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Writing proficiency level and writing development of low-achieving adolescents: the roles of linguistic knowledge, fluency, and metacognitive knowledge

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Abstract In a longitudinal design, 51 low-achieving adolescents' development in writing proficiency from Grades 7 to 9 was measured. There were 25 native-Dutch and 26 language-minority students. In addition, the roles of (1) linguistic knowledge, (2) metacognitive knowledge, and (3) linguistic fluency in predicting both the level and development of writing proficiency were assessed. Low-achieving students improved in writing proficiency, the language-minority students more so than the native-Dutch students. Regarding the level of writing proficiency, individual differences between low achieving adolescents could be accounted for by receptive vocabulary, grammatical knowledge, and speed of sentence verification, suggesting that these are important components in low-achieving adolescents' writing. Regarding development in writing proficiency, grammatical knowledge predicted variation between low-achieving students. Explanations and educational implications of these findings are discussed.

Keywords Writing development · Literacy · Low-achieving adolescents · Vocabulary · Grammar · Fluency · Metacognitive knowledge · Adolescents

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Introduction

In present society, writing is of great importance. At school, when acquiring knowledge and sharing it with others, adolescents learn to apply their language skills to write comprehensible texts. Unfortunately, despite this educational effort, many adolescents face difficulties in their writing (Alliance for Excellent Education, 2006; Baumert et al., 2001; Dutch Education Inspectorate, 2008; Greenwald, Persky, Campbell, & Mazzeo, 1999; Hofman, Spijkerboer, & Timmermans, 2009; Kuhlemeier, Van Til, & Van den Bergh, 2014; OECD, 2000; Persky, Daane, & Jin, 2003; Salahu-Din, Persky, & Miller, 2008).

Although it is acknowledged that many adolescents lack sufficient writing skills, low-achieving students' writing proficiency is not investigated thoroughly (Juzwik et al., 2006; Klassen, 2002). Several studies indicate aspects in which high-achieving adolescent writers differ from low achievers (e.g., Graham, 2006; Graham, Schwartz, & McArthur, 1993; Saddler & Graham, 2007), but studies focusing on important differences *between* low-achieving adolescent writers are scarce. These differences, however, are extremely relevant for educational interventions directed at this group. If differences in writing proficiency between low-achieving students can be explained, specific interventions can be adapted to the individual students' needs. Specifically, it is of interest to investigate the components involved in these students' writing proficiency. These components, for example vocabulary knowledge, metacognitive knowledge or linguistic fluency, can be of more or less importance in facilitating low-achievers' writing. Therefore, this study is directed at the role of linguistic and metacognitive components in explaining low-achieving adolescents' writing proficiency. In contrast to previous studies, we focus on individual differences within the group of low-achieving adolescents, instead of differences between high and low-achieving writers.

The role of linguistic and metacognitive components in the process of writing

The process of writing coherent text involves the use of different types of knowledge, the fluency in using this knowledge, switching between processes involved in using these types of knowledge, and monitoring these processes (Bereiter & Scardamalia, 1987; Berninger & Swanson, 1994; Chenoweth & Hayes, 2001; Flower & Hayes, 1981; Hayes, 1996, 2006, 2012; Hayes & Flower, 1980; McCutchen, 2006). First of all, writers need to plan. They need to put a writing task into a plan, involving generating ideas, organizing these ideas, and setting goals. Writers have to be able to keep this plan in mind throughout the entire writing process. Next, writers need to generate text, which implies the formulation of a linguistic message (i.e., putting ideas into words, sentences, and larger discourse units) as well as the transcription of this linguistic message into writing. Knowledge of vocabulary and grammar are important for formulation processes, while knowledge of spelling is important for transcription. In addition, writers need to review, i.e., interrupt their writing to reread pieces of text written so far, evaluate the

text (with respect to content and linguistic accuracy), and, if necessary, to revise. These three cycles, planning, formulating and reviewing, are not linearly ordered in time: Writers move back and forth between them (Hayes & Flower, 1980; McCutchen, 2000; Torrance & Galbraith, 2006).

To carry out the different processes effectively, writers need to call on cognitive resources stored in long-term memory (Chenoweth & Hayes, 2001; Hayes, 1996; Schoonen et al., 2003; Schoonen, Van Gelderen, Stoel, Hulstijn, & De Glopper, 2011; Torrance & Galbraith, 2006). These resources include linguistic and metacognitive knowledge. The most important parts of linguistic knowledge are vocabulary knowledge, grammar knowledge (both syntax and morphology) and orthographic knowledge (spelling) (Grabe & Kaplan, 1996). Metacognitive knowledge includes knowledge of useful strategies for writing and for monitoring the writing process (Schoonen et al., 2003).

In addition, writers have to be able to apply resources in an efficient way, because they have to process them within the restrictions of limited working memory capacity (Hayes, 2006; Kellogg, 1999; McCutchen, 2011, 2012; Piolat, Olive, & Kellogg, 2005). Fluent access to vocabulary, grammar or orthographic knowledge in long-term memory is assumed to lower the cognitive processing load. This may result in the freeing of working memory space for applying metacognitive knowledge to coordinate different writing processes (Deane et al., 2008; McCutchen, 1996; Schoonen et al., 2003, 2011; Torrance & Galbraith, 2006). Therefore, not only linguistic and metacognitive knowledge but also fluency in accessing linguistic knowledge can be considered important for writing proficiency (Schoonen et al., 2003).

Individual differences in adolescents' level of writing proficiency

Among adolescents, substantial individual differences exist with respect to the level of writing proficiency. More proficient writers need less cognitive effort for the transcription components handwriting and spelling (Christensen, 2004; Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Quinlan, 2004; Smith, 2011) and are able to use more varied lexicon and more complex grammar in their texts (Crossley, Weston, McLain, Sullivan, & McNamara, 2011; Graham, 2006; Houck & Billingsley, 1989; Myhill, 2008). More proficient writers also have more metacognitive knowledge about useful strategies for writing, about writing conventions, and about characteristics of text genres (Berninger & Swanson, 1994; Schoonen et al., 2003). The superior metacognitive knowledge of more proficient writers also involves awareness of important rhetorical aspects of writing in contrast with their less proficient peers who believe that handwriting and spelling are the main issues (Graham et al., 1993; Saddler & Graham, 2007). Furthermore, more proficient adolescent writers devote more attention to such important processes as planning and revising of their texts than less proficient writers (Graham, 2006; Graham et al., 1993; Saddler & Graham, 2007; Van Gelderen, 1997). Schoonen et al. (2003) showed that adolescents' writing proficiency (Grade 8) can be predicted to a considerable degree by linguistic knowledge (vocabulary, spelling and grammar), metacognitve knowledge, and linguistic fluency (speed of access to syntactic

knowledge). All of these components of writing proficiency correlated substantially with writing performance measures. Correlations ranged from .47 to .67. Thus, individual differences in adolescents' writing proficiency are strongly related to differences in linguistic and metacognitive knowledge, and fluency.

The studies above provide evidence for the importance of differences in components of writing proficiency for explaining differences between more and less proficient writers. No such evidence exists for the explanatory value of these components within the group of low-achieving adolescents. However, this information is extremely relevant for writing education directed at this group of adolescents. If, for example, metacognitive knowledge about writing appears to explain not only differences between high and low-achieving students, but can also explain differences within the group of low achievers, this may lead to the conclusion that more attention should be given to the role of this type of knowledge in teaching writing to this population. Although knowledge of such relations between components and writing proficiency does not directly lead to successful educational interventions, it is certainly important for educational experiments directed at improving adolescents' writing proficiency (Schoonen et al., 2003; Snellings, Van Gelderen, & De Glopper, 2004).

Adolescents' writing development

Writing development research focusing on the roles of linguistic and metacognitive development can be divided in two parts: (1) cross-sectional studies comparing younger writers with older writers and (2) longitudinal studies in which cohorts of the same students are followed.

