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# Developmental Aspects of Text Production in Writing and Speech

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If only you'd remember before ever you sit down to write that you've been a *reader* long before you were ever a writer.

from *Seymour – An introduction*  
J. D. Salinger

I have made this [letter] longer, because I have not had the time to make it shorter.

Blaise Pascal



## **Abstract**

This thesis aims at describing the developmental patterns of text production in four text types: spoken and written narrative texts, and spoken and written expository texts (n=316), produced by four age groups: 10-year-olds, 13-year-olds, 17-year-olds and university students (n=79). It explores material from an experimental study with a cross-sectional design comprising spoken texts recorded on video and written texts recorded by means of keystroke logging, which makes it possible to investigate the real-time process of written text production.

Various measures of text production were compared across age, genre and modality. This revealed almost no differences between 10-year-olds and 13-year-olds concerning the number of words, clauses or T-units. Nor were there any differences between the 17-year-olds and the university students. This indicates that a major developmental step occurs between the ages of 13 and 17. However, other results, including comparisons of MLU, words per T-unit and clauses per T-unit, an analysis of lexical density and diversity in both speech and writing, and an investigation of the use of editing and deletion operations on the keyboard during text writing, all suggest that the developmental trend is more complex. One example is that the 13-year-olds have a higher MLU and more words per T-unit than the 10-year-olds.

Further, the investigation of the keystroke-logging data reveals the real-time process behind the texts. Here we find that the 13-year-olds engage in editing operations to a larger degree. The comparatively short and lexically poor texts (especially in the expository genre) of the 13-year-olds can thus be interpreted as the result of their struggling to meet the structural demands of a specific text type. Further findings indicate that although 17-year-olds in many ways can compete with university students in writing, if they are allowed to write for longer time. However, the university students perform better at the expository spoken task, suggesting that the adults are better at drawing from strategies learned from writing as they carry out a cognitively demanding spoken task. Finally, an analysis of the global pause pattern during writing suggests that genre characteristics are important factors that influence the cognitive load during text writing.

The interplay between speech and writing is an important factor for developing and maintaining skills in both modalities. While the writing of the youngest age group in this study is influenced by strategies derived from speaking, the adults seem able to benefit from strategies and linguistic structures learned through writing when they are, for example, giving a speech. The thesis ends with a discussion of how constraints affecting working memory influence performance in both speech and writing. To reduce the cognitive effort of language production, both speakers and writers rely on strategies and knowledge they have previously acquired. This entails an important transfer of knowledge and structures between both modalities and genres.

**KEY WORDS:** development in speech and writing, keystroke logging, genre, narrative, expository, working memory, writing processes, cognitive load, expertise, pauses in writing

## Sammanfattning

Denna avhandling undersöker hur tal- och skrivefärdigheten utvecklas under skollåren. Studien använder ett material bestående av 316 texter från fyra texttyper: talade och skrivna narrativer, och talade och skrivna utredande texter (dvs. föredrag och uppsatser). Texterna är producerade av fyra åldersgrupper: 10-åringar, 13-åringar, 17-åringar och universitetsstudenter, som alla deltog i en experimentell studie där de talade texterna videofilmades, och de skrivna spelades in med tangentbordsloggning (ScriptLog). På så sätt kunde både den färdiga produkten och processen bakom textproduktionen studeras.

Ett flertal mått undersöktes för att se hur ålder, genre och modalitet inverkar på textproduktionen. Avseende exempelvis antal ord, antal satser och antal T-units fanns inga skillnader mellan 10-åringar och 13-åringar, och inte heller mellan 17-åringar och universitetsstudenter. Detta tyder på att ett stort utvecklingssprång sker mellan 13 och 17 år. När andra mått (exempelvis antal ord per fras, ord per T-unit, lexikal diversitet och densitet, samt redigeringar i skrift) undersöktes framträdde emellertid en mycket mer komplex bild av utvecklingen i tal och skrift.

När skrivprocessen studerades utifrån tangentbordsloggningssdata såg vi till exempel att 13-åringarna ägnade mer tid än 10-åringarna åt att redigera sina utredande texter. Det går att tolka 13-åringarnas jämförelsevis korta och lexikalt torftiga texter (framför allt i den utredande genren) som ett tecken på att de kämpar med att lära sig en ny genre, och att detta tar så mycket kraft i anspråk att de inte orkar producera långa, och varierade texter. 17-åringarna behöver längre tid på sig för att skriva texter som är ungefär lika långa som de vuxnas, vilket visar att denna uppgift är mer ansträngande för 17-åringarna. Vad gäller den kognitivt mer krävande uppgiften att hålla ett föredrag visade sig de vuxna använda ett mer varierat lexikon. Detta bidrar till tolkningen att de vuxna utnyttjar strategier och kunskaper som de lärt sig genom skriftspråksanvändning när de talar. En sista studie i avhandlingen analyserar pausmönster under skrivande, och visar att genre(kunskap) har inflytande på hur skribenter planerar sitt skrivande.

Resultaten visar att alla språkanvändare drar nytta av tidigare kunskaper (t. ex. lingvistiska strukturer, ordförråd och genrekunskap) för att underlätta den kognitiva börda som en krävande uppgift i tal eller skrift innebär. Det går således inte att studera språkutvecklingen endast i en modalitet, utan för att kunna förstå hela språkkompetensen behöver man inkludera många olika texttyper. Texterna från de yngsta deltagarna i den här studien var starkt influerade av strategier som de lärt sig genom att tala, medan det fanns tydliga tecken på att de vuxna kunde dra fördel av strategier och (lingvistiska) strukturer som de förvärvat genom att läsa och skriva när de exempelvis höll ett föredrag. Som en kontrast var alla deltagarna enligt vissa mått lika bra på att berätta en muntlig narrativ – en genre som redan förskolebarn behärskar.

