Morphological and Syntactic Awareness in Poor Comprehenders: Another Piece of the Puzzle

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MORPHOLOGICAL AND SYNTACTIC AWARENESS

Abstract

Poor comprehenders have intact word reading skills but struggle specifically with understanding what they read. We investigated whether two metalinguistic skills, morphological and syntactic awareness, are specifically related to poor reading comprehension by including separate and combined measures of each. We identified poor comprehenders (n = 15) and average comprehenders (n = 15) in grade 4 who were matched on word reading accuracy and speed, vocabulary, nonverbal cognitive ability, and age. The two groups performed comparably on a morphological awareness task that involved both morphological and syntactic cues. However, poor comprehenders performed less well than average comprehenders on a derivational word analogy task in which there was no additional syntactic information, thus tapping only morphological awareness, and also less well on a syntactic awareness task, in which there were no morphological manipulations. Our task and participant selection process ruled out key non-metalinguistic sources of influence on these tasks. These findings suggest that the relationships among reading comprehension, morphological awareness, and syntactic awareness, depend on the tasks used to measure the latter two. Future research needs to identify precisely in what ways these metalinguistic difficulties connect to challenges with reading comprehension.

Keywords: metalinguistic awareness, morphological awareness, syntactic awareness, reading comprehension, poor comprehenders

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Reading comprehension is one of the most fundamental skills that a child develops during the school years. In the short term, adequate reading comprehension is essential for success with the school curriculum and, in the long term, for full engagement in society (Kamil, 2003; Murane & Levy, 1996). Poor reading comprehension can arise for a wealth of reasons and a substantial proportion of children with poor reading comprehension have associated word reading and phonological skill weaknesses (e.g., Shankweiler, 1989). However, there is now a considerable literature documenting a group of children who have poor reading comprehension despite intact word reading and phonological processing skills, and also age-appropriate vocabulary skills (see Cain & Oakhill, 2007, for a review). These children with specific reading comprehension difficulties (hereafter referred to as poor comprehenders) make up approximately 10% of the school-aged population between 7 to 11 years (Yuill & Oakhill, 1991) and are the focus of this paper. Our aim is to elucidate the relation between poor reading comprehension and two aspects of grammatical awareness: morphological awareness and syntactic awareness. Both are related to reading comprehension level in developing readers (Carlisle, 2000; Deacon & Kirby, 2004; Demont & Gombert, 1996; Nagy, Berninger, & Abbott, 2006) but, to date, there is a paucity of research on how these metalinguistic skills relate to specific reading comprehension difficulties.

Metalinguistic awareness is typically defined as the ability to both reflect upon and manipulate language structure. In this way, it can be distinguished from language comprehension and production, because it requires the language user to focus on the form or structure of the

language rather than the meaning of the message itself (Bowey, 1994). Our concern in this paper is grammatical awareness. Just as grammar can be described with two linguistic levels, morphology and syntax (Crystal, 1987), so too can grammatical awareness (McBride-Chang, 2004). Tasks that measure morphological awareness focus on language structure at the word level and require the language user to reflect on and manipulate the morphemic structure of words, which can be presented in sentence frames or word pairs, as in the word analogy task (Carlisle, 1995). Tasks that measure syntactic awareness focus on the sentence level and require the language user to reflect on and manipulate the grammatical well-formedness and syntactic structure of sentences (Bowey, 1986, Nagy & Scott, 2000). In this study, we examine the nature and measurement of morphological and syntactic awareness to identify the extent of poor comprehenders' difficulties with grammatical awareness in general, and to understand better why poor comprehenders sometimes struggle on these tasks.

A number of studies have investigated the metalinguistic skills of poor comprehenders. This work demonstrates intact phonological awareness across a range of different measures (Cain, Oakhill & Bryant, 2000; Nation & Snowling, 1998; Stothard & Hulme, 1995), but weaknesses on some, but not all, measures of grammatical awareness (Nation, Snowling, & Clarke, 2005; Nation & Snowling, 2000; Tong, Deacon, Kirby, Cain, & Parrila, 2011). For example, Tong et al. (2011) found that grade 5 poor comprehenders had poorer morphological awareness than average comprehenders when measured with a word analogy task (e.g., *paint* : *painter* :: *bake* : *baker)*; in contrast, the same groups did not differ on a sentence completion task (e.g., '*She was an excellent hockey ____ [player or playful]')*. Nation et al. (2005) also found a mixed pattern of performance on their task of past tense morphological production. Poor

comprehenders had difficulties, relative to good comprehenders, with irregular but not regular past tense forms of nonwords that were presented within sentence contexts (e.g., *plam-plammed* versus *crive-crove* in sentences such as *'Today I plam over the bump. Yesterday I __ over the bump.'*). Similarly, an uneven profile of performance has been shown by poor comprehenders on a measure of syntactic awareness (Nation & Snowling, 2000). Here, weaknesses were evident for passive (e.g., *'the banana was eaten by the mouse')*, but not active (e.g., '*the mouse ate the banana'*), forms tested with a word order correction task.

Collectively, these studies suggest that poor comprehenders' weaknesses on morphological and syntactic awareness are not universal. Thus, the following question arises: do poor comprehenders have weak morphological and/or syntactic awareness or is any apparent weakness task dependent?

We begin by reviewing the methods used to assess morphological awareness in poor comprehenders: the word analogy and sentence completion tasks (Tong et al., 2011) and the past tense formation of non-words (Nation et al., 2005). Building on the definition of morphological awareness as the awareness of and ability to manipulate morphemes (Carlisle, 1988), all of the tasks used in previous research with poor comprehenders have evaluated children's ability to add or remove a morpheme from a word or non-word. The transformations in these tasks are between the base and a morphologically complex form of the word. Notably, understanding the relational component of morphemes, for example that *bake* and *baker* share the root *bake*, emerges relatively early (see e.g., Tyler & Nagy, 1989; Carlisle & Fleming, 2003). These tasks also involve selecting the appropriate suffix, which requires knowledge of the grammatical roles of individual morphemes, for example that *-able* forms adjectives. This aspect of morphological

awareness develops throughout the elementary school years and beyond (e.g., Nagy, Berninger, & Abbott, 2003; Tyler & Nagy, 1989; Tyler & Nagy, 1990).

