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Reading for Meaning: A randomised control trial investigating interventions to ameliorate the reading comprehension difficulties of secondary school students

Grace Eliot

Abstract

It is vital that secondary school students have a good level of reading comprehension, and that teachers have evidence-based interventions to improve the reading comprehension of their students. Research indicates that oral language training is effective at improving the reading comprehension of primary age children; however, it is not clear whether this also applies to secondary age children. This randomised control trial examined the efficacy of text based (TB) and oral language (OL) training on the reading comprehension of students between the ages of 11 and 13 with poor reading comprehension, when compared to a waiting list control group (WLC). The parallel intervention programmes were delivered for an hour each week over a period of eight weeks. Oral language training included vocabulary, reciprocal teaching with spoken language, spoken narrative and figurative language. Text-based training included metacognitive strategies, written narrative and inference skills. A specific attribution re-training strategy was introduced at the start of each session in both the oral language and text-based training programmes. These strategies were based on Weiner's Attribution Theory (Weiner, 1972) that focuses on how individuals interpret events and how this relates to their thinking and behaviour. For example, at the start of one session, students were taught to understand the difference between positive and negative thoughts, and explored how positive thoughts can be self-promoting and negative thoughts can be self-defeating. The aim of attribution re-training was to help students understand and develop effective beliefs about their reading comprehension success and failure. There were statistically significant gains in reading comprehension in both the text-based and oral language intervention when compared to the waiting list control group, indicating that both the oral language and text-based interventions were effective at improving reading comprehension standard score. There was also a significant increase in the word reading standard score for the text-based group when compared with the waiting list control group. There were improvements in the students' perceived value of reading and reading self-concept in both the text-based and oral language training compared to the waiting list control group.

Key Words: Randomised Control Trial, Reading Comprehension, Vocabulary, Oral Language, Text Based Strategies, Secondary School Students

Reading Comprehension

The goal of reading is to gain meaning from text. As outlined in the Simple View of Reading (Gough & Tunmer, 1986), adequate reading comprehension is dependent on the decoding of words and oral language comprehension, and both are necessary but not sufficient for successful reading comprehension to occur.

{Insert} Figure 1: Gough and Tunmer's (1986) Simple View of Reading

The term 'poor comprehender' is used to refer to students with deficits in their comprehension that is discrepant with their word reading accuracy. (Cain & Oakhill, 2007). These students can read words relatively fluently and accurately, but have difficulty understanding the meaning conveyed by a text (Oakhill, Cain & Elbro, 2014). The best available criteria for defining students with clinically significant reading comprehension difficulties is "students whose reading comprehension standard score is equal to or below 90, reading accuracy score is 90 or above, and who show a greater than one standard deviation deficit in reading comprehension compared to word reading" (Snowling et al., 2009; 109).

Research indicates that early on in learning to read, most variance is explained by decoding skill (Keenan et al., 2008). Once word reading becomes automatic and fluent, the barrier to effective reading comprehension is reduced, hence the association between reading comprehension and oral language is stronger (Verhoeven & van Leeuwe, 2012). Although we know that there is a strong relationship between oral language and reading comprehension skill in students of primary school age, there has been insufficient focus on interventions and the underlying components that can improve the reading comprehension of secondary age students.

Indeed, the processes needed for understanding the meaning of text are complex, as it involves interconnected cognitive processes at the word, sentence and discourse level (Hulme & Snowling, 2011), and therefore it is perhaps not surprising that a significant minority of children struggle to understand much of what they read. Indeed, the study of children with poor reading comprehension difficulties has highlighted that the difficulties faced by poor comprehenders can be associated with vocabulary (Quinn, Wagner, Petscher & Lopez, 2015), semantic understanding (Nation, 2005), narrative production (Clarke, Snowling, Trulove & Hulme, 2010), verbal working memory difficulties (Florit, Roch & Levorato, 2011), syntax (Perfetti & Stafura, 2014) and inference (Lepola, Lynch, Laakkonen, Silven & Niemi, 2012).

More research is needed into evidence-based interventions to improve the reading comprehension of poor comprehenders between the ages of 11 and 13. Whilst some evidence suggests that improvements in vocabulary knowledge can lead to gains in reading comprehension (Clarke, Snowling, Trulove & Hulme, 2010), few studies have examined the relative importance of other potential component skills for the development of reading comprehension such as grammar, figurative language, narrative and inference skills. Furthermore, current research indicates that this transitory year is vital for delivering effective interventions for children. Indeed, research suggests that there can be a re-emergence of literacy difficulties at the age of 11 for students who have previously been diagnosed with developmental language disorder (Snowling, Bishop & Stothard, 2000). It can also mark the start of a divergence in reading ability among poor and good readers (Cain & Oakhill, 2011). These difficulties can in turn lead to implications for academic attainment at the ages of 16 and 18 (Cain & Oakhill, 2006; Ricketts et al., 2014), and psycho-social development (Arnold et al., 2005).

