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From Knowledge Representation to Writing Text: A Developmental Perspective

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This study examined the representation of knowledge in text writing in 20 ten-year-old children and 20 adults in the Netherlands. The research analyzed the use of clause linking devices to compose larger text units. Special attention was given to the use of causal relational markers and the extent to which causal relations within the texts matched real-world causality or reflected the personal perspective of the writer. This study explored the extent to which individual differences in writing can be explained by such factors as gender, working memory, and the degree of reading and writing experience of the writer. The results showed greater textual coherence for adults than for school children. Adults tend to use more adverbial and complement constructions at the cost of coordinating devices. The causal markers produced by adults showed a broad range of personal stances, whereas those produced by children showed a high degree of detachment from real-world causality. The observed individual differences in the packaging of clauses by both the children and the adults were found to be primarily related to short-term memory constraints and to reading and writing experiences. A gender effect was found for the children's writing of expository text.

Recent insights in cognitive science suggest that the primary goal of knowledge construction is a representation of the framework of knowledge in the mind of the individual (see Bransford, Brown, & Cocking, 2000; Zwaan, Kaup, Stanfield, & Madden, 2001). The representation of the framework of knowledge refers to the

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general topic of how information can be appropriately encoded in text, which involves the packaging of ideas into larger linguistic units. In pieces of text, ideas are not simply arranged as a linear chain, but they are typically packaged into hierarchical constructions. A "clause package" can be defined as a text unit linked by syntactic, thematic, and discursive criteria (following on the idea of "syntactic packaging" as defined by Berman & Slobin, 1994, pp. 538–554). Clause packaging fulfils the role of hierarchically encoding temporal, causal, and motivational connections in the text. Such connectivity can be expressed by means of clause linking devices such as syntactic conjunction, subordination, relative clauses, nonfinite verb forms, and elliptical constructions.

Different genres of text impose their own demands on the ordering of information in knowledge representation. Narratives may function to report on a series of events. Narrative text is generally characterized in terms of a canonical action structure with an initial setting, complicating actions, and a resolution (Berman & Slobin, 1994). In contrast, expository texts have a non-temporal, logical, argumentative structure. Expository texts often start with the introduction of core propositions, followed by development statements that are elaborated by illustrative or delimiting satellite discourse elements (Britton, 1994). It is generally agreed that the establishment of causal relations is critical for the representation of knowledge in both narrative texts and expository texts on science, history, and many other topics. However, it has also been shown that the causal anchoring of expository texts is associated with a higher proportion of causal connectivity markers than the causal anchoring of narrative texts (Costermans & Fayol, 1997; Garnham & Oakhill, 1992). In simple narrative texts, the causal structure coincides with a hierarchically organized plan of action. Thematic coherence and evaluative comments are integrated with an underlying causal structure of a text that involves descriptions of a goal, attempts to attain this goal, and the outcomes of the attempts to attain the goal (Graesser, Singer, & Trabasso, 1994; Trabasso & Rodkin, 1994; Trabasso & van den Broek, 1985). In expository discourse, the causal connections between propositions are sometimes achieved by simple adjacencies, but it is often the case that causal relations require explicit and implicit connective devices. Studies by Bestgen and Vonk (1995); Millis, Graesser, and Haberlandt (1993); and Sanders and Noordman (2000) have investigated the conditions in which the use of connectives facilitate the construction and reconstruction of expository texts.

Pander Maat and Degand (2001) proposed a scale of personal involvement with respect to the propositional content of causal relations. The degree to which the writer is implicitly involved in the construal of a causal relation defines the degree of involvement. Stated differently, there is more involvement of the author when the assumptions and actions of the writer constitute the units to be related. According to Pander Maat and Degand, increasing degrees of personal involvement can be characterized by a number of prototypes:

1. Nonvolitional causal relations: First, there are nonvolitional causal relations that specify objective phenomena and no observer whatsoever. The involvement of the writer is thus at a minimum or nonexistent as in, "The sun was shining. Thus the ice started to melt." In this case, the melting of the ice is fully caused by the fact that the sun was shining.
2. Volitional causal relations: Second, there are volitional causal relations that involve some decision making on the part of a protagonist, reasoning, and thus an awareness of premises. Some involvement on the part of the protagonist may be apparent in, "It was a sunny day. Therefore he went out for a walk." In fact, what is causally effective is not the state of the whether (the fact that it was a sunny day) but its representation by the protagonist.
3. Causality-based epistemic relations: Third, there are causality-related epistemic relations, which involve the drawing of conclusions with regard to the consequences of real-world causes. In this case, the propositional attitude of the protagonist is of primary concern as in, "Because it had rained all day, he thought the match would be cancelled." In this case, it is the propositional attitude of the protagonist that is causally effective, not the content.
4. Noncausal epistemic relations: Fourth, there are noncausal epistemic relations, which involve no real-world causality whatsoever. In this case, only the propositions of the protagonist are of concern, and the degree of personal involvement is quite high as in, "Since it was noon he expected nobody to be at home." There is no causal link between the facts expressed in the two clauses, but only an expectation on the part of the protagonist.
5. Speech-act relations: Finally, there are speech acts that exclusively concern the structure of the discourse and serve the interaction in the discourse and not the presentation of any causal facts in the real world. Speech-act relations show a high personal involvement as in, "I told her I wanted to go to the cinema. I asked her if she had any plans for tonight." Here the protagonist who is identical with the writer asks someone about her plans given the fact that he wants to go to the movie. This speech-act relation presupposes a sort of social relationship between the two persons involved.

Cognitive and linguistic mechanisms also clearly interact in the development of text writing. From a cognitive point of view, children generally have a limited range of perspectives to encode. They also cannot fully assess the viewpoint of the listener. From a linguistic point of view, the range of linguistic means available to children to express various ideas is clearly restricted. Berman and Slobin (1994) further showed how the packaging of information in narratives changes as the linguistic skills of children develop. Young children start with

the production of a sequence of clauses with an order that is close to the order of the events. A growing understanding of the causal structure of events leads the child to develop complex syntax to be able to construct higher order events. More complicated syntactic devices subsequently allow the child to address and encode higher order relations, which are often of a causal nature. From a syntactic point of view, the acquisition of clause packaging requires insight into not only the notions of embeddedness and dependence, but also the layered structure of the clause. There is research evidence that the linkage of autonomous clauses is simpler than the linkage of embedded clauses (Nippold, 1998), which means that the linkage of autonomous clauses can be expected to precede the linkage of embedded clauses in children's discourse development.

Learning to distinguish different genres of text is a major aspect of children's later language development, although the teaching of such information is highly implicit in most school systems (Kress, 1994). To learn to write, the child must learn how to handle larger text structures and treat the sentence as a syntactic unit. A unit of text must have internal integrity to be considered a "sentence." Hunt (1970) introduced a measure called the *minimal terminal unit,* or *T unit,* to study the syntactic development of children. This unit is defined as one main clause plus any subordinate clauses or nonclausal structures attached to the clause. Hunt showed that children's early writing is characterized by the almost exclusive use of coordinated main clauses and that subordinating constructions appear only toward the end of grade school. Other studies of syntactic development have also documented gradual improvement in children's knowledge and use of coordinating and subordinating conjunctions. Using a sentence completion task, moreover, McClure and Steffensen (1985) showed subordinating devices to be more difficult for grade school children and adolescents than coordinating devices. The children's use of conjunctions gradually increased with grade level but also was related to their literacy level. Studies have shown more complex sentences to characterize the text production of elementary school children versus adolescents (e.g., Loban, 1976; Morris & Crump, 1982; Savage & Fallis, 1988; Scott, 1988).

Research on individual differences in writing development has been inconclusive with respect to predictors that have been proposed. Short-term memory (STM) is apparently a strong predictor of text writing in both children and adults (McCutchen, 1996). The development of writing is also dependent on the literacy practices learners go through (Berninger, Fuller, & Whitaker, 1996; Kress, 1994) and also on gender, given the trend that girls write more ideas and exhibit a better quality than boys (Hartley, 1991).

This study further explores the cognitive and linguistic factors that underlie both children's and adults' writing of both narrative and expository texts. The study builds on earlier studies that have been conducted on such comparisons (Berman & Verhoeven, 2002; Katzenberger, 2004; Ravid & Berman, 2006; van

Hell, Verhoeven, Tak, & Van Oosterhout, 2005; Verhoeven et al., 2002). Groups of 10-year-old children and young adults were asked to write personal narratives and expository texts related to the topic of "problems between people" in a laboratory setting after a video anchor procedure. The focus of the data analyses was on the distribution of text coherence devices across age levels and text genres. We explored the following research questions:

RQ1: What is the distribution of lexical, syntactic, and thematic devices in the narrative and expository texts written by the children and adults?
RQ2: How do children and adults causally relate clauses to establish discourse coherence in the narrative and expository texts?
RQ3: To what extent can the variation in the production of text devices observed for the children and the adults be explained in terms of STM, gender, or experience with writing?