Another potentially important aspect of morphological awareness tasks that might influence performance lies in the inclusion (or not) of sentences. In Nation et al.'s (2005) study, children were asked to make a morphological transformation of a nonsense verb to complete the sentence, for example transforming from the present to the past tense in '*Today I plam over the bump. Yesterday I __ over the bump*.' Certainly this task taps morphological awareness; children might produce the correct past tense form of *plam* on the basis of morphological manipulation of the present tense verb. However, the task could also be completed through syntactic awareness: understanding the structure of the sentence or the order of words in a sentence could provide a clear clue that a verb is required. Sensitivity to the co-occurrence of the time adverb 'yesterday' with *-ed* ending forms of regular verbs could then lead children to generate an appropriate form of the verb. Accordingly, both morphological awareness (of verb inflection) and syntactic awareness (of sentence structure constraints) can support performance on this task.

The sentence completion task described above to assess morphological awareness might be completed using semantic, as well as morphological or syntactic, information. Although designed to assess understanding of the specific morphological relationship between *play* and *player*, the child might choose the correct noun by semantic association with the root *play*. Thus, as noted by Bowey (1994), performance on completion tasks may be influenced by semantic processing strategies. Alternatively, syntactic awareness could enable children to use the sentence context to determine that the sentence requires a noun for completion (see e.g., Carlisle, 2003; Kuo & Anderson, 2006)), such that participants might choose correctly between two

possible options for completing a sentence, such as: '*play. She was an excellent hockey ___ (player, playful*)'. This syntactic information might be even more helpful in derivational than inflectional tasks, because the number of derivations between which children need to choose is far greater than the number of inflections, which form a restricted set. Further, typically developing children are able to succeed on measures that involve inflectional morphology earlier in development than on tasks that involve derivational morphology (Kuo & Anderson, 2006). For that reason, the support provided by the sentence context in examples such as this, may be more beneficial to tasks that tap derivational morphology, compared with tasks that tap inflectional morphology. Thus, on closer examination the sentence completion task (similar to Nation et al.'s 2005 past tense production task) does not appear to be a 'pure' assessment of morphological awareness: it may tap tacit semantic knowledge and/or syntactic awareness skills. In order to focus on metalinguistic sources of influence on our tasks, we controlled for vocabulary in our participant selection process to minimize its influence on this task.

In contrast, we might consider performance on the word analogy task used by Tong et al. (2011) to be relatively unconfounded with semantic processing strategies or syntactic awareness, in that it involves transformations of single words presented in isolation rather than in a sentence context. However, a non-metalinguistic source of influence has to be considered: reasoning skill. To focus on the metalinguistic sources of influence on task performance, we matched groups on reasoning ability in our participant selection to determine if group differences were apparent when reasoning was controlled.

This analysis of different morphological awareness tasks makes clear that there are many factors that may contribute to performance. Some of these are not metalinguistic in nature, such

as the role of semantic knowledge and reasoning ability. However, it is clear that syntactic awareness and sentence context may be involved in performance on measures of morphological awareness. As result, we cannot determine from studies to date whether poor comprehenders' lower performance on tasks that have been argued to tap morphological awareness (Nation et al., 2005; Tong et al., 2011) is due to a specific difficulty in morphological awareness, syntactic awareness, or some other non-metalinguistic factor.

This challenge in interpretation of previous research on poor comprehenders' grammatical awareness is augmented by the fact that, to our knowledge, there is only one published study evaluating poor comprehenders' syntactic awareness. In that study, Nation and Snowling (2000) asked children to correct the word order of a scrambled sentence, for example '*The by horse the was donkey kicked*' (correct answer: '*The horse was kicked by the donkey*'. Children with poor reading comprehension were less able to correct these orally presented sentences than good comprehenders matched for word reading ability. Notably, this task has relatively few morphological demands. The discrepancy in performance was the largest when the sentences had both high syntactic and semantic ambiguity.

These results suggest that syntactic awareness might be a specific area of difficulty for poor comprehenders, but there are other potential sources of task difficulty. Tasks such as the word order correction task tap not only language skills, but also working memory: the word strings need to be stored accurately and re-arranged to form grammatically correct sentences (Bowey, 1994). There is evidence that word order correction tasks are more heavily dependent on working memory than other measures of syntactic awareness, such as grammatical correction (Cain, 2007), which may be due to the need for the simultaneous storage and manipulation of the

string of words in the former. Poor comprehenders typically have intact short-term memory but poor working memory (Cain, 2006). For these reasons, we included a sentence correction task in this study to investigate further the syntactic awareness skills of poor comprehenders while minimizing the likelihood that poor performance was a result of weak working memory skills.

In summary, research to date indicates that poor reading comprehension is associated with weak metalinguistic skills, but that these weaknesses are not universal. Poor comprehenders have intact phonological awareness (e.g., Cain et al., 2000; Stothard & Hulme, 1996) and weak grammatical awareness, although their performance on measures of both syntactic awareness and morphological awareness is not consistently weak (Nation et al., 2005; Nation & Snowling, 2000; Tong et al., 2011). Given the importance of morphological and syntactic awareness to reading development (Carlisle, 2003; Deacon et al., 2012; Nagy et al., 2006) it is critical to describe more fully poor comprehenders' performance on tasks that tap these two aspects of grammatical awareness, so that we can establish the reasons for their difficulties.