Research Methodology

To investigate the impact of an oral language and text-based intervention on the reading comprehension of a group of poor comprehenders of secondary school age, two intervention programmes were designed and delivered. The aim was to determine the intervention that delivered the highest overall mean gain in reading comprehension standardised score from T1 (baseline) to T2 (immediately after the intervention). To show that any gains made by the intervention groups were greater than the gains made as a consequence of standard classroom practice, the students in the waiting list control did not receive any additional interventions between T1 and T2, and the waiting list control received the most effective intervention following data collection at T2.

The oral language intervention involved instruction in the following components:

- Re-attribution training
- Vocabulary
- Reciprocal teaching with spoken language
- Spoken narrative
- Figurative language

The text-based intervention group received instruction in the following components:

- Re-attribution training
- Metacognitive strategies

- Reciprocal teaching with written narrative
- Inferencing from text

Both programmes followed a number of teaching principles.

The first was the principles of distributed practice, which requires distributing multiple practice or study opportunities rather than learning new information in a single study session. Evidence in a wide range of tasks, from studies involving a basic memory of words (Cepeda, Pashler, Vul, Wixted & Rohrer, 2006) to tasks that require engagement with more complex reading material (Krug, Davis & Glover, 1990), indicate that the positive effects of distributing practice are robust.

The second was the importance of small group instruction. Whilst most research indicates that the smaller the group size the better the outcomes, one-to-one reading comprehension interventions have not been shown to be more effective than small-group interventions (National Reading Panel, 2000). A possible reason for this is the opportunities for collaborative work and sharing knowledge, which provides students with the opportunities to learn important aspects of reading comprehension from each other (Gersten & Jimenez, 1998).

The third was the importance of reciprocal teaching (Palincsar & Brown, 1984). This is a reading comprehension methodology in which a group of students collaboratively apply four cognitive strategies of predicting, clarifying, questioning, and summarising to their reading in order to co-construct the meaning of a written text and read proactively. Reciprocal teaching is a specific application of the cooperative learning interventions in which participants learn from the contributions of more expert peers (Brown & Palincsar, 1989). Therefore, group goals, individual accountability and engagement at the highest level are factors that contribute most to its efficacy (Tarchi & Pinto, 2016). In the initial stages of reciprocal teaching, the teacher will focus on modelling the processes and strategies. Extensive modelling by the teacher provides a clear model of covert processes required in reading comprehension, and what expert readers do when they try to understand and remember texts. After modelling, the teacher will move onto supporting students in practicing the strategies by providing specific feedback, additional modelling, coaching, and explanation.

Finally, attribution re-training was used in both intervention programmes. Re-attribution retraining refers to attempts to change students' self-beliefs regarding achievement, and relates to factors including self-concept, self-efficacy and causal attributions. Its focus is on helping students to make connections between insufficient effort and failure, to promote effort attributions and persistence (Schunk & Cox, 1986). For example, feedback that helps students to understand when academic failure is a result of lack of effort can promote future task persistence and effort attributions (*ibid*) and feedback that helps students to make links between effort and success will enhance motivation and self-efficacy (Shell et al., 1995).

Research Design

Randomised Control Trials (RCTs) are widely considered to be the best research methodology for assessing the effect of an intervention on an identified outcome (Torgerson and Torgerson, 2008). RCTs are particularly well suited for interventions in which the identified outcome is reading comprehension, due to the considerable complexity in the causal pathways and mechanisms of understanding written text.

An RCT requires groups to be formed by random allocation, as this controls for the unmeasured variables that may affect reading comprehension outcomes (Brooks, Miles, Torgerson & Torgerson, 2006). In this study, students were randomly allocated to groups whilst accounting for gender, age and baseline reading comprehension standard score so that the between group differences were minimised. The use of a waiting control group was important to account for the possibility that pupils were able to make progress in their reading comprehension over time simply due to increased maturity and irrespective of any intervention that was delivered. These maturation effects can be further exaggerated by the widespread effect of 'regression to the mean' (Morton & Torgerson, 2003). This is a widespread 'group' phenomenon that occurs when there is a measurement error so that the student's score is not determined purely by the student's academic ability. In practice, this means that high scores go down and low scores go closer to the mean score. The effect is of particular significance in interventions involving pupils with reading comprehension impairment, as students with extreme values will have a greater error value attached to their 'true' score when compared with students close to the average value. A waiting control group was considered appropriate for ethical reasons, as it was important to deliver the intervention to all pupils who had been identified as poor comprehenders. All the pupils were blinded to the intervention apart from those pupils who were randomly allocated to the waiting control group. Figure 2 outlines the steps taken to reduce bias in this RCT.

