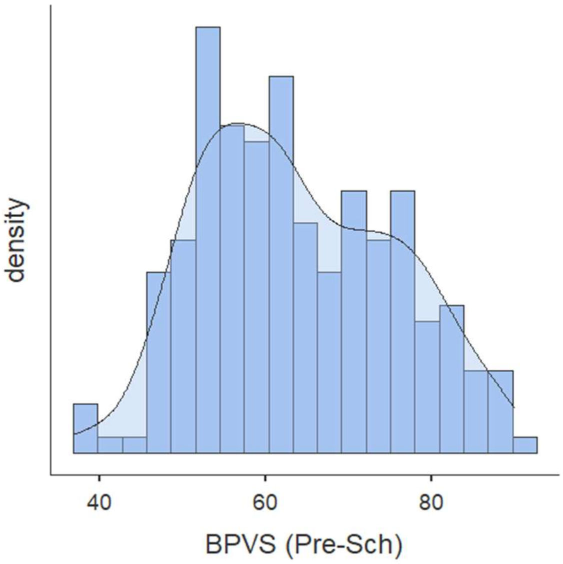

Figure 9. Histogram of Vocabulary (BPVS-II) (Pre-School)

6.1.8 Raven's CPM

Nonverbal-IQ is measured with Raven's CPM. The histogram shows a nearly normal distribution with all indices within the corresponding limits. The skewness of 0.27 indicates a slight deviation to the right, while the kurtosis of 0.41 shows somewhat pointy tails. Overall, the Shapiro-Wilk score of 0.99 with a p-value of .027 imply deviations from the normal distribution. Raven's CPM has a satisfactory internal consistency of α = .73, and ω = .73.

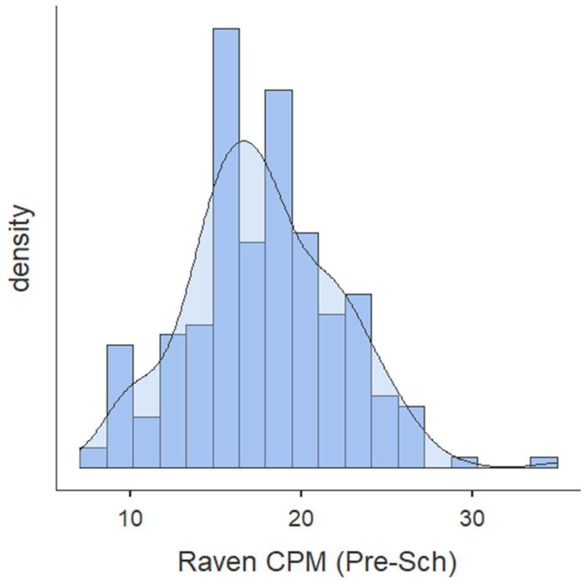

Figure 10. Histogram of nonverbal-IQ (Raven CPM) (Pre-School)

6.2 Bivariate Correlation

As a result of further analysis, covariance between the presented variables can be estimated. Bivariate correlation is a technique that determines the strength and the direction of the relationship between two variables (Gall et al., 2007). The following table 3 demonstrates the association strength between pre-school predictor variables and 3rd grade outcome variables. Pearson's product-moment correlation coefficient, commonly known as Pearson's r, is a measure of correlation. It refers to the average cross-product of the standardized scores of two variables. Pearson's r ranges from –1 to +1. A value of -1 indicates a perfect negative relationship, that is, an increase in one value implies a decrease in another. A value of +1 represents a perfect positive relationship, a rise in one value indicates a rise in the other value. The value of .00 indicates that there is no linear relationship or predictability between two variables (Tabachnick & Fidell, 2018). Another common measure is Spearman's correlation coefficient, a non-parametric statistic used when normality has been violated. The Person's equation is applied to ranked data to minimize the effect of extreme scores (Field, 2013). As the variables in this study are primarily non-normally distributed, Spearman's ρ correlation coefficient is a better indicator of correlations between variables. Both coefficients are included in Table 3. Furthermore, a squared correlation of the correlation coefficient will be calculated to provide an estimate of the proportion of variance shared by the two variables (Tabachnick & Fidell, 2018).

Table 3 Correlation Matrix

	1	2	3	4	5	6	7	8
1. Epi-inflectional Task		.546***	.222**	.262***	.253***	.368***	.302***	.385***
2. Meta-inflectional Task	.544***		.447***	.331***	.406***	.422***	.448***	.450***
3. Meta-derivational Task	.225***	.449***		.374***	.230***	.204**	.357***	.199**
4. NARA II	.274***	.339***	.360***		.245***	.207**	.370***	.148*
1. Phoneme Isolation	.254***	.399***	.224***	.247***		.743***	.280***	.287***
2. Phoneme Blending	.290***	.362***	.185**	.196**	.753***		.321***	.334***
3. BPVS-II	.274***	.439***	.360***	.364***	.276***	.303***		.275***
4. Raven's CPM	.374***	.440***	.187**	.100	.302***	.336***	.255***	

Correlation is significant at the .05 level (Two-tailed) ** Correlation is significant at the .01 level (Two-tailed) * Correlation is significant at the .001 level (Two-tailed).*
Pearson's r is displayed in blue on the left side of the diagonal; Spearman's ρ is displayed in green on the top right

Table 3 presents the strength, direction, and significance level of the relationship between variables. All interpretable correlations correlate positively, where the majority of variables correlate significantly at $p < .001$, some correlate at the level of $p < .05$, and few at $p < .01$. In the educational sciences, a correlation between .20 and .40 is considered high (Gall et al., 2007).

Firstly, morphological awareness measures correlate significantly with the outcome variable NARA-II at the significance level of $p < .001$. Epi-inflectional morphological awareness explains 7.5 % variance in reading comprehension, with $r = .274$. Meta-inflectional morphological awareness explains a slightly higher proportion of reading comprehension variance (11.5 %), with $r = .339$. Finally, the strongest association shows meta-derivational morphological awareness explaining 13 % of the reading comprehension variance ($r = .360$).

Furthermore, the measures of morphological awareness correlate significantly with the controlling variables. The table 3 illustrates the correlation between them, so it will not be discussed further. Nevertheless, it is important to examine closely the relationship between the controlling variables and the outcome variable. It was unsurprisingly the vocabulary measure BPVS-II provided the strongest significant correlation with the reading comprehension explaining 13.2 % variance ($r = .364$, p < .001). Furthermore, a significant portion of the variance is explained by measures of phonological awareness. Thus, phoneme isolation explains 6.1 % variance ($r = .247$, $p < .001$), accordingly phoneme blending explains 3.8 % variance, with $r = .196$, $p < .01$. Finally, a weaker association was obtained between nonverbal-IQ and reading comprehension with a shared variance of 1% ($r = .100$) showing no significant relationship.

Finally, a significant intercorrelation between morphological awareness measures is present. The strongest correlations are observed between meta-inflectional morphological awareness tasks and the two other measures. Respectively it has a shared variance of 29.6 % with epi-inflectional morphological awareness ($r = .544$, $p < .001$) and 20.2 % with meta-derivational awareness ($r = .449$, $p < .001$). A somewhat lower correlation is observed between epi-inflectional morphological awareness and meta-derivational awareness with a shared variance of 5.1 % ($r = .225$, $p < .01$). In general, their not very high shared variance indicates that the three measures tap morphological awareness somewhat differently.

6.3 Hierarchical Multiple Regression

This study uses hierarchical multiple regression analysis as the purpose of this study is to determine to what degree morphological awareness in pre-school predicts reading comprehension in 3rd-grade readers. After all potential control variables have been taken into account, hierarchical regression is used to determine whether a variable of interest explains a statistically significant amount of variance of the outcome variable (Tabachnick & Fidell, 2018). This analysis is particularly useful when there are many control variables, as in the present study. In hierarchical regression analysis, the researcher selects the predictors in a hierarchical order based on the theoretical knowledge and the researcher's decision (Field, 2013).

6.3.1 Assumption checking

In order for the regression analysis to be valid, a number of assumptions must be met in advance. In particular, the following assumptions will be discussed: assumptions of normality, linearity, homogeneity of variance, and independence.

The assumption of normality ensures normal distribution and independence of residuals. In a regression analysis, residuals represent values that are not accounted for by a regression line. These values are referred to as errors between predicted and achieved scores (Tabachnick & Fidell, 2018). A scatterplot inspection showed one extreme value (a score of 33 points) for the outcome variable, resulting in a significant Shapiro-Wilk test of the regression residuals. After removing the outlier, a final sample of 215 children was obtained. A scatter plot of the residuals does not indicate any problems, and the Shapiro-Wilk test result is not significant (0,99, $p < .174$). As a result of these adjustments, the assumption of normality is met.

Multiple regression analysis provides accurate estimates of predictors and outcome variables only if the relationship between them is linear. The linearity assumption is often assessed by examining scatterplots. Scatterplots with an oval shape and a straight line indicate a linear relationship (Tabachnick & Fidell, 2018). The individual residual scatterplots and Q-Q plots do not indicate any threat to linearity. Thus, we can conclude that this assumption has been met.

A residual scatterplot can be used to test the assumption of homogeneity of variance in regression analysis, which implies that the errors of prediction are approximately even across all levels of the predicted variables (Tabachnick & Fidell, 2018). On the basis of visual inspection of the residuals, shown in the plots below, it appears that they are distributed approximately evenly around the mean of 0. The assumption of homogeneity is considered to be met.

It is assumed that errors of prediction are independent of one another, and this assumption is considered met.

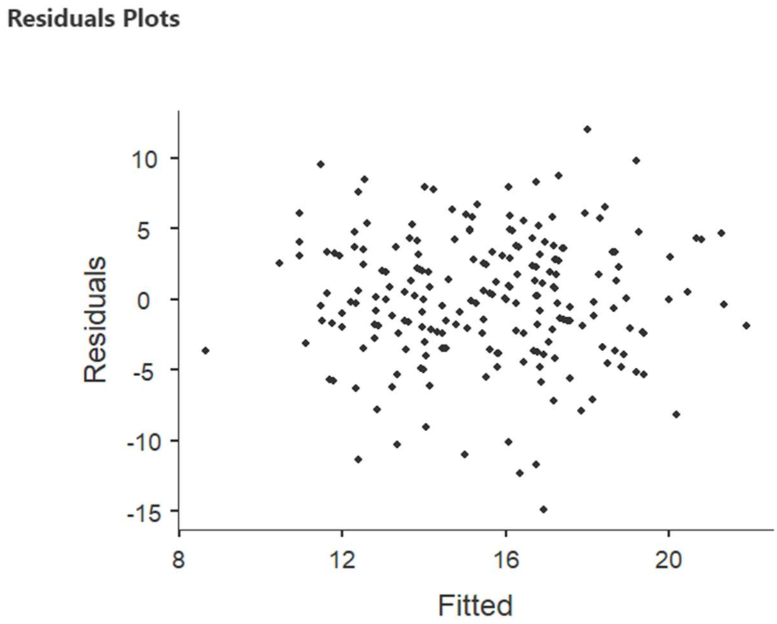

Figure 11. Scatterplot of Standardized Residuals for the Prediction of Reading Comprehension in grade 3.