In the current study, we included two morphological awareness tasks and one syntactic awareness task. The first morphological awareness task was based on Nunes, Bryant, and Bindman's (1997) word pairs task, which does not involve sentence processing. Children were presented with a word pair (e.g., *push: pushed*) and asked to generate a new word to complete the second pair (e.g., *lose:_____;* correct answer: *lost)*. The second morphological awareness task was a sentence completion task, adapted from Carlisle (2000). The task required children to manipulate the morphological structure of a word to fit a sentence, (e.g., '*Comfort. The chair was _____ [comfortable].'*) Thus, the sentence completion measure of morphological awareness could be completed using either morphological or syntactic awareness (and also semantic

processing strategies). Our syntactic awareness task (based on Bowey, 1986) was a sentence correction task specifically constructed to exclude morphologically based errors (in contrast to Bowey, 1986). In this task, a grammatical anomaly has to be fixed, such as in the sentence '*she brushed <u>them</u> teeth*'. We included this task to compare with Nation and Snowling (2000) who found differences between good and poor comprehenders on a different measure of syntactic awareness, and to identify the extent to which poor comprehenders have difficulties on measures of grammatical awareness in general. We also assessed another metalinguistic awareness skill - phonological awareness. Previous research has shown that poor comprehenders have intact phonological awareness skills (Cain, Oakhill, & Bryant, 2000; Stothard & Hulme, 1995), so it was important to replicate this finding to demonstrate a specific weakness with morphological and/or syntactic awareness, or both. These experimental tasks enable us to describe more fully poor comprehenders' performance on measures of grammatical awareness with the intention to understand better the ways in which poor and good comprehenders differ in their metalinguistic skills.

As is clear from our analysis of commonly-used tasks intended to tap grammatical awareness, there are several non-metalinguistic factors that might influence performance. We sought to establish whether poor comprehenders have specific metalinguistic deficits in morphological and/or syntactic awareness by minimizing the influence of these factors in our participant and task selection. First, we controlled for vocabulary, as a proxy for semantic skills, in our participant selection process. This served two purposes. Semantic skills are related to both reading comprehension and performance on metalinguistic awareness tasks (Bowey 1994; Cain, 2007) and we sought to eliminate individual differences in this variable as an explanation for

differences on our measures of grammatical awareness, and on the sentence completion measure of morphological awareness specifically. This control also allowed us to align our research with much of the extant literature that has examined the sources of poor reading comprehension whilst controlling for vocabulary knowledge (Cain & Oakhill, 2007, for a review). We also sought to rule out reasoning ability as a source of group differences on the morphological awareness measure that involved analogical reasoning, the word analogy task. To do so, we controlled for reasoning in our participant selection process. The third non-metalinguistic influence that we sought to minimise was working memory. We did this by selecting a measure of syntactic awareness that is less dependent on working memory than others (Bowey, 1994; Cain, 2007). By taking these three critical non-metalinguistic influences on task performance into account, we were able to establish if poor comprehenders have metalinguistic sources of difficulty on measures of morphological and syntactic awareness.

To summarize, in the present study, we argue that distinguishing morphological awareness and syntactic awareness in the measurement of grammatical awareness can lead to a better understanding of the nature between grammatical awareness and reading comprehension difficulties. Also, a direct comparison between morphological awareness and syntactic awareness in reading comprehension difficulties, whilst minimising for non-metalinguistic sources of difficulty, can yield insight into the metalinguistic strengths and weaknesses that characterize poor comprehenders. To this end, two specific research questions were addressed. First, do poor comprehenders exhibit weakness on both morphological awareness and syntactic awareness? Second, how do poor comprehenders perform on morphological awareness task with sentence context (i.e., sentence completion) and the one without sentence context (i.e., word analogy)?

Method

Participants

The participants were 15 poor comprehenders (10 boys, five girls, mean age = 9 years, 11 months) and 15 average comprehenders (eight boys, seven girls, mean age = 9 years, 11 months) selected from 100 9- to 10-year-old children who were assessed for a longitudinal project on English reading development. The initial sample of 100 children all attended 4th grade and they were recruited from seven local elementary schools in a Nova Scotia community. These seven schools were located in rural areas and children attending these schools came from the middle to low socioeconomic status neighborhoods. According to parental report, all of the participating children were normally developing children without any known behavioral and learning difficulties or developmental delay, and they were all from homes where English was the predominant language spoken. Hence, the present sample is homogenous.

On the basis of previous research (Kirby, Cain, & White, 2012; Tong, et al., 2011), a regression technique was employed to select poor comprehenders and average comprehenders. Prior to our regression analysis, an examination of univariate and multivariate outliers, linearity, independent observation, homoscedasticity and normal distribution of residual errors were conducted. These suggested that our data meet the assumptions of regression analysis (Cohen, Cohen, West, & Aiken, 2003).

In the regression analysis, we first predicted children's reading comprehension (performance measured with the Gates-MacGinitie test, described below) from performance on the following constructs: word reading ability (assessed with the Woodcock Reading Mastery Tests-Revised, Word Identification and Word Attack), receptive vocabulary (assessed with a

modified version of the Peabody Picture Vocabulary Test –III), nonverbal IQ (assessed with the Matrix Reasoning subtest from the Wechsler Abbreviated Scale of Intelligence), and also chronological age. The measures used to assess each construct are described in the Materials subsection below. These 'control' variables have been used in previous research in selection and matching of good and poor comprehenders (Catts et al., 2006; Nation & Snowling 2000; Stothard & Hulme, 1995) and in selecting good and poor comprehenders using the regression technique (Kirby et al., 2012; Tong et al., 2011). Thus, our selection procedure enables us to relate our findings with the extant literature on children with specific reading comprehension difficulties.

A total of 53% of the variance in the children's performance on the Gates-MacGinitie reading comprehension measure was explained by these variables. We then plotted the children's actual reading comprehension scores obtained on the Gates-MacGinitie test against the scores predicted from the regression equation. We identified 15 children below the lower 65% confidence interval of the regression line as poor comprehenders and 15 who scored within the 15% confidence intervals as average comprehenders. The criterion of selecting average comprehenders is the least distance of the standardized predictive values to the regression line. The standardized predictive values of these selected 15 average comprehenders were either localized in the regression line or being close to the regression lines relative to the ones for other unselected participants. Of these two selected groups of comprehenders, we excluded very good readers (whose word reading skills were 2 years or more above than their chronological age) and very poor readers (whose word reading scores were more than 2 years below their chronological age) (Cain, Oakhill, & Bryant, 2004).