With regard to the first question, research of Ravid and Berman (2006) predicted that expository texts are linguistically more complex than narratives—that is, it is predicted that the mean length of utterances (MLUs) and mean length of *T* units (MLTUs) would be longer in expository texts than in narratives. It was also expected that the adult texts would generally have greater hierarchical organization than the children's texts for both the narrative and expository genres. Moreover, an interaction between age and genre was expected, with greater differences between the children and adults for the expository texts than for the narrative texts. Some of the children may show considerable clause-packaging skill, but the dense hierarchical layering of information in syntactically packaged constructions was expected to be confined to the adult texts.

With regard to the second question, we examined the use of causal connectors as linking devices in coordinating and subordinating clauses. A form-function analysis was conducted to examine the extent to which the use of the connectors showed varying degrees of personal involvement in narrative and expository texts. Given the outcomes of previous studies (Costermans & Fayol, 1997; Garnham & Oakhill, 1992), there should be fewer causal connectors and a greater personal involvement in narratives than expository texts. The previous findings of Katzenberger (2004) would lead to the prediction that considerably more explicit causal connectors would be used in the adult texts than in the child texts. A greater variation in the use of the causal connectors in the adult texts than in the children's texts was also expected. The causal relations expressed by the children were expected to show greater personal involvement and less detachment from real-world causality when compared to the causal relations expressed by the adults.

With regard to the third question, we analyzed the number of words, the lexical variety, the clause length, the number of *T* units, the MLTU, and the use

of causal connectors by the children versus adults in the narrative and expository text genres were analyzed and related to their STM, gender, and experience with writing. Significant relations to STM were expected to occur for the number and the length of T units and the number of causal connectors on the basis of the cognitive capacity theory of writing proposed by McCutchen (1996). Significant relations of both lexical variety and syntactic complexity with gender and literacy experience were expected according to previous findings from Hartley (1991) and Berninger et al. (1996), respectively.

METHOD

Participants

A total of 20 ten-year-old children (mean age = 10.3 years, SD = 0.6 years) and 20 adults (mean age = 30.5 years, SD = 7.6 years) participated in this study. In each age group, one half of the participants were male, and one half were female. All of the participants were monolingual speakers of Dutch. The children attended a middle-class elementary school. All of the adults had the Dutch equivalent of a college education.

Data Collection

Testing was individually conducted at school for the children and at a university for the adults. The participants first viewed a 3-min video with a soundtrack but with no words about violence in school, and then completed the text production task (Berman & Verhoeven, 2002). The written narratives and expository texts were elicited in a counterbalanced order across participants. For the narrative texts, the participants were asked to write a story about an incident in which they had a problem with somebody. They were explicitly instructed not to describe what they saw on the video but to tell a story about something that they had personally experienced. For the expository texts, the participants were asked to produce a composition discussing the issue of personal conflict as was exemplified in the video. They were instructed not to write a story but to express their ideas on the topic. Extensive pilot testing showed both groups to understand the instructions.

The narrative texts written by the participants were next divided into clauses, and the clause was taken to be the basic unit of analysis. We based our definition of a clause on the definition used by Berman and Slobin (1994) in their standard work on oral narratives of the frog stories. According to this definition, a clause is any unit that contains a unified predicate, which was defined as a predicate that expresses a single situation and may thus include both finite and nonfinite

verbs, as well as predicate adjectives. The single situation can be an activity, an event, or a state.

Data Analysis

The total number of words per text was computed as a measure of text length. As a measure of lexical variety, we adopted the vocabulary diversity measure, VOCD, which is a type-to-token ratio corrected for text length (McKee, Malvern, & Richards, 2000). To measure syntactic complexity, the mean clause length in number of words was calculated. The combination of clauses into a single syntactic package was also examined. To evaluate the nesting of clauses, we computed the mean *T*-unit length in terms of the number of clauses. A *T* unit was defined as one main clause plus any subordinate clauses attached to it or embedded in it. Of particular interest was the manner in which the children and adults syntactically connected the different parts of their texts to construct a hierarchically organized piece of text. Such connections can minimally occur between one predicate clause and another, but they can also encompass extended chunks of discourse. The following distinctions and definitions were incorporated in these analyses:

- Finite linking of clauses: clauses linked by a coordinating or subordinating conjunction with a finite verb in the coordinate or subordinate clause. The analysis was confined to conjunctions that were used to connect clauses rather than phrases or individual words.
- Nonfinite linking of clauses: gerundive and infinitival constructions.
- Relative clause modification of nouns: (non)finite relative clauses.