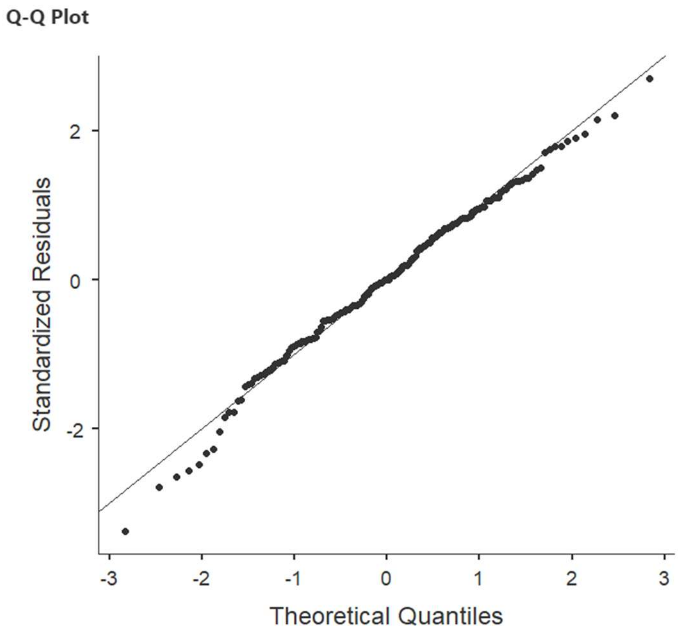

Figure 12. Quantile-Quantile Plot of Standardized Residuals for the Prediction of Reading Comprehension in grade 3.

6.3.2 Results from the Regression Analysis

Regression analysis was performed in hierarchical order with reading comprehension as an outcome variable, morphological awareness as a predictor while controlling for nonverbal-IQ, phonological awareness, and vocabulary. The hierarchical model consists of four blocks: the first block contains nonverbal ability (Raven's CPM), the second block consists of phonological awareness measures (Phoneme Isolation and Phoneme Blending), receptive vocabulary (BPVS-II) is entered in the third block, and finally, measures of morphological awareness were added (Epi-inflectional MA, Meta-inflectional MA and Meta-derivational MA). Controlling predictors were entered with consideration of theoretical and empirical background.

Table 4 below displays the hierarchical regression model fit measures: the multiple correlation (R); the total proportion of the variance in the outcome variable added by the step—squared multiple correlations (R^2); variance accounted by predictors if the model has been derived from the population - adjusted R^2; F-test of the block with an associated p-value.

Table 4. Hierarchical Regression Analyses Model Fit

model	R	R^2	adjusted R^2	F	$df\ 1$	$df\ 2$	p
1	0.100	0.010	0.005	2.145	1	213	.145
2	0.249	0.062	0.049	4.645	3	211	.004
3	0.397	0.157	0.141	9.806	4	210	< .001
4	0.486	0.236	0.210	9.136	7	207	< .001

Model 1: Reven CRP
Model 2: Reven CRP, Phoneme Isolation, Phoneme Blending
Model 3: Reven CRP, Phoneme Isolation, Phoneme Blending, BPVS
Model 4: Reven CPR, Phoneme Isolation, Phoneme Blending, BPVS, Epi-inflectional MA, Meta-inflectional MA, Meta-derivational MA
Outcome variable: NARA-II

Table 5 bellow displays the hierarchical regression model comparisons measures: ΔR^2—improvement in variance when the step is entered, ΔF—F-test of the improved variance, and its corresponding p-value.

Table 5. Hierarchical Regression Analyses Model Comparisons

Comparison	ΔR^2	ΔF	*df1*	*df2*	*p*
1 - 2	0.052	5.847	2	211	.003
2 - 3	0.095	23.783	1	210	< .001
3 - 4	0.079	7.102	3	207	< .001

Model 1 consists solely of nonverbal ability. It accounts for 1% of the variance and is a nonsignificant predictor of later reading comprehension (adjusted R^2 = .005. $F(1, 213)$ = 2.145, p .145). Nonsignificant *p*-value indicates that this result would occur by chance 14.5% of the time.

In Model 2, phonological awareness measures were added in addition to nonverbal-IQ. Model 2 explains approximately 6.2 % of the total variance of reading comprehension in grade 3. It is a significant predictor (adjusted R^2 = .062. $F(3, 211) = 4.645$, p .004). ΔR^2 shows 5.2% of the improvement in variance when the second block is entered in the model.

Model 3 adds measures of receptive vocabulary in addition to previous predictors and it accounts for approximately 15.7 % of total variance (adjusted R^2 = .141. $F(4, 210) = 9.806$, $p < .001$). Vocabulary predicts significantly children's reading comprehension ability with 9.5% of the improvement in the variance when entered in the third block of the model.

In Model 4, measures of morphological awareness were added as a final step. The total amount of variance predicted in reading comprehension (NARA-II) in 3rd grade in the overall model with all predictors included (block 4) is approximately 23.6 % (adjusted R^2 = .210. $F(7, 207) = 9.136$, $p < .001$). The morphological awareness measures accounted for an additional 7,9% of the variance of reading comprehension in 3rd graders ($\Delta R^2 = .079$, $p < .001$).

In order to compare the strength of the effect of each individual predictor to the outcome measure, it is important to look at the individual contributions of the predictors. Table 6 provides an overview of the obtained regression coefficients: an estimate of *b* refers to the actual slope of the variable, SE—standard error of the *b*, standardized estimate (β) refers to the standardized measure of the relationship between predictors and outcome measure, *t* stands for the t-statistic accompanied with an associated *p*-value. Thus, findings show that only two individual predictors have significant unique association with the outcome measure at level < .05 (Meta-derivational MA and BPVS).

Table 6. Model coefficients NARA-II

Predictor	*b*	SE	*β*	*t*	*p*
Intercept	4.258	2.388		1.783	.076
Raven CPR	-0.126	0.080	-0.110	-1.572	.118
Phoneme Isolation	0.109	0.073	0.142	1.502	.135
Phoneme Blending	-0.041	0.079	-0.050	-0.521	.603
BPVS	0.094	0.030	0.217	3.087	.002
Epi-inflectional MA	0.292	0.152	0.081	1.929	.055
Meta-inflectional MA	0.101	0.108	0.143	0.932	.352
Meta-derivational MA	0.508	0.167	0.212	3.042	.003

7 Discussion

The primary goal of the present study is to evaluate the relationship between morphological awareness and reading comprehension skills. More precisely, the purpose of the present study has been to investigate whether morphological awareness measured in preschool can predict reading comprehension in Norwegian 3rd-grade students. As discussed in the theory chapter, there are several reasons why the relationship between morphological awareness and reading comprehension is of interest.

7.1 Results in light of theoretical and empirical background

The results from hierarchical multiple regression show that morphological awareness measured in preschool accounted for a 7.9 % unique variance in reading comprehension in 3rd grade. These results are compatible with other longitudinal studies that have found a unique predictive value of morphological awareness for later reading comprehension (Deacon & Kirby, 2004; James et al., 2021; Levesque et al., 2017; Casalis & Louis-Alexandre, 2000; Diamanti et al., 2017; Lyster et al., 2021).

The consistency of the research on the relationship between morphological awareness and reading comprehension is not surprising, given that morphemes are the smallest meaningful units in the word. However, even most research conducted on this subject shows a significant relationship between two constructs, the degree to which morphological awareness and reading comprehension relate varies across the studies. Kuo and Anderson (2006) emphasized that morphological awareness is a multidimensional concept interconnected with other linguistic aspects that have inevitably been operationalized differently by the range of tests that have been used in empirical research. In other words, the varying results may be a consequence of different orthographies or simply age differences of the participants and a research method or a measurement tool that only partially maps the construct of morphological awareness. For this reason, before further discussion of the results, the nature of the morphological awareness task used in this study needs to be addressed.

Unlike most previous research that has assessed just a single aspect of morphology or used a single task, this study takes a more holistic approach, including assessments of different types of morphology (inflectional and derivational) accounting for two levels of awareness (epilinguistic and metalinguistic) across two types of responses (production and judgment). Doing so, this study reveals a more comprehensive picture of the construct of morphological awareness and, consequently, its relationship to reading comprehension.

According to the research in English, inflectional morphological awareness is the best predictor of early elementary school reading development, whereas derivational morphological awareness takes over as the best predictor beyond 2nd grade (Kuo & Anderson, 2006). Meta-derivational morphological awareness task is a significant predictor of reading comprehension, whereas two of the other measures were not statistically significant on their own. A plausible explanation is that variability in meta-derivational morphological awareness seems to outweigh the variance accountable to epi- and meta-inflectional morphological awareness. Perhaps, this subtest has a greater predictive value since it requires the most advanced levels of morphological awareness. Hence, performance on this specific task, which requires an advanced level of morphological awareness, should give a better idea of future reading comprehension abilities.

Another common limitation of previous research on morphological awareness is the use of real-words in the measurements (e.g., Kirby et al., 2012), making it challenging to distinguish the contribution of word knowledge and morphological awareness to reading comprehension. To minimize word knowledge interference, morphological awareness measures in the present study include both real and non-words.

The predictive value of the morphological awareness measured in preschool accounts for approximately 7.9 % variance in reading comprehension in Norwegian 3rd-grade students. In particular, the result from the present study seems consistent with the result by Diamanti et al. (2017), who reported that morphological awareness measured before school entry predicted 9.1 % of unique variance in reading comprehension in Greek students at the end of the 1st grade. Both, present study and Diamanti et al. (2017) measured morphological awareness at the preschool developmental stage, avoiding the reciprocal influence of literacy and morphological awareness on its development.

A similar pattern with the present study was revealed in James et al. (2021), showing that morphological awareness made significant contributions to reading comprehension for the children in age group 6-8 years old (change in adjusted $R^2 = .06$) and 12-13 years old (change in adjusted $R^2 = .04$). Children in the current study were an average of 8.3 years old, making the results comparable with the results obtained in a younger group. Furthermore, the results are in line with a longitudinal study conducted by Casalis and Louis-Alexandre (2000) with French-speaking children in 2nd grade, concluding that morphological awareness accounted for 5.7 % of the variance in comprehension beyond the contribution of age, phonological awareness, intelligence, and vocabulary.

Similarly, Carlisle (2000) found that morphological awareness explained 43% of the variance in reading comprehension of English-speaking 3rd graders and 55% variance in 5th graders. Note that neither vocabulary nor phonological awareness were controlled for in this study; thus, the unique contribution of morphological awareness to reading comprehension is likely to be overestimated. Even methodological issues deserve caution; Carlisle's (2000) findings suggest that the role of morphological awareness will increase as children grow older. In line with Carlisle (2000), findings from Deacon and Kirby (2004) showed that morphological awareness in English-speaking children to a greater extent contributes to reading comprehension in later grades, arguably due to exposure to the increasing number of complex words.

One of the main concerns in research on morphological awareness is the extent to which morphological awareness—and not just broader metalinguistic awareness—affects reading ability. Therefore, the present study includes measures of phonological awareness to distinct influence of knowledge and awareness of morphemes from general metalinguistic awareness. In addition, by controlling for vocabulary knowledge, the study demonstrates the specific influence of morphological awareness on reading comprehension beyond the influence of general language competence. Thus, findings are consistent with previous research on this subject (Deacon & Kirby, 2004; James et al. 2021; Kirby et al., 2012); the influence of morphological awareness on reading comprehension remained even after controlling for meta-linguistic measures, such as phonological awareness and vocabulary.

Does the contribution of morphological awareness increase over reading development?

As previously noted, the effect of morphological awareness on reading comprehension may vary with reading experience and age. As literacy skills develop and children are exposed to more morphologically complex words in their textbooks, morphological awareness becomes one of the most crucial factors behind reading comprehension (Anglin, 1993). James et al. (2020) state that this statement requires more research due to the lack of longitudinal studies that measure both constructs at multiple time points. By comparing the results of a study conducted by Bjerkelund-Olsen (2020), we can contribute to clearing the air on this topic. Considering that both studies have sampled from the same population of children and conducted statistical analyses with the same methodology, using the same measuring tools for all variables, the results can be comparable. The Bjerkelund-Olsen study (2020) concluded that morphological awareness measured in preschool explained 6.5 % of the variance in reading comprehension in 2nd grade when controlled for phonological awareness, vocabulary, and nonverbal intelligence. According to the present study results, the predictive value of morphological awareness in 3rd grade (7.9 %) increased by 1.4%. Thus, findings from the current study follow previous research in other languages (Anglin, 1993; Diamanti et al., 2017; Deacon & Kirby, 2004; James et al., 2021) and indicate that morphological awareness plays a greater role in reading comprehension across grades.

