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## Adolescent reading skill and engagement with digital and traditional literacies as predictors of reading comprehension

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## Abstract

The present study investigates the concurrent predictors of adolescent reading comprehension (literal, inferential) for fiction and non-fiction texts. Predictors were examined from the cognitive (word identification, reading fluency), psychological (gender) and ecological (print exposure) domains. Print exposure to traditional and digital texts was surveyed using a diary method of reading habits. A cross-sectional sample of 312 students in early (11–13 years) or middle adolescence (14–15 years) participated from a range of SES backgrounds. Word identification emerged as a strong predictor of reading comprehension across adolescence and text genres. Gender effects favouring female students were evident for reading frequency but not reading skill itself. Reading habits also differed and comprehension advantages were observed among females for fiction and males for non-fiction. Age effects emerged for reading frequency, which was lower in middle adolescence. Although more time was spent on digital than traditional texts, traditional extended text reading was the only reading habit to predict inference-making in comprehension and to distinguish skilled from less-skilled comprehenders. The theoretical and educational implications of these results are discussed.

## Introduction

A shortage of information limits our understanding of whether or not children will continue to choose reading as a leisure activity in adolescence and into adulthood (Mol and Bus, 2011). The present study explores which of a range of measures of literacy ability and engagement best predict reading comprehension in early and middle adolescence.

### *Cognitive components of reading comprehension*

According to the *Simple View of Reading* (SVR), understanding the meaning of print relies on a set of component cognitive processes broadly categorised as word identification and oral language comprehension (Gough & Tunmer, 1986). Within the intensively studied 6-to-11-year-old age range, word identification represents an important early predictor of reading comprehension, whereas higher-level language comprehension processes emerge as later predictors (Curtis, 1980; Juel, Griffith & Gough, 1986; Saarnio, Oka & Paris, 1990; Cain, Oakhill & Bryant, 2004).

Much less is understood about later development in adolescence due to studies being scarce and somewhat contradictory. Most adult studies report similar outcomes to developmental work, where measures of word identification and oral language comprehension each make significant and independent contributions to reading comprehension (Cunningham, Stanovich & Wilson, 1990; Perfetti & Hart, 2001; Landi, 2010; but see Palmer, MacLeod, Hunt & Davidson, 1985).

The contribution of word identification appears to decrease markedly at the beginning of adolescence but does not disappear (García & Cain, 2014). Among the

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few studies to examine this issue among typical adolescent readers, word identification explained unique variance in reading comprehension for 14- and 15-year-olds (Catts, Hogan & Adlof, 2005; Samuelstuen & Bråten, 2005), although the variance explained is smaller than that due to listening comprehension among 12-to-15-year-olds (Catts et al, 2005; Tilstra, McMaster, van den Broek, Kendeou & Rapp, 2009). Vellutino, Tunmer, Jaccard and Chen (2007), however, detected no such link with word identification among 11-to-13-year-olds despite a significant association with language comprehension. Nevertheless, varying profiles of poor adolescent reading comprehension have been reported encompassing both difficulties arising from weak oral language skills in the absence of word decoding problems (Cutting, Materek, Cole, Levine & Mahone, 2009; Sesma, Mahone, Levine, Eason & Cutting, 2009), as well as difficulties due to weak basic word identification (Brasseur-Hock, Hock, Kieffer, Biancarosa & Deshler, 2011). In sum, as set out in the SVR, word identification may still be necessary to predict reading comprehension accurately in adolescence.

Reading *fluency* has also been considered as a predictor of reading comprehension (Fuchs, Fuchs, Hosp & Jenkins, 2001). As with mastery of basic word identification skills such as phonological awareness, orthographic processing and phonological decoding, increases in reading fluency may free up processing capacity to allow more efficient comprehension of extended texts (Curtis, 1980; Perfetti, 1985). Word reading fluency has been considered a strong early predictor of reading comprehension, with text reading fluency becoming more important as reading skill increases (Jenkins, Fuchs, van den Broek, Espin & Deno, 2003; Klauda & Guthrie,

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2008; Kim, Wagner & Lopez, 2012). Nevertheless, empirical evidence is mixed. Adlof, Catts and Little (2006) concluded that combined (word plus text) reading fluency made no unique contribution over the SVR components to either the concurrent or longitudinal prediction of reading comprehension between 2<sup>nd</sup> and 8<sup>th</sup> grades; whereas, Tilstra et al (2009) did find a significant relationship between 4<sup>th</sup> and 9<sup>th</sup> grades using text reading fluency. Among adults with low literacy, reading fluency was strongly related to word identification and vocabulary to listening comprehension, but neither fluency nor vocabulary made a unique contribution to reading comprehension (Sabatini, Sawaki, Shore & Scarborough, 2010). One possibility is that if the test of reading comprehension is timed then a direct relationship with fluency is more likely, accounting for the discrepant results (Tilstra et al, 2009).

More recently, Tunmer and Chapman (2012) reassessed the SVR, concluding that evidence did not support the addition of fluency or vocabulary as a third component. However, listening comprehension was observed to contribute indirectly to comprehension via word identification, possibly reflecting the influence of vocabulary, which appears to undermine any strict independence between the SVR components (see also Ouellette and Beers (2010) and Protopapas, Simos, Sideridis and Mouzaki, 2012).

Therefore, as the cognitive components of adolescent reading are still under debate, the present study will examine the concurrent contribution of word identification, vocabulary and text reading fluency to adolescent reading comprehension. Text

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rather than word reading fluency is included as text reading fluency may draw upon similar processes to listening comprehension and therefore be more relevant in later reading comprehension (Jenkins et al, 2003).

### *Exploring the comprehension processes involved in reading text*

An account of the sub-skills involved in comprehending text is given in the *construction-integration* model (e.g. Kintsch, 1998). The name conveys the interaction between the construction of meaning from the text and its integration with an existing knowledge base. Initially, a bottom-up construction phase generates competing interpretations and associations from the content of the text that are then integrated to extract key ideas; these form the *textbase*. Skilled reading comprehension involves the elaboration of what is known as a *situational model* from this textbase using relevant background knowledge, inferential skills together with reader goals, interests and prior experiences (Kintsch, 2004).

Studies of young readers show that skilled comprehenders are better at inferential compared to literal text comprehension and are more likely to be misled by foils when these contain valid as opposed to invalid inferences from the text (Oakhill, Yuill & Parkin, 1986). Several types of inference may be critical for skilled comprehension (e.g. Graesser, Singer & Trabasso, 1994). Coherence inferences form representations of text meaning that are consistent across sentences (local coherence) or across the whole text (global coherence). Such inferences often depend on grammatical skill and can be contrasted with elaborative inferences that are knowledge-based and serve not simply for intelligibility but also to enrich the

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situational model of the text (Barnes, Dennis & Haefele-Kalvaitis, 1996). Evidence from the errors of 8-to-11-year olds indicates less understanding of the information relevant for making elaborative than coherence inferences (Cain, Oakhill, Barnes & Bryant, 2001). Across the 6-to-15-year-old age range, knowledge accessibility was related to coherence inferencing among younger children and elaborative inferencing among older children (Barnes, et al., 1996). By college level, the more able students are better than less able students at making elaborative inferences between elements in longer stories and make more topic-related inferences about content (Long, Oppy & Seely, 1997).

Therefore, skilled reading comprehension is associated with more constructive text processing. When higher-level comprehension problems arise, these may derive from difficulty in implementing coherence or elaborative inferential strategies, but equally elaborative processing especially is also susceptible to specific knowledge failures (Perfetti, Marron & Folz, 1996). Before going on to consider the influence of prior knowledge, it is helpful to present the outcome of a recent attempt to integrate some of the factors reviewed so far.

### *Expanding the theoretical view of reading comprehension*

The *Direct and Inferential Mediation* (DIME) model (Cromley & Azevedo, 2007) was developed to describe the influence of background knowledge, inference, reading strategies, reading vocabulary and word reading on secondary school reading comprehension. Using data from 14-to-15-year-old adolescents (Cromley & Azevedo, 2007), the direct predictors that were identified were reading vocabulary



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and background knowledge followed by weaker influences of inference and word reading (identification plus fluency). Reading vocabulary and background knowledge exerted additional indirect effects mediated by inference.