The excerpt in (1) from the written expository text of an adult is an example of a highly dense layering of information in a single thematic unit, with four clauses combined into one syntactically packaged construction:

1. *Problemen tussen mensen duren vaak lang—doordat er niet over gepraat wordt—of doordat er geen duidelijkheid omtrent het problem is—en er geen oplossing wordt gevonden.* 'Problems between people usually endure—because they are not discussed—or because the problem is not very clear—and no solution can be found.'

The analysis of the conjunctions was based on the classification scheme of the *Standard Dutch Grammar* (Haseryn, Romijn, Geerts, de Rooij, & van den Toorn, 1997). We counted the types of coordinating and subordinating devices the participants used as a function of text length. For coordinate constructions,

we counted the numbers of coordinate, adversative, causal, and consecutive conjunctions. For subordinate constructions, we counted the numbers of markers for complement clauses and adverbial clauses divided into temporal, causal, consecutive, purpose-oriented, conditional, concessive, and comparative conjunctions. The classification of conjunctions was determined by two experimenters who reached an interrater agreement of 96%.

A more fine-grained analysis of the use of Dutch causal markers was subsequently conducted. Although causal relations can be marked by a variety of causal or consecutive markers, we confined ourselves to clause-linking conjunctions and adverbial markers for purposes of this study. Coordinating conjunctions link syntactically similar autonomous clauses. Subordinating conjunctions link two syntactically different clauses, which are typically a main clause and a subordinate clause. In subordinate constructions, a main clause is modified by a subordinate clause, and the subordinate clause is grammatically dependent on the main clause. Adverbial markers express a causal relation between two subsequent clauses via an adverb.

The use of the following causal markers was examined. With respect to coordinating conjunctions, the marking of a causal relation between two clauses is exemplified in the following:

- Causal conjunction: *want* 'because' as in (2).
  2. Jan blijft thuis, *want* hij is ziek. 'Jan is staying home *because* he is ill.'
- Consecutive conjunction: *dus* 'so' as in (3).
  3. Jan is ziek *dus* hij kan niet naar school. 'Jan is sick *so* he cannot go to school.'

Subordinating conjunctions were divided into the following types:

- Causal conjunctions: *doordat* 'because' as in (4), *omdat* 'because' as in (5), and *aangezien* 'because' as in (6).
  4. *Doordat* Jan ziek is kan hij niet werken. 'Because Jan is sick, he cannot go to school.'
  5. Jan blijft thuis *omdat* hij ziek is. 'Jan is staying home *because* he is sick.'
  6. *Aangezien* Jan ziek is verwachten wij hem niet op school. '*Because* Jan is sick, we do not expect him at school.'
- Consecutive conjunctions: *zodat* 'so that' as in (7) and *opdat* 'so that' as in (8).
  7. Jan is ziek, *zodat* hij niet naar school kan. 'Jan is sick *so that* he cannot go to school.'

8. Je moet op tijd weggaan *opdat* je niet te laat komt. 'You should leave in time *so that* you will not arrive too late.'

With respect to the adverbial markers, the following connectors were considered:

- Causal relation: *daardoor* 'because of that' as in (9) and *daarom* 'therefore' as in (10).
  9. Jan is ziek. *Daardoor* kan hij niet naar school komen. 'Jan is sick. *Because of that* he cannot go to school.'
  10. Jan is ziek. *Daarom* gaat hij niet naar school. 'Jan is sick. He *therefore* isn't going to school.'
- Consecutive relation: *dus* 'thus' as in (11).
  11. Jan is ziek. Hij kan *dus* niet naar school. 'Jan is sick. He *thus* cannot go to school.'

To investigate the scaling of causal relations in terms of personal involvement on the part of the writer, we followed the analysis proposed by Pander Maat and Degand (2001). Following their framework, causal coherence relations were scaled in terms of *increased personal involvement* as follows:

- Nonvolitional causal relations: In this case, the causality is presented as pertaining to a factual state of affairs, follows a clear temporal order, and has no writer involvement. An example from our corpus is provided in (12).
  12. *Doordat er een ongelijke verhouding ontstaat wordt de normale omgang verstoord.* 'Because an unequal relationship emerges, the normal social interaction is disturbed.'
- Volitional causal relations: Volitional causal relations involve any kind of decision making or reasoning. The state of affairs is not very much causally effective but, rather, the representation of the state of affairs by a protagonist as in (13).
  13. *Hij had de sleutel van het appartement. Dus hij kon er in.* 'He had the key to the apartment. He could therefore get in.'
- Causality-based epistemic relations: In this case, a text segment describing a real-world cause constitutes a reason for drawing a certain conclusion with regard to the real-word consequences of the cause. However, in this case, it is the propositional attitude of the writer that is causally effective and not the actual text content. An example is presented in (14).
  14. *Hij durfde niks te zeggen omdat hij bang was zijn baan te verliezen.* 'He didn't dare to say anything because he was afraid to lose his job.'
- Noncausal epistemic relations: In this case, the real-world cause is taken as the argument but the causality is unlike the epistemic one or not relevant at

all, whereas the consequences highly depend on the personal assumptions made by the writer. For an example, see (15).