Relationship between morphological awareness and vocabulary knowledge

In the present study, vocabulary also made a significant unique contribution in predicting reading comprehension (β = .217, p .002). Thus, when added in the third step of hierarchical regression analysis, it accounts for 9.5% additional variance after phonological awareness and nonverbal intelligence. This finding is consistent with other studies that found significant the role of vocabulary in the development of reading comprehension (Diamanti, 2017; James et al., 2021; Spencer et al., 2015). Also, the present study falls in line with research to have established significant correlations between morphological knowledge and vocabulary knowledge (Anglin, 1993; Bowers & Kirby, 2010; Carlisle & Goodwin, 2014; Spencer et al., 2015; Levesque et al., 2019). The current study shows 30-45% covariance between different morphological awareness tasks and the measure of receptive vocabulary. Several studies have examined the relationship between those two constructs and their parallel development. For instance, many studies have looked at how the ability to reflect on the smallest meaningful parts of the words may be a tool for growth in vocabulary by assessing the meaning of the words through morphological problem solving (Anglin, 1993; Bowers & Kirby, 2010; Levesque et al., 2019). The aim of this study is not to thoroughly investigate the complex relationship between morphological awareness and vocabulary. Rather, the findings indicate that the two variables are closely related to the outcome variable and significantly correlate to one another. This emphasizes the complex nature of morphological awareness and its possible multiple effects on reading comprehension.

Results in light of presented theoretical models

The results from the present study align well with contemporary theoretical models of reading that account for the contribution of morphological awareness to reading comprehension (e.g., Perfetti & Stafura, 2014; Levesque et al., 2021). The regression analysis showed that the underlying construct of morphological awareness predicts gains in later reading comprehension. Thus, findings from the current study suggest that morphological awareness deserves to be considered in reading comprehension models. The present study can only contribute to the hypothesis regarding the direct impact of morphological awareness through language system on reading comprehension due to the limitations of statistical analysis. Morphological awareness may aid children to understand complex words and help them to interpret the meaning of the passages and text as a whole (Anglin, 1993). Alternatively, Carlisle (1995) has argued that morphological awareness may bring together semantic, phonological, and syntactic information of the word and, doing so, influence reading comprehension.

Despite the lack of comprehensive coverage in this study of the pathways by which morphological awareness contributes to reading, other research indicates their existence. Deacon et al. (2014) provided evidence that inflectional/derivational morphological awareness could, directly and indirectly, influence reading comprehension in 8- and 9-year-old students beyond the influence of phonological awareness, receptive vocabulary, and nonverbal reasoning. Levesque et al. (2017) examined this matter further, showing that morphological awareness also predicts decoding of morphologically complex words, thereby indirectly improving reading comprehension through word-reading.

7.2 Results in Light of Validity

7.2.1 Construct validity

In line with other studies in educational science, the present study faces the same challenges in operationalizing abstract constructs and determining their measurable properties (Befring, 2015). This study employs several abstract constructs, including morphological awareness, reading comprehension, vocabulary knowledge, and nonverbal intelligence. The question here is whether these abstract constructs have been adequately operationalized in the tests that were used. Regarding the present study's research question, it is of utmost importance to evaluate morphological awareness and reading comprehension measures.

Construct of morphological awareness was tested by three subtests: Epi-inflectional Awareness Judgment Task, Meta-inflectional Production Task, and Meta-derivational Awareness Production Task. One of the strengths of the morphological tests used in this study is that they measure both implicit morphological awareness through the judgment subtest and explicit morphological awareness using the production subtest. Hence, tests account for theoretical perspectives on children's gradual developmental progression from implicit to explicit knowledge (Carlisle, 1995). Furthermore, the tests are limited to two domains of morphology, inflectional and derivational, not taking a measurement of compound morphology into account. Although mastering the meaning of compound words might be crucial for the Norwegian-speaking children since the language is dense with compound words (Lyster, 2010). The reasoning behind not including compound words in the morphological awareness test battery is prediction that morphological awareness corresponding to compound words will develop at an early stage such that the mapping is likely to exhibit a roof effect. The results of the García Grande (2018) pilot study support this hypothesis. Furthermore, García Grande (2018) found that 39% of the variance in the data was attributed to the beforementioned three tasks used to estimate the morphological awareness construct. This implies that the remaining variance was due to unidentified factors, possibly other closely related (meta)linguistic skills.

Another problem with measuring morphological awareness comes from its strong association with other linguistic constructs, which might make its measurement problematic due to the issue of the "task impurity", where the test does not only measure the construct of interest but might also measure other constructs which are close to it (Miyake, Friedman, Emerson, Witzki, Howerter & Wager, 2000). Thus, by using only the real words in the tasks, it may not be possible to determine whether children utilize their morphological awareness or are merely getting words out of their lexicon to solve tasks. In this study, morphological awareness tasks included real words and non-words to measure a construct of interest more accurately. A further strength of this study is that it includes different word classes, such as nouns, adjectives, and verbs. Finally, with morphological awareness measures spanning various levels and domains of morphology, this study captures the construct of morphological awareness extensively.

Further, an accurate assessment of reading comprehension ability is essential for this study. NARA II is a test that assesses both reading accuracy and comprehension; however, only a measure of reading comprehension is considered in the present study. In order to examine complex constructs such as reading comprehension, the instruments and procedures used must be accurate and confounding factors that might affect the results must be taken into account. Therefore, Spooner et al. (2004) argue that word reading skills may limit the ability to comprehend a read text and that two test parts should not be used separately, as in the current study. Cain and Oakhill (2006) argue that this is less likely to be the case with the NARA II because the test leader corrects misread words compared to other comprehension tests.

Furthermore, reading comprehension requires different cognitive and language skills (Cain & Oakhill, 2006), including word reading, listening comprehension, vocabulary, and processing load. Therefore, it is difficult to determine a pure measure of comprehension. Additionally, NARA II typically demands very high output requirements since it assesses reading comprehension using open-ended questions. It is not known to what extent this production requirement from NARA II compromises comprehension performance. Given the complexity, Cain and Oakhill (2006) concluded that "there is not an optimum way to tap an individual's understanding of a text" and outlined that NARA II can be a valuable tool for researchers if used appropriately.

With regard to the construct validity of control variables, both receptive vocabulary (BPVS-II) and nonverbal intelligence (Raven's CPM) were assessed using standardized and validated tests (Dunn et al., 1997; Raven, 2008). NumLit project has developed two highly reliable tests for phonological awareness that account for both phoneme isolation and phoneme blending. Finally, despite the limitations discussed previously, the present study appears to have a satisfactory level of construct validity.

7.2.2 Statistical validity

Statistical validity refers to the extent to which the observed relationship between the outcome variable and predictor(s) is statistically significant and sufficiently strong (Lund, 2015). A significance level of .05 has been used to determine the statistical validity of this study. The results show significant correlations between most variables at the .001 level or less and a few at the .01 level or lower. Therefore, it is reasonable to conclude that there is a significant relationship between the variables and that the probability of error is relatively small. Moreover, the effect of preschool morphological awareness on reading comprehension in 3rd grade was approximately 7.9%, with a *p*-value of less than .001. With respect to the range of correlations found in educational science, between .20 and .40 (Gall et al., 2007), the correlation matrix indicates that morphological awareness is closely related to reading comprehension (r_s from .262 to .374), as well as receptive vocabulary (r_s from .302 to .448), and phonological awareness (r_s from .204 to .422).

Another threat to statistical validity is the sample size (Cook & Campbell, 1979). It is believed that the sample size for the current study (N=215) is sufficiently large to capture even small effects. An additional strength of the current study is that statistical analyses have been carried out properly, accounting for non-normal distributions of variables accompanied by nonparametric correlations and assumptions check prior to regression analysis.

Finally, statistical validity is partly dependent upon the reliability of the measurement tools used in research (Cook & Campbell, 1979). Overall, the majority of tests used in the current study have high internal consistency reliability and are exceeding the current requirements of .7 (Navarro & Foxcroft, 2019). The only test with a lower internal consistency value is Meta-Derivational Task, with a score of α = .65 and ω = .66. Thus, the low reliability of the Meta-Derivational Task can reduce the statistical validity of the study, as it may fail to consistently measure the property of meta-derivational morphological awareness. Although measurement noise may prevent the Regression model from accurately capturing the variance of the Meta-Derivational Task variable, the results indicate that this variable has a statistically significant predictive value for reading comprehension. Therefore, the low reliability of this task is unlikely to pose a problem in the present study.

In conclusion, the study appears to possess a sufficient level of statistical validity and reliability to enable further interpretation of the results.

7.2.3 Internal validity

Internal validity indicates whether it is possible to infer causal relationships between the examined variables (Cook & Campbell, 1979). With respect to the applied design and analysis, studies differ in the ability to address the question of causality. Due to the non-experimental design, a study like this may pose internal validity challenges because it is hard to discern causes and effects without experimental control (Lund, 2015). However, the present study is not simply interested in whether morphological awareness correlates with reading comprehension but also addresses whether it influences reading comprehension. Thus, internal validity addresses whether the study results indicating that morphological awareness statistically significant predicts reading comprehension could be safely relied upon.

There are many threats to internal validity, such as problems with confounding variables and a direction problem. The presence of confounding variables in the present study is statistically controlled by using multiple regression analysis. Therefore, it was controlled for meta(linguistic) factors such as phonological awareness, receptive vocabulary, along general cognitive ability. Consequently, the statistical control over confounding variables expected to be associated with morphological awareness was an important strength of this study. In spite of controlling for the most important confounding variables known to theory, it is not conclusive that all the potential factors have been taken into account when addressing complex and multidimensional phenomena such as morphological awareness (Gall et al., 2007).

Secondly, it is difficult to determine the direction of the causal relationship. There can be some uncertainty as to whether morphological awareness affects reading comprehension, or if reading comprehension affects morphological awareness, or if there is a reciprocal relationship between the two. The strength of this study is that the morphological awareness was measured in preschool while the reading comprehension was evaluated at a later time point. Due to the study's design, the issue of directionality of the relationship between variables is of no great concern in this study. However, a well-designed experimental study would yield more conclusive results on the relationship between morphological awareness and reading comprehension.

Overall, studies that do not employ experimental methods have lower internal validity and cannot prove causal relationships between variables with certainty. In the current study, internal validity was sought using multiple control variables and an elaborate longitudinal design. Hence, it can be claimed that the study possesses a satisfactory level of internal validity.

7.2.4 External validity

The present study examines the relationship between morphological awareness and reading comprehension in the sample in order to apply the resulting knowledge to the broader population. External validity refers to whether the results of a study can be generalized to the population of interest (Cozby & Bates, 2015). Evidently, the study's sample must be representative of the target population. Accordingly, the sample selected for the current study represents the population of typically developing children in preschool and Grade 3 with Norwegian as their first language. It is important to note that the sample used in the present study is derived from a larger study called NumLit.

For external validity, it is of the utmost importance to use a representative sample of the population. Thus, the issue of sample size and sampling procedure must be addressed. The study results are based on a convenience sample selected because of its proximity to the Institute of Special Education. Although a randomized sample was not used, researchers tried to ensure the study's external validity by recruiting children from areas covering a wide range of socioeconomic and parental educational backgrounds. Regarding the sampling procedure, all preschool children from selected municipalities who met the inclusion criteria were invited to participate in the study. Nevertheless, potential biases in the sample have to be considered. Even though it has not been proven, it is plausible that more educated parents are more likely to consent to their children participating in the study, which can lead to bias in the sample.

