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**Going Beyond Children's Single-Text Comprehension: The Role of Fundamental and
Higher-Level Skills in 4th Graders' Multiple-Document Comprehension**

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Abstract

Background. Children's comprehension of single texts relies on both foundational and higher-level skills. These are also assumed to support multiple-document comprehension, but their relative importance has not been examined, to date. Multiple-document comprehension additionally requires the identification and use of information about each document's source.

Aims. This study examined multiple-document comprehension in primary school-aged children. It sought to determine the relative importance of skills proposed to be common to both single- and multiple-document comprehension (word reading fluency, verbal working memory, comprehension monitoring) and specific to the latter (source use). Single-text comprehension and prior topic knowledge were considered as moderator and control.

Sample. Participants were 94 children in the fourth year (mean age = 9;7 years; 52% females).

Methods. Children read three documents on each of two topics (chocolate and video games).

Multiple-document comprehension and source use were assessed through short essays.

Independent measures of the foundational and higher-level skills were used.

Results. There was a significant direct and indirect influence of word reading fluency on comprehension of multiple documents on videogames and also an indirect influence of comprehension monitoring. Indirect influences of word reading fluency and comprehension monitoring on multiple-document comprehension for both topics were also apparent. Verbal working memory was not a unique predictor. When source information was identified, it was included to support the argument in the composition.

Conclusions. Efficient word reading, comprehension monitoring and single-text comprehension are important for multiple-document comprehension in young readers.

Implications of these findings and differences between the two document sets are discussed.

Word count = 250

Keywords: multiple-document comprehension; fundamental skills; higher –level skills; reading comprehension; fourth graders

Going Beyond Children's Single-Text Comprehension: The Role of Fundamental and Higher-Level Skills in 4th Graders' Multiple-Document Comprehension

The nature of literacy and educational practices is rapidly changing in the 21st century as new literacy skills are required to deal with changes in knowledge acquisition, influenced by the news media (Stadtler & Bromme, 2013). As a result, students from the primary grades upwards are required to deal with partly conflicting information across multiple documents (Goldman & Scardamalia, 2013; Rouet & Britt, 2011). The understanding of ideas presented in different documents relies on the ability to compare and reason about the information used to support a claim and is particularly important once readers have acquired basic reading fluency skills and are 'reading to learn'. Research to date has established that the ability to understand a single coherent text (hereafter, reading comprehension) is influenced by a range of skills, including word reading, verbal working memory, and comprehension monitoring (e.g., Carretti, Caldarola, Tencati, & Cornoldi, 2014; Kendeou, van den Broek, White, & Lynch, 2009; Oakhill & Cain, 2012). These skills are also assumed to play a role in multiple-document comprehension. The latter, however, requires additional higher-level skills such as the ability to identify and, more importantly, to use source information (Rouet & Britt, 2014). The present study extends knowledge about multiple-document comprehension in fourth graders by clarifying the role of key skills and source use in the understanding of printed multiple documents on two topics.

The theoretical framework for this study brings together both models of reading comprehension and its skills (Kintsch, 1988), which have mainly been tested on primary school children (e.g., Kim, 2015; Oakhill & Cain, 2012), and models of multiple-document comprehension, which have been mainly tested on older students (e.g., Bråten, Anmarkrud, Brandmo, Strømsø, 2014; Mason, Junyent, & Tornatora, 2014). These models and relevant

evidence are reviewed in the next sections. We mainly refer to work on primary and lower-secondary school students.

Models of Reading Comprehension and Multiple-Document Comprehension

Reading comprehension of single texts involves the construction of a coherent mental representation of its meaning, known as a *situation model* (Kintsch, 1988). According to developmental models of reading comprehension, the construction of this representation relies on several fundamental and higher-level skills (Kendeou et al., 2009; Kim, 2015; Language and Reading Research Consortium & Logan, 2017; Oakhill & Cain, 2012; see also Florit, Roch, & Levorato, 2011). Relevant fundamental skills include language knowledge, such as vocabulary or morphosyntactic knowledge, and general cognitive resources such as working memory and attention; higher-level skills include inferencing and comprehension monitoring. These fundamental and higher-level skills allow linguistic information from the text at the word-, sentence-, and discourse-level to be processed and integrated with reader's prior knowledge.

The fundamental skills considered in this study were word reading skills, which allow the reader to decode the printed word in order to access its meaning and also, verbal working memory, which is the mental workspace in which the processing and integration of information at the word-, sentence- and discourse-levels and the construction of the mental model takes place. The higher-level component we considered was comprehension monitoring, which supports the integration of information within the text and with prior knowledge to construct coherence at the discourse-level.

The Documents Model Framework (Rouet & Britt, 2011) was proposed to deal with the complexities of multiple-document comprehension. Documents are rhetorical entities that involve both the semantic content of texts and sources (e.g., the author/s, a publication medium). The Documents Model Framework extends models of reading comprehension and

hypothesises the existence of two additional levels of representation beyond the *situation model*: the *integrated mental model*, that includes information from different texts, and the *intertext model*, that includes source information and the relations between source and content information.

In sum, skills such as word reading, verbal working memory and comprehension monitoring are common to both single-text and multiple-document comprehension. The ability to identify sources and to represent source-content links is specific to multiple-document comprehension.

The Role of Common Skills of Reading Comprehension and Multiple-Document Comprehension

Previous research shows that word reading and comprehension monitoring account for the majority of variance in reading comprehension, once the role of other relevant language and cognitive skills has been taken into account (e.g., Carretti et al., 2014; Florit & Cain, 2011; Language and Reading Research Consortium & Logan, 2017; Liebfreund & Conradi, 2016). The contribution of word reading accuracy to reading comprehension is important across primary school years, but word reading fluency becomes more important as accuracy improves (Florit & Cain, 2011; Language and Reading Research Consortium, 2015).

Comprehension monitoring shows a stable role in reading comprehension during the first years of reading instruction (Language and Reading Research Consortium & Yeomans-Maldonado, 2017). The role of verbal working memory is less clear. Most studies find a relation between this general cognitive skill and reading comprehension (Cain, Oakhill, & Bryant, 2004; Carretti et al., 2014; Language and Reading Research Consortium & Logan, 2017; Oakhill & Cain, 2012). There is also evidence that verbal working memory, although involving the ability to manipulate verbal information, uniquely accounts for reading comprehension over and above vocabulary knowledge (e.g., Cain et al., 2004). Working

memory, however, is not a unique predictor once the role of higher-level skills is considered (Language and Reading Research Consortium & Logan, 2017; Oakhill & Cain, 2012; but see also Carretti et al., 2014). This may be because working memory supports the integrative processes involved in higher-level skills, such as comprehension monitoring.