Some modifications were necessary in order to generalise from this original investigation of adolescent domain-general text comprehension, to undergraduate students' comprehension of scientific texts (Cromley, Snyder-Hogan & Luciw-Dubas, 2010). Background knowledge, inference and reading strategy assumed stronger roles with expository than domain-general texts, for which reading vocabulary had been most predictive. However, word reading, measured by Cromley et al (2010) using text reading fluency alone, no longer featured as a direct predictor of comprehension. This may be due to the greater proficiency and uniformity of undergraduate cognitive skills or else it may indicate that the measure of word reading (word identification plus text reading fluency) used in the earlier study by Cromley and Azevedo (2007) is more predictive of reading comprehension. Alterations to the predictive value of the other components may have been due to the contrasting demands of different text genres. This is consistent with previous observations that narrative texts draw heavily on word identification skills while expository texts require higher levels of world knowledge (Best, Floyd & McNamara, 2008; García & Cain, 2014). In Eason, Goldberg, Young, Geist and Cutting's (2012) study of 10-to-14-year-olds, the contribution of word identification was relatively constant across text genres, although inference contributed more to expository than narrative text comprehension.

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Thus, the SVR provides a valuable starting point but the remaining unexplained variance in reading comprehension warrants a wider examination of variables (Tilstra et al, 2009; Ouellette & Beers, 2010). Indeed, with the aim of designing effective interventions for poor readers, Aaron, Joshi, Gooden and Bentum (2008) formulated the *Component Model of Reading (CMR)* to acknowledge that the influences on reading comprehension stretch beyond the cognitive domain (e.g. word identification, listening comprehension) to encompass the psychological domain (e.g. motivation, gender differences) and the ecological domain (e.g. home environment, parental involvement). The literature on the influence of the psychological factor, gender, and the ecological factor, prior knowledge in the form of print exposure, will be considered in the next sections.

#### *Psychological factor: Gender*

Females outperform males in reading assessments such as the OECD-PISA international study of 15-year-olds' reading comprehension, although the UK gender discrepancies are well below the OECD average (OECD, 2010; see also National Literacy Trust, 2012). Among younger readers, girls read more frequently with larger gender differences observed in recreational than academic reading (McKenna, Kear & Ellsworth, 1995; Kush & Watkins, 1996; Logan & Johnston, 2009). No gender differences were observed recently in the difficulty level of books read by British school children but, consistent with previous work (e.g. Moss & MacDonald, 2004), boys exhibited a preference for non-fiction from the age of 9 years (Topping, 2012). Digital literacy among 12-to-15-year-olds is also subject to gender differences with girls more likely to use the internet for homework, visiting social networking and other

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websites, instant messaging and Twitter, whereas boys play games or watch video clips (Ofcom, 2012).

*Adolescent reading comprehension**Ecological factor: Print exposure*

Prior knowledge for comprehension is thought to be organised in memory according to different types of *schemas*, which help readers make sense of new information encountered in text (Anderson & Pearson, 1984; Myers, 1997). Among adolescents, prior knowledge can improve text summarisation and predicts expository text comprehension, supporting the view that *domain-specific* schemas produce a “scaffolding effect” that facilitates the extraction and structuring of key points (Recht & Leslie, 1988; Samuelstuen & Bråten, 2005).

*Formal* schemas, on the other hand, are independent of specific content information, referring instead to knowledge about genre-specific text structure (Meyer & Rice, 1984). Narrative texts require indexing of time, space, characters, goals and the causal sequences of events to construct the situational model (Bohn-Gettler, Rapp, van den Broek, Kendeou & White, 2011). Even among 7-year-olds, the fact that stories contain a sequence of causally-related events linked by elements such as desires, motives, goals, actions and consequences is more familiar to good than poor comprehenders (Cain, 1996). Expository texts such as scientific texts take a variety of forms: a main idea supported by clarification or evidence; a series of facts or connected events; a system for classification; or an exploration of the similarities and differences between ideas (for a full account see Meyer and Rice (1984), Cook and Mayer (1988)). Here the reader may require a technical vocabulary and specialised topic knowledge rather than world knowledge to form appropriate relations between elements in the construction of a textbase or situational model (Graesser, León & Otero, 2002).

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Reading itself contributes to growth in vocabulary and declarative knowledge (Cunningham & Stanovich, 1991, 1997; Stanovich & Cunningham, 1992, 1993). Indeed, work by Hayes and Ahrens (1988) illustrates the superior vocabulary-learning opportunities provided by reading, as rare words were found to be more frequent in children's books than in *adult* prime time television and *college graduates'* speech. Strong links exist between reading comprehension and print exposure as measured via author/title recognition tests (Mol & Bus, 2011), and although these are indirect assessments of reading habits, more precise measures such as leisure reading frequency confirm this link and reveal variation in the impact of different reading activities.

The majority of existing research focuses on primary school children but adolescents differ in their reading habits as they typically have more choice of activities and greater independent access to digital technologies (Clark, Torsi & Strong, 2005; Ofcom, 2012; Clark, 2011). A diary technique revealed that 11-year-olds read on average for 18 minutes per day and that reading comprehension was more strongly associated with reading books than comics, newspapers or magazines (Anderson, Wilson & Fielding, 1988). Asking young adolescents to supply author names and titles revealed that more fiction was read by good than poor comprehenders but the reverse was true for non-fiction (Spear-Swerling, Brucker & Alfano, 2010). The authors argued that fiction may be less accessible to poor comprehenders due to plot complexity, whereas a knowledge base may provide a schema to facilitate information organisation in non-fiction texts. However, this contrasts with other

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studies which concluded that higher-level comprehension skills assume a greater importance for expository text (Cromley et al, 2010; Easson et al, 2012).

With increases in digital communication such as text messaging, emailing and social networking websites, adolescents' daily literacy experiences cannot be measured solely by exposure to books. A recent Ofcom report (2012) found that all of the British 12-to-15-year-olds who were surveyed used the internet and the majority possessed a smartphone (62%). Time spent online was similar to time watching television (17.1 hours per week) and 80% of these adolescents had social networking profiles with on average 286 "friends". Therefore, digital texts are now among adolescents' more typical reading habits although interestingly many students do not recognise these as "literacy" activities (Pitcher et al, 2007).

Preliminary investigations of the interaction between digital texts and literacy are encouraging such as the positive association between knowledge of text message abbreviations and spelling performance (Wood, Meachem, Bowyer, Jackson, Tarczynski-Bowles & Plester, 2011). Prior knowledge in terms of formal schemas about the structure of internet search engines enabled 12-year-olds to gather useful knowledge for reading comprehension and the incidence of complex forward-inferences (i.e. predictions) was higher online than with traditional forms of expository text (Coiro & Dobler, 2007). Struggling readers implemented comprehension strategies better online than with traditional texts, possibly because digital texts were shorter (Castek, Zawilinski, McVerry, O'Byrne & Leu, 2011). Nevertheless, some notes of caution have been sounded with some authors arguing

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that adolescents are much more adept at social networking and texting than at online information comprehension (Bennett, Maton, & Kervin, 2008).

*The present study*

Our study contains an extensive assessment of reading skill as part of the standardisation of the York Assessment of Reading for Comprehension (YARC) Secondary Test (Stothard, Hulme, Clarke, Barmby & Snowling, 2010), together with a parallel survey of reading habits. This provides a rich set of British data across adolescence which is representative of a range of social backgrounds. The value of word identification and text reading fluency will be compared with the influence of gender, and traditional and digital reading habits as predictors of reading comprehension. To our knowledge this combination of variables has never before been examined in adolescence at a level of detail that takes into account both comprehension question type (literal understanding, inference-making) and text type (non-fiction, fiction).

The aims are outlined below:

1. To extend the knowledge base concerning cognitive reading skills in adolescent reading comprehension. Word identification is expected to weaken as a predictor as students grow older (Catts et al, 2005; Vellutino et al, 2007), although text reading fluency may increase in importance (Jenkins et al, 2003).
2. To explore print exposure in the form of reading habits as it is not certain that existing findings will hold in adolescence or with diary measures. Extended

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text reading is expected to be the strongest correlate of comprehension (Anderson et al, 1988; Spear-Swerling et al, 2010), although previous comparisons have been with shorter *traditional* texts not short *digital* texts (Coiro & Dobler, 2007; Castek et al, 2011).