Cross-sectional studies

Several cross-sectional studies have shown that older students outperform younger students on spelling (Devonshire & Fluck, 2010; Keuning & Verhoeven, 2008), handwriting (Graham, Berninger, Weintraub, & Schafer, 1998), voretaincabulary (Verhoeven & Vermeer, 1992), and sentence construction (Myhill, 2008). These skills are necessary in the writing process, and presumably, a better mastery of these skills is important for improvement in writing. Furthermore, it may facilitate attention to rhetorical aspects of ideas in all types of writing processes (planning, formulation and revision) (Fayol, 1999; McCutchen 1996, 2000). In addition, older students were found to be more knowledgeable about the role of the audience (Holliway & McCutchen, 2004) and about the complex nature of composing (Graham et al., 1993) than younger students.

In several cross-sectional studies focusing on writing, written texts of several age groups are compared. Fayol (1991) studied stories by 6–10 years olds and found that older children made more use of several grammatical tools, such as textual organization clues, including the appropriate use of verbal tense, connectives and punctuation. Similar findings were obtained by Verhoeven and Van Hell (2008) in a comparison between 10-year-olds and adult writers. Adults produced longer texts with greater syntactic complexity, and tended to use a broader range of causal

markers in their texts. Between younger and older adolescents, differences in text characteristics were found as well. Older adolescents were found to produce longer sentences and make use of a greater variety of sentence structures, subordinators and connectives than younger adolescents (Crossley et al., 2011, Grade 11 vs. 9; Myhill, 2008, Grade 10 vs. 8). In addition, older students' texts were found to be lexically more diverse and more dense (Berman, Nayditz, & Ravid, 2011, 13–14 vs. 9–10 years olds; Crossley et al., 2011; Johansson, 2009, 16–17, 12–13 and 9–10 years olds). Although the use of more complex language does not necessarily imply more linguistic knowledge (Applebee, 2000), these findings suggest that gains in lexical, grammatical and textual knowledge are important aspects of adolescent students' writing development.

Other cross-sectional studies focused at the relation between writing and its components in different age groups. Limpo and Alves (2013) compared two groups of Portugese students at two developmental points: Grades 4–6 and Grades 7–9, and investigated the role of transcription and self-regulation in writing quality. In Grades 4–6, students' transcription components (spelling and handwriting) were the strongest contributers to text quality, whereas in Grades 7–9, transcription contributed indirectly (via planning and self-efficacy) to students' writing proficiency. These results are in line with outcomes of cross-sectional studies by Berninger and colleagues in a sample of 4th–6th graders (Berninger, Cartwright, Yates, Swanson, & Abbott, 1994), and a sample of 7th–9th grade students (Berninger, Whitaker, Feng, Swanson, & Abbott, 1996) in an English-speaking context. Variance explained by transcription was lower in Grades 7–9 (18%) than in Grades 4–6 (42%), suggesting that, when transcription is not fully mastered yet, it constrains text generation, but when transcription skills become more automated, writing quality suffers less from these constraints (Berninger, 1999; Graham et al., 1997). Efficient use of writing strategies is assumed to play a more dominant role in predicting writing proficiency when automization of transcription has taken place. In addition, automization of transcription skills enables a writer to free up working memory space to be devoted to rhetorical processes, such as paying attention to the needs of readers (Scardamalia & Bereiter, 1986).

Longitudinal studies

In addition to the cross-sectional studies, longitudinal studies are necessary to investigate developmental patterns and relationships more precisely. However, few longitudinal studies about writing exist, and in those studies in which the same students were repeatedly tested, analyses are often conducted cross-sectionally, rather than longitudinally (Lerkkanen, Rasku-Puttonen, Aunola, & Nurmi, 2004), that is, rather than investigating longitudinal relations, associations between variables are investigated at a specific point in time, and compared with the associations found at another time of measurement (see e.g. Berninger, Abbott, Swanson, et al., 2010; Juel, 1988; Niedo, Abbott, & Berninger, 2014). Longitudinal studies investigating writing proficiency in a longitudinal fashion may be directed at (1) development of writing proficiency, or at (2) the relation between writing

proficiency development and its constituting components, such as spelling, grammar, vocabulary and handwriting.

Smith (2011), who investigated the development of narrative writing in a heterogeneous sample of students from Grade 4 to Grade 6 in an English-speaking context in Canada, found that students' text quality improved significantly over time in this 2-year interval. However, although there was significant individual variation in the growth patterns that students displayed, none of the included components of writing proficiency (vocabulary, syntax, phonological processing, (pseudo)word reading, and spelling) predicted individual differences in growth in writing proficiency.

Abbott, Berninger, and Fayol (2010) tracked two cohorts of students (Grade 1–5, and Grade 3–7) in a longitudinal study into writing development in a heterogeneous sample of normally developing children. The authors modelled longitudinal relationships between handwriting, spelling, word reading, reading comprehension, and written composition. Their findings indicated that individual differences on these measures were relatively stable over time. Furthermore, above the autoregressive paths, there were significant longitudinal paths from spelling to written composition. That is, taking into account the contribution of previous writing proficiency, individual differences in written composition were associated with individual differences in spelling in a previous grade. The contributions from spelling to written composition were present in each of the 1-year intervals in the study.

In a meta-analysis, Graham and Santangelo (2014) investigated the importance of spelling for writing. On the one hand, they concluded that students (Grade 1–6) generalized gains in spelling (in their analysis these gains were a result of a formal spelling instruction intervention) to more correct spelling in their written texts. However, gains in spelling did not affect gains in overall text quality. Thus, whereas findings by Abbott et al. (2010) indicate that individual differences in students' *gains* in writing were related to individual differences in spelling *level*, Graham and Santangelo could not find siginificant effects of *gains* in spelling to *gains* in writing proficiency.

Schoonen et al. (2011) pays attention to adolescents' development (Grades 8–10) in writing proficiency in relation to linguistic and metacognitive knowledge and fluency components of writing. Similar to the study by Abbott et al. (2010), the authors found that individual differences in writing proficiency remained stable over time. However, whereas Abbott et al. (2010) found significant contributions from spelling to writing development, no additional contributions of any of the included components were found explaining growth in writing from Grade 8 to 10 by Schoonen et al. Possibly, the difference in findings is explained by the different age groups studied (students in the Abbott et al. study being much younger).

The current study adds to the above knowledge base. Important differences with previous studies are the following. First, we focus on low-achieving students instead of a group of adolescents that is more heterogeneous in terms of writing proficiency. Explaining individual differences within the population of low-achieving adolescents is relevant for the design of educational interventions directed at this group. Second, in our study we analyze not only the contributions of components of writing

skill, but also the explanatory value of longitudinal *development* of those components for writing development. This is an important addition, because it potentially shows whether development in the linguistic and metacognitive components in 3 years of schooling of low-achieving adolescents explains writing proficiency development. This is relevant information for education directed at writing for this group. In addition, our study analyses possible differences between the (relatively large) group of language-minority students and native students in writing skill and its components (see below), an issue that is quite novel in empirical research into writing development.

Language-minority students

Students from immigrant backgrounds constitute a substantial part of school populations in many Western countries. Among the low-achieving adolescents, these language-minority students are overrepresented (CBS, 2004; Dagevos, Gijsberts, & Van Praag, 2003; Elley, 1992; OECD, 2001; Soussi, Broi, Moreau, & Wirthner, 2004). Language-minority students on average are found to perform below their native peers in writing proficiency (Geva & Genesee, 2006; Schoonen et al., 2002), as well as in several relevant components of writing proficiency, such as vocabulary and grammar knowledge, and in reading comprehension (Aarts & Verhoeven, 1999; Ball, 2003; CBS, 2010; Farnia & Geva, 2011; García 1991; Kieffer 2008; Lesaux & Kieffer 2010; National Center for Education Statistics, 2009; Schoonen et al., 2002; Verhoeven, 1990). It is therefore of interest in our study to account for possible differences in writing proficiency between low-achieving adolescents from native-Dutch and language-minority backgrounds. In addition, Schoonen et al. (2002) demonstrated that prediction models of knowledge and fluency components of (Dutch) writing proficiency of natives and language-minority adolescent students did not differ significantly. This suggests that the componential structure of writing proficiency is similar for both groups.