Few studies have examined the role of these components in comprehension of multiple documents by primary school students. Single-text and multiple-document comprehension are related (Salmerón & García, 2011), however, there is still a debate on the extent to which each text in a set is fully understood during multiple-document comprehension (e.g., Bråten, Anmarkrud et al., 2014). Moreover, spatial working memory predicts hypertext comprehension in 4th graders (Kornmann et al., 2016) but the role of verbal working memory has not been explored. For lower-secondary school students (10th graders), the ability to recognize words rapidly accounts for unique variance in multiple-document comprehension, once prior topic knowledge is controlled (Bråten, Ferguson, Anmarkrud, & Strømsø, 2013). For 5th-7th graders, multiple-document comprehension is predicted by prior topic knowledge and language skills but not by knowledge of comprehension monitoring strategies (Davis, Huang, & Yi, 2017).

The Role of Specific Skills of Multiple-Document Comprehension

Identification and use of source information is considered essential for effective comprehension of multiple texts (Rouet & Britt, 2011). Studies of primary school children show that 4th and 5th graders can establish links between specific sources and contradictory pieces of information in documents (Macedo–Rouet, Braasch, Britt, & Rouet, 2013; Paul, Stadtler, & Bromme, in press) and primary school students can be taught how to identify and use source information (Brante & Strømsø, 2017; Paul, Stadtler, Scharrer, Pérez, & Bromme, 2017). Less is known about the role of source identification and its use in young readers' multiple-document comprehension.

In their study of 5th and 7th graders, Davis and colleagues (2017) provided qualitative evidence that a sub-sample tried to integrate the content of different documents and consider information about external sources (i.e., the author of each document) when doing so. In addition, source identification is related to the ability to synthesize information from different documents in 5th graders (Kingsley, Cassady, & Tancock, 2015). In sum, younger readers appear able to identify or use external sources but this ability has not been examined in relation to argumentation skills, considered a comprehensive measure of multiple-document comprehension, and after considering the contribution of other relevant skills.

Research Questions and Hypotheses

Our study addressed critical gaps in our knowledge about young children's multiple-document comprehension. Our first research question examined the role of skills that are common for both single- and multiple-document comprehension. There were two parts: Do word reading fluency, verbal working memory and comprehension monitoring each uniquely predict multiple-document comprehension? Is the relation between these skills and multiple-document comprehension mediated by children's single-text comprehension? We predicted that word reading fluency would explain unique variance in multiple-document comprehension (Bråten et al., 2013). A relation between single-text and multiple-document comprehension was also expected (Salmeron & Garcia, 2011). Predictions on the unique contributions of verbal working memory and comprehension monitoring were less clear because of previous contradictory findings (Carretti et al., 2014; Davis et al., 2017). If these skills play a unique role in multiple-document comprehension, they should predict performance over and above the other skills common to single- and multiple-document comprehension.

The second research question addressed the role of specific skills in multiple-document comprehension: Does the ability to identify and use source information predict

comprehension of multiple documents over and above the common skills considered in the first research question? If fourth graders can reliably use source information to support multiple-document comprehension, as has been found for adults and older children, this measure should predict performance over and above the skills common to single-text and multiple-document comprehension.

Prior topic knowledge was considered as control only. This variable was not expected to play a relevant role in the comprehension of our documents because, contrary to previous studies (e.g., Davis et al., 2017), we used non-academic topics, that is topics that are not addressed as subjects in school.

In the present work, we examined the ability to create a coherent mental representation of partially overlapping and partially contrasting information from multiple documents (i.e., the ability to construct an *intertext model* and an *integrated mental model*) by asking children to organize their mental representation around an argument schema expressed through a short essay. The latter is considered as a comprehensive measure and hybrid task; it requires an understanding of the information presented in documents, and also the identification of an organizational structure to integrate information and the translation of ideas into written texts (e.g., Arfé, Dockrell, & De Bernardi, 2016; Hayes & Flower, 1986; Mateos & Solé, 2009). We chose to use this demanding and complex task because it requires knowledge-transformation to a greater extent than other kind of tasks (i.e., verification tasks) and seems to be a better measure of deep-level understanding of multiple documents (Bråten, Anmarkrud et al., 2014). This conclusion is supported by findings from a preliminary pilot study that was aimed at testing the usability of an intertextual inference verification tasks on fourth graders (Florit & Mason, 2016). The use of hybrid reading-writing tasks as a measure of multiple-document comprehension, and specifically inter-textual integration, with upper primary and lower secondary school students has been documented in the literature (Kingsley

et al., 2015; LaRusso et al., 2016; Mason, Scrimin, Zaccoletti, Tornatora, & Goetz, 2018; for a review see Barzilai, Zohar, & Mor-Hagani, 2018). Differences in both procedures and products obtained while engaging in reading-writing tasks, such syntheses and argumentative texts, have been documented in students at different educational levels (Mateos & Solé, 2009; Spivey & King, 1989). Currently, however, even young students are required to face with these complex hybrid tasks (e.g., MIUR, 2012; see also Barzilai et al., 2018). Specifically, according to the Italian national guidelines for the primary school curriculum (MIUR, 2012; see also López, Torrance, Rijlaarsdam & Fidalgo, 2017), young students are required to understand and produce different text genres, including continuous and non continuous argumentative texts, presented both in print and digitally. Therefore, it is likely that students at this educational level possess basic knowledge on how to write an argumentative short essay, if texts appropriate for complexity are presented.

Method

Participants

Participants were 94 children in the fourth year of primary school (mean age = 9;7 years, $SD = 4$ months, range from 6;8 to 7;8 years/months; 52% females). They spoke Italian as their first language, attended schools located in northern Italy, and came from middle-class socio-economic catchment areas. None of the children had been referred to the National Health Services for treatment (teacher report). According to the Italian national guidelines for the primary school curriculum (MIUR, 2012) and informal teacher reports, it is unlikely that the students received systematic instruction in multiple-document comprehension. It is very likely, however, that the participants used technology and the Internet, and therefore were exposed to multiple-documents to deal with school-related work (Mascheroni & Ólafsson, 2014). The study was approved by the host university's ethics committee. Parental written consent was required for participation.

Materials

Documents. The participants read documents on two topics: three documents discussed whether or not chocolate is good for children by considering the effects of eating chocolate in relation to children's age (e.g., ingredients may lead to excitement and difficulty to fall asleep depending on children's age) and the type of chocolate (e.g., the presence of vitamins in only certain types of chocolate); three documents discussed whether or not playing with video games is useful by considering the physical, psychological and behavioural consequences of playing video games. All documents were taken from real websites and are representative of the kind of materials children can find on the Internet while doing school-related work. When required, however, the language was modified to make the documents suitable for this age group to read. The documents on each topic contained partially overlapping and partially conflicting information. Information about the source of the document was presented before the content of each document. Based on the finding that primary school children may pay attention to source details (Macedo-Rouet et al., 2013), we also included information about the publisher and date (if available) in the ecologically valid documents. Source, in particular the authors' credentials, varied for reliability defined in terms of expertise and stance: the most reliable sources provided more neutral accounts or argued in favour of more evidence to support their claims, whilst the less reliable sources promoted mostly or exclusively the positive effects of eating chocolate and playing video games. An overview of the critical features of the documents is presented in Table 1.

