Cognitive and Linguistic Factors in Writing Development

Elise Drijbooms

Behavioural
Science
Institute

Cognitive and Linguistic Factors in Writing Development

Elise Drijbooms

The studies described in this thesis were funded by and conducted at the Behavioural Science Institute, Radboud University Nijmegen, the Netherlands.

ISBN
978-94-028-0143-9

Cover
Francesco Isella

Design/lay-out
Bookbuilders, Nijmegen

Print
Ipskamp Drukkers, Enschede

Cognitive and Linguistic Factors in Writing Development

Proefschrift

ter verkrijging van de graad van doctor
aan de Radboud Universiteit Nijmegen
op gezag van de rector magnificus,
volgens besluit van het college van decanen

en

ter verkrijging van de graad van doctor in de Taalkunde
aan de Universiteit Antwerpen
op gezag van de rector prof. dr. A. Verschoren

in het openbaar te verdedigen op woensdag 25 mei 2016
om 10.30 uur precies

door

Elise Drijbooms
geboren op 5 februari 1986
te Wilrijk, België

Promotoren
Prof. dr. L. T. W. Verhoeven
Prof. dr. D. Alamargot (Université Paris-Est Créteil Val de Marne, Frankrijk)

Copromotoren
Dr. M. A. Groen
Dr. M. Leijten (Universiteit Antwerpen, België)

Manuscriptcommissie
Prof. dr. H. E. T. Knoors
Prof. dr. L. L. M. Van Waes (Universiteit Antwerpen, België)
Dr. R. M. Willems

Success consists in felicity of verbal expression, which every so often may result from a quick flash of inspiration, but as a rule involves a patient search for the mot juste*, for the sentence in which every word is unalterable, the most effective marriage of sounds and concepts.*

Italo Calvino

Contents

Chapter 1	General introduction	9
Chapter 2	The contribution of executive functions to narrative writing in fourth grade children	31
Chapter 3	How executive functions predict development in syntactic complexity of narrative writing in the upper elementary grades	65
Chapter 4	Children's use of evaluative devices in spoken and written narratives	93
Chapter 5	On-line management of written composition: a developmental perspective	127
Chapter 6	General discussion	165
Nederlandse samenvatting		181
Dankwoord		191
Curriculum vitae		199

1

Chapter 1

General introduction

Learning to write is one of the most important, yet also one of the most complex, skills that children attain in school. It is therefore not surprising that it is a process that operates across a long developmental time course. An important developmental transition in writing occurs during the upper elementary grades, when children shift from primarily writing letters and words, to writing extended texts (Berninger, Abbott, Whitaker, Sylvester, & Nolen, 1995). It is commonly accepted that writing texts involves a wide range of transcription skills (e.g., handwriting and spelling), linguistic skills (e.g., grammar, vocabulary), and cognitive skills (e.g., executive functions) (Berman & Ravid, 2009; Berninger & Winn, 2006). These skills support the writer while he recursively executes several writing processes, such as planning ideas, translating ideas into written symbols, and reviewing the text. In the upper elementary grades, as transcription skills become more and more automatized, it is thought that writing performance is increasingly influenced by cognitive and linguistic skills (Berninger & Winn, 2006). Until now, however, the impact of these constraining skills on the written product, in light of the fading importance of transcription skills, has remained underexplored. Moreover, empirical investigations of how developing writers manage the writing process under these constraints through the use of strategies are lacking. Identifying the nature of the cognitive and linguistic underpinnings of writing development, and the way their contribution comes to play out in the written product and writing process is critical for our understanding of the challenges that young writers face. The first, and most prevalent, genre of written discourse that young writers use in elementary school is the narrative (Berninger, Garcia, & Abbott, 2009). Studying narrative writing therefore provides a rich arena within which to study these underpinnings.

Combining a longitudinal study with an experimental study, the present dissertation sought to unravel the contribution of cognitive and linguistic factors to writing development. This introductory chapter positions the current dissertation within a broader theoretical framework, by reverting to recent models of writing development. Against the background of these models, this chapter highlights the issues that are of relevance for this dissertation. At the end of this chapter, an overview of the research questions, and empirical studies addressed in this dissertation will be outlined.

Modeling Writing Development

Writing is a complex activity involving the orchestration of a variety of processes. Models of writing have aimed to highlight the multiple processes that writers are engaged in while composing a text. The first influential model that grasped the complexity of writing was proposed by Hayes and Flower

(1980). Although throughout the years various revisions have been proposed (Chenoweth & Hayes, 2001; Hayes, 1996; 2012), the essential features of the original model are still valid for modern representations of writing. The Hayes and Flower model regards writing as a problem-solving activity during which three cognitive processes are recursively activated: planning, translating, and reviewing. More specifically, a writer must generate ideas, and think about how to organize these ideas into a coherent text, while simultaneously taking rhetorical considerations and constraints of the task environment into account (*planning*). Complex linguistic operations are required to translate ideas into grammatical strings of words (*translating*). At some point during composition, the writer needs to re-read and possibly edit his text to assure that it conveys the author's intended meaning (*reviewing*). Throughout the execution of these cognitive processes, the writer needs to attend to a broad knowledge basis in long-term memory (LTM). Importantly, planning, translating, and reviewing do not operate in a sequential way, but should be viewed as recursive operations that occur in complex patterns throughout written composition.

Despite the influential role of the Hayes and Flower (1980) model for writing research, it has been criticized for its failure to take the developmental foundations of writing into account. Bereiter and Scardamalia (1987) were the first to provide a developmental view on writing. They argued that developing writers manage the complexity of writing by adhering to a strategy that simplifies the task, and stated that this strategy is inherently different from the writing strategy that skilled writers adopt. More specifically, the model highlights that writing development involves a shift in writing strategies, from knowledge-telling in developing or immature writers to knowledge-transforming in skilled writers. The former strategy is an associative step-by-step writing strategy in which ideas are written down as they come to mind, without organizing the conceptual content or linguistic form. The more complex knowledge-transforming strategy, by contrast, involves global planning and the ability to adjust the text content according to rhetorical and pragmatic goals.

Highlighting the challenges that young or immature writers come to face during writing, Berninger and Swanson (1994) revised the Hayes and Flower (1980) model to differentiate sub-processes within translating that are particularly challenging for developing writers: transcription and text generation. The Simple View of Writing and the Not So Simple View of Writing models (Berninger & Amtmann, 2003; Berninger & Winn, 2006) integrated these sub-processes into comprehensive writing models, which constituted a breakthrough in the description of writing development. The most recent model, the Not So Simple View of Writing (Berninger & Winn, 2006), highlights three key processes of writing that interact in an environment of working

memory (WM): transcription, text generation, and executive functions (Figure 1.1).

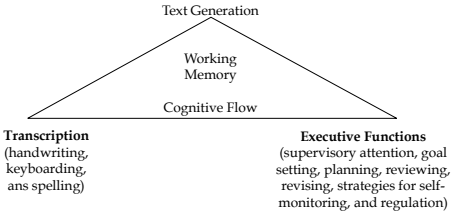

Figure 1.1 The Not So Simple View of Writing (taken from Berninger & Winn, 2006).

Transcription refers to graphomotor and orthographic processes involved in writing, and includes handwriting or keyboarding, and spelling. Graphomotor skills, including fine-motor skills, and low-level linguistic skills, including orthographic and phonological skills, underlie transcription. Text generation refers to the linguistic processes required for the production of text at the word-, sentence-, and text-level. Strengths in oral language skills are assumed to support written text generation. Executive functions encompass the cognitive foundations of writing, and include a complex system of cognitive skills, including low-level executive functions that regulate attention, and high-level executive functions that guide goal-setting, planning, reviewing, and revising.

A common assumption underlying the different models of writing highlighted above is that all writing processes are overseen by WM, which is considered the major locus of cognitive activity during writing. Following capacity theory (Just & Carpenter, 1992; McCutchen, 1996), it is generally assumed that all writing processes compete for limited resources within WM. The more efficient and automatic a writing process is, the lower its cognitive load placed on WM, and the more resources become available for other writing processes. From a developmental perspective, the cost of transcription is high for beginning writers, such that it consumes most WM resources. In order to avoid a cognitive overload, the developing writer needs to manage the different writing processes in an economical way, in order to make efficient use of the available resources. In this sense, the knowledge-telling strategy can be considered an adaptive strategy, because it eases the load on WM (Bereiter & Scardamalia, 1987). Once transcription becomes automatic, resources can be allocated to high-level writing processes and associated skills, such as the linguistic and cognitive processes depicted in the model by Berninger and Winn (2006). Enhanced attention to these high-level writing processes should affect the quality of the written product produced by the writer.

In summary, developmental models of writing have illuminated the different processes and associated skills that can constrain writing throughout

development. An important conclusion resulting from the models is that both the written product and writing process, i.e. strategies, can potentially mirror the extent to which writing is constrained by the demands of these processes on WM.

Writing in the Upper Elementary Grades: a Comprehensive Framework

The upper elementary grades are a critical period to investigate writing development and its constraints, as the nature of writing and writing tasks changes substantially from fourth grade onwards (Berninger et al., 1995). In the upper elementary grades, writers become increasingly proficient in transcription skills, while at the same time, task requirements in the curriculum change and become more complex (Berninger & Chanquoy, 2012). Considering these changes, cognitive and linguistic skills might be expected to start to exert a greater influence on writing (Berninger & Winn, 2006; McCutchen, 1996). The present dissertation is motivated by the need to enhance our understanding of the contribution of each of these skills to writing in the upper elementary grades, and the way they impact on the written product and writing process.

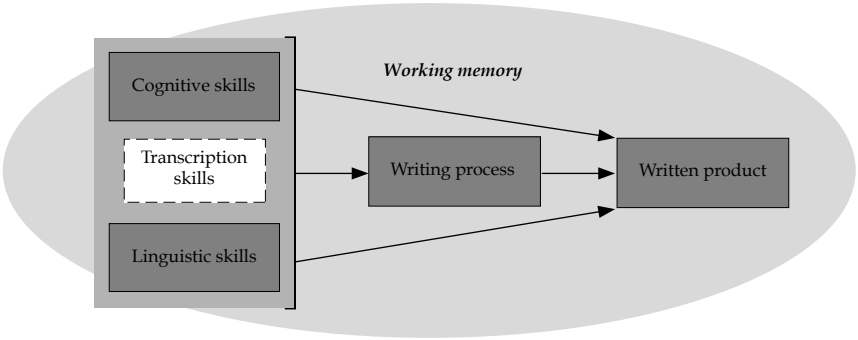

Figure 1.2 A comprehensive framework for understanding writing in the upper elementary grades.

The comprehensive framework that guides the research discussed in the present dissertation is depicted in Figure 1.2. It is not intended to describe all major aspects of writing. Yet, it serves to highlight the potential objects of inquiry and the relationships among them that may help to increase our understanding of writing development in the upper elementary grades. The writing process refers to the set of strategies that the writer uses to implement

the different processes. It is precisely through this complex writing process that the written product, i.e. a text written down, emerges. The cognitive and linguistic skills, along with the transcription skills, refer to the foundational skills as they appear in Berninger and Winn's (2006) model. The framework builds on the assumption that these skills are both directly and indirectly related to the written product through their influence on the writing process, and that WM is the cognitive system within which these relationships are established.

In what follows, the components of this model are clarified into more detail, by emphasizing the questions and issues that merit further research.

Cognitive and Linguistic Skills

Given the complexity of processes and knowledge that the writer needs to coordinate, it should not surprise that writing makes considerable demands on the writer's cognitive skills. More specifically, skilled writing heavily relies on executive functions (EF). Broadly, EF is an umbrella term for a set of cognitive functions that control and regulate purposeful and goal-directed behavior. From a neuropsychological perspective, EF activate prefrontal areas of the brain. In the neuropsychological literature, three core EF have been distinguished (Diamond, 2013; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000): *inhibition* of pre-potent responses, information *updating* and monitoring, and mental set *shifting*. These low-level core EF support high-level EF, i.e. self-regulative behaviors or cognitions such as reasoning, problem-solving, and planning (Diamond, 2013).

Within writing research, EF have generally been conceptualized and studied as the latter high-level EF. They are thus viewed as self-regulative control strategies that scaffold recursive planning, translating, and reviewing processes, and help to execute them in a more integrated manner. Within such a view, little empirical writing research exists that has included neuropsychological measures of EF. Although EF play a central role in skilled writing and have been recognized as foundational skills in Berninger and Winn's (2006) developmental model, there is surprisingly little research on their role in writing development (Graham & Harris, 2000; Hooper, Wakely, de Kruif, & Swartz, 2006). One reason for this is that it is generally assumed that young writers make very limited use of EF, because they need all their cognitive energy to spell words correctly and to form the letters on paper. While it has thus long been argued that developing writers barely engage in high-level self-regulation during writing, there is now accumulating evidence that both low- and high-level EF, as assessed with neuropsychological measures, are involved in children's writing (Altemeier, Abbott, & Berninger, 2008; Altemeier, Jones, Abbott, & Berninger, 2006; Berninger, Abbott, et al.,

2006; Hooper, Swartz, Wakely, de Kruif, & Montgomery, 2002; Hooper et al., 2011). Most research has, however, studied how EF contribute to single word or sentence writing, but none have provided evidence of how EF contribute to more extended written composition, such as narratives, characteristic of writing beyond the early grades of elementary school. Yet, such tasks are cognitively more demanding, rendering EF presumably more critical to writing success (Renz et al., 2003). At the same time, developmental models of writing (Berninger & Winn, 2006) predict that children will be able to exert a higher executive control over writing, once transcription skills start to become automatized.

Among the high cognitive demands of writing is also the need to coordinate multiple linguistic skills to generate a written product. In this respect, oral language skills (e.g., morphology, vocabulary, grammar) are foundational for children's writing development, because ideas need to be translated into oral language before they can be transcribed into written symbols (Berninger & Winn, 2006; Kim, Park, & Park, 2013). Evidence for the role of oral language skills in writing has come from studies involving children whose oral language skills are compromised (Bishop & Clarkson, 2003; Dockrell, Lindsay, Connelly, & Mackie, 2007). Furthermore, recent research has documented how individual differences in oral language skills contribute to writing fluency and writing quality of typically developing children (Hooper, Roberts, Nelson, Zeisel, & Kasambira-Fannin, 2010; Kim et al., 2011; Kim, Al Otaiba, Sidler, & Gruelich, 2013; Olinghouse, 2008; Olinghouse & Leaird, 2009). Surprisingly, there is a paucity of research into the relation between oral language proficiency and writing beyond the early grades of elementary school. Yet, there is much reason to assume that oral language skills may be more implicated in later writing development (Shanahan, 2006). More specifically, the importance of oral language skills increases as attention turns towards the production of increasingly complex extended texts as opposed to single word writing in the early grades. Moreover, as children increasingly automatize handwriting and spelling conventions, they will have more cognitive resources available for carrying out the complex linguistic operations required for translating ideas into a coherent written text (Berninger & Winn, 2006).

Taken together, despite the assumed importance of EF and oral language skills for later writing, to date surprisingly little research has examined their contribution to writing in the upper elementary grades, while simultaneously taking the decreasing importance of transcription skills into account.

The Written Product

Writing is essentially about communicating meaning by translating thoughts into words, the result of which is the written product (Abbott,

Berninger, & Fayol, 2010). The written product is a crucial instrument to look for evidence of writing development, as it may reflect several individual and developmental differences (Dockrell, Rickets, Charman, & Lindsay, 2014). One successful approach for analyzing these individual and developmental differences is the assessment of the underlying dimensions of writing (Puranik, Lombardino, & Altmann, 2008; Wagner et al., 2011). Wagner et al. (2011) proposed a model of several dimensions including macro-organization (i.e., structure or content), productivity (i.e., number of words), and complexity (i.e., mean length of a sentence). The assessment of the written product through these dimensions is based on the premise that they contribute to important properties of text quality. For instance, written texts that exhibit a clear macro-organization, including relevant semantic content and a genre-appropriate structure, demonstrate greater topical and thematic coherence. The latter is particularly important for writing quality, because it aids the reader in constructing a coherent mental representation of the text (van Dijk & Kintsch, 1983). Regarding the productivity dimension, text length is certainly not a goal of writing on its own. However, longer texts provide writers with more opportunities to elaborate sufficiently on topics and to highlight central ideas in a text (Crossley, Weston, McLain Sullivan, & McNamara, 2011). The complexity dimension, by contrast, contributes to text quality through its association with cohesion and linguistic sophistication. It fulfills the role of hierarchically encoding temporal, causal, and motivational relationships in the text (Beers & Nagy, 2009; Coirier, 1996; Verhoeven & van Hell, 2008). A developmental increase in measures tapping the complexity dimension may therefore represent an increase in the ability to express complex ideas (Beers & Nagy, 2009). Although these dimensions have been proven valid for assessment and instruction, research still has to validate which measures are most sensitive to capture developmental differences (Puranik, Wagner, Kim, & Lopez, 2012). As writers have been found to differ in their ability to translate ideas into words at each of these dimensions (Wagner et al., 2011; Whitaker, Berninger, Johnston, & Swanson, 1994), varying rates of development may be expected. Furthermore, developmental models of writing (Berninger & Swanson, 1994; Berninger & Winn, 2006) predict that writing may be constrained by transcription skills, linguistic skills, and cognitive skills. To date, however, relatively little is known about which skills predict individual differences in each of these dimensions. Such evidence could inform teachers about which skills they need to target in their instruction in order to improve particular dimensions of written composition. Longitudinal studies that include several transcription skills, linguistic skills, and cognitive skills as predictors of different dimensions of written composition are needed to answer these two questions.

A study of the written product, for instance through an analysis of the dimensions described above, may also inform our understanding of children's ability to differentiate between speech and writing. Writing differs from speech in terms of processing constraints and communicative contexts, and this exerts an important impact on both the linguistic form and content of written texts compared with speech (Berman & Ravid, 2008; Ravid & Tolchinsky, 2002). In terms of processing constraints, written language does not suffer from the same time pressure as spoken language, and therefore allows the writer to ensure more linguistic variety, and to retrieve lexically and syntactically more complex structures (Ravid & Berman, 2006). Regarding the communicative context, writing is mostly characterized by the absence of an immediate audience, whereas spoken language is inherently produced in a personalized and interactive context. This entails that the writer solely relies on linguistic means to convey meaning. All meaning must be made explicit in language, in order to render the written text meaningful to a distant audience. The writer must thus be aware of the audience and his needs (Purcell-Gates, 1991; Rader, 1982; Ravid & Tolchinsky, 2002; Tannen, 1982). Hence, in comparing speech and writing, clear differences generally arise at the lexical and phrasal level, with written discourse being longer, lexically more diverse, syntactically more complex, and often also better organized and more coherent than spoken discourse (Chafe & Danielewicz, 1986; Gillam & Johnston, 1992; Perera, 1984; Purcell-Gates, 2001; Rubin, 1982).

Previous research has demonstrated that sensitivity to the modality-specific linguistic differences is present early in childhood (Kaderavek & Sulzby, 2000; Purcell-Gates, 1992; 2001; Sulzby, 1994), but does not extend directly into the written product in elementary school (Fey, Catts, Proctor-Williams, Tomblin, & Zhang, 2004; Gillam & Jongston, 1992; Scott & Windsor, 2000). Only after age 9, in the so-called differentiation phase, do written texts appear to become linguistically superior to spoken texts (Kroll, 1981). One reason for differentiation only occurring in the upper elementary grades may be that children need a certain level of proficiency in handwriting skills. In line with developmental models of writing development (Berninger & Winn, 2006), automatization in transcription skills will free more cognitive resources, enabling the writer to increasingly implement his linguistic knowledge for benefiting from the offline time available in writing and for expressing his audience awareness. Such an increased linguistic control is characteristic of the acquisition of linguistic literacy (Ravid & Tolchinsky, 2002). Overall, differentiation of speech and writing has received relatively limited attention within the context of writing development in the upper elementary grades, and has mostly been restricted to a comparison of isolated linguistic features

(e.g., Scott & Windsor, 2000). A communicative approach is warranted which relates linguistic structures more closely to their communicative function.

The Writing Process

The seminal work by Hayes and Flower (1980) initiated a flow of research adopting a process-oriented approach to writing. The major aim of this research is to find out what happens in the writer's mind. Within this approach, it is deemed necessary to find out how writers compose and develop their texts, and which strategies writers employ to cope with the cognitive demands of writing. More specifically, as all writing processes compete for cognitive resources within WM (McCutchen, 1996), an efficient management of the different processes is necessary, in order to not exceed WM capacity. On-line management can be regarded as the temporal organization or timing of writing processes within the limits of WM. In this respect, it has been shown that on-line management of writing processes affects text quality (e.g., Beauvais, Olive, & Passerault, 2011; Breetvelt, van den Bergh, & Rijlaarsdam, 1994; Levy & Ransdell, 1995).

Given that different writing processes may place variable cognitive demands on writers, depending on the level of automatization of these processes (Berninger & Winn, 2006), writers with different levels of expertise may be expected to differ regarding this on-line management. While Bereiter and Scardamalia's (1987) model has indeed proposed that developing, immature writers and more skilled writers compose their texts using different strategies, they have not specified what this implies for the temporal management of the processes in real-time. From a developmental perspective, it is particularly important to document how high-level writing processes (planning, translating, and reviewing) are coordinated with respect to low-level writing processes (transcription), given the high cognitive load placed by these low-level writing processes on WM in young writers. It has been proposed that developing writers are forced to sequentialize low- and high-level writing processes, whereas skilled writers are able to execute low- and high-level writing processes in parallel, as long as these processes do not exceed WM capacity (e.g., Chanquoy, Foulin, & Fayol, 1999; Olive & Kellogg, 2002).

More advanced on-line methods such as registration of graphomotor activity and eye movements are now increasingly implemented in writing research, enabling a more fine-grained approach to this issue. Graphomotor activity refers to the varying patterns of pauses and handwriting that characterize writing. In general, writers spend at least half of their composition time pausing (Alamargot, Dansac, Chesnet, & Fayol, 2006). The duration of a pause is often considered to reflect the complexity of the processes engaged

in (Foulin, 1995), which is why pauses have generally been associated with the cognitively most effortful writing processes that cannot be carried out in parallel with handwriting (Foulin, 1995; Schilperoord, 2002). Although eye movements have been widely used in reading research, they constitute a relatively new research tool in composition studies. The importance of eye movements for the study of writing is strongly connected to the idea that writing is a visual activity guided by the writer's eyes (Olive & Passerault, 2012). More specifically, while writing, the eyes continually move within the task environment, which includes the text produced so far but also any potential documentary sources. Recording the eye movements within this task environment may therefore provide valuable information about when and how the writer engages in different writing processes. For instance, when writers are asked to write a text based on a source, analyzing the visual activity on the source may help to detect the presence of text elaboration processes. Hence, a combined analysis of graphomotor activity and eye movements can be used to infer whether processes occur during pauses, i.e. sequentially, or during handwriting, i.e. parallel, and to characterize these processes into more detail. Until now, very little research has reverted to such an analysis to document the on-line management of writing processes from a developmental perspective.

The Present Dissertation

As follows from the introduction above, writing a text is a challenging task, accomplished through a complex writing process that is subtended by a number of skills, which may more or less constrain writing across development. While nowadays research in the field of writing is rapidly expanding, much remains to be learned about how these constraints come together in the written product and writing process in the upper elementary grades. In the present thesis the contribution of different skills, and notably cognitive and linguistic skills, to writing will be examined both directly, as well as indirectly through an analysis of the written product and writing process. Summarizing the several gaps in the research literature as outlined above, three main questions are addressed in the current thesis:

1) To what extent do cognitive and linguistic skills contribute to different dimensions of narrative composition in the upper elementary grades?
2) To what extent do the narrative compositions of children in the upper elementary grades reflect linguistic differentiation of speech and writing?

3) To what extent does the on-line management of written narrative composition, as evidenced by graphomotor activity and eye movements, differ between fifth graders and undergraduate students?

Our focus on narrative writing is motivated by the fact that narratives are an integral part of educational curricula from the early primary grades throughout high school (Roth, 2000). As narratives have been widely used as a means towards understanding language development, their importance as a vehicle for furthering knowledge of writing development is warranted. For reasons of reliability and validity, only picture elicitation tasks were used to assess narrative writing.

The following chapters describe four empirical studies in which the research questions were addressed. The first questions were the central topics of investigation in a longitudinal study, whereas the last question was addressed through an experimental study adopting a process-oriented approach. *Chapter 2* and *Chapter 3* deal with the first research question, and present the results of the longitudinal study. We longitudinally followed a group of Dutch typically developing children from fourth to sixth grade. A large test battery tapping transcription skills, oral language skills, and EF was administered to them in fourth grade. In addition, children's narrative writing skills were assessed both in fourth and in sixth grade through a narrative picture elicitation task. *Chapter 2* discusses how low- and high-level EF contribute to different dimensions of narrative composition in fourth grade, beyond the contribution of transcription skills and oral language skills. *Chapter 3* extends the results of the previous chapter, by examining the longitudinal predictive role of transcription skills, oral language skills, and EF for growth in narrative writing between fourth and sixth grade. The study described in *Chapter 4* uses the written narratives, in addition to spoken narratives, collected through the longitudinal study to provide a linguistic account of writing development. By highlighting a key communicative function of narrative discourse, i.e. the use of evaluative devices, this study illustrates the extent to which developing writers in the upper elementary grades are able to differentiate linguistically between speech and writing. In *Chapter 5*, the results of the experimental study are presented. For this study, the writing process of 34 fifth graders and 38 undergraduate students was investigated in real-time. All participants were asked to write a narrative text from a visual source presenting a sequenced picture story, while their graphomotor activity and eye movements were recorded. Through the combined analysis of graphomotor activity and eye movements, we aimed to gain insight into the writers' on-line management of low- and high-level writing processes, and we explored the relationship between on-line management and text quality. Finally, *Chapter 6* provides a

summary of the main results of the empirical studies, and presents the general conclusions. Moreover, limitations of the present thesis, suggestions for future research, and implications for educational practice will be discussed.

References

Abbott, R. D., Berninger, V. W., & Fayol, M. (2010). Longitudinal relationships of levels of language in writing and between writing and reading in grades 1 to 7. *Journal of Educational Psychology, 102*, 281-298. doi:10.1037/a0019318

Alamargot, D., Chesnet, D., Dansac, C., & Ros, C. (2006). Eye and Pen: A new device for studying reading during writing. *Behavior Research Methods, Instruments, & Computers, 38*, 287-299. doi:10.3758/BF03192780

Altemeier, L., Abbott, R. D., & Berninger, V. W. (2008). Executive functions for reading and writing in typical literacy development and dyslexia. *Journal of Clinical and Experimental Neuropsychology, 30*, 588-606. doi:10.1080/13803390701562818

Altemeier, L., Jones, J., Abbott, R. D., & Berninger, V. W. (2006). Executive functions in becoming writing readers and reading writers: Note-taking and report writing in third and fifth graders. *Developmental Neuropsychology, 29*, 161-173. doi:10.1207/s15326942dn2901_8

Beers, S. F., & Nagy, W. (2009). Syntactic Complexity as a Predictor of Adolescent Writing Quality: Which Measures? Which Genre?. *Reading and Writing: An Interdisciplinary Journal, 22*, 185-200. doi:10.1007/s11145-007-9107-5

Beauvais, C., Olive, T., & Passerault, J.-M. (2011). Why are some texts good and others not? Relationship between text quality and on-line management of the writing processes. *Journal of Educational Psychology, 103*, 415-428.

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Lawrence Erlbaum.

Berman, R. A., & Ravid, D. (2009). Becoming a literate language user: Oral and written text construction across adolescence. In D. R. Olson & N. Torrance (Eds.), *Cambridge handbook of literacy* (pp. 92-111). Cambridge, UK: Cambridge University Press.

Berninger, V. W., Abbott, R. D., Thomson, J., Wagner, R., Swanson, H. L., Wijsman, E., Raskind, W. (2006). Modeling developmental phonological core deficits within a working memory architecture in children and adults with developmental dyslexia. *Scientific Studies in Reading, 10*, 165-198. doi:10.1207/s1532799xssr1002_3

Berninger, V. W., Abbott, R. D., Whitaker, D., Sylvester, L., & Nolen, S. B. (1995). Integrating low- and high-level skills in instructional protocols for writing disabilities. *Learning Disability Quarterly, 19*, 293-309. doi:10.2307/1511235

Berninger, V. W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In H. Swanson, K. Harris & S. Graham (Eds.), *Handbook of Learning Disabilities* (pp 323-344). New York, NY: Guilford Press.

Berninger, V. W., & Chanquoy, L. (2012). What writing is and how it changes across early and middle childhood development: A multidisciplinary perspective. In E. Grigorenko, E. Mambrino & D. Preiss (Eds.), *Writing: A mosaic of perspectives and views* (pp. 65-84). New York, NY: Psychology Press.

Berninger, V. W., Garcia, N. P., & Abbott, R. D. (2009). Multiple processes that matter in writing instruction and assessment. In G. A. Troia (Ed.), *Instruction and assessment for struggling writers* (pp. 15-50). New York, NY: Guilford Press.

Berninger, V. W., & Swanson, H. L. (1994). Modifying Hayes and Flower's model of skilled writing to explain beginning and developing writing. In J. S. Carlson (Ed.) & E. C. Butterfield (Vol. Ed.), *Advances in cognition and educational practice, Vol.2: Children's writing: Toward a process theory of the development of skilled writing* (pp. 57-81). Greenwich, CN: JAI Press.

Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C.

MacArthur, S. Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96-114). New York, NY: Guilford Press.

Berman, R. A., & Ravid, D. (2008). Analyzing narrative informativeness in speech and writing. In A. Tyler, Y. Kim & M. Takada (Eds.). *Language in the Context of Use: Cognitive Approaches to Language and Language Learning* (pp. 79-101). The Hague, NL: Mouton de Gruyter [Cognitive Linguistics Research Series].

Bishop, D. V. M., & Clarkson, B. (2003). Written language as a window into residual language deficits: A study of children with persistent and residual speech and language impairments. *Cortex, 39*, 215-237. doi:10.1016/S0010-9452(08)70106-0

Breetvelt, I., van den Bergh, H., & Rijlaarsdam, G. (1994). Relation of writing processes and text quality: When and how? *Cognition and Instruction, 12*, 103-123.

Chafe, W. L. & Danielewicz, J. (1986). Properties of spoken and written language. In R. Horowitz & S. J. Samuels (Eds.), *Comprehending oral and written language* (pp. 61-93). Orlando, FL: Academic Press.

Chanquoy, L., Foulin, J. N., & Fayol, M. (1996). Writing in adults: A real-time approach. In G. Rijlaarsdam, H. van den Bergh & M. Couzijn (Eds.), *Theories, models, and methodology in writing research* (pp 36-43). Amsterdam, the Netherlands: Amsterdam University Press.

Chenoweth, A., & Hayes, J. R. (2001). Fluency in writing: generating text in L1 and L2. *Written communication, 18*, 80-98. doi:10.1177/0741088301018001004

Coirier, P. (1996). Composing argumentative texts: Cognitive and/or textual complexity. In G. Rijlaarsdam, H. van den Bergh & M. Couzijn (Eds.), *Theories, models and methodology in writing research* (pp. 317-338). Amsterdam, the Netherlands: Amsterdam University Press.

Crossley, S. A., Weston, J., McLain Sullivan, S. T., & McNamara, D. S. (2011). The development of writing proficiency as a function of grade level: A linguistic analysis. *Written Communication, 28*, 282-311. doi:10.1177/0741088311410188

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135-168. doi:10.1146/annurev-psych-113011-143750

Dockrell, J. E., Lindsay, G. A., Connelly, V., & Mackie, C. (2007). Constraints in the production of written text in children with specific language impairments. *Exceptional Children, 73*, 147-164. doi:10.1177/001440290707300202

Dockrell, J. E., Ricketts, J., Charman, T., & Lindsay, G. (2014). Exploring writing products in students with language impairments and autism spectrum disorders. *Learning and Instruction, 32*, 81-90. doi:10.1016/j.learninstruc.2014.01.008

Fey, M. E., Catts, H. W., Proctor-Williams, K., Tomblin, J. B., & Zhang, X. (2004). Oral and written story composition skills of children with language impairment. *Journal of Speech, Language and Hearing Research, 47*, 1301-1318. doi:10.1044/1092-4388(2004/098)

Gillam, R. B., & Johnston, J. R. (1992). Spoken and written language relationships in language/learning-impaired and normally achieving school-age children. *Journal of Speech and Hearing Research, 35*, 1303-1315. doi:10.1044/jshr.3506.1303

Graham, S., & Harris, K. (2000). The role of self-regulation and transcription skills in writing and writing development. *Educational Psychologist, 35*, 3-12. doi:10.1207/S15326985EP3501_2

Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In M. Levy & S. Ransdell (Eds.), *The Science of Writing* (pp. 1-27). Hillsdale, NJ: Erlbaum.

Hayes, J. R. (2012). Modeling and remodeling writing. *Written Communication, 29*, 369-388. doi:10.1177/0741088312451260

Hayes, J. R., & Flower, L. S. (1980). Identifying the organization of writing processes. In L. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3-30). Hillsdale, NJ: Lawrence Erlbaum.

Hooper, S. R., Costa, L. J., McBee, M., Anderson, K., Yerby, D. C., Knuth, S. B., & Children, A. (2011). Concurrent and longitudinal neuropsychological contributors to written language expression in first and second grade students. *Reading and Writing: An Interdisciplinary Journal, 24*, 221-252. doi:10.1007/s11145-010-9263-x

Hooper, S. R., Roberts, J. E., Nelson, L., Zeisel, S., & Kasambira-Fannin, D. (2010). Preschool predictors of narrative writing skills in elementary school children. *School Psychology Quarterly, 25*, 1-12. doi:10.1037/a0018329

Hooper, S. R., Swartz, C. W., Wakely, M. B., de Kruif, R. E. L., & Montgomery, J. W. (2002). Executive functions in elementary school children with and without problems in written expression. *Journal of Learning Disabilities, 35*, 57-68. doi:10.1177/002221940203500105

Hooper, S. R., Wakely, M. B., de Kruif, R. E. L., & Swartz, C. W. (2006). Aptitude-treatment interactions revisited: Effect of metacognitive intervention on subtypes of written expression in elementary school students. *Developmental Neuropsychology, 29*, 217-241. doi:10.1207/s15326942dn2901_11

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review, 99*, 122-149. doi:10.1007/s11145-013-9480-1

Kaderavek, J. N., & Sulzby, E. (2000). Narrative production by children with and without specific language impairment: Oral narratives and emergent readings. *Journal of Speech, Language and Hearing Research, 43*, 34-49. doi:10.1044/jslhr.4301.34

Kim, Y. S., Al Otaiba, S., Puranik, C., Folsom, J. S., Greulich, L., & Wagner, R. K. (2011). Componential skills of beginning writing: an exploratory study. *Learning and Individual Differences, 21*, 517-525. doi:10.1016/j.lindif.2011.06.004

Kim, Y. S., Al Otaiba, S., Folsom, J. S., Gruelich, L., & Puranik, C., J. (2013). Language, literacy, and attentional behaviors, and instructional quality predictors of written composition for first graders. *Early Childhood Research Quarterly, 28*, 461-469. doi:10.1016/j.ecresq.2013.01.001

Kim, Y.S., Park, C., & Park, Y. (2013). Is academic language use a separate dimension in beginning writing? Evidence from Korean children. *Learning and Individual Differences, 27*, 8-15.

Kroll, B. (1981). Developmental relationships between speaking and writing. In B. Kroll & R. Vann (Eds.), *Exploring speaking-writing relationships: Connections and contrasts* (pp. 32-54). Champaign, IL: National Council of Teachers of English.

Levy, C. M., & Ransdell, S. (1995). Is writing as difficult as it seems? *Memory & cognition, 23*, 767-779. doi:10.3758/BF03200928

McCutchen, D. (1996). A capacity theory of writing: working memory in text composition. *Educational Psychology Review, 8*, 299-335. doi:10.1007/BF01464076

Miyake, A., Friedman, N., Emerson, M., Witzki, A., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*, 49-100. doi:10.1006/cogp.1999.0734

Olinghouse, N. G. (2008). Student- and instruction-level predictors of narrative writing in third-grade students. *Reading and Writing: An Interdisciplinary Journal, 21*, 3-26. doi:10.1007/s11145-007-9062-1

Olinghouse, N. G., & Leaird, J. T. (2009). The relationship between measures of vocabulary and narrative writing quality in second- and fourth-grade students. *Reading and Writing: An Interdisciplinary Journal, 22*, 545-565. doi:10.1007/s11145-008-9124-z

Olive, T., & Kellogg, R. T. (2002). Concurrent activation of high-and low-level production processes in written composition. *Memory and Cognition, 30*, 594-600. doi:10.3758/BF03194960

Olive, T., & Passerault, J.-M. (2012). The visuospatial dimension of writing. *Written Communication, 29*, 326-344. doi:10.1177/0741088312451111

Perera, K. (1984). *Children's writing and reading*. London, UK: Basil Blackwell.

Puranik, C., Lombardino, L., & Altmann, L. (2008). Assessing the microstructure of written language using a retelling paradigm. *American Journal of Speech-Language Pathology, 17*, 107-120. doi:10.1044/1058-0360(2008/012)

Puranik, C., Wagner, R. K., Kim, Y., & Lopez, D. (2012). Multivariate Assessment Of Processes In Elementary Students' Written Translation. In M. Fayol, D. Alamargot & V. W. Berninger (Eds.), *Translation of Thought to Written Text While Composing: Advancing Theory, Knowledge, Research Methods, Tools, and Applications* (pp. 249-274). New York, NY: Psychology Press.

Purcell-Gates, V. (1991) Ability of well-read-to kindergartners to decontextualise/recontextualise experience into a written-narrative register. *Language and Education, 5*, 177-188. doi:10.1080/09500789109541309

Purcell-Gates, V. (2001). Emergent literacy is emerging knowledge of written, not oral language. *New Directions for Child and Adolescent Development, 92*, 7-22. doi:10.1002/cd.12

Rader, M. (1982). Context in written language: the case of imaginative fiction. In D. Tannen (Ed.), *Exploring orality and literacy* (pp. 189-198). Norwoord, NJ: Ablex.

Ravid, D., & Berman, R. A. (2006). Information density in the development of spoken and written narratives in English and Hebrew. *Discourse Processes, 41,* 117-149. doi:10.1207/s15326950dp4102_2

Ravid, D., & Tolchinsky, L. (2002). Developing linguistic literacy: a comprehensive model. *Journal of Child Language, 29*, 419-448. doi:10.1017/S0305000902005111

Renz, K., Lorch, E. P., Milich, R., Lemberger, C., Bodner, A., & Welsh, R. (2003). On-line story representation in boys with attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology, 31*, 93-104. doi:10.1023/A:1021777417160

Roth, F. P. (2000). Narrative writing: Development and teaching with children with writing difficulties. *Topics in Language Disorder, 20*, 15-28. doi:10.1097/00011363-200020040-00004

Rubin, D. (1982). Adapting syntax in writing to varying audiences as a function of age and social cognitive ability. *Journal of Child Language, 9*, 497-510. doi:10.1017/S0305000900004839

Schilperoord, J. (2002). On the cognitive status of pauses in discourse production. In T. Olive & M. C. Levy (Eds.), *Contemporary Tools and Techniques for Studying Writing* (pp. 61–87). Dordrecht, NL: Kluwer Academic Publishers.

Scott, C. M., & Windsor, J. (2000). General language performance measures in spoken and written narrative and expository discourse of school-age children with language-learning disabilities. *Journal of Speech, Language and Hearing Research 43,* 324-339. doi:10.1044/jslhr.4302.324

Shanahan, T. (2006). Relations among oral language, reading, and writing development. In C. MacArthur, S. Graham & J. Fitzgerald (Eds). *Handbook of Writing Research* (pp. 171-183). New York, NY: Guilford.

Sulzby, E. (1994). Children's emergent reading of favorite storybooks: A developmental study. In R. B. Ruddell, M. R. Ruddell & H. Singer (Eds.), *Theoretical models and processes of reading* (pp. 244-280). Newark, DE: International Reading Association.

Tannen, D. (1982). Oral and Literate Strategies in Spoken and Written Narratives. *Language, 58*, 1-21. doi:10.2307/413530

van Dijk, T.A., & Kintsch, W. (1983). *Strategies of discourse comprehension*. New York, NY: Academic Press.

Verhoeven, L. , & Van Hell, J. G. (2008). From knowledge representation to writing text: A developmental perspective. *Discourse Processes, 45*, 387-405. doi:10.1080/01638530802145734

Wagner, R. K., Puranik, C. S., Foorman, B., Foster, E., Tschinkel, E., & Kantor, P. T. (2011). Modeling the development of written language. *Reading and Writing: An Interdisciplinary Journal, 24*, 203-220. doi:10.1007/s11145-010-9266-7

Whitaker, D., Berninger, V. W., Johnston, J., & Swanson, L. (1994). Intraindividual differences in levels of language in intermediate grade writers: Implications for the translating process. *Learning and Individual Differences, 6*, 107-130. doi:10.1016/1041-6080(94)90016-7

Chapter 2

The contribution of executive functions to narrative writing in fourth grade children

2

This chapter has been published as: Drijbooms, E., Groen, M. A., & Verhoeven, L. (2015). The contribution of executive functions to narrative writing in fourth grade children. *Reading and Writing: An Interdisciplinary Journal, 28*, 989-1011. doi:10.1007/s11145-015-9558-z

Abstract

The present study investigated the contribution of executive functions to narrative writing in fourth grade children, and evaluated to what extent executive functions contribute differentially to different levels of narrative composition. The written skills of 102 Dutch children in fourth grade were assessed using a narrative picture elicitation task. In addition, a large test battery assessing transcription skills, language skills and executive functions, was administered. The results showed that executive functions contributed both directly and indirectly to narrative composition. More specifically, analyses revealed that inhibition and updating, but not planning, contributed directly to the text length of the narrative, and indirectly, through handwriting, to the text length, syntactic complexity, and story content. The findings underscore the need to assess a variety of executive functions and support the idea that in developing writers executive functions also play a role in more complex written composition tasks, such as narrative writing.

One of the first and most widely accepted definitions of writing is that the act of composing a text is a goal-directed thinking process which is guided by the writer's own growing network of goals (Hayes & Flower, 1980). Regarding writing as a goal-directed activity entails the assumption that several executive functions (EF) – mental processes involved in goal-directed activities (Miller & Cohen, 2001; Shallice, 1982) – underlie and support its execution.

Within developmental writing research, EF have mostly been conceptualized as higher-level self-regulation strategies that guide and monitor the cognitive processes in writing. In the Hayes and Flower (1980) model these are known as planning, translating, reviewing, and revising. As such, much research has adopted a pedagogical approach and has focused on training these self-regulative EF in children (e.g., Graham & Harris, 1993; Graham & Harris, 1998; Harris & Graham, 1996). According to the Simple View of Writing (Berninger & Amtmann, 2003) these EF play a limited role in the early stages of writing development due to children's immature transcription skills and the limited capacity of working memory (WM). The model conceptualizes the writing process as consisting of two primary components, transcription and EF, that support a third component known as text generation in an environment of WM. In the model, transcription encompasses handwriting and spelling. EF include the high-level processes of planning, monitoring and revising. Text generation refers to the translation of ideas into linguistic representations at the word-, sentence-, and text-level. In developing writers, transcription contributes most to text generation, as it takes up all of the available cognitive resources in WM. In order to avoid a cognitive overload, young writers resort to a knowledge-telling strategy that includes linearly writing whatever the writer knows about a topic, with very limited involvement of higher-level EF such as planning and revising (Bereiter & Scardamalia, 1987; Graham, Harris, & Olinghouse, 2007). As writing development progresses and the cognitive load of the writing task associated with the demands of transcription decreases, it is thought that young writers gradually move towards a knowledge-transforming strategy: an increasing use of higher-level EF allows them to attend to the global structure of the text, resulting in greater overall coherence (Bereiter & Scardamalia, 1987).

Recently, researchers have begun to elaborate the idea that not only high-level EF, but also low-level EF contribute to the writing process of developing writers (Berninger & Chanquoy, 2012; Berninger & Winn, 2006). In a subsequent adaptation of the Simple View of Writing, Berninger and Winn (2006) incorporate a complex system, called supervisory attention, to account for the role of low-level EF in the executive control of the writing process. Supervisory attention is thought to enable the writer to maintain attentive during the writing task, to devote conscious attention to several

metalinguistic and metacognitive subtasks, and to generate cognitive engagement necessary for effective writing performance. Berninger and Richards (2002, 2010) have consequently proposed that a panel of low-level EF constitute the underpinnings of this supervisory attention architecture. The latter then enhances the intercommunication between the sensory and motor, language, and high-level EF as they engage in writing processes. In all, it is argued that both the low- and high-level EF contribute to writing. Although low-level EF have previously been conceptualized as a unitary construct of supervisory attention, there is now general agreement that there exist three core low-level EF that are both intercorrelated and separable: inhibition, updating, and shifting (Diamond, 2013; Lehto, Juujarvi, Kooistra, & Pulkkinen, 2003; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Following Diamond (2013), inhibition involves 1. the capacity to selectively attend to specific stimuli in WM while suppressing attention to other stimuli (selective attention), 2. the discipline to stay on task and complete the task despite distractors (sustained attention), and 3. the ability to inhibit prepotent responses (response inhibition). Updating refers to the ability to store and update relevant information in WM. Shifting, finally, including cognitive flexibility, involves the capacity to switch between tasks and mental sets. From these so-called low-level EF higher-level EF are built such as reasoning, problem solving and planning (Diamond, 2013). Table 2.1 presents an overview of these EF and their corresponding cognitive skills.