Research questions

We investigate associations between the components of low-achieving adolescents' writing proficiency level and development. On the one hand, we use measures for linguistic and metacognitive knowledge and fluency as predictors for students' writing proficiency *level*. On the other hand we use *repeated* measures for the aforementioned predicting variables for the prediction of writing *development* over three grades (7–9). The following research questions are posed:

(RQ 1) To what extent are individual differences in writing proficiency level of low-achieving adolescents predicted by level of linguistic and metacognitive knowledge, and fluency?

(RQ 2) To what degree does the level of writing proficiency of low-achieving adolescents improve from Grade 7 to 9? And are there differences between native-Dutch and language-minority students?

(RQ 3) To what extent is development in writing proficiency from Grade 7 to 9 predicted by development in linguistic and metacognitive knowledge and fluency in that same period?

(RQ 4) To what extent do the predictions of writing proficiency level and development differ for native-Dutch and language-minority students?

Regarding question 1, we expect on the basis of previous research among heterogeneous groups of adolescents (Schoonen et al., 2003) that linguistic and metacognitive knowledge and fluency significantly predict writing proficiency level of low-achieving adolescents. Regarding question 2, we expect that both groups of low-achieving adolescents improve in writing proficiency in the course of the three school years. Regarding question 4, we expect to find no differences between the componential structure of writing proficiency for native and language minority adolescents in line with the previous findings of Schoonen et al. (2002). Regarding question 3 and the issue of differences in improvement in writing we do not have clear expectations, based on previous research.

Research questions 1 and 3 are important, because very few studies have discriminated prediction of *level* and *development* in writing proficiency of adolescents as proposed. Question 2 is of interest because it provides background to the issue of writing development of low-achieving students of native-Dutch and language-minority backgrounds. Question 4 additionally probes the possibility of differential roles of the components in each of these groups of low-achieving students.

Method

Participants

In the Netherlands, students in the lowest prevocational tracks are among the 30 percent lowest achieving on a national school aptitude test of reading, language and mathematical skills.[1] Therefore, it is assumed that this group of students contains the poorest readers and writers in the adolescent population.

We invited schools in urban areas in the western part of the Netherlands to participate, provided that they offered these lowest prevocational tracks. From the positive reactions we selected the schools with mixed populations of native and language minority students. Finally, nine schools for prevocational secondary education conformed to our criteria and participated in the first year of this study. In the next years, some of the participating students changed schools. Therefore we followed these students in their new schools, which resulted in the participation of eleven schools in the third year of the study.

We recruited students from seventh-grade classes, which is the first year of secondary education in the Netherlands. From each class 6–7 students were

[1] At the time of this study this aptitude test was obligatorily administered in primary schools at the end of grade 6 and was largely decisive for the secondary track that each individual student would take (roughly: prevocational, higher general secondary education and pre-academic education).

selected. For student selection two types of data were used. First, information from the school records enabled us to select a sample of students not suffering from diagnosed learning or behavioral disorders. Furthermore, immigrant students who had visited a Dutch primary school for less than 3 years were excluded in order to keep the language-minority sample homogeneous with respect to previous schooling experiences and related opportunities for acquisition of Dutch.

Second, data about the ethnic and linguistic backgrounds (country of birth of student and parents, languages spoken at home, and frequency of use of these languages in contacts at home) of the students were obtained by means of a questionnaire that was filled out by the students themselves. Students were selected for the native-Dutch group if both parents were born in the Netherlands,[2] if they were native speakers of Dutch, and if Dutch was their dominant home language (i.e., most language contacts within the home had to be in Dutch). Students were selected for the language-minority group if both parents were born outside the Netherlands and if students spoke another language than Dutch with their parents for half of the time or more. This decision was based on information about the language spoken in interactions with father and/or mother. Most students in the language-minority group (21 students) had learned to read and write in the other home language to some extent. However, the first language they had learned to read and write in was Dutch.

Most of these 26 language-minority students had Moroccan (9) or Turkish (7) backgrounds, the remainder had Surinamese (3), Antillean (3), Cape Verdean (3), and Chinese (1) backgrounds.[3] All but five of the students with a minority background were born in the Netherlands; most students are thus second generation immigrants.

In the first year of the longitudinal study, the sample consisted of 63 students from 10 classes in 9 different schools. In the last year of the study, the sample consisted of 51 students divided over 28 classes from 11 schools.[4] For these 51 students we have complete data in Grades 7, 8 and 9. For our analyses we chose to investigate only the data of these students: 29 boys and 22 girls, of whom 25 were of a native-Dutch, and 26 of a language-minority background.

[2] We accepted two exceptions to this rule. Two native-Dutch students have one parent born outside the Netherlands. We decided to include these students after verifying that Dutch is the only language spoken at home for these students.

[3] In the Netherlands, most of the secondary-school students from immigrant backgrounds are from the second generation Turkish and Moroccan immigrants. In general, their families have low socioeconomic status, low level of education and low levels of professional training (CBS, 2012; Tesser & Iedema, 2001). At home, the language spoken by their parents is often the ethnic group language, although Dutch may be used beside this home language. Outside the domestic environment, for example, at school, Dutch is the language that is primarily used.

[4] Twelve students dropped out of the study for different reasons (chronical illness, change of school and the burden of the requirements of research participation). *t* tests showed no significant difference on any of the measured variables between the students dropping out and the remaining students in our sample.

Instruments

Writing proficiency

The writing proficiency test consisted of three writing assignments.[5] Each assignment specified a realistic communicative task (assumedly) connected to young people's daily lives. The three assignments covered instructive, argumentative and narrative text types. In Assignment 1 (Exchange project), students wrote a letter to two students from Belgium who were visiting the Netherlands as part of an exchange project. Their task was to describe the program for a day out in Amsterdam and provide instructions on where to meet, what to bring, et cetera. In Assignment 2 (Candy bar) (adapted from Rijlaarsdam et al., 2009), students were asked to imagine they were taking part in a competition for which they were saving coupons on candy bar wrappers in order to receive two free cinema tickets. However, they were unable to find enough wrappers with coupons. Students wrote a letter to the candy bar factory, arguing that it was not their fault that they were not able to send the required number of coupons and convincing the recipient to send them the cinema tickets. In Assignment 3 (Kings clothes), students wrote a sequel to a story about a very poor boy, who once dressed up like a very rich man. Start and closing sentence of the story were given.

Each assignment was rated by two independent and trained raters using a primary trait scoring procedure (Lloyd-Jones, 1977). For each assignment, the central objective—the primary trait—was formulated. On the basis of this primary trait, a set of rating criteria were specified for each task separately. For example, in the Candy bar task the criteria were: (1) use of letter conventions, (2) taking account of social distance between writer and reader, (3) describing the context of the letter, (4) describing the goal of the letter, (5) including arguments and (6) quality of language use (spelling and grammar). The raters used these criteria to assign each student a single score. To arrive at this score, the raters used a scale of five benchmark texts. This scale was developed separately for each task using forty randomly sampled texts from all students of whom writing assignments were administered.[6] These texts were rated by two independent raters. Following a procedure based on Blok (1986) and adopted in Schoonen et al. (2011), the five benchmark texts for each task were selected as the 10th, 25th, 50th, 75th, and 90th percentiles of the forty rated texts. For each of the benchmarks texts, a description was added of the degree to which they satisfied each of the rating criteria derived from the primary trait. In the final round, raters used the benchmark texts (and the accompanying descriptions) to compare with the texts to be assessed and based their score on this comparison. A score of 100 corresponded to the middle of the scale. Raters were free to decide on how much the text deviated from that midpoint, resulting in a continuous scale. The interrater reliability of the scores was satisfactory: For Task 1, $r = .89$, .86, and .65

[5] These writing assignments were pretested with students in the prevocational tracks (grade 7 and 9) together with three other assignments in order to select the ones that appeared to be the best prompts for the students in both ages.