Table 1 summarizes the mean raw scores, standard deviations, age-equivalent scores and percentile ranks of performance of the two groups of comprehenders on reading, vocabulary, and nonverbal ability measures. To put the reading scores for our sample into context, the mean chronological age for each group was 9 years, 11 months and the mean raw scores for word reading accuracy were equivalent to mean scores of 10 years, 2 months of age and 10 years, 7 months of age, for the poor comprehender and average comprehender groups, respectively. In contrast, the mean raw score for comprehension for the poor comprehenders was equivalent to a reading comprehension age of 9 years, 5 months, and that for average comprehenders was equivalent to a reading comprehension age of 11 years, 2 month. For the vocabulary, the mean scores were equivalent to mean scores of 12 years of age and 12 years, 11 months of age, for the poor comprehender and average comprehender groups, respectively. These age equivalencies demonstrate the clear disparity between word reading and reading comprehension for our poor comprehenders.

The *F* test statistics, as shown in Table 1, further confirmed that poor comprehenders obtained significantly lower scores than the average comprehenders on the passage reading comprehension measure (Gates-MacGinitie reading comprehension ($p < .001$). Our second measure of reading comprehension, the Passage Comprehension subtest of Woodcock Reading Mastery Tests-Revised (WRMT-R, Woodcock, 1998), was included as an additional check of the group selection and confirmed that the poor comprehenders performed more poorly than the average comprehenders ($p < .001$). Finally, the groups did not differ on any of the other variables used in the group selection process: word reading (Word Identification, $p = .45$; Word Attack, p

= .49), vocabulary (PPVT, p = .72), nonverbal ability (Matrix Reasoning, p = .80), and age (p = .58).

Materials

Reading ability. Reading comprehension was assessed with Gates-MacGinitie Reading Comprehension Test-Fourth Edition (MacGinitie, MacGinitie, Maria, & Dreyer, 2002) and the Passage Comprehension Subtest of Woodcock Reading Mastery Tests-Revised (WRMT-R, Woodcock, 1998), both standardized tests. In the first test, children read short passages and then answer a set of multiple-choice questions after each one. The second test was cloze-based, in which children were asked to fill in a missing word of a sentence with the context provided in the preceding short sentence, e.g., '*The can of paint is nearly full. Susan will use it to ___the walls. (*correct answer*: paint/cover')*. The reliabilities of these two tests are .96 and .92, respectively.

Word reading was assessed using Word Identification and Word Attack*,* two subtests from the WRMT-R (Woodcock, 1998), in which children were asked to read aloud visually presented real words and pseudowords, respectively. The reliabilities of these two tests are both .94.

Vocabulary. Vocabulary knowledge was assessed with a modified version of the Peabody Picture Vocabulary Test - Third Edition (M-PPVT-III; Dunn & Dunn, 1997). This task was modified from the full version by selecting every fourth item to create a 51-item test; this modification has been successfully used to assess receptive vocabulary of children of a similar age (Deacon, Benere, & Castles, 2012). The task was amended to reduce testing time to within a reasonable limit for school-based testing. As with the full test, children were asked to choose

one out of four pictures that best represented the meaning of the word spoken by the experimenter.

Nonverbal ability. Nonverbal ability was assessed using the Matrix Reasoning subtest from the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). In this task, children were asked to choose one out of five pictures to complete the missing portion of a picture pattern. The reliabilities of these two tests are .70 and .89, respectively.

Morphological awareness. Children completed two measures of morphological awareness, which were both presented to children aurally: a word analogy task and a sentence completion task. The word analogy task, comprised 7 inflectional and 7 derivational items in the form A: B:: C: D (e.g., Nunes, Bryant, & Bindman, 1997). Children were orally presented with the first pair of words and the first word of the second pair, and were asked to generate a new word to complete the pattern. An example of an inflection item is '*push*: *pushed*:: *lose*: (*lost)'* (involving a change from present to past tense). An example of a derived item is '*paint* is to *painter* as *bake* is to (*baker)'* involving a transformation from verb to noun. Separate scores were calculated for the inflection and derived items, as well as a composite score (sum of these two). Internal consistency assessed with Cronbach's α for the whole scale was .71.

The sentence completion task, adapted from Carlisle's (2000) morphological production task, assessed children's ability to manipulate the morphological structure of a spoken word to fit in an orally presented sentence. There were 10 transparent forms in which there was no phonological shift between the derived form and the base form (e.g., *Comfort. The chair was _____ [comfortable]*). There were 10 opaque forms, in which there was a phonological shift between the derived form and the base (e.g., *Popularity. The girl was very _____ [popular]*).

The task was to alter the word spoken by the assessor so that it best fit the sentence. For half of the items, the task was to produce the derived form of a root word (e.g., *comfort* to *comfortable*); for the other half, the task was to identify the root of a morphological complex word (e.g., *comfortable* to *comfort*). We selected transparent and opaque words so that they had similar frequency in terms of root forms and derived forms at grade 4 level according to a children's frequency database (Zeno, 1995). All the target words were designed to appear at the end of the sentence. Separate scores were calculated for the transparent and opaque items and summed to create a composite score. Cronbach's α for the measure as a whole is .71.

Syntactic awareness. A sentence correction task, developed from Bowey (1986), was used to assess syntactic awareness. This was presented to children aurally. Children were asked to fix a grammatical mistake in a sentence spoken by an experimenter. For example, the experimenter would say an incorrect sentence such as '*she brushed them teeth.'* The correct response would be '*she brushed her teeth*.' We selected items that did not include morphological changes, so that performance on the task would more purely assess syntactic awareness. The sentences to be corrected included syntactic changes from Bowey (1986) and from errors in children's naturalistic speech (taken from Otto, 2006). There were 18 items and a single score was calculated. Cronbach's α is .81.

Phonological awareness. This aurally presented measure was included to contrast with performance on the morphological and syntactic awareness tasks: previous research demonstrates that good and poor comprehenders do not differ on this metalinguistic skill (Cain, Oakhill, & Bryant, 2000). We adapted a 20-item elision task from Rosner and Simon (1971). Children were first asked to repeat a monosyllabic (e.g., *farm*) or polysyllabic word (e.g.,

powder) spoken by the experimenter and then to say the remaining part of word without a specific sound, e.g., *farm* without the /f/ would be *arm*. A single score was calculated. Cronbach's α is .93.