3. To circumvent the differing composition of reading comprehension tests (Cutting & Scarborough, 2006) by separately exploring the correlates of literal and inferential comprehension for fiction and non-fiction. Reading habits and vocabulary are likely to be more predictive of inferential than literal comprehension since background knowledge is required for elaborative inference (e.g. Barnes et al, 1996). However, this effect may interact with text genre as the demands on inferential skills may be higher for non-fiction than fiction (Easson et al, 2012).
4. To examine gender differences responsible for British male underachievement in reading (OECD, 2010; National Literacy Trust, 2012). Females are expected to exhibit more leisure reading (McKenna et al, 1995; Kush & Watkins, 1996; Logan & Johnston, 2009) together with a preference for fiction and social communication, and males are predicted to prefer non-fiction and gaming (Moss & MacDonald, 2004; Ofcom, 2012; Topping, 2012). Reading habits may translate into comprehension advantages for males with non-fiction and females with fiction texts consistent with possession of genre-specific (formal) schemas (e.g. Bohn-Gettler et al, 2011).
5. To contrast skilled and less-skilled comprehenders as a test of our correlational results regarding the predictors of reading comprehension.



## Method

### *Participants*

A sample of 1,230 British secondary school students from Years 7-11<sup>1</sup> who were taking part in the standardisation of the YARC Secondary test (Stothard et al, 2010) were asked to complete a reading habits questionnaire. The questionnaire was completed by 312 students (25.4% of the standardisation sample) and all further information relates solely to this group. The students who responded to the reading habits questionnaire were a representative sample on the basis of age, gender, ethnic background and school status (see Stothard et al (2010) for details of the full standardisation sample).

Students were from 29 state-supported and 2 fee-paying schools located in suburban, rural and inner-city areas across the UK: Northern England (31.3%), Southern England (34.3%), Northern Ireland (3.2%), Scotland (24%) and Wales (7.1%). Note that in the full standardisation sample, slightly fewer children came from Scotland (11%) and Southern England (18%). Female students made up 55.4% of the present sample, which was predominantly White British (86.9%) with the remaining students from a range of ethnic backgrounds. Students were distributed across the school years: Year 7 (23.7%), Year 8 (24.4%), Year 9 (19.6%), Year 10 (17.3%) and Year 11 (15.1%).

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<sup>1</sup> The school years 7- 11 are given in relation to the educational system in England and Wales. In Scotland, the equivalent designations would be S1-5 and in Northern Ireland, Years 8-12.

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Socio-economic status (SES) was derived for 220 pupils (70.5% of the sample) from the Index of Multiple Deprivation (IMD) for England (2010)<sup>2</sup>, Northern Ireland (2010)<sup>3</sup>, Scotland (2009)<sup>4</sup> and Wales (2011)<sup>5</sup>. Student postcodes were ranked in equal 10% bands such that rank 1 represented the most deprived 10% of postcodes and rank 10, the least deprived: low SES (Ranks 1-3 = 17.7%), average SES (Ranks 4-7 = 48.2%) and high SES (Ranks 8-10 = 34.1%).

### *Materials*

#### *1. Reading Ability*

The assessments are from the standardisation of the YARC Secondary Test (Stothard et al, 2010). Reliabilities (Cronbach's alpha) for the two forms and two levels of difficulty of this assessment range between .85 and .90 (see Stothard et al, 2010 for full details). In all three reading assessments (single word reading, reading fluency, reading comprehension), raw scores were converted into standardised scores (Mean = 100; SD = 15) based on the entire standardisation sample.

##### *a) Word identification*

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<sup>2</sup> <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>

<sup>3</sup> [http://www.nisra.gov.uk/deprivation/update\\_of\\_nimdm\\_2005.htm](http://www.nisra.gov.uk/deprivation/update_of_nimdm_2005.htm)

<sup>4</sup> <http://www.scotland.gov.uk/Topics/Statistics/SIMD/>

<sup>5</sup> <http://wales.gov.uk/topics/statistics/theme/wimd/wimd2011/?lang=en>

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The Single Word Reading Test (SWRT 6-16, Foster (2007)) was extended by adding 10 low frequency words to increase the difficulty level. Students read aloud a list of 70 words of increasing complexity and accuracy was recorded.

*b) Reading comprehension*

Students completed 3, 4 or 5 comprehension (non-fiction or fiction) passages at Level 1 or 2 of difficulty from the two parallel forms (A and B) of the YARC Secondary test. When students indicated that they had finished reading a passage silently, their accuracy at answering twelve comprehension questions was noted. They could look at the passage while answering to reduce the impact of memory.

Performance was also examined by comprehension question type: vocabulary, literal or inferential. Inferential questions comprised several forms (evaluative inference, knowledge-based inference, predictive inference, elaborative inference, cohesive devices and figurative language). A full classification of the YARC comprehension questions together with examples is provided by Stothard et al (2010). Percentage accuracy for each of the three main question types was calculated for all fiction and all non-fiction passages separately.

*c) Reading fluency*

The number of words correctly read aloud per second was averaged across reading fluency passages at difficulty levels 1 (137 words) and 2 (129 words).

*2. Reading habits questionnaire*

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Students completed a questionnaire to assess reading frequency and habits.

Reading frequency was measured by the total score from 4 questions (scale 1 – 4 for each): a) How often do you borrow books from a library? b) How often do you start a new book? c) How often do you read at home as part of your school work? and d) How often do you read at home for fun? Two further questions assessed which type of text children preferred and which they read more (only fiction, more fiction than non-fiction, more non-fiction than fiction, only non-fiction).

Students then graded different reading habits according to how much time they had spent reading the material the previous weekend using a five point Likert scale (1: *didn't read this*, 2: *thirty minutes or less*, 3: *one hour*, 4: *two hours*, 5: *three hours or more*). Fourteen habits were listed in the following order: magazine, comic/graphic novel/manga, newspaper, song lyrics, set of instructions/manual, non-fiction book, school textbook/reference book, text messages/emails, networking website (e.g., Facebook), fiction book, computer/console game, online searching, factual website or blog (e.g., Wikipedia), poetry, Twitter.

### *Procedure*

Students completed the YARC Secondary test individually with an assessor as part of the standardisation process. This session lasted approximately one hour and took place between September and November. Afterwards all students were asked to spend 15 minutes completing either an online or a paper-and-pencil version of the reading habits questionnaire and a prize draw was offered as an incentive. Children were told that responses would remain confidential and were given the following

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instructions: "We would like to know how you honestly feel about your reading. This is not a test and there are no right or wrong answers".

## Results

The sample was divided according to age: early adolescence (School Years 7, 8 and 9; mean age =12.66 years (SD=0.89)); and middle adolescence (School Years 10, 11; mean age = 15.09 years (SD=0.53)). This made sense from an educational perspective as the National Curriculums of England, Wales and Northern Ireland distinguish between these groups as Key Stages 3 and 4. Scotland has a different educational system, although school leaving exams are also taken in the equivalent of Years 10 and 11.

Group data can be inspected in Table 1. A two-way ANOVA confirmed the age difference between early and middle adolescence,  $F(1, 307) = 625.71, p < .001, \eta_p^2 = .67$ , and indicated that gender groups did not differ in age at either level ( $F_s < 1$ ). In a similar analysis of SES, sample size was reduced (early adolescence:  $N = 156$ ; middle adolescence,  $N = 64$ ) but no significant differences emerged for adolescent group or gender (all  $F_s < 1$ ).

Insert Table 1 about here

### *Reading skills*

All mean standardised scores for the YARC Secondary test in Table 1 were average for age (standardised mean = 100 (SD=15)). Two-way between-participants ANOVAs showed no gender or age differences in any YARC test except for reading comprehension, where performance was better in early than middle adolescence,  $F(1, 308) = 10.07, p = .002, \eta_p^2 = .03$ . Introducing SES as a covariate, did not alter

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the outcomes reported above. SES exerted only a marginal effect on reading comprehension and reading fluency ( $p = .05$ ).

*Reading habits*

Within our sample, 79% completed the questionnaire online and 21% completed the paper-and-pencil version, the medium reflecting their school's preference for administration rather than self-selection.

Table 2 contains means for time spent on reading habits and two-way between-participants ANOVA outcomes for the effects of gender and adolescent group. No interactions were significant. Male students spent more time than female students with comics/graphic novels and computer games, whereas females engaged more than males with song lyrics, text/email messages, social networking websites and poetry.