[6] For the purpose of another study not only the selected students within each class, but also their classmates produced texts on the writing assignments (N = 199).

in year 1, 2, and 3, respectively; for Task 2, $r = .85$, .85, and .74 in year 1, 2, and 3, respectively; and for Task 3, $r = .85$, .89, .73 in year 1, 2, and 3, respectively. Across all 3 years, one rater remained the same in order to avoid differences in severity of rating and to make the ratings across years comparable. Our measurement of writing proficiency was based on the sum of scores over the three assignments in each grade. The reliability of the measurement (Cronbach's alpha over 3 assignments) was .65 in Grade 7, .67 in Grade 8 and .51 in Grade 9. Correlations between the tasks are reported in "Appendix 1".

Receptive vocabulary

This paper-and-pencil test, based on[7] the receptive vocabulary test by Van Gelderen et al. (2003) and Van Gelderen et al. (2007), consisted of 73 multiple-choice questions, testing the knowledge of nouns, verbs, adjectives, and adverbs belonging to the 23,000 words in a dictionary for junior high school students (see Hazenberg & Hulstijn, 1996, for details). Each item consisted of a neutral carrier sentence with a target word in bold print. The students had to choose between four options, printed underneath, one of which represented a correct synonym of the target word. The Cronbach's alpha coefficients for this test were .85 (Grade 7), .88 (Grade 8) and .86 (Grade 9).

Grammatical knowledge

In this 50-item paper-and-pencil test, based on the grammatical knowledge test by Van Gelderen et al. (2003, 2007), students had to complete sentences containing a word-gap with the correct form of verbs, adjectives, anaphora, comparatives, and articles, and they had to put words or phrases into the correct order, taking into account the correct form for number, time, aspect, and agreement. There were both fill-in-the-blanks and multiple-choice items in this test. The Cronbach's alphas for this test were .71 (Grade 7), .80 (Grade 8) and .67 (Grade 9).

Orthographic knowledge

The orthographic knowledge of the students was assessed by means of a paper-and-pencil test of 68 multiple-choice questions. The test was based on the orthographic knowledge test by Schoonen et al. (2003, 2011). Sentences were presented in which one word contained a gap. Students had to choose which letter or letter combination, presented underneath, should be used to fill that gap. The Cronbach's alpha coefficients for this test were .64 (Grade 7), .74 (Grade 8) and .71 (Grade 9).

[7] For the vocabulary test and for all following tests, items were selected from the previous studies by deleting the items that were regarded too difficult for the group of low-achieving students.

Metacognitive knowledge

Metacognitive knowledge was measured by means of a paper-and-pencil questionnaire consisting of statements about text characteristics and reading and writing strategies. It was based on the metacognitive knowledge test used by Van Gelderen et al. (2003, 2007). Items consisted of correct or incorrect statements. Students had to tick whether they agreed or disagreed with a statement. An example of an (incorrect) statement concerning text characteristics is *The order in which you present the information in your text is usually not relevant*. An example of a (correct) statement concerning writing strategies is *It is sensible to think of the readers of your text and what they know about the subject*. An example of a (correct) statement concerning reading strategies is *It is sensible to think beforehand why you are going to read a text*. The test had 45 items and the Cronbach's alpha coefficients were .50 (Grade 7), .60 (Grade 8) and .54 (Grade 9). These relatively low reliabilities were probably caused by the difficulty of the task for our population (the average scores being 27.8, 28.5 and 30.0, with a guessing score of 22.5).

Speed of written word recognition

Speed of word recognition was tested by means of a computer-administered lexical decision task, based on the test from Van Gelderen et al. (2003). The stimuli consisted of 119 letter strings (3–8 letters), 59 of which were existing (well-known) words; the remainder consisted of phonologically correct pseudo-words. Students were asked to decide as quickly as possible whether the stimulus was an existing word or not and press the corresponding key on the keyboard. Responses were automatically coded in terms of both accuracy and latencies (from stimulus onset). The mean accuracy was 94%. The latency measure was computed using only correct responses to existing words (hits). Extremely fast or extremely slow responses were coded as missing values, following the scoring instructions described for this test in Van Gelderen et al. (2004). The Cronbach's alphas for this speed test were .83 (Grade 7), .90 (Grade 8) and .82 (Grade 9).

Speed of lexical retrieval

In the lexical retrieval task (based on Schoonen et al., 2003, 2011), participants were asked to "name" pictures of objects as quickly as they could. They did this by pressing the first letter of the target word on the keyboard of a laptop computer. Only reaction times on correct responses were used in the analyses. The test consisted of 38 easy words that can be expected to be known to all students. There were ten trial items before the test started. In order to be able to correct for typing fluency, we also administered a test for this skill. Students had to type a letter as quickly as possible after it was shown on the computer screen.[8] Typing fluency was used as a control variable for lexical retrieval in such a way that we used the

[8] Cronbach's alpha coefficient for the typing speed test were .96 (Grade 7), .94 (Grade 8) and .95 (Grade 9).

difference between the lexical retrieval speed and the typing speed in the analyses. The Cronbach's alpha coefficients for the lexical retrieval test were .85 (Grade 7), .83 (Grade 8) and .84 (Grade 9).

Speed of sentence verification

Speed of sentence verification was measured using the same lexical decision paradigm as described for word-recognition speed. It was a computer-administered task. The task was based on the sentence-verification speed test by Van Gelderen et al. (2003, 2007). A sentence was displayed on the screen as a whole. Students decided as quickly as possible whether the sentence made sense or not. Half of the 72 items made sense (e.g., *The man went to bed because he wanted to sleep*), the other half did not make sense (e.g., *Most bicycles have seven wheels*). The sentences referred to common knowledge that seventh-grade students can be assumed to have. The average accuracy on the true assertions was 98%. Responses were automatically coded in terms of both accuracy and latencies (from the onset). The latency measure was computed only on the basis of the correct responses to the 36 true assertions (hits). Extremely fast or extremely slow responses were coded as missing values, following the scoring instructions described for this test in Van Gelderen et al. (2004). The Cronbach's alphas for this speed test were .95 (both in Grade 7 and 8) and .96 (Grade 9).

Procedure

The tests were administered in February–June 2008 (seventh grade), February–June 2009 (eighth grade), and February–June 2010 (ninth grade). The writing assignments were administered to whole classes in one session of 40 min (2 assignments) and one session of 20 min (1 assignment). The order of the assignments was the same at each occasion. The other tests were administered to small groups of about three students in three different sessions. We scheduled no more than two sessions per day in order to minimize test fatigue. All sessions were introduced by a researcher or a trained test assistant. The writing-proficiency classroom-test sessions were also attended by a teacher to assist in maintaining order.

Analyses

In order to establish the relative contributions of students' knowledge and fluency to writing proficiency level and development, several regression analyses were performed (using MLwiN 2.16, Rasbash, Steele, Brown, & Goldstein, 2009). First, we checked whether the multi-level regression analyses should include a class level. We found a significant proportion of class level variance (see "Appendix 2"). Therefore, in addition to a *student* level (variance between students) and an *occasion* level (variance within students between times of measurement) (cf.

Rasbash et al., 2009), a *class* level was included in the models.[9] For appropriate estimates of class-, student- and occasion-level variance, time of measurement[10] (Grades 7, 8 and 9), was also included in the model as a *predictor* (Hox, 2010).

To determine which components contributed to the explanation of writing proficiency level and development, we added the components to the model (one at a time) and we estimated proportions of explained *class*, *student* (first research question) and *occasion* level variance (third research question) respectively. In these analyses we corrected for students' background.[11] To determine whether there is an improvement in writing proficiency (second research question), we estimated the regression coefficient of time of measurement. We also investigated possible differences in improvement in writing proficiency between native-Dutch students and language-minority students by verifying whether the interaction effect between background and time of measurement is significant.

To test whether the relation between writing proficiency level and development on the one hand and the components of writing proficiency on the other hand differed between native-Dutch students and language-minority students (fourth research question), interaction effects between background and each of the repeatedly measured components were included (one by one) as predictors in the regression equation.

Results

Means and standard deviations of writing proficiency and the predictors are presented for each occasion (Grade 7–9) in "Appendix 3". For descriptive purposes, we analyzed raw differences between native-Dutch and language-minority students for all variables involved. "Appendix 4" presents an overview of the significant differences between the two groups found. The native-Dutch students outperformed the language-minority students on receptive vocabulary, grammatical knowledge, lexical-retrieval speed and sentence verification speed. The language-minority students started at a lower level than their native-Dutch peers on a number of variables, i.e., writing proficiency, orthographic knowledge and metacognitive knowledge, but differences between both groups diminished over time.