[Insert Table 1 about here]

Readability for each document was calculated using the Gulpease Index (Lucisano, 1992), which is based on word and sentence length. This formula yields a readability score ranging from 0 (very difficult) to 100 (very easy) and different qualitative categories (e.g. document with a not sufficient, sufficient, discrete readability). The readability scores of our

documents indicated sufficient to discrete readability (Piemontese, 1996). Data from nine language art teachers and from a pilot study on 25 fourth graders confirmed the suitability of the documents for this age group. Teachers rated the documents as very appropriate and interesting for young students ($Mdn = 3$, $SD = .44$ for both sets of documents; 0 = not appropriate and interesting - 3 = very appropriate and interesting) and comprehensible ($Mdn = 2$, $SD = .50$ for chocolate; $Mdn = 2$, $SD = .78$ for video games; 0 = not comprehensible - 3 = very comprehensible). Children in the pilot study produced compositions to explain what they understood about chocolate or videogames based on their reading of documents.

Compositions were comparable for length (chocolate: $M = 67.85$ words, $SD = 25.14$; videogames: $M = 64.12$, $SD = 27.38$) and the majority of children (23 out of 25) included relevant information from texts. Overall, these results indicated that documents were appropriate and challenging for 4th graders.

Ten doctoral students and post-doctoral research fellows evaluated the perceived contrast between the different perspectives presented in the documents about chocolate and also in the documents about video games. The two set of documents were presented in a random order. Students were asked to read the documents and to pay attention to the contrast between perspectives presented by the documents in each set. Finally, students were required to rate the contrast between perspectives presented in each set of documents by using two Likert scales ranging from 1 (no contrast) to 6 (very significant contrast). The contrast between information presented in the documents on video games was higher than the one for documents on chocolate ($Mdn = 5$ – significant contrast-, and $Mdn = 3$ – little contrast, respectively; Wilcoxon test $z = 2.87$, $p = .004$). This difference may be accounted for the inclusion of the document arguing for only positive effects in the set of video games.

Measures

Multiple-document comprehension, and source identification and use. Children

read three different documents for two topics, presented as discussing two questions: “Is chocolate good for children or not?” and “Are video games useful or not?”. They were asked to write a short essay to answer each question. Essays were coded as follows. First, the argument about the effects of chocolate and video games provided an index of deep comprehension, reflecting whether participants considered and integrated the two different perspectives presented within each set of materials. Measures of the number of information units that represented valid inferences (both intra and inter-textual inferences) and the number of texts the children referred to in the short-essays were also computed. This was done in order to provide additional evidence that the comprehensive measure of multiple-document comprehension captured children’s ability to consider and integrate information from texts satisfactorily. Finally, the number of explicit references to sources and the number of source-to-content links was coded to measure attention to and use of external sources.

The coding schemes were developed and refined in a pilot study (see above) and informed by previous research on reading comprehension (Barzilai & Zohar, 2012; Mason et al., 2014, 2018; see also Bråten, Anmarkrud, et al., 2014; Bråten, Ferguson, Anmarkrud, & Strømsø, 2014; Diakidoy, Mouskounti, & Ioannides, 2011). The coding scheme for the argument structure was based on the model of epistemic development proposed by Kuhn and colleagues (Kuhn, Cheney, & Weinstock, 2000), which includes three levels of thinking about knowledge: absolutism, multiplism, and evaluativism. At the absolutism level, knowledge is conceived as absolute, certain, and does not need to be justified. At the multiplism level, knowledge is conceived as ambiguous and each individual has his or her own views and own truths. At the evaluativism level, some positions are conceived as reasonably more justified and sustainable than others. The coding scheme was constructed as to attribute higher scores to written compositions in which the student considered two different perspectives (e.g., positive and negative effects of chocolate/video games), rather than focusing on only a single

perspective, and adhered to one perspective and tried to justify it. Finally, in line with the Documents Model Framework (Rouet & Britt, 2011; see also Bråten, Anmarkrud et al., 2014; Mason et al., 2018), higher scores were attributed when perspectives were compared and integrated.

Overall, the scoring system allowed the identification of the two perspectives by considering content information provided in short essays. In other words, we identified claims and reasons on the negative and/or positive effects of playing video games (or eating chocolate) taken from the texts. Specifically, the following criteria were used: no response or essays that were not informative on the controversial question were awarded 0 points; essays that identified a single perspective (claim/s on negative or positive effects) with or without explanation were awarded 1 point; essays that included both perspectives (claim/s on negative and positive consequences) but demonstrated limited explanation, no comparisons, and no acknowledgment that the two were in opposition, were awarded 2 points; essays that identified both perspectives (claim/s on negative and positive effects) with explanations for one or both of them, comparisons between the two and acknowledgment that the two were in opposition were awarded 3 points; essays that identified both perspectives (claim/s on negative and positive effects) with explanations for one or both of them, comparisons between the two, acknowledgment that the two were in opposition and a justification for supporting one perspective were awarded 4 points.

The number of information units that represented valid inferences was computed by attributing 1 point to each information unit in the essays that correctly integrated information within or between documents; the number of documents the children referred to in the short-essays was computed by attributing one point for information unit/s that correctly report/s unique information from a document in a set (maximum score: 3 as there were three documents in each set; Barzilai & Zohar, 2012; Diakidoy et al., 2011).

Finally, measures of source identification and use were computed by attributing one point to each explicit and accurate piece of source information (i.e., information about author, publisher, date or absence of date) and to each source – content link in accurate and explicit citations to a particular document, respectively (Mason et al., 2018; see also Bråten, Ferguson et al., 2014).

All essays were coded by a postgraduate student trained by the first author using essays collected during the pilot study, and 20% of the essays on each topic were also coded by the first author independently. The overall agreement for both sets of materials was good (Cohen's kappa = .84 and .85 for chocolate and video games, respectively). The kappa scores for the number of explicit source statements were 1.00 for each topic, and the scores for the source-content links were 1.00 and .94 for chocolate and videogames, respectively. Each disagreement was examined and discussed until consensus was reached.

Word reading fluency. The word and non-word reading tasks from the *Test Battery for the Evaluation of Developmental Dyslexia and Dysorthography* (Sartori, Job, & Tressoldi, 2007) were used. Children were asked to read 112 words and 48 non-words without errors and as fast as they could. Reading fluency (number of syllables/reading time in seconds) was computed for each task. Cronbach's alpha of both tasks for the present sample was good (.91).