Procedure

After the informed written consent was obtained from parents and caregivers, children were assessed in a quiet room in the child's school by trained research assistants. All of the tasks were presented to children in two 45-minute sessions this includes other tasks that were part of the larger research project that are not reported here. The tasks relevant to this paper were administered in the following order: vocabulary (PPVT), word reading and passage comprehension (WRMT-R); phonological awareness; morphological awareness word analogy; syntactic awareness sentence correction; morphological awareness sentence completion; reading comprehension (Gates-MacGinitie). All standardized tasks were administered according to the standardized protocol.

Results

Prior to the selection of poor comprehenders and average comprehenders, the data distributions for the experimental measures of morphological awareness, syntactic awareness, and phonological awareness were examined. This examination indicated that the word analogy derivation data were positively skewed, and this was corrected with the squared root transformation (Tabachnick & Fidell, 2007). All analyses were carried out on raw scores with the exception of the word analogy derivation task, for which the transformed scores were used.

Correlations among performance on the morphological awareness, syntactic awareness, phonological awareness and reading comprehension tasks for the entire sample (N=100) are

reported in Table 2. Moderate correlations were observed between these measures. Both measures of reading comprehension showed a similar pattern of relations. Specifically Gates-MacGinitie reading comprehension was significantly and moderately correlated with word analogy (r = .42), sentence completion (r = .59), sentence correction (r = .67) and phonological awareness (r = .54). Passage comprehension was also significantly correlated with word analogy (r = .48), sentence completion (r = .66), sentence correction (r = .62), and phonological awareness (r = .51).

Do Poor Comprehenders Exhibit Weakness on Both Morphological Awareness and Syntactic Awareness?

Table 3 summarises the performance of the two groups on the metalinguistic awareness tasks. To determine whether or not poor comprehenders had weaknesses on metalinguistic awareness in general, or specifically on the measures of morphological and phonological awareness, a multivariate analysis of variance (MANOVA) was performed with the following dependent variables: the composite scores of word analogy (the sum of inflection and derivation items) and the composite scores of the sentence completion (the sum of transparent and opaque items) tasks which were indicators of morphological awareness; the sentence correction score which was the sole indicator of syntactic awareness; and the phoneme elision score which was the indicator of phonological awareness. Group (poor comprehenders vs. average comprehenders) was an independent variable.

There was a significant overall effect of group, $\Lambda = .57$, $F\,(4, 25) = 4.75$, $p < .01$, $\eta_p^2 = .43$; the poor comprehenders performed less well than the average comprehenders. The univariate F tests further revealed that, in line with previous research (Tong et al., 2011), the poor

comprehenders performed worse than the average comprehenders on one measure of morphological awareness, the word analogy task, $F(1, 28) = 7.75$, $p < .05$, $\eta_p^2 = .22$, but not on the other measure of this construct, the sentence completion task, $F(1, 28) = 0.01$, $p = .94$. Also in line with previous research (Nation & Snowling, 2000), the groups differed on the measure of syntactic awareness, the sentence correction task, $F(1, 28) = 12.08$, $p < .01$, $\eta_p^2 = .30$. Finally, in line with the previous findings (Cain et al., 2000), the groups did not differ on the measure of phonological awareness $F(1, 28) = 0.08$, $p = .77$. These results suggest that our poor comprehenders have difficulties with both morphological awareness and syntactic awareness but not phonological awareness. Further, in line with the extant literature, difficulties are apparent on some, but not all, measures of morphological awareness.

How Do Poor Comprehenders Perform on Tasks of Inflectional and Derivational Morphology?

To further examine poor comprehenders' performance on morphological awareness tasks and to compare with the extant literature (Tong et al., 2011), we conducted MANOVA for word analogy, for which we found a group difference in the main analysis. This MANOVA examined group difference on two types of word analogy, inflection and derivation, by entering the separate scores as dependent variables, and group as an independent variable. As in the analyses reported earlier, there was a significant overall effect of group, $\Lambda = .65$, $F(2, 27) = 7.23$, $p < .01$, $\eta_p^2 = .35$. The F tests further revealed the same pattern of performance as in by Tong et al. (2011): the poor comprehenders scored lower than average comprehenders on only the derivational items, $F(1, 28) = 14.99$, $p < .01$, $\eta_p^2 = .35$; there was no significant group difference in the inflectional items, $F(1, 28) = 1.11$, $p = .30$.

Discussion

The present study was designed to evaluate metalinguistic skills in children with poor reading comprehension, specifically morphological and syntactic awareness. Building on prior work, we evaluated these skills with individual tasks that evaluated each one separately: a word analogy task that presented words in isolation to measure morphological awareness, and a sentence correction task to evaluate syntactic awareness that did not include morphological errors. A third task, the sentence completion task, although commonly used to assess morphological awareness, tapped both aspects of metalinguistic awareness. We controlled for non-metalinguistic sources of influences when selecting our participants and tasks to establish that where differences existed, they were metalinguistic in source. We also included an additional measure of phonological awareness to identify whether weaknesses in metalinguistic awareness were specific or general.

Our findings were in line with previous research: poor comprehenders performed less well than good comprehenders on the measure of morphological awareness that had few syntactic demands, the word analogy task (Tong et al., 2011) and on the syntactic awareness task that did not include morphological errors (Nation & Snowling, 2000). In contrast, the groups did not differ on the task that tapped both aspects of metalinguistic awareness, the sentence completion task, in line with the findings of Tong et al. (2011). Further, we demonstrated specific, rather than broad metalinguistic weaknesses: the groups did not differ on the measure of phonological awareness (Cain et al., 2000). Finally, when item types were compared we found that the poor comprehenders had specific difficulties with morphological awareness when the task tapped derivational ability, similar to Tong et al. (2011). It should be noted that all of our

tasks were orally presented, confirming the general finding that children with a reading comprehension deficit also show weaknesses on oral language measures (Catts et al., 2006).