15. *Omdat het een stukje lopen is moeten we om 2 uur vertrekken.* 'Because it is quite a walk, we have to leave at two o'clock.'

- Speech-act relations: Speech-act relations concern the structure of the discourse itself as in (16).

16. *Het waren melige grappen. Dus niks grofs of kwetsends.* 'They were silly jokes. Thus nothing rude or offensive.'

For each sequence of linguistically marked causal relations, the degree of writer involvement was determined by two experimenters with an interrater agreement of 93%.

To answer the third research question, we administered the subtest *Digit Span* of the Wechsler Intelligence Scale for Children (Wechsler, 1991) and of the Wechsler Adult Intelligence Scale (Wechsler, 1997). In another questionnaire, we asked the children to indicate the number of hours they read on a weekly basis and to rate their experiences with writing on a 5-point scale ranging from 1 (*never*), 2 (*seldom*), 3 (*monthly*), 4 (*weekly*), to 5 (*daily*). The adults were asked for the same reading frequencies and also their estimated writing proficiency on a 4-point scale ranging from 1 (*excellent*), 2 (*good*), 3 (*average*), to 4 (*bad*).

RESULTS

General Text Characteristics

Table 1 shows the means and standard deviations for the following text characteristics: number of words, VOCD, MLU, number of T units, and MLTU. As can be seen, the adults consistently showed higher scores than the children.

For each measure, an analysis of variance was conducted with age and text genre as the independent variables. For the number of words, we found a significant main effect of age, $F(1, 38) = 75.38, p < .001$, showing more words expressed in the adult group. Genre was not significant, nor was the Age $\times$ Genre interaction. The results were similar for VOCD with only a significant effect of age, $F(1, 38) = 77.98, p < .001$. With respect to MLU, a significant main effect of age—$F(1, 38) = 53.19, p < .001$—and a significant Age $\times$ Genre interaction—$F(1, 38) = 3.97, p < .05$—were detected. For the number of T units, only a significant main effect of age occurred, $F(1, 38) = 26.54, p < .01$. Finally, for the MLTU, both a significant main effect of age—$F(1, 38) = 19.37, p < .001$—and a significant main effect of genre—$F(1, 38) = 14.06, p < .01$—were found, but there was no significant interaction.

TABLE 1
Means and Standard Deviations for Number of Words, VOCD, Mean Length of Utterance (MLU), Number of *T* Units, and Mean Length of *T* Unit (MLTU) as a Function of Age and Text Genre

	Children		*Adults*	
Variable	*M*	*SD*	*M*	*SD*
No. of words				
Narrative	80.00	47.10	247.70	106.73
Expository	68.95	43.02	283.55	129.23
VOCD				
Narrative	49.12	13.98	94.19	21.33
Expository	61.80	21.20	95.13	23.03
MLU				
Narrative	5.64	0.96	7.07	0.81
Expository	5.39	0.99	7.48	0.95
No. of *T* units				
Narrative	9.00	4.97	16.80	7.33
Expository	7.30	4.68	16.55	7.90
MLTU				
Narrative	1.56	0.28	2.10	0.38
Expository	1.74	0.67	2.35	0.49

Further analysis of the distribution of the different types of clause packaging revealed that main clauses without a connective dominated the narratives and expository texts of both children (37% and 40%) and adults (43% and 40%). With respect to clause linkage, a genre difference occurred in that coordinate conjunctions were preferred in narrative texts and subordinate conjunctions were preferred in expository texts. Some differences between children and adults also emerged with regard to the types of conjunctions used. The children used in their narratives and expository texts the coordination devices (38% and 23%) more frequently than the subordination devices (14% and 27%). The adults, on the other hand, used subordination (32% and 38%) more often than coordination (16% and 11%).