Furthermore, the results of a too small sample may not be generalized to a larger population. This study contains a relatively large sample size of 215 participants. It strengthens its external validity and makes it possible to infer that the sample demonstrates heterogeneity in the population. In conclusion, the current findings can be generalized with caution to children within the same age range who share Norwegian as their first language and are known to be free of any developmental disabilities.

8 Conclusion

Morphological awareness is shown to be related to reading comprehension, so the findings from the current study are not particularly surprising. Even after controlling for aspects of linguistics, metalinguistics, and nonverbal reasoning, morphological awareness remains a significant, long-term independent predictor of reading comprehension. Moreover, aside from contributing to reading comprehension, morphological awareness was significantly associated with both phonological awareness and receptive vocabulary, both of which contributed to reading comprehension. The close relationship between morphological awareness and a construct of reading comprehension, as well as two other previously mentioned significant predictors, places morphological awareness at the heart of reading comprehension research. Since morphological awareness continues to grow in importance for reading skills across grades and has a complex role in reading comprehension, findings from this study support the claim that it should be given more attention within reading models. Based on the previous research and the findings of this study, Morphological Pathway Framework is found to be a good example demonstrating the importance of morphological awareness to reading comprehension and literacy in general.

8.1 Limitations

There are some limitations to the present study that should be noted. The first limitation of this study is that it has a non-experimental design, which implies that no firm conclusions can be drawn regarding causality between the variables. Further concerns relate to limitations in operationalizing morphological awareness. Although the study addressed both inflectional and derivational morphology extensively, it did not account for compound morphology, which is commonly found in Norwegian. This could potentially result in a reduction in the overall construct validity of the study. Furthermore, due to the limitations in the statistical analysis employed in the study, it has been challenging to obtain a detailed picture of the role of morphological awareness in reading comprehension. As a result, the present study's findings can only support the direct relationship between morphological awareness and reading comprehension within the language system. Finally, other cognitive constructs such as working memory could have been included in the present study, although it is unclear how this would have improved the results.

Although it has some limitations, this study provides a valuable insight into the better understanding of the importance of morphological awareness to later reading comprehension.

8.2 Theoretical and Practical Implications of the Present Study

The present study and prior research suggest that morphological awareness is a significant predictor of reading comprehension. Given its importance, some of the implications of implementing morphological awareness instruction should be discussed. The added value of the present study is that it indicates that preschool morphological awareness is predictive of reading comprehension later in school. Thus, knowing that morphological awareness is important for reading comprehension could also be helpful for the early identification of children who need support to develop appropriate reading comprehension skills, even well before their formal education begins. Based on children's ability to reflect on and manipulate morphemes in preschool age, they may be identified as at risk for later reading comprehension difficulties. Furthermore, by identifying children who are at risk, preventive measures can be taken before difficulties start to manifest. Based on the results of this study, both linguistic and metalinguistic factors contribute to later reading comprehension. Considering that morphological awareness displays significant correlations with both phonological awareness and vocabulary knowledge, and at the same time, predicts later reading comprehension on a significant level, it may indicate that morphological awareness plays a central role in literacy acquisition. Conclusively, in order to prevent reading comprehension problems later in life, children must be exposed to a variety of word-level stimuli, including morphological awareness.

This study focuses not only on practical applications but also contributes to further theoretical development in the field. Although morphological awareness is experiencing a recent growth in interest, there is still uncertainty surrounding this area of research. Across a broad range of studies, including this one, it has been shown that morphological awareness plays an important role in reading comprehension. Nevertheless, a more nuanced understanding of the role of morphological awareness in reading comprehension and reading skills is required. Findings from the present study indicate a direct influence of morphological awareness on reading comprehension and offer a starting point for future research to investigate further indirect pathways through which morphological awareness influences reading skills.

Experimental studies have not been commonly used; therefore, to determine the influence of morphological awareness on reading comprehension with greater certainty, it is necessary to conduct more experimental studies. In relation to the practical implications, intervention studies with randomized control trials have the most informative value. In such a study, Lyster et al. (2016) found that Norwegian-speaking children have significantly improved their reading comprehension skills in 1st grade after receiving instruction on morphological awareness in preschool. These results are encouraging, and more research is needed to examine this issue across a wide age range.

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Appendix 1: Normal Q-Q-plots of the Variables

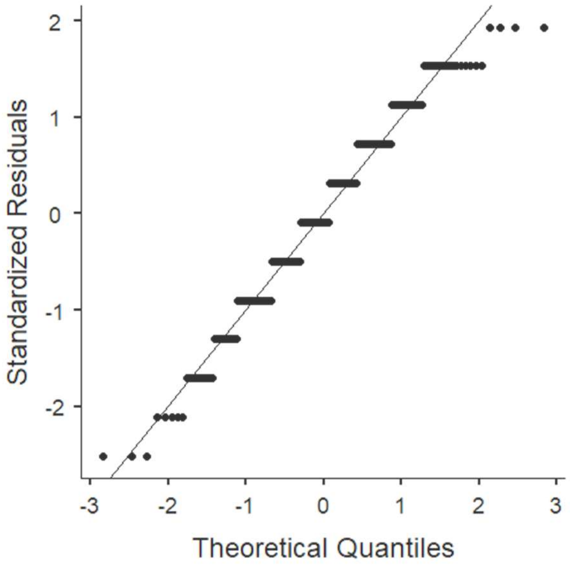


Figure 13. Q-Q- plot: Epi-inflectional Awareness Judgment Task (Pre-School)

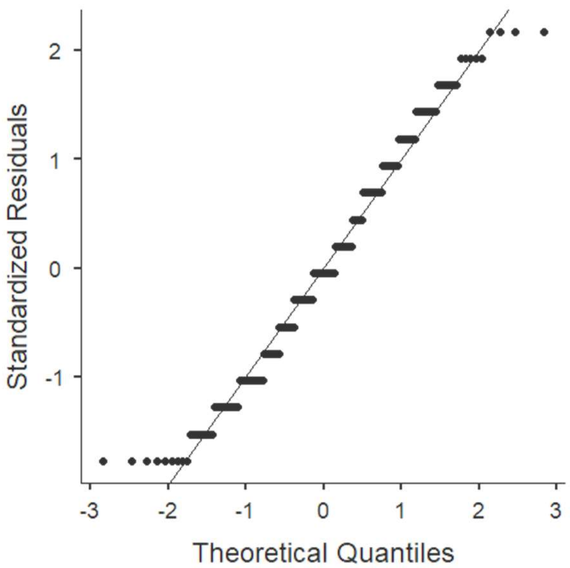


Figure 14. Q-Q- plot: Meta-inflectional Awareness Production Task (Pre-School)

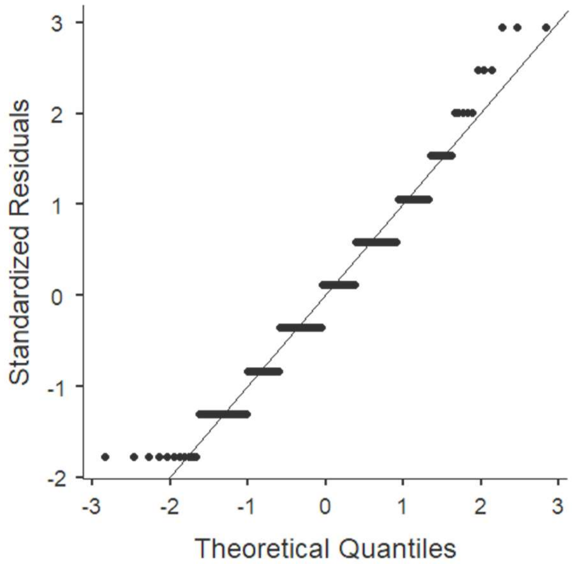


Figure 15: Q-Q- plot: Meta-derivational Awareness Production Task (Pre-School)

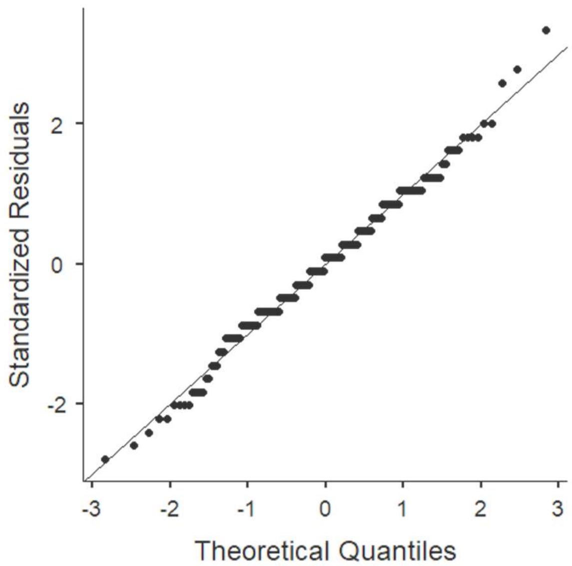


Figure 16. Q-Q-plot: Neale Analysis of Reading Ability (NARA II) (3rd grade)

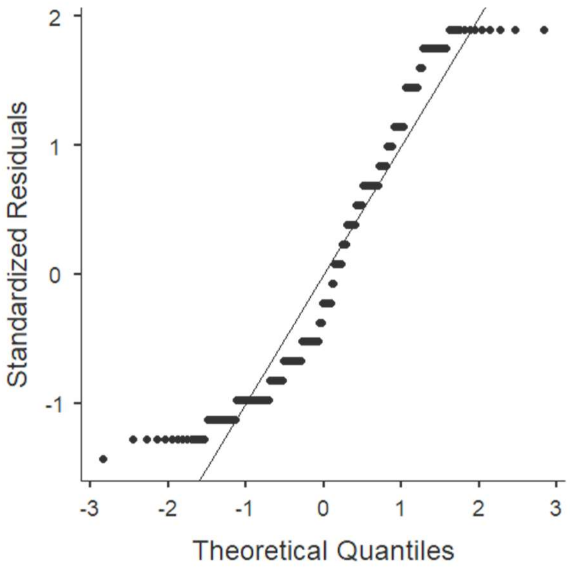


Figure 17. Q-Q-plot: Phoneme Isolation (Pre-School)

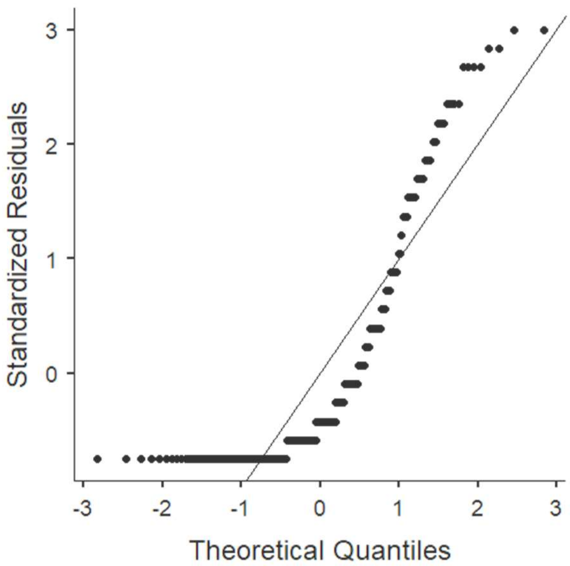


Figure 18. Q-Q-plot: Phoneme Blanding (Pre-School)