Insert Table 2 about here

More time was spent in middle than early adolescence on reading magazines, newspapers, school text books, texts or emails, social networking websites, online searching and factual websites. Students reported spending longer on digital than traditional literacies and engagement with digital literacies was more common in middle than early adolescence. Controlling for SES using the reduced sample made little difference except that fiction book reading became more frequent among females than males and age differences in factual website reading disappeared.

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The total score from the reading frequency items in our reading habits questionnaire indicated that female students read more frequently than male students ( $M=10.98$  ( $SD=2.76$ ) vs.  $M=9.62$  ( $SD=2.83$ ), respectively),  $F(1, 308) = 15.82, p < .001, \eta_p^2 = .05$ . Reading frequency was lower in middle ( $M=9.40, SD=2.38$ ) than early adolescence ( $M=10.84, SD=2.97$ ),  $F(1, 308) = 16.79, p < .001, \eta_p^2 = .05$ . No gender differences in text genre preference emerged from the questionnaire but mean scores tended to be higher than a neutral score of 2.50 indicating a general preference for fiction. Pearson Product Moment correlations (used throughout) confirmed the expressed preference by showing negative correlations between preference scores and reading non-fiction books ( $r(301) = -.14, p = .01$ ) and (marginally) school textbooks ( $r(298) = -.11, p = .07$ ), and positive correlations with reading fiction books ( $r(299) = .24, p < .001$ ).

Correlations also examined the relations between reading habits and YARC reading measures. The strongest correlates were the extended traditional texts (early adolescence - fiction book reading correlated with comprehension,  $r(203) = .48, p < .001$ , SWRT,  $r(203) = .36, p < .001$ , and fluency,  $r(202) = .40, p < .001$ ; and middle adolescence - school textbooks correlated with SWRT,  $r(95) = .25, p < .05$ , and fiction books with comprehension,  $r(94) = .47, p < .001$ ).

### *Reading skills and reading frequency as predictors of reading comprehension*

1. *Correlations.* The YARC reading measures showed highly significant inter-correlations for each adolescent group (Table 3). Correlation strength for SWRT and reading comprehension did not differ between early and middle adolescence



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( $Z=1.16$ ,  $p = 0.25$ ) but the correlation between reading fluency and reading comprehension was weaker in middle than early adolescence ( $Z = 2.06$ ,  $p = .04$ ). Reading frequency, as measured by the reading habits questionnaire, showed weaker but significant correlations with all reading measures in early adolescence but did not correlate with any measure in middle adolescence. Using the smaller sample containing SES data, the influence of SES was restricted to a correlation with SWRT in middle adolescence.

Insert Table 3 about here

2. *Multiple regression.* Table 4 summarises the analyses to investigate the predictors of reading comprehension. In early adolescence, SWRT ( $\beta = .47$ ,  $p < .001$ ) and reading fluency ( $\beta = .28$ ,  $p < .001$ ) were significant predictors and reading frequency was marginal ( $\beta = .09$ ,  $p = .07$ ). The model explained 53% of the variance in reading comprehension,  $F(4, 205) = 58.20$ ,  $p < .001$ . In middle adolescence, only SWRT ( $\beta = .55$ ,  $p < .001$ ) was significant but the model explained 41% of the variance,  $F(4, 94) = 16.53$ ,  $p < .001$ .

Insert Table 4 about here

*Reading comprehension sub-skills*

Means for the reading comprehension sub-skills for fiction and non-fiction texts can be inspected in Table 5.

Insert Table 5 about here

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A four-way mixed ANOVA examined within-participants factors, text type (non-fiction, fiction) and question type (vocabulary, literal, inferential), and between-participants factors, adolescent group (early, middle) and gender. Significant effects emerged for question type,  $F(2, 592) = 361.72, p < .001, \eta_p^2 = .55$ , and adolescent group,  $F(1, 296) = 6.57, p = .01, \eta_p^2 = .02$ . Question type interacted with text type,  $F(1, 592) = 8.98, p < .001, \eta_p^2 = .03$ : reading vocabulary questions were answered more accurately for non-fiction than fiction,  $F(1, 299) = 7.69, p = .006$ , whereas literal comprehension and inference-making were better for fiction than non-fiction (literal:  $F(1, 299) = 17.35, p < .001$ ; inferential:  $F(1, 301) = 8.03, p < .005$ ). Performance was best on literal questions across genres. For non-fiction, accuracy was better for vocabulary than inferential questions, but this was not true for fiction. For the three-way interaction, adolescent group by text type by gender,  $F(1, 296) = 4.20, p = .04, \eta_p^2 = .01$ , simple effects showed that text type interacted with gender in early adolescence,  $F(1, 199) = 4.94, p = .03$ , with females scoring significantly better for fiction than non-fiction,  $F(1, 116) = 7.30, p = .008$  but males showing no difference between text types,  $F < 1$ . Text type did not interact with gender in middle adolescence,  $F < 1$ .

*Reading skills and reading habits as predictors of reading comprehension sub-skills*

1. *Correlations*. Significant correlations were found between SWRT, reading fluency and comprehension question type across text genres for each adolescent group (Table 6). Associations between reading habits and question type were more limited and specific. A number of correlations were observed for early

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adolescence that were significant but small in magnitude ( $r < .3$ ): non-fiction book reading and text/email with non-fiction literal comprehension; online searching with both literal and inferential comprehension for fiction; and social networking websites *negatively* with non-fiction reading vocabulary. Fiction book reading, however, was a much stronger correlate of each comprehension question type. In middle adolescence, fiction book reading also correlated with each question type except fiction literal comprehension. School textbook reading correlated with reading vocabulary (fiction and non-fiction) and computer gaming correlated *negatively* with fiction literal comprehension.

Insert Table 6 about here

2. *Hierarchical multiple regression.* Table 7 summarises the analyses of the predictors of literal and inferential comprehension for each text genre. After controlling for SWRT, reading fluency and reading vocabulary at Step 1, gender was entered at Step 2. The Step 3 predictors were the reading habits that had shown significant associations with comprehension during early (Non-Fiction Book, Fiction Book, Online Searching, Text/email) or middle (Fiction Book, School Textbook, Computer Game) adolescence.

Insert Table 7 about here

- a) *Early adolescence.* At Step 1, two reading skills emerged as significant (or marginal) predictors in each analysis: SWRT (all  $\beta$ s  $\geq .18$ ); and reading vocabulary (all  $\beta$ s  $\geq .26$ ). Reading fluency only contributed significantly to non-

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fiction literal comprehension,  $\beta = .21$ ,  $p = .004$ . Gender entered at Step 2 was not significant in any analysis. At Step 3, reading habits explained additional variance for fiction inferential skills ( $\Delta R^2 = 4\%$ ,  $F$  change (4, 181) = 3.33,  $p = .01$ ), and non-fiction literal comprehension ( $\Delta R^2 = 4\%$ ,  $F$  change (4, 181) = 4.23,  $p = .003$ ). Fiction books predicted both ( $\beta = .21$ ,  $p = .001$ , and  $\beta = .15$ ,  $p = .01$ , respectively) and text/email predicted only non-fiction literal comprehension ( $\beta = .15$ ,  $p = .003$ ).

b) *Middle adolescence*. At Step 1, SWRT was significant for fiction and (marginally) non-fiction inferential skills ( $\beta = .25$ ,  $p = .03$ , and  $\beta = .23$ ,  $p = .08$ , respectively). Reading vocabulary was a significant (or marginal) predictor in each analysis (all  $\beta$ s  $\geq .23$ ). At Step 2, gender was a significant predictor of non-fiction literal comprehension, favouring male students ( $\beta = -.19$ ,  $p = .04$ ). The entry of reading habits at Step 3 explained significant additional variance for each comprehension skill except non-fiction inference (fiction literal:  $\Delta R^2 = 7\%$ ,  $F$  change (3, 81) = 2.69,  $p = .05$ ; fiction inference:  $\Delta R^2 = 6\%$ ,  $F$  change (3, 81) = 3.21,  $p = .03$ ; non-fiction literal:  $\Delta R^2 = 5\%$ ,  $F$  change (3, 81) = 3.02,  $p = .03$ ). Fiction books emerged as a significant predictor of fiction inference ( $\beta = .27$ ,  $p = .004$ ). Computer gaming was a significant but *negative* predictor of literal comprehension (fiction:  $\beta = -.33$ ,  $p = .008$ ; non-fiction:  $\beta = -.24$ ,  $p = .008$ ).