Distribution of Causal Connectors

Table 2 shows the distributions of the different causal markers as a function of age, text genre, and syntactic type. With respect to syntactic type, a distinction was made between coordination of two verbal constituents, subordination of two verbal constituents, and adverbial constituents. Separate analyses of variance with age and genre as independent factors revealed a significant main effect

TABLE 2
Distribution of Causal Markers as a Function of Age and Syntactic Type

	Children		*Adults*	
Variable	*Narrative*	*Expository*	*Narrative*	*Expository*
Coordination				
Causal *want*	2	6	8	9
Consecutive *dus*	3	2	9	4
Subordination				
Causal				
Doordat	—	2	4	16
Aangezien	—	—	—	4
Omdat	4	5	13	12
Vermits	—	—	—	1
Consecutive				
Opdat	—	—	—	1
Zodat	1	—	8	11
Adverbial				
Causal				
Daardoor	1	1	4	23
Daarom	1	1	11	6
Consecutive				
Dus	4	1	13	16
Dan ook	—	1	2	—
Total	16	19	72	103

of age, $F(1, 38) = 26.62$, $p < .001$; and a significant main effect of genre, $F(1, 38) = 4.23$, $p < .05$; but there was no significant Age × Genre interaction. However, if we control for text length, the children showed use of causal connectors in 6.2% of the clauses in narratives and 10.6% of the clauses in expository texts, whereas for the adults these percentages were 7.7 and 13.2, respectively. In this case, there is still a significant main effect for genre, $F(1, 38) = 4.49$, $p < .05$; but no longer for age; and no significant Age × Genre interaction.

As a next step, we conducted a form-function analysis on the data in the two age groups. Closer inspection of the children's data revealed several inconsistencies. In about one third of the cases, the linguistic markers produced by the children were difficult to interpret as causal. For example, in (17) the child seems to have reversed the order of cause and effect:

17. *Ik word vaak gepest. Omdat ik veel verdriet heb.* 'I often get teased. Because I am very sad.'

An analysis was conducted on the degree of personal involvement in the causal markers produced by the children. Both volitional and nonvolitional types of causal relations were rarely used. In the children's narratives, virtually all of the relations were in the noncausal epistemic (as in (18)) or speech-act (as in (19)) categories:

18. *Ik had ruzie met een meisje omdat ik niet op de schommel mocht.* 'I had a fight with a girl because she wouldn't let me on the swing.'
19. *Ze hadden ruzie want de ene raakte de ander.* 'They had a fight because the one touched the other.'

In the children's expository texts, we counted only four cases in which a causal epistemic relation was expressed, as in (20):

20. *Ze kijken bij elkaar af omdat ze het zelf niet weten.* 'They copy each other because they don't know it themselves.'

In the adult data, on the other hand, all of the causal markers were correctly produced. The distribution of the clause linking causal markers was further explored with respect to the degree of active involvement on the part of the writer.

In Table 3, the distribution of the clause linking causal markers is presented as a function of personal involvement. As can be seen, the degree of personal involvement widely varied. Chi-square analysis showed that the notion of independency in the form-function distribution of markers had to be rejected

TABLE 3
Distribution of Clause Linking Causal Markers in Adult Texts as a Function of Text Genre and Degree of Personal Involvement on the Part of the Writer

	Want	*Dus*	*Doordat*	*Omdat*	*Zodat*
Narrative					
Nonvolitional causal	—	—	1	—	—
Volitional causal	2	2	2	1	3
Causal epistemic	1	2	1	4	—
Noncausal epistemic	1	3	—	9	5
Speech act	5	2	—	—	—
Expository					
Nonvolitional causal	3	—	9	2	2
Volitional causal	2	1	7	6	5
Causal epistemic	1	2	—	7	2
Noncausal epistemic	1	—	—	1	2
Speech act	1	1	—	—	—

for both narratives, $\chi^2(16, N = 20) = 35.04, p < .01$; and expository texts, $\chi^2(16, N = 20) = 28.96, p < .05$. In the narratives, nonvolitional causal markers were generally lacking, which is commensurate with the genre of personal narrative. In the expository texts, volitional and nonvolitional causal markers predominated (in about two thirds of the cases), which—together with the findings for the narrative texts—provides evidence for a clear genre effect.

