Abstract

The present study examined associations between individual differences and comprehension capabilities of secondary school children when reading texts about science topics of varying levels of cohesion (i.e. low versus high cohesion). We administered measures of learning after reading high and low cohesion texts to 60 students (31 boys, 29 girls) and measured cognitive ability, facets of conscientiousness, and science self-efficacy. Students achieved better learning from high cohesion text. High cognitive ability was associated with good performance with both texts, whereas low cognitive ability was grouped with poor performance on low cohesion text. High science self-efficacy grouped with good performance on both texts, low science self-efficacy grouped with average performance with the texts. Low dutifulness (conscientiousness facet) grouped with poor performance on low cohesion text. These results have significant implications for the design of science textbooks and potential teacher intervention strategies with the aim of improving science education.

Keywords: text cohesion; science learning; individual differences; general intelligence; self-efficacy.
1.1 Introduction

There is growing awareness in many advanced societies of the need to encourage young people to study science in secondary levels of education and beyond, in order to increase the scientific skill base and maintain a strong workforce (e.g. Krajcik & Sutherland, 2010). However, students beginning compulsory science education often find science more difficult than other academic subjects (Jenkins & Nelson, 2005; Lyons, 2006; Osborne & Collins, 2001), and have particular difficulty in understanding scientific text (Bowen, 1999; Snow, 2002, 2010), which may dissuade them from following careers in science. Consequently, if we are to improve young students’ understanding of science, it is important to increase our understanding of the causes of these comprehension difficulties, and to make science more accessible to a broader range of students.

1.1.2 The Importance of Text Cohesion

It is widely argued that successful text comprehension relies on the reader forming a coherent mental representation of the text (Ehrlrich, 1991; Graesser, Millis, & Zwaan, 1997; McNamara, Louwerse, McCarthy, & Graesser, 2010). Text cohesion refers to the degree to which concepts, ideas, and relations within a text design are made explicit, and this influences our ability to form mental representations (Graesser, McNamara, & Louwerse, 2003; Graesser, McNamara, Louwerse, & Cai, 2004; O’Reilly & McNamara, 2007). However, science text is often structured so that logical connections and meanings between the sentences are difficult to infer (low cohesion text), making science text particularly hard to understand (Kamberelis, 1999). Specifically, ‘high cohesion’ text which explicitly links referents in sentences, by avoiding the use of pronouns (e.g. ‘them’, ‘it’) improves comprehension (Graesser, et al., 2003). Other cohesive text variables include explicit logical connections and signalling words that make relationships explicit. When these relationships are not explicit, readers have to infer relationships between different linguistic expressions, and this can be a source of
comprehension difficulty (Grasser et al., 2003). Research on adults and college-aged students has shown that increasing text cohesion can benefit comprehension (e.g. Erlrich & Remond, 1997; Ozuru, Briner, Best, & McNamara, 2010; Ozuru, Dempsey, & McNamara, 2009). In particular, text which is high cohesion increases recall and performance on multiple choice questions (McNamara & Kintsch, 1996), because it easier to read and consolidate to memory (McNamara, Kintsch, Songer, & Kintsch, 1996). To further explain, successful language comprehension is thought to be strongly reliant on the development and retrieval of an accurate mental representation of the situation described in the text (see Zwaan & Radvansky). High cohesion text promotes the formation of coherent mental representations (e.g. Graesser et al., 2004) and therefore improves memory recognition and recall.

Text cohesion in science texts is particularly poor in comparison to narrative style text (Beck, McKeown, Sinatra, & Loxterman, 1991). Notably, academics typically use a high frequency of pronouns in preference to less ambiguous nouns (Gray, 2006 as cited in Gray, 2010; Swales, 2005). Therefore, students’ ability to comprehend science text is likely to be strongly mediated by the reader’s ability to achieve cohesion between the sentences. However, the effects of text cohesion have predominantly been investigated using an adult (undergraduate) sample. Although a review by Best, Rowe, Ozuru and McNamara (2005) infers that similar benefits may be observed with younger school children the experimental evidence to support this has primarily used children who have not started secondary science education (7-10 years) and have used narrative text styles (Cain, 2003; Cain & Nash, 2011). Two studies which have used science text with children have shown little effect of text cohesion in science comprehension, when text cohesion is modulated by a range of variables (avoiding pronouns, elaborating on concepts, use of connectives, conceptual overlap) (Best, Ozuru, Floyd, & McNamara, 2006; McNamara, Ozuru, & Floyd, 2011). However, a study, by McNamara et al. (1996), showed that 11-15 year olds ability to comprehend biology text (about mammals) was
better when the text was expanded upon and high cohesion. Although this study provides promise for the effects of text cohesion with secondary school children, only 12 children, with a 4 year age range, were tested on each text design. Additionally, the texts were revised to add information which explicitly identified that the subtopics in the paragraph were talking about traits of mammals, and did not look specifically at the effects of referential cohesion in terms of pronoun use and argument repetition.