Verbal working memory. A memory updating task with six lists of nouns was used (Carretti et al., 2014). The child had to remember and write down the three nouns that represent the smallest objects in each list, in the right order of presentation. All the words were highly familiar and referred to objects that were easy to compare for size. The number of correctly recalled words was the dependent variable (max score 18). The split-half reliability for the present sample was lower than desired (0.58) and also lower than that reported for younger primary school children (Cornoldi, Drusi, Tencati, Giofrè, & Mirandola, 2012).

Comprehension monitoring. An inconsistency detection task of twenty-four stories

developed for English speaking children (Ammi & Cain, 2014) was adapted for Italian pupils by the authors. Sixteen stories with two inconsistent sentences and eight stories without inconsistencies were used as filler stories. All stories were six sentences long and inconsistent/consistent information appeared either in adjacent or distant sentences. The stories were assembled into booklets to produce thirty-two different orders. Children were told that the stories may contain inconsistent information and, after a practice trial, were asked to read the stories and underline any inconsistent sentences. The detection of inconsistencies and the recognition of consistencies were awarded one point (max score 24). Cronbach's alpha for the present sample was good (0.83).

Reading comprehension. Reading comprehension was evaluated using a standardized measure, the MT task (Cornoldi & Colpo, 2011). Each participant read a fourth-grade information text (215 words) with 14 multiple-choice literal and inferential questions. Children were allowed to return to the text while answering questions. The raw score was the sum of correct answers (max score 14). Cronbach's alpha for the present sample was acceptable (0.61) and in line with values reported for primary school children (Florit, Cain, & Levorato, 2017).

Prior topic knowledge (control). Four multiple-choice questions were devised for assessing previous knowledge of each topic (max score = 4 for each topic). The content of the items refers to concepts related to the issues discussed in the texts (e.g., ingredients of chocolate; compulsive play). These are basic concepts, although not commonsense or every day concepts, necessary but not sufficient to understand the issues discussed in the texts. For instance, a knowledge question on the topic of chocolate stated: "Chocolate is a foodstuff that usually contains: a) cocoa, fats and sugar; b) only cocoa without fats and sugar; c) fats and eggs; d) cocoa, sugar and eggs". All items showed a positive correlation with the total score ($.45 < r < .64$ for documents on both topics; cfr. Davis et al., 2017 for a similar procedure).

Procedure

The measures were administered in three group sessions of 30 minutes each and one individual session (for reading fluency) of 10 minutes in school. Tasks were administered and coded by the first author and by a trained postgraduate student.

Results

Descriptive Statistics

Descriptive statistics are presented in Tables 2 and 3. Measures of multiple-document comprehension, source identification and use, and prior topic knowledge are reported in Table 2. The average number of words showed that children's essays were informative from a quantitative point of view. In addition, essays on the topic of chocolate were longer than those on video games.

[Insert Tables 2 and 3 about here]

Preliminary analyses on the comprehension scores for the topic of video games revealed an outlier. This data point was changed to the next lowest non-outlier number as recommended by Tabachnick and Fidell (2001) to improve the distribution of the data (i.e., to obtain values of skewness and kurtosis below 1). On average, children reported information that was just sufficient to identify one perspective for documents on chocolate while were able to clearly identify one perspective in documents on video games.

In order to better explore children's performance on the two set of documents, we looked in more detail at the percentage of essays that were awarded a score of 0 (essays that reported no information/no relevant information on the controversial question), a score of 1 (essays that identified one perspective) and a score of 2 (essays that identified two perspectives) in documents on the topic of chocolate and video games. Note that the percentage of essays that were awarded a score of 3 (essays that identified two perspectives and acknowledged that the two were in opposition) were not compared because were present

in the set of documents on video games only. Essays that reported no information or irrelevant information were 32% and 12 % in the set of chocolate and video games, respectively; essays that identified one perspective were 50% and 54 % in the set of chocolate and video games, respectively; essays that identified two perspectives were 18% and 31% in the set of chocolate and video games, respectively. The difference between the percentage of essays that reported no information or irrelevant information in the two set of documents was significant ($X^2(2)=13.56, p=.001$; *standardized residual* = 2.1; the comparisons for the percentage of essays that identified one perspective or two perspectives were not significant with *standardized residual* of -0.3, and -1.5, respectively). This result shows that participants reported information that was not informative on the controversial question more frequently in documents about chocolate than in documents about video games.

Multiple-document comprehension (i.e., the argument structure score) was correlated with the number of valid intra- and inter-textual inference units in short essays on chocolate ($r = .58$) and video games ($r = .54$), and with the number of documents that were referred to in short-essays ($r = .50$ and $.56$ for chocolate and video games). Taken together, these data suggest that our measures of multiple-document comprehension tap into children's ability to take into account information from the different texts and their integrative skills, including inter-textual inferences, satisfactorily.

Few children identified external sources ($n = 1$ and $n = 9$ for documents about chocolate and video games, respectively) and, in line with previous research, source information was about the authors of the documents (Macedo-Rouet et al., 2013). Almost all children ($n = 8$) who referred to source information also included information about that particular document in their essay (i.e., source-content links). Given the low variability of source identification and use measures for both sets of documents, no comparisons were run and in the following analyses only the more complex measure of source use (i.e., explicit

source-content links) was considered in an exploratory way. Children had reasonable prior knowledge of each topic and ceiling effects were not detected. Knowledge of chocolate was higher than knowledge of video games.

Finally, post-hoc power analyses were conducted with the program *G*Power* (Faul, Erdfelder, Buchner, & Lang, 2009). The analyses revealed that the sample size in the present study did not play a role in limiting the significance of the crucial paired *t-test* conducted.

The descriptive statistics presented in Table 4 show that performance on the reading fluency and the working memory tasks was appropriate for year of schooling (Carretti et al., 2014; Sartori et al., 2007). A composite score for word reading fluency (averaged Z scores) was used in the following analyses. Eight-five percent of the sample had average or good levels of reading comprehension; all others performed below average levels.

Preliminary Analyses

Gender had a significant effect on the comprehension monitoring task ($t(92) = -2.94, p = .004$; for all the other comparisons $t < 1.54, ps > .13$) and was controlled for in the subsequent analyses. Neither chronological age ($-.13 < r < .10, ps > .22$) nor prior topic knowledge ($-.11 < r < .20, ps > .06$) were significantly correlated to any of the other variables.

Correlation Analyses

Zero-order and partial (with gender as control) correlations between measures of multiple-document comprehension, and measures of fundamental and higher-level skills are presented in Table 4 and 5. With very few exceptions, the pattern of zero-order and partial correlations was comparable. Comprehension scores for the topics of chocolate and video games were moderately correlated with each other. A significant pattern of moderate correlations emerged between comprehension of the multiple documents on video games and all other variables. Comprehension of the documents about chocolate was correlated significantly (and weakly) with reading comprehension and, when gender was not controlled,

with comprehension monitoring. Given the different pattern of correlations, subsequent analyses were run by considering the comprehension score for documents on video games only and also a composite comprehension score (sum of scores) for documents on both topics.