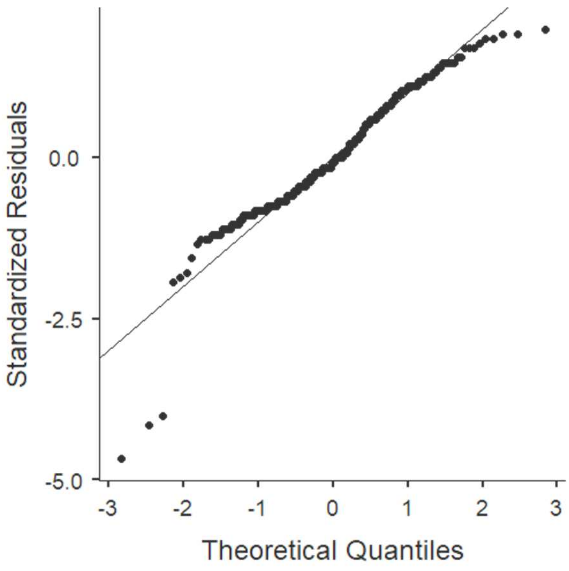


Figure 19. Q-Q-plot: Vocabulary (BPVS-II) (Pre-School)

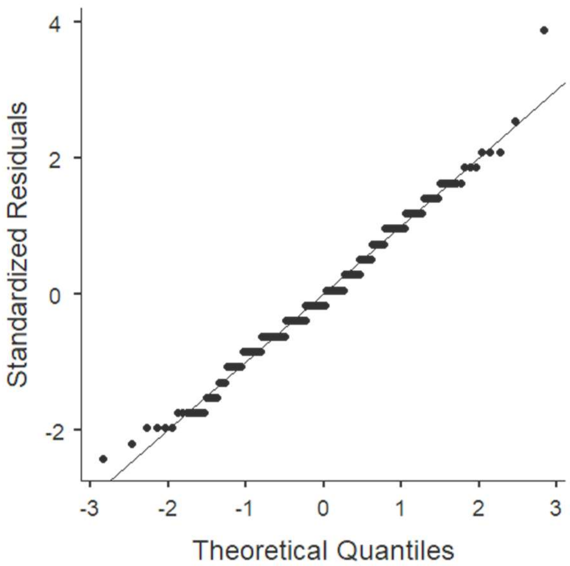


Figure 20. Q-Q-plot: nonverbal-IQ (Raven CPM) (Pre-School)

Appendix 2. Morphological Awareness Test (Protocol & Pictures)

Epi-inflectional Awareness Judgment Task (Oppgave 1)

NB! Se i manualen for uttale av non-ord

Instruksjon til barnet: "Vi skal se på noen bilder av skilpadder (vis heftet med bilder til barnet). Dukkene vil si hva skilpaddene gjør på hvert bilde på sitt eget, rare språk. Men bare én av dukkene sier det riktig. Du må høre godt etter og peke på den dukken som sa det riktig. Det er ikke den samme dukken hver gang. La oss prøve sammen":

Eksempler :

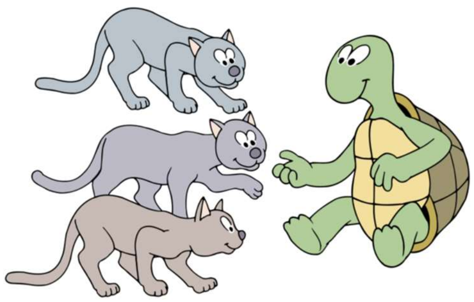
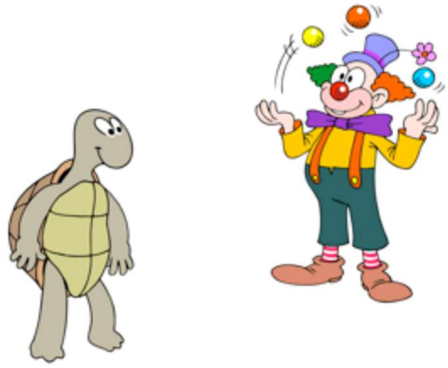
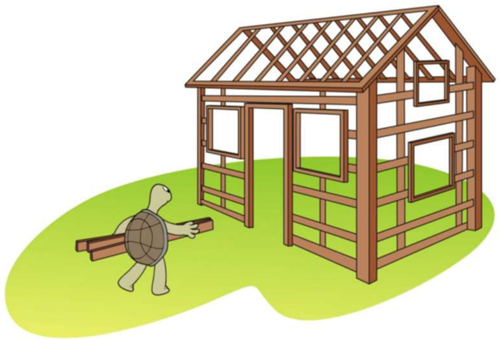
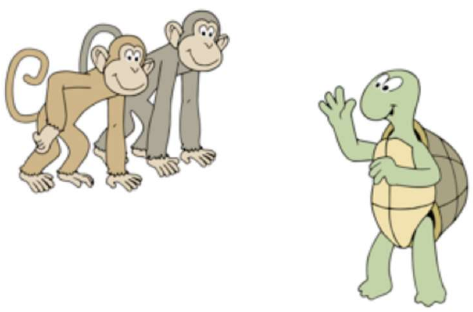
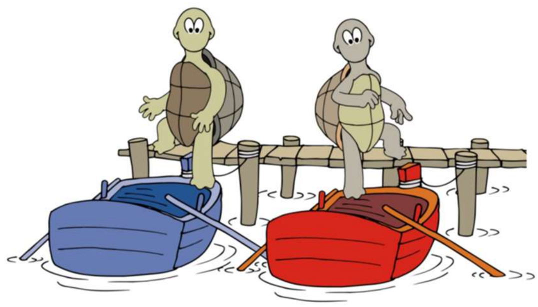
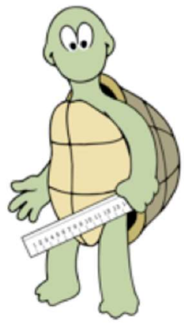
<table>
<tr><td>Skilpadden leker med en duss</td><td>Skilpadden leker med tre dusser</td></tr>
<tr><td colspan="2">Etter barnets respons, si: "Veldig bra. Denne dukken sa det riktig" eller "Hør godt etter".
Repetér den riktige setningen og si: "Denne dukken sa det riktig fordi skilpadden leker med tre dusser". "Nå prøver vi noen fler". Gjør det samme med de andre eksemplene.

Viktig: Dersom barnet spør om testleder kan gjenta setningen, kan du kun gjøre det én gang. Sett ring rundt den setningen barnet velger for hvert bilde.</td></tr>
<tr><td>Skilpadden ser en føls klovn.</td><td>Skilpadden ser følse klovner.</td></tr>
<tr><td>I går vukket skilpadden et hus</td><td>Nå vukker skilpadden et hus</td></tr>
<tr><td>Nå gjummer skilpadden tørsten med vann</td><td>I går gjumte skilpadden tørsten med vann</td></tr>
</table>

Det **korrekte** svaralternativet står med **fet skrift**. Skriv 1 for riktig svar og 0 for galt svar.

Item	*Forslag: Dukke høyre hånd*	*Dukke vestre hånd*	*Riktig 1*	*Galt 0*
1.	**Skilpadden hilser på *ådene***	**Skilpadden hilser på *åden***		
2.	**Skilpaddene går ombord i *jægen***	**Skilpaddene går ombord i *jægene***		
3.	**Skilpadden bærer *favene***	**Skilpadden bærer *faven***		
4.	**Skilpadden holder en *væsp***	**Skilpadden holder to *væsper***		
5.	**Skilpadden fargelegger *åmtet***	**Skilpadden fargelegger *åmtene***		
6.	**Skilpadden spretter kebelen**	**Skilpadden spretter keblene**		
7.	**Skilpadden sklir ned de *prosse* skliene**	**Skilpadden sklir ned den *prosse* sklia**		
8.	**Skilpadden spiser en *prin* sitron**	**Skilpadden spiser *prine* sitroner**		
9.	**Skilpadden ligger på en *kræs* pute.**	**Skilpadden ligger på *kræse* puter.**		
10.	**Skilpadden drikker av en *flei* kopp**	**Skilpadden drikker av *fleie* kopper**		
11.	**Skilpadden kaster de *kvyre* skoene**	**Skilpadden kaster den *kvyre* skoen**		
12.	**Nå *pyrer* skilpaddene i mål.**	**I går *pyrte* skilpaddene i mål.**		
13.	**Nå *såmerer* skilpadden en pakke**	**I går *såmerte* skilpadden en pakke**		
14.	**I går *terdret* skilpadden på butikken.**	**Nå *terdrer* skilpadden på butikken.**		
15.	**Nå *gudder* skilpadden sakte.**	**I går *guddet* skilpadden sakte.**		
16.	**I går *kræste* skilpaddene sammen.**	**Nå *kræser* skilpaddene sammen.**		

Epi-inflectional Awareness Judgment Task (Oppgave 1)

Eksempel 1 	Eksempel 2 
Eksempel 3 	Eksempel 4 
Item 1 	Item 2 
Item 3 	Item 4 

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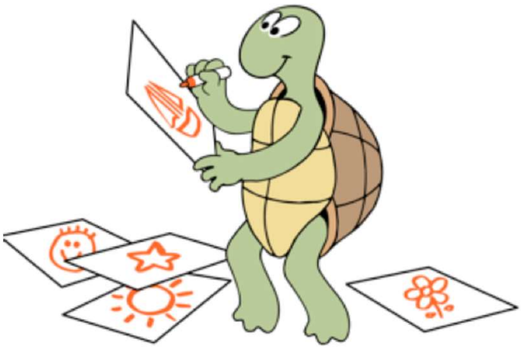

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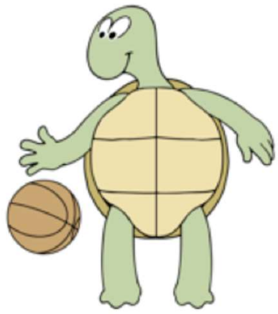
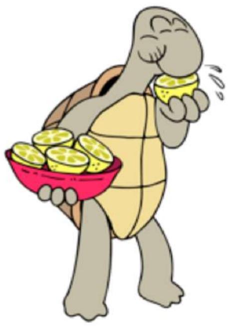
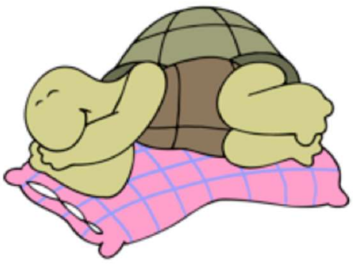


Item 7

Item 8

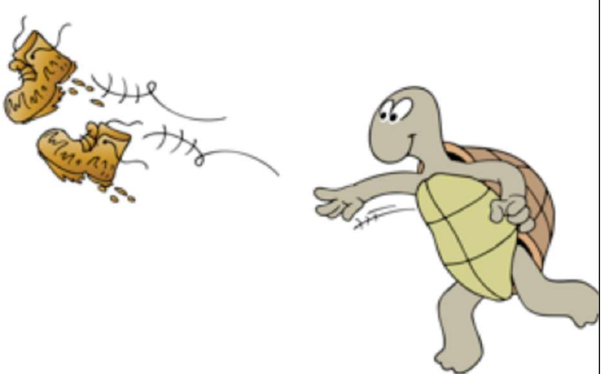


Item 9

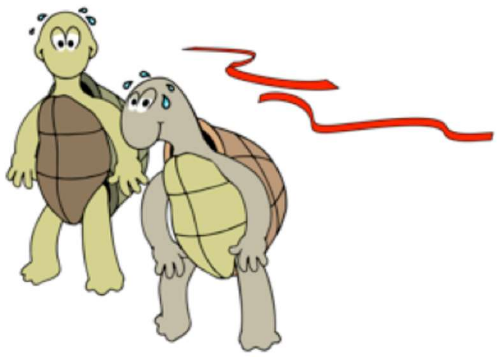


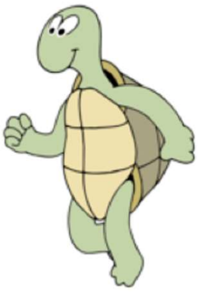
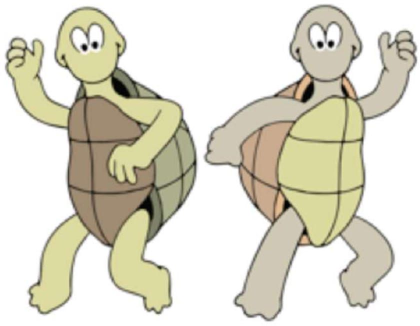
Item 10____________________________

Item 11



Item 12



Item 13 	Item 14 
Item 15 	Item 16 

Meta-inflectional Awareness Production Task (Oppgave 2)

Instruksjon til barnet: "Tidligere har vi sett at skilpadden gjør forskjellige ting. Nå skal vi se på bildene igjen. Jeg vil si hva som skjer på det ene bildet, og så kan du si hva som skjer på det andre bilde. La oss prøve."