Despite the increasing policy concern that students starting secondary education regress in their interest and attainment in science (Galton, 2009), it is clear this age group (11-13 years) has largely been ignored in science reading comprehension studies. In order to identify ways to promote science attainment and interest in science it is essential that we understand how to best support science education at the beginning of secondary school. With evidence to suggest that text cohesion, in particular the ability to achieve referential cohesion is important to successful science comprehension (Beck et al., 1991) this study focusses on beginning secondary school students’ comprehension of high and low cohesion science text, as determined by referential cohesion (pronoun use and argument repetition).

1.1.3 The Role of Individual Differences

Social cognitive theory emphasises that intelligence and learning are not simply the product of taking in information, but instead result from active interpretation of information which influences learning experiences (Bandura, 1977). Within social cognitive theory personality and self-efficacy are key learnt behaviours which are integral to determining task achievement. For example, Bandura (1977) emphasised that individuals develop their personality by watching what other people do and do not do, which subsequently shapes their approaches to tasks. Furthermore, self-efficacy, a learned behaviour of perceived task competence, explains how an individual approaches goals and tasks. For example, high self-efficacy is associated with greater motivation and perseverance to achieve tasks (e.g. Crothers,
In support of this model in educational research, general cognitive ability (common performance on a range of cognitive tasks, see, Deary, Penke, & Johnson, 2010) and personality are key factors in determining attainment (see, Chamorro-Premuzic & Furnham, 2005; Deary, 2012; Neisser, Boodoo, Bouchard, et al., 1996). More pertinently to this research, general cognitive ability has been shown to predict reading comprehension of adults (Primor, Pierce, & Katzir, 2011) and children (Tiu, Thompson, & Lewis, 2003). Indeed, the primary objective of intelligence tests is to predict academic achievement (Ackerman & Heggestad, 1997). With regard to personality, the conscientiousness facet of the five-factor model of personality has been widely reported as a predictor of academic performance (e.g. Nofzle & Robins, 2007) particularly with children in the middle years of compulsory education (i.e. early secondary school) (Laidra, Pullmann, & Allik, 2007). Conscientiousness can be defined as the tendency to show self-discipline, act dutifully, and aim for achievement (Costa & McRae, 1992). Recently, conscientiousness has been related to achievement in science (Eilam, Zeidner, & Aharon, 2009; Fesit, 2012), but has not been explored specifically to learning from science text. Indeed, a recent review appealed for more research to examine potential relationships between personality traits and reading comprehension in determining academic attainment (Sadeghi, Kasim, Tan, & Abdullah, 2012). Specific to self-efficacy and science, evidence suggests that self-efficacy and competence in science is related to general science achievement (Wang, Oliver, & Staver, 2008), but this has yet to be examined in terms of learning from science text.

The rationale for focusing on intelligence and conscientiousness in this paper derives from the common sense notion that achievement is, broadly speaking, the result of ability and success (Gagné & St Pére, 2001). Given that science self-efficacy is learnt from previous successes and failures in the science classroom this factor is likely to be inherent to both ability and conscientiousness and therefore is important to include when considering
individual differences in science learning. Accordingly, the aim of the present research was to
establish the role of key individual differences (general intelligence, conscientiousness and
self-efficacy in science) in predicting learning (as measured by comprehension) from scientific
text in which the level of cohesion is varied.