Results regarding research questions 1 and 3 are presented in Table 1. Each column represents a model. Model 0 has only time of measurement as predictor. In Model 1 the variable background is included. In Models 2a–2g the knowledge and fluency components are added (each separately) to the regression equation.

Table 1 shows that according to Model 0 20.0% of the variance in level of writing proficiency is on the class level, 38.8% on the student level and the remaining variance (41.2%) is on the occasion level (within-student variance). In the lowest part of the table it is shown whether each consecutive model makes a

[9] During the 3 years of the longitudinal study students spread into diverse classes. In the analysis we chose to use the categories based on in which class they were in the first year of the study.

[10] Coded as 0 (Grade 7), 1 (Grade 8), and 2 (Grade 9).

[11] Coded as 0 (native-Dutch students) and 1 (language-minority students).

Table 1 Multilevel analyses with writing proficiency (repeatedly measured) as dependent variable

	0	1	2a	2b	2c	2d	2e	2f	2g
51 students, 10 classes, 3 times of measurement									
Variance									
Class	1247.4 (864.8)	987.1 (742.9)	472.1 (478.7)	39.3 (291.7)	900.3 (700.9)	882.7 (684.1)	1050.3 (749.4)	926.7 (692.4)	1008.1 (657.1)
Student	2425.9 (734.8)	2374.5 (723.7)	1984.6 (641.8)	2075.5 (645.8)	2351.8 (719.7)	2255.0 (700.0)	2129.9 (672.6)	2128.3 (673.6)	1280.0 (503.2)
Occasion	2575.7 (360.7)	2575.7 (360.7)	2620.4 (367.0)	2450.5 (343.1)	2585.4 (362.1)	2605.6 (365.0)	2600.6 (364.1)	2644.5 (371.0)	2787.5 (390.9)
Total	6249.0	5937.3	5077.1	4565.3	5837.5	5743.3	5780.8	5699.5	4075.6
Distribution of variance									
Class (%)	20.0	17.2	9.3	0.9	15.4	15.4	18.2	16.3	24.7
Student (%)	38.8	41.4	39.1	45.5	40.3	39.3	36.8	37.3	31.4
Occasion (%)	41.2	41.4	51.6	53.7	44.3	43.6	45.0	46.4	43.9
Explained variance									
Class (%)		20.9	52.2	96.0	8.8	10.6	–	6.1	–
Student (%)		2.1	16.4	12.6	1.0	5.0	10.3	10.4	46.1
Occasion (%)		–	–	4.9	–	–	–	–	–
Total (%)		5.0	14.5	23.1	1.7	3.3	2.6	4.0	31.4
Intercept	237.3 (14.7)	250.3 (16.2)	107.1 (49.7)	46.4 (42.9)	215.0 (55.4)	210.5 (41.2)	306.9 (42.0)	248.5 (15.8)	388.6 (42.1)
Main effects									
Time of measurement	33.3*** (5.0)	33.3*** (5.0)	25.9*** (5.6)	26.1*** (5.1)	32.4*** (5.2)	31.7*** (5.3)	30.4*** (5.4)	33.2*** (5.1)	18.2** (6.8)
Language background		− 24.9 (16.5)	− 5.6 (17.0)	− 8.2 (16.0)	− 23.8 (16.6)	− 22.2 (16.4)	− 23.8 (15.9)	− 21.1 (16.3)	− 6.2 (14.5)

Table 1 continued

	0	1	2a	2b	2c	2d	2e	2f	2g
Receptive vocabulary			2.7*** (0.9)						
Grammatical knowledge				5.9*** (1.2)					
Orthographic knowledge					0.7 (1.1)				
Metacognitive knowledge						1.4 (1.3)			
Word recognition (ms)							− 0.07 (0.05)		
Lexical retrieval (ms)								− 0.03 (0.03)	
Sentence verification (ms)									− 0.03*** (0.01)
Fit (− 2 * loglikelihood)	1714.9	1712.8	1705.0	1693.4	1712.3	1711.7	1710.7	1711.8	1704.0
Difference		2.1	7.8*	19.4***	0.5	0.9	2.1	1.0	8.8**
Difference *df*		1	1	1	1	1	1	1	1

Predictors are the 7 components (repeated measurements of knowledge and fluency), time of measurement (coded as 0, 1 and 2), and language background (coded as 0 and 1). Models 0–2g are explained in the text

Model 0 is Model 1 from "Appendix 4". Models 2a–2g are compared to model 1

*$p < .05$; **$p < .01$; ***$p < .001$

significant improvement of fit compared to the previous model (see difference – 2 * loglikelihood). Inclusion of background, in Model 1, does not significantly improve the model fit. Compared to Model 1, only Models 2a, 2b and 2g have significantly better model fit (values for difference – 2 * loglikelihood ($df = 1$) are 7.8, 19.4 and 8.8 respectively). The repeatedly measured knowledge and fluency components (see models 2a–2g in Table 1) that appear to be a significant predictor of writing proficiency variance (the total of class, student and occasion level) are therefore receptive vocabulary, grammatical knowledge and sentence-verification speed.

In order to answer research question 1, we examined the predictors that explain variance on the *student* level, which are receptive vocabulary (16.4%), grammatical knowledge (12.6%) and sentence-verification speed (46.1%) (Models 2a, 2b and 2g). The other knowledge (orthographic and metacognitive knowledge) and fluency (word-recognition and lexical retrieval speed) components do not explain differences in writing proficiency between students.

In order to answer the second research question, namely whether there is improvement in writing proficiency in low-achieving adolescents, an additional regression analysis was conducted which is presented in Table 2. In Model 0, only background is included. In Model 1, it is shown that inclusion of two grade variables (which indicate whether the second and third measurement differ significantly from the first) make a significant contribution to the model (difference – 2 * loglikelihood = 38.0, $df = 2$, $p < .001$). Therefore, we can conclude that low-achieving students' writing proficiency improves between Grade 7 and 9 ($Z = 6.66$, $p < .001$).[12] The growth trajectories for the native-Dutch adolescents and the language-minority students are displayed in Fig. 1. We further investigated whether the growth trajectories differed between the native-Dutch and the language-minority students. Inclusion of the interaction variables (Table 2, Model 2) significantly improves model fit (difference − 2 * loglikelihood = 6.4, $df = 2$, $p < .05$), which indicates that the developmental patterns differ between both groups. Improvement in writing proficiency is more substantial in the language-minority students (coded as 1) than in the native-Dutch students (coded as 0).

Of the three variables that have significant explanatory power for writing proficiency only grammatical knowledge explains writing proficiency development (see Table 1). Of the variance in writing proficiency *development* 4.9% is explained by including grammatical knowledge in the model. A unilevel regression analysis on the difference scores (both for grammatical knowledge and for writing proficiency between Grades 7 and 9) indicates that *gains* in grammatical knowledge are significantly related to gains in writing proficiency ($F(1,49) = 5.89$, $p < .05$, $R^2 = .11$).

In the fourth research question we investigated whether there is a difference between native-Dutch students and language-minority students in the predictive power of the components. Interaction effects between background and each of the

[12] Improvement is also present between Grade 7 and 8 ($Z = 4.38$, $p < .001$) as indicated in the Time of measurement (2) row in Table 2. An additional analysis indicates that there is growth between Grade 8 and Grade 9 ($Z = 1.99$, $p < .05$) as well.