The panel of low-level EF, assumed to underlie and support the high-level EF (Berninger & Richards, 2010), has received much less attention and little empirical research has used standard neuropsychological measures of EF to investigate their role in developing writers. Hooper, Swartz, Wakely, de Kruif, and Montgomery (2002) showed that low-level EF tapping initiating, set shifting and sustaining could differentiate good and poor writers in fourth and fifth grade. A subsequent study by their group (Hooper et al., 2011) demonstrated the importance of low-level EF as early predictors of spelling and written expression in even younger (first and second grade) children. Altemeier, Jones, Abbott, and Berninger (2006) investigated the importance of low-level EF for developing reading-writing connections in third and fifth graders and found that different low-level EF contributed uniquely, depending on the specific reading-writing task and the grade level of the children. More specifically, inhibition was found to contribute most to a note-taking task, whereas a shifting measure was a strong predictor of a report-writing task. Altemeier, Abbott, and Berninger (2008) showed that the low-level EF of inhibition and shifting explained variance in spelling and written expression in third, fourth and fifth grade children. The contribution of low-level EF to written expression was, however, not easily interpreted due to the lack of a

linear progression across development. The authors suggested therefore that different EF might differentially contribute to word-level versus text-level writing skills: inhibition and shifting may support word-level processing, whereas other more high-level EF, not measured in their study, may predict text-level processing.

Table 2.1
Overview of Executive Functions and their Corresponding Cognitive Skills

Executive Functions and their Corresponding Cognitive Skills		
Low-level EF	Inhibition	1. The ability to selectively attend to specific stimuli while suppressing attention to other stimuli (selective attention) 2. The ability to stay on task and complete the task despite distractors (sustained attention) 3. The ability to inhibit prepotent responses (response inhibition)
	Updating	The ability to store and update relevant information in WM
	Shifting	The ability to switch between tasks and mental sets
High-level EF	Reasoning, problem-solving, planning	The ability to develop new ideas, to plan in advance, and to approach tasks in an efficient/ strategic manner. Writing-specific EF: 1. planning involving both idea generation and goal-setting, 2. translating cognitive representations in linguistic symbols, 3. reviewing and revising text

Although these recent studies suggest that empirically measured low- and high-level EF might be more important to the early development of written

language skills than previously asserted, some limitations are worth noting. Firstly, few attempts have been made to disentangle the contribution of different EF to writing in children. Some have consolidated several variables assessing EF into a single EF construct for data analysis (Hooper et al., 2011), whereas others did differentiate the contribution of different EF, but used a limited test battery to assess EF (Altemeier, Jones, et al., 2006; Altemeier, Abbott, et al., 2008). While previous research has left largely unspecified how the three low-level EF of inhibition, updating and shifting established by Miyake et al. (2000) contribute to overall writing performance, based on their nature it can be assumed that they jointly contribute to assert cognitive control during the composition of written text (Kellogg, Whiteford, Turner, Cahill, & Mertens, 2013). Inhibition might for instance play a substantial role in suppressing inappropriate lexical representations at the word-level and grammatical structures at the sentence-level, and selecting a relevant set of words and phrase structures (Kellogg et al., 2013). Shifting could be involved in supporting this process by switching between an inhibited set and a newly activated set. Writers who experience difficulties in selecting the appropriate lexical and grammatical representations may take longer to generate text, resulting in shorter texts and simpler sentences. Similarly, at the textual level, writers need to inhibit irrelevant ideas so as to focus and organize the main ideas (Altemeier, Jones, et al., 2006; Kellogg et al., 2013). The organization of ideas, in turn, involves thinking over larger stretches of space and time, and might be more easily supported by higher-level EF such as planning (Altemeier, Abbott, et al., 2008). Updating, finally, might be required in changing and manipulating the contents of WM as the writer's thoughts develop and the text emerges. Composing a text requires building and storing a text representation in long-term memory. As composing progresses, the contents of WM need to be constantly updated to align with this stored representation. Previous representations of how far the writer has progressed in the task require updating as the writer keeps track of the position in the sentence at hand and the position in the written text as a whole (St-Clair Thompson & Gathercole, 2006).

A second limitation of previous studies on writing and EF is that a variety of measures of written outcome has been used in these studies, but none have provided an elaborated assessment of written composition, such as narrative expression. Particularly in middle to late elementary school, writing tasks shift towards text composing and become more demanding and difficult. Such tasks require careful planning and thoughtful reflection, making EF presumably more critical to writing quality (Milch-Reich, Campbell, Pelham, Connelly, & Geva, 1999; Renz et al., 2003; Luo & Timler, 2008). It is thus important to relate EF to more complex writing tasks such as written composition.

Recent research has specified two levels of written composition: microstructure (i.e. at the local word and sentence level) and macrostructure (i.e. at the global text or discourse level) (Puranik, Lombardino, & Altmann, 2008; Wagner et al., 2011). Microstructural analysis typically includes measures of productivity and complexity. Macrostructural analysis, on the other hand, refers to the overarching coherence and organization of a text and may include measures of structure (e.g., logical ordering and episode structure) and content (e.g., idea units). As shown by Table 2.2, these micro- and macrostructural levels correspond very closely to the levels of language at which text is generated (Wagner et al., 2011; Whitaker, Berninger, Johnston, & Swanson, 1994): the productivity factor corresponds to the word-level, the complexity factor to the sentence-level, and the macrostructural factor to the text-level. Assessment of writing performance on micro- and macrostructural levels has the potential to differentiate both interindividual and intraindividual differences in the ability to translate ideas into words, sentences and text (Wagner et al., 2011; Whitaker et al., 1994). Within developing writers themselves, the competence to translate ideas into words does not necessarily imply equal competence at the sentence- and text-level. These intraindividual differences suggest that the levels of language at which text generation occurs, might each require a different process, bearing a different cognitive cost. In view of the assumption that different low- and high-level EF may be differentially relevant to word-level versus text-level writing activities (Altemeier, Abbott, et al., 2008), an interesting question is whether the word-, sentence-, and text-level within a written composition are also regulated by different EF.

Table 2.2
Overview of Levels of the Written Composition, their Corresponding Levels of Language and the Measures Used to Assess Performance

Levels of Composition	Levels of Language	Measures
Microstructure	Word-level	Productivity
	Sentence-level	Complexity
Macrostructure	Text-level	Content, structure

To summarize, EF have been recognized as an important contributor to writing in the adult writer and recently also in the beginning writer. However, studies on EF in writing of children that used standard neuropsychological measures of low- and high-level EF are limited. Furthermore, although narrative composition constitutes an important writing activity in elementary school grades, little is known about the relationship between EF and narrative composition in the young writer (but see Hooper et al., 2002). Some of the

studies that adopted a neuropsychological approach have suggested that different EF may contribute differentially to word-level and text-level writing outcomes in children (Altemeier, Jones, et al., 2006; Altemeier, Abbott, et al., 2008). As such we ask whether the word-, sentence-, and text-level aspects of a written composition are also regulated by different low- and high-level EF. The current study addresses these issues by assessing narrative writing in typically developing children in fourth grade and consequently evaluating whether individual differences in empirically measured EF can predict individual differences in narrative composition at the micro- and macrostructural level. In contrast to previous studies, a broad neuropsychological test battery is used to assess low- and high-level EF tapping inhibition, updating, shifting, and planning skills, in addition to measures of transcription and language skills. Given recent evidence of the role of EF in writing of early elementary school children, it is hypothesized that EF will also predict narrative writing skills of fourth grade children. At this age, the constraint of transcription skills is assumed to have decreased significantly, allowing for more EF to be allocated to text generation. Second, we tested the hypothesis that the micro- and the macrostructural levels of the narrative composition are affected differentially by different EF, given the different levels of language involved.

Method

Participants

Participants included 121 Dutch fourth grade children from four elementary schools in the Netherlands. Teachers assisted in the selection process in order to exclude children with known sensory and motor impairments and children diagnosed with dyslexia, Asperger syndrome, PDD-NOS, and/or Attention Deficit (Hyperactivity) Disorder. This resulted in the exclusion of 14 children with divergent diagnoses. Children with a nonverbal cognitive ability of at least two standard deviations below the mean were also excluded from the sample (Raven's Coloured Progressive Matrices; Raven, 1956). This was the case for five children, resulting in a final sample of 102 children for data analysis. The sample comprised 46.1% girls and children ranged in age from 8.6 to 11.1 years, with a mean age of 9.6 years (*SD* = 5.74 months). No information about the socio-economic status (SES) of the individual children was available. However, the children attended schools that were all situated in neighbourhoods, categorized as middle to middle-high SES according to The Netherlands Institute for Social Research. All participating children spoke Dutch, but 7% of the children were bilingual in that they also spoke another language at home. To control for a possible influence of linguistic diversity on the results, we ensured that bilingual children did not perform worse on

vocabulary, grammar and spelling than monolingual children. The data of all bilingual children were retained for the analyses, as no significant differences were found. The children were tested at the beginning of the school year.

Two individual sessions and two classroom sessions were administered. The measures were divided between two administration blocks: Block A and Block B. Block A included the measure of nonverbal cognitive ability, the measure of handwriting fluency, and the language measures. Block B comprised the executive function measures. The order in which the blocks were administered was then counterbalanced to minimize order effects. The classroom sessions were administered by the first author and included the spelling task (first classroom session), and the narrative writing task (second classroom session).

The Narrative Task

For the purpose of this study, a picture elicitation task – the Expression, Reception and Recall of Narrative Instrument (ERRNI; Bishop, 2004) – was used to assess children's written narrative composition skills. The instrument consists of two parallel forms, the Beach Story and the Fish Story, that are each linked to a sequenced story of 15 pictures. In this study, the initial story-telling part of the Fish Story was used as the written narrative task. Children were each presented with the picture booklet for the Fish Story. The booklet was available to them throughout the session, so they were allowed to look at the pictures while writing. The children were instructed to take their time to look at all the pictures, after which they were asked to start writing a story. Neither the duration of composition nor the length of the narrative were imposed.

Analysis of Written Narratives

All written narratives were transcribed using CLAN from CHILDES (MacWhinney, 2000). Stories were divided into T-units, or minimal terminable syntactic units: defined as an independent main clause with any subordinate clauses associated with it (Hunt, 1966). The transcripts were prepared by two transcribers. Twenty percent of the narratives were transcribed by both transcribers, so that inter-rater agreement could be calculated. Inter-rater agreement was computed for segmentation of T-units. A high level of agreement (97%) was reached. The following measures of microstructure and macrostructure were derived from the transcripts.

Productivity. Text length in number of words was used as a microstructural measure of productivity. Text length was calculated by counting the number of words produced in each written narrative. This variable is automatically calculated by CLAN, and therefore does not require a reliability estimate.

Syntactic complexity. The Mean Length of a T-unit in words (MLTUw) was used as a microstructural measure of syntactic complexity. Complexity was thus calculated by dividing the number of words produced by the number of T-units. This variable is automatically calculated by CLAN, and therefore does not require a reliability estimate.

Story content. Story content was used to assess the macrostructure of the narrative. Story content or content coherence refers to the degree of semantic informativeness in a text, and is a frequently used measure in narrative assessment (e.g., Bishop, 2004; Cragg & Nation, 2006). Story content of the written narratives was measured following standard ERRNI procedures. The ERRNI test contains a list of 24 main ideas that are represented in the story. These ideas overlap with components of story structure (Stein & Trabasso, 1982). Two points were awarded for each idea included in the narrative; one point was given when the idea was represented only partially, or when over-general or vague language was used to represent the idea. A maximum score of 48 could be achieved. Two raters scored the story content of 20% of the transcripts in common to practice the scoring scheme. Disagreements were resolved through discussion. Afterwards, half of the transcripts were scored by the first rater and half by the second rater. Twenty percent of the transcripts was scored by both raters to determine inter-rater reliability. The inter-rater reliability was calculated as .94.

Transcription Skills

Transcription skills were assessed by measuring handwriting fluency and spelling skills.

Handwriting fluency was assessed in terms of speed by means of a standardized Dutch handwriting task (the "Systematische Opsporing van Schrijfproblemen" ,Van Waelvelde, De Mey, & Smits-Engelsman, 2008). This task required children to copy a short text during five minutes. The raw score was calculated by counting the number of letters written in five minutes. Test-retest reliability is reported as .69 (Van Waelvelde, Hellinckx, Peersman, & Smits-Engelsman, 2012).

To assess *spelling* skills, a standardized Dutch spelling task, the "PI-dictee" (Geelhoed & Reitsma, 1999) was administered. This task required children to spell isolated words with increasing difficulty. Words were presented in sentences, and children were asked to write down the repeated word from each sentence. The raw score was the number of words spelled correctly (max. score = 135). Test-retest reliability for this task is reported as .91 (Geelhoed & Reitsma, 1999).

Language Skills

Grammar was assessed by measuring the Mean Length of a T-unit in words (MLTUw), as an index of syntactic complexity, during an oral narrative production task. The Beach Story of the ERRNI (Bishop, 2004) was used to elicit the oral narrative. This variable is automatically calculated by CLAN, and therefore does not require a reliability estimate.

Receptive *vocabulary* knowledge was measured using the Peabody Picture Vocabulary Test (PPVT-III-NL; Dunn & Dunn, 2005). Children were shown four pictures and were asked to indicate the target picture that corresponded best to the word presented orally by the experimenter. Words were presented in 12-word sets and testing was discontinued when the child missed eight or more items in a 12-item set. Raw scores were used in the analyses (max. = 204). Internal consistency reliability is reported as .95 (Dunn & Dunn, 2005).

Executive Functions

The EF tasks were chosen as specific exemplars of the three core low-level EF of inhibition, updating, and shifting (Diamond, 2013; Miyake et al., 2000). In addition, the high-level EF of planning that has previously been suggested to be associated with written language was included in the test battery as well. Where multiple tasks were used as exemplars of an EF, the underlying aim was to ensure the representation of multiple facets of that specific EF.

To assess **inhibition** four tasks were selected. The subtest Sky Search of the Test of Everyday Attention for Children (Tea-Ch Sky Search; Manly, Robertson, Anderson, & Nimmo-Smith, 1999) was administered to assess *selective attention*. This subtest required the child to circle as many pairs of identical crafts as possible on an A3 sheet with numerous pairs of crafts randomly distributed across it. To control for motor speed, a motor control version of the test was subsequently carried out. The total time in seconds needed to complete the motor control version was then subtracted from the total time needed to complete the experimental version, resulting in an attention standard score. Test-retest reliability for this task is reported as .80 (Manly et al., 1999). To measure *sustained attention*, the Letter Digit Substitution Task (LDST; Jolles, Houx, Van Boxtel, & Ponds, 1995) was used. Children were given a sheet with a key, which represented the numbers 1 to 9, each paired with a different letter. The test items, i.e. letters, were printed beneath the key. Children were required to replace as many letters as possible with the appropriate digit indicated by the key in 90 seconds. The number of correct substitutions made in 90 seconds was used as the raw score. Test-retest reliability for this task is reported as .88 (Jolles et al., 1995). The subtest Walk Don't Walk (Tea-Ch Walk Don't Walk) and the subtest Opposite Worlds (Tea-Ch Opposite Worlds) of the Tea-Ch were used to assess *response inhibition*. The

Walk Don't Walk subtest involved listening to a tape playing go tones and stop tones. During the task, the child was given an A4 sheet showing footprints on a path of 14 squares. While listening to the tape, the child was asked to mark the footprints for the go tone until the stop tone appeared. One point was awarded when children avoided the target footprint on a stop tone; a mark in the footprint constituted a failure. The number of correct items out of 20 items was the total raw score for this task. The test-retest reliability for this task is reported as .71 (Manly et al., 1999). In the subtest Opposite Worlds children were shown a sheet with a path representing the digits one and two. In the same world trial, children were asked to say the digits actually presented as quickly as possible. In the opposite world trial, children were asked to say two for the digit one and one for the digit two. The time in seconds taken to complete the opposite world trial was recorded as the score for this subtest. Test-retest reliability for this task is reported as .85 (Manly et al., 1999).

To assess **updating** skills the Wechsler Intelligence Scale for Children-IV-Integrated Digit Span subtest (WISC-IV-I Digit Span; Wechsler, 2004) was used. In the Forward Digit Span, the child was required to repeat a sequence of digits in the correct order. Each task began with a sequence that was one digit in length. The length of the sequence increased with one digit after a level had been presented twice. In the Backward Digit Span, the procedure was the same, except the child was asked to repeat the numbers in the reverse order. The raw scores were based on 1 or 0 scores for each of the two trials for each length of digit span. The total raw score for this task was calculated by combining the raw score of the Forward Digit Span (max. = 14) and the raw score of the Backward Digit Span (max. =14), resulting in a maximum score of 28. The internal consistency reliability for this task was calculated as .78.

To assess **shifting** skills two tasks were selected. The Letter Fluency subtest from the Delis-Kaplan Executive Function System (D-KEFS-Letter Fluency; Delis, Kaplan, & Kramer, 2001) was used to tap phonemic *verbal fluency*. Letter fluency tasks entail strategic searches with word retrieval by letters requiring the ability to mentally shift between multiple subsets of words (Rende, Ramsberger, & Miyake, 2002). During this task, the child was asked to generate as many words as possible starting with a target letter within one minute. Two trials of the phonemic verbal fluency task were administered, one with words that begin with the letter M and one with words that begin with the letter K. The raw score was calculated by adding the number of correct words in both trials. The test-retest reliability for this task is reported as .76 (Korkman et al., 1998). The Trail Making Test from the D-KEFS (D-KEFS-TMT; Delis, Kaplan, & Kramer, 2001) was administered to assess *cognitive flexibility*. The task consisted of a sheet of paper over which 32 circles were distributed. The circles included both numbers (1-16) and letters (A-P) and the child was

asked to draw lines to connect the circles in an ascending pattern, with the extra challenge of alternating between the numbers and letters (i.e. 1-A-2-B-3-C, etc.). The raw score was the time needed to complete this task. The test-retest reliability for this task is reported as .89 (Delis et al., 2001).

The high-level EF of **planning** was assessed by means of the Tower of London (TOL; Shallice, 1982). Children were required to build nine increasingly difficult towers with five discs corresponding to configurations represented in a stimulus book. The children were instructed to try to achieve the goal arrangement in as few moves as possible, while taking into account specific rules regarding the movement of the discs. Scores were assigned according to the number of moves needed to finish each tower. The total raw score – used in the analyses – was calculated by adding the score of each tower (max. = 30). Internal consistency reliability for this task is reported as .84 (Delis, Kaplan, & Kramer, 2001).

Results

Descriptive Statistics and Correlation Matrix

Descriptive statistics for the measures of the written narrative, and the measures of transcription skills, language skills, and EF are reported in Table 2.3. The correlations between all these measures are presented in Table 2.4.

Principal Components Analysis

In this study, the EF tasks were treated as formative measures of the EF constructs, meaning that they were seen as components of one particular EF that (jointly) define or "cause" that EF, rather than being "effects" of an underlying EF (Willoughby, Holochwost, Blanton, & Blair, 2014). As such, analyses were not conducted with the aim of revealing an underlying EF structure. To reduce and summarize the data, a principal components analysis (PCA) with orthogonal rotation (varimax) was conducted on the EF measures of the 102 subjects. Using the criteria of eigenvalues greater than one, the PCA extracted three factors. The eigenvalues and percentage of variance accounted for by the first three factors before rotation are reported in Table 2.5. These three factors explained 55.5% of the total variance in the data set. The rotated factor loadings for each of the eight dependent measures are presented in Table 2.6. To determine factor consistency, a loading of ± .50 was used as a criterion (Tabachnick & Fidell, 2001).

The PCA demonstrated that the measures of EF could be consolidated into three different factors. Factor 1 includes the Tea-Ch Walk Don't Walk and the Tea-Ch Opposite Worlds, both measuring response inhibition, the LDST, measuring sustained attention, and the D-KEFS-TMT, measuring

cognitive flexibility. Factor 2 includes the WISC-IV-I Digit Span, assessing updating of WM, the Tea-Ch Sky Search, measuring selective attention, and the D-KEFS-Letter Fluency, measuring phonemic verbal fluency. Factor 3 encompasses the TOL, measuring the high-level EF of planning and strategic organization, and also the D-KEFS-TMT, measuring cognitive flexibility, loads on this factor. The PCA demonstrates some important findings. Factor 1 includes several attentional tasks, and can thus reliably be labeled Inhibition. The tasks measuring updating of WM and selective attention both load on Factor 2, which is not surprising given their similarity in terms of neural basis (Diamond, 2013). This factor was therefore called Updating. Factor 3 distinguishes the higher-level EF of planning as a separable factor, showing a moderate intercorrelation with aspects of cognitive flexibility. This factor was therefore called Planning. The PCA showed that the tasks jointly representing the EF of shifting, D-KEFS-TMT and D-KEFS-Letter Fluency, load on all three factors. Previous studies have suggested that in children shifting might not be dissociable from inhibition and updating (van der Ven, Kroesbergen, Boom, & Leseman, 2013). In addition to the general idea that shifting highly builds on the other two core low-level EF and comes in later in development (Diamond, 2013), this might explain our finding. Overall, the PCA does not correspond entirely to the fractionation of the EF tasks as put forward by our formative measurement model, but does show a distinction between the low-level EF of inhibition and updating, and the high-level EF of planning.

The standardized factor scores ($M = 0$, $SD = 1$) derived from the PCA were subsequently computed for each child, for each factor. The factor scores were used as the variables inhibition, updating and planning in the subsequent analyses.

Table 2.3
Descriptive Statistics for the Measures of the Written Narrative, Transcription Skills, Language Skills, and Executive Functions

n = 102	*Mean*	*SD*	*Min.*	*Max.*
The written narrative				
Text length	235.37	102.53	75	560
Syntactic complexity	6.38	1.39	2.68	10.27
Story content	26.33	5.85	12	40
Transcription skills				
Handwriting fluency	177.00	39.53	63	260
Spelling	95.40	16.88	41	127
Language skills				
Grammar	7.67	1.34	4.86	10.66
Vocabulary	115.16	9.24	96	141
Executive functions				
Tea-Ch Sky Search	4.42	1.58	2	12.90
Tea-Ch Walk Don't Walk	14.00	3.50	1	20
Tea-Ch Opposite Worlds	31.49	5.03	22	47
LDST	32.52	7.25	14	49
WISC-IV-I Digit Span	12.08	2.36	5	20
D-KEFS-Letter Fluency	14.57	4.29	4	28
D-KEFS-TMT	113.63	39.41	38	240
TOL	15.14	2.63	6	21

Note. Tea-Ch = Test of Everyday Attention for Children. LDST = Letter Digit Substitution Task. WISC-IV-I Digit Span = Wechsler Intelligence Scale for Children-IV-Integrated Digit Span. D-KEFS-Letter Fluency = Delis-Kaplan Executive Function System Letter Fluency. D-KEFS-TMT = Delis-Kaplan Executive Function System Trail Making Test. TOL = Tower of London.

Table 2.4

Correlations between Written Narrative Task Measures, Transcription Skills, Language Skills, and Measures of Executive Functions

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Text length	1														
2. Syntactic complexity	.33**	1													
3. Story content	.53**	.44**	1												
4. Handwriting fluency	.30**	.22*	.30**	1											
5. Spelling	.27**	.24*	.17	.26**	1										
6. Grammar	.14	.44**	.23*	.05	.14	1									
7. Vocabulary	.19	.03	.26**	.11	.13	-.10	1								
8. Tea-Ch Sky Search	.27**	-.00	.14	.24*	.06	.09	.07	1							
9. Tea-Ch Walk Don't Walk	.25*	.18	.17	.16	.22*	.12	.02	.02	1						
10. Tea-Ch Opposite Worlds	.24*	.21*	.10	.26**	.13	-.09	.02	.09	.36**	1					
11. LDST	.42**	.12	.24*	.20	.23*	.07	-.02	.13	.15	.42**	1				
12. WISC-IV-I Digit Span	.15	.22*	.14	.16	.41**	.13	-.09	.13	.18	.15	.10	1			
13. D-KEFS-Letter Fluency	.18	.07	.16	-.04	.05	.02	.06	.12	.13	.21*	.17	.15	1		
14. D-KEFS-TMT	.07	.11	.17	.19	.19	.11	.14	.14	.25*	.49**	.25*	.27**	.19	1	
15. TOL	.07	.05	.15	-.01	-.03	.07	.06	.03	.07	.03	.12	.07	-.01	.32**	1

Note. *$p < .05$. **$p < .01$.

Table 2.5
Eigenvalues and Percent of Variance for Three Factors

Factor	Eigenvalue	Percent of Variance	Cumulative Percent
1	2.32	29.0	29.0
2	1.09	13.6	42.6
3	1.03	12.9	55.5

Table 2.6
Executive Function Component Structure Identified in Principal Components Analysis with Orthogonal Rotation

	Factor		
	1	2	3
Tea-Ch Walk Don't Walk	.67	-.08	.03
Tea-Ch Opposite Worlds	.83	.12	.02
LDST	.56	.21	.06
D-KEFS-TMT	.56	.26	.52
WISC-IV-I Digit Span	.20	.49	.22
D-KEFS-Letter Fluency	.34	.50	-.25
Tea-Ch Sky Search	-.11	.83	.03
TOL	.02	.01	.91

Correlational Analyses

Having summarized our battery of EF into three factors, the next set of analyses addressed the relationships between individual differences in writing and transcription skills, language skills and EF. Performance on writing was evaluated by assessing productivity (text length in number of words) and syntactic complexity (MLTUw) on a microstructural level, and story content (number of idea units mentioned in the text) on a macrostructural level of the written narrative. Descriptive statistics for the writing measures can be found in Table 2.3. Table 2.7 shows the correlations of the written narrative task measures with transcription skills, language skills and EF. These results demonstrate that on a microstructural level, text length correlates significantly with transcription skills of handwriting fluency and spelling, as well as with the factors of inhibition and updating. Microstructural syntactic complexity correlates significantly with transcription skills of handwriting fluency and spelling, as well as with grammar and with inhibition. On a macrostructural

level, story content relates to handwriting fluency, to vocabulary and to grammar.

Table 2.7
Correlations of Written Narrative Task Measures with Transcription Skills, Language Skills and Executive Functions

		Microstructure		Macrostructure
		Text length	Syntactic complexity	Story content
Transcription	Handwriting fluency	.30**	.22*	.30**
	Spelling	.27**	.24*	.17
Language skills	Vocabulary	.19	.03	.26**
	Grammar	.14	.44**	.23*
EF	Inhibition	.29**	.23*	.19
	Updating	.28**	.07	.19
	Planning	-.01	.05	.13

Note. *p < .05. **p < .01.

Regression Analyses

Based on the observed correlations, three multiple regression analyses were used in order to determine the variables that predict text length, syntactic complexity and story content. Hierarchical regression analyses were used to test whether EF could improve the prediction of performance on the written narrative, after controlling for transcription and language skills. More specifically, the first step always comprised the transcription skills, whereas the second step comprised the language skills. The target set of variables, i.e. the EF, were entered in the last step so that their contribution would not be overestimated. Table 2.8 summarizes the outcome of these analyses.

For the prediction of text length, transcription skills accounted for 13% of the unique variance. As can be seen from the standardized beta scores of each variable, the variance is explained by both handwriting fluency and spelling. In this analysis, language skills did not account for a statistically significant amount of variance. EF explained 8% of unique variance after controlling for transcription and language skills. The variance is almost entirely explained by inhibition and updating. Considering syntactic complexity, transcription skills accounted for 9% of the observed variance in syntactic complexity, with only spelling being a significant contributor. After adding the language skills, the model accounted for an additional 16% of the observed variance. The

variance is entirely explained by the variable grammar. EF did not make a significant contribution to the prediction of syntactic complexity. Finally, for story content of the written narrative, transcription skills accounted for 10% of the variance in story content, which is entirely explained by handwriting fluency. Language skills accounted for an additional 10% of the variance, with both vocabulary and grammar being significant predictors. Finally, none of the EF domains made a unique significant contribution to the prediction of story content.

Table 2.8
Hierarchical Regression Analyses Predicting Text Length, Syntactic Complexity and Story Content of the Written Narratives

	Microstructure				Macrostructure	
	Text length		Syntactic complexity		Story content	
Predictor variables	R^2	β	R^2	β	R^2	β
1. Transcription	.13		.09		.10	
Handwriting		.24*		.17		.28**
Spelling		.22*		.20*		.10
2. Language skills	.16		.25		.20	
Vocabulary		.14		.02		.25**
Grammar		.11		.41**		.24*
3. EF	.24		.27		.24	
Inhibition		.22*		.15		.13
Updating		.21*		-.03		.12
Planning		-.04		.00		.08

Note. *p < .05. **p < .01.

Path Analysis

The regression analyses showed that EF did not contribute to the syntactic complexity nor to the story content of the written narratives over and above transcription skills and language skills. These findings could be interpreted in the framework of recent models of writing (e.g., Berninger & Winn, 2006), that state that in young writers, transcription skills hinder the contribution of EF to text generation, as unautomatized transcription consumes most of the available cognitive resources. However, as the contribution of EF to transcription skills is expected from the literature (Altemeier, Abbott, et al., 2008), a path analysis, using LISREL software (version 8.80, Jöreskog &

Sörborn, 2006) and maximum likelihood estimation, was undertaken to test the possibility that EF do influence performance on the written narrative, with transcription skills functioning as a mediator. Language skills were not included in the model for both methodological and theoretical reasons. Methodologically, including language skills would render the ratio for the number of subjects in our sample to the number of model parameters to be estimated insufficient. Furthermore, the path analysis was conducted to test the theoretically motivated hypothesis that transcription skills mediate the relationship between EF and narrative composition. The contribution of language skills – a theoretically less likely candidate for mediation – was already explored in the regression analyses, and therefore excluded from the path analysis.

The fit of the path model was evaluated by chi-square analyses and a number of goodness of fit indices. For an adequate fit, the chi-square test should exceed .05 (Ullman, 2001). For a model to be satisfactory, the goodness of fit index (GFI), the comparative fit index (CFI), the adjusted goodness of fit (AGFI) and the normed fit index (NFI) should be greater than .90 and the root mean square error of approximation (RMSEA) lower than .08 (Hu & Bentler, 1999; Jaccard & Wann, 1996). The final model is depicted in Figure 2.1. Dashed lines represent paths that are not significant. The fit of this model was satisfactory ($\chi^2 = 11.01$, $p = .14$, $df = 7$; RMSEA = .07, GFI = 1.00, NFI = .91, CFI = .97, AGFI = .90). The contribution of planning to the transcription and writing performance outcomes was not significant, so this EF was removed from the final model.

Figure 2.1 shows that both inhibition and updating directly contribute to text length, whereas they do not contribute directly to syntactic complexity or to story content. This result confirms the findings of the regression analyses previously discussed. Figure 2.1 also shows that inhibition and updating contribute to both handwriting fluency and spelling, and that handwriting fluency, but not spelling, contributes to text length, syntactic complexity and story content. Inhibition and updating therefore indirectly affect all writing performance outcomes. This implies that handwriting fluency mediates the relation between EF and writing performance on both the microstructural and macrostructural level.

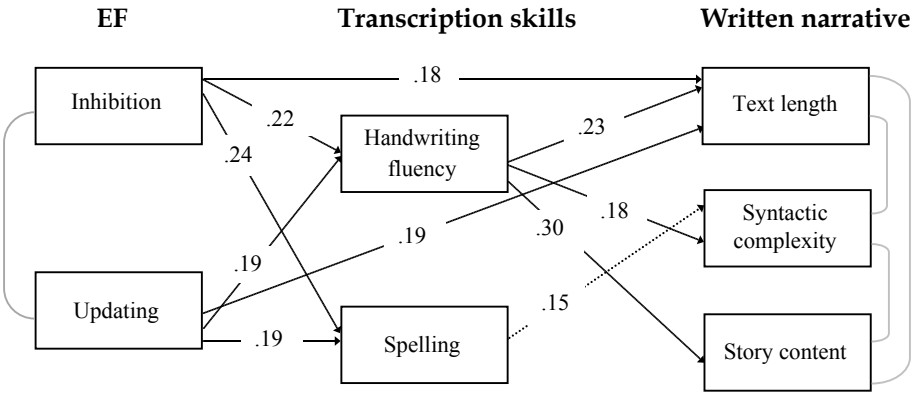

Figure 2.1. The influence of transcription skills on the relation between EF and the written narrative.

Discussion

The aim of the current study was to investigate the contribution of EF to narrative writing in fourth grade children. Our study adds to the existing literature in the following respects. First, unlike much research in the area of written language, a large test battery of standard neuropsychological measures of low- and high-level EF was used. Second, a developmentally relevant writing task, narrative composition, was used to assess writing skills. Finally, by focusing on the micro- and macrostructural level of the composition, this study provided the first investigation of the relationship between EF and word-, sentence-, and text-level aspects of a written composition. It was hypothesized, first, that EF would predict narrative composition, and second, that different EF would contribute differentially to the different levels of the composition.

Overall, our results show that in fourth grade children EF contribute to narrative composition in two ways. First of all, inhibition and updating contributed uniquely and directly to the text length of the written narratives, thus to word-level text generation, over and above transcription skills and language abilities. Text length in number of words is a frequently used measure of production fluency in written language and a good predictor of writing quality (e.g., Berman & Verhoeven, 2002; Wagner et al., 2011). The finding that inhibition and updating contribute directly to text length may be explained by the need to suppress inappropriate lexical representations, to select the relevant ones and to actively hold and update the representations in WM during composition. A lack of fluency in these processes may result in

slower language generation, and may force the child to disrupt the writing process, leading to lower production fluency and thus to a shorter text.

Secondly, inhibition and updating contributed indirectly to text length, syntactic complexity and story content of the written narratives, i.e. to the word-, sentence-, and text-level respectively, with handwriting fluency mediating the relationship between them. It is generally acknowledged that transcription requires a large amount of cognitive resources, including EF, in developing writers (Berninger & Amtmann, 2003). More precisely, in our study the link between inhibition and updating, and handwriting fluency, might reflect the role of executive control in the coordination of multiple processes during handwriting, including motor planning, orthography, orthographic-motor integration and processing speed (Altemeier, Abbott, et al., 2008; Berninger & Amtmann, 2003). Fluent handwriting skills, in turn, free up cognitive resources that can be devoted to facilitate text generation at the word-, sentence- and text-level, affecting the quantity, complexity and content of the product (e.g., Berninger et al., 1997).

These findings also lead us to conclude that the second hypothesis – that EF would contribute differentially to the word-, sentence-, and text-level of the narrative composition – was confirmed to some degree. However, the contribution of EF to the different levels of the composition does not reside in the nature of the EF, but rather in the direct or indirect way in which they exert their influence. The word-level of the composition results to be the only level that is directly regulated by EF. Previously, Altemeier, Abbott, et al. (2008) concluded that low-level EF explain variance in word-level writing processes such as spelling. The contribution of inhibition and updating to the text length of the narrative composition in our study suggests that the word-level of a written composition taps some of the same cognitive processes as those involved in word-level literacy skills such as spelling. By contrast, the sentence- and text-level of the composition only benefit indirectly from EF through handwriting. The lack of a direct contribution of EF to the sentence-level of the composition corresponds to the idea that young writers, using a serial, knowledge-telling strategy make very few executive decisions about how ideas can be arranged into hierarchical syntactic constructions (Perfetti & McCutchen, 1987). They tend to use the first linguistic expression that occurs to them to frame their ideas, without being concerned about shaping the linguistic expression in response to discourse demands (McCutchen & Perfetti, 1982). Similarly, at the textual level, young writers' main concern is what to say next, rather than a concern for how to fit every new idea into the overall coherence of the text (Bereiter & Scardamalia, 1987). Ideas are linearly retrieved from memory and readily translated into sentences, without shaping or adjusting these ideas to the reader's needs. The syntactic

skills and attendance to the coherence of the text have thus not come under the executive control that writing requires. The use of this knowledge-telling strategy is said to be related to the high cognitive demands of handwriting (Bereiter & Scardamalia, 1987). It could thus be hypothesized that attending to the complexity of the sentence level and the coherence of the text level will come more directly under executive control, once children grow older and automatize their handwriting. Overall, our finding of a mediating role of handwriting fluency subscribes to the idea that the impact of transcription skills on children's writing is not limited to the early grades of elementary school but extends into the intermediate grades (Graham, 1997; Wagner et al., 2011).

Inhibition and updating showed an equal pattern of contribution to the narrative composition – direct to the word-level, and indirect to the word-, sentence-, and text-level. Given the assumption that high-level EF such as planning support text-level processing in both reading comprehension and written expression (Altemeier, Abbott, et al., 2008; Altemeier, Jones, et al., 2006), it is striking that we did not find any contribution of planning skills to any of the levels of the narrative composition. Several explanations come to mind. First, planning is a complex higher-order cognitive skill that develops particularly late in childhood and undergoes a final growth spurt during the beginning of adolescence (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001; Welsh & Pennington, 1988). It might be that the fourth grade children in our sample have not yet developed their planning skills sufficiently so as to be able to devote their capacity to the thinking processes involved in written composition. Second, developing writers generally show little or no planning and goal-directed behaviour during composition (McCutchen, 1988; Scardamalia & Bereiter, 1986). The idea is that children, who have not automatized their handwriting skills, can dedicate few cognitive resources to higher-level processes of planning. Given the considerable role of handwriting fluency in our sample, this explanation seems to be valid to explain the lack of contribution of planning skills to written composition. However, an indirect contribution through handwriting skills was not found either. Moreover, Altemeier, Jones, et al. (2006) did find that planning skills, as assessed by a Tower Task, contributed to expository written composition in third graders. It may therefore be that the predictive ability of planning in middle elementary school depends on the task at hand. The narrative picture elicitation task used in our study may trigger some sort of linear storytelling: children linearly retrieve information from the pictures, with each picture serving as a stimulus for the next idea. The presence of the pictures may reduce the need for planning skills, as the structure and content of the story are more readily available to the writer. In this respect, the picture elicitation task might have

enhanced young writers' tendency to adopt a knowledge-telling strategy, encompassing local planning with each preceding written sentence serving as a stimulus for conducting the next search of long-term memory (Bereiter & Scardamalia, 1987). Further research is needed to see whether planning skills do contribute uniquely to open-ended narrative composition, which might encourage the use of planning skills to a larger extent. Similarly, other genres such as argumentative and expository writing call upon more complex and effortful knowledge transformation skills, and require highly demanding cognitive operations (van Hell, Verhoeven, & van Beijsterveldt, 2008). This might lead to a higher involvement of EF, particularly of planning as a high-level EF. In this respect, future studies might examine the role of low- and high-level EF in genres other than narrative writing.

In general, our results support the idea that EF play a role in the writing of developing writers. Moreover, our study found that EF influence narrative writing, both directly, and indirectly through handwriting skills. Furthermore, the study emphasizes the importance of assessing many different low- and high-level EF with standard neuropsychological measures. Previous writing research generally conceptualized EF as self-regulating control processes necessary for implementing planning, revising and reviewing strategies. Accordingly, EF were mostly investigated by targeting these strategies in intervention studies on self-regulation. We argue that those higher-level cognitive processes cannot account for all the EF involved in writing, and that it is necessary to assess a variety of EF, including low-level EF with standard neuropsychological measures, in order to acquire more insight into the contribution of EF to writing outcomes in developing writers.

Our study has some limitations that are worth mentioning. First, only one grade in writing development was discussed. Further longitudinal research is needed to examine how the contribution of EF to narrative writing changes as children move into the late elementary grades, particularly with respect to different low-level and high-level EF involved. As transcription skills become fluent with age and have less impact on cognitive load (Berninger & Winn, 2006), EF might exert a stronger influence on the written product. Consequently, it could for instance be hypothesized that in older children and more mature writers, inhibition and updating contribute directly and independently of handwriting to the sentence- and text-level of the written composition. Fourth grade is, however, a transitional grade in literacy development (Fitzgerald & Shanahan, 2000) and thus we believe that it provides a good, initial stage of development for the study of written composition.

Second, our study offers the first attempt to relate EF to micro- and macrostructural levels of narrative composition. However, measures of micro- and macrostructure can be manifold, and here only three measures –

productivity, complexity and story content – were included. Other components of micro- and macrostructure, such as lexical diversity – involving semantic knowledge – or logical ordering of ideas – requiring advanced reasoning skills – might tap different cognitive and language abilities and thus change the dynamics encountered in this study. Relatedly, further research is needed to determine the predictive ability of EF when different writing outcomes are considered.

Third, our study focused on writing a narrative by hand. The results emphasize that fluent handwriting skills are essential for writing development, as non-automatized transcription skills are cognitively demanding and may constrain the use of EF. Nowadays, however, the use of computers in classrooms has become universal and children increasingly often produce their written texts by typing. Typing involves less complex motor processes than handwriting, and is therefore considered to be less cognitively demanding (Quinlan, 2004). Following this idea, we might expect EF to contribute more strongly and more directly to narrative writing, if the writing task is performed on a computer. More specifically, with typing requiring little cognitive effort, more cognitive resources could be allocated to EF to guide and monitor text generation. This premise remains to be studied, however, as some recent studies demonstrate that the cognitive advantage of typing only holds for fluent typists. A lack of typing automaticity substantially affects the quality of a composition, as much as non-fluent handwriting does (e.g., Christensen, 2004; Connelly, Gee, & Walsh, 2007). In much the same way as in handwriting, it thus seems to be critical that typing skills are developed early. Nevertheless, an interesting direction for future research could be to empirically investigate this premise and explore the contribution of EF to different levels of the written text, produced by typing on a word-processor.

Finally, two potential methodological limitations affect the current study. As we adhered to a formative approach to EF, our analyses were not primarily intended to reveal the underlying structure of EF. The large test battery of EF tests was reduced by means of a PCA. Although the three resulting factors correspond relatively well to components of EF previously identified (Diamond, 2013; Miyake et al., 2000), PCA is above all a dimension reduction technique. The interpretation of the underlying EF structure should thus be considered cautiously. Furthermore, small sample size is a limiting factor that constrained us to opt for a path analysis rather than a structural equation model. Sensitivity to error is a specific limitation of path analysis. To accommodate this limitation, construct validity was maximized through the use of established measures, and the reliabilities of the measures were carefully inspected. Nevertheless, the reported impact among variables

should be considered as suggestive, and further research with a bigger sample size is warranted.

In conclusion, this study contributes to the limited empirical research on EF in young writers, showing that EF contribute both directly and indirectly to narrative writing, a previously neglected writing outcome in this regard. Specifically, inhibition and updating directly contributed to text length, and indirectly via handwriting fluency to text length, syntactic complexity, and story content. Our study also shows that studying different levels of a written composition has the potential to relate cognitive cost in writing to different word-, sentence-, and text-level aspects of a written composition. Although writing researchers are showing an increased interest in EF as neuropsychological predictors of writing skills, much remains to be learned about how EF support young writers in the process of becoming expert writers.

References

Altemeier, L., Abbott, R. D., & Berninger, V. W. (2008). Executive functions for reading and writing in typical literacy development and dyslexia. *Journal of Clinical and Experimental Neuropsychology, 30*, 588-606. doi:0.1080/13803390701562818

Altemeier, L., Jones, J., Abbott, R. D., & Berninger, V. W.(2006). Executive functions in becoming writing readers and reading writers: Note-taking and report writing in third and fifth graders. *Developmental Neuropsychology, 29*, 161-173. doi:10.1207/s15326942dn2901_8

Anderson, V., Anderson, P., Northam, E., Jacobs, R., & Catroppa, C. (2001). Development of executive functions through late childhood and adolescence in an Australian sample. *Developmental Neuropsychology, 20*, 385-406. doi:10.1207/S15326942DN2001_5

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Erlbaum.

Berman, R., & Verhoeven, L. (2002). Developing text-production abilities across languages, genre and modality. *Written Languages and Literacy, 5*, 1-43. doi:10.1075/wll.5.1.02ber

Berninger, V. W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In H. Swanson, K. Harris & S. Graham (Eds.), *Handbook of learning disabilities* (pp. 323- 344). New York, NY: Guilford Press.