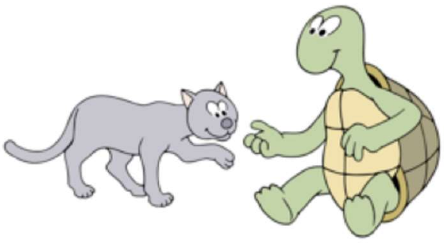
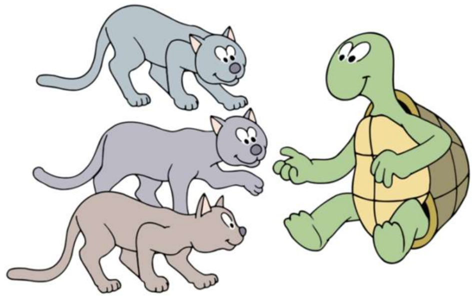
Eksempler:

<table>
<tr><td colspan="2">Testleder viser det første bildet og sier: "Skilpadden leker med en duss".
Testleder peker så på neste bilde og sier:" Skilpadden leker med tre..." (Om barnet ikke svarer, kan det tilføyes: Hva ville skilpadden sagt?)
Barnet fortsetter setningen med nonordet: "dusser"</td></tr>
<tr><td colspan="2">Etter barnets respons, si: "Veldig bra" eller "Skilpadden leker med en duss. Skilpadden leker med tre <u>dusser</u>". Legg trykk på nonordet!
Viktig: Dersom barnet spør om testleder kan gjenta setningen, kan du kun gjøre det én gang.
Testleder sier: " La oss se på noen fler!"</td></tr>
<tr><td>Skilpadden ser en føls klovn. Skilpadden ser ...</td><td>følse klovner.</td></tr>
<tr><td>I går vukket skilpadden et hus. Nå ...</td><td>vukker skilpadden et hus</td></tr>
<tr><td>Nå gjummer skilpadden tørsten med vann. I går ...</td><td>gjumte skilpadden tørsten med vann</td></tr>
</table>

OBS! Noter barnets **eksakte svar** dersom barnet svaret noe annet enn svaret oppgitt i tabellen. Feil uttale er tillatt så lenge barnet bøyer ordet korrekt. F. Eks. barnet sier *gukket* istedenfor *vukket*, eller *tølse* istedenfor *følse.*

Item	Bilde 1	Bilde 2	Annet svar:	Riktig 1	Galt 0
1.	Skilpadden hilser på *ådene*. Skilpadden hilser på ...	*åden*			
2.	Skilpaddene går ombord i *jægen.* Skilpaddene går ombord i...	*jægene*			
3.	Skilpadden bærer *favene.* Skilpadden bærer ...	*faven*			
4.	Skilpadden holder en *væsp.* Skilpadden holder to...	*væsper*			
5.	Skilpadden fargelegger *åmtet.* Skilpadden fargelegger ...	*åmtene*			
6.	Skilpadden spretter *kebelen.* Skilpadden spretter ...	*keblene*			
7.	Skilpadden sklir ned de *prosse* skliene. Skilpadden sklir ned den ...	*prosse* sklia (begge ordene for poeng)			
8.	Skilpadden spiser en *prin* sitron. Skilpadden spiser ...	*prine* sitroner (begge ordene)			
9.	Skilpadden ligger på en *kræs* pute. Skilpadden ligger på ...	*kræse* puter (begge ordene)			
10.	Skilpadden drikker av en *flei* kopp. Skilpadden drikker av ...	*fleie* kopper (begge ordene)			
11.	Skilpadden kaster de *kvyre* skoene. Skilpadden kaster den ...	*kvyre* skoen (begge ordene)			
12.	Nå *pyrer* skilpaddene i mål. I går ...	*pyrte* skilpaddene i mål.			
13.	Nå *såmerer* skilpadden en pakke. I går ...	*såmerte* skilpadden en pakke			
14.	I går *terdret* skilpadden på butikken. Nå ...	*terdrer* skilpadden på butikken			
15.	Nå *gudder* skilpadden sakte. I går ...	*guddet* skilpadden sakte			
16.	I går *kræste* skilpaddene sammen. Nå ...	*kræser* skilpaddene sammen.			

Meta-inflectional Awareness Production Task (Oppgave 2)

Eksempel 1	
	
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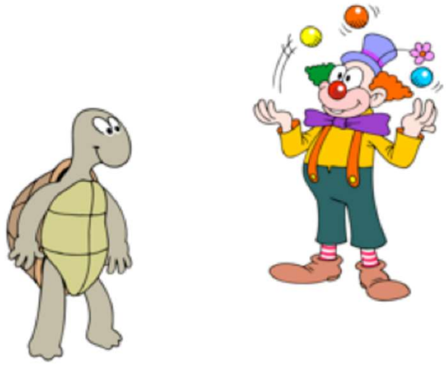	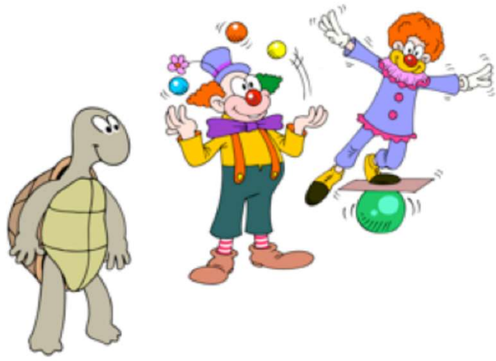
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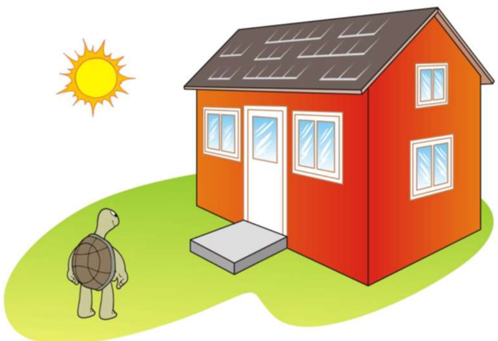	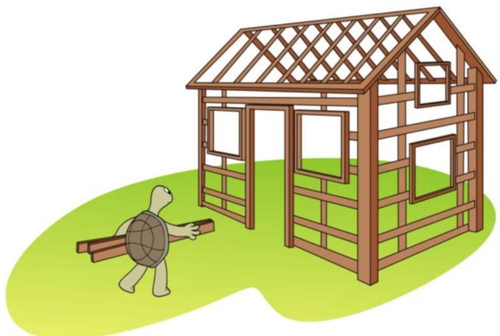
Eksempel 4	
	
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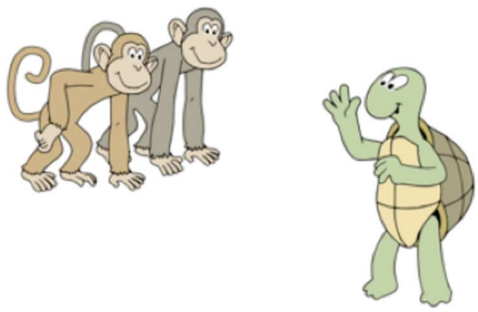
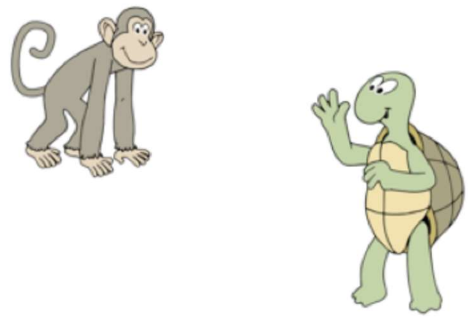

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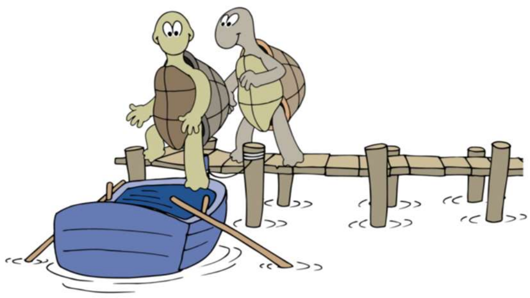
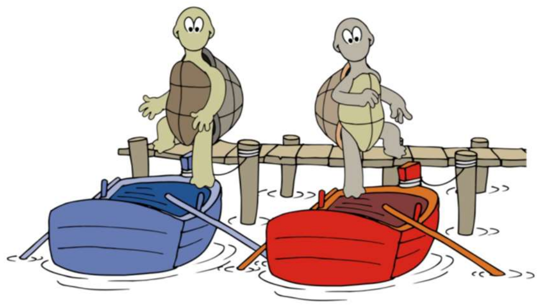
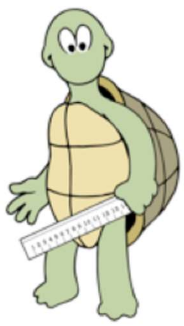
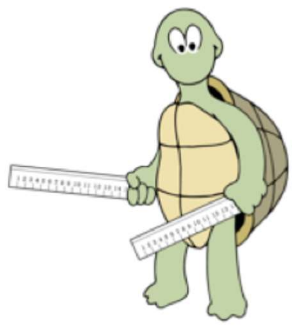



Item 3


Item 4

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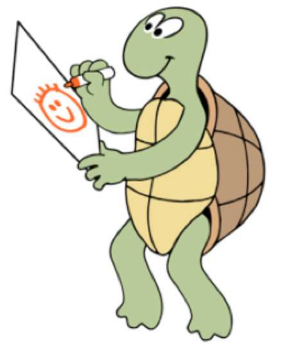 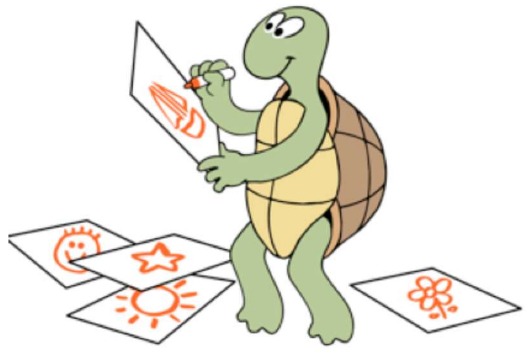