[Insert Table 4 and Table 5 about here]

Regression Analyses and Bootstrapping Tests

Fixed-order hierarchical multiple regression analyses were carried out to identify the unique predictors of multiple-document comprehension and the nature of the relations among common and specific skills. Results are presented in Table 6. The criterion variable of the first and second regression analysis was comprehension of multiple documents on the topic of video games and comprehension of multiple documents on both topics, respectively.

In both regressions, gender was included as a control (Model 1), word reading fluency, verbal working memory, and comprehension monitoring (i.e., common skills of reading and multiple-document comprehension; Model 2) were included as predictors and reading comprehension (Model 3) was included as a mediator. The number of the source-content links (i.e., specific skill of multiple-document comprehension) was entered in the last step as predictor (Model 4).

[Insert Table 6 about here]

The pattern of results for documents on video games showed that word reading fluency and comprehension monitoring, but not verbal working memory, were unique predictors of multiple-document comprehension (Model 2). Reading comprehension accounted for additional significant variance (Model 3) and, after its inclusion, word reading fluency was still a significant but less powerful predictor of multiple-document comprehension whilst comprehension monitoring was not. These results suggest that reading comprehension mediates the relation between both skills and multiple-document comprehension. Indirect relations between common skills and comprehension of multiple

documents on video games were tested independently (see below). The unique contribution of source use was not significant (Model 4).

The pattern of results for the composite score for documents on both topics showed a similar, albeit lower in magnitude, pattern of relations and variance explained. The most significant difference emerged in Model 3 where, after the inclusion of reading comprehension, both word reading fluency and comprehension monitoring were no longer significant predictors. Like in the first regression, however, this result suggested the existence of indirect relations that were tested independently below.

Bootstrap tests were carried out to test for indirect relations between word reading fluency and comprehension monitoring, and comprehension of multiple documents on video games and on both topics. In these tests, reading comprehension was included as a mediator and the role of gender, verbal working memory and source use was controlled. Depending on the indirect relation tested, also the role of comprehension monitoring or, alternatively, word reading fluency was controlled. The procedure recommended by Hayes and Rockwood (2017) based on 10,000 bootstrap samples was followed. The results supported the existence of an indirect relation between both predictors and multiple-document comprehension on video games ($\beta = .07$, BC 95% CI [.01, .18] and $\beta = .16$, BC 95% CI [.06, .29] for word reading fluency and comprehension monitoring, respectively) and on both topics ($\beta = .06$, BC 95% CI [.01, .18] and $\beta = .13$, BC 95% CI [.02, .27] for word reading fluency and comprehension monitoring, respectively). These results confirmed that both fundamental and higher-level skills predict multiple-document comprehension through a global measure of reading comprehension. The indirect relations identified by means of regressions, and the overall pattern of results, were also confirmed by means of exploratory path analyses (see Figure 1 and 2 in Appendix A).

Finally, post-hoc power analyses were conducted with the program *G*Power* (Faul et

al., 2009) to test whether the sample size in the present study plays a role in limiting the significance of the regression analyses. The power for both regression analyses was appropriate (observed power = .99; alpha = .05; Effect size = .47 for comprehension of multiple documents on video games; observed power = .99; alpha = .05; Effect size = .35 for comprehension of multiple documents on both topics).

Discussion

This study makes a unique contribution to our understanding of primary school children's multiple-document comprehension. Word reading fluency and comprehension monitoring uniquely predicted multiple-document comprehension through direct and indirect (i.e., mediated by reading comprehension) relations. Verbal working memory and source use were positively related to multiple-document comprehension but were not unique predictors. We discuss these findings and possible reasons for the partially different results obtained for the two sets of documents. Finally, even if the present work was not focused on instruction, we put forward some practical implications suggested by our findings.

The Role of Common Skills of Reading and Multiple-Document Comprehension

Individual differences in both fundamental and higher-level skills were uniquely related to comprehension of multiple documents. This is in line with the Documents Model Framework, which assumes the involvement of different '*internal permanent resources*' (Rouet & Britt, 2011, p. 28). Specifically, our results support the involvement of both word reading skills and comprehension monitoring that were included as permanent resources in the Documents Model Framework, but have not been analysed together. Thus, our findings extend earlier research by providing new evidence that a range of reading-related skills support multiple-document comprehension (Davis et al., 2017). Most critically, we have shown that there is a relation between single-text and comprehension of multiple documents on two different topics in children younger than those considered by Salmeron and Garcia

(2011), a relation that exists even when the role of other relevant skills are considered. The relation between single-text and multiple-document comprehension was confirmed in both sets of analyses. The consistency of this result is in line with the theoretical assumption that single-text and multiple-document involve many of the same skills that are required to the reader to process linguistic information from the text at the word-, sentence-, and discourse-level, and to integrate this information with prior knowledge. This relation also suggests that the comprehension of single texts, rather than just some relevant parts (e.g., parts presenting unique or conflicting information; Bråten, Anmarkrud et al., 2014; Rouet & Britt, 2011), is required to understand multiple documents, at least in young students. However, additional research on the processing of multiple documents is required to further clarify this relation.

The direct and indirect relation between word reading fluency and multiple-document comprehension is in line with models of single-text and multiple-document comprehension, demonstrating that word reading fluency influences the construction of meaning of both (e.g., Language and Reading Research Consortium, 2015; Rouet & Britt, 2011). This is the first study to examine this in primary school children, extending the research base obtained with older students (Bråten et al., 2013). Although our data support the involvement of other skills, we showed that word reading fluency influences multiple-document comprehension, even in young readers of a transparent orthography who have mastered word reading skills (Florit & Cain, 2011). This is an important finding for educators suggesting that the ability to read fluently exerts a unique influence on comprehension across multiple texts. Efficient word reading may be particularly important for multiple-document comprehension, because of the need to assimilate and integrate information across several sources within time constraints. The results of the present study demonstrate that efficient word reading skills are crucial especially when documents have to be assimilated but include information that is clearly in contrast.

Children's ability to monitor their comprehension uniquely predicted individual differences in multiple-document comprehension, via reading comprehension. This indirect relation can be explained by considering that comprehension monitoring was assessed with an inconsistency detection task that assesses the ability to integrate propositions and ideas in single texts (Language and Reading Research Consortium & Yeomans-Maldonado, 2017). Thus, our measure of comprehension monitoring can be seen as a higher-level integrative skill that is likely to act as a predictor of the ability to integrate ideas and to identify contradictions across texts. Our findings differ from previous results (Davis et al., 2017) that did not show a unique role for knowledge of single-text strategies, which tap comprehension monitoring, in the prediction of multiple-document comprehension in 5-7 graders. A possible reason for this difference, acknowledged by Davis and colleagues (2017), is that their measure assessed *familiarity* with strategies rather than *strategy use*. Our findings suggest that our measure is particularly appropriate for the assessment of deliberate and strategic skills that play a relevant role in the meaning-making process. Future studies should examine this further by including measures that tap the ability to identify inconsistencies across texts (for a study on older students see Maier & Richter, 2014). In this regard, the work of Davis and colleagues (Davis et al., 2017) provides qualitative evidence that, when prompted to describe their processes using think-aloud protocols, children used some inter-textual strategies mainly to identify information that was repeated in different texts (i.e., corroboration).