2.1 Method

2.1.1 Participants

60 students (31 boys, 29 girls) from a general comprehensive secondary school in the East
Midlands of England took part in the study. Participants’ ages ranged from 12 – 14 years old
with a mean (M) age of 12.75 and a standard deviation (SD) of .65. Participants were told the
study was concerned with the design of science text books. Parental consent was obtained for

2.1.2 Materials

To assess the influence of text cohesion on comprehension ability, students were
presented with six high and six low cohesion texts (12 texts in total). Using a paired sample
design the texts were counterbalanced so that no participant saw both high and low cohesion
versions of the text, but each text was seen across participants in both version. These were
adapted from academic science text books used for working towards the General Certificate of
Secondary Education qualification (e.g. Gallagher & Ingram, 2000; Pople, 1999; Williams,
2006). High and low cohesion versions of each text were created following previously used
methods (Ozuru et al., 2009). High cohesion text avoided the use of pronouns to refer to
previously introduced noun-phrases, and included using argument overlap to ensure referential
clarity. Low cohesion text did not repeat facts and used pronouns to refer to key referents (see
Figure 1). For each text (high and low cohesion versions), three multiple choice questions
(MCQs) were used to assess text comprehension (totalling 36 questions, 18 for each
condition). These were designed to assess inferential levels of comprehension that are a
hallmark of good science text comprehension rather than more superficial aspects of the text. To explain by example using the first two sentences in Figure 1; in the low cohesion condition the target word ‘Enzymes’ is later referred to by the pronoun ‘They’; ‘Enzymes have become very important in the industry. They are versatile and far more efficient than other catalysts.

For successful comprehension the student must remember that the referent in first sentence was ‘enzymes’ and that ‘they’ refers to the ‘enzymes’. To assess whether the student had correctly linked the two referents (‘enzyme’ and ‘they’) one of the multiple choice questions asked ‘Why are enzymes important in the industry?’ with the correct response being ‘they are versatile and efficient’. In the high cohesion condition the referent was repeated across the two sentences ‘Enzymes have become very important in the industry. Enzymes are versatile and far more efficient than other catalysts.’ Therefore, successful comprehension relies on the student remembering that the referent in first sentence was the same as in the second sentence.

[FIGURE 1]

2.1.3 Individual Differences

General Intelligence: We used a measure of general intelligence derived from the Ravens Progressive Matrices (RPM) (Raven, Raven, & Court, 1998). Each item requires the participant to infer a rule which relates the elements together, and then to use this rule to identify the next element in the sequence by choosing from eight alternatives (Alderton & Larson, 1990). Raven Matrices are straightforward to administer and have well documented reliability and validity scores (Strauss, Sherman, & Spreen, 2006), with correlations with other intelligence test between .40 - .75 (Raven et al., 1998). Recent updates to the Ravens manual state that when time is limited, as with our relatively young sample, Set 1 alone (out of a possible 5 sets) provides a sufficient measurement (Harcourt Assessment, 2003). Indeed, shortened versions of the RPM have been shown to have similar psychometric properties to the full test (Hammel & Schmittmann, 2006; Van der Elst, Ouwehand, van Rijn, Lee, Van
Boxtel, & Jolles, 2011), with good Cronbach’s alpha (Cronbach, 1951) scores of internal validity (.73; Bors & Stokes, 1998), good convergent validity scores consistent with the full item (Arthur, Tubre, Paul, & Sanchez-Ku, 1999), and high test-retest scores (.75; Arthur et al., 1999). In this study we gave students 10 minutes to complete Set 1. It is worth noting then that when using a timed condition, the measure of general intelligence is thought to reflect intellectual efficiency, an overall competency and ability to efficiently use one’s general intelligence (Raven et al., 1998).

Conscientiousness: The short five (S5) measure of personality (e.g., see Konstabel, Nnqivist, Walkowitz, Konstabel, & Verkasalo, 2011) was constructed to measure 30 facets of the Five-factor model of personality (NEO-PI-R, Costa & McCrae, 1992) for use when time is limited. As this study was primarily interested in conscientiousness only 12 items (6 positively keyed, 6 negatively keyed) were selected for use. The questions measured the 6 facets thought to define conscientiousness; competence (e.g. I am sensible and competent; I can find practical, quick, and effective solutions to problems), order (e.g. I am a methodical person and I love cleanliness and order. I want everything to be in its right place), dutifulness (e.g. I am a reliable person, who values ethical principles; I keep my promises and work carefully and thoroughly), achievement-striving (e.g. I know for certain what I want to accomplish and I work hard for it), self-discipline (e.g. When I have started something, I finish it despite fatigue or other distractions. I always finish my tasks on time) and deliberation (e.g. I consider things carefully before acting or deciding; I take the possible consequences of my actions into account). The statements were evaluated as to how they reflected the reader on a scale of one to five, ranging from ‘very inaccurate’ to ‘very accurate’. The S5 has good internal consistencies for the five broad factors (average $\alpha = 0.87$) and for the facets (average $\alpha = 0.69$). The S5 has good convergent validity with other measures of the big-five (average correlation with NEO and NEO-PI-R = 0.71) (Konstabel et al., 2011).
Science Self-efficacy: The Sources of Middle School Mathematics Self-Efficacy (MSMSE) Scale (Usher & Pajares, 2009) was adapted to assess self-efficacy in science. For the purpose of this study we reworded the MSMSE scale so that the scale measured science self-efficacy with questions being adapted so that ‘math’ was replaced with ‘science’; for example ‘I get excellent marks on science tests’ and ‘People have told me that I have a talent for science’. Additionally, some of the wording used in the scale was changed so that it was more appropriate for use with English children (e.g. ‘report card’ was changed to ‘school report’, ‘grades’ was changed to ‘marks’). Each statement is rated on six-point scale (1 = definitely false, 6 = definitely true). The Cronbach’s alpha for the 24 items was satisfactory (α = .91) suggesting adequate internal reliability for the scale as a measure of self-efficacy of science.