Berninger, V. W., & Chanquoy, L. (2012). What writing is and how it changes across early and middle childhood development: A multidisciplinary perspective. In E. Grigorenko, E. Mambrino & D. Preiss (Eds.), *Writing: A mosaic of perspectives and views* (pp. 65-84). New York, NY: Psychology Press.

Berninger, V. W., Vaughan, K., Abbott, R., Abbott, S., Brooks, A., Rogan, L.,… Graham, S. (1997). Treatment of handwriting fluency problems in beginning writing: Transfer from handwriting to composition. *Journal of Educational Psychology, 89*, 652-666. doi:10.1037/0022-0663.89.4.652

Berninger, V. W., & Richards, T. L. (2002). *Brain literacy for educators and psychologists*. New York, NY: Academic Press.

Berninger, V. W., & Richards, T. L. (2010). Inter-relationships among behavioral markers, genes, brain, and treatment in dyslexia and dysgraphia. *Future Neurology, 5*, 597-617. doi:10.2217/fnl.10.22

Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. MacArthur, S. Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96-114). New York, NY: Guilford Press.

Bishop, D. (2004). *Expression, reception and recall of narrative instrument*. London, UK: Harcourt Assessment.

Christensen, C. A. (2004). Relationship between orthographic-motor integration and computer use for the production of creative and well-structured written text. *British Journal of Educational Psychology, 74*, 551-565. doi:10.1348/0007099042376373

Connelly, V., Gee, D., & Walsh, E. (2007). A comparison of keyboarded and handwritten compositions and the relationship with transcription speed. *British Journal of Educational Psychology, 77*, 479-492. doi:10.1348/000709906X116768

Cragg, L., & Nation, K. (2006). Exploring written narrative in children with poor reading comprehension. *Educational Psychology, 21*, 55-72. doi:10.1080/01443410500340991

Delis, D., Kaplan, E., & Kramer, J. (2001). *Delis-Kaplan executive function scale*. San Antonio, TX: The Psychological Corporation.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135-168.

Dunn, L. M., & Dunn, D. M. (2005). *Peabody Picture Vocabulary Test-III-NL. Nederlandse versie Liesbeth Schlichting. Handleiding*. Amsterdam, the Netherlands: Harcourt Test Publishers.

Fitzgerald, J., & Shanahan, T. (2000). Reading and writing relations and their development. *Educational Psychologist, 35*, 39-50. doi:10.1207/S15326985EP3501_5

Geelhoed, J. W., & Reitsma, P. (1999). *PI-dictee*. Lisse: Swets & Zeitlinger.

Graham, S. (1997). Executive control in the revising of students with learning and writing difficulties. *Journal of Educational Psychology, 89*, 223-234. doi:10.1037/0022-0663.89

Graham, S., & Harris, K. R. (1998). Writing and self-regulation: Cases from the self- regulated strategy development model. In D. Schunk & B. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 20-41). New York, NY: Guilford Press.

Graham, S., Harris, K. R., & Olinghouse, N. (2007). Addressing executive function problems in writing: An example from the self-regulated strategy development model. In L. Meltzer (Ed.), *Executive function in education* (pp. 216-236). New York, NY: Guilford.

Graham, S., & Harris, K. R. (1993). Self-regulated strategy development: Helping students with learning problems develop as writers. *Elementary School Journal, 94*, 169-181. doi:10.1086/461758

Harris, K. R., & Graham, S. (1996). *Making the writing process work: Strategies for composition and self-regulation*. Cambridge, MA: Brookline.

Hayes, J. R., & Flower, L. S. (1980). Identifying the organization of writing processes. In L.W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3-30). Mahwah, NJ: Erlbaum.

Hooper, S. R., Costa, L. J., McBee, M., Anderson, K., Yerby, D. C., Knuth, S. B., & Children, A. (2011). Concurrent and longitudinal neuropsychological contributors to written language expression in first and second grade students. *Reading and Writing: An Interdisciplinary Journal, 24*, 221-252. doi:10.1007/s11145-010-9263-x

Hooper, S. R., Swartz, C. W., Wakely, M. B., de Kruif, R. E. L., & Montgomery, J. W. (2002). Executive functions in elementary school children with and without problems in written expression. *Journal of Learning Disabilities, 35*, 57-68. doi:10.1177/002221940203500105

Hu, L., & Bentler, P. M. (1999). Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling, 6*, 1-55. doi:10.1080/10705519909540118

Hunt, K. W. (1966). Sentence structures used by superior students in grades four and twelve, and by superior adults. *CRP 5-0313*. Tallahassee, FL: Florida State University.

Jaccard, J., & Wan, C. K. (1996). *LISREL approaches to interaction effects in multiple regression*. Thousand Oaks, CA: Sage publications Inc.

Jolles, J., Houx, P., Van Boxtel, M., & Ponds, R. (1995). *Maastricht aging study: Determinants of cognitive aging*. Maastricht, the Netherlands: Neuropsych Publishers.

Jöreskog, K. G., & Sörborn, D. (1996). *LISREL 8 user's reference guide*. Chicago, IL: Scientific Software International.

Kellogg, R. T., Whiteford, A.P., Turner, C. E., Cahill, M., & Mertens, A. (2013). Working memory in written composition: An evaluation of the 1996 model. *Journal of Writing Research, 5*, 159-190.

Lehto, J., Juujarvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British Journal of Developmental Psychology, 21*, 59–80. doi:10.1348/026151003321164627

Luo, F., & Timler, G. R. (2008). Narrative organization skills in children with attention deficit hyperactivity disorder and language impairment: Application of the causal network model. *Clinical linguistics and phonetics, 22*, 25-46. doi:10.1080/02699200701627430

MacWhinney, B. (2000). *The CHILDES Project: Tools for Analyzing Talk*. Mahwah, NJ: Lawrence Erlbaum Associates.

Manly, T., Robertson, I. H., Anderson, V., & Nimmo-Smith, I. (1999). *TEA-Ch: The Test of Everyday Attention for Children Manual*. Bury St. Edmunds, UK: Thames Valley Test Company Limited.

McCutchen, D. (1988). "Functional automaticity" in children's writing: A problem of metacognitive control. *Written Communication, 5*, 306-324. doi:10.1177/0741088388005003003

Milch-Reich, S., Campbell, S. B., Pelham, W. E., Connelly, L. M., & Geva, K. (1999). Developmental and individual differences in children's on-line representations of dynamic social events. *Child Development, 70*, 413-431. doi:10.1111/1467-8624.00030

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex functions. *Annual Review of Neuroscience, 24*, 167-202. doi:10.1146/annurev.neuro.24.1.167

Miyake, A., Friedman, N., Emerson, M., Witzki, A., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*, 49-100. doi:10.1006/cogp.1999.0734

Perfetti, C. A., & McCutchen, D. (1987). Schooled language competence: Linguistic abilities in reading and writing. In S. Rosenberg (Ed.), *Advances in applied psycholinguistics, reading, writing and language learning, Vol. 2* (pp. 105-141). New York, NY: Cambridge University Press.

Puranik, C., Lombardino, L. J., & Altmann, L. J. (2008). Assessing the microstructure of written language using a retelling paradigm. *American Journal of Speech-Language Pathology, 17*, 107-120. doi:10.1007/s11145-006-9030-1

Quinlan, T. (2004). Speech Recognition Technology and Students With Writing Difficulties: Improving Fluency. *Journal of Educational Psychology, 96*, 337-346. doi:10.1037/0022-0663.96.2.337

Raven, J. C. (1956). *Coloured Progressive Matrices, Sets A AB, B*. London, UK: H.K. Lewis and Co., Ltd.

Rende, B., Ramsberger, G., & Miyake, A. (2002). Commonalities and differences in the working memory components underlying letter and category fluency tasks: A dual-task investigation. *Neuropsychology, 16*, 309-321. doi:10.1037/0894-4105.16.3.309

Renz, K., Lorch, E. P., Milich, R., Lemberger, C., Bodner, A., & Welsh, R. (2003). On-line story representation in boys with attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology, 31*, 93-104. doi:10.1023/A:1021777417160

Scardamalia, M., & Berciter, C. (1986). Research on written composition. In M. Wittroch (Ed.), *Handbook of research on teaching* (pp. 378-803). New York, NY: Macmillan.

Shallice, T. (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society London, B, 298*, 199-209. doi:10.1098/rstb.1982.0082

Stein, N. L., & Trabasso, T. (1982). What's in a story: Critical issues in story comprehension. In R. Glaser (Ed.), *Advances in the psychology of instruction* (pp. 213-268). Hillsdale, NJ: Lawrence Erlbaum Associates.

St Clair-Thompson, H., L., & Gathercole, S., E. (2006). Executive functions and achievements in school: Shifting, updating, working memory. *The Quarterly Journal of Experimental Psychology, 59*, 745-759. doi:10.1080/17470210500162854

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics (4th ed.).* Needham Heights, MA: Allyn & Bacon.

Ullman, J. B. (2001). Structural equation modeling. In B. G. Tabachnich & L. S. Fidell (Eds.), *Using multivariate statistics* (pp. 653-771). (4th ed.). New York, NY: Allyn & Bacon.

van der Ven, S., Kroesbergen, E., Boom, J., & Leseman, P. (2013). The structure of executive functions in children: A closer examination of inhibition, shifting, and updating. *British Journal of Developmental Psychology, 31*, 70-87. doi:10.1111/j.2044-835X.2012.02079.x

van Hell, J. G., Verhoeven, L., & van Beijsterveldt, L. M. (2008). Pause time patterns in writing narrative and expository texts by children and adults. *Discourse Processes, 45*, 406-427. doi:10.1080/01638530802070080

Van Waelvelde, H., De Mey, B., & Smits-Engelsman, B. (2008). *Handleiding SOS. Systematische opsporing van schrijfmotorische problemen*. Ghent, Belgium: Revalidatiewetenschappen en Kinesitherapie Gent.

Van Waelvelde, H., Hellinckx, T,. Peersman, W., & Smits-Engelsman, B.C.M. (2012). SOS: A screening instrument to identify children with handwriting impairments. *Physical and Occupational Therapy in Pediatrics, 32*, 306-319. doi:10.3109/01942638.2012.678971

Wagner, R. K., Puranik, S., Foorman, B., Foster, E., Wilson, L., Tschinkel, E., & Kantor-Thatcher, P. (2011). Modeling the development of written language. *Reading and Writing: An Interdisciplinary Journal, 24*, 203-220. doi:10.1007/s11145-010-9266-7

Wechsler, D. L. (2004). *Wechsler intelligence scale for children. Fourth edition*. San Antonio, TX: The Psychological Corporation.

Welsh, M., & Pennington, B. (1988). Assessing frontal lobe functioning in children: Views from developmental psychology. *Developmental Neuropsychology, 4*, 199-230. doi:10.1080/87565648809540405

Whitaker, D., Berninger, V. W., Johnston, J., & Swanson, L. (1994). Intraindividual differences in levels of language in intermediate grade writers: Implications for the translating process. *Learning and Individual Differences, 6*, 107–130. doi:10.1016/1041-6080(94)90016-7

Willoughby, M., Holochwost, S. J., Blanton, Z. E., & Blair, C. B. (2014). Executive functions: Formative versus reflective measurement. *Measurement: Interdisciplinary Research and Perspectives, 12*, 69-95. doi:10.1080/15366367.2014.929453

Chapter 3

How executive functions predict development in syntactic complexity of narrative writing in the upper elementary grades

3

This chapter is based on: Drijbooms, E., Groen, M. A., & Verhoeven, L. (submitted). How executive functions predict development in syntactic complexity of narrative writing in the upper elementary grades.

Abstract

The aim of this study was to examine the contribution of transcription skills, oral language skills, and executive functions to growth in narrative writing between fourth and sixth grade. While text length and story content of narratives did not increase with age, syntactic complexity of narratives showed a clear developmental progression. Results from path analyses revealed that later syntactic complexity of narrative writing was, in addition to initial syntactic complexity, predicted by oral grammar, inhibition, and planning. These results are discussed in light of the changes that characterize writing development in the upper elementary grades. More specifically, this study emphasizes the relevance of syntactic complexity as a developmental marker as well as the importance of executive functions for later writing development.

Learning to write is an essential, yet challenging, part of literacy acquisition in the elementary grades that is supported by a number of important component skills. According to a pivotal, developmental model of writing (Berninger & Winn, 2006), three interrelated component skills underlie written text production, as they interact functionally during the writing process in an environment of working memory (WM): transcription skills, oral language skills, and executive functions (EF). This model provides a framework for the study of children's writing development, as it specifies the constraints that influence the writing process. In comparison to the preponderance of studies concerned with transcription skills and oral language skills, fewer studies have studied the importance of EF. Furthermore, it is postulated that the relative influence of each of these component skills on children's written composition changes over time. Whereas transcription skills are considered critical at the early stage of writing development, automaticity with these skills frees up WM resources for implementing language skills and EF. These latter skills are thus expected to play a more constraining role in later written composition (Berninger & Swanson, 1994; Berninger & Winn, 2006). However, the majority of studies have focused on concurrent predictors of writing. Longitudinal predictive studies are lacking, particularly in the upper elementary grades when important steps in writing development are hypothesized to alter the interaction between the components. In light of these gaps in the literature, the present study assessed the predictive role of these component skills for the development of narrative writing in typically developing children in the upper elementary grades.

A first critical component of writing is transcription (Berninger & Winn, 2006). Transcription skills include handwriting fluency and word spelling (Berninger, 2000). These skills are essential for translating language representations into written symbols. In young writers, a lack of automaticity in transcription skills may largely constrain content generation and writing fluency, by increasing children's processing load of their already limited WM resources (McCutchen, 1996). As such, cross-sectional research has found handwriting and spelling to be closely associated with written composition in elementary school, especially between kindergarten and the early elementary grades (e.g., Kim et al., 2011; Kim, Al Otaiba, Folsom, Gruelich, & Puranik, 2014; Puranik, Al Otaiba, Folsom, & Gruelich, 2012; Wagner et al., 2011). From a longitudinal perspective, Kent, Wanzek, Petscher, Al Otaiba, and Kim (2014) found that children's spelling in kindergarten is predictive of their first grade writing, a result that was replicated by Kim, Al Otaiba, and Wanzek (2015) for third grade writing. A consistent longitudinal relationship between spelling and composing has also been reported for children ranging from first to seventh grade (Abbott, Berninger, & Fayol, 2010).

Relatedly, instruction aimed at improving handwriting (e.g., Berninger et al., 1997; Graham, Harris, & Fink-Chorzempa, 2000) or spelling (e.g., Berninger et al., 1998) has been shown to improve composition in beginning writers.

The second component of writing, i.e. oral language skills (Berninger & Winn, 2006), equally constitutes an important cornerstone of the text generation process in writing. Oral language skills serve to translate ideas into language representations at the word-, sentence-, and text-level. For instance, writers draw on their vocabulary knowledge to convey their ideas in writing and structure them into sentences (Berninger et al., 1992). The development of a rich and varied vocabulary can therefore be seen as an essential step in becoming a proficient writer (Baker, Gersten, & Graham, 2003; Roth, 2000). Also grammatical skills are considered to be important in text generation, as they enable the expression of complicated relationships among ideas (Coirier, 1996). A lack of adequate grammatical skills may impede sentence construction during writing, and result in shorter text, syntactically less complex sentences and a reduced compositional quality (Graham & Harris, 1989; Saddler & Graham, 2005; Tindal & Parker, 1989). Oral language skills have indeed been found to contribute concurrently to writing in children ranging from kindergarten to the intermediate grades of elementary school (Abbott & Berninger, 1993; Hooper, Roberts, Nelson, Zeisel, & Kasambira-Fannin, 2010; Kim et al., 2011; Kim, Al Otaiba, Folsom, Gruelich, & Puranik, 2013; Olinghouse, 2008; Olinghouse & Leaird, 2009). Further evidence of the role of oral language skills in writing comes from studies involving children with oral language impairment (Bishop & Clarkson, 2003; Dockrell, Lindsay, Connelly, & Mackie, 2007). In addition, the effectiveness of instruction in syntax for enhancing writing performance among elementary grade students underscores the significance of grammatical skills for writing development (Saddler, Behforooz, & Asaro, 2008; Saddler & Graham, 2005). Longitudinal evidence regarding the contribution of oral language skills to writing is limited. Coker (2006) found that receptive vocabulary proficiency in first grade was concurrently related to the quality and quantity of writing, but did not predict narrative writing growth from first to third grade. By contrast, Hooper et al. (2010) found that oral language skills prior to kindergarten entry predicted the rate of growth in narrative writing between third and fifth grade, suggesting that oral language skills only become predictive of writing in later grades.

The third component underlying writing performance is executive functioning. EF may either refer to the cognitive processes of planning, translating, reviewing, and revising that manage self-regulation of the writing process, or to the low-level EF that scaffold these high-level EF (Berninger & Richards, 2002; Berninger & Richards, 2010). Low-level EF can be viewed as

cognitive subcomponents of a single supervisory attentional mechanism, and typically include inhibition, updating of WM, and shifting (Miyake, Friedman, Emerson, Witzki, Howerter, & Wagner, 2000). While empirical research has only recently started to unravel the role of these low-level EF in writing, they each bear a clear relevance to the complex process of writing. Inhibition may be engaged in during planning to suppress knowledge that writers do not want to include in their composition. Similarly, while translating ideas into language, writers need to inhibit inappropriate lexical representations and syntactic structures, and select a relevant set of words and phrase structures (Kellogg, Whiteford, Turner, Cahill, & Mertens, 2013; Olive, 2011). Shifting, in turn, may support the translation process by constantly switching between sub-processes and knowledge (Quinlan, Loncke, Leijten, & Van Waes, 2012). Updating of WM, finally, may be involved in monitoring and integrating new information in WM, in order to sustain the writing process. More specifically, as composing progresses, the writer needs to update the contents of WM in line with the text produced so far (Olive, 2011; St Clair-Thompson & Gathercole, 2006).

The relative contribution of EF to writing in developing writers has received scant attention compared to the other two components, as it is generally assumed that young writers do not exhibit much self-initiated executive control during composition due to their immature transcription skills and limited capacity of WM (Bereiter & Scardamalia, 1987; McCutchen, 1988). While this may be true for the late developing high-level EF of planning (McCutchen, 1988; Scardamalia & Bereiter, 1986), recent empirical evidence suggests that low-level EF are involved in the early development of written language skills in elementary school (Altemeier, Abbott, & Berninger, 2008; Altemeier, Jones, Abbott, & Berninger, 2006; Berninger, Abbott, et al., 2006; Drijbooms, Groen, & Verhoeven, 2015; Hooper, Swartz, Wakely, de Kruif, & Montgomery, 2002; Hooper et al., 2011; Kent et al., 2014; Kim et al., 2013; Kim, Al Otaiba, & Wanzek, 2015; Thomson et al., 2005). However, a paucity of these studies used an extensive test battery of neuropsychological measures to study EF. Some used a single latent construct summarizing EF measures (Hooper et al., 2011), whereas others used a limited test battery to assess EF (Altemeier, Jones, et al., 2006; Altemeier, Abbott, et al., 2008) or employed parents and teacher ratings of attentiveness (Kent et al., 2014; Kim et al., 2013; Kim et al, 2015; Thomson et al., 2005). Furthermore, while Kent et al. (2014) found attention regulation in kindergarten to be longitudinally predictive of both composition quality and fluency in first grade, other longitudinal studies have failed to replicate these findings for second (Hooper et al., 2011) and third grade writing outcomes (Kim, Al Otaiba, & Wanzek, 2015). Moreover, longitudinal investigations tracing the predictive role of executive control

beyond the early grades of elementary school are lacking. The importance of EF for writing in the upper elementary grades is, however, evident in the findings of intervention research, showing that training EF and attentional processes in fourth to sixth graders significantly improves children's compositional skills (Chenault, Thomson, Abbott, & Berninger, 2006) and spelling performance (Hooper, Wakely, de Kruif, & de Schwartz, 2006).

Taken together, while research investigating the component skills involved in writing has grown substantially, the majority of studies focus on concurrent predictors, with a particular emphasis on transcription and oral language skills. Longitudinal predictive studies, that also include an extensive array of EF, are lacking, with the upper elementary grades being a particularly understudied age range. These grades are, however, a critical period to examine the predictive role of these components, as the nature of writing and writing tasks changes substantially from fourth grade onwards. With transcription skills becoming automatized after fourth grade and beyond, more cognitive resources should become available for implementing oral language skills and EF (Berninger & Swanson, 1994; Berninger & Winn, 2006). Simultaneously, from fourth grade onwards, task requirements in the curriculum change and the translation process becomes more complex (Altemeier, Abbott, et al., 2008; Berninger & Chanquoy, 2012; Mehta, Foorman, Branun-Martin, & Taylor, 2005). Whereas writing in the early grades involves primarily learning to write letters, spell, and compose short texts, by fourth grade children are expected to compose increasingly complex and lengthy written texts, requiring closer attention to the structural and compositional aspects of the text as a whole (Berninger, Abbott, Whitaker, Sylvester, & Nolen, 1995; Graham, Harris, & Olinghouse, 2007; Wagner et al., 2011). As such, children are required to call upon sophisticated lexical and syntactic skills for the translation of ideas into coherent, extended discourse (Nippold, 2004; Shanahan, 2006). With such complex tasks, children have to engage more extensively in self-regulation and attentional control in order to manage the increasingly complex translation of ideas into language, the complex writing environment, the constraints imposed by the topic, and the associated compositional processes, such as revising, editing, organizing, and planning written expression (Altemeier, Abbott, et al., 2008; Hooper et al., 1993; Kellogg, 1987; Scardamalia & Bereiter, 1986). Hence, in such a context EF presumably become more critical to writing quality.

An increasingly popular approach to the assessment of writing quality is through the analysis of linguistic features. Frequently recurring features include measures of productivity (e.g., text length), complexity (e.g., syntactic complexity), and macro-organization (e.g., structure or content) (Puranik, Lombardino, & Altmann, 2008; Wagner et al., 2011). Unlike holistic ratings, these features concern characteristics that can be quantitatively measured

(Crossley, Weston, McLain Sullivan, & McNamara, 2011). There is growing evidence that these measures correspond to three relatively independent and dissociable dimensions of writing. Hence, individual children have been shown to vary in their writing performance at each of these dimensions (e.g., Puranik, Lombardino, & Altmann, 2008; Wagner et al., 2011; Kim et al., 2015). While the validity of these measures for writing assessment has been established, research still has to validate which measures are most sensitive to capture growth in children's writing (Puranik, Wagner, Kim, & Lopez, 2012).

The Present Study

The present study aimed to complement existing understanding of the role of component skills in writing development in two respects. First, we examined the longitudinal, rather than concurrent, predictive role of these skills. Second, we focused on writing growth in the upper elementary grades, given the substantial changes in writing development generally occurring in this age range. In particular, this study aimed to investigate how transcription skills, oral language skills, and EF as assessed by a broad neuropsychological test battery, predict narrative writing growth over time from fourth to sixth grade. In order to monitor growth in narrative writing, children's written compositions were evaluated on three measures: text length, syntactic complexity, and story content. Given this study design, specific research questions were as follows:

1) To what extent do measures of text length, syntactic complexity, and story content of narrative composition develop between fourth and sixth grade?
2) To what extent are the measures of text length, syntactic complexity, and story content longitudinally predictive of later measures, within and across themselves?
3) To what extent do transcription skills, oral language skills, and EF predict growth in these measures of narrative writing?

It was expected that each measure would show development over time, though the magnitude of progression may differ between measures. Further, in accordance with the relative independence of the different dimensions of writing, it was hypothesized that the measures would be longitudinally predictive within but not across themselves, confirming their nature as dissociable dimensions of writing. Finally, based on the changes that characterize later writing development, we predicted that oral language skills and EF would be powerful predictors of later narrative writing, whereas

transcription skills would constitute a relatively less important predictor of growth in this age group.

Method

Participants

Participants were recruited from four mainstream elementary schools in the Netherlands, with on average a middle to middle-high socio-economic background according to the Netherlands Institute for Social Research. Children displaying learning or behavioral problems were excluded from participation. Upon initial measurement in fourth grade, the sample consisted of 102 children (Age *M* = 9.6 years, *SD* = 5.74 months). This sample has been reported upon in an earlier study (Drijbooms, Groen, & Verhoeven, 2015). Due to dropouts throughout the years, the final sample comprised 93 children (46.6% girls) in the second testing phase in sixth grade (Age *M* = 11.1 years, *SD* = 5.29 months). Analyses were conducted on the data of children who participated both in fourth and in sixth grade. Active parental consent was obtained for each child. All participating children spoke Dutch and were raised in the Netherlands. Seven percent of the children were bilingual as they also spoke an additional language at home. However, the bilingual children did not perform significantly worse on vocabulary, oral grammar, and spelling than the monolingual children, so their data were retained for the analyses.

Procedure

In fourth grade, children's transcription skills, oral language skills, EF, and narrative writing skills were assessed. Assessments for handwriting fluency, oral language skills, and EF were individually administered in two administration blocks (Block A and Block B) by the first author and three trained research assistants. Block A consisted of the oral language measures, and the measure of handwriting fluency. Block B comprised the EF measures. Administration of the blocks was counterbalanced to minimize order effects. The narrative writing skills and spelling skills were group-administered by the first author. In sixth grade, only narrative writing skills were re-administered.

Measures

Narrative writing. To assess children's narrative writing skills, a picture elicitation task – the Expression, Reception and Recall of Narrative Instrument (ERRNI; Bishop, 2004) – was administered. The instrument includes two parallel tasks, the Beach Story and the Fish Story, that are each composed of a sequenced story of 15 pictures. To elicit a written narrative, children were each presented with the picture booklet for the Fish Story. They were

allowed to consult the pictures throughout the composition task. Children were instructed to look carefully at the pictures, before starting to write. The duration of the task and the length of the narrative were not imposed. The same story task was used in fourth and in sixth grade. All narratives were transcribed using CLAN from CHILDES (MacWhinney, 2000).

Following the coding scheme developed by Puranik, Lombardino, and Altmann (2007, 2008), three measures were derived from children's written narratives: text length measured by the total number of words, syntactic complexity measured by the mean length of a t-unit in words, and story content measured by the total number of ideas. Total number of words is a frequently used measure of compositional fluency and productivity, and a strong predictor of writing quality. The mean length of a t-unit in words was calculated by dividing the number of words produced by the number of t-units. A t-unit, or minimal terminable syntactic unit, is defined as an independent main clause, with any subordinate clauses associated with it (Hunt, 1966). Total number of ideas was calculated according to standard ERRNI procedures. The instrument contains a list of 24 main ideas that are represented in the story. Two points were awarded for each idea included in the narrative, one point was given when the idea was represented only partially.

Transcription skills. Children's handwriting fluency and spelling skills were both assessed. *Handwriting fluency* was assessed by means of the Systematic Screening of Handwriting Difficulties (the "Systematische Opsporing van Schrijfproblemen", Van Waelvelde, De Mey, & Smits-Engelsman, 2008), requiring children to copy a short text during 5 min. Handwriting fluency is calculated by counting the number of letters written in 5 min. Test-retest reliability is reported to be .69 (Van Waelvelde, Hellinckz, Peersman, & Smits-Engelsman, 2012). *Spelling skills* were assessed through a standardized Dutch dictation task, the "PI-dictee" (Geelhoed & Reitsma, 1999), containing 135 words that gradually increase in difficulty. Words were presented in sentences, after which children were instructed to write down the repeated word from each sentence. The raw score was the number of words spelled correctly (max. score = 135). Test-retest reliability for this task is reported as .91 (Geelhoed & Reitsma, 1999).

Oral language skills. Oral language skills were assessed by measures of receptive vocabulary knowledge and oral grammar. *Vocabulary* knowledge was measured through the Peabody Picture Vocabulary Test (PPVT-III-NL; Dunn & Dunn, 2005). Children were shown a test page containing four pictures and were asked to indicate the target picture that corresponded best

to the word presented orally by the experimenter. Words were presented in a pre-determined block of 12 trials, and testing was discontinued when the child missed eight or more items in a 12-item set. Raw scores (max. = 204) were used in the analyses. Internal consistency reliability is reported to be .95 (Dunn & Dunn, 2005). *Oral grammar* was assessed by measuring the mean length of a t-unit in words as an index of syntactic complexity during an oral narrative production task. This variable is automatically calculated by CLAN, and therefore does not require a reliability estimate. The Beach Story of the ERRNI was used to elicit the oral narrative (Bishop, 2004).

Executive functions. For the domain of EF, a battery of tasks was chosen to represent the three core low-level EF of inhibition, updating, and shifting, and the high-level EF of planning. To assess *inhibition*, four tasks were selected: the subtest Sky Search of the Test of Everyday Attention for Children (Tea-Ch Sky Search; Manly, Robertson, Anderson, & Nimmo-Smith, 1999) was administered to assess selective attention. The Letter Digit Substitution Task (LDST; Jolles, Houx, Van Boxtel, & Ponds, 1995) was selected to measure sustained attention. The subtest Walk Don't Walk (Tea-Ch Walk Don't Walk) and the subtest Opposite Worlds (Tea-Ch Opposite Worlds) of the Tea-Ch were administered to assess response inhibition. To assess *updating skills*, the Wechsler Intelligence Scale for Children-IV-Integrated Digit Span subtest (WISC-IV-I Digit Span; Wechsler, 2004) was administered. Furthermore, two *shifting* tasks were chosen: the Letter Fluency subtest from the Delis-Kaplan Executive Function System (D-KEFS-Letter Fluency; Delis, Kaplan, & Kramer, 2001) was used to tap phonemic *verbal fluency*, and the Trail Making Test from the D-KEFS (D-KEFS-TMT; Delis et al., 2001) was administered to assess *cognitive flexibility*. Finally, the high-level EF of *planning* was assessed by means of the Tower of London (TOL; Shallice, 1982). Additional description of the tasks, and methodological details for administering and scoring the measures are given in Drijbooms et al. (2015). A principal component analysis with varimax rotation, described in detail in Drijbooms et al. (2015), was run on all the EF measures. Three factors were found (Eigenvalues: 2.32, 1.09, and 1.03). The first factor showed high loadings on Tea-Ch Walk Don't Walk (.67), Tea-Ch Opposite Worlds (.83), LDST (.56), and D-KEFS-TMT (.56). The second factor showed high loadings on WISC-IV-I Digit Span (.49), D-KEFS-Letter Fluency (.50), and Tea-Ch Sky Search (.83). The third factor, finally, showed high loadings on D-KEFS-TMT (.52), and TOL (.91). Given these results, the EF measures were consolidated into three factors, labeled Inhibition, Updating, and Planning respectively. Shifting was thus not distinguished as a separate factor. This corresponds to recent evidence suggesting that in children shifting may not be dissociable from inhibition and updating, but builds highly upon

them (van der Ven, Kroesbergen, Boom, & Leseman, 2013), and comes later in development (Diamond, 2013). The factor scores were used as variables in the subsequent analyses.

Results

Preliminary analyses included descriptive statistics (see Table 3.1) and correlational analyses (see Table 3.2). A number of patterns are evident in the correlations. First, the predictor variables and initial writing measures were differentially correlated with later writing measures. For later text length, only a correlation with initial text length could be established. For later syntactic complexity, significant correlations with all measures were found, except with handwriting fluency, spelling, vocabulary, and updating skills. For later story content, a significant correlation was established with initial text length, initial story content, oral grammar, and later text length. Second, individual differences on each narrative measure were consistently correlated longitudinally between fourth and sixth grade. The magnitude of the autoregressive paths was moderate and similar for each measure (range = .30 - .39).

In order to answer the first research question, i.e. to what extent do text length, syntactic complexity, and story content develop between fourth and sixth grade, three paired sample t- tests were conducted for each of the writing measures. The results evidenced a significant increase in syntactic complexity ($t(92) = -7.91$, $p < .001$; $d = -.82$), but no developmental progression was observed for text length ($t(92) = .31$, $p = .76$; $d = .03$), nor for story content ($t(92) = .22$, $p = .82$; $d = .02$).

With regard to the second and third research question, a series of path analyses were conducted with AMOS 22 (Arbuckle, 2013), using maximum likelihood estimation method. Non-significant paths, i.e. paths exceeding the p-level of < .05, were removed stepwise to obtain the most parsimonious models. The fit of the models was evaluated using the following fit indices: a model fits well if the chi square (χ^2) exceeds .05 (Ullman, 2001), the goodness of fit index (GFI), the comparative fit index (CFI), the adjusted goodness of fit (AGFI) and the normed fit index (NFI) are greater than .90 and the root mean square error of approximation (RMSEA) is lower than .08 (Hu & Bentler, 1999).

Table 3.1
Descriptive Statistics for the Measures of the Written Narratives in Fourth and Sixth Grade, Transcription Skills, Oral Language Skills, and Executive Functions

	Fourth grade		Sixth grade	
n = 93	*Mean (SD)*	*Min.-max.*	*Mean (SD)*	*Min.-max.*
The written narratives				
Text length	240.61 (104.95)	75-560	236.78 (99.97)	70-538
Syntactic complexity	6.35 (1.42)	2.68-10.27	7.69 (1.53)	4-10.94
Story content	26.49 (6.00)	12-40	26.34 (5.57)	12-40
Transcription skills				
Handwriting fluency	177.08 (39.65)	63-260		
Spelling	95.31 (16.61)	41-127		
Oral language skills				
Oral grammar	7.61 (1.35)	4.86-10.66		
Vocabulary	115.59 (9.43)	96-141		
Executive functions				
Tea-Ch Sky Search	4.40 (1.61)	2-12.90		
Tea-Ch Walk Don't Walk	14.06 (3.26)	3-20		
Tea-Ch Opposite Worlds	31.47 (5.13)	22-47		
LDST	32.96 (7.28)	14-49		
WISC-IV-I Digit Span	12.01 (2.30)	5-20		
D-KEFS-Letter Fluency	14.65 (4.40)	4-28		
D-KEFS-TMT	113.04 (40.53)	38-240		
TOL	15.14 (2.72)	6-21		

Note. Tea-Ch = Test of Everyday Attention for Children. LDST = Letter Digit Substitution Task. WISC-IV-I Digit Span = Wechsler Intelligence Scale for Children-IV-Integrated Digit Span. D-KEFS-Letter Fluency = Delis-Kaplan Executive Function System Letter Fluency. D-KEFS-TMT = Delis-Kaplan Executive Function System Trail Making Test. TOL = Tower of London·

Table 3.2

Correlations between Transcription Skills, Oral Language Skills, Executive Functions, and Measures of the Written Narratives in Fourth Grade, and Measures of the Written Narratives in Sixth Grade

	1	2	3	4	5	6	7	8	9	10	11	12	13
Fourth grade measures													
1. Text length	1												
2. Syntactic complexity	.35**	1											
3. Story content	.52**	.45**	1										
4. Handwriting fluency	.31**	.23*	.32**	1									
5. Spelling	.29**	.22*	.16	.22*	1								
6. Grammar	.17	.44**	.26*	.06	.15	1							
7. Vocabulary	.17	.02	.24*	.10	.13	-.09	1						
8. Inhibition	.27**	.23*	.17	.24*	.26*	.03	.02	1					
9. Updating	.28**	.04	.20	.17	.12	.11	.05	-.03	1				
10. Planning	-.01	.05	.12	.05	.01	.10	.06	.02	-.03	1			
Sixth grade measures													
11. Text length	.30**	.16	.15	.16	.10	.14	.00	.17	.08	.03	1		
12. Syntactic complexity	.22*	.39**	.23*	.10	.05	.37**	-.00	.25**	-.07	.22*	.24*	1	
13. Story content	.35**	.15	.37**	.16	.09	.23*	.15	.20	.06	.06	.23*	.13	1

Note. *$p < .05$. **$p < .01$.

In order to answer the second research question, i.e. to what extent are the initial measures of text length, syntactic complexity, and story content longitudinally predictive of later narrative measures, a simplex autoregressive and cross-lagged model was constructed to test how each measure influences itself over time (i.e., within-measure autoregressive longitudinal path) and how each measure crosses over to influence another measure at a subsequent time (i.e., between-measures longitudinal cross-lagged path). Hence, this model was evaluated to determine a) the degree of stability of each measure over time, and b) the longitudinal relationships across the measures. As no developmental progression was observed for text length or for story content, the only cross-lagged paths included were from text length in fourth grade to syntactic complexity in sixth grade, and from story content in fourth grade to syntactic complexity in sixth grade. Neither of the two cross-lagged paths turned out to be significant, indicating that text length and story content in fourth grade were not predictive of syntactic complexity in sixth grade. Hence, the best fit for the model was obtained when the non-significant cross-lagged paths were removed: χ^2 (6) = 5.32, p = .50, GFI = .98, CFI = 1.00, AGFI = .94, NFI = .95, RMSEA = .00. An examination of the values of the autoregressive path coefficients revealed that each measure in fourth grade had a significant longitudinal path and explained unique variance in itself in sixth grade (text length: standardized coefficient = .27; syntactic complexity: standardized coefficient = .38; story content: standardized coefficient = .37). Hence, the longitudinal relationships within measures reflect that each of these measures is relatively stable across the upper elementary grades. Furthermore, the lack of a longitudinal relationship across the measures confirms that each measure constitutes a relatively independent and dissociable dimension of writing.

In order to answer the third research question, i.e. to what extent do component skills predict growth in each measure of narrative writing, a second path model was constructed. Considering the lack of developmental progression for text length and story content, and the longitudinal independence of the measures, we decided to construct a path model that only considered the contribution of transcription skills, oral language skills and EF to development in syntactic complexity. First, a saturated model was fitted to the data with all possible paths from the predictor variables to the outcome variable. Non-significant paths were then dropped iteratively from the model, examining changes in fit, resulting in the final model as depicted in Figure 3.1. This model had a strong fit: χ^2 (4) = .98, p = .91, GFI = 1.00, CFI = 1.00, AGFI = .98, NFI = .98, RMSEA = .00. The path model showed that syntactic complexity in sixth grade was, in addition to the stability effect of syntactic complexity in fourth grade (β = .24), predicted by inhibition (β = .19), planning (β = .18), and oral grammar (β = .24). Inhibition and oral grammar

also indirectly influenced syntactic complexity in sixth grade through their concurrent contribution to syntactic complexity in fourth grade (respectively: β =.21, and β = .43).

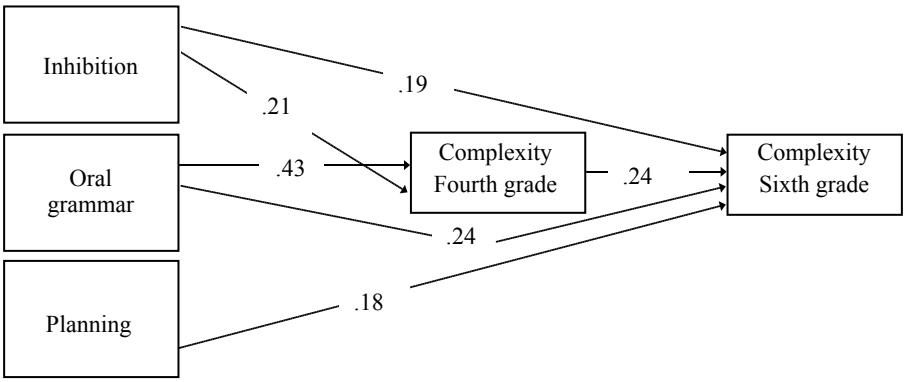

Figure 3.1. Path model with EF and oral grammar in fourth grade, and syntactic complexity of narratives in fourth and in sixth grade. All path coefficients are significant, $p < .05$. *Note*: paths between vocabulary and transcription skills in fourth grade and syntactic complexity in fourth and in sixth grade were estimated, but were not found to be significant.

3

Discussion

In the present study, we investigated development of narrative writing in the upper elementary grades, and its predictors, by assessing narrative writing along three dimensions and simultaneously administering a large test battery of transcription skills, oral language skills, and EF. In answer to our first and second research questions, we found that syntactic complexity, but not text length nor story content, improved significantly with age, that each measure was longitudinally predictive within itself, and that there were no longitudinal relationships across measures. Regarding the third research question, we focused exclusively on the longitudinal predictors of syntactic complexity, in the absence of a developmental progression in text length and story content. Findings showed that oral grammar and the EF of inhibition and planning were longitudinally related to syntactic complexity of written narratives. Our results can be interpreted in light of the changes in the nature of writing and writing tasks that characterize writing development in the upper elementary grades.

The developmental progression of syntactic complexity between fourth and sixth grade is convergent with the general idea that syntactic coding is an increasingly important factor in writing proficiency from fourth grade

onwards until college (e.g., Berninger, Abbott, et al., 2010; Berninger, Nagy, & Beers, 2011). Development in syntactic complexity is a key feature of later language development (Nippold, 2004) and reflects children's growing ability to express complex ideas, and their frequent exposure and familiarity with the literate genre (Fang, Schleppegrell, & Cox, 2006). In this sense, children's progress on syntactic complexity is fully commensurate with the more complex writing tasks that children are exposed to in the upper elementary grades (e.g., Berninger et al., 1995; Wagner et al., 2011). It is somewhat surprising that text length and story content did not increase with age, as they represent two widely examined dimensions of writing, i.e. productivity and macro-organization respectively. A tentative explanation could be found in the nature of our writing task. The relatively simple picture elicitation task may not have been challenging enough for the sixth graders, thereby constraining children's motivation to perform well on the task (Troia, 2011). Syntactic complexity may be less affected by motivational constraints as for young writers syntax may still be a part of implicit linguistic knowledge that is applied holistically rather than explicitly reasoned about (Ravid & Tolchinsky, 2002). In agreement with previous studies (e.g., Kim et al., 2014; Kim et al., 2015; Puranik et al., 2008; Wagner et al., 2011), this developmental finding, along with the longitudinal relationships within but not across measures, underscores the idea that writing is not a single dimension but is composed of multiple dimensions that may each show a different developmental trajectory, and may be differentially subject to writing constraints. While it is beyond the scope of the current study to fully evaluate the dimensionality of writing, these findings do emphasize the importance of assessing writing at different dimensions.

Regarding the longitudinal predictors of syntactic complexity, the findings of the present study showed how oral grammar and EF, but not transcription skills, in fourth grade relate to later syntactic complexity of narrative writing. This confirms our hypothesis and supports a developmental theory of writing (Berninger & Swanson, 1994; Berninger & Winn, 2006). Prior research has found transcription skills, and particularly spelling, to be longitudinally predictive of writing skills in the early and middle grades of elementary school (e.g., Kent et al., 2014; Kim et al., 2015; Abbott et al., 2010). Examining more specifically the dimension of complexity, Wagner et al. (2011) found a significant concurrent relationship between handwriting fluency and syntactic complexity of written composition for first, but not for fourth, graders. Similarly, in a study by Kim et al. (2014), spelling was a unique predictor of syntactic complexity of first graders' narrative written composition. Together with these previous findings, the lack of a longitudinal relationship of transcription skills to syntactic complexity in the present study

indicates that their influence declines once children get older and automatize their handwriting and spelling skills (Berninger & Swanson, 1994). Hence, the ability to produce syntactically complex sentences at this stage of writing development seems to be no longer constrained by handwriting and spelling skills. This should imply an increased availability of cognitive resources for higher-order processes, such that it allows children to employ their accumulated language and EF skills to produce text (Berninger & Winn, 2006).

Indeed, the longitudinal contribution of oral language skills to syntactic complexity confirms that proficiency in spoken sentence production in fourth grade boosts the development of the ability to write syntactically complex sentences. More specifically, children with superior oral sentence construction skills may have access to a larger syntactic repertoire, which facilitates written sentence production. This extends previous research with younger children (e.g., Abbott & Berninger, 1993; Kim et al., 2013; Kim et al., 2015; Olinghouse, 2008), by revealing that oral language sophistication is longitudinally related to a specific dimension of narrative writing. While receptive vocabulary was not predictive of syntactic complexity in the current study, this not necessarily implies that vocabulary is not important for written composition. Rather, we hypothesize that our vocabulary measure might be more sensitive for capturing individual differences in other dimensions of writing, such as macro-organization.

Importantly, besides oral language skills, we found that executive control contributes to development in syntactic complexity. More particularly, children who exhibited higher inhibition and planning skills in fourth grade were more likely to improve on syntactic complexity of their narratives between fourth and sixth grade. In producing sentences, a writer has to linguistically translate a preverbal semantic message into a grammatical structure (Alamargot & Chanquoy, 2001; Levelt, 1989). This process consists of drafting a syntactic and lexical plan, taking into account that the unordered elements of the preverbal message must end up in a linear and unidimensional sequence of words (Levelt, 1989). Determining the order of elements is thus a critical part of the production of a sentence, which requires considerable planning skills. Sentence production in this sense also requires keeping several grammatical options and sequences in WM, and inhibiting irrelevant ones (Thornton & Light, 2006). While this explains the longitudinal contribution of inhibition to syntactic complexity, it leaves the question unanswered as to why the EF of updating WM does not contribute to the syntactic complexity of children's written narratives. A possible explanation is that the syntactic structures used by the children do not place a high cognitive load on WM, because they are planned locally and incrementally instead of prior to writing (Nottbusch, 2010). Overall, the predictive role of inhibition and planning confirms that EF

are required for managing the production of complex texts (Graham & Harris, 2000; Kellogg, 1987; Scardamalia & Bereiter, 1986). Planning, in contrast to inhibition, plays only a longitudinal, but not a concurrent, predictive role. This seems to suggest that planning skills are not yet fully operational in fourth grade. Generally, developing writers have indeed been found to show little, overt planning behavior during composition, as their writing is constrained by non-automatic lower-level writing processes (McCutchen, 1988; Scardamalia & Bereiter, 1986).