{Insert} Figure 2: A summary of steps taken to reduce bias in this RCT

To ensure that the students in this study met the specific inclusion criteria (of a reading comprehension standard score below 90 and word reading standard score above 90), screening data for two different year groups in each of the six large secondary schools was collected and analysed prior to group allocation. A total of 279 students were initially selected from screening tests; however, informed consent for inclusion in the intervention study was obtained from only 150 students.

Both before and after receiving the intervention, the following data was collected:

Measured using the York Assessment of Reading for Comprehension (YARC)

- Single word reading
- Reading comprehension
- Summarisation
- Reading fluency

Measured using the Wide Range Intelligence Test (WRIT)

- Vocabulary
- Verbal Analogies
- Verbal IQ

Measured using the Motivation to Read, Revised Profile Questionnaire (MPR-P)

- Perceived value of reading
- Self-concept as a reader

Results

For each outcome measure, the pre-intervention (T1) and post-intervention (T2) data is reported in Table 1, and then analysed alongside data from the waiting list control group. These analyses were completed in SPSS (IBM SPSS version 23).

{Insert} Table 1

Effect of the intervention on reading comprehension

Overall, there was an increase in the mean reading comprehension standard score of students in both the oral language and the text-based intervention programme, with a smaller increase in the waiting list control.

The average increase in mean reading comprehension standard score for the oral language intervention was 20.4% (with an effect size of 0.67) and for the text-based intervention was 11.9% (with an effect size of 0.53), whereas for the control group the score increased by only 2.1%. Figure 3 shows that at Time 2 (post-intervention), the text-based and oral language intervention groups made large mean gains relative to the waiting list control group reading comprehension standard score. It is also clear that there was an increase in the standard deviation of reading comprehension standard scores in both the oral language and text-based group, with a particularly large increase in the oral language group.

{Insert} Figure 3

A repeated measure mixed ANOVA was used to analyse the effect of intervention group (between subjects factor: control, oral language and text-based) and time (within subjects factor: T1 and T2) on reading comprehension standard score. The effect of the intervention on reading comprehension score was highly significant $F(1,105) = 16.35, p < .0001$.

This was further analysed using a post-hoc Bonferonni test, which showed that the comparison of text-based intervention group and waiting list control group was significant (mean difference = 5.855, $SE = 1.478, p < .001$), and between oral language intervention group and waiting list control groups was significant (mean difference = 8.178, $SE = 1.468, p < 0.0001$). The difference between the oral language and text-based intervention groups was not significant (mean difference = 2.32, $se = 1.458, p = 0.343$), showing that both intervention groups produced significant differences when compared with the waiting list control group.

Given the significant interaction, simple effects tests were carried out. To explore the interaction further, at pre-intervention (T1), a one-way ANOVA showed that there was no significant difference in the reading comprehension standard scores of oral language, text-based and waiting list control groups $F(2,105) = 0.986, p = 0.377$, but at post-intervention (T2) there was a significant difference between the groups $F(2,105) = 26.287, p < .0001$.

After Bonferroni correction, pairwise comparisons of the groups at T2 showed that the text based and waiting list control group were significantly different (mean difference = 10.08, $SE = 2.24, p < .0001$) and oral language and waiting list control groups were also significantly different (mean difference = 16.02 $SE = 2.23, p < .0001$). However, the text based and oral language differences (mean difference = 5.9, $SE = 2.21, p = .025$) were not significant after Bonferroni correction.

Effect of the intervention on the students' perceived value of reading and students' self-concept as a reader

Measures of the perceived value of reading and students' self-concept as a reader were collected using the Motivation to Read, Revised Profile (MPR-P). The questionnaire provided an overall score for value of reading and self-concept as a reader, and the average score for each group was calculated at T1 and T2.

Students' self-concept as a reader

Overall, students who received the oral language intervention training had higher adjusted means for reading self-concept than the control group, resulting in large effect size ($ES = 0.86$), while students in the text-based group reported similar reading self-concept

scores to the waiting list control group, resulting in a smaller effect size ($ES = 0.24$). The mean scores for three categories for the students' self-concept as a reader at pre and post-intervention are shown in Table 2.

{Insert} Table 2

For further analysis, the items for reading self-concept were categorised into three different aspects:

1. Perception of how others view their reading ability
2. Perception of their reading ability compared to their friends
3. Perception of their own reading ability

The change in score from T1 to T2 for students' reading self-concept in each of these three aspects is shown in Figure 4.

{Insert} Figure 4

Figure 4 indicates that there were gains in all three measures for the intervention groups and waiting list control group. The largest average increase in score was made by the oral language intervention group in their perception of how others view their reading ability, and the smallest gains for all groups were made in the perception of their own reading ability.