Table 2 Multilevel analyses with writing proficiency (repeatedly measured) as dependent variable

	0	1	2
51 students, 10 classes			
Variance			
Class	1036.4 (775.8)	987.1 (742.9)	987.1 (742.9)
Student	2013.1 (727.7)	2386.6 (723.4)	2437.8 (722.2)
Occasion	3685.6 (516.1)	2539.3 (355.6)	2385.7 (334.1)
Total	6735.2	5913.0	5810.6
Distribution of variance			
Class (%)	15.4	16.7	17.0
Student (%)	29.9	40.4	42.0
Occasion (%)	54.7	42.9	41.1
Explained variance			
Class (%)		4.8	–
Student		–	–
Occasion (%)		31.1	6.0
Total (%)		12.2	1.7
Intercept	289.3 (12.9)	246.8 (16.4)	260.5 (17.3)
Main effects			
Language background	− 25.1 (16.5)	− 24.9 (16.5)	− 51.8* (19.9)
Time of measurement (1)		43.8*** (10.0)	27.5 (13.8)
Time of measurement (2)		66.6*** (10.0)	41.7** (13.8)
Time of measurement (1) * background			31.8 (19.3)
Time of measurement (2) * background			48.8* (19.3)
Fit (− 2 * loglikelihood)	1749.3	1711.3	1704.9
Difference		38.0***	6.4*
Difference *df*		2	2
Compared to model		0	1

Predictors are time of measurement (coded as 0, 1 and 2), language background (coded as 0 and 1), and the interaction variables created by time of measurement and background

*$p < .05$; **$p < .01$; ***$p < .001$

repeatedly measured components were included (one by one) as predictors in the regression equation. However, these analyses showed no significant interactions (values for difference − 2 * loglikelihood ($df = 1$) range from .03 to 1.73.), indicating that in our study we could not find differences between the two groups with respect to the predictive power of components of writing proficiency.

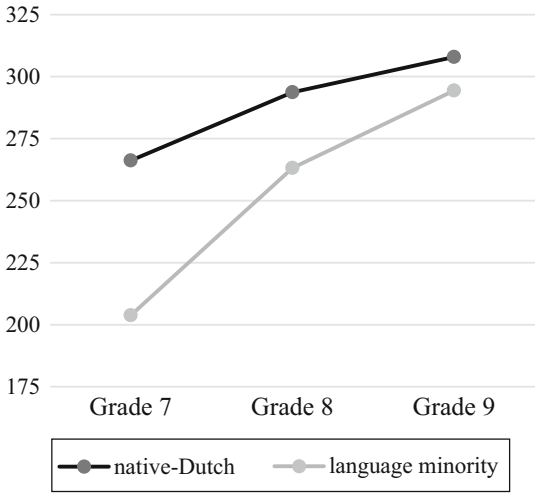

Fig. 1 Writing proficiency mean scores for native-Dutch and language-minority students in Grade 7, 8 and 9

Discussion

In this study, we aimed to explore to what extent low-achieving adolescents' writing proficiency is determined by linguistic knowledge, metacognitive knowledge, and fluency variables. The study adopted a longitudinal design, allowing us to examine both students' level and development of writing proficiency as well as analyze the associations of these variables with the level and development of linguistic knowledge, metacognitive knowledge, and fluency. In addition, we examined differences in developmental patterns and relationships among skills within students from native-Dutch and language-minority backgrounds.

Vocabulary and grammar knowledge contributed significantly to the explanation of low-achieving adolescents' level of writing proficiency. The roles of vocabulary and grammar knowledge are in line with theoretical accounts of the writing process by, for example, Hayes (1996), attributing a prominent role to linguistic resources: a large vocabulary and a rich repertoire of sentence frames enable writers to retrieve clear representations for the contents of their texts (Beers & Nagy, 2009; Nagy & Scott, 2000). This adds to text quality and writing proficiency. The results also corroborate outcomes of previous research by Schoonen et al. (2003) involving a heterogeneous sample of adolescent students, showing that vocabulary and grammar knowledge are important components of their writing proficiency. The results of our current study demonstrate that even within the narrower population of low-achieving adolescents, vocabulary and grammar knowledge explain individual differences in students' level of writing proficiency.

Additionally, we found a significant relation between the low-achieving adolescents' level of writing proficiency and sentence-verification speed. This finding suggests that for these students fluent comprehension of sentences is an important component of their writing quality. This is consistent with the claim made by Flower and Hayes (1981) in their influential model of the writing process that

reading comprehension is an important aspect. Writing involves frequent rereading, both for evaluating text written so far (Flower & Hayes, 1981) and for reinstating information on the basis of which new text is generated (Torrance & Galbraith, 2006). Consequently, as the ability to (re)read becomes more fluent, the writing process can be monitored more efficiently. In addition, it is possible that more fluent reading helps students switch more efficiently between the writing prompts and their own writing. It is known from the literature that if information is processed more efficiently, more working memory capacity remains available for storage during these switches (McCutchen, 2000; Torrance & Galbraith, 2006). Therefore, writers who are more efficient in processing and storage of what has been read, may dedicate more attention to text quality. The association between sentence-verification speed and writing proficiency, found in this study, suggests that, within the group of adolescent low achievers, fluency of reading is an important component of their level of writing proficiency.

Knowledge of orthography is an important aspect of writing (Berninger & Swanson, 1994; Chenoweth & Hayes, 2001; McCutchen, 2012). Nevertheless, in our study it was not found to play a significant role in explaining low-achieving adolescents' level of writing. The lack of explanatory power of orthographic knowledge in our study contrasts with the outcomes of Abbott et al. (2010) and Schoonen et al. (2003) who used more heterogeneous samples. Possibly, low-achieving adolescents use a more restricted vocabulary to avoid spelling problems while writing, whereas in more heterogeneous samples the better spellers are also the ones that use a more varied vocabulary, contributing to text quality. If that is the case, the absence of a relation between spelling and level of writing proficiency for low-achieving adolescents can be attributed to the quite low lexical variety that is used by these students.

In contrast with results presented by Schoonen et al. (2003), in our study metacognitive knowledge was not found to be a significant predictor of level of writing proficiency. The lack of significant explanatory power of metacognitive knowledge for our low-achieving adolescents might well be accounted for by their limited metacognitive knowledge in comparison to their academically more advanced peers. This limited knowledge prevents poor writers effectively making use of text characteristics and writing strategies in their process of text production (Alamargot & Fayol, 2009; Berninger & Swanson, 1994). Unfortunately, this also resulted in a less than desirable reliability of the measurement of metacognitive knowledge in our study. This may have obscured that there still may be relevant differences even within the group of low-achievers. To define these differences and measure them in a reliable fashion is a challenge for future research.

Our analyses did not show a significant relation between word-recognition speed and writing. Although reading of what has been written is an important aspect in writing, it is not restricted to the reading of isolated words, which is captured in the word-recognition speed task. It may be, though, that the fluent reading of larger units (as exemplified in our sentence-verification speed task) is of more relevance for good writing. In addition, word-recognition speed is shown to be less explanatory for text comprehension with increasing age (Francis, Fletcher, Catts, & Tomblin, 2005; Perfetti, 1999) and does not correlate (or only weakly) with

reading comprehension of low-achieving students in the age range 13–16 (Trapman, Van Gelderen, Van Steensel, Van Schooten, & Hulstijn, 2014; Trapman, Van Gelderen, Van Schooten, & Hulstijn, 2017; Van Steensel, Oostdam, Van Gelderen, & Van Schooten, 2016). Therefore, it is to be expected that it becomes less explanatory for individual differences between these students' writing quality as well.

We did not find a significant relation between low achievers' lexical retrieval speed and writing proficiency either. This finding is supported by the findings of Schoonen et al. (2002) who also did not find a significant contribution of lexical retrieval speed to the explanation of writing proficiency in a more heterogeneous sample of students. From the literature it appears that in general writing quality is related to the use of rich and varied vocabulary (Crossley et al., 2011; Engber, 1995). It is therefore plausible that differences in writing quality of our low-achieving students are also related to differences in lexical richness even within this group of low-achieving adolescents. This may explain why our measure of lexical retrieval speed consisting solely of easy (highly frequent) words for our students does not capture relevant aspects for explaining differences in their writing quality and lexical richness. These differences in richness within the group of low–achievers may be more important for their writing than can be explained by retrieval speed of words that are highly familiar to all of them.

The next issue concerns *development* in writing proficiency of low-achieving adolescents. Using a repeated-measures multilevel model we established that the low-achieving students significantly improved their writing proficiency between seventh and ninth grade. Growth in writing proficiency in this period is important for meeting academic literacy requirements for this academically vulnerable population. Our finding suggests that in the course of these three grades low-achieving adolescents' writing proficiency benefits from education and/or experience.