There are several alternative explanations of the findings that poor comprehenders have weaknesses in morphological awareness in a task without a sentence context (word analogy) but, notably, no weaknesses when we assessed morphological awareness in a task with a sentence context (sentence completion). This pattern has been found in two separate samples of poor comprehenders (Tong et al., 2011 and our own study here) and, thus, does not appear to be a spurious finding. Clearly, not all measures of morphological awareness are the same. One obvious difference between the tasks is that the word analogy task involves analogical reasoning, whilst the sentence completion task does not. We do not believe that reasoning skills *per se* underpin the differences between our groups, because a nonverbal reasoning task was used as a control in our group selection process.

The second clear difference between these tasks is that the sentence completion task includes a sentence context whilst the word analogy task does not. This might lead one to suspect that poor comprehenders have a relative strength in syntactic awareness that might help to boost their performance in the sentence completion task (of morphological awareness). We do not believe that it is necessarily the case because we also found that our poor comprehenders had a weakness in syntactic awareness, a finding that replicated and extended the finding of Nation and Snowling (2000) by using a different measure. We chose our measure of syntactic awareness because other work has demonstrated that is has lower working memory demands than the word order correction task. Thus, we believe that our finding of a syntactic awareness weakness is robust and specific to metalinguistic awareness, rather than language use in general. Clearly, an

alternative explanation for the pattern of performance on our measures of morphological awareness is required.

Sentence contexts offer other forms of support, in addition to syntactic information. As we outlined in the introduction, parts of the sentences can help children to work out the right word to complete a sentence because the target word carries the meaning with other parts of the sentence. Although other research has demonstrated semantic deficits in poor comprehenders (Nation & Snowling, 1998), the broad tradition of research on specific reading comprehension deficits has selected poor comprehenders with age-appropriate vocabulary skills (see Cain & Oakhill, 2007; Yuill & Oakhill, 1991, for reviews) and it should be noted that our groups did not differ on the measure of receptive vocabulary, which was used in the group selection process (see also Stothard & Hulme, 1992). Our selection process enables us to relate our findings to this broad literature and is in line with other research that further demonstrates that children can have passage reading comprehension weaknesses in the presence of intact oral vocabulary skills (e.g., Cain, Oakhill, & Bryant, 2004). Thus, it is plausible that our selection process resulted in groups that were both able to use vocabulary knowledge sufficiently to support performance in the sentence completion task in spite of less than perfect representations of the structures of the words. We believe that poor comprehenders who have additional vocabulary weaknesses (such as those studied by Nation and Snowling, 1998) may have greater difficulties on metalinguistic tasks that can be carried out by recourse to semantic processing skills (Bowey, 1994).

An alternative, but not mutually exclusive, hypothesis is that the sentence context provided support for weak memory. Although we did not include an assessment of memory in our study, other work has shown that poor comprehenders have weak working memory (Cain,

2007). The rich semantic context provided by the stimuli in the sentence completion measure of morphological awareness may have helped the poor comprehenders retain the stimuli and, together with the semantic support, consequently perform at a level comparable to that of the average comprehenders. The word analogy task is, in essence, a set of words and does not provide the same degree of contextual support. There is evidence from the working memory literature itself to support this idea. The findings of Cowan et al. (2003) suggested that sentential information supports the recall in reading and listening span tasks because participants can reconstruct information from the sentence context, something that is not possible from working memory tasks with numbers, such as the counting span task or, as we would argue here, a morphological awareness task such as the word analogy task, which comprises a set of words without a sentence context.

If the context of the sentence completion task provided sufficient support for poor comprehenders to succeed, why then did they not benefit from the sentential support provided by our measure of syntactic awareness, the sentence correction task? Correct responses in our sentence correction task required a sensitivity to grammar, not semantics. For example, knowing to replace *'them'* with *'her'* in *'she brushed them teeth'* relies on an understanding of which appropriate pronoun to be used, replacing one pronoun with another to refer correctly to the doer of the action. It has demonstrated that such tasks can overestimate metalinguistic skills, because children may automatically edit their speech and thus gain higher scores through this process (Bowey, 1994, 1996). We discount this explanation of our findings for two reasons. First, Bowey (1986) demonstrated that children in our age group (Grade 4) are very able to imitate sentences containing errors, with little evidence of automatic correction. Second, if our poor

comprehenders behaved like younger children and were prone to automatic correction, the likelihood of finding a group difference would be slight. Thus, we believe that the poor comprehenders' weaknesses on the measure of syntactic awareness represent a syntactic awareness weakness, in line with Nation and Snowling's (2000) findings.

The present study is novel in that it aims to disentangle the relations between morphological awareness and syntactic awareness and reading comprehension difficulties. However, it should be noted that there are several limitations. First, our study, like most others involving the investigation of poor comprehenders, has a small sample size. It is for this reason that it is reassuring to see consistency between the findings reported here and prior studies (e.g., Nation & Snowling, 2000; Tong et al., 2011). Second, the word analogy task comprised a small number of both inflection and derivation items and we also assessed a greater variety of derivational morphemes than inflectional morphemes, which form a more restricted set. Together, these factors (number and variety of items) may explain why the internal consistency for the derivation subscale was low (internal consistency = .47) compared with the inflection subscale (.64). Future studies could usefully determine how the wide range of derivational morphemes should be best reflected in scales of this aspect of morphological awareness. Third, we do not have working memory scores for the children, which would go some distance in evaluating one of our explanations for the pattern of the results. Fourth, we need to be clear here as elsewhere (e.g., Tong et al. 2011) that the design of the present study does not allow for causal conclusions to be made; it only allows us to show an association between morphological and syntactic awareness weaknesses and poor reading comprehension. Recent meta-analyses of intervention data also lead us to similar caution; Bowers et al. (2010) showed that teaching

children morphological awareness impacted the supralexical level of reading (of which reading comprehension was a component) when compared with an untrained control group, but not when compared with an alternative treatment control group (*d* values of .28 and -.08, respectively). As the authors of that review note, it is a somewhat higher bar to outperform alternative treatments given that these are much more established intervention approaches (such as phonological awareness). Nevertheless this is precisely the level of data that is required, i.e., in combination with longitudinal evidence with typical and atypical readers to generate causal conclusions.