Differences between our findings and the ones of Davis and colleagues (Davis et al., 2017) on the role of higher-level skills should be clarified also considering measures used to assess multiple-document comprehension. The study of Davis and colleagues (Davis et al., 2017) used an inference verification task whilst the present study used short-essays. These two tasks are likely to tap fundamental and higher-order skills to a different extent and, therefore, may lead to different patterns of results.

Verbal working memory was associated with comprehension of multiple documents of video games, but it was not a unique predictor of multiple-document comprehension once the role of the other skills was taken into account. This does not mean that working memory is not important for multiple-document comprehension; rather, it may reflect the importance of working memory for component skills such as comprehension monitoring (Language and Reading Research Consortium & Logan, 2017). The present findings are in line with previous research on the role of verbal working memory in reading comprehension in primary school children (e.g., Language and Reading Research Consortium & Logan, 2017). Nevertheless, the verbal working memory task we used required additional writing skills compared to other working memory tasks used in the literature (see Carretti, Borella, Cornoldi, & De Beni, 2009 for a review). For that reason, our results should be confirmed in future studies that also include other measures of verbal working memory.

The Role of Specific Skills of Multiple-Document Comprehension

Our study shows that few children were able to spontaneously identify and use source information, which is in line with previous literature (e.g., Paul, Macedo-Rouet, Rouet, & Stadtler, 2017). Nevertheless, almost all children who correctly identified sources were also able to establish correct source-to-content links in short essays. This is an important finding providing the first evidence of a relation between the ability to establish source-content links and multiple-document comprehension in terms of argumentation in primary school children. It should be noted that this result is valid only for one set of the documents used in the present study (see also results from path analyses in Appendix A) and that future studies should test the reproducibility of this correlational finding by using more robust methodologies. Nevertheless, our findings are valuable since they extend previous literature by analyzing the function of source use in the construction of a coherent representation of the content of multiple documents (cfr. Paul, Stadtler, & Bromme, in press).

Of note, the relation between source identification and use in short essays was found for documents that presented the most obvious contradictions – those about video games. This result, along with our descriptive data about identification and source use in the two sets of documents, seems to be in line with the *Discrepancy Induced Source Comprehension* assumption (Braasch, Rouet, Vibert, & Britt, 2012). According to this assumption, readers pay attention to source information when documents include discrepant rather than coherent information. This explanation is also in line with recent data concerning source identification in more informal forum messages (Salmerón, Macedo-Rouet, & Rouet, 2016). Our findings should be treated with caution because of the restricted variability of our measure of source use, but they provide a useful foundation for future research and educational practice. Based on evidence that students are able in principle to identify and evaluate source information and that prompts are effective for source use (Kammerer, Meier, & Stahl, 2016; Paul et al., in press), future studies should assess source identification and use by also considering more explicit and independent measures (cfr. Mason et al., 2014; Paul, Stadtler, et al., 2017). Such studies will highlight how best to construct materials to teach this critical skill.

Different Results for Documents on Chocolate and Video Games

Findings from the regressions (see also the path analyses) on documents on the topic of video games only or on both topics were coherent in suggesting the existence of relations between word reading fluency, comprehension monitoring and reading comprehension, and multiple-document comprehension. Nevertheless, these contributions were reduced when comprehension of multiple documents on both topics was considered. In order to explain this finding, we considered similarities and differences between the two sets of documents. Our analysis indicated that the documents were comparable in terms of readability, interest and comprehensibility. Prior topic knowledge was related neither to multiple-document comprehension nor to the linguistic and cognitive components considered in the present

study. These results suggest that differences in prior knowledge of the two topics did not significantly affect the relations between key skills and multiple-document comprehension in our analyses. Nevertheless, the engagement and the intra- and inter-textual processing of multiple documents results from the interaction of prior topic knowledge and other skills such as motivational factors (e.g., students' interest for the topic; List & Alexander, 2018; Paul et al., 2017). More fine grain analyses could therefore clarify whether knowledge and interest for the two topics account for differential engagement with the two sets of texts, and, in turn, for the different role of some key skills, such as reading fluency and source use, showed by our models.

Some differences between the two sets of documents, however, were evident: the contrast between positions was higher for documents on video games than for documents on chocolate (see information presented on page 12 of the Method section). This difference can be related to differences in multiple-document comprehension. Children wrote longer essays on chocolate than on video games but, on average, only the essays about video games identified clearly one of the two perspectives described in the documents. Inspection of the percentage of essays that were awarded 0, 1 and 2 points in the two sets of documents suggests that the difference might have arisen because essays for chocolate comprised to a higher extent limited and descriptive information (e.g., children like milk chocolate, but not dark chocolate) that was not informative on the controversial question. This analysis suggests that fourth graders had difficulties identifying the different perspectives in the documents about chocolate, which in turn, may have resulted in the low and restricted performance in multiple-document comprehension and, consequently, a different pattern of relations and reduced amount of variance explained.

In sum, our materials were ecologically valid and comparable but there was also evidence of a possible effect related to a difference in the salience of the perspectives. Future

research should explore this possibility with more controlled materials and experimental settings in order to establish the extent to which contradictions are obvious affects source use and integration of perspectives in multiple-document comprehension (cfr. Braasch, McCabe, & Daniel, 2016). This will also provide additional information on how the two sets of materials reflect the construct of multiple-document comprehension in fourth graders.

Limitations

In addition to the limitations already discussed, we note the following and how they can be addressed in future research. Concerning the measures used, the internal consistency of the verbal working memory and prior topic knowledge measures was lower than desirable and future studies should include more reliable measures. The inconsistency detection tasks to assess comprehension monitoring primed children to detect inconsistencies. Future studies should also focus on children's ability to detect inconsistencies spontaneously and its relation with multiple-document comprehension. Since the detection of internal inconsistencies is particularly difficult for young children (Baker, 1984; Cain, 1999; Markman, 1979), a different pattern of results may be obtained. Specifically, we can hypothesise that children in our study would notice fewer inconsistencies if not prompted to do this. The present study findings are informative since (a) the inconsistency detection paradigm is a widely used measure of comprehension monitoring in studies on text comprehension (e.g., Kim, 2015; Language and Reading Research Consortium & Yeomans-Maldonado, 2017; Oakhill & Cain, 2012; Oakhill, Hartt, & Samols, 2005); (b) filler items (i.e., coherent passages without inconsistencies) were included in our task and performance on these items were considered to compute the total score (thus taking the ability to discriminate between texts that differ in coherence). Finally, future research should include direct measures to assess children's topic interest, in addition to information obtained through indirect measures (i.e., teachers' ratings).