### *Comparison of skilled versus less-skilled comprehenders*

The YARC standardised distribution (M=100, SD=15) was used to classify students whose reading comprehension score was one or more standard deviations above the mean for age as skilled comprehenders (N= 41; Female = 61%), and those who

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scored one or more standard deviations below the mean as less-skilled comprehenders (N=33; Female = 45%). The groups were matched for age. SES information was available for 16 less-skilled and 31 skilled comprehenders (less-skilled: M=5.13, SD=2.83; skilled: M=6.61, SD=2.25), and there was a marginal tendency for the groups to differ,  $F(1, 45) = 3.88, p = .06$ .

Table 8 contains group means for YARC reading skills and reading frequency from the reading habits questionnaire. A two-way between-participants ANOVA investigated effects of comprehender group and gender. Less-skilled comprehenders produced lower scores than the skilled comprehenders on all measures.

Comprehender group and gender interacted for SWRT,  $F(1, 70) = 10.69, p = .002, \eta_p^2 = .13$ , and reading fluency,  $F(1, 68) = 5.12, p = .03, \eta_p^2 = .07$ . Males had lower SWRT than females among less-skilled comprehenders, but the reverse was true for skilled comprehenders. For reading fluency, the discrepancy between skilled and less-skilled comprehenders was larger for male than female students. Subsequent ANCOVAs showed that SES was not significant as a covariate.

Insert Table 8 about here

Reading comprehension was associated with both reading frequency and fluency for skilled but not for less-skilled comprehenders (see Table 9). SWRT correlated significantly with reading fluency and marginally with reading comprehension in both comprehender groups. Performance for the reading comprehension sub-skills revealed tendencies to ceiling effects among skilled comprehenders and floor effects

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among less-skilled comprehenders so no further analysis of these data was attempted.

Insert Table 9 about here

Two-way between-participants ANOVAs examined comprehender group and gender in relation to reading habits. Gender was not significant but the effect of comprehender group is noteworthy since the groups differed only in time spent reading extended traditional texts: non-fiction books (skilled:  $M=1.90$ ,  $SD=0.80$ ; less-skilled:  $M=1.53$ ,  $SD=0.68$ ;  $F(1, 67) = 3.95$ ,  $p = .05$ ,  $\eta_p^2 = .06$ ) and fiction books (skilled:  $M=3.63$ ,  $SD=1.37$ ; less-skilled:  $M=1.55$ ,  $SD=0.68$ ;  $F(1, 65) = 52.70$ ,  $p < .001$ ,  $\eta_p^2 = .45$ ).

### General Discussion

This study makes an important contribution to the relatively sparse literature on adolescent reading comprehension. The students who participated were a representative sample of British secondary school students in terms of age, gender, ability, SES, ethnicity and geographic location. The outcome therefore provides an insight into what would be regarded as current and typical among British adolescents.

*Reading comprehension, word recognition and reading fluency in adolescence*

In early adolescence, word identification made a strong contribution to reading comprehension as did text reading fluency (e.g. Tilstra et al (2009; cf. Adlof et al, 2006), in spite of the untimed nature of the YARC Secondary test. Reading

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frequency had a marginal effect and, together, the variables explained 53% of the variance in reading comprehension. Contrary to expectation, the association between word identification and reading comprehension did not diminish in middle relative to early adolescence, nor did the influence of reading fluency increase. Only word identification was significant in middle adolescence, explaining 41% of the variance.

SES correlated positively with word identification in middle adolescence but did not mediate the regression results. While the outcome suggests that word identification continues to make a strong contribution to reading comprehension during adolescence (Cunningham et al, 1990; Perfetti & Hart, 2001), it should be noted that listening comprehension was not measured in the present study. Nonetheless, the lexical quality hypothesis predicts this type of continuing influence as the richness of the phonological, orthographic and semantic information stored in lexical representations is seen as a stable predictor of reading comprehension due to the resulting efficiencies in lexical access (Perfetti & Hart, 2001).

*Concurrent links between adolescent reading habits, gender and reading comprehension*

Gender differences in reading were limited but clear differences emerged in reading habits: males spent more time reading comics/graphic novels and computer gaming; whereas females favoured song lyrics, text/email messages, social networking websites, poetry, and, in a smaller sample where SES was controlled, fiction books.

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Student reading habits reflected the growing tendency for more time to be spent with digital than traditional texts (see Pitcher et al, 2007). Nevertheless, more associations with reading comprehension, word identification and fluency were observed for traditional than digital literacies. The strongest correlate of reading in early adolescence was the extended traditional text, fiction books, and, in middle adolescence, school textbooks related to word identification and fiction books to reading comprehension. Thus, time spent with extended texts was identified as an important predictor of reading comprehension across adolescence. Nevertheless, the association between reading skill and choice of reading material is likely to be reciprocal as students with better reading skills may be more likely to seek out extended and challenging texts, thereby further developing their reading skills.

*Predictors of literal and inferential comprehension sub-skills in adolescence*

Performance on the YARC Secondary test was broken down by text type (non-fiction, fiction) and question type (vocabulary, literal, inferential). This enabled us to be more explicit about the competencies measured by our test (see Cutting and Scarborough (2006)). Across adolescence, accuracy was highest for literal questions regardless of text type as predicted by Perfetti et al (1996), suggesting that literal comprehension may often rely on the formation of a textbase rather than implicating more demanding constructive text processing. Vocabulary was better than inference-making for non-fiction passages but these sub-skills were equivalent for fiction. Vocabulary questions were answered more accurately for non-fiction than fiction passages, whereas literal comprehension and inference-making were better for fiction than non-fiction.



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Adolescents were generally more accurate at fiction than non-fiction inferences, which is consistent with their expressed preference for fiction texts. A characteristic of expository text comprehension is the necessity to integrate content with background topic knowledge (Recht & Leslie, 1988; McNamara, Kintsch, Songer & Kintsch, 1996; Wolfe & Woodwyk, 2010), and, as a result, comprehension is often worse for non-fiction texts. When concepts are unfamiliar or abstract, processing load increases, making it more difficult to establish global coherence and forcing reliance on a textbase rather than a situational model, which in turn may restrict inference-making (Kintsch, 1998; Diakidoy, Mouskounti & Ioannides, 2011).

Text-specific vocabulary knowledge was the strongest and most consistent predictor of comprehension sub-skills across adolescence. This measure was part of the YARC Secondary test so the vocabulary measured was directly related to the text being read, making this a particularly strong control variable. Across adolescence reading vocabulary was a reliable predictor of inferential comprehension for both text genres but a stronger predictor of non-fiction than fiction literal comprehension. This appears consistent with the importance of background knowledge in making elaborative inferences to form the situational model and the increased reliance on topic knowledge in expository text even for literal comprehension (Graesser et al, 1994, 2002; Cromley et al, 2010). Awareness of the importance of vocabulary is increasing either as an index of lexical quality (Perfetti & Hart, 2001) or as a component of both listening comprehension and word identification (e.g., Tunmer & Chapman, 2012). Word identification also predicted unique variance in

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comprehension sub-skills but evidence that this effect was stronger for fiction was mixed (cf. Best et al, 2008). While word identification was only a marginal predictor of non-fiction inference-making, the regression coefficients were very similar in scale to their fiction counterparts, and it was a moderate predictor of non-fiction literal comprehension in early adolescence. By middle adolescence, word identification was no longer a significant predictor of literal comprehension for non-fiction or fiction. Reading fluency was only a predictor in early adolescence and then only for non-fiction literal comprehension.

*Reading habits*

Fiction book reading contributed unique variance to fiction inference-making across adolescence and non-fiction literal comprehension in early adolescence. These are robust findings as they survived controls for word identification, reading fluency and text-specific vocabulary. As the only reading habit to be a predictor of inference-making, the narrative elements of fiction books may be well-suited to the development of formal schemas to support inference. Narratives are similar in structure to events in our daily lives and may easily engage the episodic memory system that monitors our personal experience (Tulving, 1984), with the links to specific episodes forming a basis for inference (Eichenbaum, 2004).