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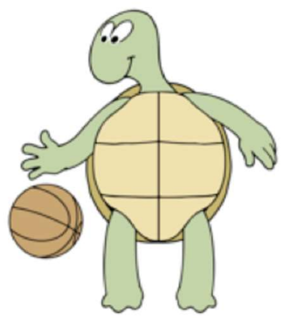 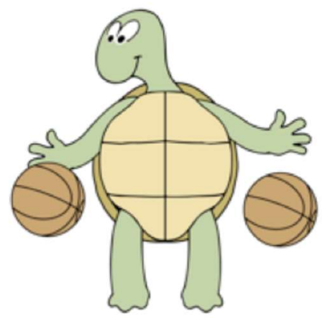

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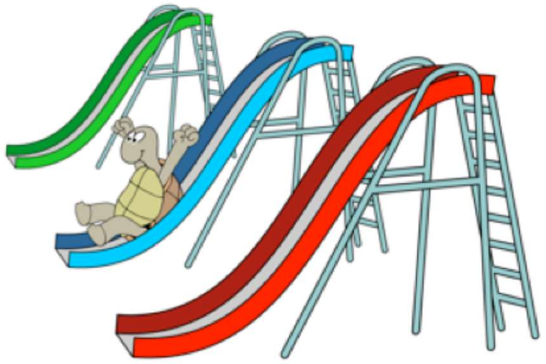 

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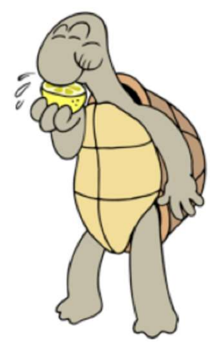 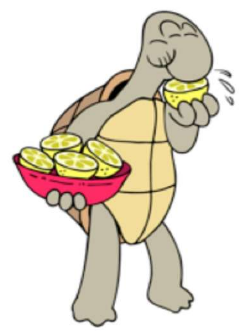

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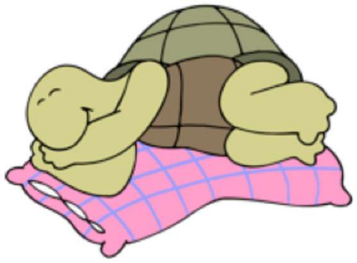

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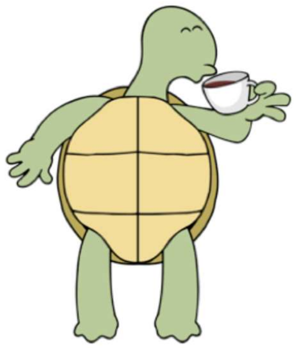

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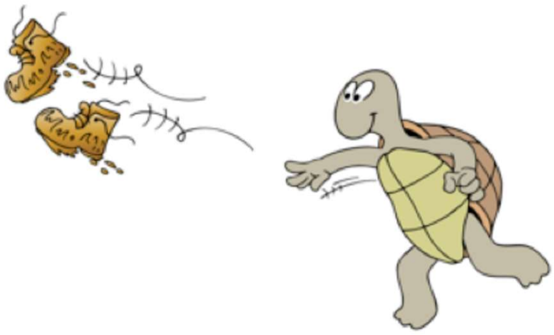

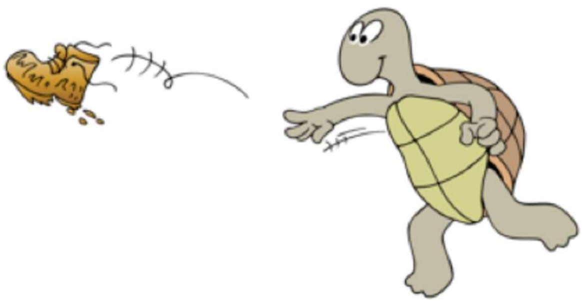

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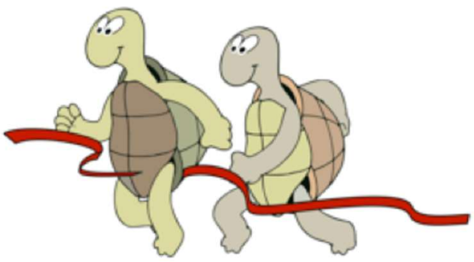

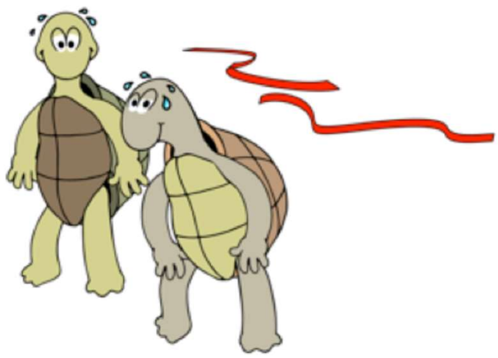

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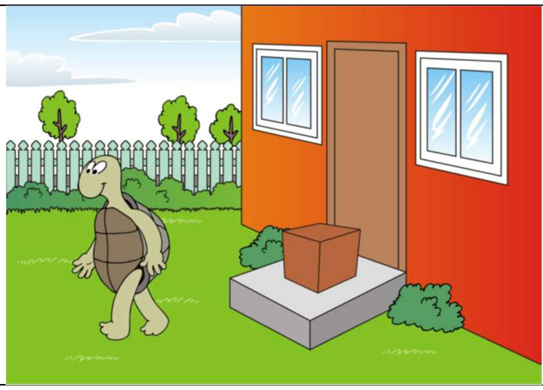
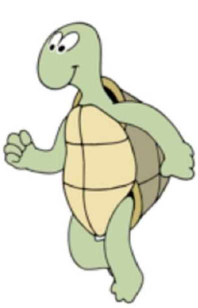
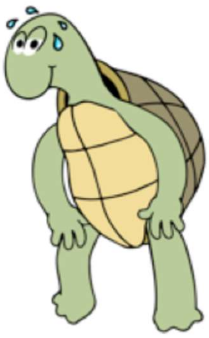


Item 14


Item 15

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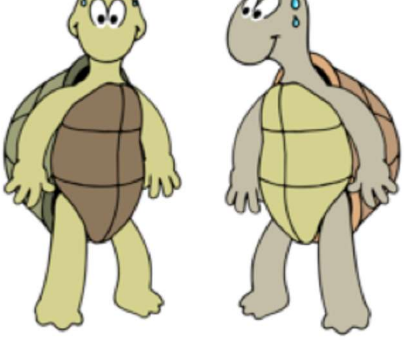
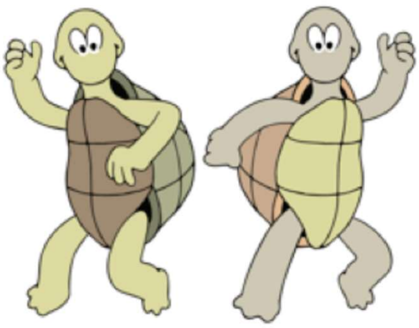



Meta-derivational Awareness Production Task (Oppgave 3)

Instruksjon til barnet: *"Vi skal se på noen bilder sammen* (vis heftet med bilder til barnet). *Først skal jeg fortelle hva jeg ser. Etterpå skal jeg begynne den andre setningen og så vil jeg at du si resten av setningen med* <u>*ett ord*</u>*. La oss prøve først."*

OBS! Legg trykk på ordet barnet må bøye når eksemplene presenteres.

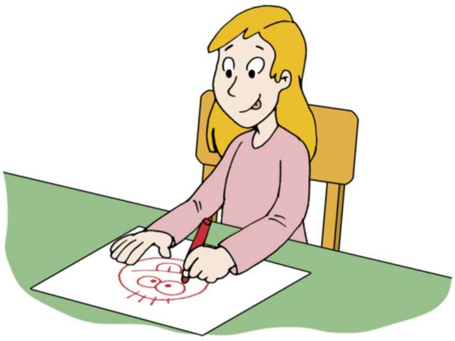
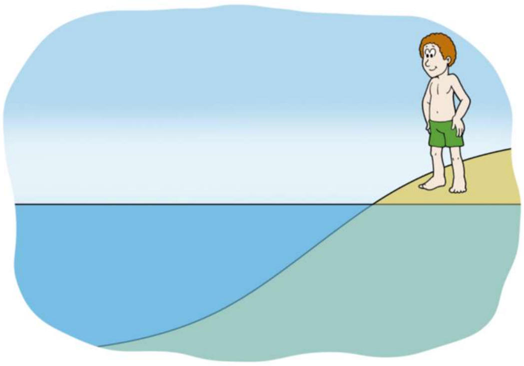
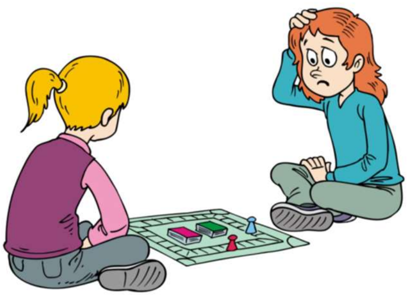
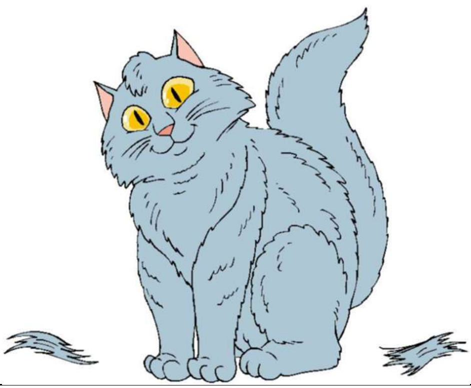
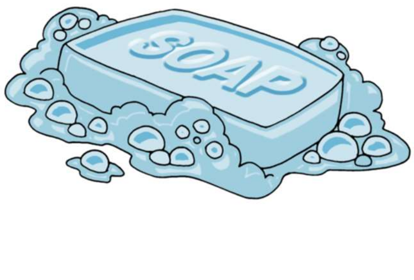
Eksempler:

1. Jenta **tegner**. Derfor kan vi si at jenta lager en.... (*tegning)*
Etter barnets respons til hvert eksempel, sier testleder: *"Veldig bra".* Dersom barnet svarer feil, sier testleder: "*La oss si det en gang til. Jenta tenger, derfor kan vi si at jenta lager en ... tegning!* Minn barnet på at det må svare kun med ett ord. **Testleder sier:** *Nå prøver vi noen fler*". **Viktig:** Dersom barnet spør om testleder kan gjenta setningen, kan du kun gjøre det en gang.
2. Lukas er glad i ***svømming.*** Lukas er glad i å .....(*svømme*)
3. Hun blir ***forvirret*** av spillet. Hun synes spillet er .... *(forvirrende)*
4. Jenta sitter og ***smiler.*** Jenta sitter .... *(smilende)*

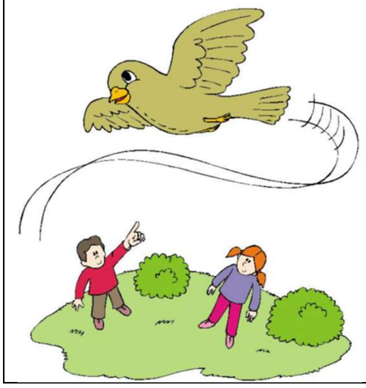
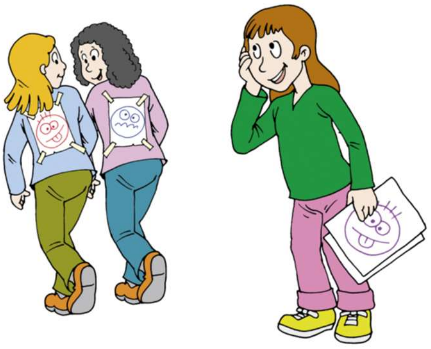
OBS! Dersom barnet svarer **noe annet** enn svaret i tabellen, noter barnets eksakte svar.