As this data used interval data, Wilcoxon signed rank test was used to determine if there was a significant difference in scores between T1 and T2. A Bonferroni correction was applied as multiple tests were carried out. This meant it was necessary to reduce the p-value for significance to $p=.005$. The p-value (0.05) was divided by 9 to obtain a criterion value as there were 9 tests carried out. Analysis of the data indicates that the text-based intervention group showed significant improvements in their scores between T1 and T2 across all three measures of reading self-concept. The oral language intervention group showed significant improvements in their scores between T1 and T2 for the students' perception of how others view their reading ability, but not for the other two measures of reading self-concept. Whilst for the waiting list control group the change in scores between T1 and T2 are not significantly different for any of the measures of reading self-concept used.

Value of reading

The oral language and text-based groups had similar scores at pre- and post-test, which resulted in a medium effect size for the oral language ($ES = 0.65$) and text-based ($ES = 0.62$) intervention groups. The mean scores for three categories for the perceived value of reading at pre and post-intervention are shown in Table 3.

{Insert} Table 3

The oral language group displayed a slightly higher score for the value of reading at post-test ($M=3.04$, $SD = 0.78$), and higher scores are indicative of higher student perception of the value of reading.

For the purpose of this analysis, the items for value of reading were divided into three categories:

1. Interest in reading
2. Engagement in reading
3. Intrinsic motivation

The change in score from T1 to T2 for each of these categories is summarised in Figure 5.

{Insert} Figure 5

Figure 5 indicates that there were gains in all three measures for the intervention groups. The largest average increase in score was made by the text-based intervention group in their engagement in reading.

An analysis was carried out to test whether there were significant differences between the scores at T1 and T2 for each intervention group using Wilcoxon signed rank test, which compares two related samples to see if the rankings are different in the two groups. A Bonnferroni correction was applied as multiple tests on the same data were being carried out, and this involves reducing the p-value for significance to $p=0.005$. This analysis indicated that both the text-based and oral language group showed a significant improvement from T1 to T2 all three measures of value of reading.

Discussion

This research shows that evidence-based interventions can be feasibly implemented within a school environment to ameliorate the reading comprehension difficulties of students within secondary schools. The interventions directly targeting both students' oral language comprehension and text-based skills produce significant gains in the reading comprehension of secondary-age students relative to a waiting list control group. This highlights the importance of interventions targeting oral language comprehension, vocabulary, inference making skills and metacognitive skills.

The role of oral language comprehension in reading comprehension interventions is consistent with the conclusions that have been drawn in studies involving younger children (e.g. Bianco et al., 2010; Bowyer-Crane et al., 2008; Clarke et al., 2010; Fricke et al., 2013;), as well as theoretical models such as the Simple View of Reading (Gough & Tunmer, 1986,

Hoover & Gough, 1990;). This further highlights the importance of oral language comprehension for reading comprehension.

One hypothesis for the significant improvements in reading comprehension experienced by the text-based intervention group is that improvements in inference making skills and metacognition had a direct impact on reading comprehension. Indeed, Lepola, Lynch, Laakkonen, Silven, and Niemi (2012) found that inference making skills were a unique predictor of later reading comprehension beyond vocabulary and prior listening comprehension skills. An alternative hypothesis for the significant improvements experienced by the text-based intervention group is related to the fact that this group also showed a significant improvement in the average word reading standard score when compared with the waiting list control group. The role of word reading in improvements to reading comprehension is supported by research highlighting the prominent role of word identification and decoding skills with regard to reading comprehension (García & Cain, 2014). Indeed, word reading errors contribute to problems in activating the correct meaning of words in the context of the passage (Perfetti, 2010), and difficulties with word identification and decoding skills means that more cognitive resources must be allocated for word reading (Perfetti, 1985), leading to less cognitive capacity for skills such as inference-making (Prior, Goldina, Shany, Geva, & Katzir, 2014).

Promising differences were found in perceived value of reading and reading self-concept after instruction for the text-based and oral language training relative to the waiting list control. Specifically, the text-based group showed significant improvements in students' perception of how others view their reading ability, students' perception of their own reading ability compared with their friends, students' perception of their own reading ability, interest in reading, engagement in reading and intrinsic motivation. The oral language group also showed significant improvements in these aspects, apart from students' perception of their own reading ability compared with their friends and students' perception of their own reading ability. As a student's perception of their reading and the value of reading is often engrained due to a complex interplay of socio-cultural factors alongside possible years of difficulty at school, the findings of overall improvements in the perceived value of reading and reading self-concept for both intervention groups over a short period of time are promising.

Given the significant impact of this intervention programme on the reading comprehension of a large number of poor comprehenders who were involved in the study, as well as those reported in other studies, we must continue to find new ways to make it easier for teachers to access relevant research on reading comprehension, in particular for pupils as they transition to secondary school. This must take place alongside improvements in the training of teachers to deliver evidence-based interventions to poor comprehenders.