The negative contribution of computer gaming to literal comprehension across text genres was a striking finding among older students. It is assumed that this outcome does not reflect a negative contribution of some aspect of gaming itself but rather that gaming could reduce time for activities that might increase background

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knowledge (e.g. Perfetti et al, 1996) or that weaker reading skills may lead to increased frequency of gaming (e.g. Willoughby, 2008). Using the PISA 2009 dataset from 22 OECD countries, Drummond and Sauer (2014) found only a trend for reduced reading achievement among 15-year-olds who were daily users of multi-player computer games compared to those who never played. Therefore, the influence of gaming is a key outcome of the present study, which suggests that longitudinal examination of this issue within individual OECD countries is warranted using a measure like ours that is sensitive to the number of hours spent gaming over set time periods.

Overall, limited evidence emerged of genre-specific predictors except for younger adolescents' text/email time which predicted non-fiction literal comprehension.

*Gender*

In contrast, text genre interacted with gender in early adolescence as females scored better on fiction than non-fiction but male comprehension was unaffected by text genre. In middle adolescence, non-fiction literal comprehension was better among males than females.

While the scarcity of gender effects stands in contrast to the OECD-PISA outcome (OECD, 2010), Logan and Johnston (2009) note that effect sizes among English-speakers are often small and gender differences in ability much less pronounced than those for attitudes to reading. If so, gender effects may be closely related to societal norms since reading is known to be a gender-typed activity (Hall & Coles,

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1999; Jacobs, Lanza, Osgood, Eccles & Wigfield, 2002; McGeown, Goodwin, Henderson & Wright, 2012), which may link to our finding that reading frequency is consistently higher among females.

*Skilled versus less-skilled adolescent reading comprehension*

Less-skilled comprehenders underperformed on all reading measures and were marginally more likely to be of lower SES than skilled comprehenders. Among less-skilled *comprehenders*, word identification and (marginally) reading frequency was lower among male than female students. Males were also over-represented among less-skilled *word identifiers* in early adolescence, who scored more than one SD below the mean for word identification,  $\chi^2(1) = 3.86, p = .049^6$ . In the YARC Secondary test, less-skilled comprehenders appeared better at literal than inference-making or reading vocabulary, which were both subject to floor effects. This may reflect a greater reliance on the textbase perhaps due to difficulties in the construction of a situational model.

In terms of reading habits, skilled and less-skilled comprehenders differed only in relation to their reading of extended traditional texts, fiction and non-fiction books. This is consistent with the DIME model, which predicts that students who lack background knowledge and vocabulary are at a particular disadvantage because

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<sup>6</sup> No such gender differences were observed for decoding in middle adolescence or for comprehension at either age (all  $\chi^2$ s  $\leq 1$ ).

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these skills have direct and mediated effects on comprehension (Cromley & Azevedo, 2007).

*Limitations*

The study has a number of limitations. First, the cross-sectional nature of the research limits conclusions about the extent to which differences between early and middle adolescence should be regarded as developmental or participant effects, and a longitudinal follow-up is necessary. Second, the study is correlational and so experimental manipulations of the variables identified here are necessary to establish causation. Third, SES information was only available for a subset of the sample which may have reduced the number of effects reaching significance due to low power. A fourth limitation is the lack of data about listening comprehension as our information about language skills was limited to reading vocabulary.

*Adolescent reading comprehension**Conclusions*

Theoretically, the results document the strong contribution from the cognitive domain to adolescent reading comprehension with the influence of word identification spanning adolescent groups and text genres, consistent with the predictions of the SVR. Nevertheless, variables from the psychological domain (gender) and ecological domain (print exposure) were found to have an additional impact, reinforcing the need to extend the range of variables used to build models of reading comprehension in adolescence.

In terms of print exposure, gender differences were evident in reading habits, coinciding with better female than male comprehension of fiction in early adolescence and better male than female literal comprehension of non-fiction in middle adolescence. Shorter traditional and digital texts did not appear to have the same explanatory value as traditional extended texts. Indeed, fiction book reading was the only reading habit to make a robust, unique contribution to the higher-level comprehension skill of inference-making. Equally striking was the finding that the only difference in reading habits between skilled and less-skilled comprehenders concerned the reading of traditional extended texts. Future longitudinal research should examine the causality of this association and explore how key features of extended text structure such as the indexing of time or understanding sequences of related events may foster component comprehension skills.

Evidence of the importance of reading frequency also warrants further research as this correlated extensively with reading measures in early adolescence and

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remained a predictor, albeit marginal, of reading comprehension even after controlling for gender and cognitive reading skills (word identification, reading fluency). Both reading frequency and reading comprehension were lower and unrelated in middle adolescence, although comprehension was still well within average levels. Reading frequency also distinguished skilled from less-skilled comprehenders, and males generally read less frequently than females. Reading frequency may be linked to the observed predictive value of background knowledge in the form of text-specific reading vocabulary, since vocabulary development and reading are thought to have a reciprocal relationship. It will be important to test the direction of any such relationships as it remains possible that the associations with reading frequency arise because less-skilled readers are simply reluctant readers as reading is very effortful for them. Nevertheless, a recent UK report suggests that societal norms, which gender-type reading as “feminine”, are a key factor in male underachievement in reading (National Literacy Trust, 2012), and the present data indicates that reading frequency tends to be lower among males than females even when both genders have equally low levels of reading comprehension. Future challenges for educators lie in combatting adolescent attitudes about the gender-typed nature of reading and in motivating extended text reading habits.

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## Tables

Table 1

*Means and Standard Deviations for Chronological Age, Reading Comprehension, Word Identification (SWRT), Reading Fluency and SES for Male and Female Students in Early and Middle Adolescence*

	YARC Secondary											
	Chronological Age			Reading Comprehension		SWRT		Reading Fluency		SES <sup>#</sup>		
	(Years)			(Standardised Scores)						(IMD Postcode Rank)		
	N	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	N
<b>Early Adolescence</b>												
Female	122	12.63	0.92	103.54	11.32	103.21	12.33	102.00	13.63	6.23	2.63	93
Male	89	12.70	0.85	102.53	12.77	103.36	15.80	100.35	16.07	6.25	2.56	63
<b>Total</b>	<b>211</b>	<b>12.66</b>	<b>0.89</b>	<b>103.11</b>	<b>11.94</b>	<b>103.27</b>	<b>13.86</b>	<b>101.31</b>	<b>14.69</b>	<b>6.24</b>	<b>2.60</b>	<b>156</b>
<b>Middle Adolescence</b>												
Female	51	15.08	0.56	99.08	11.86	99.55	12.64	102.59	12.75	5.76	2.37	37
Male	50	15.09	0.51	97.86	11.35	102.53	13.76	101.46	13.65	6.41	2.65	27
<b>Total</b>	<b>101</b>	<b>15.09</b>	<b>0.53</b>	<b>98.47</b>	<b>11.57</b>	<b>101.02</b>	<b>13.23</b>	<b>102.03</b>	<b>13.15</b>	<b>6.03</b>	<b>2.49</b>	<b>64</b>

# SES data was only available for a reduced sample of 156 younger and 64 older adolescents

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Table 2

*Medians, means and standard deviations for time<sup>a</sup> spent reading each type of material and reported reading frequency<sup>b</sup> for males and females in early and middle adolescence*

Reading Material		Early Adolescence		Middle Adolescence		<i>F</i> (Gender) <sup>#</sup>	<i>F</i> (Age Group) <sup>#</sup>
		Female	Male	Female	Male		
<b>Traditional Literacies</b>							
Magazine	Mean	1.88	1.87	2.34	2.02	2.15 n.s.	7.72**
	SD	0.77	0.88	1.00	1.08		
	Median	2	2	2	2		
Instructions or Manual	Mean	1.39	1.48	1.50	1.58	1.28 n.s.	1.83 n.s.
	SD	0.62	0.61	0.71	0.65		
	Median	1	1	1	1.5		
Comic or Graphic Novel	Mean	1.28	1.79	1.31	1.48	12.65***	2.30 n.s.
	SD	0.55	0.85	1.00	0.85		
	Median	1	2	1	1		
Poetry	Mean	1.48	1.29	1.62	1.31	7.47**	<1 n.s.
	SD	0.76	0.53	1.03	0.59		
	Median	1	1	1	1		
Non-Fiction Book	Mean	1.69	1.73	1.58	1.68	<1 n.s.	<1 n.s.
	SD	0.85	0.91	0.95	0.84		
	Median	1	1	1	1		
School Text Book	Mean	2.19	2.08	2.67	2.42	2.21 n.s.	11.08**
	SD	0.85	0.99	1.13	1.16		
	Median	2	2	3	2		
Fiction Book	Mean	2.63	2.32	2.56	2.28	2.90 <sup>†</sup>	<1 n.s.