Item			**Annet svar:**	**Riktig** **1**	**Galt** **0**
1.	Katten har mye ***hår****.*	Katten er veldig …(*hårete)*			
2.	Erik ***trener*** mye.	Erik har vært mye på .....(*trening)*			
3.	Såpen ***skummer****.*	Såpen er veldig .....*(skummete)*			
4.	Mari ***skriver*** i timen.	Mari har en time med ......(*skriving)*			
5.	Ole har en genser med ***striper****.*	Lukas har en genser som er .....(*stripete)*			
6.	Nicolai ***beveger* seg** til musikken	Nicolai gjør en......(*bevegelse)*			
7.	Anne ***føler seg*** trist.	Anne har en trist ....(*følelse)*			
8.	Moren ***trøster*** jenta	Moren er .... (*trøstende)*			
9.	Gutten er glad i ***lesing***	Gutten liker å ....*(lese)*			
10.	Han ***maler*** veggen	Han dekker veggen med .....*(maling)*			
11.	Han blir ***sliten*** av å danse	Han synes at å danse er...... *(slitsomt)*			
12.	Parfymen ***dufter*** godt	Parfymen er ......*(duftende)*			
13.	Fuglen ***flyr***	Fuglen kommer ......*(flyvende)*			
14.	Jenta ***fleiper*** med de andre	Jenta er veldig ....*(fleipete)*			

Meta-derivational Awareness Production Task (Oppgave 3)

Eksempel 1 	Eksempel 2 
Eksempel 3 	Eksempel 4 
Item 1 	Item 2 
Item 3 	Item 4 

Item 5 	Item 6 
Item 7 	Item 8 
Item 9 	Item 10 
Item 11 	Item 12 

Item 13	Item 14
	

Appendix 3 Phonological Awareness Test (Instruction & Test)

Phoneme Isolation Task Instruction

Instruksjon og øvelsesledd:

Både første (Blokk 1) og siste lyd (Blokk 2) skal administreres. Stopp etter 6 feil på rad i hver av blokkene

Hvis barnet krever repetisjon av ordet, kan det gis maksimalt to repetisjoner per ord. Skåring Korrekt svar = 1, Feil svar = 0.

Første lyd (Blokk 1)

Si: "Nå skal vi leke en annen gjettelek. Jeg skal si et ord, så skal du gjette hvilken lyd ordet begynner på". Pek på bildene og si: "Her er en bil, her er en /såkk/ og her er et tre. Hvilen av disse tingene begynner på den lyden jeg sier nå? /s/" (si lyden og hold den i to sekunder). Hvis barnet svarer riktig si: "bra, det er /såkk/ som begynner på /s/" (si /s/ tydelig). Hvis barnet svarer feil, så si: Nei, det er /såkk/ som begynner på /s/ (si /s/ tydelig både i ordet og for seg selv).

Pek på bildene og si: "Her er en sol, her er en rev og her er et /tåg/ (tog). Hvilen av disse tingene begynner på den lyden jeg sier nå? /t/" (si lyden tydelig). Hvis barnet svarer riktig si: "Bra, det er /tåg/ som begynner på /t/" (si /t/ tydelig). Hvis barnet svarer feil, så si: Nei, det er /tåg/ som begynner på /t/ (si /t/ tydelig både i ordet og for seg selv).

Det er kun de fire første leddene som har bildestøtte. Etter at barnet er ferdig med de fire første leddene sier testleder: "Nå skal vi gjøre det samme uten bilder. Jeg sier et ord og du skal gjette hva første lyden i ordet er".

Husk at Blokk 2 skal administrerer uansett om barnet stoppet etter 6 feil på rad i Blokk 1!

Siste lyd (Blokk 2)

Si: " Nå skal du prøve å finne siste lyden i ordene. Jeg skal si et ord, så skal du gjette hvilken lyd ordet slutter på". Pek på bildene og si: "Her er en sag, her er en pus og her er en duk. Hvilen av disse tingene slutter på den lyden jeg sier nå? /g/" (si lyden tydelig). Hvis barnet svarer riktig si: "Bra, det er /sag/ som slutter på /g/" (si /g/ tydelig). Hvis barnet svarer feil, så si: Nei, det er /sag/ som slutter på /g/ (si /g/ tydelig både i ordet og for seg selv).

Pek på bildene og si: "Her er et tak, her er en nål, her er mat. Hvilen av disse tingene slutter på den lyden jeg sier nå? /t/" (si lyden tydelig). Hvis barnet svarer riktig si: "Bra, det er /mat/ som slutter på /t/" (si /t/ tydelig). Hvis barnet svarer feil, så si: Nei, det er /mat/ som slutter på /t/ (si /t/ tydelig både i ordet og for seg selv).

Det er kun de fire første leddene som har bildestøtte. Etter at barnet er ferdig med de fire første leddene sier testleder: "Nå skal vi gjøre det samme uten bilder. Jeg sier et ord og du skal gjette hva siste lyden i ordet er".

Phoneme Isolation Task

PHONEME ISOLATION (Blokk 1 – første lyd)

Skåre: 1 for riktig og 0 for feil.

Testledd:

Si ordene tydelig i vanlig tempo (ingen hjelp gis).

1) katt mor sopp (m) __________________ (bildestøtte)
2) kam pil vott (v) __________________(bildestøtte)
3) elg and buss (a) __________________ (bildestøtte)
4) ful (fugl) mann løk (f) __________________(bildestøtte)

Si: *"nå skal vi gjøre det samme uten bilder. Jeg sier et ord og du skal gjette hva første lyden i ordet er"*

Si (ikke tallene):

5) *Hva er første lyd* i */lam/* (l) __________________
6) *Hva er første lyd* i */båt/* (b) __________________
7) *Hva er første lyd i /gutt/* (g) __________________
8) *Hva er første lyd* i */dør/* (d) __________________
9) *Hva er første lyd* i */smør/* (s) __________________
10) *Hva er første lyd* i */klær/* (k) __________________
11) Hva er første lyd i */bjørn/* (b) __________________
12) Hva er første lyd i */frakk/* (f) __________________

STOPP etter **6 påfølgende feil** og fortsett med Blokk 2!

Første lyd sum: ……/12

PHONEME ISOLATION (Blokk 2 – siste lyd)

Skåre: 1 for riktig og 0 for feil.

Testledd:

Si ordene tydelig i vanlig tempo (ingen hjelp gis).

1) gutt tann bok (n) ___________________ (bildestøtte)
2) sel mann mur (r) ___________________(bildestøtte)
3) bie båt hjul (t) ___________________ (bildestøtte)
4) fly gås bil (y) ___________________(bildestøtte)

Si: *"nå skal vi gjøre det samme uten bilder. Jeg sier et ord og du skal gjette hva første lyden i ordet er"*

Si (ikke tallene):

5) *Hva er siste lyd i /nål/* (l) ________________
6) *Hva er siste lyd i /kjepp/* (p) ________________
7) *Hva er siste lyd i /mygg/* (g) ________________
8) *Hva er siste lyd i /sokk/* (k) ________________
9) *Hva er siste lyd i /fest/* (t) _________________
10) *Hva er siste lyd i /form/* (m) _________________
11) *Hva er siste lyd i /heks/* (s) _________________
12) *Hva er siste lyd i /ravn/* (n) _________________

STOPP etter **6 påfølgende feil**!

Siste lyd sum: ....../12

....../8

Total sum første + siste lyd: ....../24

Phoneme Blending Task (Instruction)

PHONEME BLENDING

Instruksjon

Si: "*Nå skal leke et gjettelek med ord. Jeg skal si lydene til et hemmelig ord, og du skal prøve å finne ut hvilket ord det er jeg har sagt. Jeg skal vise deg hva jeg mener*".

Demonstrer (vis bilde av kuen). *"Hva er dette? "* Hvis barn sier "ku", så sier du: *"Det stemmer".* Hvis barnet sier noe annet, da sier du *"Vel, dette er en ku; si "ku".* (få barnet å gjenta ordet). Vær oppmerksom på hvordan barnet uttaler ordet for å gjøre segmenteringen senere.

"Lydene til ordet ku er K-U. Hvis du sier lydene K-U raskere (demonstrer), *så blir de til ordet "ku"*

*"*La oss prøve et annet ord*"* (Vis bildet av boken) "Hva er dette?" Hvis barn sier "bok", så sier du, *"Det stemmer"* Hvis barnet sier noe annet, da sier du *"Vel, dette er en bok; si "bok".* (få barnet å gjenta ordet).

"Lydene til ordet bok er B-O-K. Hvis du sier lydene B-O-K raskere (demonstrer), *så blir de til ordet "BOK"*

ØVINGER:

Si: *"Nå skal vi prøve uten bilde. Jeg sier lydene til et hemmelig ord, og du forteller meg hva du tror ordet er. Hør godt etter, T-A* (si segmentene med en hastighet på 1 per sekund). *Hva tror du ordet er?"* Hvis barn ikke vet svaret, så gjenta segmentene med samme hastighet. Hvis barnet sier riktig ord, så si *"godt gjort, du gjettet det hemmelige ordet".* Hvis barnet ikke vet eller gjetter feil, så si segmentene i raskere rekkefølge (men likevel med hørbare pauser mellom lyder), og spør barnet om han/hun kan gjette det nå. Hvis ja, si: *"Godt gjort, du gjettet det hemmelige ordet".* Hvis ikke, så uttalt ordet og si: *"Ordet er" ta ", hører du? T-A, blir ta.*

Si: *"La oss prøve et ord til".* Hør godt etter: *S-K-O* (si segmentene med en hastighet på 1 per sekund). *Hva tror du ordet er?"* Hvis barn ikke vet, så gjenta segmentene med samme hastighet. Hvis barnet sier riktig ord, så si: *"godt gjort, du gjettet det hemmelige ordet".* Hvis barnet ikke vet eller gjetter feil, så si segmentene i raskere rekkefølge (men likevel med hørbare pauser mellom lyder), og spør barnet om han/hun kan gjette det nå. Hvis ja, si: *"Godt gjort, du gjettet det hemmelige ordet".* Hvis ikke, så uttalt ordet og si *"Ordet er" sko ", hører du? S-K-O, blir sko.*

"Nå skal vi prøve på ordentlig. Hør nøye på lydene, og prøv å gjett hva hemmelig ordet er".

STOPP etter 6 sammenhengende feil.

Hvis barnet krever repetisjon av lydene, kan det gis maksimalt to repetisjoner per ord.

Skåring Korrekt svar = 1, Feil svar = 0.

Phoneme Blending Task

PHONEME BLENDING

Skåre: 1 for riktig og 0 for feil. STOPP etter **6 påfølgende feil.**

1) t-å (tå) ____________________
2) e-n (en) ____________________
3) u-t (ut) ____________________
4) n-y (ny) ____________________
5) s-o-l (sol) ____________________
6) f-o-t (fot) ____________________
7) f-l-y (fly) ____________________
8) m-i-n (min) ____________________
9) m-å-n-e (måne) ____________________
10) r-o-l-i (rolig) ____________________
11) l-e-g-o (lego) ____________________
12) f-i-s-k (fisk) ____________________
13) l-u-f-t (luft) ____________________
14) d-r-i-v (driv) ____________________
15) k-a-n-i-n (kanin) ____________________
16) b-a-n-a-n (banan) ____________________
17) p-o-t-e-t (potet) ____________________
18) f-r-å-s-k (frosk) ____________________
19) s-p-a-r-k (spark) ____________________
20) t-r-i-s-t (trist) ____________________
21) s-a-n-d-a-l (sandal) ____________________
22) l-i-n-j-a-l (linjal) ____________________

Sum: ………/24

23) k-o-m-f-y-r (komfyr) ____________________
24) s-t-a-t-i-v (stativ) ____________________