From a theoretical perspective, the critical importance of EF for writing in the upper elementary grades as evidenced by this study confirms predictions of developmental models of writing. It further demonstrates that research investigating predictors of writing skills in children should include neuropsychological measures of EF. More broadly, this study enhances our current understanding of EF in writing, by specifying their contribution to a specific dimension of writing. While the act of writing is frequently documented as a problem-solving activity, which requires executive functioning to manage complex cognitive processing, few writing studies have attempted to relate EF to specific aspects of the translation process of writing. From an educational perspective, the present study offers perspectives for instruction and assessment practices. Instructionally, our results imply that in order to improve children's sentence production in written composition in the upper elementary grades, attention needs to be paid to enhancing children's EF, and particularly inhibition and planning skills. This is aligned with the idea that children have to be trained more extensively in self-regulation skills in order to manage written composition (Graham & Harris, 2000; Altemeier, Abbott, et al., 2008). Such training may be crucial, as evidence exists that enhancing syntactic complexity of written composition positively impacts on overall compositional quality (Saddler et al., 2008; Saddler & Graham, 2005). Furthermore, although there is a general lack of syntax-focused instruction in current writing curricula (Beers & Nagy, 2009), our findings demonstrate that children do progress significantly on the syntactic complexity of written narratives in the upper elementary grades. Hence, syntactic complexity could be considered an important developmental marker of written language, and thus a sensitive indicator to monitor children's progress in writing.

Some limitations of the present study should be acknowledged and point to directions for future research. First, although using written picture elicitation tasks has several advantages, our writing task might not be fully representative of the complex writing tasks in the later grades of elementary school. Future studies with cognitively more challenging tasks and genres are needed to determine how component skills contribute to different writing outcomes. Furthermore, while this study included the major component

skills of writing according to developmental models of writing, several other potential predictors of writing have not been explored, such as reading skills, motivation, and instructional quality. Finally, monitoring the predictors of writing development over a longer time span, including both younger and older writers, could complete the picture of the changing relationships between component skills and writing across development.

In summary, the results of the present study support oral language skills and particularly EF as building blocks of writing development in the upper elementary grades. To our knowledge, this is the first study that confirmed such a longitudinal relationship for the complexity dimension of narrative writing. While further research into the multiple influences on writing is clearly warranted, the findings of the current study have provided initial, valuable information about the complex foundations of writing development in the upper elementary grades.

References

Abbott, R. D., & Berninger, V. W. (1993). Structural equation modeling of relationships among developmental skills and writing skills in primary- and intermediate-grade writers. *Journal of Educational Psychology, 85*, 478-508. doi:10.1037/0022-0663.85.3.478

Abbott, R. D., Berninger, V. W., & Fayol, M. (2010). Longitudinal relationships of levels of language in writing and between writing and reading in grades 1 to 7. *Journal of Educational Psychology*, 102, 281-298. doi:10.1037/a0019318

Alamargot, D., & Chanquoy, L. (2001). *Through the models of writing*. Dordrecht, the Netherlands: Kluwer.

Altemeier, L., Abbott, R. D., & Berninger, V. W. (2008). Executive functions for reading and writing in typical literacy development and dyslexia. *Journal of Clinical and Experimental Neuropsychology, 30*, 588-606. doi:10.1080/13803390701562818

Altemeier, L., Jones, J., Abbott, R. D., & Berninger, V. W. (2006). Executive functions in becoming writing readers and reading writers: Note-taking and report writing in third and fifth graders. *Developmental Neuropsychology, 29*, 161-173. doi:10.1207/s15326942dn2901_8

Arbuckle, J. L. (2013). *IBM SPSS Amos 22 user's guide*. Crawfordville, FL: Amos Development Corporation.

Baker, S., Gersten, R., & Graham, S. (2003). Teaching expressive writing to students with learning disabilities: Research-based applications and examples. *Journal of Learning Disabilities, 36,* 109-123. doi:10.1177/002221940303600204

Beers, S. F., & Nagy, W. (2009). Syntactic complexity as a predictor of adolescent writing quality: which measures? Which genre?. *Reading and Writing: An Interdisciplinary Journal,* 22*,* 185-200. doi:10.1007/s11145-007-9107-5

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Erlbaum.

Berninger, V. W., Yates, C., Cartwright, A., Rutberg, J., Remy, E., & Abbott, R. (1992). Lower-level developmental skills in beginning writing. *Reading and Writing: An Interdisciplinary Journal, 4*, 257-280. doi:10.1007/BF01027151

Berninger, V. W., & Swanson, H. L. (1994). Modifying Hayes and Flower's model of skilled writing to explain beginning and developing writing. In J. S. Carlson (Ed.) & E. C. Butterfield (Vol. Ed.), *Advances in cognition and educational practice, Vol.2: Children's writing: Toward a process theory of the development of skilled writing* (pp. 57-81). Greenwich, CN: JAI Press.

Berninger, V. W., Vaughan, K. B., Abbott, R. D., Abbott, S. P., Rogan, L. W., Brooks, A., Reed, E., & Graham, S. (1997). Treatment of handwriting problems in beginning writers: transfer from handwriting to composition. *Journal of Educational Psychology, 89*, 652-666. doi:10.1037/0022-0663.89.4.652

Berninger, V. W., Vaughan, K., Abbott, R., Brooks, A., Abbott, S., Reed, E., Rogan, L. & Graham, S. (1998). Early intervention for spelling problems: Teaching spelling units of varying size within a multiple connections framework. *Journal of Educational Psychology, 90*, 587-605. doi:10.1037/0022-0663.90.4.587

Berninger, V. W. (2000). Development of language by hand and its connections with language by ear, mouth, and eye. *Topics in Language Disorders,* 20, 65-84. doi:10.1097/00011363-200020040-00007

Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. MacArthur, S. Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96-114). New York, NY: Guilford Press.

Berninger, V. W., Abbott, R., Thomson, J., Wagner, R., Swanson, H. L., Wijsman, E., & Raskind, W. (2006). Modeling developmental phonological core deficits within a working-memory

architecture in children and adults with developmental dyslexia. *Scientific Studies in Reading, 10*, 165-198. doi:10.1207/s1532799xssr1002_3

Berninger, V. W., & Chanquoy, L. (2012). What writing is and how it changes across early and middle childhood development: A multidisciplinary perspective. In E. Grigorenko, E. Mambrino & D. Preiss (Eds.), *Writing: A mosaic of perspectives and views* (pp. 65-84). New York, NY: Psychology Press.

Berninger, V. W., Abbott, R. D., Whitaker, D., Sylvester, L., & Nolen, S. B. (1995). Integrating low- and high-level skills in instructional protocols for writing disabilities. *Learning Disability Quarterly, 19*, 293-309. doi:10.2307/1511235

Berninger, V. W., & Richards, T. L. (2002). *Brain literacy for educators and psychologists.* New York, NY: Academic Press.

Berninger, V. W., & Richards, T. L. (2010). Inter-relationships among behavioral markers, genes, brain, and treatment in dyslexia and dysgraphia. *Future Neurology, 5*, 597-617. doi:10.2217/fnl.10.22

Berninger, V. W., Nagy, W., & Beers, S. F. (2011). Developing Writers' Sentence and Syntactic Awareness: Constructing and Combining Sentences. *Reading and Writing: An Interdisciplinary Journal,* 24, 151-182. doi:10.1007/s11145-010-9262-y

Berninger, V. W., Abbott, R., Swanson, H. L., Lovitt, D., Trivedi, P., Lin, S., Gould, L., Youngstrom, M., Shimada, S., & Amtmann, D. (2010). Relationship of word- and sentence-level working memory to reading and writing in second, fourth, and sixth grade. *Language, Speech, and Hearing Services in Schools, 41*, 179-193. doi:10.1044/0161-1461(2009/08-0002)

Bishop, D. V. M., & Clarkson, B. (2003). Written language as a window into residual language deficits: A study of children with persistent and residual speech and language impairments. *Cortex, 39*, 215-237. doi:10.1016/S0010-9452(08)70106-0

Bishop, D. V. M. (2004). *Expression, reception and recall of narrative instrument*. London, UK: Harcourt Assessment.

Chenault, B., Thomson, J., Abbott, R. D., & Berninger, V. W. (2006). Effects of prior attention training on child dyslexics' response to composition instruction. *Developmental Neuropsychology, 29*, 243-260. doi:10.1207/s15326942dn2901_12

Coirier, P. (1996). Composing argumentative texts: Cognitive and/or textual complexity. In G. Rijlaarsdam, H. van den Bergh & M. Couzijn (Eds.), *Theories, models and methodology in writing research* (pp. 317-338). Amsterdam, the Netherlands: Amsterdam University Press.

Coker, D. (2006). Impact of first-grade factors on the growth and outcomes of urban school children's primary-grade writing. *Journal of Educational Psychology, 98*, 471-488. doi:10.1037/0022-0663.98.3.471

Crossley, S. A., Weston, J., McLain Sullivan, S. T., & McNamara, D. S. (2011). The development of writing proficiency as a function of grade level: A linguistic analysis. *Written Communication, 28*, 282-311. doi:10.1177/0741088311410188

Delis, D., Kaplan, E., & Kramer, J. (2001). *Delis–Kaplan executive function scale*. San Antonio, TX: The Psychological Corporation.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135-168. doi:10.1146/annurev-psych-113011-143750

Dockrell, J. E., Lindsay, G. A., Connelly, V., & Mackie, C. (2007). Constraints in the production of written text in children with specific language impairments. *Exceptional Children, 73*, 147-164. doi:10.1177/001440290707300202

Drijbooms, E., Groen, M. A., & Verhoeven, L. (2015). The contribution of executive functions to narrative writing in fourth grade children. *Reading and Writing: An Interdisciplinary Journal, 28*, 989-1011. doi:10.1007/s11145-015-9558-z

Dunn, L. M., & Dunn, D. M. (2005). *Peabody Picture Vocabulary Test-III-NL*. Nederlandse versie Liesbeth Schlichting. Handleiding. Amsterdam, the Netherlands: Harcourt Test Publishers.

Fang, Z., Schleppegrell, M. J., & Cox, B. (2006). Understanding the language demands of schooling: Nouns in academic registers. *Journal of Literacy Research, 38*, 247-273. doi:10.1207/s15548430jlr3803_1

Geelhoed, J. W., & Reitsma, P. (1999). *PI-dictee*. Lisse: Swets & Zeitlinger.

Graham, S., & Harris, K. R. (2000). The role of self-regulation and transcription skills in writing and writing development. *Educational Psychologist, 35*, 3-12. doi:10.1207/S15326985EP3501_2

Graham, S., & Harris, K. R. (1989). A components analysis of cognitive strategy training: Effects on learning disabled students' compositions and self-efficacy. *Journal of Educational Psychology, 81*, 353-361. doi:10.1037/0022-0663.81.3.353

Graham, S., Harris, K. R., & Fink-Chorzempa, B. (2000). Is handwriting causally related to learning to write? Treatment of handwriting problems in beginning writers. *Journal of Educational Psychology, 92*, 620-633. doi:10.1037/0022-0663.92.4.620

Graham, S., Harris, K. R., & Olinghouse, N. (2007). Addressing executive function problems in writing: An example from the self-regulated strategy development model. In L. Meltzer (Ed.), *Executive function in education* (pp. 216-236). New York, NY: Guilford.

Hooper, S. R., Swartz, C. W., Wakely, M. B., de Kruif, R. E. L., & Montgomery, J. W. (2002). Executive functions in elementary school children with and without problems in written expression. *Journal of Learning Disabilities, 35*, 57-68. doi:10.1177/002221940203500105

Hooper, S. R., Swartz, C., Montgomery, J., Reed, M. S., Brown, T., Wasileski, T., & Levine, M. D. (1993). Prevalence of writing problems across three middle school samples. *School Psychology Review, 22*, 608-620.

Hooper, S. R., Wakely, M. B., de Kruif, R. E. L., & Swartz, C. W. (2006). Aptitude-treatment interactions revisited: effect of metacognitive intervention on subtypes of written expression in elementary school students. *Developmental Neuropsychology, 29*, 217-241. doi:10.1207/s15326942dn2901_11

Hooper, S. R., Roberts, J. E., Nelson, L., Zeisel, S., & Kasambira-Fannin, D. (2010). Preschool predictors of narrative writing skills in elementary school children. *School Psychology Quarterly, 25*, 1-12. doi:10.1037/a0018329

Hooper, S. R., Costa, L. J., McBee, M., Anderson, K., Yerby, D. C., Knuth, S. B., & Childress, A. (2011). Concurrent and longitudinal neuropsychological contributors to written language expression in first and second grade students. *Reading and Writing: An Interdisciplinary Journal, 24*, 221-252. doi:10.1007/s11145-010-9263-x

Hu, L., & Bentler, P. M. (1999). Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling, 6*, 1-55. doi:10.1080/10705519909540118

Hunt, K. W. (1966). *Sentence structures used by superior students in grades four and twelve, and by superior adults*. CRP 5-0313. Tallahassee, FL: Florida State University.

Jolles, J., Houx, P., Van Boxtel, M., & Ponds, R. (1995). *Maastricht aging study: Determinants of cognitive aging*. Maastricht: Neuropsych Publishers.

Kellogg, R. T. (1987). Writing performance: Effects of cognitive strategies. *Written Communication, 4*, 269-298. doi:10.1177/0741088387004003003

Kellogg, R. T., Whiteford, A. P., Turner, C. E., Cahill, M., & Mertens, A. (2013). Working memory in written composition: An evaluation of the 1996 model. *Journal of Writing Research,* 5, 159-190.

Kent, S., Wanzek, J., Petscher, Y., Al Otaiba, S., & Kim, Y-S. (2014). Writing fluency and quality in kindergarten and first grade: The role of attention, reading, transcription, and oral language. *Reading and Writing: An Interdisciplinary Journal, 27*, 1163-1188. doi:10.1007/s11145-013-9480-1

Kim, Y. S., Al Otaiba, S., Puranik, C., Folsom, J. S., Greulich, L., & Wagner, R. K. (2011). Componential skills of beginning writing: an exploratory study. *Learning and Individual Differences, 21*, 517-525. doi:10.1016/j.lindif.2011.06.004

Kim, Y. S., Al Otaiba, S., Folsom, J. S., Gruelich, L., & Puranik, C. (2014). Evaluating the dimensionality of first grade written composition. *Journal of Speech, Language, and Hearing Research, 57*, 199-211. doi:10.1044/1092-4388(2013/12-0152)

Kim, Y. S., Al Otaiba, S., Folsom, J. S., Gruelich, L., & Puranik, C., J. (2013). Language, literacy, and attentional behaviors, and instructional quality predictors of written composition for first graders. *Early Childhood Research Quarterly, 28*, 461-469. doi:10.1016/j.ecresq.2013.01.001

Kim, Y. S., Al Otaiba, S., & Wanzek, J. (2015). Kindergarten predictors of third grade writing. *Learning and Individual Differences, 37*, 27-37. doi:10.1016/j.lindif.2014.11.009

Levelt, J. M. W. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.

MacWhinney, B. (2000). *The CHILDES project: Tools for analyzing talk*. Mahwah, NJ: Lawrence Erlbaum Associates.

Manly, T., Robertson, I. H., Anderson, V., & Nimmo-Smith, I. (1999). *TEA-Ch: The test of everyday attention for children manual*. Bury St. Edmunds: Thames Valley Test Company Limited.

McCutchen, D. (1988). "Functional automaticity" in children's writing: A problem of metacognitive control. *Written Communication, 5*, 306-324. doi:10.1177/0741088388005003003

McCutchen, D. (1996). A capacity theory of writing: Working memory in composition. *Educational Psychology Review, 8*, 299-325. doi:10.1007/BF01464076

Mehta, P. D., Foorman, B. R., Branum-Martin, L., & Taylor, W. P. (2005). Literacy as a unidimensional multilevel construct: Validation, sources of influence, and implications in a longitudinal study in grades 1 to 4. *Scientific Studies of Reading, 9*, 85-116. doi:10.1207/s1532799xssr0902_1

Miyake, A., Friedman, N., Emerson, M., Witzki, A., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*, 49-100. doi:10.1006/cogp.1999.0734

Nippold, M. A. (2004). Research on later language developments: International perspectives. In R. A. Berman (Ed.), *Language development across childhood and adolescence: Volume 3. Trends in language acquisition research* (TILAR) (pp. 1-8). Amsterdam, the Netherlands: John Benjamins.

Nippold, M. A. (2007). *Later language development: School-age children, adolescents, and young adults (3rd ed.).* Austin, TX: Pro-Ed.

Nottbusch, G. (2010). Grammatical planning, execution, and control in written sentence production. *Reading and Writing: An Interdisciplinary Journal, 23*, 777-801. doi:10.1007/s11145-009-9188-4

Olinghouse, N. G. (2008). Student- and instruction-level predictors of narrative writing in third-grade students. *Reading and Writing: An Interdisciplinary Journal, 21*, 3-26. doi:10.1007/s11145-007-9062-1

Olinghouse, N. G., & Leaird, J. T. (2009). The relationship between measures of vocabulary and narrative writing quality in second- and fourth-grade students. *Reading and Writing: An Interdisciplinary Journal, 22*, 545-565. doi:10.1007/s11145-008-9124-z

Olive, T. (2011). Working memory in writing. In V. W. Berninger (Ed.) *Past, Present, and Future Contributions of Cognitive Writing Research to Cognitive Psychology* (pp. 485-503). New York, NY: Psychology Press.

Puranik, C., Al Otaiba, S., Folsom, J. S., & Gruelich, L. (2012). Examining the contribution of letter writing fluency and spelling to composition in kindergarten children. *Reading and Writing: An Interdisciplinary Journal, 25*, 1523-1546. doi:10.1007/s11145-011-9331-x

Puranik, C., Lombardino, L., & Altmann, L. (2007). Writing through retellings: An exploratory study of language impaired and dyslexic populations. *Reading and Writing: An Interdisciplinary Journal, 20*, 251-272. doi:10.1007/s11145-006-9030-1

Puranik, C., Lombardino, L., & Altmann, L. (2008). Assessing the microstructure of written language using a retelling paradigm. *American Journal of Speech-Language Pathology, 17*, 107-120. doi:10.1044/1058-0360(2008/012)

Puranik, C., Wagner, R. K., Kim, Y., & Lopez, D. (2012). Multivariate assessment of processes in elementary students' written translation. In M. Fayol, D. Alamargot & V. W. Berninger (Eds.), *Translation of Thought to Written Text While Composing: Advancing Theory, Knowledge, Research Methods, Tools, and Applications* (pp. 249-274). New York, NY: Psychology Press.

Quinlan, T., Loncke, M., Leijten, M., & Van Waes, L. (2012). Coordinating the Cognitive Processes of Writing. *Written Communication, 29*, 345-368. doi:10.1177/0741088312451112

Ravid, D. & Tolchinsky, L. (2002). Developing linguistic literacy: A comprehensive model. *Journal of Child Language, 29*, 419-448. doi:10.1017/S0305000902005111

Roth, F. P. (2000). Narrative writing: development and teaching with children with writing difficulties. *Topics in language disorders, 20*, 15-28. doi:10.1097/00011363-200020040-00004

Saddler, B., & Graham, S. (2005). The effects of peer-assisted sentence combining instruction on the writing performance of more and less skilled young writers. *Journal of Educational Psychology, 97*, 43-54. doi:10.1037/0022-0663.97.1.43

Saddler, B., Behforooz, B., & Asaro, K. (2008). The effects of sentence-combining instruction on the writing of fourth-grade students with writing difficulties. *Journal of Special Education, 42*, 79-90. doi:10.1177/0022466907310371

Scardamalia, M., & Bereiter, C. (1986). Research on written composition. In M. Wittroch (Ed.), *Handbook of research on teaching* (pp. 378-803). New York, NY: Macmillan.

Shallice, T. (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society London, B, 298*, 199-209. doi:10.1098/rstb.1982.0082

Shanahan, T. (2006). Relations among oral language, reading, and writing development. In C. MacArthur, S. Graham & J. Fitzgerald (Eds). *Handbook of Writing Research* (pp. 171-183). New York, NY: Guilford.

St Clair-Thompson, H. L., & Gathercole, S. E. (2006). Executive functions and achievements in school: Shifting, updating, working memory. *The Quarterly Journal of Experimental Psychology, 59*, 745-759. doi:10.1080/17470210500162854

Thomson, J. B., Chenault, B., Abbott, R., Raskind, W. H., Richards, T., Aylward, E., & Berninger, V. W. (2005). Converging evidence for attentional influences on the orthographic word form in child dyslexics. *Journal of Neurolinguistics, 18*, 93-126. doi:10.1016/j.jneuroling.2004.11.005

Thornton, R., & Light, L. L. (2006). Language comprehension and production in normal aging. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (pp. 262-287). Amsterdam, the Netherlands: Elsevier Academic Press.

Tindal, G., & Parker, R. (1989). Assessment of written expression for students in compensatory and special education programs. *Journal of Special Education, 23*, 169-183. doi:10.1177/002246698902300204

Troia, G. A. (2011). *Instruction and assessment for struggling writers*: Evidence-based practices. New York, NY: Guilford.

Ullman, J. B. (2001). Structural equation modeling. In B. G. Tabachnich & L. S. Fidell (Eds.), *Using multivariate statistics* (pp. 653-771). New York, NY: Allyn & Bacon.

van der Ven, S., Kroesbergen, E., Boom, J., & Leseman, P. (2013). The structure of executive functions in children: A closer examination of inhibition, shifting, and updating. *British Journal of Developmental Psychology, 31*, 70-87. doi:10.1111/j.2044-835X.2012.02079.x

Van Waelvelde, H., De Mey, B., & Smits-Engelsman, B. C. M. (2008). *Handleiding SOS. Systematische opsporing van schrijfmotorische problemen*. Ghent: Revalidatiewetenschappen en Kinesitherapie Gent.

Van Waelvelde, H., Hellinckx, T., Peersman, W., & Smits-Engelsman, B. C. M. (2012). SOS: A screening instrument to identify children with handwriting impairments. *Physical and Occupational Therapy in Pediatrics, 32*, 306-319. doi:10.3109/01942638.2012.678971

Wagner, R. K., Puranik, C. S., Foorman, B., Foster, E., Tschinkel, E., & Kantor, P. T. (2011). Modeling the development of written language. *Reading and Writing: An Interdisciplinary Journal, 24*, 203-220. doi:10.1007/s11145-010-9266-7

Wechsler, D. L. (2004). *Wechsler intelligence scale for children (4th ed.).* San Antonio, TX: The Psychological Corporation

Chapter 4

Children's use of evaluative devices in spoken and written narratives

4

This chapter is based on: Drijbooms, E., Groen, M. A., & Verhoeven, L. (accepted for publication). Children's use of evaluative devices in spoken and written narratives. *Journal of Child Language.*

Abstract

This study investigated the development of evaluation in narratives from middle to late childhood, within the context of differentiating between spoken and written modalities. Two parallel forms of a picture story were used to elicit spoken and written narratives from fourth and sixth graders. It was expected that, in addition to an increase of evaluative devices with age, written narratives would exhibit a higher frequency and diversity as a result of the intrinsic differences between the two modalities. From a developmental perspective, the results showed that only few categories exhibited the expected increase with age. Qualitative analyses provided a fruitful method to illustrate developmental changes. The results further indicated that modality had the expected impact on the diversity, and on the frequency of most categories of evaluative language. Specifically, markers of decontextualized language and categories with a high degree of syntactic complexity were prone to modality differences.

From an early age, children produce oral stories and by the time children enter elementary school, they also start to compose written stories. Although narrative writing has its roots in oral narration (Roth, 2000), it is generally acknowledged that speaking and writing are different realities that each require a different style (Carvalho, 2002). As such, children need to become aware of these modality differences and learn how to reflect them in the linguistic encoding of their narratives. In both modalities, a coherent story typically consists of essential story elements including the main events, actions and characters of the story – the referential aspects –, as well as information on the thoughts, feelings, beliefs and motivations that underlie these essential story elements – the evaluative aspects (Labov & Waletzsky, 1967). The present study compares the development of evaluative aspects of spoken and written fictional narratives in middle to late elementary school, by analyzing the diversity and frequency of evaluative devices in the two modalities in a longitudinal sample.

Narratives are extended pieces of discourse that can be found in a variety of meaningful social contexts. According to the Labovian framework (Labov, 1972; Labov & Waletzky, 1967), a narrative consists of a series of temporally ordered events whose importance is highlighted through evaluation. More specifically, in Labov's narrative model, the story's main events, actions, and characters are structured in a prototypical narrative structure, comprising an initial orientation, a complication, and a resolution, which is intertwined with evaluative information, conveying a meaningful interpretation of the narrated events. While the recapitulation of successive events is a basic requirement of a narrative, the evaluative aspects of the narrative stimulate real interest in the audience and increase the audience's knowledge state and involvement in the story (van Beijsterveldt & van Hell, 2009). The inclusion of evaluative aspects represents not only what the storyteller believes, but also what he perceives that the audience needs to be told in order to comprehend the narrative (Eaton, Collis, & Lewis, 1999), thereby providing overall coherence to the narrative (Bamberg & Damrad-Frye, 1991). Originally, Labov and Waletzky (1967) stated that evaluation is a separate component, positioned between the complication and the resolution, which serves to emphasize the highpoint where the complication reaches its climax. However, Labov (1972) revised the original model and suggested that evaluative devices can be found distributed throughout the whole narrative. Evaluative devices can be manifold. They often involve explicit reference to the feelings, thoughts and intentions of the story characters, but also more implicit devices that impart the narrator's perspective are considered evaluative (e.g., Bamberg & Damrad-Frye, 1991; Eaton et al., 1999; Mason, 2008; Peterson & Biggs, 2002; Shiro, 2003; Ukrainetz et al., 2005; van Beijsterveldt & van Hell, 2009; Zevenbergen, Whitehurst, &

Zevenbergen, 2003). In spoken discourse, nonlinguistic and paralinguistic devices, such as facial expression, gestures and prosody, can also serve an evaluative function (Reilly, 1992).

Since Labov and Waletzky's article in 1967, researchers have extensively studied the use of evaluation in narratives from a developmental perspective. This is not surprising, given its potential to illuminate the development of both linguistic as well as socio-cognitive skills. Evaluation relies on linguistic proficiency in both lexicon and syntax, but it also requires two fundamental abilities of social cognition: the ability to adopt the perspective of the audience and adjust the story to the audience's needs (van Dongen & Westby, 1986), and the ability to understand, talk about, and reflect upon characters' actions, mental states, and beliefs, and to make inferences about them (Bamberg & Damrad-Frye, 1991; Eaton et al., 1999; Fox, 1991). Indeed, populations with atypical socio-cognitive development show differences in the use of evaluation in narratives. For instance, it has been found that children with autism, who exhibit impaired social and emotional understanding, rely on a more restricted amount and range of evaluative devices (Losh & Capps, 2003; Tager-Flusberg & Sullivan, 1995), whereas the highly social nature of children with Williams syndrome is evident in an excessive use of evaluation in narratives (Losh, Bellugi, Reilly, & Anderson, 2000; Reilly, Losh, Bellugi, & Wulfeck, 2004). Typically developing children as young as 2.5-3 years are able to adhere to the evaluative function of a narrative and have been found to include evaluative devices in their narratives, although the use of these devices in preschoolers is still scarce (Burger & Miller, 1999; Haden, Haine, & Fivush, 1997; Miller & Sperry, 1988; Umiker-Sebeok, 1979). With age, the diversity and frequency of evaluative devices in narratives increases significantly, both in personal (e.g., Peterson & Biggs, 1998, 2001; Peterson & McCabe, 1983), as well as in fictional narratives (e.g., Bamberg & Damrad-Frye, 1991; Eaton et al., 1999; Longobardi, Spataro, Renna, & Rossi-Arnaud, 2014). Furthermore, development may not only reside in a quantitative change, but may also alter the qualitative nature of evaluative devices. The use of frames of mind, for instance, illustrates this qualitative development. Frames of mind encompass evaluative expressions that refer to cognitive, physical and affective states of characters in a narrative. Frames of mind are among the most commonly used evaluative devices (Sah, 2011). Similar to other evaluative devices, they function to qualify the nature of links between events, and they provoke empathy and interest in the audience (Küntay & Nakamura, 2004). Research has shown that young children tend to tie *frames of mind* to a local outcome, whereas with an increasing age, frames of mind are used to signal the hierarchical organization of the story from a global perspective, clustered around the emotional highpoints of a story (Bamberg & Damrad-Frye, 1991; Chen & Yan, 2011).

Although evaluation in narratives is an active area of research, most studies in typically developing children consider preschoolers (e.g., Burger & Miller, 1999; Miller & Sperry, 1988; Umiker-Sebeok, 1979) and early childhood (e.g., Peterson & Biggs, 2001) or adopt a cross-sectional approach, focusing on the comparison between preschoolers, middle childhood, adolescence, and adulthood (e.g., Bamberg & Damrad-Frye, 1991; Longobardi et al., 2014; Peterson & McCabe, 1983; Ukrainetz et al., 2005). A limitation of the latter approach is that improvement in smaller age ranges, such as in the transition from middle to late childhood, is neglected. The transition from middle to late childhood is a particularly interesting stage in terms of evaluation. From middle childhood onwards several areas of development undergo substantial changes, notably in the areas of linguistic proficiency (Berman, 2008; Nippold, 2004) and socio-cognitive skills (Rubin, 1984). A central component of later language development is the acquisition of a literate lexicon and figurative language, referring to a rich, abstract, and complex vocabulary (Berman, 2008; Nippold, 2004; Ravid & Tolchinsky, 2002). Another aspect of linguistic acquisition beyond the early school years is the ability to recruit different morphosyntactic structures (Ravid & Tolchinsky, 2002). This implies an increased ability to package information into larger syntactic units, reflected in syntactically denser structures and hierarchically organized texts (Berman, 2000). Overall, language proficiency in later school years is characterized by the availability of multiple linguistic resources, and the ability to use them flexibly for diverse communicative purposes (Ravid & Tolchinsky, 2002). Linguistically, children's ability to deploy a larger range of advanced linguistic forms (Berman, 2008) might extend to an increased diversity of evaluative devices in narratives. In addition, evaluative devices, and specifically those that require complex language skills, may increase, as children become increasingly able to call upon their sophisticated lexical and syntactic skills. With augmented socio-cognitive skills, evaluative devices could be expected to increase in frequency, as children refine their ability to represent the story characters' inner world, and become more conscious of the role of evaluation in involving the audience in narrative discourse. An empirical investigation of the development of evaluation in this age group is, however, lacking.

Most of what we know about children's use of evaluative devices results from studies on spoken narratives. Little is known about children's evaluation in written narratives and how it relates to their evaluation in spoken narratives. Developmentally, this issue is particularly relevant within the context of children's developing linguistic literacy (Ravid & Tolchinsky, 2002). Acquisition of linguistic literacy means gaining increased control over a large linguistic repertoire and simultaneously recognizing that speech and writing are essentially two different linguistic modalities (Olson, 1994;

Ravid & Tolchinsky, 2002). Speaking and writing differ, first of all, in terms of processing constraints: compared with rapid speech production, writing does not suffer from the same time constraints and thus allows for more planning, revising, and monitoring of the production process (Ravid & Berman, 2006). A writer thus has a higher control over the linguistic output. More specifically, writing provides more offline time to look for the appropriate words or for syntactic structures that provide a different perspective, and to ensure variety in linguistic expression. Written discourse has therefore been found to exhibit a greater variety of vocabulary (e.g., Chafe & Daneliewicz, 1996; Purcell-Gates, 2001; Strömqvist et al., 2002) and to be lexically and syntactically more complex with many embedded constructions, also referred to as integration (Perera, 1984; Ravid & Tolchinsky, 2002; Rubin, 1982). Significantly more often in written than in spoken narratives, embeddedness is accomplished with constructions such as dependent clauses, nominalizations, adjectival and adverbial clauses, and attributive adjectives (Purcell-Gates, Jacobson, & Degener, 2009). Furthermore, the processing constraints of speech and writing interact with their communicative conditions. Speaking is typically produced and comprehended within a shared physical context, whereas in the most prototypical writing situation, there exists a physical and temporal distance between writer and audience. As a consequence, in order for the reader to form the right image, a writer is forced to lexicalize and grammaticalize all information that in oral discourse can also be conveyed through nonlinguistic and paralinguistic channels, including gestures, prosody, facial expression and use of shared context (Tannen, 1982). Written discourse is therefore inherently more often than spoken discourse characterized by highly decontextualized language (Rader, 1982), that is, language that is explicit, precise, and complex, providing all the contextual information for the audience (Kantor & Rubin, 1981). In other words, more than in speech, a writer must appeal to linguistic means to control and shape the flow of information (Olson, 1994; Ravid & Tolchinsky, 2002). For written narratives it has been suggested that a writer must create a more explicit, vivid, and detailed story world, conveyed strictly through linguistic means, to set in motion the reader's imagination (Purcell-Gates, 1991; Rader, 1982; Tannen, 1982).

Taking differences in processing constraints and communicative context into account, we might expect the use of evaluative devices to differ between spoken and written narratives. More specifically, it can be expected that the lack of on-line processing constraints in writing affects the range of evaluative devices that the writer uses, as writing allows for more accurate and more varied linguistic choices. Furthermore, evaluative devices in written narratives could be expected to outnumber those in spoken narratives for two reasons. First, there is more offline time to elaborate the referential plane of the narrative

with evaluative information. This can be expected to have powerful linguistic consequences for lexically and syntactically complex devices. Second, the writer solely relies on linguistic means to create a vivid story for the reader, whereas the speaker may also bring nonlinguistic and paralinguistic means into play to achieve an evaluative effect. The comparison of evaluation in spoken and written narratives has received little attention in previous research. A developmental study by De Temple, Wu, & Snow (1991) showed that late elementary school grade children used more references to characters' internal states in their written as opposed to their spoken narratives. Nevertheless, the results only encompassed a global narrativity rating, as their research was not specifically targeted at the study of evaluation. A more recent study by Özyildirim (2009) analyzed evaluative language in adults' personal spoken and written narratives. She concluded that the use of evaluative language was significantly more prominent in the written version, and found the frequency of occurrence of different categories of evaluative devices to be similar in both modalities, with emotional and cognitive terms being most frequently used. However, the study did not discuss modality differences of individual categories, nor did it address questions regarding development.

Learning to differentiate between speaking and writing, as a feature of linguistic literacy, has a long developmental time course. Previous research has demonstrated that sensitivity to modality differences is present early in childhood (e.g., Kaderavek & Sulzby, 2000; Purcell-Gates, 2001; Sulzby, 1994), but does not extend directly into writing tasks in elementary school (Fey, Catts, Proctor-Williams, Tomblin, & Zhang, 2004; Gillam & Johnston, 1992; Scott & Windsor, 2000). Only from the age of 9, a crossover effect starts to occur with written texts becoming linguistically superior to spoken texts. From middle elementary school onwards, speaking and writing thus become increasingly differentiated (Kroll, 1981). An explanation for this crossover effect can be found in the interplay of several areas of development, some of which have been mentioned previously. First, a high control of all the components of language, typical of later language development (Berman, 2008; Nippold, 2004), enables the developing writer to reflect differences between speaking and writing in the linguistic encoding of discourse to a greater extent (Ravid & Tolchinsky, 2002). Second, developing maturity in socio-cognitive skills enhances writers' awareness of the absent reader and increases their desire to engage in interaction with this audience (Kantor & Rubin, 1981; Rubin, 1984). The third, and perhaps most important, reason for an increased differentiation of speech and writing from middle elementary school onwards may be found in crucial changes characterizing writing development. More particularly, from fourth grade onwards children begin to automatize their handwriting and spelling skills (Berninger & Winn, 2006). This frees cognitive resources in

working memory that can be more efficiently dedicated to the implementation of linguistic and socio-cognitive skills, required for reflecting modality differences in written texts (Alamargot & Chanquoy, 2001: Carvalho, 2002; Berninger & Winn, 2006). Moreover, education provides school-age children with ample exposure to reading and writing tasks, increasing their sensitivity to characteristics of written discourse. Similarly, with increasingly demanding writing tasks, requiring a more thoughtful and reflective approach (Graham, Harris, & Olinghouse, 2007), children start to plan before they write, learn to revise, and begin to evaluate whether their texts address the audience's needs (Bereiter & Scardamalia, 1987).

The Present Study

The present study aims to enhance our understanding of the development of evaluation in narratives from middle to late childhood, within the context of learning to produce spoken and written narratives. In considering the interaction of modality differences with evaluation in narratives in this age group, our research contributes to the literature in two important ways: First, we extend previous research on children's use of evaluation in narratives, by conducting a longitudinal study in middle to late childhood, an age range that has previously been understudied in this respect. Second, by comparing evaluation in spoken and written narratives, we assess children's ability to reflect modality differences in a significant, yet neglected, area of narrative discourse. Investigating these issues in this population is relevant, given the development of linguistic and socio-cognitive skills, and the crucial steps in writing development, typically occurring between middle and late childhood.

We explored and compared the development of evaluative devices in spoken and written fictional narratives from fourth to sixth grade. Narratives were elicited with a wordless picture book that provided enough referential support along with the opportunity for evaluative elaboration. In short, ten categories of evaluative devices were considered, including direct speech, emotive terms, intellectual terms, perceptual terms, negative qualifiers, hedges, modal verbs, figurative language, evaluative comments, and intensifiers. We chose these categories based on their frequent occurrence in previous research, or on the fact that they rely on complex language skills (e.g., modal verbs) or socio-cognitive skills (e.g., figurative language) that develop later in childhood, rendering them particularly relevant for this age group. Both diversity and frequency of evaluative devices were analyzed.

The first aim of the study was to investigate how the use of evaluative language in spoken and written narratives changes from fourth to sixth grade. We expected to find an increase in both the diversity and frequency

of evaluative language, as a result of overall improvement in linguistic proficiency, and increased social-cognitive maturity. The developmental increase was expected to be most prevalent in written narratives, as a result of an increasing automatization of spelling and handwriting, and a gradual change in writing strategies.

The second aim of the study was to compare the use of evaluative devices between spoken and written narratives. Based on differences in processing constraints and communicative context, we expected that children's written narratives would possess a higher diversity and a higher frequency of evaluative devices compared to their spoken narratives. In terms of particular categories of evaluative devices, we expected that all categories would exhibit such a modality difference. However, we predicted the modality difference to be particularly evident for the evaluative categories that in the literature have also been referred to as markers of decontextualized language, such as intellectual terms (Curenton & Justice, 2004; Greenhalgh & Strong, 2001), direct speech (Sulzby, 1994; Sulzby & Zecker, 1991), and figurative language (Halliday, 1979; Olson, 1977). Furthermore, we expected the category of modal verbs, requiring advanced syntactic skills, to be particularly prone to modality differences. For the categories of emotive and perceptual terms, evaluative comments, intensifiers, negative qualifiers, and hedges, no strong a priori hypotheses were proposed.

Method

Participants

Participants were tested at two developmental time points, namely in fourth grade and later in sixth grade. Children with neurodevelopmental disorders were excluded from participation. At the start of the study 102 Dutch children in fourth grade (Age *M* = 9.6 years, *SD* = 5.74 months) took part in the study. The children in the study came from four schools in the Netherlands with on average a middle to middle-high socio-economic background (*M* = 0.45, *SD* = 1.13; ranging from -0.76 to 1.94; based on calculations of education, income, and work status per zip code as published by the Netherlands Institute for Social Research). Parents gave their active consent for participation of their child. Due to dropouts throughout the years, the final sample consisted of 93 children (46.6% girls) in the second testing phase in sixth grade (Age *M* = 11.1 years, *SD* = 5.29 months). Participants showed normal non-verbal cognitive ability (*M* = 6.74, *SD* = 1.58) as assessed by the Raven's Coloured Progressive Matrices (standard score: *M* = 5, *SD* = 2; Raven, 1956) and average vocabulary ability (*M* = 102.25, *SD* = 10.73) as assessed by the Peabody Picture Vocabulary Test (standard score: *M* = 100, *SD* = 15; Dunn & Dunn, 2005). Analyses were

conducted on the data of children who participated both in fourth and in sixth grade.

Materials and Procedure

Testing was done by the first author and by three trained research assistants. One individual session and one classroom session were organized. The Raven's Coloured Progressive Matrices, the Peabody Picture Vocabulary Test, and the elicitation of the spoken narratives were administered during the individual session, whereas the written narratives were collected during the classroom session. Individual sessions took place in a quiet room in each of the schools.

The Expression, Reception and Recall of Narrative Instrument (ERRNI; Bishop, 2004) was used to elicit the spoken and written narratives. The ERRNI is a wordless picture book that tests children's ability to tell a story based on pictures, understand the story, and remember it after a delay. In the current study, only story-telling ability was assessed. The instrument consists of two parallel forms, the Beach Story and the Fish Story, that each include a series of 15 sequenced pictures. The parallel nature of the stories allowed for testing narrative production in the two modalities whilst minimizing practice effects. The Fish Story was used to elicit the written narratives, whereas the Beach Story was used to elicit the spoken narratives.

For the elicitation of the written narratives, children were each presented with the picture booklet for the Fish Story. They were instructed to familiarize themselves with the pictures that told a narrative, and to take their time to look at the pictures, before starting to write a story. The researcher ensured that the children looked through the pictures carefully prior to writing. The booklet remained available to the children while writing, so they could consult the booklet as and when they liked. If the researcher noticed that a child had difficulty starting to write, a prompt was used for that individual child: "What happened at the beginning of the story?". No other prompts were provided. Children were allowed to edit their written texts as needed, until they were satisfied and handed in their stories.

For the elicitation of the spoken narratives, the participants were presented with the picture booklet for the Beach Story and were given the same instructions as for the written narratives. Similarly, if a child appeared to have difficulty starting to tell the story, he was encouraged with the same prompt as in the case of the written narratives. If children fell silent during the task, they were probed with a neutral prompt, such as "What happened next?". No further support or other prompts were provided throughout the task. Children were complimented on their story after they finished. Children's spoken narratives were registered using a digital tape-recorder.

Children were encouraged to do their best for these story-telling tasks, by announcing that the best stories would be rewarded with a prize. The tasks and the procedure were identical in fourth and in sixth grade.

Coding

All narratives were transcribed using CLAN from Childes (MacWhinney, 2000). In the transcription process, narratives were divided into clauses, each containing a subject and a predicate. Typical features of spoken language such as hesitations, intonation and false starts were ignored in the transcriptions. Likewise, features of written language such as deleted words or spelling mistakes were not considered.

Two raters coded the evaluative devices in the narrative, after having received a brief training from the first author. Half of the transcripts were scored by each of the two raters. Inter-rater agreement was assessed for twenty percent of the narratives. Cohen's kappa was estimated at 0.97, indicating that the coding scheme was reliable for the purposes of this study.

Our coding scheme is adapted from Labov and Waletzky (1967), and van Beijsterveldt and van Hell (2009). The coding scheme included the following categories of evaluative devices:

(1) *Direct speech* involves the narrator reporting the speech of characters in the narrative speaking directly to each other. Labov (1972) considered direct speech such as "He said *I go to the beach*" to be evaluative, because it suspends the action by reporting dialogue taking place during the described events. Additionally, when using character speech, the narrator must adopt a different epistemic stance and interpret how the story character might be thinking or feeling. Clauses that directly report character speech may also convey referential content. As the referential function does not exclude the evaluative effectiveness, such clauses were coded as evaluative. Indirect speech was not coded in this study, because the evaluative impact of indirect speech is much more limited (Mason, 2008). Indirect speech involves the narrator reporting the speech of characters by rephrasing the speaker's original utterance. Grammatically, indirect speech entails syntactic transformations of the wording of the original utterance, often also including semantic adjustments. Compared to indirect speech, direct speech provides a more direct and authentic reproduction of wording of the original utterance expressed by the story characters (Holt, 2000), which contributes to its vividness and dramatization and to interpersonal involvement (Mason, 2008; Tannen, 1989). In this respect, Baynham (1988) commented that direct speech foregrounds the utterance, whereas indirect speech backgrounds the utterance.

(2) *Emotive terms* refer explicitly to the feelings of the story characters, leading to audience interest and sympathy. This category included adjectives describing emotional feelings ("He was *sad*"), verbs describing emotional actions ("He was *smiling*"), or verbs describing volitional feelings of hopes, intentions, or desire (e.g., "She *hopes* that she can find him", "He *wants* to buy a new fish").