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	SD	1.38	1.28	1.54	1.36		
	Median	2	2	2	2		
Newspaper	Mean	1.59	1.78	1.96	1.92	<1 n.s.	7.88**
	SD	0.59	0.79	0.86	0.90		
	Median	2	2	2	2		
Song Lyrics	Mean	2.07	1.33	2.02	1.48	33.86***	<1 n.s.
	SD	1.07	0.54	1.08	0.65		
	Median	2	1	2	1		
<b>Digital Literacies</b>							
Factual Website or Blog	Mean	1.92	1.76	2.04	2.21	<1 n.s.	5.91*
	SD	0.82	0.87	1.15	1.15		
	Median	2	2	2	2		
Online Searching	Mean	2.54	2.51	2.85	3.23	1.71 n.s.	16.01***
	SD	1.00	1.02	1.07	1.13		
	Median	2	2	3	3		
Text or Email Messages	Mean	2.58	2.28	3.46	2.81	10.99**	24.80***
	SD	1.18	1.02	1.28	1.21		
	Median	2	2	3	2.5		
Social Networking Website	Mean	2.90	2.44	3.80	3.33	6.98**	26.18***
	SD	1.46	1.42	1.46	1.34		
	Median	3	2	4	3		
Twitter	Mean	1.32	1.33	1.20	1.21	<1 n.s.	2.28 n.s.
	SD	0.75	0.66	0.63	0.50		
	Median	1	1	1	1		
Computer Game	Mean	2.22	3.13	1.88	3.29	55.25***	<1 n.s.
	SD	1.08	1.42	1.18	1.43		
	Median	2	3	1.5	3		

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Reading Frequency							
Mean	11.34	10.16	10.12	8.66	15.82 <sup>***</sup>	16.79 <sup>***</sup>	
SD	2.86	3.00	2.33	2.22			
Median	12	11	11	9			

<sup>a</sup> Reading habits ratings: 1=*didn't read this*; 2=*30 minutes or less*; 3=*1 hour*; 4=*2 hours*;  
5=*3 hours or more*

<sup>b</sup> Reading frequency ratings: 1(*low*)-16(*high*)

<sup>#</sup> *F* for main effect

<sup>\*\*\*</sup>  $p < .001$ ; <sup>\*\*</sup>  $p < .01$ ; <sup>\*</sup>  $p < .05$ ; <sup>†</sup>  $p < .09$

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Table 3

*Pearson Product Moment Correlations between standardised scores in the Reading Comprehension, Word Identification (SWRT) and Reading Fluency components of the YARC Secondary Test and SES (Upper Quadrant = Early Adolescence (n=211); Lower Quadrant = Middle Adolescence (n=101))*

	Reading Comp.	SWRT	Reading Fluency	Reading Frequency	SES <sup>#</sup>
Reading Comp.	-	.70***	.65***	.24***	.11
SWRT	.62***	-	.73***	.19**	.02
Reading Fluency	.48***	.61***	-	.21**	.14
Reading Frequency	.11	.09	.12	-	.01
SES <sup>#</sup>	.20	.26*	.13	-.19	-

# SES data was only available for a reduced sample of 156 younger adolescents and 64 older adolescents

\*\*\*  $p < .001$  level, \*\*  $p < .01$  level, \*  $p < .05$  level (all 2-tailed)



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Table 4

*Multiple Regression Analyses to investigate the contribution of Gender, Word Identification (SWRT), Reading Fluency and Reading Frequency to Reading Comprehension in Early and Middle Adolescence*

	b	SE b	$\beta$	R <sup>2</sup>
<i>Early Adolescence</i>				
Gender	0.14	1.17	.01	
SWRT	0.41	0.06	.47***	
Reading Fluency	0.23	0.06	.28***	
Reading Frequency	0.36	0.20	.09 <sup>†</sup>	
				0.53***
<i>Middle Adolescence</i>				
Gender	3.15	1.93	.14	
SWRT	0.48	0.09	.55***	
Reading Fluency	0.13	0.09	.14	
Reading Frequency	-0.06	0.41	-.01	
				0.41***

\*\*\*  $p < .001$ , \*  $p < .05$ , <sup>†</sup>  $p = .07$

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Table 5

*Male and Female Student Mean Percentage Accuracy in Response to Comprehension Questions assessing Vocabulary, Literal Comprehension and Inference-Making Skill for Fiction and Non-Fiction Passages of Text According to Adolescent Group (Standard Deviations in Parentheses)*

		Fiction			Non-Fiction			
		N	Vocabulary	Literal	Inferential	Vocabulary	Literal	Inferential
<b>Early</b>								
<b>Adolescence</b>								
	Female	117	40.95 (27.29)	72.56 (23.97)	42.76 (23.61)	45.15 (28.29)	63.87 (26.05)	36.49 (26.88)
	Male	84	39.29 (30.82)	66.15 (26.10)	39.68 (25.47)	49.12 (34.07)	63.73 (29.01)	36.41 (25.81)
	<b>Total</b>	201	40.26 (28.75)	69.88 (25.02)	41.47 (24.39)	46.81 (30.82)	63.82 (27.25)	36.46 (26.37)
<b>Middle</b>								
<b>Adolescence</b>								
	Female	51	50.33 (28.39)	77.98 (21.01)	45.68 (23.87)	55.42 (35.90)	72.49 (26.40)	46.32 (33.27)
	Male	48	50.95 (27.24)	72.40 (23.64)	46.71 (24.77)	48.39 (31.56)	71.62 (23.85)	41.24 (35.11)
	<b>Total</b>	99	50.63 (27.70)	75.28 (22.39)	46.18 (24.19)	52.01 (33.88)	72.07 (25.07)	43.85 (34.09)
<b>Whole Group</b>		300	43.68 (28.78)	71.66 (24.28)	43.03 (24.39)	48.53 (31.90)	66.54 (26.79)	38.90 (29.30)

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Table 6

*Pearson Product Moment Correlations between Reading Habits, Reading Skills and the Vocabulary, Literal and Inferential Components of Reading Comprehension in Early (n=201) and Middle Adolescence (n=99)*

	Early Adolescence						Middle Adolescence					
	Fiction			Non-Fiction			Fiction			Non-Fiction		
	Voc.	Lit.	Inf.	Voc.	Lit.	Inf.	Voc.	Lit.	Inf.	Voc.	Lit.	Inf.
<b>Reading Habits</b>												
<i>Traditional Literacies</i>												
Magazine	-.07	-.04	-.04	-.04	-.01	-.05	-.11	-.06	-.04	-.03	-.18	.10
Newspaper	-.09	-.08	-.06	-.07	-.02	-.13	-.14	-.11	-.14	-.02	-.06	-.08
Song Lyrics	-.05	-.08	-.01	-.06	-.10	.01	.12	.08	.08	.15	.14	.11
Non-Fiction Book	.12	.13 <sup>‡</sup>	.07	.03	.14*	.07	.10	.13	.11	.08	.09	.03
School Text Book	-.11	-.04	-.11	-.08	-.06	-.11	.21*	.04	.13	.29**	.18	.13
Fiction Book	.31***	.32***	.42***	.36***	.44***	.26***	.41***	.17	.45***	.37***	.36***	.23*
<i>Digital Literacies</i>												
Factual Website	.04	.11	-.01	.10	.03	.00	.03	-.10	.07	.07	-.04	.06