Concerning the constructs, subsequent work should include a wider range of fundamental and higher-level skills in order to provide a more complete picture of the role of individual skills. This might also increase the amount of variance explained in multiple-document comprehension. The additional skills considered should be cognitive, linguistic and motivational in nature (e.g., Bråten et al., 2013; Davis et al., 2017; List & Alexander, 2018; see also Richter & Maier, 2017). In particular, since measures of vocabulary and morphosyntactic knowledge have been shown to be relevant predictors of multiple-document comprehension in 5th-7th graders (Davis et al., 2017), these measures should be considered in future studies. This is particularly important when analysing the existence of indirect or mediated relations between language knowledge, single-text comprehension and multiple-document comprehension.

Conclusion

Despite these limitations, our results provide new relevant information on multiple document-comprehension and spontaneous source use in young readers. Theoretically, according to our results both fundamental and higher-level skills are involved in multiple-document comprehension, particularly when documents include obvious contradictions. The pattern of contributions resembles the one found for reading comprehension in very beginner readers (Language and Reading Research Consortium & Logan, 2017) and, thus, seems to characterize the first phase of acquisition of complex abilities that involve active meaning construction. Practically, our results indicate word reading fluency and comprehension monitoring as key aspects to work on to support a critical literacy skill of the 21st Century, from the first phases of acquisition. Finally, our findings that readers pay more attention to sources when the contrast between information is high could inform both education practices and interventions on source use.

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Appendix A

[Insert Figure 1 and 2 about here]

Path analysis for multiple-document comprehension on the topic of video games

FIT for Model 1: $\chi^2(17) = 6.96, p = .98, CFI = 1, RMSEA = 0, SRMR = .04$. The indirect relations between word reading fluency and comprehension monitoring, and multiple-document comprehension were significant ($\beta = .08$ and $\beta = .13, p < .05$, respectively).

Path analysis for multiple-document comprehension on the topic of chocolate and video games

FIT of the model: $\chi^2(17) = 7.12, p = .98, CFI = 1, RMSEA = 0, SRMR = .04$. The indirect relation between word reading fluency and multiple-document comprehension was not significant ($\beta = .06, p = .06$). The indirect relation between comprehension monitoring and multiple-document comprehension was significant ($\beta = .13, p < .05$, respectively).

Table 1

Features of Multiple Documents.

Topic	Content of the documents	N° of Words	Readability ^a	Source information ^b
Chocolate				
	Document 1 describes consequences of chocolate in more neutral terms	184	61	Paediatrician; www.mammaepapa.it ; no date available
	Document 2 emphasises negative consequences of chocolate	184	61	Mother; www.mamme24.it ; date: 8-10-2013
	Document 3 emphasises positive effects of chocolate	182	59	Journalist; www.lastampa.it date: 25-10-2013
Video games				
	Document 1 acknowledges the negative consequences of video games, but also that these are not certain	233	55	Psychologist; www.citta-invisibile.it no date
	Document 2 mostly describes the negative effects of video games	232	55	Parent; www.guidagenitori.it no date

Document 3 describes only positive effects of video games	234	55	video game creator; www.repubblica.it; no date
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Note. ^a Gulpease index (Lucisano, 1992); ^b author, publisher and dat

Table 2

Descriptive Statistics and Power Analyses for Measures of Multiple-document Comprehension, Source Identification and Use, and Prior Topic Knowledge.

	Chocolate			Video games			Paired <i>t</i> test	Observed power ^a
	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range		
Words in essays	68.97	31.20	20-156	55.56	26.10	7-160	$t(93)=4.91^*$	0.99 ($ES^b = 0.51$)
Multiple-document comprehension	.86	.70	0-2	1.26	.70	0-3	$t(93)=-4.90^*$	0.99 ($ES^b = 0.51$)
N° of inferences	1.80	1.54	0-6	2.05	1.49	0-8	$t(93)=-1.33$ <i>ns.</i>	0.25 ($ES^b = 0.13$)
N° of documents	2.33	.65	1-3	2.19	.75	1-3	$t(93)=1.58$ <i>ns.</i>	0.35 ($ES^b = 0.13$)
N° of sources	.02	.21	0-2	.15	.53	0-3	–	
N° of source-content links	.02	.21	0-2	.14	.50	0-3	–	
Prior topic knowledge	2.59	.99	0-4	1.97	.90	0-4	$t(93)=4.74^*$	0.99 ($ES^b = 0.49$)

Note. ^a Post hoc power analyses ($\alpha = .05$) were conducted; ^b ES = Effect Size

* $p < .007$

Table 3

Descriptive Statistics for Measures of Non-Word and Word Reading Fluency, Verbal Working Memory, Comprehension Monitoring, and Reading Comprehension.

	<i>M</i>	<i>SD</i>	Range
Non-word reading fluency	1.94	.53	0.68-3.55
Word reading fluency	3.22	.76	1.18-5.05
Verbal working memory	10.23	2.36	6-15
Comprehension monitoring	18.24	3.87	6-24
Reading comprehension	10.27	2.31	4-14

Table 4

Zero-Order Correlations Between Variables.

	2	3	4	5	6	7
1. Multiple-text comprehension (chocolate)	.38**	.14	.18	.22*	.23*	–
2. Multiple-text comprehension (video games)	–	.36**	.22*	.35**	.47**	.24*
3. Word reading fluency		–	.15	.16	.35**	.06
4. Verbal working memory			–	.15	.22*	.09
5. Comprehension monitoring				–	.52**	.12
6. Reading comprehension					–	.11
7. Number of source-content links (video games)						–

* $p < .05$; ** $p < .01$

Table 5

Partial Correlations Between Variables (Gender as Control).

	2	3	4	5	6	7
1. Multiple-text comprehension (chocolate)	.38**	.15	.20	.20	.24*	–
2. Multiple-text comprehension (video games)	–	.36**	.22*	.37**	.47**	.24*
3. Word reading fluency		–	.14	.19	.35**	.07
4. Verbal working memory			–	.21*	.21*	.11
5. Comprehension monitoring				–	.58**	.09
6. Reading comprehension					–	.11
7. Number of source-content links (video games)						–

* $p < .05$; ** $p < .01$

Table 6

Hierarchical Multiple Regression Analyses Predicting Multiple-document Comprehension.