2.1.4 Procedure

In a classroom, students were presented with one of two booklets. The content of the two booklets were identical apart from the text was counterbalanced so that the text in booklet A which was viewed in a high cohesion format was viewed in low cohesion format in booklet B (and vice versa). Thus, each booklet contained 6 high and 6 low cohesion texts that were intermixed pseudo-randomly. The booklets were arranged so that once a participant read a text, they then completed a short distractor test (a number completion task). Following this, the three MCQs were presented on a separate page. The MCQs were identical for high and low cohesion versions of each story. Students were instructed to work through this booklet, reading the text for comprehension, and no time restraints were set. After completion of the booklet the individual difference tests were administered. The total testing time was 55 minutes.

3.1 Results

Two control measures were initially taken. First, to ensure that individual difference
scales had acceptable internal reliability, Cronbach’s alphas were conducted (Table 1). All scales showed good internal reliability ($\alpha \geq .77$), above the criteria of .7 suggested by Kline (1986). Second, in consideration of the reports of gender differences in students’ interest in science (Baram-Tsabari & Yarden, 2011) and reading abilities (Clark, 2012) we compared males and females performance on the tests used; no significant differences emerged (Table 1). Comprehension scores were higher for the high (total correct: 91.9%; range: 61.1 - 100%) than the low (total: 86%; range: 27.7 - 100%) cohesion texts ($t(59) = 4.19, p < .001$) demonstrating that referential cohesion (pronoun use and argument overlap) affected comprehension, and therefore how effectively participants learnt from these texts.

[TABLE 1]

To establish which individual differences were suitable for cluster analysis we conducted Pearson’s correlations to calculate correlations between individual differences and text performance (Table 2) (see, Yoshioka, Kawase, & Ishii, 2002). Cognitive ability, science self-efficacy and dutifulness correlated with performance on both high cohesion and low cohesion text; therefore these variables were entered into the cluster analysis.

[TABLE 2]

To explore how individual differences were related to successful comprehension of high and low cohesion text we conducted a hierarchical cluster analysis. Sixty cases (participants) responding to five variables (cognitive ability, science self-efficacy, dutifulness and performance with high and low cohesion text) were entered using the Ward’s method and squared Euclidean Distance as the similarity measure. Data was standardised using z-score transformation. The first step of the analysis explored the optimum number of clusters in the data. The coefficient change scores and visual inspection of the dendrogram plots showed that three core clusters emerged (Table 3).

[TABLE 3]
To confirm that the three clusters were significantly different from each other a 5 (individual measures and comprehension of high and low cohesion text) × 3 (clusters) Analysis of Variance (ANOVA) was conducted. The clusters significantly differed across the five variables; cognitive ability, $F(2, 59) = 15.36, p < .001$; science self-efficacy, $F = 29.49, p < .001$; dutifulness, $F = 19.41, p < .001$; high cohesion text, $F = 29.01, p < .001$; low cohesion text, $F = 33.45, p < .001$. Multiple comparisons with Bonferroni corrections (Table 4) were conducted to establish the exact nature of the clusters.