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Online Searching	.10	.15*	.16*	.07	.16*	.12	-.05	-.18	-.11	-.07	-.06	.01
Text or Email	.02	.09	.07	.07	.15*	.05	-.09	.12	.00	.06	.13	.09
Social Networking	-.06	.04	-.06	-.13 <sup>‡</sup>	-.06	-.01	-.13	-.04	-.08	-.11	-.08	-.05
Computer Game	-.01	.03	.09	.07	.06	.09	-.12	-.28**	-.08	-.02	-.12	-.08
<b>Reading Skills</b>												
SWRT	.50***	.54***	.56***	.50***	.62***	.45***	.59***	.42***	.55***	.55***	.59***	.48***
Reading Fluency	.47***	.46***	.54***	.41***	.59***	.37***	.42***	.32**	.42***	.44***	.46***	.41***
<b>SES<sup>#</sup></b>	.08	.13	.08	.05	.08	-.01	.18	-.02	.06	.05	.16	.18

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# SES data was only available for a reduced sample of 156 younger adolescents and 64 older adolescents

\*\*\*  $p < .001$  level, \*\*  $p < .01$  level, \*  $p < .05$  level (all 2-tailed); <sup>‡</sup>  $p < .07$

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Table 7

*Hierarchical Multiple Regression to Examine Reading Habits as Predictors of Literal and Inferential Comprehension in Fiction and Non-Fiction Reading in Early (n=201) and Middle Adolescence (n=99) using Gender, Word Identification (SWRT), Reading Fluency and Fiction or Non-Fiction Reading Vocabulary as Control Variables*

	Early Adolescence				Middle Adolescence			
	B	SE b	$\beta$	$\Delta R^2$	B	SE b	$\beta$	$\Delta R^2$
<b>Fiction</b>								
<b>DV=Literal</b>								
<i>Step 1</i>					<i>Step 1</i>			
SWRT	0.55	0.17	.30**		SWRT	0.31	0.22	.19
Reading	0.15	0.16	.09		Reading	-	0.20	-.02
Fluency					Fluency	0.03		
Fiction Reading	0.22	0.06	.26***		Fiction Reading	0.18	0.10	.23 <sup>‡</sup>
Vocab					Vocab			
				.34***				.18**
<i>Step 2</i>					<i>Step 2</i>			
Gender	4.35	3.06	.09		Gender	-	4.96	-.02
						0.62		
				.01				.02
<i>Step 3</i>					<i>Step 3</i>			
Non-Fiction	1.03	1.84	.04		School	0.66	1.91	.04
Book					Textbook			
Fiction Book	1.44	1.32	.08		Fiction Book	0.73	1.49	.05
Online	0.36	1.62	.02		Computer	-	1.68	-.33**
Searching					Game	4.59		
Text/email	1.34	1.46	.06					
				.01				0.07*
<b>DV=Inferential</b>								
<i>Step 1</i>					<i>Step 1</i>			
SWRT	0.31	0.14	.18*		SWRT	0.45	0.21	.25*
Reading	0.20	0.13	.12		Reading	0.02	0.19	.01

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Fluency				Fluency			
Fiction Reading	0.36	0.05	.44***	Fiction Reading	0.30	0.09	.35**
Vocab				Vocab			
<i>Step 2</i>			.49***	<i>Step 2</i>			.42***
Gender	0.46	2.51	.01	Gender	-	4.67	-.06
						2.50	
<i>Step 3</i>			.00	<i>Step 3</i>			.00
Non-Fiction	-2.30	1.51	-.08	School	-	1.80	-.02
Book				Textbook			
Fiction book	3.65	1.08	.21**	Fiction Book	4.17	1.40	.27**
Online	0.27	1.33	.01	Computer	-	1.58	-.12
Searching				Game			
Text/email	1.70	1.20	.08				
			.04*				.06*

**Non-Fiction*****DV=Literal***

<i>Step 1</i>				<i>Step 1</i>			
SWRT	0.40	0.15	.20**	SWRT	0.22	0.19	.12
Reading	0.39	0.13	.21**	Reading	0.15	0.17	.08
Fluency				Fluency			
Non-Fiction	0.35	0.05	.40***	Non-Fiction	0.41	0.06	.59***
Reading Vocab				Reading Vocab			
<i>Step 2</i>			.56***	<i>Step 2</i>			.55***
Gender	-1.52	2.65	-.03	Gender	-	4.20	-.19*
						8.95	
<i>Step 3</i>			.00	<i>Step 3</i>			.00
Non-Fiction	1.88	1.57	.06	School	0.90	1.61	.05
Book				Textbook			
Fiction Book	3.03	1.16	.15*	Fiction Book	1.55	1.23	.10
Online	-0.61	1.40	-.02	Computer	-	1.37	-.24**

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Searching					Game	3.74		
Text/Email	3.79	1.27	.15**					
				.04**				.05*
<b>DV=Inferential</b>								
<i>Step 1</i>					<i>Step 1</i>			
SWRT	0.37	0.20	.19 <sup>‡</sup>		SWRT	0.58	0.33	.23 <sup>‡</sup>
Reading	0.06	0.18	.03		Reading	0.10	0.30	.04
Fluency					Fluency			
Non-Fiction	0.31	0.07	.36***		Non-Fiction	0.38	0.11	.39**
Reading Vocab					Reading Vocab			
				.27***				.34***
<i>Step 2</i>					<i>Step 2</i>			
Gender	0.90	3.48	.02		Gender	2.13	7.37	.03
				.00				.01
<i>Step 3</i>					<i>Step 3</i>			
Non-Fiction	-0.04	2.06	.00		School	-	2.83	-.02
Book					Textbook	0.56		
Fiction Book	0.75	1.53	.04		Fiction Book	1.20	2.16	.05
Online	1.15	1.84	.04		Computer	-	2.40	-.13
Searching					Game	2.76		
Text/email	0.00	1.66	.00					
				.00				.02

\*\*\*  $p < .001$  level, \*\*  $p < .01$  level, \*  $p < .05$  level, <sup>†</sup>  $p = .05$  <sup>‡</sup>  $p \leq .08$  (all 2-tailed)

Table 8

*Means and Standard Deviations for Chronological Age, Reading Comprehension, Word Identification (SWRT), Reading Fluency and Reading Frequency for Skilled and Less-skilled Comprehenders*

Skilled Comprehenders			Less-skilled Comprehenders			$F^{\ddagger}$
Male	Female	Total	Male	Female	Total	

*Adolescent reading comprehension*

		(N=16)	(N=25)	<b>(N=41)</b>	(N=18)	(N=15)	<b>(N=33)</b>	
Chronological Age (years)	Mean	12.82	12.99	<b>12.92</b>	13.48	13.28	<b>13.39</b>	1.98 n.s.
	SD	1.35	1.43	<b>1.38</b>	1.30	1.61	<b>1.43</b>	
Reading Comprehension (standardised score)	Mean	117.96	117.80	<b>117.86</b>	77.33	77.91	<b>77.60</b>	2117.49***
	SD	2.82	2.61	<b>2.66</b>	4.58	4.74	<b>4.59</b>	
SWRT (standardised score)	Mean	120.25	113.44	<b>116.10</b>	80.25	89.43	<b>84.43</b>	171.35***
	SD	8.13	9.75	<b>9.65</b>	12.53	10.37	<b>12.33</b>	
Reading Fluency (standardised score)	Mean	115.92	110.71	<b>112.75</b>	81.09	87.90	<b>84.16</b>	117.81***
	SD	11.96	9.46	<b>10.05</b>	11.96	12.95	<b>12.68</b>	
Reading Frequency	Mean	11.19	12.48	<b>11.98</b>	9.33	10.40	<b>9.82</b>	10.17**
	SD	2.88	2.14	<b>2.51</b>	1.97	3.52	<b>2.79</b>	

<sup>#</sup> F for Comprehender group contrast

\*\*\* p < .001; \*\* p < .01



*Adolescent reading comprehension*

Table 9

*Pearson Product Moment Correlations between standardised scores in the Reading Comprehension, Word Identification (SWRT) and Reading Fluency components of the YARC Secondary Test and Reading Frequency (Upper Quadrant = Skilled Comprehenders (n=41); Lower Quadrant = Less-skilled Comprehenders (n=33))*

	Reading Comp.	SWRT	Reading Fluency	Reading Frequency
Reading Comp.	-	.29 <sup>†</sup>	.41**	.38*
SWRT	.33 <sup>†</sup>	-	.57***	-.10
Reading Fluency	.22	.61***	-	.26
Reading Frequency	.18	.08	-.06	-

\*\*\*  $p < .001$  level, \*\*  $p < .01$  level, \*  $p < .05$  level, <sup>†</sup> $p \leq .07$  (all 2-tailed)