(3) *Intellectual terms* provide explicit information about the cognitive processes of story characters. This category comprised verbs denoting thinking, believing, knowledge, or mental ability (e.g., "He *thought*", "The child *knew*", "She *believes* the watch was lost").

(4) *Perceptual terms* included verbs that refer to seeking or obtaining information through senses ("He *saw* the bird", "The man *heard* his dog barking"). These terms enrich the action of the event by providing information on the character's internal perceptual processes.

(5) *Negative qualifiers* provide a means of evaluating events by comparing them with events that did not happen. Emphasizing the nonoccurrence of an event enriches the narration of what did happen, rendering it therefore evaluative. For example, "I *don't* like that", "He *never* listens".

(6) *Hedges* such as "The watch is *probably* lost" express the narrator's or story character's uncertainty, and thus characterize the event in terms of multiple, possible worlds. Hedges function as distancing devices.

(7) *Modal verbs* can be either epistemic ("He *should* be home by now"), expressing the degree of certainty or possibility of a given state of affairs, or deontic ("He *must* buy the fish today"), expressing the necessity or obligation for such state of affairs to occur (Chung & Timberlake, 1985; Reilly, Zamora, & McGivern, 2005). As both deontic and epistemic verbs share the characteristic of non-commitment to the truth-value of the proposition, we did not distinguish between them in the coding of the current study.

(8) *Figurative language* included irony and metaphors ("*I was burning with anger*") and nicknames ("He acted like *the boss of the class*"). Figurative language has an evaluative function because it involves imagery, and it adds a non-literal connotation to the conceptual meaning (van Beijsterveldt & van Hell, 2009).

(9) *Evaluative comments* are adjectives that express an opinion about an event or a person ("It was a *fun* afternoon"). Through this evaluative device, the subjective perception of the narrator or a story character is expressed. In clauses such as "The *tall* man helped him", "The sky was *blue*", or "The man runs *fast*" the cursive words can perform both a referential and an evaluative function. Such occurrences, where

the evaluative function cannot clearly be distinguished from the referential function, were not coded.

(10) *Intensifiers* are devices for emphasizing particular parts of a narrative, and include both emphatic lexical markers as well as repetition of words or ideas. Emphatic lexical markers are adverbs of intensification that function to emphasize the words they modify ("She was *really* sad"). They obtain their meaning only within a particular context, on their own they serve little function. Repetition of words or ideas involves the literal reiteration of words ("He *ran* and *ran*") or a close paraphrase of previously mentioned ideas (e.g., "It was a *fun* day... that was *fun*"). Repetition has an evaluative function in intensifying a particular part within a narrative. More specifically, repetition intensifies the importance of the word or the expressed idea by stating it multiple times.

Nonlinguistic and paralinguistic means of evaluation were not coded in this study.

Results

Diversity

The diversity of evaluative categories was calculated by summing the number of types of evaluation (out of ten) used in each narrative. Table 4.1 presents the mean number of types in spoken and written narratives in fourth and in sixth grade. A 2 x 2 within-subjects ANOVA was conducted to compare the diversity of evaluative categories in spoken and written narratives across development. The analysis showed a significant main effect of modality ($F(1,92) = 26.16$, $p < .001$, *partial* $\eta 2 = .22$), with children using a wider range of evaluative categories in their written as opposed to their spoken narratives. Although the main effect of development was not significant ($F(1,92) = 1.05$, $p = .31$, partial $\eta 2 = .01$), a statistically significant interaction between modality and development was observed ($F(1,92) = 11.40$, $p < .01$, *partial* $\eta 2 = .11$). Pairwise comparisons using t-tests with Bonferroni adjustment for multiple comparisons were conducted to follow-up the significant interaction. The diversity of evaluative devices did not change across development in written narratives ($t(92) = -1.72$, $p = .09$, $d = -.17$), but decreased significantly in spoken narratives ($t(92) = 2.74$, $p < .01$, $d = .28$).

Table 4.1
Means (SD) for Number of Types of Evaluative Categories in Spoken and Written Narratives across Development

	Fourth grade		Sixth grade	
	Spoken	Written	Spoken	Written
Number of types	6.39 (1.93)	6.77 (1.77)	5.70 (2.22)	7.19 (1.80)

The measure of diversity used in this study does not take the length of the narrative into account. Nevertheless, longer narratives are likely to display a higher diversity of evaluation, as they provide more opportunities for the child to produce different types of evaluation (Shiro, 2003). In our study, however, written narratives were significantly shorter than spoken narratives ($F(1, 92) = 6.31$, $p = .01$, *partial* $\eta 2 = .06$). This suggests that the higher diversity of evaluation in written narratives is not due to length differences but reflects an actual modality difference in the extent to which children employ various linguistic realizations of evaluation.

Frequency

To assure that appropriate comparisons would be conducted for frequency measures of evaluation, it was necessary to control for the length of children's stories. Hence, in order to take length differences into account, proportional measures were calculated. The frequency of each evaluative category was calculated by multiplying the number of occurrences by 100 and dividing by the total number of clauses in the narrative. The frequency of an evaluative category then roughly represents the percentage of clauses that contain an evaluative device of that specific category. The percentage should not be interpreted too strictly, as some clauses may contain more than one evaluative device. Table 4.2 presents the mean frequency of evaluative devices in percentages in children's spoken and written narratives across development, including a composite score, summing the percentages of the individual evaluative categories. This composite score thus provides a measure for the total frequency of evaluative devices.

Table 4.2
Means (SD) for Frequency of Evaluative Devices in Percentages in Children's Spoken and Written Narratives across Development

	Fourth grade		Sixth grade	
	Spoken	Written	Spoken	Written
Direct speech	15.92 (21.46)	33.59 (24.93)	6.77 (9.36)	23.70 (20.38)
Emotive terms	1.05 (1.48)	2.47 (3.08)	1.19 (1.68)	2.66 (2.63)
Intellectual terms	2.14 (2.58)	2.99 (2.98)	2.18 (2.52)	3.48 (3.30)
Perceptual terms	9.51 (4.86)	6.15 (3.91)	10.63 (4.51)	5.98 (3.74)
Negative qualifiers	5.37 (3.92)	2.34 (2.45)	5.91 (3.77)	2.76 (2.91)
Hedges	0.93 (1.66)	0.22 (0.65)	0.57 (1.21)	0.33 (0.89)
Modal verbs	4.27 (3.22)	7.14 (4.46)	5.73 (3.90)	8.13 (4.30)
Figurative language	0.76 (1.35)	1.04 (1.78)	1.54 (2.10)	2.04 (2.38)
Evaluative comments	2.94 (3.96)	5.25 (3.72)	2.70 (3.31)	6.10 (4.35)
Intensifiers	7.10 (5.65)	7.47 (5.37)	6.78 (5.38)	12.11 (7.54)
Total	49.99 (29.88)	68.63 (30.56)	44.05 (16.82)	67.28 (27.25)

A three-way 2 x 2 x 10 within-subjects ANOVA was conducted to evaluate the effects of modality (i.e. spoken vs. written), development (i.e. fourth grade vs. sixth grade), and category on the mean frequency of evaluative devices. Mauchly's test indicated that the assumption of sphericity had been violated for the main effects of category, $\chi^2(44) = 1344.57$, $p < .001$, for the interaction between modality and category $\chi^2(44) = 861.36$, $p < .001$, for the interaction between development and category $\chi^2(44) = 1277.01$, $p < .001$, and for the interaction between modality, development and category $\chi^2(44) = 894.57$, $p < .001$. Degrees of freedom were therefore corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .16$ for the main effect of category, .21 for the interaction between modality and category, .16 for the interaction between development and category, and .21 for the interaction between modality, development and category). The analysis showed significant main effects of modality ($F(1, 92) = 80.06$, $p < .001$, *partial* $\eta 2$=.47), and category ($F(1.41,129.75) = 160.16$, $p < .001$, *partial* $\eta 2 = .64$), but not development ($F(1, 92) = 2.89$, $p = .09$, *partial* $\eta 2$= .03). However, the interactions between modality and category ($F(1.90,175.02) = 93.20$, $p < .001$, *partial* $\eta 2$= .50), and between development and category ($F(1.43, 131.95) = 19.69$, $p < .001$, *partial* $\eta 2$= .18) proved to be significant. Finally, the three-way interaction between modality, development

and category approached significance ($F(1.89, 173.75) = 2.54$, $p = .09$, *partial* $\eta 2 = .03$).

The two-way and three-way interactions were further explored in a series of 2 x 2 within-subjects ANOVA's. For each category of evaluative devices, a separate analysis with modality and development as factors was conducted. For *direct speech*, the analyses revealed that direct speech was used significantly more often in written than in spoken narratives ($F(1, 92) = 111.10$, $p < .001$, *partial* $\eta 2 = .55$). In addition, the frequency of use of direct speech decreased significantly from fourth grade to sixth grade ($F(1,92) = 20.24$, $p < .001$, *partial* $\eta 2 = .18$). For *emotive terms*, for *intellectual terms*, and for *perceptual terms* a main effect of modality was found (emotive terms: $F(1,92) = 31.77$, $p < .001$, *partial* $\eta 2 = .26$; intellectual terms: $F(1,92) = 10.58$, $p < .01$, *partial* $\eta 2 = .10$; perceptual terms: $F(1,92) = 126.43$, $p < .001$, *partial* $\eta 2 = .58$). Emotive terms and intellectual terms were used more often in written than in spoken narratives. Perceptual terms, by contrast, were used more often in spoken than in written narratives. Similarly, both for *negative qualifiers* as well as for *hedges*, the analyses indicated that their use occurred more often in spoken than in written narratives (negative qualifiers: $F(1,92) = 94.17$, $p < .001$, *partial* $\eta 2 = .51$; hedges: $F(1,92) = 19.06$, $p < .001$, *partial* $\eta 2 = .17$). For *modal verbs*, the analyses showed that they were used more often in written than in spoken narratives ($F(1,92) = 41.17$, $p < .001$, *partial* $\eta 2 = .31$). In addition, the use of modal verbs increased significantly across development ($F(1,92) = 8.29$, $p < .01$, *partial* $\eta 2 = .08$). For *figurative language*, we found that it was used more frequently in written than in spoken narratives ($F(1,92) = 6.08$, $p < .05$, *partial* $\eta 2 = .06$). Additionally, the use of figurative language increased significantly across development ($F(1,92) = 17.42$, $p < .001$, *partial* $\eta 2 = .16$). For *evaluative comments*, the analyses showed a significant main effect of modality ($F(1,92) = 45.76$, $p < .001$, *partial* $\eta 2 = .33$), with evaluative comments being expressed more frequently in written than in spoken narratives. For *intensifiers*, significant main effects of modality ($F(1,92) = 20.67$, $p < .001$, *partial* $\eta 2 = .18$), and development ($F(1,92) = 12.22$, $p = .001$, *partial* $\eta 2 = .12$) were modified by a significant interaction ($F(1,92) = 33.22$, $p < .001$, *partial* $\eta 2 = .26$). Pairwise comparisons using t-tests with Bonferroni adjustment for multiple comparisons were conducted to follow-up the significant interaction. The difference in the frequency of use of intensifiers in written narratives across development was significant ($t(92) = -5.97$, $p < .001$, d = -.62), with a higher frequency observed in sixth grade than in fourth grade. No such effect of development was observed in spoken narratives ($t(92) = .75$, $p = .45$, $d = .08$).

Discussion

The transition from middle to late childhood is a particularly interesting stage of development in terms of linguistic proficiency and socio-cognitive skills. These skills are deemed important for both the development of evaluative language, a prerequisite of successful storytelling, as well as for the ability to reflect modality differences in the linguistic encoding of spoken and written discourse. Furthermore, increasing automatization of transcription skills in this age group is likely to support the differentiation of speech and writing. To our knowledge, this is the first study to directly compare evaluative language in spoken and written narratives from a developmental perspective in middle to late childhood. We expected both developmental differences, revealing an increasing diversity and frequency of evaluative devices with age, as well as modality differences, reflecting a higher diversity and frequency of evaluative devices in written compared to spoken narratives.

The overall picture that emerges from the results is complex, and demands for a differentiation between different categories of evaluative devices, both in terms of developmental trajectories as well as regarding their susceptibility to modality differences. Below we discuss the quantitative results regarding developmental differences and modality differences separately, illustrated by a qualitative analysis when appropriate.

Developmental Differences

The ability to employ evaluative devices in narrative discourse presupposes a combination of linguistic proficiency and sophisticated socio-cognitive skills (Bamberg & Damrad-Frye, 1991), two areas that develop substantially from middle to late childhood (Berman, 2008; Nippold, 2004; Rubin, 1984). In this regard, it is surprising that the diversity of evaluative devices used by the children in this study did not increase between fourth and sixth grade, and even slightly decreased in spoken narratives. A possible explanation is that the nature of the story does not trigger a higher diversity of devices. Alternatively, given the high mean number of types of evaluative categories, it may be that at this age, children already possess the necessary linguistic skills to use all ten evaluative categories distinguished in our study.

Furthermore, only few categories showed the expected developmental change in their frequency of use. A clear developmental increase was observed for the categories of figurative language and modal verbs. The use of figurative language and modal verbs requires a rich lexicon and advanced syntactic skills respectively, two hallmarks of later language development (Berman, 2008; Nippold, 2004; Ravid & Tolchinsky, 2002). It should be noted that we did not distinguish between epistemic and deontic modality. Reilly, Zamora, and

McGivern (2005) have found that between late childhood and adolescence, children shift from predominantly using deontic types of modal expressions to an increased use of epistemic modality. Future research might be directed at a more fine-grained analysis of modality to shed additional light on the emergent use of modal verbs and related syntactic skills in this age group. Furthermore, the frequency of use of intensifiers increased significantly with age in written, but not in spoken, narratives. Prior research did find a developmental increase in the use of intensifiers in spoken narratives, but focused on younger children (Bamberg & Damrad-Frye, 1991; Peterson & Biggs, 2001). A possible explanation is that children use other means to signify intensifiers in speech. For example, when speaking, children may also use prosodic signals such as a higher pitch, an increased volume, a higher density of accented syllables, and lengthened pitch accents that highlight salient clauses of discourse and render them evaluative (Labov, 1972; Wennerstrom, 2001). It might be that sixth graders do not elaborate further upon the lexical intensifiers in their spoken narratives, as they start to enrich their spoken discourse with prosodic intensifiers instead. In this sense, we suggest that the developmental increase found for written but not for spoken narratives is not so much related to language development, but is caused by differences between modalities.

A surprising finding was the substantial developmental decrease of direct speech in both modalities. Direct speech renders the story dynamic and vivid. The notable decrease in its use, however, suggests that frequency is not always directly associated with the quality of the narrative. This premise can be illustrated by the following two stories told by a fourth grader and by a sixth grader. The excerpt of the fourth grader's story is almost entirely composed of direct speech. Based on the content, it can be concluded that the fourth grader switches between characters while reporting their speech.

Example 1a. Spoken Narrative by Fourth Grader
"Hoe gaat ie?". "Goed ik ben aan het vissen". "Zie je het?". "Ja ik zie het inderdaad". "Wat ga je vissen?". "Misschien baars". "Misschien zelfs goudvissen". "Oke ik ga ervandoor". "Ik ga naar het strand". "Hoi". "Hoe gaat ie?". "Ja goed". "Ik ga lekker in het water". Dan gaat ze uit het water.
'"How are you?". "Fine I am fishing". "Can you see it?". "Yes, I can indeed". "What are you going to fish?". "Maybe perch". "Maybe even goldfish". "Ok I am off". "I am going to the beach". "Hi". "How are you?". "I am fine". "I am going into the water". Then she gets out of the water.'

Example 1b. Spoken Narrative by Sixth Grader
Onderweg komt ze iemand tegen. Dat is Bart. Die zit te vissen. "Hallo", zegt Ilse. "Hoi", zegt Bart. "Waar ga je heen?", vraagt hij. "Ik ga naar het strand",

antwoordt Ilse blij. Eenmaal bij het strand komt ze Mohammed tegen. Mohammed zegt "hoi".
'She meets someone on the way. It's Bart. He's fishing. "Hello", Ilse says. "Hi", Bart says. "Where are you going?", he asks. "I am going to the beach", Ilse answers happily. Once she's at the beach, she meets Mohammed. Mohammed says "hi".'

Two important aspects downgrade the evaluative effectiveness of direct speech in the fourth grader's story. First, the excerpt presents a dialogue between two or more story characters, but no reference is made to the identity of the characters, nor is turn-taking overtly signaled by introductory verbs. A listener unknown to the story may experience difficulties in understanding this dialogue. Second, with a predominance of evaluative utterances, the referential content is entirely neglected. The sixth grader, by contrast, alternates direct speech with referential utterances describing the actions that precede the dialogues. In this way, the listener gets a better grasp of how the characters' thoughts and feelings support and affect the story events. As noted by Shiro (2003), it is the combination of evaluative and referential content that contributes to the overall coherence of a story. In addition, the sixth grader also makes use of introductory verbs that signal the identity of the character whose speech is reported, providing additional contextual information. A possible explanation for the abundant use of direct speech by younger children resides in its grammatical form. Whereas direct speech reproduces literally the deictic references of the original speech act, other types of reported speech, such as indirect speech, require a syntax transformation that involves embedding the original linguistic form into a subordinate clause, often also including semantic adjustments. The mastery of this transformation is a gradual process that extends throughout childhood (Goodell & Sachs, 1992). In addition to balancing the evaluative and the referential content more carefully, it might therefore be that children in sixth grade start to make use of their improved syntactic skills to manage the syntactic complexity of other types of reported speech (Berman, 2008; Nippold, 2004), and consequently use direct speech less than fourth graders. The idea that the use of direct speech functions as a tool to avoid syntactic complexity is supported by a significant negative correlation between the frequency of direct speech and the syntactic complexity of the narratives (as measured by the mean length of a t-unit in words), both in speech (r = -.69, p < .001) and in writing (r = -.64, p < .001). Coding indirect speech in future research would be useful to underpin the idea that with age children reduce their use of direct speech in favor of grammatically more complex types of reported speech such as indirect speech.

Another category that did not show the expected developmental increase is the category of evaluative comments. A careful observation of the narratives shows that evaluative comments, through which opinions are expressed, frequently occur in contexts of direct speech, as in the following examples:

Example 2a. Written Narrative by Fourth Grader
"Kijk", riep hij. "Een man op een coole, rode motor".
'"Look", he screamed. "A man on a cool, red motorbike".'

Example 2b. Written Narrative by Sixth Grader
De mevrouw gaf hem de vis en zei "dit is een speciale vis". "Bewaar hem goed".
'The lady gave him the fish and said "this is a special fish". "Keep him safely".'

These excerpts demonstrate that the narrator often uses the voice of a story character to comment upon an object. The lack of an age-related increase in the use of evaluative comments – its use remains stable across development – might therefore be related to the decrease in the use of direct speech. In this sense, it could even be said that children in sixth grade do show progress on their use of evaluative comments, as they continue to use them as frequently as in fourth grade, despite the overall decline of direct speech. Example 3 illustrates how a sixth grader does not only use evaluative comments to overtly present a story character's perspective, but also employs the comments to represent evaluative information on the story events from the perspective of an omniscient narrator. Mature perspective-taking abilities are required to shift between this narrator's stance and the story character's perspective (Sah, 2011).

Example 3. Spoken Narrative by Sixth Grader
Op een mooie lentedag zat Vera met haar kat te spelen. Opeens ging de telefoon. Vera pakte de telefoon en hoorde dat het Bram was. Bram is een hele goede vriend van Vera. Bram vroeg of Vera mee wou naar het strand. "Wat een leuk idee!", zei Vera.
'On a beautiful spring day Vera was playing with her cat. Suddenly, the telephone rang. Vera took up the telephone and heard that it was Bram. Bram is a very good friend of Vera's. Bram asked if Vera wanted to come with him to the beach. "What a nice idea!", Vera said.'

Also negative qualifiers and hedges failed to show a developmental increase with age. As children move into middle childhood, they exhibit an increased tendency to be more concrete and to be more tied to facts (Ely,

MacGibbon, & McCabe, 2000). In light of this tendency, children in middle to late childhood may be less willing to make reference to nonevents or possible events. Alternatively, a more detailed coding of specific forms of negative qualifiers and hedges could reveal whether some devices are more evaluative than others, as suggested by Ely et al. (2000), and are thus more likely to decrease or increase with age.

While children used a variety of emotive, intellectual, and perceptual terms to enrich their narratives, none of these terms showed any developmental change in the sample of our study. This result contradicts Bamberg and Damrad-Frye (1991), who found that reference to cognitive and emotional states increased markedly with age. The lack of a developmental growth may be explained in different ways. First, Bamberg and Damrad-Frye (1991) studied evaluation in younger children. It may be that the use of these terms undergoes significant improvement in preliterate and early elementary school children until becoming one of the dominant forms of evaluation in late elementary school. Second, the nature of the story in our study may have influenced the use of these terms. In older children and adults, these types of terms tend to be clustered around the emotional highpoints of the story (Bamberg & Damrad-Frye, 1991). The relatively simple story used in this study does not involve a high number of emotional highpoints, and may therefore not invite the narrator to label the character's emotional, intellectual, or perceptual state more than once. While development does not affect the frequency of these terms, the quality or strategy of use may change with later development (Bamberg & Damrad-Frye, 1991; Chen & Yan, 2011). Consider the following two excerpts of a story, one written by a fourth grader and one by a sixth grader.

Example 4a. Written Narrative by Fourth Grader
De moeder vraagt waar zijn vis is. De jongen geeft zijn pop en de meisjes zijn vis. Ze zijn allebei blij. Einde.
'The mother asks where his fish is. The boy gives his doll and the girls his fish. They are both happy. End.'

Example 4b. Written Narrative by Sixth Grader
Het meisje gaf de vis terug. Het meisje zei dat het haar speet en dat ze het nooit meer zou doen. Maar Henk was niet boos. Hij was blij omdat hij zijn goudvis terug had."Kom, we gaan hem in het aquarium doen", zei hij. En zo kwam het toch nog goed.
'The girl returned the fish. The girl said that she was sorry and that she would never do it again. But Henk was not angry. He was happy because

he had his goldfish back. “Come on, let’s put him in the aquarium” he said. And that’s how it all turned out fine.'

These excerpts describe the concluding sequence, showing the two girls returning the fish they took from the boy and the boy finally showing his fish in the aquarium to the girls. This sequence represents an emotional highpoint related to the resolution of the story. Both the fourth grader and the sixth grader refer to the positive emotion of the boy after the girls return his fish. However, opposite to the sixth grader, the fourth grader does not explicitly express the causal link between the boy's happiness and the fact that his fish was returned. Though the reader can probably infer the causal link between these two events, the lack of an explicit relationship results in a fragmented story ending. The sixth grader, by contrast, does not only refer to the boy's emotions but also includes the girl's expression of regret. In this way, the narrator does not merely provide a causal justification of the boy's happiness, but also embeds the emotion in a dynamic interaction between the story characters. The attention towards the resolution of the story helps the audience in interpreting the plotline and contributes greatly to the coherence of the story as a whole. This descriptive analysis corresponds to Bamberg and Damrad-Frye's (1991) findings that younger children tend to tie emotions to a local outcome, but not to the global coherence of the story.

Modality Differences

Speech and writing have been shown to differ along several linguistic dimensions. Intrinsic differences between the two modes of language production, i.e. a difference in processing constraints and in communicative context, are thought to underlie these modality differences. Previous research has shown that from middle childhood onwards children start to show sensitivity to these modality differences in their written texts, reflecting their acquisition of linguistic literacy. Hence, the use of evaluative devices in children’s spoken and written narratives was expected to display a modality difference as well. Extending previous research by De Temple et al. (1991) and Özyildirim (2009), our results largely support this hypothesis.

In terms of diversity, children recruited a wider range of evaluative devices in their written as opposed to their spoken narratives. These results are in agreement with previous findings of a greater variety of vocabulary in written than in spoken discourse (e.g., Chafe & Danielewicz, 1986; Purcell-Gates, 2001; Strömqvist et al., 2002) and confirm our hypothesis that children are more likely to ensure variety in evaluative expression in writing, as a result of a lack of on-line processing constraints.

In terms of frequency, the majority of categories exhibited the expected modality effect, showing a higher frequency of use in written as opposed to spoken narratives. Our findings suggest that the offline benefits of planning, reflection, and revision available to the writer (Ravid & Berman, 2006) are particularly beneficial for evaluative devices requiring a certain level of lexical or syntactic complexity. For instance, modal verbs, requiring advanced syntactic skills, occurred more often in written than in spoken narratives. This is convergent with previous findings showing that written discourse is syntactically more complex than spoken discourse, as the writer has more time at his disposal to carefully integrate information into complex syntactic units (Perera, 1984; Purcell-Gates et al., 2009; Rubin, 1982). A similar explanation may hold for the finding of a higher frequency of evaluative comments in written than in spoken narratives. Evaluative comments mostly take the form of adjectives that modify a noun or verb, also called attributive adjectives. In addition to providing a semantically more rich object or event description, evaluative comments thus also represent a certain degree of syntactic embeddedness (Purcell-Gates et al., 2009). Hence, similar to modal verbs, semantic and syntactic enrichment associated with the production of evaluative comments may be more difficult to achieve under the on-line processing constraints imposed by speech. Much in the same way, regarding the higher frequency of figurative language in written than in spoken narratives, it can be assumed that the weaker on-line processing demands of writing provide the writer with more time to elaborate upon literal discourse and opt for the more complex use of figurative language instead.

Besides processing constraints, also communicative context is thought to result in modality differences between spoken and written discourse. A writer, in the absence of his reader, needs to produce an explicit and autonomous text without the external cues that exist in spoken communication (e.g., Purcell-Gates, 1991; Tannen, 1982). External cues can, among other nonlinguistic and paralinguistic means, refer to prosodic intensifiers (Labov, 1972; Wennerstrom, 2001). As previously discussed, this might explain why the evaluative category of intensifiers occurred more often in sixth graders' written narratives as opposed to their spoken narratives. Decontextualized language has also been shown to be particularly suitable for rendering a text explicit and autonomous (Kantor & Rubin, 1982; Purcell-Gates, 1991). In this study, evaluative devices that have been identified as markers of decontextualized language, i.e. figurative language, direct speech, and intellectual terms, were indeed found to occur more frequently in written than in spoken language. Figurative language, for instance, can serve a self-contextualizing function to render decontextualized discourse, such as written texts, more autonomous (Halliday, 1979; Olson, 1977). Furthermore, also direct speech

aids in providing the contextual information in decontextualized discourse, by making events in a narrative more explicit, immediate, and realistic (Sulzby, 1994; Sulzby & Zecker, 1991). Finally, intellectual terms have been associated with decontextualized language, as they provide explicit and elaborated information on story characters (Curenton & Justice, 2004). The idea that intellectual terms render discourse more explicit may equally hold for emotive terms, which also occurred more frequently in written than in spoken narratives. These findings, along with those by De Temple et al. (1991), indicate that such explicitness may be particularly required in written discourse, where only linguistic means can be employed to denote cognition and emotion.

Some categories did not exhibit the expected modality effect. More specifically, perceptual terms, negative qualifiers, and hedges occurred more often in spoken than in written narratives. A possible explanation for the finding that perceptual terms occurred more often in spoken narratives is that children used these terms to point out information in the extra-linguistic context to the listener ("In this picture you can *see* that…") rather than to portray the characters' perceptual processes. Regarding negative qualifiers and hedges, this modality effect may also be explained by the tendency to be more concrete with age (Ely et al., 2000), previously referred to in order to explain the lack of a developmental increase. More specifically, children may show this tendency more clearly towards the absent audience in writing.

Conclusions and Future Research

The comparison of evaluative language in spoken and written fictional narratives across development demonstrates that children in middle and late elementary school are able to recruit a varied range of linguistic means to meet the evaluative function of a narrative.

From a developmental perspective, we can conclude that diversity of evaluative devices did not increase, and only few categories showed a clear developmental increase in frequency of use with age. Some considerations are worth noticing here. First, the decrease in the use of direct speech suggests that frequency of evaluative language is not always directly associated with excellent storytelling. In this respect, a qualitative analysis of the narratives proved to be a fruitful method to underpin this statement. Second, the same qualitative approach was helpful in demonstrating that developmental changes are not always reflected in the frequency of use, but may also reside in the way evaluative language is used to support the referential content and structure, and thus the overall coherence, of the narrative. While qualitative analyses have been widely used in the study of evaluative language in young

children (e.g., Bamberg & Damrad-Frye, 1991; Losh et al., 2000; Shiro, 2003; Ukrainetz et al., 2005), they might be particularly interesting for studying language development in older children, in whom acquisition of linguistic forms is no longer central to language production. Rather, later language development revolves around learning to deploy linguistic forms flexibly and appropriately to meet communicative goals (Berman, 2008; Ravid & Tolchinsky, 2002). Third, our hypothesis that a developmental increase would be most prevalent in written narratives was not confirmed, except for the category of intensifiers. In line with the qualitative development of evaluative devices, it might be that the freed cognitive resources, resulting from an increasing automatization of handwriting skills between fourth and sixth grade, do not result in a higher frequency of evaluative devices, but are instead employed to implement evaluative devices in a more strategic way to support the coherence of the narrative. An alternative, but less likely, explanation is that an influential change in the degree of automatization of handwriting skills is yet to occur in this sample.

Based on our results, we can conclude that in this age group modality had a major impact on the diversity of evaluative language, and on the frequency of most, but not all, categories of evaluative devices. Specifically, categories of evaluative devices that have been referred to as markers of decontextualized language and those with a high degree of syntactic complexity reflected modality differences. In considering the interaction between modality and evaluative language, our study thus demonstrates that children in this age group understand and reflect the greater need for evaluative language in written as opposed to spoken narratives, resulting from the intrinsic differences between the two modes of production (e.g., Berman, 2008; Ravid & Berman, 2006). Such reflection of modality differences provides evidence for children's consolidation of linguistic literacy (Ravid & Tolchinsky, 2002).

Some limitations of our study are worth noticing and pave the way for future research. In this study, a fictional picture elicitation task was chosen to assess written and spoken narrative production. The predefined content of such a narrative reduces the influence of prior topic knowledge, and constitutes an economical way of assessing narrative skills. Nevertheless, it is important to note that our results cannot be generalized to other narrative genres. It has, for instance, been shown that a child's performance on fictional narratives is minimally related to performance on personal narratives (McCabe, Bliss, Barra, & Bennett, 2008), and might follow a different developmental path (e.g., Allen, Kertoy, Sherblom, & Petit, 1994). In terms of evaluation, there is some evidence that the ability to evaluate does not transfer from one narrative genre to the other (Shiro, 2003), and is engaged in more frequently in personal than in fictional narratives (Losh & Capps, 2003). It is therefore recommended

that future studies compare our results to the use of evaluative language in other narrative genres.

Furthermore, one of the rationales guiding our hypothesis regarding modality differences was that written narratives would exhibit more evaluative devices, because the writer cannot rely on nonlinguistic and paralinguistic channels to achieve an evaluative effect. While our findings support this hypothesis, we cannot formulate any conclusions about the extent to which nonlinguistic and paralinguistic evaluative tools were used in children's spoken narratives. In the current study, spoken narratives were tape-, but not video-recorded. As such, no information on facial expressions and gestures is available. From an exploratory observation of the data, however, it does seem that children often made use of prosodic features in their spoken narratives to differentiate between their own voice as the reporter of events, and the voices of story characters anchored in the story-world. Explorations along this dimension would provide an additional, solid foundation for the idea that modality differences are reflected in the use of evaluation in narratives.

Moreover, as not all categories showed a developmental increase, future studies could test the possibility that some evaluative devices contribute more to the quality of a narrative than others and are thus more likely to increase with age. In this context, the relationship between evaluation and narrative coherence would be a relevant topic for further research.

Finally, fundamental skills for producing a coherent narrative enriched with evaluation are linguistic skills and socio-cognitive abilities. The present study could be extended to include variables assessing these skills in order to determine their role as a source of individual differences in the ability to use evaluation in spoken and written narratives. Relatedly, it could be explored whether individual differences in handwriting and spelling skills can account for variance in the ability to reflect modality differences in the use of evaluative devices. On a similar vein, it is commonly known that home environment and home literacy can have an impact on the emerging literacies of children. Parallel to previous studies (e.g., Carmiol & Sparks, 2014; Haden, Haine, & Fivush, 1997; Küntay & Nakamura, 2004; Shiro, 2003), future research on evaluation could therefore incorporate variables such as socio-economic status, home literacy practices, or cultural background.

In sum, the present study clearly demonstrates that to fully describe developmental progression in the use of evaluation in narratives in the upper elementary grades, one should combine a quantitative and a qualitative approach to children's narratives. Importantly, this study is the first one to provide evidence for children's ability to reflect the intrinsic differences between speech and writing in the evaluative encoding of their narratives, confirming an important aspect of the acquisition of linguistic literacy.

References

Alamargot, D., & Chanquoy, L. (2001). *Through the models of writing in cognitive psychology*. Boston, Dordrecht, NY: Kluwer Academic Publishers.

Allen, M. S., Kertoy, M. K., Sherblom, J. C., & Petit, J. M. (1994). Children's narrative productions: A comparison of personal event and fictional stories. *Applied Psycholinguistics, 15*, 149-176. doi:10.1017/S0142716400005300

Bamberg, M., & Damrad-Frye, R. (1991). On the ability to provide evaluative comments: Further explorations of children's narrative competence. *Journal of Child Language, 18*, 689-710. doi:10.1017/S0305000900011314

Baynham, M. J. (1988). Narrative and Narrativity in the English of a First Generation Migrant Community. Unpublished Ph.D. Thesis, University of Reading.

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Erlbaum.

Berman, R. (1995). Narrative competence and storytelling performance: How children tell stories in different contexts. *Journal of Narrative and Life History, 5*, 285-313. doi:10.1075/jnlh.5.4.01nar

Berman, R. (2008). The psycholinguistics of developing text construction. *Journal of Child Language, 35*, 735-771. doi:10.1017/S0305000908008787

Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. MacArthur, S. Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96-114). New York, NY: Guilford Press.

Bishop, D. (2004). *Expression, Reception and Recall of Narrative Instrument*. London, UK: Harcourt Assessment.

Burger, L. K., & Miller, P. J. (1999). Early talk about the past revisited: Affect in working-class and middle-class children's co-narrations. *Journal of Child Languag, 26*, 133-162. doi:10.1017/S0305000998003675

Carmiol, A., & Sparks, A. (2014) Narrative development across cultural contexts: Finding the pragmatic in parent-child reminiscing. In D. Mathews (Ed.), *Pragmatic Development: Trends in Language Acquisition Research*. Amsterdam, the Netherlands: John Benjamins.

Carvalho, J. (2002). Developing audience awareness in writing. *Journal of Research in Reading, 25*, 271-282. doi:10.1111/1467-9817.00175

Chafe, W. L., & Danielewicz, J. (1986). Properties of spoken and written language. In R. Horowitz & S. J. Samuels (Eds.), *Comprehending oral and written language* (pp. 61-93). Orlando, FL: Academic Press.

Chen, L., & Yan, R. (2011). Development and use of English evaluative expressions in narratives of Chinese-English bilinguals. *Bilingualism: Language and Cognition, 14*, 570-578. doi:10.1017/S1366728910000362

Chung, S., & Timberlake, A. H. (1985). Tense, aspect and mood. In T. Shopen (Ed.), *Language Typology and Syntactic Description: Grammatical Categories and the Lexicon* (pp. 202-258). Cambridge, UK: Cambridge University Press.

Clark, H. H., & Brennan, S. A. (1991). Grounding in communication. In L. B. Resnick, J. M. Levine & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 127–149). Washington, DC: APA Books.

Curenton, S. M., Craig, M. J., & Flanigan, N. (2008). Use of decontextualized talk across story texts: how oral storytelling and emergent reading can scaffold children's development. *Early education and development,19*, 161-187. doi:10.1080/10409280701839296

Curenton, S. M., & Justice, L. M. (2004). African American and Caucasian Preschooler's Use of Decontextualized Language: Literate Language Features in Oral Narratives. *Language, Speech, and Hearing Services in Schools, 35*, 240-253. doi:10.1044/0161-1461(2004/023)

De Temple, J. M., Wu, H. F., & Snow, C. E. (1991). Papa pig just left for pigtown: Children's oral and written picture descriptions under varying instructions. *Discourse Processes, 14*, 469-495. doi:10.1080/01638539109544797

Dunn, L. M., & Dunn, L. M. (2005). *Peabody Picture Vocabulary Test-III-NL. Nederlandse versie Liesbeth Schlichting. Handleiding*. Amsterdam, the Netherlands: Harcourt Test Publishers.

Eaton, J., Collis, G., & Lewis, V. (1999). Evaluative explanations in children's narratives of a video sequence without dialogue. *Journal of Child Language, 26,* 699-720. doi:10.1017/S0305000999003967

Ely, R., MacGibbon, A., & McCabe, A. (2000). She don't care: negatives in children's narratives. *Merrill-Parlmer Quarterly, 46*, 465-490.

Fey, M. E., Catts, H. W., Proctor-Williams, K., Tomblin, J. B., & Zhang, X. (2004). Oral and written story composition skills of children with language impairment. *Journal of Speech, Language and Hearing Research, 47*, 1301-1318. doi:10.1044/1092-4388(2004/098)

Fox, R. (1991). Developing awareness of mind reflected in children's narrative writing. *British Journal of Developmental Psychology, 9*, 281-298. doi:10.1111/j.2044-835X.1991.tb00877.x

Gillam, R. B., & Johnston, J. R. (1992). Spoken and written language relationships in language/learning-impaired and normally achieving school-age children. *Journal of Speech and Hearing Research, 35*, 1303-1315. doi:10.1044/jshr.3506.1303

Goodell, E., & Sachs, J. (1992). Direct and indirect speech in English-speaking children's retold narratives. *Discourse Processes, 15*, 395-422. doi:10.1080/01638539209544820

Graham, S., Harris, K. R., & Olinghouse, N. (2007). Addressing executive function problems in writing: An example from the self-regulated strategy development model. In L. Meltzer (Ed.), *Executive function in education* (pp. 216-236). New York, NY: Guilford.

Greenhalgh, K. S., & Strong, C. J. (2001). Literate language features in spoken narratives of children with typical language and children with language impairments. *Language, Speech, and Hearing Services in Schools, 32*, 114-125. doi:10.1044/0161-1461(2001/010)

Haden, C. A., Haine, R. A., & Fivush, R. (1997). Developing narrative structure in parent-child reminiscing across the preschool years. *Developmental Psychology, 33*, 295-307. doi:10.1037/0012-1649.33.2.295

Halliday, M. A. K. (1979). Differences between Spoken and Written Language: Some Implications for Literacy Teaching. In G. Page, J. Elkins, & B. O'Connor (Eds). *Communication through Reading: Proceedings of the Fourth Australian Reading Conference* (pp. 37-51). Adelaide, S.A.: Australian Reading Association.

Hayes, J. R. (2000). A new framework for understanding cognition and affect in writing. In R. Indrisano & J .R. Squire (Eds.), *Perspectives on writing* (pp. 6-44). Newark, DE: International Reading Association.

Holt, E. (2000). Reporting and Reacting: Concurrent Responses to Reported Speech. *Research on Language and Social Interaction, 33*, 425-454. doi:10.1207/S15327973RLSI3304_04

Jisa, H. (2004). Growing into academic French. In R. A. Berman (Ed.), *Language development across childhood and adolescence* (pp. 135-162). Amsterdam, the Netherlands: John Benjamins.

Kaderavek, J. N., & Sulzby, E. (2000). Narrative production by children with and without specific language impairment: Oral narratives and emergent readings. *Journal of Speech, Language and Hearing Research, 43*, 34-49. doi:10.1044/jslhr.4301.34

Kantor, K. J., & Rubin, D. L. (1981). Between speaking and writing: Processes of differentiation. In B. Kroll & R. Vann (Eds.), *Exploring speaking-writing relationships: Connections and contrasts* (pp. 55-81). Champaign, IL: National Council of Teachers of English.

Küntay, A., & Nakamura, K. (2004). Linguistic strategies serving evaluative functions: A comparison between Japanese and Turkish narratives. In S. Strömqvist, & L. Verhoeven

(Eds.), *Relating events in narrative, Volume 2: Typological and contextual perspectives* (pp. 329-358). Mahwah: Lawrence Erlbaum Associates.

Kroll, B. (1981). Developmental relationships between speaking and writing. In B. Kroll & R. Vann (Eds.), *Exploring speaking-writing relationships: Connections and contrasts* (pp. 32-54). Champaign, IL: National Council of Teachers of English.

Labov, W. (1972). *Language in The Inner City: Studies in the Black English Vernacular*. Philadelphia, PA: University of Pennsylvania Press.

Labov, W., & Waletzky, J. (1967). Narrative analysis: Oral versions of personal experience. In J. Helm (Ed.), *Essays on the verbal and visual arts* (pp. 12-44). Seattle, WA: University of Washington Press.

Longobardi, E., Spataro, P., Renna, M., & Rossi-Arnaud, C. (2014). Comparing fictional, personal, and hypothetical narratives in primary school: Story grammar and mental state language. *European Journal of Psychology of Education, 29*, 257-275. doi:10.1007/s10212-013-0197-y

Losh, M., Bellugi, U., Reilly, J., & Anderson, D. (2000). Narrative as a social engagement tool: the excessive use of evaluation in narratives from children with Williams syndrome. *Narrative Inquiry, 10*, 265-290. doi:10.1075/ni.10.2.01los

Losh, M., & Capps, L. (2003). Narrative Abilities in High-functioning Children with Autism or Asperger's Syndrome. *Journal of Autism and Developmental Disorders, 33*, 239-251. doi:10.1023/A:1024446215446

MacWhinney, B. (2000). The CHILDES Project: Tools for Analyzing Talk. Mahwah, NJ: Lawrence Erlbaum Associates.

Mason, R. (2008). *The use of evaluative devices in the narrative discourse of young second-language learners*. Dallas, TX: SIL International.

McCabe, A., Bliss, L., Barra, G., & Bennett, M. (2008). Comparison of personal versus fictional narratives of children with language impairment. *American Journal of Speech-Language Pathology, 17*, 194-206. doi:1058-0360/08/1702-0194

Miller, P. J., & Sperry, L. L. (1988). Early talk about the past: the origins of conversational stories of personal experience. *Journal of Child Language, 15*, 293-315. doi:10.1017/S0305000900012381

Nippold, M. A. (2004). Research on later language development: International perspectives. In R. A. Berman (Ed.), *Language development across childhood and adolescence* (pp. 1-9). Trends in Language Acquisition Research (TILAR). Amsterdam, the Netherlands: John Benjamins.

Olson, D. R. (1977). From Utterance to Text: The Bias of Language in Speech and Writing. *Harvard Educational Review, 47*, 257-281. doi:10.17763/haer.47.3.8840364413869005

Olson, D. R. (1994). *The world on paper: The conceptual and cognitive implications of writing and reading*. Cambridge, UK: Cambridge University Press.

Özyildirim, I. (2009). Narrative analysis: An analysis of oral and written strategies in personal experience narratives. *Journal of Pragmatics, 41*, 1209–1222. doi:10.1016/j.pragma.2009.01.003

Perera, K. (1984). *Children's writing and reading*. London: Basil Blackwell.

Peterson, C., & Biggs, M. (1998). Stitches and casts: emotionality and narrative coherence. *Narrative Inquiry, 8*, 51-76. doi:10.1075/ni.8.1.04pet

Peterson, C., & Biggs, M. (2001). "I was really, really mad!" Children's use of evaluative devices in narratives about emotional events. *Sex roles, 45*, 801-825. doi:10.1023/A:1015692403932

Peterson, C. & McCabe, A. (1983). *Developmental psycholinguistics: Three ways of looking at a child's narrative*. New York, NY: Plenum.

Piaget, J. (1977). *Epistemology and psychology of functions.* Dordrecht, Netherlands: D. Reidel Publishing Company.

Purcell-Gates, V. (1991) Ability of well-read-to kindergartners to decontextualise/recontextualise experience into a written-narrative register. *Language and Education, 5*, 177-188. doi:10.1080/09500789109541309

Purcell-Gates, V. (2001). Emergent literacy is emerging knowledge of written, not oral language. *New Directions for Child and Adolescent Development, 92*, 7-22. doi:10.1002/cd.12

Purcell-Gates, V., Jacobson, E., & Degener, S. (2009). *Print Literacy Development: Uniting Cognitive and Social Practice Theories*. London, UK: Harvard University Press.

Rader, M. (1982). Context in written language: the case of imaginative fiction. In D. Tannen (Ed.), *Exploring orality and literacy* (pp. 189-198). Norwoord, NJ: Ablex.

Raven, J. C. (1956). *Coloured Progressive Matrices, Sets A AB, B*. London, UK: H.K. Lewis and Co., Ltd.