[TABLE 4]

The first cluster was predominant (25 cases) and was characterised by high cognitive ability, high science self-efficacy and high performance on high cohesion and low cohesion text. The second cluster (22 cases) was defined by having low science self-efficacy and performing in the middle range (compared to cluster 1 and 3) on high cohesion and low cohesion text. The third cluster (13 cases) was characterised by low cognitive ability, low dutifulness and poor performance on low cohesion text. These clusters show that good comprehension of both high cohesion and low cohesion text groups with high cognitive ability and high science self-efficacy. Middle of the range performance with both texts groups with low science self-efficacy and finally, poor performance with low cohesion text groups with low cognitive ability and low dutifulness.

4.1 Discussion

By comparing secondary school students’ learning from reading high cohesion and low cohesion science text we observed significant benefits, in terms of increased MCQ accuracy, from reading high referential cohesion text. To explore associations between students’ comprehension abilities of high and low cohesion science text and individual differences we conducted Ward’s cluster analysis to identify how these variables best grouped together.
Three groups emerged from the analysis. These groups highlight key factors associated with high, average, and low learning from science text. Successful comprehension with both high and low cohesion text was related to high cognitive ability and high science self-efficacy (cluster 1), suggesting that these two factors may be key areas to target for achieving high levels of learning from reading in science. Middle of the range comprehension skills, with both high and low cohesion text, was associated with low science self-efficacy (cluster 2), indicating that promoting science self-efficacy may be a key strategy for improving the performance of ‘average’ students. Finally, poor comprehension of low cohesion text was associated with low cognitive ability and low dutifulness (cluster 3). This suggests that to best support science learning in lower performing students (i.e. those with lower cognitive abilities) science text should be structured so that it avoids the use of pronouns and instead uses noun-repetition. Additionally, increasing students’ sense of dutifulness may prove a key pathway to promoting science learning.

Evidence of improved comprehension with high cohesion text supports previous research with college-aged students (e.g. McNamara & Kendeou, 2011; Ozuru et al., 2009). However, the present research extends these basic findings in several ways that may be important in relation to science education. In particular, this is the first study to investigate the effects of referential text cohesion on science text comprehension with children as the start of their secondary education (12 – 14 years). This time period is critical to decisions students make about the topics they enjoy and wish to study to secondary educational levels and beyond, difficulty they have in understanding science during this period may be important to determining whether they pursue the subject further. Indeed, previous research highlighting the role of text cohesion in science comprehension has predominately used older age groups (e.g. see, Ozuru et al., 2009), and so is not directly informative about the influence of text cohesion on science text comprehension by this critical age group. Moreover, this previous
research has examined performance on science text comprehension without assessing the
importance of individual differences between readers for predicting comprehension
performance. Thus, the present research makes an additional and important contribution to the
understanding of factors affecting science text comprehension by revealing key individual
difference that are predictors of comprehension performance by this target age group.

With regard to the role of individual differences in text comprehension our study
highlights the potential importance of cognitive ability, science self-efficacy and dutifulness as
aspects of text comprehension. In support of studies with adult readers our study shows the
consequence of cognitive ability in determining students’ learning from science texts that
differ in cohesiveness (Primor et al., 2011). Specifically, we show that students who achieved
high learning from both text designs were associated with high cognitive ability and students
who demonstrated poor learning from low cohesion text were associated with low cognitive
ability. In this study, Ravens matrices were completed under a time limit, to provide a measure
of general intelligence that reflects intellectual efficiency. This suggests that general
competency and ability to efficiently use ones general intelligence (ability to deduce, induce,
problem solve, grasp relationships, and infer rules) is important for learning from science
texts. In particular, the association between low cognitive ability and poor performance on low
cohesion text indicates that when logical connections and relationships within the text are not
explicit, it is important that the student is equipped with the cognitive abilities to infer these
relationships. Therefore, developing these cognitive skills may prove a key pathway to
improving science learning.

A novel relationship was identified with science self-efficacy and science text
comprehension. High science self-efficacy was associated with good performance with both
text designs, whereas low science self-efficacy was associated with poorer performance on
both texts, suggesting an important role for science self-efficacy in learning about science
from text. As self-efficacy is associated with task perseverance (Bandura, 1997) we suggest this as a likely explanation for the results and suggest that encouraging and rewarding persistence may improve science learning. High science self-efficacy was also coupled with high cognitive ability, suggesting a relationship between achievement and perceived competence. Although we cannot determine the nature of such relationships in this study, previous reports suggest reciprocal effects (e.g. Wang et al., 2008). However, we should also consider that the self-efficacy tests were completed after the reading tests. Although the very nature of self-efficacy means that it is partly formed by prior academic achievements (Shavelson, Hubner, & Stanton, 1976), in this study it is possible that the measure of self-efficacy was influenced by how difficult the student found the reading task. Therefore, our measurement of self-efficacy may reflect specific efficacy to the task completed rather than general science self-efficacy. Nonetheless, this is still an noteworthy finding and highlights that the students were approximately accurate in their perceptions of experimental task competency and that such self-assessment is important in promoting learning (Andrade & Valtcheva, 2009).