Despite these limitations, the present study opens up several promising research avenues in the area of morphology, syntax and reading comprehension difficulties. First, in the present study, poor comprehenders were selected and matched on word reading proficiency and vocabulary. There is no doubt that these poor comprehenders exist. They have been identified and studied by other research groups (e.g., Cain et al., 2004; Stothard & Hulme, 1992). Nevertheless, it is also obvious that some poor comprehenders have problems in either word reading (Shankweiler, 1989) or vocabulary (Cain et al., 2004), or both (Perfetti & Stafura, in press). Therefore, future research can examine the role of morphological awareness and syntactic awareness in different types of poor comprehenders to separate the relations between these skills and establish whether language knowledge or metalinguistic awareness is the more likely source of weaknesses in these different groups. Second, given the bidirectional association observed between morphological awareness and word reading in normal readers (Deacon, Benerre, & Pasquarella, 2012), the investigation of the reciprocal relations between morphological awareness, syntactic awareness and reading comprehension is an interesting topic that merits future research. Recent studies reveal the emerging weaknesses of poor comprehenders in

morphological awareness (Tong et al., 2011) and vocabulary (Cain & Oakhill, 2011). This may be caused by the impoverished experience with text, which could result in delayed learning of more complex morphological and syntactic rules, particularly those which occur more readily in written texts (Scott, 2009). In addition, the morphological awareness and syntactic awareness tasks used in the present study were both offline tasks that required children's explicit manipulation of the morphological or syntactic structure of oral language. Implicit priming is a promising approach to tap into children's processing of morphological structure of words as they read (McCutchen, Logan & Biangardi-Orpe, 2009) and could usefully determine the locus of poor comprehenders' difficulties: do their difficulties arise at the level of tacit morphological and syntactic knowledge or when attention must focus on the structure, rather than the content, as in metalinguistic tasks.

In conclusion, our data show for the first time that poor comprehenders have weaknesses with both morphological and syntactic awareness. The pattern of the findings is convergent with the limited previous research in this area and adds to a growing literature that poor comprehension is associated with a broad range of language weakness that are specific to the meaning-related aspects of reading, rather than phonological skills, which are intact in this group. This study also clearly points to the need to further develop measures that cleanly tap these two critical aspects of metalinguistic awareness to understand better how they disrupt the reading comprehension process.

References

Bowers, P. N., Kirby, J. R., & Deacon, S. H. (2010). The effects of morphological instruction on literacy skills: A systematic review of the literature. *Review of Educational Research*, *80*, 144–179.

Bowey, J. A. (1986). Syntactic awareness and verbal performance from preschool to fifth grade. *Journal of Psycholinguistic Research, 15*, 285–306.

Bowey, J. A. (1994). Grammatical awareness and learning to read: A critique. In E. M. H. Assink (Ed.), *Literacy Acquisition and Social Context* (pp. 122-149). London: Harvester Wheatsheaf.

Cain, K. (2007). Syntactic awareness and reading ability: Is there any evidence for a special relationship? *Applied Psycholinguistics, 28*, 679-694.

Cain, K., & Oakhill, J. (2007). Reading comprehension difficulties: Correlates, causes, and consequences. In K. Cain & J. Oakhill (Eds.), *Children's comprehension problems in oral and written language: A cognitive perspective* (pp. 41-75). New York: Guilford Press.

Cain, K., & Oakhill, J. (2006). Profiles of children with specific reading comprehension difficulties. *British Journal of Educational Psychology, 76*, 683-696.

Cain, K., & Oakhill, J. V. (2011). Matthew Effects in young readers: reading comprehension and reading experience aid vocabulary development. *Journal of Learning Disabilities, 44*, 431-443.

Cain, K., Oakhill, J., & Bryant, P. (2000). Phonological skills and comprehension failure: A test of the phonological processing deficit hypothesis. *Reading and Writing: An Interdisciplinary Journal, 13*, 31–56.

Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology, 96(1)*, 31-42.

Carlisle, J. F. (1988). Knowledge of derivational morphology and spelling ability in fourth, sixth, and eighth graders. *Applied Psycholinguistics, 9*, 247–266.

Carlisle, J. F. (1995). Morphological awareness and early reading achievement. In L.B. Feldman (Ed.), *Morphological aspects of language processing* (pp.189-209). Hillsdale, New Jersey: Erlbaum.

Carlisle, J. F. (2000). Awareness of the structure and meaning of morphologically complex words: Impact on reading. *Reading and Writing: An Interdisciplinary Journal, 12*, 169-190.

Carlisle, J. F. (2003). Morphology matters in learning to read: A commentary. *Reading Psychology, 24*, 291-322.

Carlisle, J. F. & Fleming, J. (2003). Lexical processing of morphologically complex words in the later elementary years. *Scientific Studies of Reading 7,* 239–54.

Catts, H. W., Adlof, S.M., & Weismer, S.E. (2006). Language deficits in poor comprehenders: A case for the simple view of reading. *Journal of Speech, Language and Hearing Research, 49*, 278-293.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Erlbaum.

Cowan, N., Towse, J. N., Hamilton, Z., Saults, J. S., Elliott, E. M., Lacey, J. F., & Moreno, M. V. (2003). Children's working-memory process: A response-timing analysis. *Journal of Experimental Psychology: General, 132*, 113-132.

Crystal, D. (1987). *The Cambridge encyclopedia of language*. Cambridge: Cambridge University Press.

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

Deacon, S., Benere, J., & Castles, A. (2012). Chicken or egg? Untangling the relationship between orthographic processing skill and reading accuracy. *Cognition, 122(1)*, 110-117.

Deacon, S. H., Benere, J., & Pasquarella, A. (2012). Reciprocal relationship: Children's morphological awareness and their reading accuracy across grade 2 to 3. *Developmental Psychology.* Advance online publication. doi: 10.1037/a0029474

Demont, E., & Gombert, J. E. (1996). Phonological awareness as a predictor of recoding skills and syntactic awareness as a predictor of comprehension skills. *British Journal of Educational Psychology, 66*, 315-332.