Ravid, D., & Berman, R. A. (2006). Information density in the development of spoken and written narratives in English and Hebrew. *Discourse Processes, 41*, 117-149. doi:10.1207/s15326950dp4102_2

Reilly, J. (1992). How to tell a good story: the intersection of language and affect in children's narratives. *Journal of Narrative and Life History, 2*, 355-377. doi:10.1075/jnlh.2.4.04how

Reilly, J., Losh, M., Bellugi, U., & Wulfeck, B. (2004). "Frog, where are you?" Narratives in children with specific language impairment, early focal brain injury, and Williams syndrome. *Brain and Language, 88*, 229-247. doi:10.1016/S0093-934X(03)00101-9

Reilly, J., Zamora, A., & McGivern, R. (2005). Acquiring perspective in English: The development of stance. *Journal of Pragmatics, 37*, 185-208. doi:10.1016/j.pragma.2004.08.010

Roth, F. P. (2000). Narrative writing: Development and teaching with children with writing difficulties. *Topics in Language Disorders, 20*, 15-28. doi:10.1097/00011363-200020040-00004

Rubin, D. (1982). Adapting syntax in writing to varying audiences as a function of age and social cognitive ability. *Journal of Child Language, 9*, 497-510. doi:10.1017/S0305000900004839

Rubin, D. (1984). Social cognition and written communication. *Written Communication, 1*, 211-245. doi:10.1177/0741088384001002003

Sah, W. (2011). Emotion expressions and knowledge of story structure: A study of Mandarin-speaking children's narrative development. *Taiwanese Journal of Linguistics, 9*, 67-110.

Scott, C. M., & Windsor, J. (2000). General language performance measures in spoken and written narrative and expository discourse of school-age children with language-learning disabilities. *Journal of Speech, Language and Hearing Research 43,* 324-339. doi:10.1044/jslhr.4302.324

Shiro, M. (2003). Genre and evaluation in narrative development. *Journal of Child Language, 30*, 165-195. doi:10.1017/S0305000902005500

Sulzby, E. (1994). Children's emergent reading of favorite storybooks: A developmental study. In R. B. Ruddell, M. R. Ruddell & H. Singer (Eds.), *Theoretical models and processes of reading* (pp. 244-280). Newark, DE: International Reading Association.

Sulzby, E., & Zecker, L. B. (1991). The oral monologue as a form of emergent reading. In A. McCabe & C. Peterson (Eds.), *Developing narrative structure* (pp. 175-214). Hillsdale, NJ: Lawrence Erlbaum.

Tager-Flusberg, H., & Sullivan, K. (1995). Attributing mental states to story characters: a comparison of narratives produced by autistic and mentally retarded individuals. *Applied Psycholinguistics, 16*, 241-256. doi:10.1017/S0142716400007281

Tannen, D. (1982). Oral and Literate Strategies in Spoken and Written Narratives. *Language, 58*, 1-21. doi:10.2307/413530

Tannen, D. (1989). *Talking Voices: Repetition, Dialogue, and Imagery in Conversational Discourse*. Cambridge, UK: Cambridge University Press.

Ukrainetz, T. A., Justice, L. M., Kaderavek, J. N., Eisenberg, S. L., Gillam, R. B., & Harm, H. M. (2005). The development of expressive elaboration in fictional narratives. *Journal of Speech, Language, and Hearing Research, 48*, 1363-1377. doi:10.1044/1092-4388(2005/095)

Umiker-Sebeok, D. J. (1979). Preschool children's intraconversational narratives. *Journal of Child Language, 6*, 91-109. doi:10.1017/S0305000900007649

van Beijsterveldt, L. M. & van Hell, J. G. (2009). Evaluative expression in deaf children's written narratives. *International Journal of Language and Communication Disorders, 44*, 675-692. doi:10.1080/13682820802301498

van Dongen, R., & Westby, C. E. (1986). Building the narrative mode of thought through children's literature. *Topics in Language Disorders, 7*, 70-83. doi:10.1097/00011363-198612000-00009

Wennerstrom, A. (2001). Intonation and evaluation in oral narratives. *Journal of Pragmatics, 33*, 1183-1206. doi:10.1016/S0378-2166(00)00061-8

Westby, C. E. (1991). Learning to talk, talking to learn: Oral-literate language differences. In C. S. Simon (Ed.), *Communication skills and classroom success* (pp. 334-357). Eau Claire, WI: Thinking Publications.

Zevenbergen, A. A., Whitehurst, G. J., & Zevenbergen, J. A. (2003). Effects of a shared-reading intervention on the inclusion of evaluative devices in narratives of children from low-income families. *Applied Developmental Psychology, 24*, 1-15. doi:10.1016/S0193-3973(03)00021-2

Chapter 5

On-line management of written composition: a developmental perspective

5

This chapter is based on: Drijbooms, E., Groen, M. A., Alamargot, D., & Verhoeven, L. (in preparation). On-line management of written composition: a developmental perspective.

Abstract

This study was designed to enhance our understanding of the on-line management of written composition from a developmental perspective, and to explore the impact of this on-line management on text quality. The study particularly aimed at unraveling developmental differences in the coordination of low- and high-level writing processes. To this aim, fifth graders and undergraduate students were asked to compose a narrative from a visual source of images, while their graphomotor activity and eye movements were recorded. Results showed that fifth graders and undergraduate students used a different strategy to engage in high-level source-based text elaboration processes throughout the writing process. The main differences concerned the percentage of composition time dedicated to parallel processing, and the intensity with which the source was consulted during prewriting on the one hand, and during pauses on the other hand. Relationships between these characteristics of on-line management and text quality were minimal in fifth graders, whereas in undergraduate students more relationships were encountered. Results are discussed in light of capacity theory and developmental models of writing.

Writing development is a complex extended process that requires the gradual mastery of a number of low-level (i.e. transcription skills such as handwriting, and spelling) and high-level (i.e. planning, translating, reviewing) writing processes. Several theoretical models have described the way these processes develop with increasing writing expertise (Bereiter & Scardamalia, 1987; Berninger & Swanson, 1994). As all writing processes require cognitive resources of working memory (WM), an efficient management of writing processes within the limits of WM is fundamental to producing good-quality texts (e.g., Breetvelt, van den Bergh, & Rijlaarsdam, 1994; Levy & Ransdell, 1995). Writing research using real time indicators has started to advance our knowledge of this on-line management, and has accumulated evidence that writing expertise might favor a parallel, as opposed to a sequential execution of low- and high-level writing processes, as long as these processes do not exceed WM capacity. Moreover, eye movements are now increasingly used in writing research and allow for a more fine-grained analysis of the dynamics of writing. However, very little research has reverted to such analysis to document the on-line management of written composition from a developmental perspective. In the present study, we therefore aimed to (i) more precisely document and compare the on-line management of writing processes of fifth graders and undergraduate students during narrative composition from a visual source, as evidenced by a combined analysis of graphomotor activity and eye movements, and (ii) explore the relationship between the functional characteristics of this on-line management and text quality.

The Development of Writing Processes and their Management

In two complementary models, Bereiter and Scardamalia (1987) and Berninger and Swanson (1994) attempted to describe the development of writing expertise, as a gradual emergence of strategies and processes that operate within the limits of WM. Bereiter and Scardamalia (1987) conceived of the acquisition of writing expertise as a shift in writing strategies, from knowledge-telling in young writers to knowledge-transforming in more skilled writers. The former strategy involves formulating ideas as they are retrieved from long-term memory (LTM) or the task environment, without re-organizing the conceptual content or linguistic form of the text. It entails step-by-step, local planning of clear-cut small chunks of information. In the high school grades, the more complex knowledge-transforming strategy emerges, enabling the writer to engage in overall planning, reflected in the ability to generate content and organize ideas before starting to write. It also involves the use of increasingly complex processing strategies, often resulting in lengthy composition times, whereby the writer continues to adjust the form and text content until it matches rhetorical and pragmatic goals. According to

Berninger and Swanson (1994), writing development progresses through three stages: 1) during the lower primary grades, low-level transcription processes such as handwriting, and high-level writing processes such as planning, translating, and reviewing gradually emerge but operate on a very local level, 2) during the upper elementary grades, transcription gradually automatizes, reviewing starts to operate on higher-level aspects of the text, and planning prior to writing emerges, though it does not guide text generation yet, 3) during the lower secondary grades, all writing processes interact and become more complex, and metacognitive knowledge starts to play a more prominent role.

Both models attribute a significant role to the limited capacity of WM in explaining the increasing complexification of strategies and processes. According to capacity theory (Just & Carpenter, 1992; McCutchen, 1996), all writing processes compete for limited cognitive resources in WM. Throughout development, automatization of transcription will free cognitive resources that can then be allocated to high-level writing processes, which by consequence become increasingly complex. An important consequence of the limited capacity of WM, is that an efficient on-line management of the different writing processes all along the activity is necessary, in order to not exceed WM capacity (McCutchen, 1996). Writers thus have to coordinate the resources allocated to the different processes in writing (Kellogg, 1987; Kieft, Rijlaarsdam, & van den Bergh, 2008). As such, management should be interpreted as the temporal organization or timing of a writing process within the limits of WM, and reflects the strategies that writers use to cope with the cognitive demands of the writing processes.

In the last three decades, many studies have attempted to document the on-line management of writing processes by looking into their duration, timing, frequency, and demands through analyses of verbal protocols, dual or triple tasks, and pauses. One focus has been to analyze the amount of cognitive resources devoted to each of these processes, using triple task techniques, in order to evaluate how writers succeed or not in activating the different processes within the limits of WM (e.g., Kellogg, 1986; Kellogg, 1987; Kellogg, 2001; Olive, Kellogg, & Piolat, 2001; Piolat & Olive, 2000). Given that writing is a highly integrative activity, another focus has been to investigate the patterns of activation of the high-level writing processes of planning, translating, and reviewing, and the transitions between them in the course of writing (e.g., Beauvais, Olive, & Passerault, 2011; Braaksma, Rijlaarsdam, van den Bergh, & van Hout-Wolters, 2004; Breetvelt et al., 1994; Levy & Ransdell, 1995, 1996; Rijlaarsdam & van den Bergh, 1996; van den Bergh & Rijlaarsdam, 1999; van den Bergh & Rijlaarsdam, 2007; van den Bergh & Rijlaarsdam, 2001; van der Hoeven, 1997). Focusing on junior high school grades and beyond, all these

studies have evidenced that the way writers distribute planning, translating, and reviewing over time during a writing task, is related to the quality of the resulting text. More particularly, the relationship between text quality and writing processes has been shown to be dependent on the task representation, which constantly changes during writing. As such, the relationship between text quality and writing processes varies throughout the writing process. For instance, reading the writing assignment has a positive effect on text quality in the first phase of the writing process, but a negative effect during the second phase (e.g., Breetvelt et al., 1994). Beauvais et al. (2011) confirmed the importance of the initial phase of the writing process, by showing a positive relationship between the duration of prewriting and text quality of narrative and argumentative texts. Beauvais et al. (2011) further demonstrated that students write narrative texts by frequently alternating between short episodes of planning and translation processes. The authors explained this as evidence that an internalized narrative schema guides narrative composition. Argumentative texts, instead, require long episodes of planning processes.

Importantly, the majority of these studies have dealt with sequences of high-level writing processes in. However, to go further in the comprehension of writers' on-line management of written composition, it is fundamental to characterize how the high-level writing processes are coordinated with respect to the low-level writing processes. This is particularly important from a developmental perspective, given the high cognitive load placed by low-level writing processes on WM in young, immature writers (Berninger & Swanson, 1994).

From Sequential to Parallel Processing

In order to document the coordination of low- and high-level writing processes, writing researchers have reverted to the theoretical distinction between parallel and sequential processing (van Galen, 1991). The idea underlying this distinction is that high-level writing processes may be activated in a parallel or in a sequential way with respect to low-level writing processes, depending on their cost in terms of cognitive resources. In accordance with capacity theory (McCutchen, 1996), a prerequisite for parallel processing is the availability of a sufficient amount of cognitive resources in WM. Insufficient cognitive resources, by contrast, can result in a sequentialization of processes, with a lower-level process being brought to a halt, i.e. resulting in a pause, awaiting the representation of a higher-level process (Olive, 2014). In this respect, Fayol (1999) proposed that automatization of low-level writing processes is essential, because it provides additional resources that can allow for the parallel activation of low- and high-level writing processes. An enhanced availability of cognitive resources will, indeed, mostly be due

to the automatization of low-level rather than high-level writing processes, as the latter require constant attentional control and are much more difficult to automatize (Kellogg, 2008). Although parallel and sequential processing are now seminal notions within writing research, relatively few on-line studies have empirically investigated these two strategies of on-line process coordination in written composition.

Using direct verbalization and secondary reaction times, Alves, Castro, and Olive (2008) and Olive, Alves and Castro (2009) examined the distribution of writing processes across periods of handwriting and pauses in undergraduate students. They demonstrated that translating is the process that is most frequently activated in parallel with handwriting, followed by planning and revising, because it is the least cognitively demanding process. This does not mean that in adult writers translating always occurs during handwriting. When accumulated demands of handwriting and other high-level writing processes exceed WM, even the adult writer is forced to sequentialize the writing processes, and thus to activate high-level writing processes during pauses.

Chanquoy, Foulin, and Fayol (1990)'s experimental study was the first study to show evidence of developmental differences in the sequential and parallel activation of writing processes. Using video recording of adults' and children's composition of written endings for orally presented text beginnings, they showed that the predictability of the content influenced the prewriting, the between-clause and within-clause pause duration for adults, but not for children. It is argued that adults were able to conduct transcription processes in parallel with the high-level process of planning, and adjusted their writing speed to the changing demands of the required conceptual operation. That is, the reduced fluency in their writing indicated that attention was divided between handwriting and high-level writing processes. Children, by contrast, were not able to modify the rhythm of their writing in a similar way, because they were more constrained by their demanding handwriting activities, and therefore forced to sequentialize low- and high-level writing processes. The importance of automatized handwriting skills for the parallel execution of writing processes was also confirmed by Olive and Kellogg (2002). In their experimental study, third graders, undergraduate students using their familiar handwriting style, and undergraduate students using an unfamiliar handwriting style, were asked to compose a text and then copy it. Using secondary reaction times, they were able to demonstrate that undergraduate students could concurrently activate high-level writing processes when writing in their familiar handwriting. By contrast, third graders and undergraduate students using an unfamiliar handwriting style were forced to

activate the writing processes sequentially due to the high cognitive demands of handwriting.

Beauvais, Favart, Passerault, and Beauvais (2012) indirectly attested developmental differences in sequential and parallel processing, by comparing the percentage of time spent in prewriting, pausing, and transcribing in fifth, seventh, and ninth graders during the composition of a procedural and expository text. Results showed a decrease in the percentage of time spent pausing and an increase in prewriting time in ninth graders, suggesting that younger writers have a more sequentialized writing process. Furthermore, they found that across all grades spending more time on prewriting lessened the cognitive cost of organizing content in the course of composition, resulting in a lower percentage of time spent pausing. The authors further concluded that the different writing strategy of the ninth graders possibly explains why they used a wider variety of connectives in their texts than fifth and seventh graders.

Indeed, the way low-level and high-level writing processes are coordinated may impact on text quality, with automatization of handwriting playing a fundamental role in this respect. If unautomatized handwriting is activated in parallel with higher-level writing processes, this may affect the efficiency of the high-level writing processes, as the writer does not possess enough resources to allocate to these processes. By adopting a more sequential coordination of low- and high-level writing processes, the writer succeeds in avoiding a cognitive overload. However, with such a think-and-then-write strategy, text quality may suffer, as there are more opportunities for forgetting ideas or text that have already been prepared but are not yet written down (Olive, 2014). Instead, when attention is freed from the demanding low-level writing processes, a thinking-while-writing strategy can be more efficiently implemented. That is, high-level writing processes that are activated in parallel can receive more cognitive resources, and can therefore be more successfully coordinated in WM, ensuring a well-written text (Berninger & Winn, 2006; Olive, 2014; Olive, Favart, Beauvais, & Beauvais, 2009).

Taken together, there is now increasing evidence that writing expertise favors a parallel, rather than sequential, activation of low- and high-level writing processes, and that different patterns of process coordination may account for differences in text quality. Nevertheless, our understanding of on-line management of writing processes is still to some extent in its infancy. One important question to answer, for instance, is how the task environment interacts with the coordination of writing processes. More particularly, high-level writing processes may also involve elaborating text by looking at the emerging text or at a source within the task environment (Wengelin et al., 2009). Whereas pauses and dual or triple tasks can signal the parallel or

sequential occurrence of a certain high-level writing process, they are not sufficient to explain *how* the process operates within the task environment during handwriting or during pauses. More fine-grained research is needed to address such issues.

Eye Movements to Study On-line Management of Written Composition

Recently, eye movements have started to be increasingly implemented in writing research, as they allow for a more fine-grained analysis of the dynamics of writing (Alamargot, Chesnet, Dansac, & Ros, 2006; Alamargot, Dansac, Chesnet, & Fayol, 2007; Alamargot, Plane, Lambert, & Chesnet, 2010; Alamargot et al., 2015; Johansson et al., 2010; Lambert, Alamargot, Larocque, & Caporossi, 2011; Nottbusch, 2010; Sita & Taylor, 2015; Torrance & Nottbusch, 2012; Van Waes, Leijten, & Quinlan, 2010; Wengelin et al., 2009; Torrance, Johansson, Johansson, & Wengelin, 2015). A combined analysis of graphomotor activity and eye movements has proven to be particularly important to document the on-line management of written composition, including parallel and sequential processing, from a more precise temporal perspective. More particularly, while carrying out high-level writing processes such as planning or revising, the eyes continually move within the task environment, including the text produced so far or any potential documentary sources (Olive & Passerault, 2012). Recording the eye movements within the task environment relative to the writer's graphomotor activity (i.e. the varying patterns of handwriting and pauses) can therefore provide valuable information about how low- and high-level writing processes are managed. Alamargot, Dansac, Chesnet, and Fayol (2007), for instance, demonstrated that in graduate students, visual searches on a source or on the text produced so far can take place in parallel with handwriting, for as much as 10% of the handwriting time.

Eye movements are particularly useful to more accurately describe how high-level writing processes operate with respect to the different clues available in the task environment. Alamargot, Caporossi, Chesnet, and Ros (2011) documented how undergraduate students with different levels of WM capacity elaborate a procedural text, based on a documentary source. They found that high WM capacity writers spent more time on the task than low WM capacity writers, because they undertook more intensive source-based text elaboration during long pauses, as evidenced by more and longer fixations on the source, and more eye movement transitions between different parts within the source. Their texts also achieved the communicative goal more efficiently, by using more reader supports. These results were interpreted to reflect high WM writers' ability to strategically activate high-level writing

processes during pauses in order to engage in more complex text planning. Such a decrease in writing fluency resulting from more complex, skilled high-level writing processes had previously been described by Torrance (1996). Alamargot et al. (2011) did not specifically look into parallel processing. Yet, by unraveling patterns of skilled, complex processing during pauses, the study illustrates that it is not sufficient to identify episodes of parallel and sequential processing. In order to fully understand on-line management of written composition, one also needs to examine into depth how high-level writing processes operate within the task environment during these episodes.

To our knowledge, the only study that has looked at the on-line management of written composition from a developmental perspective by analyzing graphomotor activity and eye movements is a case study by Alamargot, Plane, Lambert, and Chesnet (2010), carried out with a 7th, 9th, and 12th grader, a graduate student, and a professional writer. Participants were asked to write a text from a documentary source, consisting of the beginning of a narrative. Similar to Alamargot et al. (2011), source consultation was thought to reflect high-level writing processes necessary for text elaboration. It was measured by analyzing the fixation frequency per word and fixation duration on the source during prewriting, i.e. prior to the first pen stroke, and during composition. The authors referred to these measures as the "density of source reading", and interpreted this to reflect how intensively the writers read the source. Three key findings of the study are worth mentioning: First, the 7th grader stood out on account of her very superficial source reading during prewriting. During composition, she was found to use pauses to read the source more intensely, albeit still quite superficially compared to the other writers. The authors interpreted this writing strategy as local planning, characteristic of knowledge-telling (Bereiter & Scardamalia, 1987), which required the 7th grader to frequently return to the source in order to elaborate text. Second, the 12th grader was found to engage in a strategic, overall planning of the text through an intensive reading of the source during prewriting, which allowed her to read the source more scantily during composition. Third, across all writers, most source consultation took place during pauses, but there was a gradual emergence of more frequent episodes of parallel processing in the graduate student and the professional writer, who regularly engaged in source consultation during handwriting. Furthermore, the general temporal parameters of the writers' writing process revealed an increased speed and fluency, and a reduced mean pause duration, and pause frequency with age. Overall, the authors summarized the developmental trends observed in the study as a gradual automatization of low-level writing processes and a complexification of high-level writing processes between 7th and 12th grade, and a gradual proceduralization of high-level writing processes, favoring

more frequent parallel processing, in the more expert writers. While the results of this study paint a coherent, developmental picture of the on-line management of written composition, they are based on a case study only, and should therefore be replicated in larger samples, including younger writers in elementary school.

In summary, writing is a complex activity during which several writing processes need to be managed on-line within the limits of WM. For young writers, whose low-level writing processes consume a substantial amount of cognitive resources within WM, coordinating low- and high-level writing processes is particularly challenging. There is now increasing evidence substantiating a predominantly sequential activation of low- and high-level writing processes in young writers, as opposed to the emergence of episodes of parallel activation in more mature writers. However, in order to clarify the relationship between low- and high-level writing processes and unravel writing strategies, it seems important to not only ascertain the extent to which high-level writing processes occur sequentially or in parallel with low-level writing processes, but also to describe into more detail how the high-level writing processes operate within the task environment during these different time frames of the writing process.

The Present Study

Describing developmental differences in the on-line management of written composition is a first step towards understanding the strategies that writers use to cope with the cognitive demands of writing. The present study therefore aimed to describe how writers with different levels of expertise, notably fifth graders and undergraduate students, manage writing processes on-line during the composition of a narrative from a visual source, based on a fine-grained analysis of graphomotor activity and eye movements. Furthermore, it is equally important to understand the relationship between on-line management and text quality, in order to identify effective writing strategies that could be targeted in education. Hence, the present study addressed the following two questions:

1) To what extent does the on-line management of written composition differ between fifth graders and undergraduate students?
2) To what extent are the functional characteristics of this on-line management in fifth graders and undergraduate students related to text quality?

The specific aims underlying the first question were a) to shed light on the extent to which high-level writing processes of source-based text elaboration are activated sequentially or in parallel with low-level writing processes, and b) to document more precisely how the high-level writing processes operate within the task environment during different time frames of the writing process.

To this purpose, participants were asked to compose a narrative from a visual source of images, while their graphomotor activity and eye movements were registered. The inclusion of fifth graders and undergraduate students allowed us to compare writers who span writing stages associated with knowledge-telling and knowledge-transforming (Bereiter & Scardamalia, 1987). A task consisting of writing based on a source of images makes text elaboration highly dependent on a visual exploration of the source. As such, this task allowed us to more strictly control the moments where the writers engaged in high-level text elaboration processes. The writer's involvement in these high-level writing processes was investigated by analyzing writers' eye movements within the task environment. Following previous research (e.g., Alamargot et al., 2010; Alamargot et al., 2011), it was analyzed how frequently the writers moved from the text produced so far to the source ("frequency of source consultation"), and how intensively they observed the source ("density of source consultation"). By calculating the percentage of composition time that is spent handwriting with the eyes on the source, a general indicator of the amount of parallel processing of low-level writing processes and high-level text elaboration processes could be obtained. Furthermore, to elucidate more clearly how the high-level text elaboration processes operate throughout the writing process, writers' source consultation was analyzed separately for three time frames: during prewriting, during episodes of sequential processing (i.e. when source consultation takes place during pauses), and during episodes of parallel processing (i.e. when source consultation takes place during handwriting). General temporal parameters and characteristics of graphomotor activity were taken as a point of departure for the eye movement analysis.

With regards to the first question, integrating assumptions of developmental models of writing with the previously reviewed findings, we hypothesized that insufficiently automatized transcription skills, and a lack of global planning and complex processing skills would jointly determine the on-line management of written composition in fifth graders and distinguish it from the way undergraduate students manage their writing processes (Bereiter & Scardamalia, 1987; Berninger & Swanson, 1994). Generally, we expected fifth graders to engage less in parallel processing than undergraduate students due to the higher constraining role of transcription skills (e.g., Chanquoy et

al., 1990; Fayol, 1999; McCutchen, 1996; Olive & Kellogg, 2002). Furthermore, during prewriting, we expected fifth graders to consult the source less intensively than students, as a result of their more limited ability to engage in global planning (e.g., Alamargot et al., 2010; Bereiter & Scardamalia, 1987; Chanquoy et al., 1990). During episodes of sequential processing, we expected fifth graders to make more transitions from the text to the source than students, in line with their step-by-step composition of the text and their inability to process and retain in memory multiple chunks of information at once (Alamargot et al., 2010; Bereiter & Scardamalia, 1987). By contrast, we expected students to consult the source more intensively than fifth graders, as a result of their more complex processing strategies (Alamargot et al., 2010; Alamargot et al., 2011; Bereiter & Scardamalia, 1987; Berninger & Swanson, 1994; Torrance, 1996). During episodes of parallel processing, we expected students to return more frequently from the text to the source, and to consult the source more intensively than fifth graders, as they will be able to sustain their handwriting for longer before accumulated demands of writing processes induce a pause.

With regards to the second question, our approach was exploratory in nature. However, we hypothesized to find several relationships between functional characteristics of on-line management and text quality, in light of the idea that effective writing depends on the writer's ability to coordinate all the different processes involved (Galbraith & Rijlaarsdam, 1999). It was, for instance, hypothesized that density of source consultation during prewriting would affect text quality (e.g., Beauvais et al., 2011; Beauvais et al., 2012). Furthermore, as strategies of on-line management in young writers may result from the way writers deal with cognitive demands (Berninger & Winn, 2006; Olive et al., 2009; Olive, 2014), but in more skilled writers possibly also from a more strategic activation of high-level writing processes (e.g., Alamargot et al., 2011), differential relationships of on-line management with text quality in the two groups of writers may be expected.

Method

Participants

Thirty-eight undergraduate students and 34 children in fifth grade from two different schools in the Netherlands participated in this study. Education levels of the students were bachelor's degree (52%) and master's degree (48%). The student sample comprised 11 men and 27 women. The students had different academic backgrounds: 89% was drawn from the humanities, and 11% from the exact sciences. The mean age of the sample was 22.6 years (SD = 3.4), with ages ranging from 19 to 36. The children's sample comprised

18 boys and 16 girls. Children with divergent diagnoses, such as dyslexia and Attention Deficit (Hyperactivity) Disorder, were excluded from participation. The mean age of the sample was 10.5 years (*SD* = 0.8), with ages ranging from 9 to 11 years.

Writing Task

The narrative composition task consisted in producing a story from a series of eight images depicting a narrative (Taaltoets Alle Kinderen, TAK; Verhoeven & Vermeer, 2001). Although the instrument was originally designed for assessing oral narrative skills, the instructions were adapted for assessing writing. Throughout the composition task, participants were free to consult the images. The duration of the task was not imposed. Participants were instructed to write their story on two 12-lines columns below the images, and were asked to complete their story by the end of the second column. The exact wording of the writing assignment was: "You will be given eight images depicting a story. The images are put in the right order. Write a story that goes with the images. Look carefully at the images, before starting to write. The images will remain visible throughout the task, so you can consult them as and when you like". Participants were not given the possibility to elaborate a written draft prior to writing.

Apparatus

During the composition, eye and graphomotor movements were recorded by means of the Eye & Pen software (Chesnet & Alamargot, 2005). Participants wrote on a digitizing tablet, a Cintiq 22HD LCD tablet, driven by a computer running the Eye & Pen software. Eye movements were simultaneously recorded by an Eyelink II head-mounted eye-tracker (S.R. Research Ltd), which equally transmitted the data to the computer running the Eye & Pen software. The Eyelink II has a sampling frequency of 500Hz for monocular (dominant-eye) recording.

The Cintiq 22HD LCD tablet was placed on an adjustable-height table. Participants were asked to stand up while writing. The table height was then elevated to the elbow to suit each individual participant's height. A chinrest was used to ensure that the participant would limit his or her movements and to keep the distance between the eyes and the writing surface constant. The participant's position was set up to be as comfortable as possible.

An image displayed on the tablet showed the eight pictures and delimited the writing area. The writing area consisted of two 12-lines columns. The button depicting the words 'EINDE' at the right bottom side of the writing area enabled the subject to end the task after finishing the writing assignment.

Figure 5.1 shows the task environment with the information displayed on the screen during composition.

Procedure

After the eye-tracker had been installed and the calibration had been completed successfully, the composition task was carried out. For this task, instructions were both displayed on the screen and orally explained by the investigator. For the fifth graders, however, the investigator carefully explained the instructions, but the instructions on the screen were reduced to a minimum, to avoid distracting the fifth graders during explanation of the instructions.

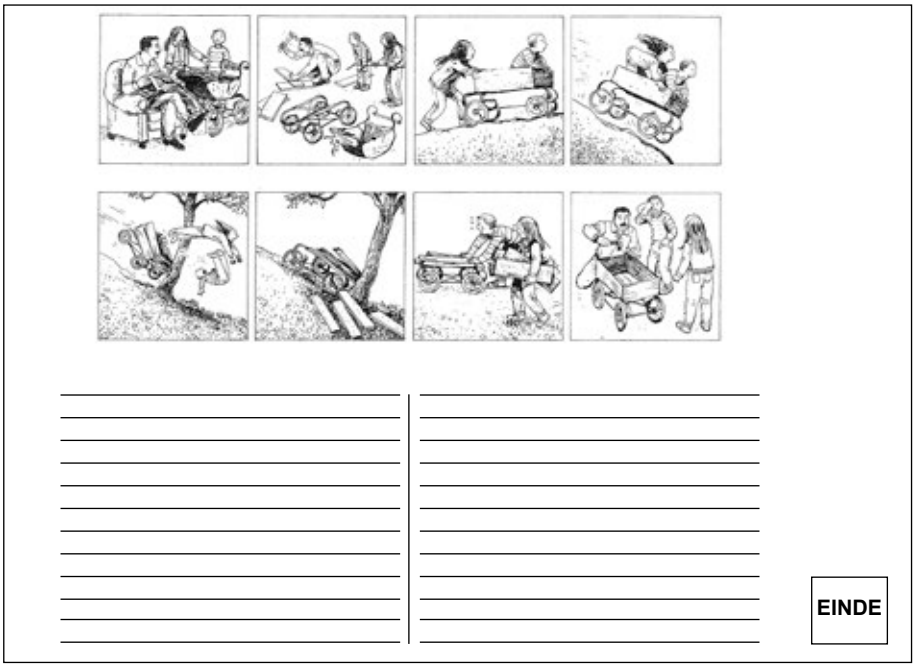

Figure 5.1 The task environment with the information displayed on the screen during composition.

Measures

Once the texts had been composed, two sets of variables were analyzed: 1) process measures, derived from the analysis of graphomotor activity and eye movements, and 2) product measures, resulting from an analytic scoring of the text quality of the written product.

Process measures. Process measures involved *general temporal parameters and measures of graphomotor activity.* Several measures related to the general temporal parameters of the compositions were obtained, namely prewriting duration (in milliseconds, i.e. the time that elapses between the appearance of the image on the tablet and the setting of pen to paper), total time on task (in minutes), and compositional fluency (in words per minute, wpm). Regarding graphomotor activity, mean pause duration (in milliseconds), and pause frequency (in number of pauses per minute, ppm) were calculated. Note that all pauses lasted longer than a predetermined threshold of 35ms. This threshold is the result of a methodological criterion, which determines that a pause is at least equivalent to three successive digital samples (see Alamargot et al., 2010 for further details). Pauses were ranked and divided into quartiles according to their duration.

Another set of process measures involved *eye movements.* Fixations and gaze transitions served as the basis for four eye movement measures capturing the frequency and density of source consultation. A fixation is defined as a position at which the eye stops for at least 50ms in order to process information. A gaze transition is defined as the eye shifting from one fixation to the next, whereby no information is processed. Frequency of source consultation was determined by analyzing the number of gaze transitions from text to source, which is thought to reflect the frequency with which the writer consults the source for information uptake (Alamargot, Chesnet, & Caporossi, 2012). Density of source consultation was determined by analyzing the number of fixations on images, the number of gaze transitions between images, and the total gaze duration (in milliseconds). Building further on research on eye movements in reading, these eye movements were interpreted to reflect respectively the amount of information processed, the attempts to establish links between chunks of information depicted in different images, and the cognitive effort associated with it (e.g., Orrantia, Munez, & Tarin, 2014; Torrance et al., 2015). These eye movements were analyzed for three time frames of the writing process, i.e. during prewriting, during episodes of sequential processing (i.e. when source consultation takes place during pauses), and during episodes of parallel processing (i.e. when source consultation takes place in parallel with handwriting). For prewriting, only density of source consultation was calculated, as by definition prewriting does not involve any transitions from text to source. In order to pinpoint parallel processing, and distinguish it from sequential processing, two criteria were established: 1) the distance between the point of fixation on the source, and the point of inscription had to be greater than 4 cm, to ensure that the latter was not in the parafoveal field of vision (Alamargot et al., 2007), 2) visual activity on the source, or from the text to the source had to occur during pauses whose duration was determined according

to a relative pause threshold. Such a relative pause threshold was preferred over an absolute pause threshold, as it takes individual differences and group differences in graphomotor skills into account. Establishing this relative threshold involved appealing to the categorization of pauses into quartiles. Following Alamargot et al. (2010), the two quartiles with the lowest pause durations (Q1 and Q2) were considered to reflect graphomotor pauses and thus handwriting. More particularly, pauses below this threshold correspond, for example, to the transcription of a dot on the "i". Hence, visual activity on the source, or from text to source, occurring during Q1 and Q2 pauses, thus during actual handwriting, was defined as parallel processing. Consequently, visual activity on the source, or from text to source, occurring during Q3 and Q4 pauses was considered to reflect sequential processing.

Besides these eye movement measures, a general indicator of amount of parallel processing was obtained, by calculating the percentage of composition time during which handwriting is continued with the eyes fixated on the source.

Product measures. Text quality of the written product was measured by means of an analytic scoring method focusing on distinct levels of written language. Such an analytic scoring method is convergent with the idea that writing is a multidimensional construct, and that writers can differ within themselves in their ability to produce text at the word-, sentence-, or text-level (Wagner et al., 2011; Whitaker, Berninger, Johnson, & Swanson, 1994). Participants' written narratives were analyzed at three levels of language. At the word-level, a measure of text length in number of words was obtained. At the sentence-level, the mean length of a t-unit in words was taken as a measure of syntactic complexity. A t-unit is defined as a main clause with all subordinate clauses associated with it (Hunt, 1966). Both text length and syntactic complexity were calculated using Computerized Language Analysis (CLAN) software (MacWhinney, 2000). At the text-level, two macrostructural measures were obtained: story ideas and story structure. Story ideas were scored following the standard procedures of the TAK task (Verhoeven & Vermeer, 2001). The TAK task contains a list of nine main ideas that are represented in the story. One point was awarded for each idea included in the narrative. Raw scores were used in the analyses (max. = 9). Inter-rater reliability for this task is reported as .90 (Verhoeven & Vermeer, 2001). The story structure was evaluated by scoring the presence of the narrative categories of setting, initiating event, internal response, attempts, direct consequence, and reaction (Stein & Trabasso, 1982). Two points were awarded if the narrative category was described sufficiently; one point was awarded if the narrative category was only partially represented. This

analysis of story structure provides a measure of the extent to which the writer infers the causal relationships between events in the story instead of simply describing the pictures as a series of unrelated events (Norbury & Bishop, 2003). Raw scores were used in the analyses (max. = 12). All stories were rated separately by two raters on story ideas and story structure, and inter-rater reliability was good (.89 and .88 respectively).

Results

On-line Management of Written Composition

Analysis of general temporal parameters and graphomotor activity. The means and standard deviations of the general temporal parameters and characteristics of graphomotor activity are presented in Table 5.1. These data provide an overview of the temporal characteristics of the written trace. A comparison between the two groups of writers revealed that students spent significantly more time on prewriting than fifth graders ($t(70) = 2.62$, $p = .01$; $d = .59$). There was no significant difference between fifth graders and students regarding the time spent on task ($t(70) = -.480$, $p = .63$; $d = -.34$). Furthermore, students wrote more fluently throughout composition ($t(70) = 10.15$, $p < .01$; $d = 2.41$). Mean pause duration was significantly higher for fifth graders than for students ($t(70) = -7.90$, $p < .01$; $d = -1.90$), but students paused significantly more often per minute than fifth graders ($t(70) = 10.02$, $p < .01$; $d = 2.35$). Pauses in all quartiles were significantly longer in fifth graders than in students (Q1: $t(70) = -2.29$, $p < .05$; $d = -.55$; Q2: $t(70) = -9.13$, $p < .01$; $d = -2.19$; Q3: $t(70) = -6.25$, $p < .01$; $d = -2.44$; Q4: $t(70) = -6.25$, $p < .01$; $d = -1.51$).

Overall, these findings raise the question of how the high-level text elaboration processes operate within the task environment during prewriting, as well as during the Q1 and Q2 pauses, and during the Q3 and Q4 pauses. The eye movement analysis provides an answer to this question. Recall that Q1 and Q2 pauses were defined as pauses inherent to handwriting, and Q3 and Q4 as actual pauses resulting from an interruption of handwriting. As such, eye movements occurring during Q1 and Q2 pauses are defined as parallel processing, and eye movements occurring during Q3 and Q4 pauses as sequential processing.

Table 5.1
Means (SD) of the General Temporal Parameters and Characteristics of Graphomotor Activity According to Level of Expertise

	5th graders	Students
	Mean (SD)	*Mean (SD)*
Prewriting duration (ms)	21953 (20614)	33607 (17137)
Time on task (min)	6.90 (2.53)	6.10 (2.23)
Compositional fluency (wpm)	12.72 (3.08)	20.90 (3.69)
Mean pause duration (ms)	796 (270)	398 (122)
Pause frequency (ppm)	37.99 (13.47)	73.05 (16.21)
Pause duration Q1 (ms)	92.48 (39.05)	76.01 (16.22)
Pause duration Q2 (ms)	271.87 (80.29)	133.58 (38.93)
Pause duration Q3 (ms)	553.67 (140.67)	269.55 (85.19)
Pause duration Q4 (ms)	2293.51 (1019.35)	1122.96 (412.25)

Eye movement analysis. First of all, the general indicator of parallel processing showed that students dedicated a larger percentage of their composition time to parallel processing than fifth graders (Students: $M = 1.10$; $SD = 1.22$; Fifth graders: $M = .62$; $SD = .57$; $t(70) = 2.17$, $p < .05$; $d = .50$).

Table 5.2 presents the differences between fifth graders and students concerning the frequency and density of source consultation in the different time frames of the writing process. Regarding prewriting, results revealed that students made significantly more transitions between images in the source than fifth graders ($t(70) = 2.07$, $p < .05$; $d = .49$). While students made slightly, but not significantly more fixations on images ($t(70) = 1.70$, $p = .095$; $d = .39$), on average they looked significantly longer at images than fifth graders, as evidenced by the total gaze duration ($t(70) = 2.92$, $p < .01$; $d = .69$). Opposite to our predictions, students' intensive source consultation during prewriting was not evidently pursued during episodes of sequential processing: fifth graders demonstrated a more intensive visual activity on the source than students, as demonstrated by the number of fixations ($t(70)= -3.54$, $p = .001$, $d = -.85$), the number of transitions between images ($t(70)= -3.03$, $p < .01$, $d = -.72$), and the total gaze duration ($t(70)= -3.05$, $p < .01$, $d = -.71$). Regarding frequency of source consultation, no differences were found between fifth graders and students in terms of the number of transitions from text to source ($t(70)= .47$, $p = .64$, $d = .11$). During episodes of parallel processing, students made a higher number of fixations on the source than fifth graders ($t(70) = 2.78$, $p < .01$; $d =$

Table 5.2

Means (SD) of Frequency and Density of Source Consultation during Prewriting, Sequential Processing, and Parallel Processing According to Level of Expertise

		During prewriting		During sequential processing		During parallel processing	
		5th graders	Students	5th graders	Students	5th graders	Students
		Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
Frequency	Transitions text-source	-	-	20.00 (12.93)	21.34 (11.42)	1.44 (1.71)	1.84 (1.57)
Density	Number of fixations	46.03 (44.94)	61.55 (32.90)	120.18 (78.39)	66.95 (41.71)	7.88 (6.94)	15.16 (14.37)
	Transitions images	17.24 (16.03)	25.24 (16.70)	36.29 (27.59)	19.74 (16.78)	1.26 (1.56)	2.21 (2.62)
	Total gaze duration	16553 (18038)	27917 (14963)	35404 (22530)	21908 (14495)	2696 (2295)	3893 (3254)

Note. Transitions text-source = number of transitions from text to source. Number of fixations = number of fixations on images. Transitions images = number of transitions between images. Total gaze duration = total gaze duration on images in milliseconds.

.65), and a marginally higher number of transitions between images ($t(70) = 1.88$, $p = .065$; $d = .46$). Also, students' total gaze duration on the source tended to be slightly longer than fifth graders' total gaze duration ($t(70) = 1.82$, $p = .073$; $d = .43$). Regarding frequency of source consultation, again no differences were found between fifth graders and undergraduate students in terms of the number of transitions from text to source ($t(70)= 1.04$, $p = .30$, $d = .24$).

Summarizing the findings regarding the on-line management of written composition, fifth graders composed their texts through a more superficial observation of the source during prewriting, followed by a more intensive source consultation during long pauses. Students, by contrast, composed their texts through a more intensive source consultation during prewriting, followed by short and frequent pauses during composition, during which the source was less intensively observed.

The Relationship between On-line Management and Text Quality

Table 5.3 presents fifth graders' and students' compositional performance on the different measures of text quality. Analyses showed that students wrote significantly longer ($t(70) = 5.28$, $p < .01$; $d = 1.26$), and syntactically more complex ($t(70) = 4.72$, $p < .01$; $d = 1.10$) texts than fifth graders. Furthermore, students included significantly more story ideas ($t(70) = 4.07$, $p < .01$; $d = .97$) and more narrative categories of story structure ($t(70) = 2.89$, $p < .01$; $d = .68$) in their stories compared to fifth graders.

Table 5.3
Means (SD) of Compositional Performance on Word-, Sentence-, and Text-Level of Text Quality According to Level of Expertise

	5th graders	Students
	Mean (SD)	*Mean (SD)*
Text length	80.15 (29.26)	123.61 (39.22)
Syntactic complexity	5.25 (0.88)	6.35 (1.10)
Story ideas	6.15 (1.71)	7.55 (1.13)
Story structure	10.12 (2.90)	11.82 (1.93)

For the calculation of the correlations between the functional characteristics of on-line management and text quality, a composite score for density of source consultation during prewriting, during sequential processing, and during parallel processing was computed. In light of the modest sample size and the explorative character of the correlational analysis, it was deemed

necessary to reduce the data in order to control a family-wise error rate. Based on conceptual relationships, and high correlations between variables, the composite scores were computed by adding and averaging the z-scores of prewriting duration, number of fixations, number of transitions between images, and total gaze duration for the prewriting phase, and by adding and averaging the z-scores of number of fixations, number of transitions between images, and total gaze duration for the episodes of parallel and sequential processing.

The correlation coefficients in Table 5.4 illustrate the relationships between the functional characteristics of on-line management and text quality. For fifth graders, text length correlated significantly with time on task, compositional fluency, and frequency of source consultation during sequential processing. A nearly significant correlation was found between syntactic complexity and density of source consultation during prewriting (p = .06). No correlations were found between characteristics of on-line management and story ideas or story structure. For students, text length correlated significantly with time on task, and with frequency and density of source consultation during sequential processing. Furthermore, syntactic complexity correlated significantly with mean pause duration and with density of source consultation during prewriting. Story ideas correlated negatively with mean pause duration, and positively with frequency of source consultation during parallel processing. Finally, story structure correlated significantly with time on task, and negatively with mean pause duration.

Discussion

In the present study, we sought to portray the on-line management of written composition from a developmental perspective, and explored its relationship with the text quality of the written product. Studying eye movements within the task environment, relative to different time frames of the writing process enabled us to identify the extent to which writers implement low-level writing processes and high-level text elaboration processes sequentially or in parallel, and to describe into more detail how these high-level writing processes operate within the task environment during different time frames.