Of further note is the relationship between dutifulness and science learning from text, this is consistent with the suggestion that dutifulness is one of the key conscientiousness domains in predicting academic achievement (Chamorro-Premuzic & Furnham, 2003). Low dutifulness was associated with poor performance with low cohesion text. Thus, the indication is that performance on the more difficult, low cohesion text is associated with working carefully and thoroughly on a problem (see, Konstabel et al., 2011).

The results from this study provide a valuable contribution to our understanding of how individual differences influence learning based on text comprehension with high and low cohesion text. As the purpose of this study was to examine referential cohesion in isolation, it provides motivation for future studies to assess whether similar results are observed with other
cohesive ties, such as modulating the text by the addition of causal connectives. Additionally, whilst the use of MCQs to assess co-referential inferences has been shown to be effective at assessing a deeper understanding of the text (McNamara & Kintsch, 1996; McNamara et al., 1996), we cannot establish the durability of this comprehension. By testing students at delayed periods post-testing the sustainability of comprehension performance could be examined.

These findings have significant implications for both the design of science text books and for the teaching of science. As comprehension is considerably improved when referential cohesion is maintained it is important that academic publishers minimise the use of pronouns and maximise repetition of noun-phrases and key text meanings when designing science text books. Furthermore, in light of research highlighting the importance of readers having knowledge on text structure to achieve sound comprehension (e.g. Kendeou & van den Broek, 2007; Meyer, 2003; Snyder, 2010) it seems crucial that teaching strategies on science text structure (see Akhondi, Makayeri, & Samad, 2011) should focus on pronoun resolution and establishing argument overlap. Given the strong associations between cognitive ability and learning from science text, improving general cognitive abilities (e.g. see, Chiesa, Calati, & Serretti, 2011) may have a positive effect on the comprehension of science text. In particular, practicing tasks that involve inferring relationships, grasping rules and identifying similarities and differences could enhance students’ comprehension of science text. Additionally, education interventions which focus on increasing students’ self-efficacy and sense of dutifulness (Essa & Burnham, 2009) may also prove to be beneficial in improving learning from science text in the classroom.

4.1.2 Conclusion

Students, who are starting their secondary school education of science, show greater learning (comprehension) of science text when it is highly cohesive, as determined by noun-phrase repetition. Comprehension is decreased when referential cohesion is reduced by using
pronouns and argument overlap, an important implication for the design of science textbooks and the teaching of secondary school science. High cognitive ability was associated with good performance on both high and low cohesion text, and low cognitive ability was associated with poor performance on low cohesion text. High science self-efficacy was also related to good performance on both text designs, whereas low self-efficacy was related to average performance on both texts. Dutifulness was associated with poor performance with low cohesion text. These results have significant implications for understanding the relationships between individual differences and learning in promoting science learning.
References


Clark, C. (2012). Boys reading commission 2012: A review of existing research conducted to underpin the Comission. *National Literacy Trust*


Graesser, A. C., McNamara, D. S., & Louwerse, M. M. (2003). What do readers need to learn in order to process coherence relations in narrative and expository text? In A. P. Sweet & C. E. Snow (Eds.), *Rethinking Reading Comprehension* (pp. 82-98). New York: Guilford.


O’Reilly, T., & McNamara, D. S. (2007). Reversing the Reverse Cohesion Effect: Good Texts can be better for strategic, high knowledge readers. *Discourse Processes, 43*, 121-152.


Snow, C. (2002). *Reading for Understanding: Toward a Research and Development Program in Reading Comprehension*. Arlington, VA: Rand


http://dl.dropbox.com/u/8416806/Website/Van%20der%20Elst%20et%20al.%2C%202011e.pdf


5

6

7

8

9

**Acknowledgements**

10 This research was financially supported by The Leverhulme Trust. Grant title ‘Improving Secondary School Students’ Science Text Comprehension, grant RPG-094.