Dunn, L.M., & Dunn, L.C. (1997). *PPVT-III: Peabody Picture Vocabulary Test* – Third Edition. Circle Pines, MN: American Guidance Service.

Kamil, M. (2003). *Adolescents and literacy: Reading for the twenty-first century*. Washington, DC: Alliance for Excellent Education. Retrieved September 21, 2009, from http://www.all4ed.org/files/archive/publications/AdolescentsAndLiteracy.pdf.

Kirby, J. R., Cain, K., & White, B. (2012). Deeper learning in reading comprehension. In J. R.

Kirby & M. J. Lawson (Eds.), *Enhancing the Quality of Learning: Dispositions, Instruction, and Learning Processes* (pp. 315-338). New York: Cambridge University Press.

Kuo, L., & Anderson, R. C. (2006). Morphological awareness and learning to read: A cross-language perspective. *Educational Psychologist, 41*, 161–180

MacGinitie, W., MacGinitie, R., Maria, K., & Dreyer, L. (2002). *Gates-MacGinitie Reading Tests (4)*. Itasca, IL: Riverside.

McBride-Chang, C. (2004). *Children's literacy development*. London: Arnold.

McCutchen, D., Logan, B., & Biangardi-Orpe, U. (2009). Making meaning: Children's sensitivity to morphological information during word reading. *Reading Research Quarterly*, *44(4),* 360-376.

Murnane, R., & Levy, F. (1996). *Teaching the new basic skills: Principles for educating children to thrive in a changing economy*. New York: Martin Kessler.

Nagy, W., Berninger, V. W., & Abbott, R. D. (2006). Contributions of morphology beyond phonology to literacy outcomes of upper elementary and middle-school students. *Journal of Educational Psychology, 98*, 134-147.

Nagy,W. E., Berninger, V.W., Abbott, R. C., Vaughan, K. & Vermeulen, K. (2003). Relationship of morphology and other language skills to literacy skills in at-risk second-grade readers and at-risk fourth-grade writers. Journal of Educational Psychology, 95, 730–742.

Nagy,W. E., & Scott, J. A. (2000). Vocabulary processes. In M. L. Kamil, P.B. Mosenthal, P. D. Pearson, & R. Barr (Eds), Handbook of reading research: Volume III (pp. 269–284).Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Nation, K., Clarke, P., Marshall, C-M., & Durand, M. (2004). Hidden language impairments in children: Parallels between poor reading comprehension and specific language impairment? *Journal of Speech, Language, and Hearing Research, 47*, 199-211.

Nation, K., Cocksey, J., Taylor, J. S. H., & Bishop, D. V. M. (2010). A longitudinal investigation of early reading and language skills in children with poor reading comprehension. *Journal of Child Psychology and Psychiatry, 51*, 1031–1039.

Nation, K., & Snowling, M. J. (1998). Semantic processing and the development of word-recognition skills: evidence from children with reading comprehension difficulties. *Journal of Memory and Language, 39*, 85–101.

Nation, K., & Snowling, M. J. (2000). Factors influencing syntactic awareness skills in normal readers and poor comprehenders. *Applied Psycholinguistics, 21*, 229–241.

Nation, K., Snowling, M. J., & Clarke, P. (2005). Production of the English past tense by children with language comprehension impairment. *Journal of Child Language, 32*, 117-137.

Nunes, T., Bryant, P., & Bindman, M. (1997). Morphological spelling strategies: Developmental stages and processes. *Developmental Psychology, 33*, 637-649.

Oakhill, J.V. (1984). Inferential and memory skills in children's comprehension of stories. *British Journal of Educational Psychology, 54*, 31–39.

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

Otto, B. V. (2006) *Language development in early childhood*. 2nd Edition. New Jersey: Upper Saddle River.

Perfetti, C. A., & Stafura, J. (in press). Reading comprehension: Including word knowledge in a theoretical framework. *Scientific Studies of Reading*.

Rosner, J., & Simon, D. (1971). The Auditory Analysis Test: An initial report. *Journal of Learning Disabilities, 4*, 384-392.

Scott, C. (2009). A case for the sentence in reading comprehension. *Language, Speech, and Hearing Services in Schools, 40*, 184-191.

Shankweiler, D. (1989). How problems of comprehension are related to difficulties in decoding. In D. Shankweiler & I. Y. Liberman (Eds.), *Phonology and Reading Disability: Solving the Reading Puzzle* (pp. 35-68). Ann Arbor: University of Michigan Press.

Stothard, S. E., & Hulme, C. (1992). Reading comprehension difficulties in children: The role of language comprehension and working memory skills. *Reading and Writing, 4*, 245-256.

Stothard, S. E., & Hulme, C. (1995). A comparison of phonological skills in children with reading comprehension difficulties and children with decoding difficulties. *Journal of Child Psychology and Psychiatry, 36*, 399-408.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Allyn & Bacon.

Tong, X., Deacon, S. H., Kirby, J.,Cain, K., Parrila, R. (2011). Morphological awareness: A key to understanding poor reading comprehension in English. *Journal of Educational Psychology, 103*, 523-534.

Tyler, A. & Nagy, W. (1989). The acquisition of English derivational morphology. *Journal of*

Memory and Language, 28, 649–67.

Tyler, A., & Nagy, W. (1990). Use of derivational morphology during reading. *Cognition, 36*, 17–34. doi:10.1016/0010-0277(90)90052-L.

Wechsler, D. (1999). *Wechsler abbreviated scale of intelligence*. San Antonio, TX: The Psychological Corporation.

Woodcock, R. W. (1998). *Woodcock Reading Mastery Tests-Revised Forms* (WRMT-R): G & H. USA: American Guidance Service.

Yuill, N. M., & Oakhill, J. V. (1991). *Children's problems in text comprehension: An experimental investigation*. Cambridge: Cambridge University Press.

Zeno, S. (Ed.). (1995). The educator's word frequency guide. Brewster, N.J.: Touchstone Applied Science Associates.