Table 5.4

Pearson Correlation Coefficients between Characteristics of On-line Management and Text Quality According to Level of Expertise

	Text length		Syntactic complexity		Story ideas		Story structure	
	5th graders	Students	5th graders	Students	5th graders	Students	5th graders	Students
Time on task	.66**	.78**	.08	.17	-.22	.20	-.27	.34*
Compositional fluency	.34*	.22	-.04	-.14	.14	.25	.15	.28
Mean pause duration	-.20	.04	.03	.40*	-.20	-.42**	-.20	-.33*
Pause frequency	.03	.06	-.03	-.22	.17	.11	.12	.19
% Parallel processing	.04	-.26	-.15	-.02	-.32	.02	-.18	-.04
Prewriting density	-.09	.08	.33#	.50**	-.02	-.16	-.08	-.06
Parallel frequency	.24	.30	.12	-.21	.02	.34*	-.05	.17
Parallel density	.31	-.03	.06	-.07	-.27	.24	-.15	.08
Sequential frequency	.43*	.62**	-.05	.07	-.20	.16	-.30	.13
Sequential density	.15	.43**	.01	.08	-.11	-.13	-.18	-.06

Note. #$p < .10$. *$p < .05$. **$p < .01$. % Parallel processing = % of composition time dedicated to parallel processing. Prewriting density = density of source consultation during prewriting. Parallel frequency = frequency of source consultation during parallel processing. Parallel density = density of source consultation during parallel processing. Sequential frequency = frequency of source consultation during sequential processing. Sequential density = density of source consultation during sequential processing.

On-line Management of Written Composition

With regards to the on-line management of written composition, first of all, results demonstrated that students engaged more in parallel processing than fifth graders. Put simply, students spent more time looking at the source while continuing handwriting than fifth graders. By providing a precise temporal indicator of parallel processing, this study both replicates and extends previous findings (i.e., Olive & Kellogg, 2002; Chanquoy et al., 1990; Alamargot et al., 2010), suggesting that in fifth graders, low-level writing processes consume more cognitive resources, leaving less resources available for concurrent activation of high-level text elaboration processes. The general temporal parameters are in keeping with this interpretation. That is, both the compositional fluency and the mean pause duration of pauses in the Q1 and Q2 quartiles confirm that fifth graders' automatization of low-level writing processes is still ongoing (Berninger & Swanson, 1994; McCutchen, 1988). Furthermore, their lower density of source consultation suggests that source consultation during handwriting consists of very quick glances, presumably because accumulated demands of different processes do not allow for more complex processing of the source. Importantly, compared to the third graders in the study by Olive and Kellogg (2002), fifth graders did exhibit some episodes of parallel processing. As transcription skills are thought to gradually automatize in the upper elementary grades (Berninger & Swanson, 1994), this may be interpreted as evidence that transcription skills in fifth graders are sufficiently automatized as to enable on some occasions the parallel execution of high-level text elaboration processes. As translating is the sub-process of text elaboration that is first acquired (Berninger & Swanson, 1994), and the least cognitively demanding (Alves et al., 2008), it is conceivable that this is the process underlying source consultation that will run most often in parallel with handwriting both in fifth graders and in undergraduate students. It may, for instance, be that while writers are still writing down the previous word, they consult the source to prompt lexical retrieval for the next word. Two considerations are worth noticing here. First, it is important to emphasize that in both groups of writers parallel processing represented only a very small percentage of the total composition time. Second, text elaboration processes can also take place on the basis of the text produced so far, or on the basis of an internal source, i.e. through the processing of knowledge stored in LTM. This implies that the actual percentage of composition time dedicated to parallel processing might be larger than reported here. For instance, given the high frequency of short pauses in undergraduate students, it is likely that other writing processes such as language preparation occur in parallel with handwriting, and as such alter the rhythm of handwriting (Chanquoy et al., 1990).

Periods of pen inactivity, whether that is during prewriting, or during episodes of sequential processing, remained clearly the most important locations of high-level text elaboration processes. An in-depth exploration of the frequency and density of source consultation during prewriting and during episodes of sequential processing revealed further differences between fifth graders and undergraduate students. In line with developmental models of writing (Bereiter & Scardamalia, 1987; Berninger & Swanson, 1994), previous on-line studies have attested that with age and expertise, writers start to spend more time generating and organizing ideas prior to writing (e.g., Alamargot et al., 2010; Beauvais et al., 2012; Chanquoy et al., 1990). The longer prewriting duration of students compared to fifth graders in the present study replicates this finding. Furthermore, through the analysis of eye movements on the source, the present study was able to demonstrate that prewriting in more proficient writers is not only longer, but also entails more intensive, and perhaps more complex, text elaboration. That is, when looking at the source, students seemed to register more information represented in the images. Moreover, the multiple transitions they made between images can be taken as evidence for their increased effort to establish links between information in the source. While this is entirely convergent with assumptions by Bereiter and Scardamalia (1987) and Berninger and Swanson (1994), stating that writing expertise is associated with more global text elaboration prior to writing, until now, empirical support using real time indicators for this claim had been limited (but see Alamargot et al., 2010). Children's more superficial consideration of the source prior to writing indeed suggests that they were less concerned with conceptual planning in advance of writing, and presumably registered less information available in the pictures.

During episodes of sequential processing, the main difference between the two groups of writers concerned the density of source consultation, showing that students engaged in a less intensive source consultation than fifth graders, and this during pauses that were significantly shorter than fifth graders' pauses. They did return as frequently to the source as fifth graders. Several explanations combine to explain these characteristics of students' and fifth graders' on-line management. As pointed out by Beauvais et al. (2011), narrative composition is guided by a narrative schema, referring to an internalized representation of the parts of a typical story and the relationships among those parts. Such a narrative schema makes thinking easier, because it helps the writer to organize and interpret information. In the case of students, an efficient use of the internalized narrative schema may have been facilitated by a longer and more intensive source consultation during prewriting. That is, similar to the 12th grader in the study by Alamargot et al. (2010), students may have grasped the story in its entirety during prewriting, and retained a

global idea of the content in memory throughout the remainder of the writing task. This may have facilitated filling in the internalized schema with content retrieved from the source, thereby reducing the need for long pauses to reflect over the images. In a capacity view of writing (McCutchen, 1996), it could thus be said that prewriting activity lessened the cognitive cost of text elaboration processes during composition (Beauvais et al., 2012). Additionally, due to the availability of a proceduralized narrative schema in students, and the highly chronological order of the story events, presumably no major transforming of content during composition was required. The finding that students returned as frequently to the source as fifth graders should not be inconsistent with this interpretation. More specifically, a possible consequence of the prewriting activity and the proceduralized narrative genre in students is that it not only enabled them to more quickly uptake information during pauses, but also to consult the source for cognitively less demanding sub-processes of text elaboration, such as to guide linguistic formulation processes. Indeed, the fact that, overall, students made very frequent, albeit short, pauses, let suggest that students' writing process does proceed in a somehow fragmented, sequentialized way, similar to the step-by-step composing characteristic of knowledge-telling (Bereiter & Scardamalia, 1987). This may, however, be a marker of skilled composition, indicating a high degree of recursion between different processes (Olive, 2014). These results resemble the findings reported by Beauvais et al. (2011), who found students to alternate frequently between short episodes of translating and planning during narrative composition. Our results suggest that these alternations are presumably embedded in varying patterns of handwriting and short pauses. Finally, as previously mentioned, frequent, short pauses may also indicate that several writing processes run in parallel, and that the rhythm of writing slows down to accommodate these processes (Chanquoy et al., 1990).

Turning to the fifth grader, instead, the more superficial exploration of the source prior to writing may partially explain why fifth graders have to use longer pauses during composition to grasp all the information depicted in the source, in order to fill in the narrative schema. Hence, in line with capacity theory (McCutchen, 1996), the limited source consultation during prewriting postpones major text elaboration processes to the composition phase, increasing the amount of cognitive resources necessary for their implementation. In this respect, it is very likely that the longer pauses in fifth graders result from the accumulated demands of different writing processes. Whereas the student may consult the source for information uptake, and immediately proceed to transcribing the information while simultaneously thinking about how to convert the information into linguistic material (Alves et al., 2008; McCutchen, 1996), the fifth grader may be forced to devote

execution periods exclusively to handwriting, and pauses to high-level writing processes, including both conceptual processing of information in the source and preparation of the linguistic formulation of this information. An additional complication, which does not exclude the previous interpretation, may be that the use of the narrative schema is not sufficiently proceduralized yet in fifth graders, hindering the writer to make efficient use of it during writing. The overall result is a sequentialized step-by-step writing process, which alternates longer pauses with execution periods. The fact that fifth graders did explore the source extensively during the pauses, different from the 7th grader in the study by Alamargot et al. (2010) and opposite to our predictions, may indicate that the task at hand, providing a clearly delineated amount of information, more easily invites the young writer to process all information extensively as opposed to a task with a documentary source as in Alamargot et al. (2010).

Undergraduate students outperformed fifth graders on all measures of text quality. In light of the previous interpretations and a capacity view of writing (McCutchen, 1996), some interpretative hypotheses can be put forward. While a different degree of linguistic proficiency may for obvious reasons be a prime factor to explain differences in text length and syntactic complexity, a lack of available cognitive resources may equally account for fifth graders' writing performance. That is, with low-level writing processes still being highly demanding, fewer resources will be at children's disposal to linguistically elaborate their texts (Berninger & Winn, 2006; Olive et al., 2009). In a similar vein, although both groups of writers are familiar with the narrative genre, fifth graders' sequentialized writing strategy with long pauses may have created more risks of forgetting story ideas or categories of narrative structure in the course of writing (Olive, 2014).

In summary, several key differences characterize the strategies that fifth graders and undergraduate students use to manage written composition on-line. A similarity between both groups of writers is the fragmented, sequentialized writing process, which confirms that in the case of simple, narrative tasks, a step-by-step way of composing, likened to the knowledge-telling strategy (Bereiter & Scardamalia, 1987), is commonly used by writers, irrespective of their level of expertise. Importantly, however, the sequentialization manifests itself differently in terms of pause duration and characteristics of source consultation, suggesting that it is governed by different purposes and constraints. Further research into these purposes and constraints would be required to clarify the functional role of pauses in writers with different levels of expertise.

Relationship between On-line Management and Text Quality

The way writers manage writing processes on-line has been put forward as a decisive factor for text quality (e.g., Breetvelt et al., 1994; Levy & Ransdell, 1995). In the present study, most correlations were found between characteristics of on-line management and the word-level, i.e. the text length of the narratives. Spending more time on the task led to longer texts, and this held for both fifth graders and undergraduate students. For undergraduate students, engaging in more frequent and dense source consultation during sequential processing also led to longer texts. As this beneficial effect was not observed for the sentence- or text-level of the narrative, it seems reasonable to conclude that in undergraduate students, more frequent and dense source consultation during pauses served predominantly to support linguistic formulation processes that advanced the length of texts. It might, for instance, be that during pauses students looked at the source to capture information that did not affect the plot of the story, but that added details to the story, leading to longer texts. This interpretation is convergent with the assumptions about their on-line management as outlined above.

Furthermore, the correlation between compositional fluency and text length in fifth graders replicates findings reported by von Koss Torkildsen, Morken, Helland, and Helland (2016), suggesting that when the writing process is not fluent, this will reduce the opportunity for elaborating the text sufficiently at the word-level (Chanquoy & Alamargot, 2002). As low-level writing processes account for a large part of the variance in children's compositional fluency (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997), one explanation is that automatization of low-level writing processes, and thus enhanced compositional fluency, frees cognitive resources in WM that can be devoted to planning, translating, and revising processes, which consequently increase the text length (Olive, 2014). The fact that this relationship was not encountered in students indicates that lack of compositional fluency is not detrimental to text production, presumably because in students it does not result from a lack of automatization in handwriting processes but from a more strategic implementation of pauses.

At the sentence-level, syntactic complexity of the narratives was found to be significantly and nearly significantly related to density of source consultation during prewriting in students and fifth graders respectively. This emphasizes that producing well-structured sentences may depend on the ability to take the time before writing to plan the text to come (Beauvais et al., 2011). This should not straightforwardly be interpreted as evidence for the idea that good writers plan the syntax of their texts before writing it down. Instead, in the framework of capacity theory (McCutchen, 1996), it is possible that the more the content is planned prior to writing, the more cognitive

resources are available during writing to dedicate to the packaging of content into syntactically complex units.

Finally, at the text-level, mean pause duration in students was negatively correlated with story ideas and story structure, indicating that shorter pauses yield better narrative texts. This is similar to results reported by Beauvais et al. (2011), who found narrative text quality in adult writers to be negatively related to the length of high-level writing processes. These findings may indicate that the writing process is mainly driven by a narrative schema, and that shorter pauses are beneficial for filling in the narrative schema. By contrast, a longer mean pause duration was found to lead to syntactically more complex texts. As pause duration may be taken as an index of the mental effort that the writer is exerting in constructing the text (Olive & Cislaru, 2015), it could thus be said that good writers devote little effort to writing a narrative with sufficient story ideas embedded in a rich story structure, but more effort to packaging the content in complex syntactic constructions.

Taken together, it can be concluded that in fifth graders only few relationships between on-line management and text quality were encountered, whereas in students more, though still relatively few, relations were found. These findings thus suggest that with age, on-line management as measured in the present study becomes more closely related to text quality. This fits with the idea that in the upper elementary grades, more complex and interactive processing, such as the engagement in planning prior to writing, does not necessarily guide text generation yet (Berninger & Swanson, 1994). In other words, it suggests that in young writers strategies are mostly an implicit consequence of trying to cope with the cognitive demands of writing, rather than the result of an explicit, self-regulative decision implemented in order to improve text quality. Another possibility is that variance in on-line management in fifth graders does not substantially affect the aspects of text quality that were measured in the present study, because fifth graders tend to be more concerned with local-level aspects of the text (Berninger & Swanson, 1994). In this sense, measures of text quality related to writing conventions, such as spelling accuracy, may be more closely associated with differences in on-line management in younger writers.

Furthermore, the overall limited relations between on-line management and text quality, and particularly the text-level, may stem from the narrative genre and the associated picture elicitation task chosen for the present study. Rather than relying on an efficient writing strategy, text quality at the text-level, as measured in the present study, may be more heavily dependent on the availability of an internalized narrative schema in LTM. Scoring different dimensions of the narrative product, and studying other writing genres, for which more complex writing strategies are required, may potentially reveal

different relations with text quality. Finally, following previous research (e.g., Breetvelt et al., 1994; Levy & Ransdell, 1995), the relationship between high-level writing processes and text quality may vary according to different stages of the writing process, because task representations change throughout composition. Applied to this study, source-based text elaboration processes at the start of the writing process have perhaps a different function in the middle of the writing process. It seems, therefore, important to get more insight into the sub-processes driving source consultation in both groups of writers to establish a meaningful relationship between characteristics of on-line management on the one hand, and text quality on the other hand.

Educational Implications, Limitations and Future Directions

In terms of education, to what extent do the results of the present study attest issues related to writing instruction? The results demonstrated that neither the on-line management nor the text quality of the written product of fifth graders reached student-like performance. In young writers, unautomatized transcription skills constrain the overall compositional fluency of the writing process, and as they deplete cognitive resources in WM, this can have detrimental effects on writing performance. Promoting fast and accurate transcription processes should thus be central in school settings, even in the upper elementary grades, such that transcription can facilitate, not hinder, text production. Furthermore, although on-line management was not extensively related to text quality, the importance of teaching a more mature writing strategy may reside in a potential transfer to other genres, in which a closer relationship between on-line management and text quality could be expected. Teaching children how to activate high-level writing processes may be effective to boost writing performance. The fifth graders in this study took limited time to inspect the whole sequence of pictures, although they were clearly instructed to do so prior to the task. This suggests that the instruction of planning in response to prompts administered by a teacher needs to be combined with increasing children's metacognitive awareness of the effectiveness of such a strategy. Considering that fifth graders did show some prewriting activity, it would be of particular importance to teach them explicitly how to take benefit of this prewriting phase. Self-Regulated-Strategy-Development, for instance, is an empirically validated instructional approach designed to improve writing in young writers, by teaching them general and genre-specific strategies for planning in conjunction with the knowledge and self-regulatory procedures needed to implement these strategies effectively (Graham, Harris, & Olinghouse, 2007). A final type of educational support could consist in providing explicit instruction in narrative structure, so as to facilitate the use of the narrative schema during writing and enhance the

overall textual quality of the written narrative. Although children are highly familiar with the narrative genre, knowledge must be extensive, stable and well-practiced before it can be used during composition (McCutchen, 2000).

It is important to raise some limitations here that could reduce the scope of our findings.

First, in the present study a highly controlled experimental design using a visual source of images was used to single out high-level text elaboration processes. We did not, however, distinguish between different sub-processes of text elaboration that may drive source consultation, such as planning the content, verifying the content of the text produced so far with the information available in the source, and prompting lexical retrieval (Alamargot, Chanquoy, & Chuy, 2005). In light of the idea that a high-level writing process can have a different function throughout the writing task, and accordingly, have a varying relationship with text quality (e.g., Breetvelt et al., 1994), it might be important to more clearly delineate the functions that high-level text elaboration processes fulfill throughout the writing task. This may be helpful to substantiate our interpretations of the writers' on-line management, and to study the relationships with text quality into more depth. A more detailed analysis that links the eye movements on the source to the immediately following writing performance in the text produced so far may be informative in this respect. Relatedly, although our task rendered text elaboration highly dependent on source consultation, we certainly did not capture all moments where writers engaged in text elaboration. More particularly, a writer may also use the text produced so far as an external source in order to elaborate and create new content (Alamargot et al., 2010) or he may stare at the blank page when he is carrying out complex thinking processes (Alamargot et al., 2006). Future studies will therefore need to include eye movements on the text produced so far and gaze aversions while studying the on-line management of written composition.

A second limitation relates to the writing task and genre used in the present study. The prompt consisting of a sequence of images may have enhanced fifth graders' sequentialized writing strategy. More specifically, illustrations have been found to have a load-adding effect (Mayer, Heiser, & Lonn, 2001), especially for people with limited WM capacity (Orrantia, Munez, & Tarin, 2014). For fifth graders, whose WM is already more susceptible to a cognitive overload due to the dynamic interaction of the different demanding writing processes, this task may have constrained, not facilitated, narrative composition, and may have partly determined their on-line management of the writing process. Furthermore, for narrative writing, writers may rely on a stored narrative schema, whereas no such schema exists for argumentative texts (Olive, Favart, Beauvais, & Beauvais, 2009). The cognitive load for writing

argumentative texts is therefore significantly higher than for writing narrative texts (Kellogg, 2001). Relatedly, writing tasks that do not include an external prompt to assist with content generation may require the writer to use more sophisticated and explicit writing strategies (Burtis, Bereiter, Scardamalia, & Tetroe, 1983; Grabowski, 1996). Hence, future studies should investigate on-line management of more complex genres in more ecologically valid writing tasks using different sources, and explore its impact on text quality.

A final limitation of the study is that we adopted a novice/expert paradigm, wherein interindividual differences within groups of writers were not explored. However, both novices and more expert writers can be defined in many ways (Torrance, 1996). Hayes (2011), for instance, has proposed that the knowledge-telling strategy for expository writing in children can be divided into different subcategories, accounting for both developmental and interindividual differences. As such, fifth graders' narrative writing strategies as evidenced in the present study could also be clustered into sub-groups on the basis of the characteristics of on-line management. Hence, the results of the present study could be taken a step further, by investigating variance in on-line management of written composition, and by identifying the factors that are most heavily implicated in compromising this on-line management. Degree of handwriting automatization (e.g., Olive & Kellogg, 2002) and WM capacity (Alamargot et al., 2011), particularly visual WM (Olive & Passerault, 2012), are likely sources of individual differences, but also executive functions may mediate writing process coordination (Olive, 2014).

Conclusion

In conclusion, in this study we were able to describe developmental differences in the on-line management of written composition through a very fine-grained methodological paradigm of graphomotor activity and eye movements. The strictly controlled experimental design entailed some limitations, which may have comprised the relationship with text quality, and which raise new questions regarding generalization of findings to other writing tasks. Yet, the proven feasibility of the methodology for investigating composition in writers of different ages, and the wealth of data generated by it, provide ample possibilities for future research to further explore the on-line management of written composition from a developmental perspective.

References

Alamargot, D., Chesnet, D., & Caporossi, G. (2012). Using Eye and Pen Movements to Study the Writing Process. In M. Fayol, D. Alamargot & V. W. Berninger (Eds.), *Translation of Thought to Written Text While Composing: Advancing Theory, Knowledge, Research Methods, Tools, and Applications*. Psychology Press.

Alamargot, D., Chanquoy, L., & Chuy, M. (2005). L'élaboration du contenu du texte: de la mémoire à long terme à l'environnement de la tâche [Text content elaboration: from long-term memory to task environment]. *Psychologie Française, 50*, 287-304.

Alamargot, D., Chesnet, D., Dansac, C., & Ros, C. (2006). Eye and pen: A new device to study the reading during writing. *Behavior Research Methods, Instruments and Computers, 38*, 287-299. doi:10.3758/BF03192780

Alamargot, D., Dansac, C., Chesnet, D., & Fayol, M. (2007). Parallel processing before and after pauses: A combined analysis of graphomotor and eye movements during procedural text production. In M. Torrance, L. van Waes & D. Galbraith (Eds.), *Writing and cognition: Research and applications* (pp. 13-29). Amsterdam, the Netherlands: Elsevier.

Alamargot, D., Plane, S., Lambert, E., & Chesnet, D. (2010). Using eye and pen movements to trace the development of writing expertise: Case studies of a seventh, ninth and twelfth grader, graduate student, and professional writer. *Reading and Writing: An Interdisciplinary Journal, 23*, 853-888. doi:10.1007/s11145-009-9191-9

Alamargot, D., Caporossi, G., Chesnet, D., & Ros, C. (2011). What makes a skilled writer? Working memory and audience awareness during text composition. *Learning and individual differences, 21*, 505-516. doi:10.1016/j.lindif.2011.06.001

Alamargot, D., Flouret, L., Larocque, D., Caporossi, G., Pontart, V., Paduraru, C., Morisset, P., & Fayol, M. (2015). Successful written subject-verb agreement: an online analysis of the procedure used by students in grades 3, 5, and 12. *Reading and Writing: An Interdisciplinary Journal, 28*, 291-312. doi:10.1007/s11145-014-9525-0

Alves, R. A., Castro, S. L., & Olive, T. (2008). Execution and pauses in writing narratives: Processing time, cognitive effort and typing skill. *International Journal of Psychology, 43*, 969-979. doi:10.1080/00207590701398951

Berninger, V. W., & Swanson, H. L. (1994). Modifying Hayes and Flower'smodel of skilled writing to explain beginning and developing writing. In J. S. Carlson (Ed.) & E. C. Butterfield (Vol. Ed.), *Advances in cognition and educational practice, Vol.2: Children's writing: Toward a process theory of the development of skilled writing* (pp. 57-81). Greenwich, CN: JAI Press.

Beauvais, L., Favart, M., Passerault, J. M., & Beauvais, C. (2012). Temporal management of the writing process: effects of genre and organizing constraints in grade 5, 7, and 9. *Written communication, 31*, 251-279.

Beauvais, C., Olive, T., & Passerault, J. M. (2011). Why some texts are good and others not? Relationship between text quality and management of the writing processes. *Journal of Educational Psychology, 103*, 415-428. doi:10.1037/a0022545

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Lawrence Erlbaum.

Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. MacArthur, S. Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96-114). New York, NY: Guilford Press.

Braaksma, M. A. H., Rijlaarsdam, G., van den Bergh, H., & Van Hout-Wolters, B. H. A. M. (2004). Observational learning and its effects on the orchestration of the writing process. *Cognition and Instruction, 22*, 1–36. doi:10.1207/s1532690Xci2201_1

Breetvelt, I., van den Bergh, H., & Rijlaarsdam, G. (1994). Relations between writing processes and text quality: When and how? *Cognition and instruction,12*, 103-123. doi:10.1207/s1532690xci1202_2

Burtis, J., Bereiter, C., Scardamalia, M., & Tetroe, J. (1983). The development of planning in writing. In G. Wells & B. Kroll (Eds.), *Explorations in the development of writing* (pp. 153–174). Chicester, Englsand: John Wiley.

Chanquoy, L., & Alamargot, D. (2002). Mémoire de travail et rédaction de textes: Evolution des modèles et bilan des premiers travaux. *L'année Psychologique, 102*, 363-398. doi:10.3406/psy.2002.29596

Chanquoy, L., Foulin, J. N., & Fayol, M. (1990). The on-line management of short text writing by children and adults. *European Bulletin of Cognitive Psychology, 10,* 513-540.

Chesnet, D., & Alamargot, D. (2005). Analyses en temps réel des activités oculaires et graphomotrices du scripteur: intérêt du dispositif 'Eye and Pen'. *L'Année Psychologique, 105*, 477-520. doi:10.3406/psy.2005.29706

Fayol, M. (1999). From on-line management problems to strategies in written composition. In M. Torrance & G. Jeffery (Eds.), *The cognitive demands of writing: Processing capacity and working memory effects* (pp. 13-23). Amsterdam, the Netherlands: Amsterdam University Press.

Galbraith, D., & Rijlaarsdam, G. (1999). Effective strategies for the teaching and learning of writing. *Learning and Instruction, 9*, 93-108. doi:10.1016/S0959-4752(98)00039-5

Grabowski, J. (1996). Writing and speaking: Common grounds and differences toward a regulation theory of written language production. In C. M. Levy & S. Ransdell (Hrsg.), The science of writing: Theories, methods, individual differences, and applications (pp. 73-91). Mahwah, NJ: Erlbaum.

Graham, S., Berninger, V., Abbott, R., Abbott, S., & Whitaker, D. (1997). The role of mechanics in composing of elementary school students: A new methodological approach. *Journal of Educational Psychology, 89*, 170-182. doi:10.1037/0022-0663.89.1.170

Hayes, J. R. (2011). Kinds of Knowledge-Telling: Modeling Early Writing Development. *Journal of Writing Research, 3*, 73-92. doi:10.17239/jowr-2011.03.02.1

Hunt, K. W. (1966). Sentence structures used by superior students in grades four and twelve, and by superior adults. *CRP 5-0313*. Tallahassee, FL: Florida State University.

Johansson, R., Wengelin, A., Johansson, V., Holmqvist, K., Wengelin, A., Johansson, V., & Holmqvist, K. (2010). Looking at the keyboard or the monitor: relationship with text production processes. *Reading and Writing: An Interdisciplinary Journal, 23*, 835-851. doi:10.1007/s11145-009-9189-3.

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review, 99*, 122-149. doi:10.1037/0033-295X.99.1.122

Kellogg, R. T. (1986). Designing idea processors for document composition. *Behavior Research Methods. Instruments, & Computers, 18*, 118-128. doi:10.3758/BF03201010

Kellogg, R. T. (1987). Effects of topic knowledge on the allocation of processing time and cognitive effort to writing processes. *Memory & Cognition, 15*, 256-266. doi:10.3758/BF03197724

Kellogg, R. T. (2001). Competition for working memory among writing processes. *American Journal of Psychology, 114*, 175-191. doi:10.2307/1423513

Kellogg, R. T. (2008). Training writing skills: A cognitive developmental perspective. *Journal of writing research, 1*, 1-26. doi:10.17239/jowr-2008.01.01.1

Kieft, M., Rijlaarsdam, G., & van den Bergh, H. (2008). An aptitude-treatment interaction approach to writing-to-learn. *Learning and Instruction, 18*, 379-390. doi:10.1016/j.learninstruc.2007.07.004

Lambert, E., Alamargot, D., Larocque, D., & Caporossi, G. (2011). Dynamics of spelling process during a copy task: effects of regularity and frequency. *Canadian Journal of Experimental Psychology, 65*, 141-150. doi:10.1037/a0022538

Levy, C. M., & Ransdell, S. E. (1995). Is writing as difficult as it seems?. *Memory and Cognition, 23*, 767-779. doi:10.3758/BF03200928

Levy, C. M., & Ransdell, S. E. (1996). Writing signatures. In C. M. Levy & S. E. Ransdell (Eds.), *The science of writing. Theories, methods, individual differences and applications* (pp. 149-161). Mahwah, NJ: Erlbaum.

MacWhinney, B. (2000). *The CHILDES Project: Tools for Analyzing Talk*. Mahwah, NJ: Lawrence Erlbaum Associates.

Mayer, R. E., Heiser, J., & Lonn, S. (2001). Cognitive constraints on multi-media learning: When presenting more material results in less understanding. *Journal of Educational Psychology, 93*, 187-198. doi:10.1037/0022-0663.93.1.187

McCutchen, D. (1988). "Functional automaticity" in children's writing: A problem of metacognitive control. *Written Communication, 5*, 306-324. doi:10.1177/0741088388005003003

McCutchen, D. (1996). A capacity theory of writing: Working memory in composition. *Educational Psychology Review, 8*, 299-325. doi:10.1007/BF01464076

Norbury, C. F., & Bishop, D. V. (2003). Narrative skills of children with communication impairments. *International Journal of Language and Communication Disorders, 38*, 287-313. doi:10.1080/136820310000108133

Nottbusch, G. (2010). Grammatical planning, execution, and control in written sentence production. *Reading and writing: an interdisciplinary journal, 23*, 777-801. doi:10.1007/s11145-009-9188-4

Olive, T. (2014). Toward a parallel and cascading model of the writing system: A review of research on writing processes coordination. *Journal of Writing Research, 6*, 141-171. doi:10.17239/jowr-2014.06.02.4

Olive, T., Alves, R. A., & Castro, S. L. (2009). Cognitive processes in writing during pauses and execution periods. *European Journal of Cognitive Psychology, 21*, 758-785.

Olive, T., & Cislaru, G. (2015). Linguistic forms at the process/product interface. Analysing the linguistic content of bursts of production. In Georgeta Cislaru (Ed.), *Writing(s) at the crossroads: the process/product interface* (pp. 99-123). Amsterdam – Philadelphia: John Benjamins.

Olive, T., Favart, M., Beauvais, C., & Beauvais, L. (2009). Children's cognitive effort and fluency in writing: Effect of genre and of handwriting automatisation. *Learning and Instruction, 19*, 299-308. doi:10.1016/j.learninstruc.2008.05.005

Olive, T., & Kellogg, R. T. (2002). Concurrent activation of high- and low-level production processes in written composition. *Memory & Cognition, 30*, 594-600. doi:10.3758/BF03194960

Olive, T., Kellogg, R. T., & Piolat, A. (2001). The triple-task technique for studying the process of writing. In T. Olive & C. M. Levy (Eds), *Contemporary tools and techniques for studying writing* (pp. 31-58). Dordrecht: Kluwer Academic Publishers.

Olive, T. & Passerault, J.-M. (2012). The visuospatial dimension of writing. *Written Communication, 29*, 326-344. doi:10.1177/0741088312451111

Orrantia, J., Munez, D., & Tarín, J. (2014). Connecting goals and actions during reading: the role of illustrations. *Reading and Writing: An Interdisciplinary Journal, 27*, 153-170. doi:10.1007/s11145-013-9437-4

Piolat, A., & Olive, T. (2000). Comment étudier le coûte et le déroulement de la rédaction de textes? La méthode de triple-tâche: un bilan méthodologique. *L'Année Psychologique, 100*, 465-502. doi:10.3406/psy.2000.28655

Rijlaarsdam, G. & van den Bergh, H. (1996). Essentials for writing process studies: many questions and some answers. In, M.C. Levy & S. Ransdell (Eds.), *The science of writing* (pp. 107-126). New York, NY: Lawrence Erlbaum ass.

Sita, J. C., & Taylor, K. A. (2015). Eye movements during the handwriting of words: individually and within sentences. *Human movement science*. *43*, 229-38. doi:10.1016/j.humov.2015.01.011

Stein, N. L., & Trabasso, T. (1982). What's in a story: Critical issues in story comprehension. In R. Glaser (Ed.), *Advances in the psychology of instruction* (pp. 213-268). Hillsdale, NJ: Lawrence Erlbaum Associates.

Torrance, M. (1996). Is writing expertise like other kinds of expertise? In G. Rijlaarsdam, H. van den Bergh & M. Couzijn (Eds.), *Theories, models and methodology in writing research* (pp. 268-281). Amsterdam, the Netherlands: Amsterdam University Press.

Torrance, M., & Nottbusch, G. (2012). Written production of single words and simple sentences. In V. Berninger (Ed.), *Past, present, and future contributions of cognitive writing research to cognitive psychology* (pp. 403-422). New York, NY: Taylor Francis.

Torrance, M., Johansson, R., Johansson, V., & Wengelin, A. (2015). Reading during the composition of multi-sentence texts: an eye-movement study. *Psychological Research,* 1-15. doi:10.1007/s00426-015-0683-8

van den Bergh, H., & Rijlaarsdam, G. (1999). The dynamics of idea generation during writing: An on-line study. In M. Torrance & D. Galbraith (Eds.), *Studies in writing. Vol. 4. Knowing what to write: Cognitive perspectives on conceptual processes in text production* (pp. 99–120). Amsterdam, the Netherlands: Amsterdam University Press.

van den Bergh, H., & Rijlaarsdam, G. (2001). Changes in cognitive activities during the writing process, and relations with text quality. *Educational Psychology, 21*, 373-385. doi:10.1080/01443410120090777

van den Bergh, H., & Rijlaarsdam, G. (2007). The dynamics of idea generation during writing: an online study. In G. Rijlaarsdam (Series Ed.) and M. Torrance, L. van Waes & D. Galbraith (Vol. Eds.), *Studies in Writing Vol. 20, Writing and Cognition: Research and Applications* (pp. 125-150). Amsterdam, the Netherlands: Elsevier.

van der Hoeven, J. (1997). *Children's composing: A study into the relationship between writing processes, cognitive and linguistic skill and text quality*. Amsterdam: Rodopi.

Van Galen, G. P. (1991). Handwriting: Issues for a psychomotor theory. *Human Movement Science, 10*, 165-191. doi: 10.1016/0167-9457(91)90003-G

Van Waes, L., Leijten, M., & Quinlan, T. (2010). Reading during sentence composing and error correction: a multilevel analysis of the influences of task complexity. *Reading and Writing: An Interdisciplinary Journal, 23*, 803-834. doi:10.1007/s11145-009-9190-x.

Verhoeven, L., & Vermeer, A. (2001). *Taaltoets Alle Kinderen [TAK].* Arnhem: Cito groep.

von Koss Torkildsen, J., Morken, F., Helland, W.A., & Helland, T. (2015). The dynamics of narrative writing in primary grade children: writing process factors predict story quality. *Reading and Writing: An Interdisciplinary Journal, 29*, 529-554. doi:10.1007/s11145-015-9618-4

Wagner, R. K., Puranik, C. S., Foorman, B., Foster, E., Tschinkel, E., & Kantor, P. T. (2011). Modeling the development of written language. *Reading and Writing: An Interdisciplinary Journal, 24*, 203-220. doi:10.1007/s11145-010-9266-7

Wengelin, A., Torrance, M., Holmqvist, K., Simpson, S., Galbraith, D., Johansson, V., & Johansson, R. (2009). Combined eyetracking and keystroke-logging methods for studying cognitive processes in text production. *Behavior Research Methods, 41*, 337-351. doi:10.3758/BRM.41.2.337

Whitaker, D., Berninger, V. W., Johnston, J., & Swanson, L. (1994). Intraindividual differences in levels of language in intermediate grade writers: Implications for the translating process. *Learning and Individual Differences, 6*, 107-130. doi:10.1016/1041-6080(94)90016-7

Chapter 6

General discussion

6

The primary aim of this dissertation was to investigate the contribution of cognitive and linguistic factors to writing development in the upper elementary grades, and the way this contribution comes to play out in the written product and writing process. The underlying rationale is that the contribution of cognitive and linguistic factors to writing is, in large part, dependent on a shift in cognitive resources allocation within working memory (WM). More particularly, in the early grades of elementary school, transcription skills of handwriting and spelling are extremely effortful and consume most cognitive resources within WM. In the upper elementary grades, instead, transcription gradually starts to automatize, leaving more resources available for the implementation of cognitive and linguistic skills, resulting in a better written text and a more mature writing process. Several main research questions related to this general aim have been examined. The first research question asked to what extent cognitive and linguistic skills contribute to writing performance at different dimensions of narrative composition in the upper elementary grades. The second research question involved the extent to which children in the upper elementary grades are able to linguistically differentiate between speech and writing in their narratives. The last research question regarded the writing process, and investigated to what extent the on-line management of written composition, as evidenced by a combined analysis of graphomotor activity and eye movements, differs between fifth graders and undergraduate students. These questions were addressed through a longitudinal and an experimental study, the results of which were presented in four empirical studies.

This final chapter summarizes the key findings and conclusions of these studies. In the overarching conclusions, all findings will be integrated in light of existing theories and approaches to writing development. Moreover, limitations of the present research, along with recommendations for future research and educational implications will be presented.

The Role of Executive Functions in Writing Development

Executive functions, i.e. cognitive skills that control and regulate goal-directed behavior, are critical supports for writing, which enable the self-government of text production. With regard to the first research question, the predictive value of a comprehensive set of transcription skills, language skills, and EF skills to writing performance at different dimensions of narrative composition was examined concurrently in Chapter 2 and longitudinally in Chapter 3. This design enabled us to directly test the assumption of an increasing importance of EF and language skills, relative to a decreasing

contribution of transcription skills in the upper elementary grades (Berninger & Winn, 2006).

Chapter 2 investigated the contribution of several low-level EF (inhibition, updating) and high-level EF (planning) to different dimensions of written narratives in fourth graders, after controlling for transcription skills (handwriting, spelling), and language skills (grammar, vocabulary). The results indicated that low-level EF contributed directly to text length, over and above transcription and language skills. In addition, low-level EF were also found to contribute indirectly to text length, syntactic complexity, and story content, with handwriting skills functioning as a mediator. These results let suggest that fourth graders do exert some executive control over their text production, pending a sufficient level of EF skills. Simultaneously, however, the results highlight that fourth graders' writing is still constrained by handwriting skills. This is convergent with a gradual automatization of transcription skills (Berninger & Swanson, 1994) and confirms that fourth grade is a transitional grade in writing development (Fitzgerald & Shanahan, 2000).

The role of EF was further examined in Chapter 3. Here, a longitudinal perspective on the same set of transcription skills, language skills, and EF was provided, by studying their contribution to writing development between fourth and sixth grade. While text length and story content of narratives did not increase with age, syntactic complexity of narratives showed a clear developmental progression. A longitudinal contribution of grammar, inhibition, and planning was found for the syntactic complexity of written narratives, suggesting that both language skills and EF are important building blocks for the syntactic dimension of writing development in the upper elementary grades. Although the contribution of EF to narrative writing in fourth grade is thus still to some extent constrained by handwriting skills (Chapter 2), strong EF in fourth grade are crucial because they lead to a more prospective writing development between fourth and sixth grade. Relatedly, no contribution of transcription skills in predicting writing development over time was found, attesting their fading importance with age (Berninger & Winn, 2006).

Taken together, the findings of Chapter 2 and Chapter 3 endorse the changing dynamics between the different constraints on writing across the upper elementary grades (Berninger & Winn, 2006), and are particularly novel in pinpointing the role of both low- and high-level EF in writing development. Moreover, the developmental improvement in syntactic complexity of narrative writing, evidenced by the results in Chapter 3, joins to a growing body of research, demonstrating the critical status of the upper elementary

grades in the development of complex language use (Berninger, Abbott, et al., 2010; Berninger, Nagy, & Beers, 2011; Nippold, 2004).

Linguistic Differentiation of Speech and Writing

An increased cognitive and linguistic control over written language production, due to the reduced demands of transcription skills, is likely to enhance the quality of the written product. An analysis of the written product is therefore an indirect way to substantiate the contribution of cognitive and linguistic factors. With regards to the second research question, in Chapter 4 a longitudinal comparison between the use of evaluative devices in spoken and written narratives was taken as a point of reference for assessing children's ability to linguistically differentiate between speech and writing across the upper elementary grades. Such differentiation requires the availability of multiple linguistic resources, which allows the writer to benefit from the offline time available in writing and to express audience awareness with linguistic means.

Extending previous research by De Temple, Wu and Snow (1991) and Özyildirim (2009), results showed that both fourth and sixth graders used a greater diversity and frequency of evaluative devices in their written as opposed to their spoken narratives. In addition, speech/writing distinctions did not become more marked with age. Developmental differences, instead, were almost exclusively observed in the qualitative, but not quantitative analysis, of the narratives. More specifically, some lexically and syntactically complex evaluative devices did increase in frequency with age, but most developmental differences were found in the way evaluative devices were employed to sustain the coherence of the narrative. Overall, the findings reflect the following two trends in development. First, the ability to use lexically and syntactically complex evaluative devices to enrich the referential content, and the flexible implementation of evaluative devices to support the narrative coherence seem to emerge as a function of age-schooling in both modalities. This is in keeping with the development of complex language use observed in Chapter 3, and can be anchored in general linguistic and socio-cognitive development (Berman, 2016; Nippold, 2004; Ravid & Tolchinsky, 2002). Second, the speech and writing distinctiveness regarding evaluative language supports the idea that children in the upper elementary grades are in the differentiation phase (Kroll, 1981), and manifests children's consolidation of linguistic literacy (Ravid & Tolchinsky, 2002). Hence, neither fourth nor sixth graders seem to be hampered by unautomatized transcription skills in their ability to linguistically differentiate between speech and writing. In other words, both fourth and sixth graders appear to dispose of enough cognitive

resources in WM that can be used to draw more freely on their linguistic and cognitive skills, as a means of differentiating between modalities. Importantly, however, these findings do not take account of individual differences in transcription skills. In light of the results of Chapter 2 and Chapter 3, it could be expected that in fourth but not in sixth graders, individual differences in handwriting skills can account for variation in the ability to use evaluative language to differentiate between speech and writing.

The On-line Management of Written Composition

At any moment during writing, writers have to deal with the temporal management of several processes and their associated skills. It has been proposed that the cost of transcription skills has a clear impact on the extent to which low-level writing processes (e.g., handwriting) and high-level writing processes (e.g., text elaboration) are implemented sequentially or in parallel (McCutchen, 1996; Olive & Kellogg, 2002). The writing process thus potentially mirrors the cognitive burden of transcription skills, and the strategies that the writer uses to cope with these cognitive demands. With regards to the third research question, Chapter 5 shed light on fifth graders' on-line management of narrative source-based composition by opposing it to undergraduate students' on-line management. In this way, the study indirectly evaluated the constraining role of transcription skills in these writers.

Results showed that fifth graders spent on average less time on source-based text elaboration in parallel with handwriting than students. Their local planning of the text, based on a superficial source-based text elaboration during the prewriting period, forced them subsequently to compose their narratives by frequently interrupting their handwriting to look more intensively at the source and elaborate text during long pauses. The students, instead, engaged in more intensive text elaboration during prewriting, whereas during composition they frequently looked at the source, but did so superficially and during short pauses. Both groups of writers thus demonstrated to some extent a sequential, step-by-step writing strategy, likened to the knowledge-telling strategy proposed by Bereiter and Scardamalia (1987), but the sequentialization manifested itself differently, and is presumably governed by different purposes and constraints. It can tentatively be assumed that two developmental constraints are responsible for the fifth graders' on-line management of written composition: a lack of self-regulation skills, which leads to a limited engagement in global planning prior to writing, and insufficiently automatized transcription skills, which account for children's long pauses and their difficulty with engaging in effortful text elaboration in parallel with handwriting. It is, however, important to note that fifth graders

did show some episodes of parallel processing throughout the writing process. This suggests that transcription skills in fifth graders are automatized to such an extent as to allow the least effortful sub-processes of source-based text elaboration to be executed in parallel with handwriting. It should be kept in mind, though, that their composition strategy might have partially resulted from the instructional context.

Furthermore, the limited relationship between characteristics of on-line management and text quality, particularly in fifth graders, may indicate that the type of narrative writing assessed in Chapter 5 relies more heavily on the availability of a narrative schema, rather than on an efficient writing strategy. For fifth graders, it may indicate that whichever strategy they use, it is above all still merely a coping mechanism, which does not necessarily have a positive effect on the text quality. Important, however, was the nearly significant relationship between syntactic complexity and a more intensive and longer prewriting activity, which can be associated with planning of the content. In addition to the longitudinal contribution of the higher-level EF of planning to development in syntactic complexity (Chapter 4), this relationship emphasizes again the importance of complex language use in the upper elementary grades, which is subtended by self-regulative and EF skills.

Overall, the results regarding the on-line management of written composition as revealed by Chapter 5 complement developmental models of writing (Bereiter & Scardamalia, 1987; Berninger & Swanson, 1994; Berninger & Winn, 2006) by adding a highly fine-grained temporal dimension to the description of writing processes. On an individual level, it remains to be studied which skills, transcription skills but also WM or executive functions, are most heavily implicated in compromising the on-line management of written composition. Furthermore, cross-sectional studies including writers of different ages between childhood and adolescence are required to more clearly determine the developmental time point at which more mature writing strategies emerge.

Overarching Conclusions

Throughout the studies in this dissertation, we have opted for converging, complementary research methods to study the cognitive and linguistic underpinnings of writing development from multiple perspectives. A consequence of this methodological choice is that not all questions regarding their contribution to writing could be answered univocally, and that new questions have risen. Given the overall strengths of our findings, however, we can conclude that bringing together different tools and methodologies has great potential for grasping the complexity of writing development.