Analyses directed at our second research question revealed that performance of both native-Dutch students and language-minority students improved significantly, but that for the latter the increase was significantly larger than for the former. This catching up is consistent with the absence of an overall effect of language background on writing proficiency; only in Grade 7 did we find a significant difference between writing proficiency of both subgroups in our sample (see "Appendix 4"). However, the language-minority students had significantly lower knowledge of vocabulary and grammar in all three grades than their native-Dutch peers (see "Appendix 4"). We will return to this issue below.

Our third research question concerned the relative contributions of knowledge and fluency on writing *development*. In relation to this question, we found a significant effect of grammar knowledge. In addition to its explanatory power on *level* of writing proficiency, grammar knowledge significantly contributed to *development* in writing proficiency, a small effect of 4.9% explained variance on the occasion level. We performed an additional regression analysis revealing that differences in writing development were positively related to differences in *development* in grammatical knowledge. The positive effect of growth in grammatical knowledge on development of writing suggests that low-achieving

students' growth in grammar knowledge is conditional or causally linked to (a part of) their growth in writing proficiency. The nature of this relationship between grammar and writing development however, is still an open issue. On the one hand, increased (morpho-) syntactic knowledge may enable a student to use more varied sentences in writing, resulting in texts that express ideas more clearly or adequately (Beers & Nagy, 2009; Myhill, 2008; Scott, 2004). Another possibility is that increased grammatical knowledge facilitates students' formulation of sentences in writing, thereby freeing cognitive resources for conceptual processes, such as rhetorical aspects of writing (Deane et al., 2008; McCutchen, 1996; Torrance & Galbraith, 2006). On the other hand, however, it might well be that development in grammar knowledge is rather a consequence of writing experience. Experience in writing provides students with occasions for reflection on formulation processes and constraints, and might therefore lead to more awareness of grammatical structure. So, although it is not clear whether growth in grammar precedes growth in writing proficiency or the other way around, our result does suggest that for low-achieving students one is (partly) conditional on the other in the timeframe in question (between Grades 7–9).

The explanation of development in writing proficiency was quite limited. This might have been due to the fact that reliability coefficient for writing proficiency seemed to be quite low in the grade 9 level. Therefore, a substantial part of the variance that we established was not related to individual differences in writing development. This may explain why this development could not be explained by most of our predictor variables.

The fourth question that was addressed in this study concerned the comparison of contributions of knowledge and fluency to writing (level and development) between low-achieving students with language-minority backgrounds and their native-Dutch peers. Although significant differences were present between both groups with respect to the *levels* of grammar knowledge and receptive vocabulary (both of which significantly contributed to students' level of writing proficiency), and with respect to the progress students displayed in writing proficiency, no significant interactions were detected between students' background and any of the components. This suggests that the components of writing may be of equal importance in writing proficiency and writing development of both subgroups of low-achieving adolescents.

The faster growth in writing we found for the language-minority subgroup would normally be accounted for by the so-called threshold hypothesis in much of the second language literature (for example Alderson, 1984; Bernhardt, 2000; Hulstijn, 2015, Ch. 8). The notion of a threshold implies that a critical amount of L2 knowledge is needed for reading or writing texts in a second language. In our case, low vocabulary and grammar knowledge would have hampered language-minority students' achievements in Grade 7, but passing the threshold would have allowed them to catch up with their native-Dutch peers in Grades 8 and 9. In other words, the language-minority students would have profited more from their expanded linguistic resources than the native-Dutch students. However, our finding that there are no significant interactions of vocabulary and grammar knowledge explaining both groups' different slopes for writing development is inconsistent with this

explanation. If a threshold of linguistic knowledge exists for our students, then substantial interactions between their linguistic knowledge and language background would exist. Therefore, other explanations have to be developed for the difference in growth between our language-minority and native subpopulations. Maybe the language-minority students profit more from writing education in these years than their peers, or maybe they have profited from more writing experience out of school.

Suggestions for future research

Knowledge of grammar and vocabulary were found to be associated with low-achieving adolescents' level of writing proficiency. Investigating these students' written texts may shed more light on changes in lexical or morpho-syntactic characteristics in their writing. This may lead to a better understanding of the roles that vocabulary and grammar play in low-achieving students' writing proficiency level and development. With respect to orthographic knowledge, it is of interest to investigate whether low-achieving students avoid spelling problems by using restricted vocabulary and grammatical structures. This can be done, for example, by examining differences in word use and spelling between low achievers and more proficient writers of the same age.

In order to unravel the nature of the relationship between low-achieving adolescents' gains in grammar knowledge on the one hand and their writing development on the other, we recommend a more detailed investigation of the directionality of the relationship. This can be done, for example, by experimentally manipulating morpho-syntactic knowledge or by interventions directed at systematic exercises in sentence building embedded in the teaching of writing. The effects should be compared with effects of writing instruction without a grammatical training component. Insights into the effects of both conditions on students' writing proficiency as well as on students' grammatical knowledge might provide us with a deeper understanding of the directionality of the relation between growth in grammatical knowledge and writing proficiency. In previous studies among heterogeneous samples, teaching adolescents to construct a complex sentence out of some basic sentences (sentence combining), had positive effects on these students' writing performance (Graham & Perin, 2007). In addition, Fearn and Farnan (2007), Hoogeveen and Van Gelderen (2015), and Myhill, Jones, Lines, and Watson (2012) found positive effects of functional grammar teaching, i.e., grammar teaching related to semantic functions in specific types of texts (genres). This contextualized teaching of grammar does not focus on formal grammatical rules. Rather, the functioning of word groups or grammatical structures in texts is crucial, and students are guided in using these structures appropriately in their own writings. In the study by Myhill et al. (2012) the benefits of this type of grammar teaching were stronger for the more proficient writers in the sample. Therefore, more research within the population of low-achieving adolescents is needed on the issue of whether these students' writing proficiency is positively affected by sentence combining or functional grammar instruction.

Third, assessing low-achieving adolescents' metacognitive knowledge may have suffered from these students' limited explicit knowledge of strategies for reading and writing. In future research, a test in which metacognitive knowledge is assessed in a more concrete context (e.g., consisting of statements explicitly focusing on concrete tasks, such as 'writing a recipe' or 'writing a letter to a friend'), might be a better way of assessing their knowledge and exploring individual differences.

In this study, we did not find a significant relation between metacognitive knowledge and writing. It is important to keep in mind that metacognitive knowledge is distinct from the metacognitive skills that students use in reading and writing (cf. Veenman, Van Hout-Wolters, & Afflerbach, 2006). De Milliano, Van Gelderen, & Sleegers (2012), who conducted a think-aloud study with low-achieving adolescents, showed that students who applied more varied self-regulating strategies in writing, produced texts of higher quality (in that specific task) than their peers who used less varied self-regulatory activities. Thus, differences between low-achieving adolescents' writing quality appear to be related to differences in the application of metacognitive skills in a specific writing task. It would be interesting to investigate how low-achieving students' metacognitive knowledge relates to their metacognitive skills applied in different writing contexts, and analyze both knowledge and skill in relation to students' writing proficiency. For example, associations between students' knowledge of text structures (e.g., knowledge about functions of (sub)titles, or the understanding that only one central idea should be put into a paragraph), and their use of text structuring (e.g., use of appropriate paragraphing) in a specific writing task could be investigated. In addition, relations of the assessed metacognitive knowledge and use with global text quality in the same writing task could be established, as well as relations with global quality of other texts (of the same genre).

Finally, we recommend research into the differential growth patterns in writing proficiency between native-Dutch and language-minority students. We could not explain the differential growth by different roles of vocabulary or grammar knowledge or fluency, neither by differences in metacognitive knowledge. Possibly, there are other differences between both subgroups that could account for the more substantial growth of the language-minority students, for example, differences with respect to their motivation, self-regulation, out-of-school experiences with writing, or the way both groups profit from education.