The degree of personal involvement was also explored with respect to the adverbial causal markers *dus* 'thus,' *daarom* 'therefore,' and *daardoor* 'by that' produced by the adult writers. The pattern of results is very similar to the pattern displayed for the clause linking markers used. Nonvolitional causal markers and causal epistemic markers were exceptional in the narrative texts, but they were frequent in the expository texts. Volitional causal markers occurred to an equal extent in the two text genres, whereas noncausal epistemic markers and speech-act markers occurred infrequently and more so in narratives. Chi-square tests indicated that independence in the form-function distribution of markers had to be rejected for narratives, $\chi^2(8, N = 20) = 18.58, p < .05$; and expository texts, $\chi^2(8, N = 20) = 39.80, p < .001$. It is interesting to note that the marker *daardoor* is almost exclusively used to express nonvolitional causal relations, and the marker *dus* to express to express causal epistemic relations, which conforms to earlier findings with respect to the use of causal markers in Dutch expository text by Pander Maat and Degand (2001).

Individual Differences

We examined individual differences in the causal marking of the narrative and expository texts by the children and adults in greater detail. The variables explored were the number of words, number of T units, and MLTU; and number of causality markers were related to STM, lexical variety, MLU, reading and writing frequency, and gender of the participant. The Pearson correlations were separately calculated for the narrative versus expository texts and for the children versus adults (see Table 4).

With respect to the children's narrative production, it can be seen that both the lexical variety and the number of T units was significantly associated with the frequency of writing. The number of causality markers significantly correlated with the variables of reading frequency and writing experience. With regard to the children's production of expository texts, both the number of words and the number of T units significantly correlated with reading frequency and the gender of the participant. The girls produced more T units than the boys. The number of T units was correlated with the experience with writing. Furthermore, the number of causality markers was found to be related to writing experience.

With respect to the narrative texts of the adults, the number of words, lexical variety and the number of T units significantly correlated with reading frequency,

TABLE 4
Pearson Correlations for Children's and Adults' Narratives and Expository Texts Between Number of Words, Lexical Variety (VOCD), Mean Length of Utterance (MLU), Number of *T* Units, Mean Length of *T* Unit (MLTU), Number of Causality Markers and Short-Term Memory (STM), Reading Frequency, Writing Frequency, and Gender

	STM		*Reading Frequency*		*Writing Frequency*		*Gender*	
Variable	*Narrative*	*Expository*	*Narrative*	*Expository*	*Narrative*	*Expository*	*Narrative*	*Expository*
Children								
No. of words	.29	.07	.37*	.52**	−.17	.33*	−.07	.54**
Lexical variety	.15	−.16	.24	.37*	−.08	.35*	−.02	.77***
MLU	.22	.01	.12	.23	.13	.40*	.13	.15
No. of *T* units	.34*	−.10	.01	.56**	.37*	.35*	.13	.48**
MLTU	.10	.30	.35*	−.17	.41*	−.12	.33*	−.01
No. of causality markers	.31	.03	.36*	−.08	.21	−.18	.26	−.17
Adults								
No. of words	.26	−.09	.37*	.59**	.24	.04	.12	.28
Lexical variety	−.18	−.12	.34*	.29	.11	.42*	.59**	.31
MLU	.01	−.13	−.24	−.06	−.29	−.09	.09	.13
No. of *T* units	.25	−.15	.37*	.66***	.30	.11	.03	.28
MLTU	.10	.43*	−.07	.11	−.14	−.19	.02	−.10
No. of causality markers	.33*	.23	.13	.11	−.16	.03	−.27	−.03

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

whereas gender correlated with lexical variety. With regard to the expository texts of the adults, both the number of words and number of *T* units significantly correlated with reading frequency. MLTU was also significantly related to STM, and lexical variety was related to writing proficiency.

CONCLUSION AND DISCUSSION

The following conclusions can be drawn on the basis of these findings. To start with, we found that the adult data in our study highly conform with the outcomes of previous studies related to genre-specific text characteristics. The greater length of thematic units in expository text as compared with narratives corresponds to Katzenberger (2004) and Ravid and Berman (2006), whereas the greater proportion of connectives in expository texts in comparison with narratives is in agreement with studies by Garnham and Oakhill (1992) and Costermans and Fayol (1997). It is interesting to note that the use of causal markers by the adults showed a wide range of active personal involvement across the two text genres. Linguistically, this shows the adults to command the means to express contrasting stances (Berman, Ragnarsdottir, & Strömqvist, 2002; van Hell et al., 2005). The ability to adopt a particular stance may reflect a greater ability on the part of the adults to evaluate alternative states

of mind. As states of affairs change into actions, beliefs, or speech acts, the role of the protagonist shifts from none at all to actor, concluder, and writer. It can tentatively be assumed that adults have at their disposal epistemological beliefs concerning the nature of knowledge and learning that enable them to sort out causal connections (Schommer, 1993). In our study, adults were able to distinguish real-world causality in nonvolitional and volitional relations from epistemic causal relations that transpose a real-world causal relation to the mental domain of inference making. In a similar vein, they were able to distinguish these relations from noncausal epistemic or speech-act relations, displaying maximal detachment from real-world causality. This result is very much in keeping with the analyses of causal relations put forth by Pander Maat and Degand (2001). The scaling of adverbial markers by the adults in this study also corresponds to the results of their cross-linguistic analysis of the use of such markers in French and Dutch newspaper corpora.