The results of the research presented in the present dissertation support the idea that the upper elementary grades are a transitional phase in writing development, where demands of transcription processes slowly fade, leaving traces in some but not all aspects of the written product and process, while simultaneously allowing for more cognitive and linguistic control over written text production. As a whole, these findings provide empirical support for the assumptions put forward by developmental models of writing (Berninger & Winn, 2006).

Regarding transcription skills, and particularly proficiency in handwriting, findings support the theoretical proposition that the ability to write down letters is foundational for writing performance up until the upper elementary grades (Berninger & Winn, 2006; Wagner et al., 2011; Graham, 1997). Transcription skills still influence the length, complexity, and macrostructure of written texts in fourth grade, and demand capacity in fifth graders that is decisive for a highly sequentialized writing strategy. Simultaneously, handwriting skills do not longitudinally predict writing in sixth grade. In addition, they seem to be sufficiently automatized as to allow for a linguistic differentiation between speech and writing across the upper elementary grades, and to enable some, though limited, parallel processing during written composition in fifth grade.

Regarding cognitive skills, both low- and high-level EF appear to play a central role in the production of written narratives for children in the upper elementary grades. Previous research has claimed that developing writers barely engage in high-level self-regulation (Graham & Harris, 2000; Bereiter & Scardamalia, 1987). However, as evidenced by the results in the present dissertation, children in the upper elementary grades do exhibit lower-level executive control over their text production process, with higher-level EF coming to play a more important role towards the end of primary school. From a theoretical perspective, substantiating the importance of EF for narrative writing development serves to bolster previous research findings of this relationship for single word or sentence writing (e.g., Altemeier, Abbott, & Berninger, 2008; Berninger, Abbott, et al., 2006; Altemeier, Jones, Abbott, & Berninger, 2006; Hooper et al., 2011), and highlights the importance of differentiating between low- and high-level EF in developmental models of writing (Berninger & Richards, 2002; Berninger & Winn, 2006).

Regarding linguistic skills, several findings throughout the present dissertation point towards complex language use as a linguistic phenomenon dominating writing development in the upper elementary grades. This is fully convergent with ideas proposed by theories of later language development (Nippold, 2004; Ravid & Tolchinsky, 2002), emphasizing that flexibility in using an enriched lexicon and more complex syntactic structures is a hallmark of language development beyond the early grades of elementary school. The

theoretical significance for writing lies in recognizing that writing in the upper elementary grades may above all be about learning to make flexible and efficient use of the writer's toolbox, referring to a repertoire of choices for conveying meaning, available to the writer as he or she writes. Myhill (2011) has acknowledged this characteristic of linguistic development by referring to the writer as a "designer". Though the notion of the writer as a designer is implicit in Bereiter and Scardamalia's (1987) concepts of knowledge-telling and knowledge-transforming, current writing research has given insufficient attention to the linguistic aspects of writing development. Previous research either largely ignored linguistic development, or has an impoverished view, reducing linguistic development to the avoidance of errors or bad grammar (Myhill, 2011). More empirical and pedagogical attention should be directed towards understanding how to support children in crafting sentences to satisfy the rhetorical demands of the task, using the linguistic tools available to them.

Two concluding remarks apply to the previous conclusions. First, while variable evidence was found for the cognitive and linguistic control over text generation in the upper elementary grades, this developmental pattern, like many other aspects of literacy development, is likely to be attributed to the combined effect of increasing automatization of transcription skills, and general cognitive and linguistic development occurring in late childhood (Ravid & Tolchinsky, 2002). More specifically, the later school age and adolescent years are marked by an increased maturation of the frontal lobes of the brain, on which executive functions depend (Kuhn, 2006). Similarly, major changes in linguistic abilities are witnessed in the transition from childhood to adolescence (Nippold, 2004).

Second, the importance of cognitive and linguistic control for the written product and writing process begs the critical issue of whether such control occurs consciously or unconsciously, explicitly or implicitly. Though it is likely that initially many developmental processes occur implicitly, it should be clear that enhancing metacognitive and metalinguistic knowledge about writing has the potential to foster writing development in the upper elementary grades. It follows that classroom teachers have an important role to play in promoting such knowledge.

Limitations and Directions for Future Research

The present dissertation has several limitations, which point to encouraging directions for future research. First, the results of this research confirmed that, in order to master writing, children need to develop increasingly proficient transcription, linguistic, and cognitive skills. Further

research should take these results a step further by investigating whether an intervention, promoting these skills in an integrated way, may function as a tool for fostering writing development. Relatedly, overall conclusions should be considered with care, as the contribution of cognitive and linguistic factors was not evaluated in a univocal way across chapters. Referring back to the comprehensive framework depicted in Chapter 1, future research should attempt to capture the relationships between the writing process, written product, and their foundational skills in one single paradigm.

Furthermore, the results discussed in this research apply to typically developing children in the upper elementary grades, and should therefore not be generalized to other populations in different developmental stages. Given the protracted time course of cognitive and linguistic development (Nippold, 2004), and the increasing writing requirements of the educational curriculum (Berninger, 2009), there is much reason to believe that the interaction of transcription, cognitive, and linguistic skills with writing will continue to undergo changes as children move into adolescence. Future research should examine their contribution to writing, and the extent to which they constrain the writing process and the resulting written product beyond the upper elementary grades.

A third limitation relates to the genre and writing task. For the studies presented in the current research we deliberately chose to focus on narrative writing, and picture elicitation tasks were preferred over open-ended writing tasks. Generalizability of our results to other genres may be questionable, as genres differ in the cognitive and linguistic skills that are needed to express meaning. Argumentative writing, for instance, calls upon more complex linguistic skills and necessitates more highly demanding cognitive operations (Kuhn, Hemberger, & Khait, 2016; van Hell, Verhoeven, & van Beijsterveldt, 2008). Furthermore, the picture elicitation task may have steered the writing process and product. From the process perspective, the sequence of pictures may have enhanced a linear, step-wise strategy of storytelling. From the product perspective, children may have under-performed due to the unchallenging nature of the task. Findings of the present dissertation should therefore be extended to include different writing outcomes, while simultaneously controlling for motivational aspects.

Finally, writing in the 21th century opens up a new debate about the importance of continued instruction in handwriting, given the increasingly important role of computers and typing in our current, digitalized society. This debate has been left aside in the current thesis. Yet, we acknowledge that the issue has a strong societal and educational importance. Hence, future research is needed on how the written product and writing process of writing

by pen versus writing by keyboard may be differentially affected by the cognitive and linguistic skills discussed in the present dissertation.

Educational Implications

Although this research was theoretical in nature, some potentially important implications for educational practice can be formulated.

For classroom teachers, it is important to be aware of the cognitive complexity of writing. Classroom instruction tends to focus on the product, rather than on the process. As a result, there is usually a large gap between the skills that are taught in school, and the EF processes that are needed for achieving writing success. In this respect, teachers should be aware that struggling writers might be hindered by weaknesses in EF. For these writers, teachers can focus on achieving relative automaticity in specific writing processes that consume much cognitive effort, so that EF can be devoted more efficiently to manage their deployment. The most obvious candidate for automatization is transcription, but the relative effort required to plan a text or fluently generate sentences can also be reduced through training. Similarly, structuring writing activities in ways that prevent overload, for instance by encouraging the use of external memory aids such as outlines, may enhance writing performance (e.g., de Smet, Brand-Gruwel, Leijten, & Kirschner, 2014; Favart & Coirier, 2006). Furthermore, self-regulated learning and EF principles may be encouraged and facilitated through instruction that explicitly models these skills. The Self-Regulated-Strategy-Development model, for instance, is an effective, instructional method that teaches writing strategies such as planning before embarking on writing, using instructional procedures that help students deliberately strengthen their attentional control, and planning skills, among other EF (Graham, Harris, & Olinghouse, 2007). Moreover, classroom accommodations such as preferential seating, and extended time, may support children with EF weaknesses to focus and sustain attention to the writing task. While strategies and accommodations are fundamental for children whose EF difficulties interfere with their writing performance, they may be helpful to all children in the classroom.

Furthermore, it is important that writing assessment and instruction is targeted on what children are particularly challenged with given their developmental level of literacy. The central role of complex language use in the upper elementary grades should be acknowledged by teachers as a possibility to teach children how complex linguistic structures support the communicative act of writing. More specifically, children should be encouraged to see linguistic structures as meaningful resources that help to establish a relationship with the reader. Sentence-combining exercises, for

instance, are often implemented in education to teach children the use of well-crafted, syntactically correct sentences (Hillocks, 1986). On their own, however, these exercises have little more value than learning grammatical writing skills. Teaching methods should integrate such exercises in the context of actual writing, in order to enhance children's understanding of how such skills contribute to a coherent and meaningful text. Mini-lessons, focus groups, and writing workshops, that mix both whole-class instruction, peer assistance, and individual support, may be useful opportunities to increase such metalinguistic awareness in developing writers. This could be easily integrated in existing writing lessons. For the Dutch educational system, for instance, *Tekster* (Koster, 2014), was recently developed as a method for teaching writing strategies, in which peer modeling of communicatively relevant writing assignments also constitutes a central component.

References

Altemeier, L., Abbott, R. D., & Berninger, V. W. (2008). Executive functions for reading and writing in typical literacy development and dyslexia. *Journal of Clinical and Experimental Neuropsychology, 30*, 588-606. doi:10.1080/13803390701562818

Altemeier, L., Jones, J., Abbott, R. D., & Berninger, V. W. (2006). Executive functions in becoming writing readers and reading writers: Note-taking and report writing in third and fifth graders. *Developmental Neuropsychology, 29*, 161-173. doi:10.1207/s15326942dn2901_8

Beauvais, C., Olive, T., & Passerault, J.-M. (2011). Why are some texts good and others not? Relationship between text quality and on-line management of the writing processes. *Journal of Educational Psychology, 103*, 415-428.

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Lawrence Erlbaum.

Berman, R. (2016). Linguistic literacy and later language development. In J. Perera, M. Aparici, E. Rosado & N. Salas (Eds.), *Written and Spoken Language Development across the Lifespan: Essays in Honor of Liliana Tolchinsky* (pp. 181-200). New York, NY: Springer Verlag.

Berninger, V. W. (2009). Highlights of programmatic, interdisciplinary research on writing. *Learning Disabilities: Research and Practice, 24*, 68-79. doi:10.1111/j.1540-5826.2009.00281.x

Berninger, V. W., Abbott, R., Swanson, H. L., Lovitt, D., Trivedi, P., Lin, S., Gould, L., Youngstrom, M., Shimada, S., & Amtmann, D. (2010). Relationship of word- and sentence-level working memory to reading and writing in second, fourth, and sixth grade. *Language, Speech, and Hearing Services in Schools, 41*, 179-193. doi:10.1044/0161-1461(2009/08-0002)

Berninger, V. W., Abbott, R., Thomson, J., Wagner, R., Swanson, H. L., Wijsman, E., & Raskind, W. (2006). Modeling developmental phonological core deficits within a working-memory architecture in children and adults with developmental dyslexia. *Scientific Studies in Reading, 10*, 165-198. doi:10.1207/s1532799xssr1002_3

Berninger, V. W., Nagy, W., & Beers, S. F. (2011). Developing Writers' Sentence and Syntactic Awareness: Constructing and Combining Sentences. *Reading and Writing: An Interdisciplinary Journal, 24*, 151-182. doi:10.1007/s11145-010-9262-y

Berninger, V. W., & Richards, T. L. (2002). *Brain literacy for educators and psychologists.* New York, NY: Academic Press.

Berninger, V. W., & Swanson, H. L. (1994). Modifying Hayes and Flower'smodel of skilled writing to explain beginning and developing writing. In J. S. Carlson (Ed.) & E. C. Butterfield (Vol. Ed.), *Advances in cognition and educational practice, Vol.2: Children's writing: Toward a process theory of the development of skilled writing* (pp. 57-81). Greenwich, CN: JAI Press.

Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. MacArthur, S. Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96-114). New York, NY: Guilford Press.

De Temple, J. M., Wu, H. F., & Snow, C. E. (1991). Papa pig just left for pigtown: Children's oral and written picture descriptions under varying instructions. *Discourse Processes, 14*, 469-495. doi:10.1080/01638539109544797

De Smet, M. J. R., Brand-Gruwel, S., Leijten, M., & Kirschner, P. A. (2014). Electronic outlining as a writing strategy: Effects on students' writing products, writing processes and mental effort. *Computers & Education, 78*, 352-366. doi:10.1016/j.compedu.2014.06.010

Favart, M., & Coirier, P. (2006). Acquisition of the linearization process in text composition in third to ninth graders: Effects of textual superstructure and macrostructural organization. *Journal of Psycholinguistic Research, 35*, 305-328. doi:10.1007/s10936-006-9017-8

Fitzgerald, J., & Shanahan, T. (2000). Reading and writing relations and their development. *Educational Psychologist, 35*, 39-50. doi:10.1207/S15326985EP3501_5

Graham, S. (1997). Executive control in the revising of students with learning and writing difficulties. *Journal of Educational Psychology, 89*, 223-234. doi:10.1037/0022-0663.89.2.223

Graham, S., & Harris, K. (2000). The role of self-regulation and transcription skills in writing and writing development. *Educational Psychologist, 35*, 3-12. doi:10.1207/S15326985EP3501_2

Graham, S., Harris, K. R., & Olinghouse, N. (2007). Addressing executive function problems in writing: An example from the self-regulated strategy development model. In L. Meltzer (Ed.), *Executive function in education* (pp. 216-236). New York, NY: Guilford.

Hillocks, G. (1986). *Research on Written Composition: New Directions for Teaching*. Urbana, IL: ERIC Clearinghouse on Reading and Communication Skills and the National Conference on Research in English.

Hooper, S. R., Costa, L. J., McBee, M., Anderson, K., Yerby, D. C., Knuth, S. B., & Children, A. (2011). Concurrent and longitudinal neuropsychological contributors to written language expression in first and second grade students. *Reading and Writing: An Interdisciplinary Journal, 24*, 221-252. doi:10.1007/s11145-010-9263-x

Koster, M. (2014). Nieuwe methode schrijfonderwijs: Tekster. *Beter Begeleiden Digitaal*, juni 2014.

Kroll, B. (1981). Developmental relationships between speaking and writing. In B. Kroll & R. Vann (Eds.), *Exploring speaking-writing relationships: Connections and contrasts* (pp. 32-54). Champaign, IL: National Council of Teachers of English.

Kuhn, D. (2006). Do cognitive changes accompany developments in the adolescent brain?. *Perspectives on Psychological Science, 1, 59*.

Kuhn, D., Hemberger, L., & Khait, V. (2016). *Argue with me: Argument as a path to developing students' thinking and writing*. New York, NY: Routledge.

McCutchen, D. (1996). A capacity theory of writing: working memory in text composition. *Educational Pscyhology Review, 8*, 299-335. doi:10.1007/BF01464076

Myhill, D. A. (2011). Grammar for Designers: How Grammar Supports the Development of Writing. In S. Ellis, E. McCartney & J. Bourne (Eds.). *Insight and Impact: Applied Linguistics and the Primary School* (pp. 81-92). Cambridge, UK: Cambridge University Press.

Nippold, M. A. (2004). Research on later language development: International perspectives. In R. A. Berman (Ed.), *Language development across childhood and adolescence: Trends in Language Acquisition Research (TILAR)* (pp. 1-9). Amsterdam, the Netherlands: John Benjamins.

Olive, T., & Kellogg, R. T. (2002). Concurrent activation of high-and low-level production processes in written composition. *Memory and Cognition, 30*, 594-600. doi:10.3758/BF03194960

Özyildirim, I. (2009). Narrative analysis: An analysis of oral and written strategies in personal experience narratives. *Journal of Pragmatics, 41*, 1209-1222. doi:10.1016/j.pragma.2009.01.003

Ravid, D., & Tolchinsky, L. (2002). Developing linguistic literacy: a comprehensive model. *Journal of Child Language, 29*, 419-448. doi:10.1017/S0305000902005111

van Hell, J. G., Verhoeven, L., & van Beijsterveldt, L. M. (2008). Pause time patterns in writing narrative and expository texts by children and adults. *Discourse Processes, 45*, 406-427. doi:10.1080/01638530802070080

Wagner, R. K., Puranik, C. S., Foorman, B., Foster, E., Tschinkel, E., & Kantor, P. T. (2011). Modeling the development of written language. *Reading and Writing: An Interdisciplinary Journal, 24*, 203-220. doi:10.1007/s11145-010-9266-7

Nederlandse samenvatting

Leren schrijven is één van de belangrijkste vaardigheden die kinderen in het basisonderwijs verwerven. Tijdens de eerste jaren van het basisonderwijs ligt de nadruk vooral op het leren schrijven van letters en het spellen van woorden. Dit zijn de zogenaamde transcriptievaardigheden. In de latere jaren van het basisonderwijs verschuift de focus naar het schrijven van teksten, zoals bijvoorbeeld verhalen. Het schrijven van een tekst is een complexe vaardigheid, die niet alleen beroep doet op transcriptievaardigheden, maar ook de nodige cognitieve vaardigheden en taalvaardigheden vereist. Algemeen wordt aangenomen dat deze cognitieve en linguïstische vaardigheden een grotere invloed op schrijfvaardigheid zullen uitoefenen, naarmate transcriptievaardigheden meer en meer geautomatiseerd zijn (Berninger & Winn, 2006). De achterliggende gedachte hierbij is dat het werkgeheugen dan minder cognitief belast wordt door transcriptievaardigheden, waardoor er meer cognitieve energie van het werkgeheugen over is om cognitieve en linguïstische vaardigheden in te zetten (McCutchen, 1996). Tot nu toe, echter, is de impact van deze vaardigheden op schrijfvaardigheid in de latere jaren van het basisonderwijs, wanneer kinderen de transcriptievaardigheden steeds meer onder de knie hebben, slechts in beperkte mate bestudeerd. In dit proefschrift is daarom vanuit verschillende invalshoeken onderzocht hoe cognitieve en linguïstische vaardigheden, in combinatie met de afnemende invloed van transcriptievaardigheden, bijdragen tot de ontwikkeling van schrijfvaardigheid in de latere jaren van het basisonderwijs, en hoe hun bijdrage tot uiting komt in het schrijfproduct en het schrijfproces.

Hoe Executieve Functies Bijdragen aan de Ontwikkeling van Schrijfvaardigheid

Executieve functies (EF) zijn cognitieve vaardigheden en denkprocessen die doelgericht gedrag ondersteunen en reguleren. Aangezien schrijven een bij uitstek doelmatige cognitieve activiteit is, is het vanzelfsprekend dat EF hierbij een belangrijke rol spelen. Er is echter nog weinig bekend over hoe EF bijdragen aan de ontwikkeling van schrijfvaardigheid in beginnende schrijvers. In Hoofdstuk 2 werd onderzocht hoe individuele verschillen in lagere orde EF (inhibitie en updaten van informatie in het werkgeheugen) en hogere orde EF (planning) variantie verklaren in de tekstlengte, syntactische complexiteit, en inhoud van verhalen geschreven door kinderen in groep 6, na het controleren voor transcriptievaardigheden (spelling en automatisering van handschrift) en linguïstische vaardigheden (grammaticale taalvaardigheid en woordenschat). De resultaten lieten zien dat lagere orde EF op een directe manier bijdroegen aan de tekstlengte van de verhalen, bovenop transcriptievaardigheden en linguïstische vaardigheden. Bovendien werd ook aangetoond dat lagere orde

EF tevens indirect bijdroegen aan de tekstlengte, syntactische complexiteit, en inhoud van de verhalen, doordat automatisering van handschrift de relatie tussen de lagere orde EF en deze dimensies van het schrijfproduct medieerde.

In Hoofdstuk 3 werd de rol van EF verder onderzocht vanuit longitudinaal oogpunt. Er werd met name bekeken in welke mate transcriptievaardigheden, linguïstische vaardigheden en EF in groep 6 de ontwikkeling van schrijfvaardigheid tussen groep 6 en groep 8 kunnen voorspellen. Uit de analyse van de resultaten bleek dat kinderen tussen groep 6 en groep 8 geen vooruitgang maakten op het vlak van tekstlengte en inhoud van verhalen, maar enkel op het vlak van syntactische complexiteit. Ontwikkeling in syntactische complexiteit van de geschreven verhalen werd bovendien voorspeld door grammaticale taalvaardigheid, en door de lagere orde EF van inhibitie en de hogere orde EF van planning. Zowel cognitieve als linguïstische taalvaardigheden leggen dus in groep 6 al het fundament voor de ontwikkeling van syntactische schrijfvaardigheid tegen het einde van de basisschool, terwijl transcriptievaardigheden hierbij geen rol blijken te spelen.

Samengevat laten de bevindingen van Hoofdstuk 2 en Hoofdstuk 3 zien dat de invloed van transcriptievaardigheden in de latere jaren van de basisschool afneemt, terwijl linguïstische, en vooral cognitieve vaardigheden zoals EF, een belangrijke voorspellende rol vervullen. Hiermee worden de aannames van de voornaamste schrijfontwikkelingsmodellen bevestigd (Berninger & Winn, 2006). Bovendien is de ontwikkeling van syntactische complexiteit tussen groep 6 en groep 8 volledig in lijn met eerdere onderzoeken die het belang van complex taalgebruik in de latere jaren van de basisschool onderstrepen (Berninger, Nagy, & Beers, 2011; Nippold, 2004).

Linguïstische Differentiatie van Gesproken en Geschreven Verhalen

De toenemende linguïstische en cognitieve controle die schrijvers over hun tekstproductie kunnen uitoefenen, wanneer hun transcriptievaardigheden geautomatiseerd zijn, heeft positieve gevolgen voor de kwaliteit van de geschreven teksten. Een analyse van het schrijfproduct is daarom een indirecte manier om de invloed van cognitieve en linguïstische vaardigheden op schrijfvaardigheid te beoordelen. In Hoofdstuk 4 werden de verhalen van de longitudinale studie uit Hoofdstuk 2 en Hoofdstuk 3 linguïstisch geanalyseerd. Er werd meer bepaald onderzocht in welke mate kinderen in groep 6 en in groep 8 linguïstisch differentiëren tussen gesproken en geschreven verhalen op basis van een analyse van het gebruik van evaluatieve uitingen. De functie van evaluatieve uitingen is het verrijken van of betekenis verlenen aan de referentiële aspecten van een verhaal, en het

opwekken en vasthouden van de aandacht van de luisteraar of spreker. Een linguïstische differentiatie tussen gesproken en geschreven teksten is enkel mogelijk wanneer transcriptievaardigheden voldoende geautomatiseerd zijn, en er aldus genoeg cognitieve energie in het werkgeheugen overblijft om cognitieve en linguïstische vaardigheden in te zetten om deze differentiatie te bewerkstelligen (Berninger & Winn, 2006; Kroll, 1981). Verwacht werd dat kinderen in groep 6 en in groep 8, vanwege de afnemende invloed van transcriptievaardigheden, voldoende in staat zouden zijn om gesproken en geschreven verhalen linguïstisch te differentiëren. Er werd verwacht dat dit weerspiegeld zou zijn in een grotere diversiteit en hoeveelheid evaluatieve uitingen in hun geschreven in vergelijking met hun gesproken verhalen. Dit omwille van het feit dat schrijvers meer tijd hebben om na te denken, waardoor er meer mogelijkheid is om het referentieel kader van het verhaal te verrijken met een gevarieerd aanbod aan evaluatieve uitingen (Ravid & Berman, 2006). Bovendien is de schrijver vooral afhankelijk van linguïstische uitingen om een verhaal te creëren voor de lezer, terwijl een spreker zijn publiek voor zich heeft en daardoor ook gebruik kan maken van nonlinguïstische en paralinguïstische middelen om een evaluatief effect te bewerkstelligen (Ravid & Tolchinsky, 2002; Tannen, 1982).

De resultaten toonden aan dat kinderen in zowel groep 6 als groep 8 een grotere diversiteit en hoeveelheid aan evaluatieve uitingen in hun geschreven dan in hun gesproken verhalen gebruikten. Kwantitatief gezien bleek er tussen groep 6 en groep 8 enkel een toename te zijn in een beperkt aantal categorieën van lexicaal en syntactisch complexe evaluatieve uitingen. Een kwalitatieve analyse liet echter wel zien dat de oudere kinderen in groep 8 hun evaluatieve uitingen op een andere manier gingen inzetten om de coherentie van het verhaal te ondersteunen. Deze bevindingen benadrukken opnieuw het belang van complex taalgebruik in deze leeftijdsgroep. De resultaten suggereren bovendien dat kinderen in deze leeftijdsfase niet gehinderd worden door onvoldoende geautomatiseerde transcriptievaardigheden en bijgevolg hun cognitieve en linguïstische vaardigheden voldoende kunnen inzetten om de twee modaliteiten linguïstisch te differentiëren. Het is hier wel belangrijk om op te merken dat er in deze studie geen rekening werd gehouden met individuele verschillen in transcriptievaardigheden. Deze interpretaties dienen dus met een zekere voorzichtigheid gelezen te worden. Naar aanleiding van de resultaten van Hoofdstuk 2 en Hoofdstuk 3 zou kunnen worden verondersteld dat in groep 6, maar niet in groep 8, individuele verschillen in automatisering van handschrift variantie kunnen verklaren in het gebruik van evaluatieve uitingen om te differentiëren tussen gesproken en geschreven verhalen.

Online Management van Schrijfprocessen

In Hoofdstuk 5, tot slot, stond het schrijfproces centraal. Het schrijfproces verwijst naar de strategieën die schrijvers gebruiken om verschillende schrijfprocessen temporeel te coördineren. Een onderscheid kan gemaakt worden tussen de lagere orde schrijfprocessen (i.e. processen waarvoor transcriptievaardigheden vereist zijn, zoals handschrift) en de hogere orde schrijfprocessen (i.e. het plannen van de inhoud, het formuleren van de ideeën, en het reviseren van de tekst). Eerder onderzoek heeft gesuggereerd dat beginnende schrijvers deze lagere orde en hogere orde schrijfprocessen sequentieel uitvoeren omdat de lagere orde schrijfprocessen te cognitief belastend zijn en daardoor niet in parallel kunnen worden uitgevoerd met de hogere orde schrijfprocessen (e.g., Olive & Kellogg, 2002). Concreet betekent dit dat deze beginnende schrijvers bijna altijd een pauze zullen moeten nemen om de hogere orde schrijfprocessen uit te voeren. Aan de hand van een gecombineerde analyse van pauzes en oogbewegingen (Alamargot, Chesnet, Dansac, & Ros, 2006) werd in Hoofdstuk 5 getracht om duidelijker in kaart te brengen hoe kinderen uit groep 7 en universiteitsstudenten hun schrijfprocessen coördineren tijdens het schrijven van een verhaal op basis van een visuele bron van plaatjes.

Uit de resultaten bleek dat kinderen minder vaak hun lagere orde processen in parallel met hun hogere orde processen uitvoerden dan studenten. Concreet hield dit in dat kinderen minder lang dan studenten naar de bron konden kijken zonder het schrijven te onderbreken. Dat kinderen toch in staat waren om op bepaalde momenten tijdens het schrijven deze processen in parallel uit te voeren, suggereert dat hun transcriptievaardigheden voldoende geautomatiseerd zijn om af en toe de minst cognitief belastende hogere orde schrijfprocessen uit te voeren in parallel met handschrift. Bovendien spendeerden kinderen minder tijd aan het bekijken van de bron voor ze begonnen te schrijven, waardoor ze tijdens het schrijven vaker lange pauzes moesten nemen om de bron te bekijken en tekst te genereren. De studenten, anderzijds, bekeken de bron uitgebreid alvorens ze aan hun tekst begonnen. Tijdens het schrijven keken studenten nog wel vaak terug naar de bron, maar op een oppervlakkige manier en tijdens korte pauzes. Er kan dus geconcludeerd worden dat beiden groepen van schrijvers een redelijk sequentieel, stapsgewijs schrijfproces vertoonden. Echter, aangezien de sequentialisering zich op een verschillende manier uitte, is het waarschijnlijk om te veronderstellen dat er een verschillende oorzaak ten grondslag ligt aan deze sequentialisering. Tot slot bleek er, zowel bij kinderen als studenten, slechts een minimale relatie te zijn tussen het schrijfproces en het schrijfproduct. Een mogelijke verklaring kan gevonden worden bij de relatief simpele taak, die vooral gestuurd

wordt door het gebruik van een narratief schema, en die weinig complexe denkprocessen vereist.

Conclusies en Implicaties voor de Praktijk

Voor de studies in dit proefschrift werden diverse complementaire benaderingen en methodologieën aangewend om de cognitieve en linguïstische factoren die betrokken zijn bij de ontwikkeling van schrijfvaardigheid vanuit verschillende invalshoeken in kaart te brengen.

Het huidige onderzoek onderschrijft dat de latere jaren van het basisonderwijs een overgangsfase in de schrijfontwikkeling zijn, waarbij de rol van transcriptievaardigheden afneemt, maar nog sporen achterlaat in sommige aspecten van het schrijfproduct en het schrijfproces. Tegelijkertijd zien we dat er in deze leeftijdsfase een belangrijke rol weggelegd is voor linguïstische, maar vooral ook voor cognitieve vaardigheden, en met name de lagere orde en hogere orde executieve functies.

Hoewel de toenemende cognitieve en linguïstische controle over geschreven tekstproductie in de latere jaren van het basisonderwijs wellicht deels onbewust en impliciet gebeurt, lijkt het tevens wenselijk om metacognitieve en metalinguïstische kennis over schrijven te stimuleren in het onderwijs. Leerkrachten dienen zich bewust te zijn van het schrijfproces dat vooraf gaat aan het schrijfproduct, en van de cognitieve en linguïstische vaardigheden die dit proces ondersteunen. Naast het focusen op de automatisering van het handschrift, is het belangrijk kinderen aan te leren hoe ze het schrijfproces zelf kunnen reguleren, bijvoorbeeld door het gebruik van schrijfstrategieën zoals plannen voor het schrijven. Ten slotte, kan de belangrijke rol van complex taalgebruik zoals aangetoond in dit proefschrift aangewend worden om kinderen te leren hoe complexe linguïstische structuren de communicatieve boodschap van een geschreven tekst kunnen ondersteunen. Korte lessen, focusgroepen en schrijfworkshops zijn uitgelezen mogelijkheden om dit soort metalinguïstisch bewustzijn aan te moedigen in jonge schrijvers.

Referenties

Alamargot, D., Chesnet, D., Dansac, C., & Ros, C. (2006). Eye and pen: A new device to study the reading during writing. *Behavior Research Methods, Instruments and Computers, 38*, 287-299. doi:10.3758/BF03192780

Berninger, V. W., Nagy, W., & Beers, S. F. (2011). Developing Writers' Sentence and Syntactic Awareness: Constructing and Combining Sentences. *Reading and Writing: An Interdisciplinary Journal, 24*, 151-182. doi:10.1007/s11145-010-9262-y

Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. MacArthur, S. Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96-114). New York, NY: Guilford Press.

Kroll, B. (1981). Developmental relationships between speaking and writing. In B. Kroll & R. Vann (Eds.), *Exploring speaking-writing relationships: Connections and contrasts* (pp. 32-54). Champaign, IL: National Council of Teachers of English.

McCutchen, D. (1996). A capacity theory of writing: working memory in text composition. *Educational Psychology Review, 8*, 299-335. doi:10.1007/BF01464076

Nippold, M. A. (2004). Research on later language development: International perspectives. In R. A. Berman (Ed.), *Language development across childhood and adolescence* (pp. 1-9). Trends in Language Acquisition Research (TILAR). Amsterdam, the Netherlands: John Benjamins.

Olive, T., & Kellogg, R. T. (2002). Concurrent activation of high-and low-level production processes in written composition. *Memory and Cognition, 30*, 594-600. doi:10.3758/BF03194960

Ravid, D., & Berman, R. A. (2006). Information density in the development of spoken and written narratives in English and Hebrew. *Discourse Processes, 41*, 117-149. doi:10.1207/s15326950dp4102_2

Ravid, D., & Tolchinsky, L. (2002). Developing linguistic literacy: a comprehensive model. *Journal of Child Language, 29*, 419-448. doi:10.1017/S0305000902005111

Tannen, D. (1982). Oral and Literate Strategies in Spoken and Written Narratives. *Language, 58*, 1-21. doi:10.2307/413530

Dankwoord

Dat schrijven een complex proces is blijkt niet alleen uit de resultaten van mijn onderzoek. Ik heb het zelf ook mogen ervaren tijdens het schrijven van dit proefschrift, en tijdens het hele proces dat daaraan vooraf is gegaan. Gelukkig stond ik er nooit helemaal alleen voor. Een heel netwerk van mensen is direct of indirect, van dichtbij of van veraf, bewust of onbewust, betrokken geweest bij de totstandkoming van dit proefschrift. Ik wil dit proefschrift daarom graag afsluiten met het bedanken van deze mensen voor hun hulp en steun.

Allereerst wil ik graag mijn promotoren bedanken van wie ik de afgelopen jaren veel heb mogen leren. Zowel hun inhoudelijke inbreng, als hun gedrevenheid en wetenschappelijke houding heb ik enorm gewaardeerd en hebben van mij een betere onderzoeker gemaakt. **Ludo**, ik ben dankbaar dat jij vanaf het begin vertrouwen toonde in mij als onderzoeker. Terwijl ik de details van het onderzoek door en door kende, hield jij de grote lijn steeds voor ogen. Ik heb van jou de vrijheid gekregen om het project een eigen invulling te geven, en ik ben dankbaar voor de vele kansen die je me hebt gegeven om in het buitenland mijn blik te verruimen en met andere schrijfonderzoekers in overleg te gaan. **Margriet,** of ik nu met grote of kleine vragen bij jou langskwam, je was altijd bereid om mee na te denken. Jouw nuchtere en rationele kijk op mijn onderzoek zorgde ervoor dat ik weloverwogen beslissingen kon nemen, wanneer ik zelf even door de bomen het bos niet meer zag. Jouw kritische vragen tijdens elk overleg hielpen me steevast om de resultaten van mijn proefschrift beter te begrijpen en bewuster het doel van mijn onderzoek voor ogen te houden. Bedankt hiervoor. **Mariëlle**, we hebben elkaar voor het eerst ontmoet toen ik je had uitgenodigd als spreker op een workshop in Nijmegen. Jij bleek niet door te hebben dat ik Vlaams was, en ik hoorde niet aan jou dat jij Nederlands was. Bedankt voor de steun, het waardevol advies en de leerzame werkbesprekingen de afgelopen twee jaren. Ik ben jou en **Luuk** heel erg dankbaar voor de kansen die ik gekregen heb om in Antwerpen te komen werken aan mijn PhD, en om deel uit te maken van een succesvol team van schrijfonderzoekers, dat met de jaren bovendien ook steeds groter is geworden. Ik hoop van harte dat we in de toekomst nog mogen samenwerken.

For the last article, I am particularly grateful to **Denis**. Your research and expertise has been an important stimulus for the experiment described in the last chapter. I would like to thank you for our collaboration, for your help with the analysis of the data, and for your availability to share your thoughts on the results.

Verder ook een speciaal woord van dank voor de leden van de manuscriptcommissie. Professor **Harry Knoors**, professor **Luuk van Waes**, en dr. **Roel Willems**, bedankt dat jullie de tijd hebben genomen om mijn

proefschrift te lezen en te beoordelen, en bedankt om te zetelen in mijn promotiecommissie.

Onmisbaar voor mijn onderzoek was ook de medewerking van de **scholen** en van alle **kinderen** die zo ijverig hun verhalen neerpenden, en met de andere taken al even ijverig aan de slag gingen. Bedankt dat jullie de deuren van jullie klassen openstelden, ondanks het drukke lesprogramma. Bedankt voor jullie interesse en enthousiasme.

De "schrijf-aio's" wil ik ook bedanken voor de interessante bijeenkomsten in Nederland en Vlaanderen, en voor de gezelligheid tijdens conferenties. Dat schrijven niet langer het ondergeschoven kindje in wetenschappelijk onderzoek is blijkt uit de vele aio's die zich in de laatste jaren bij ons intervisieclubje hebben aangesloten.

Werken aan een proefschrift is soms eenzaam, maar gelukkig wist ik mij in de afgelopen jaren steeds omringd door collega's bij wie ik terecht kon om onderzoeksproblemen aan te kaarten, om ervaringen uit te wisselen, of om gewoon gezellig samen koffie te drinken en over alledaagse dingen te kletsen. Bedankt aan alle Nijmeegse collega's van de vierde en vijfde verdieping, voor de vele nuttige en fijne overlegmomenten, lunches, koffies, en uitjes. **Anne-Els, Lanneke,** en **Christel,** bedankt voor jullie secretariële ondersteuning, en voor jullie luisterend oor. **Suzan,** van onbekenden op een terras in Milaan tot kamergenootjes en collega's in Nijmegen. Ik ben enorm blij dat jij mijn kamergenoot was, dat je in de loop van de jaren ook een goeie vriendin bent geworden, en dat je op de dag van mijn promotie als paranimf naast mij wilt staan. Bij jou kon ik altijd terecht om de leuke, maar ook de minder leuke momenten van dit PhD traject te delen. Al zien we elkaar de laatste tijd wat minder en hebben we nooit genoeg tijd om elkaar helemaal bij te praten, ik word altijd blij als ik jou weer zie. **Gesa,** we hadden het plan opgevat om elkaar te helpen een andere taal te leren. Daar is jammer genoeg niet zo veel van terecht gekomen. Misschien was dat plan te ambitieus, maar eigenlijk denk ik dat we het gewoon veel leuker vonden om over andere dingen te kletsen. Bedankt dat je me af en toe mee naar buiten nam voor een ontspannende wandeling, waardoor ik wat meer afstand kon nemen van mijn werk en er achteraf weer met een frisse blik voor kon gaan zitten. **Linda,** wij liepen vaak tegen dezelfde struikelblokken aan en hadden dezelfde twijfels over onze wetenschappelijke toekomst. Ik heb er veel aan gehad dat er bij jou steeds ruimte was om deze dingen te bespreken. Bovendien vond ik onze koffiepauzes altijd een erg welkome afwisseling en ben ik er trots op dat ik samen met jou een succesvolle workshop georganiseerd heb.

Ook mijn collega's in Antwerpen wil ik graag bedanken. Of het nu komt door de Vlaamse omgeving, of door de gezelligheid op de gang en tijdens de lunches, op de vierde verdieping van het departement management

in Antwerpen voelde ik mij vanaf het begin thuis. Een erg fijne, en rustige omgeving om mijn proefschrift af te ronden, bedankt hiervoor. **Julie,** een betere kamergenoot voor het einde van mijn PhD traject had ik mij niet kunnen wensen. Jij was er steeds voor mij, of het nu was om een grappige anekdote te delen of voor een serieuze peptalk. Bedankt voor de vele morele en praktische steun (vaak in de vorm van cola's en broodjes...) de afgelopen maanden. Een speciaal bedankje ook aan alle schrijfonderzoekers **Brenda, Cathérine, Elke, Eric, Gert, Hideyuki, Iris, Lise, Luuk, Margot, Mariëlle, Nina, Sarah, Tom,** en **Yvonne** voor de wednesday break sessions, en de wijntjes om onze (toekomstige) successen te vieren. Bedankt ook aan **Caroline** en **Tanya** voor de administratieve ondersteuning, en om steeds met veel enthousiasme de wekelijkse koffiepauzes te organiseren.

Buiten de deuren van de universiteit, kon ik altijd rekenen op de steun van vriendinnen. Enkele van hen dank ik hier graag in het bijzonder. Lieve **Evelinne**, bedankt dat je al zo lang mijn lieve vriendinnetje bent, en dat je altijd zo geïnteresseerd bent in de voortgang van mijn onderzoek. Bedankt dat ik steeds bij jou terecht kon als ik weer eens in Parijs moest zijn. Ik ben ontzettend blij dat jij in alle opzichten achter mij staat. Je neemt je rol als paranimf heel serieus, en uiteraard zal ik binnenkort op jouw trouw met veel liefde hetzelfde doen. Lieve **Joy**, we kennen elkaar al zo lang, en hebben in het verleden dezelfde storm getrotseerd. Ik ben blij dat we de laatste jaren weer meer naar elkaar zijn toegegroeid. Bedankt dat je altijd een trouwe vriendin voor mij bent gebleven die steeds bereid was om een luisterend oor te bieden, zelfs al had ik door de afwerking van mijn proefschrift weinig tijd om af te spreken. Ik kijk ernaar uit om weer samen leuke dingen te gaan ondernemen, te beginnen met jouw trouwfeest binnenkort. Lieve **Milou**, je maakte deel uit van de harde kern van schrijfaio's, maar ik leerde je pas echt kennen toen je mijn kamergenootje en collega werd in Antwerpen. Dat was zo gezellig dat ik je echt gemist heb toen je weer wegging. Gelukkig ben je ondertussen ook een goeie vriendin geworden en zien en horen we elkaar nog regelmatig.

Cari **Rosangela** e **Giuseppe**, avete sempre seguito con tanto interesse il mio lavoro in questi anni. Ammiro il vostro ottimismo e la vostra gioia di vita che mi hanno insegnato tanto su come affrontare le difficoltà. Grazie di essere dei nonni fantastici per Lennart. Grazie anche a **Margherita** e **Michele**: state affrontando lo stesso percorso, e sono orgogliosa di vedere con quanto entusiasmo stiate lavorando nel mondo accademico. Zii lontani fisicamente ma sempre vicini nei miei pensieri.

Lieve **mama** en **papa**, zonder jullie zou ik hier nu niet staan. Jullie hebben mij altijd alle kansen gegeven en jullie hebben mij onvoorwaardelijk gesteund in de keuzes die ik gemaakt heb. Bedankt dat jullie er altijd voor mij en voor mijn gezin zijn. **Papa**, jij vroeg regelmatig naar mijn "thesis". Misschien heb

ik je er te weinig over verteld, besef ik nu. Ik vind het heel bijzonder dat we nu weer dichterbij elkaar wonen, en ik hoop dat we nog veel mogen praten in de prachtige tuin van ons gezamenlijk project. **Mama**, je bent een heel sterke vrouw, ook al zie je dat zelf zo niet. Weten dat ik aan jou alles kan vertellen, dat ik bij jou met alles terecht kan, is van onschatbare waarde voor mij. **Hannah**, ik ben trots dat jij mijn kleine zusje bent, en ik hoop dat er nu meer tijd komt om samen leuke dingen te ondernemen. **Marijke,** ook al wonen jullie zo ver weg, het is steeds een feest om jou, **Rosalie** en **Wu Yuhua** op Skype te horen. Ik kijk er enorm naar uit om jullie binnenkort weer terug te zien.

Francesco, gli ultimi ma più forti ringraziamenti sono per te e per il nostro figlio. Sei la persona che più di tutti mi è stata vicina in questi anni, sia nei momenti difficili, sia nei momenti felici. Non mi hai mai mancato di incondizionato amore, ascolto e attenzione, spingendomi sempre ad andare avanti per la mia strada. Adesso che questo percorso sta per terminare, non vedo l'ora di continuare la *nostra* strada insieme. Lieve **Lennart**, ik ben zo dankbaar dat ik jouw mama mag zijn, dat ik jou de grote en kleine dingen in het leven kan aanleren, en dat jij mij op jouw beurt, op jouw eigen manier, met belangrijke levenslessen confronteert. Mijn liefde voor jou is onvoorwaardelijk, en als jij 's avonds, vlak voor je in slaap dommelt, je hoofdje tegen mij aanduwt, dan weet ik dat voor jou hetzelfde geldt.

Curriculum vitae

Elise Drijbooms (1986) was born on February 5 in Antwerp (Belgium). After completing her secondary education at the College van het Eucharistisch Hart in Essen, Elise obtained a bachelor degree in Dutch and Spanish linguistics and literature (2008; magna cum laude) and a master degree in linguistics (2009; magna cum laude) at the Catholic University of Leuven. Subsequently, Elise was selected to take part in an interdisciplinary European Research Master, providing training for international students in the field of neurolinguistics, clinical linguistics, and psycholinguistics. Her master thesis, under the supervision of prof. dr. Roelien Bastiaanse (University of Groningen) and prof. dr. Claudio Luzzatti (University of Milano-Bicocca), regarded grammatical processing in bilingual aphasia. In April 2011, Elise started her PhD project on writing development at the Behavioural Science Institute of the Radboud University Nijmegen. Following meetings with renowned researchers in the field of writing research, Elise was twice invited to the University of Antwerp for a visit of six months, which led to a joint PhD degree. During these visits, Elise became more acquainted with writing research methodology. Throughout her PhD, Elise also worked as a university teacher, providing courses and supervision of bachelor and master students. Elise obtained her University Teaching Qualification in 2015.

Behavioural
Science
Institute

Radboud University

Universiteit
Antwerpen