Implications for education

Although inter-individual differences in level of writing proficiency could be explained by vocabulary knowledge, we did not find effects of gains in vocabulary on students' *growth* in writing proficiency. It could be that individual gains in vocabulary knowledge do not (yet) predict individual differences in writing development because low-achieving students lack the abilities to appropriately apply these gains in vocabulary knowledge in the complex process of composing a text (cf. Graham, Harris, & Mason, 2005). As a consequence, many low-achieving students would potentially benefit from educational attention focusing on the actual use of their (enriched) vocabulary during writing, for example, by raising students'

awareness of the importance of rich vocabulary in texts, and encouraging them to make full use of their lexical knowledge in the process of writing.

Apart from knowledge of vocabulary and grammar, sentence-verification speed accounted for a substantial part of *level* of writing proficiency. Frequent reading helps students to become more fluent readers and, additionally, has a positive effect on their linguistic knowledge (Cunningham & Stanovich, 1991; Swanborn & De Glopper, 1999). These are important components in the process of writing, and, as the findings of this study suggests, they also explain differences in the writing proficiency of low-achieving adolescents. In addition, experience with reading might lead these students to more awareness of characteristics of good texts. Therefore, presumably, frequent reading of different genres may be a good way for improving low-achieving students' writing proficiency. Since many low-achieving adolescents do not read frequently (Van Kruistum, 2013), we recommend to motivate them to read more often and provide them with ample opportunities for access to texts concerning topics that are enjoyable or relevant for them.

Although students' writing proficiency presumably would benefit substantially from practice in writing, in general, text writing is not prioritized in Dutch primary education (Dutch Education Inspectorate, 2012; Kuhlemeier, Van Til, Feenstra, & Hemker, 2013). Apparently, many students do not dispose of elaborate experience in writing texts when they enter Grade 7. Especially for low-achieving students, this limited writing experience might have serious consequences for their writing development during adolescence. Writing practice could raise students' awareness of text types, text writing strategies, text structures, and the appropriate use of linguistic features in texts, which is important in writing. Furthermore, frequent writing might lead to more efficient transcription processes in writing, enabling adolescents to devote more working-memory capacity to rhetorical aspects of their texts. Therefore, we would recommend providing low-achieving adolescents with ample opportunities to write texts, preferably combined with strategic and linguistic support. A teacher could, for example, introduce a writing task by focusing on the role of the reading audience or the function of temporal markers in a text. Students could be provided with (peer) feedback on their first drafts specifically directed to issues that were presented in the introduction of the writing task (cf. Hoogeveen & Van Gelderen, 2015). Presumably, by practicing writing, in combination with this kind of support, students become more aware of specific characteristics of good texts. In addition, it is likely that they make more use of these characteristics in other texts as well, leading to texts of better quality. Finally, positive experiences with writing texts might provide students with more confidence and motivation, which is of great value in learning to write and in approaching new (writing) tasks.

A limitation of the current study concerns the small sample size ($N = 51$). However, our study used a precisely defined and focused sample, in which we controlled for quite a lot of variables (see "Participants" section). For that reason we selected a small group of students from within classrooms. This procedure has the advantage that the characteristics of students in our sample (such as language background) are much more sharply defined than usual in larger samples. Furthermore, testing of all predictors occurred in individual or small group sessions throughout the whole study (see "Procedure" section) making sure that students

understood their tasks well and carried them out according to the instructions. In addition, the use of repeated measures analyses provided us with extra statistical power, using 153 instead of 51 data points for each variable. Therefore, although research to replicate our findings in other samples of schools is highly recommended, we believe the current study has offered some valuable insights into writing proficiency and development of low achievers. First, it has shown that for this group of adolescents improvement in writing proficiency from Grade 7 to 9 is feasible, and, despite their initial falling behind, language-minority students can achieve the same level of writing as their native peers. Second, we have found that vocabulary and grammar knowledge, and speed of sentence verification, play substantial roles in the explanation of *level* of writing proficiency while the contributions of spelling, metacognitive knowledge and word-level fluency were negligible for this group of adolescents. Finally, regarding *development* in writing proficiency, grammatical knowledge accounted for a small part of the variation between students. These are important stepping stones in further establishing the types of educational interventions that are beneficial for low-achieving adolescents' development in writing proficiency.

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Appendix 1

Correlations between writing tasks in Grade 7, 8 and 9. N = 51.

	1. Instructive	2. Argumentative	3. Narrative
Grade 7 correlations			
1. Instructive	1		
2. Argumentative	.36**	1	
3. Narrative	.39**	.38**	1
Grade 8 correlations			
1. Instructive	1		
2. Argumentative	.56**	1	
3. Narrative	.27	.41**	1
Grade 9 correlations			
1. Instructive	1		
2. Argumentative	.23	1	
3. Narrative	.41**	.17	1

Appendix 2

Results of multilevel analyses. Dependent variable is 'writing proficiency—repeatedly measured'.

51 students, 10 classes, 3 times of measurement	Model 0	Model 1	
Variance			
Class		1247.4 (864.8)	
Student	3607.7 (892.6)	2425.9 (734.8)	
Occasion	2575.7 (360.7)	2575.7 (360.7)	
Total	6183.4	6249.0	
Distribution of variance			
Class		20.0%	
Student	58.3%	38.8%	
Occasion	41.7%	41.2%	
Intercept	237.9	237.3	
Main effects	Coef. (SE)		Coef. (SE)
Time of measurement	33.3 (5.0)		33.3 (5.0)
Fit (− 2 * loglikelihood)	1719.9		1714.9
Difference − 2 * loglikelihood			5.0*
Difference *df*			1

*$p < .05$; **$p < .01$; ***$p < .001$

Appendix 3

Means and standard deviations for native-Dutch (n = 25) and language-minority (n = 26) students in grades 7, 8 and 9.

	Grade 7		Grade 8		Grade 9	
	Native-Dutch	Language-minority	Native-Dutch	Language-minority	Native-Dutch	Language-minority
Writing proficiency	266.2 (75.4)	203.8 (93.9)	293.7 (76.1)	263.2 (97.1)	307.9 (41.1)	294.4 (65.2
Receptive vocabulary (Max = 73)	54.3 (6.9)	46.0 (7.6)	56.9 (6.6)	48.0 (9.4)	60.5 (3.3)	50.9 (8.5)
Grammatical knowledge (Max = 50)	36.3 (3.8)	31.2 (5.6)	36.6 (4.3)	31.8 (7.2)	38.0 (4.3)	34.4 (4.6)
Orthographic knowledge (Max = 68)	49.9 (4.6)	45.4 (6.0)	50.4 (5.8)	49.3 (6.9)	51.6 (5.1)	48.5 (6.4)
Metacognitive knowledge (Max = 45)	29.2 (3.9)	26.3 (3.9)	30.0 (4.7)	27.2 (4.3)	31.0 (3.5)	29.2 (4.9)
Word recognition (ms)	825.9 (133.1)	842.8 (114.8)	809.5 (121.0)	826.3 (97.2)	738.4 (148.2)	753.7 (143.3)
Lexical retrieval[a] (ms)	− 120.2 (269.2)	126.0 (329.7)	− 63.1 (196.1)	59.9 (186.9)	− 45.9 (152.6)	44.2 (143.3)
Sentence verification (ms)	4063.9 (653.9)	4587.8 (706.8)	3516.3 (690.0)	4103.2 (593.7)	3097.5 (623.5)	3774.8 (628.2)

[a]Scores corrected by typing speed (difference scores)

Appendix 4

Significant effects of background on students' (N = 51) performance on writing proficiency and the seven independent variables.

	Grade 7	Grade 8	Grade 9
Writing proficiency	*[a]	n.s.	n.s.
Receptive vocabulary	***	***	***
Grammatical knowledge	***[a]	**[a]	**[a]
Orthographic knowledge	**	n.s.	n.s.[a]
Metacognitive knowledge	**	*	n.s.
Word recognition (ms)	n.s.	n.s.	n.s.
Lexical retrieval (ms)	**	*	*
Sentence verification (ms)	**	**	***

n.s. not significant

*$p < .05$; **$p < .01$; ***$p < .001$

[a]With class level included

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