	Topic: Video games				Topic: Chocolate and Video games			
	R ²	Δ R ²	B (SE)	β	R ²	Δ R ²	B (SE)	β
Model 1	.00	.00			.00	.00		
Intercept			1.27 (0.11)				2.02 (0.17)	
Gender			-.02 (.15)	-.02			.12 (.23)	.05
Model 2	.24**	.24**			.20**	.20**		
Intercept			-.05 (.40)				-.17 (.65)	
Gender			-.09 (.14)	-.07			.04 (.23)	.02
Word reading fluency			.22 (.07)	.29**			.28 (.12)	.24*
Verbal working memory			.04 (.03)	.12			.18 (.05)	.08
Comprehension monitoring			.05 (.02)	.30**			.07 (.03)	.27**
Model 3	.29**	.05*			.24**	.04*		
Intercept			-.44 (.42)				-.70 (.69)	
Gender			.00 (.14)	.00			.17 (.23)	.08

Word reading fluency			.16 (.07)	.22*		.21 (.12)	.18
Verbal working memory			.03 (.03)	.11		.08 (.05)	.16
Comprehension monitoring			.03 (.02)	.14		.04 (.03)	.13
Reading comprehension			.09 (.04)	.30*		.12 (.06)	.25*
Model 4	.32**	.03°			.26**	.02	
Intercept			-.36 (.42)			-.62 (.68)	
Gender			-.02 (.14)	-.02		.13 (.23)	.06
Word reading fluency			.16 (.07)	.21*		.22 (.12)	.18
Verbal working memory			.03 (.03)	.09		.08 (.05)	.16
Comprehension monitoring			.02 (.02)	.13		.04 (.03)	.12
Reading comprehension			.09 (.04)	.29*		.12 (.06)	.24*
Source-content links			.24 (.13)	.17°		.31 (.19)	.15

Note. Multicollinearity test for predictors of the two regressions: $1.03 < \text{Variance Inflation Factor} < 1.68$

** $p < .01$; * $p < .05$; ° $p = .06$

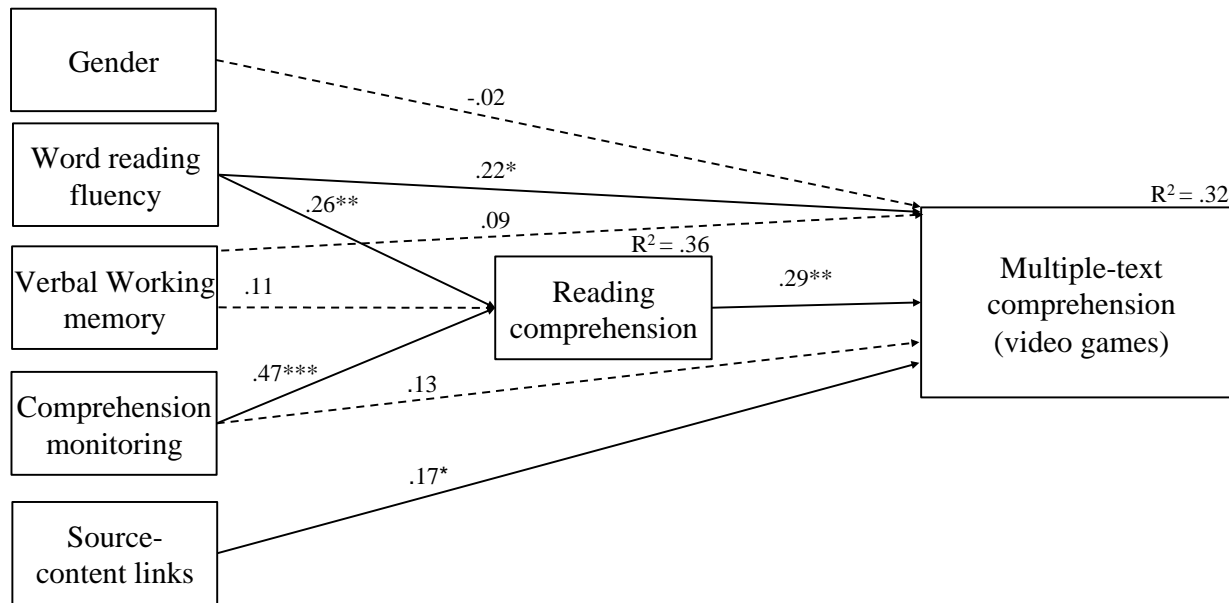


Figure 1. Standardized Solution for Path Analysis With Multiple-document Comprehension on Video Games as the Dependent Variable.

Note. Straight continue lines = significant paths; straight broken lines = not significant paths; associations between independent variables were not reported.

* $p < .05$, ** $p < .01$

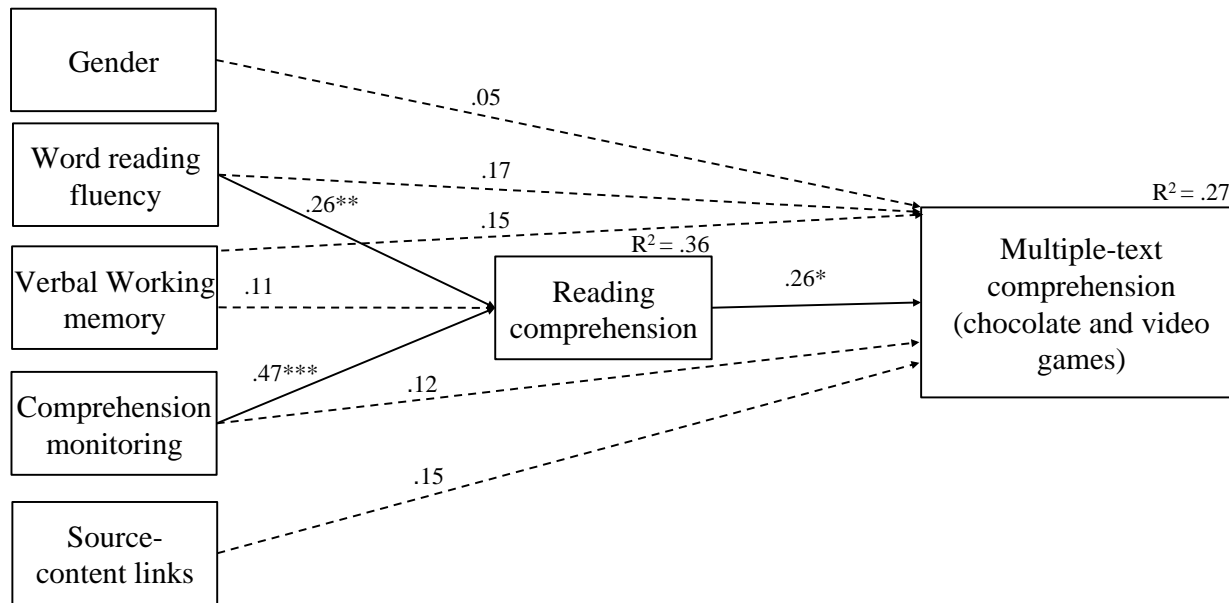


Figure 2. Standardized Solution for Path Analysis With Multiple-document Comprehension on Chocolate and Video Games as the Dependent Variable.

Note. Straight continue lines = significant paths; straight broken lines = not significant paths; associations between independent variables were not reported.

* $p < .05$, ** $p < .01$