From a developmental point of view, our data show substantial differences in the coherence marking of narrative and expository texts when written by adults versus children. The adults produce longer texts with a greater syntactic complexity and greater informational density than the school-aged children. The higher level of syntactic complexity is indicated by the greater MLU, whereas the higher informational density is indicated by the greater MLTU in terms of clauses. Therefore, adults are better at piling up connective devices across chunks of clauses than school children. This results in relatively longer sequences of event packaging and more tightly woven texts that are composed of units that are highly cohesive with regard to both syntactic organization and thematic relevance. The adult texts are not only longer but also show greater lexical variety and greater syntactic complexity as reflected by a greater MLU and MLTU.

The results of the more detailed analyses of the specific conjunctions being used point in the same direction. Relative to the children, the adults use relatively more subordination and clause embedding, which also shows the adults to explicitly link the propositions underlying individual clauses more successfully than children. The greater incidence of subordination similarly reflects a greater ability to express thematic units occurring in sequence or simultaneously. This is in line with the findings of earlier research (Berninger et al., 1992; Katzenberger, 2004; Kress, 1994; Ravid & Berman, 2006; Verhoeven et al., 2002).

Our analyses of the causal connectors show the school children to be limited in their overt expression of causal relations. Although children use causal connectors in their writing, they show clear problems with the intersentential cohesion devices needed to combine thematic units in a coherent propositional system (Karmiloff-Smith, 1985). Insofar as they use explicit markers to link clauses, a minimal connection between the discourse relation, on the one hand, and the real-world order of causality, on the other hand, is demonstrated—that

is, the linguistic markers for causal coherence used by the children express largely noncausal epistemic relations or speech-act relations, and thus show a high degree of detachment from real-world causality.

With respect to individual differences, the results provide evidence for the importance of STM for writing behavior, which has also been emphasized by McCutchen (1996). The significant correlations between STM and the number of causal markers in narratives and the length of thematic units for the adults show that STM may constrain the causal marking of propositions in the text. Gender also significantly predicted writing achievement for both the children and adults in that relatively high correlations with text length and lexical variety were detected. This result is in keeping with the findings of Hartley (1991), who found that girls tend to write longer texts with a greater variety in lexical items being used.

This study shows that individual differences in the production of coherent text can be largely explained in terms of the literacy experience of the writer. For the children, variation in text length in terms of the number of words and number of *T* units for both the narrative and expository texts significantly correlated with reading frequency and writing experience. It is interesting to note that reading frequency remained a significant predictor of written text production within the adult group. Therefore, it can be concluded that writing ability develops as a result of regular and frequent opportunities to use language in a literate manner. Via reading, children are exposed to infrequent syntactic structures in different genre-specific contexts. Via writing, children are given an opportunity to practice with these newly encountered structures in their own personalized texts. The distinction between different genres of text permits greater precision, integration, reduction, and compression of information in the sentence and new modes of cognitive, conceptual, and linguistic ordering in the text. With an eye on education, we recommend that children be provided with abundant opportunities of writing practice in which teachers help children to overcome the structural difficulties of writing by means of genre-specific instruction (Kress, 1994).

This study can only be seen as a first step toward an understanding of the textual representation of knowledge through writing. The extent to which the textual cohesiveness provided by overt connectors was confined to a narrow or local level of organization and not a more global level of organization for text segments remains unclear and might, therefore, be considered in future research (cf. Sanders & Van Wijk, 1996a, 1996b). It is important to gather data on different age groups to arrive at a more reliable picture of the development of text writing. A form-function analysis of data from junior and senior high school students will help shed further light on how the development of text writing proceeds (Peterson & McCabe, 1991; Wright & Rosenberg, 1993). Finally, it should be mentioned that in these analyses we have left aside temporal aspects of

the writing process, like pauses and writing rates. To gain more insight into the temporal constraints of the writing process, we recently explored the cognitive and linguistic processes as they unfold in real time by analyzing the pause time patterns of writing narrative and expository text in children and adults (see van Hell, Verhoeven, & van Beijsterveldt, this issue).

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