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# **Part I**

## **Introduction**



# Chapter 1

## Introduction

Since 1969, Swedish Radio has broadcast a show called *På minuten* (roughly, ‘On the minute’) (Sveriges Radio, 2009). The concept is that four contestants take turns at producing a one-minute narrative on a previously unknown and often absurd topic. This they must do *without hesitation, deviation or repetition*, as the British version of the show has it<sup>1</sup>. If the other contestants think the speaker has broken the rules, they can (and do) protest, and may then have the opportunity to finish the narrative themselves. The topics are often designed by malevolent listeners trying to put the speaker in an awkward position. The examples of topics set during the 18 March 2006 show include: *Så har jag byggt upp mitt eget hemmagym av loppisfynd* (‘How I built my own home gym from flea-market find’), and *Så använder jag telepati för att vinna fördelar på min arbetsplats* (‘How I use telepathy to gain advantage at my workplace’).

However enjoyable it may be for the radio listener (or the studio audience), why have I chosen to begin this thesis with an account of this radio show? Well, I would say that my thesis deals in every way with *why* we admire the winner of *På minuten*. It is very difficult to give a speech on a topic you have not chosen yourself, and it is almost impossible to do so without hesitating, or making the task easier by deviating to a subject field you are more familiar with. This simply cannot be done without a considerable amount of both effort and training.

In fact, what the show does by imposing the utterly unattainable criteria of no hesitation, no deviation and no repetition on spoken accounts is to take the ideal delivery of the finished, edited piece of written composition and apply it to unprepared speech (cf. Clark and Clark, 1977; Linell, 1982). What I want to show in this thesis is not only that there is a considerable amount of invisible work behind text production, but also that by practising writing throughout our school years, and beyond, we will eventually improve our performance also in speaking.

---

<sup>1</sup>The BBC broadcasts a radio show with the same concept under the name of *Just a minute*. As far as I have been able to find out, the concept was in fact invented at the BBC. The web site of the British show describes how some 40 years ago Ian Messiter remembered being ordered, as a punishment, to repeat what his schoolmaster had been saying for the past minute, without hesitation or repetition. Hence the rules: “no hesitation, deviation or repetition” (BBC, 2009).

## 1.1 The study of writing

The modern, scientific, branch of linguistics has prided itself that its object of study is speech and speaking. Bloomfield stated that “Writing is not language, but merely a way of recording language by means of visible marks” (Bloomfield, 1933, p. 21). He further claims that “All languages were spoken through nearly all of their history by people who did not read or write; the languages of such peoples are just as stable, regular, and rich as languages of literate nations.” While I agree with his second claims, I disagree with the first. I believe (along with Wengelin, 2002) that writing *is* a linguistic expression in and of itself. It is not merely a way of recording speech, or a way of representing speech, but a mode of communication in its own right. This position makes it important to study written language in order to understand the various terms, limitations and constraints influencing written language production.

Saussure gives the spoken language pride of place, even though he states that the linguist cannot ignore written language because it is the only record we have of languages spoken in distant times and places (Saussure, 1983). This is of course correct. Historically, writing (of various kinds) has been virtually the only means to record and preserve all manner of language<sup>2</sup>, and in this sense, writing cannot be ignored as a source for the linguist.

But Saussure also writes that “[l]inguistics takes for its data in the first instance all manifestations of human language” (Saussure, 1983, p. 6, translated from French by Roy Harris). This definition would include the subject of today’s writing research. Writing is in itself a manifestation of human language, and as such it is worthy of study. Until very recently, we had to restrict ourselves to studying final versions of written texts, very often edited and without traces of how the text was produced or what parts caused the writer special difficulties. Today, however, new technology (e.g. keystroke logging, maybe combined with eye-tracking technology) enables us to follow the process of writing in much the same way as we can access and analyse the process of speaking (Strömqvist et al., 2006; Wengelin et al., 2009b).

## 1.2 The scope of this thesis

### 1.3 Scope of this thesis

This thesis will focus on written language, but I would like to do so by contrasting it with speech. Bloomfield (1933) said that we were all speakers before some of us became writers. To this, I would add that those of us who have become writers still remain speakers; in fact, most of us speak more than we write. Although it would have been very interesting (and I did have some intentions in that direction when I began this project), I will not now carry out a full-scale comparative investigation of the interplay between the development of spoken and written language, for instance by comparing hesitation and disfluencies in speech (e.g. Eklund, 2004) with pausing and editing in writing. Still, even though my centre of interest is writing

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<sup>2</sup>Of course, artistic expressions like paintings, sculptures, ceramics, buildings, textiles, etc. can also be described as possessing symbolic, or even linguistic, features.

development, I will compare it with, and relate it to, speech whenever there is an opportunity.

The studies presented in this thesis use data from a cross-sectional study with an age range from 10-year-old schoolchildren to adult university graduates (mean age: 30 years). They investigate experimentally collected data from 316 spoken and written monological texts, belonging to two different genres: narrative and expository. The written texts were recorded by means of keystroke logging (ScriptLog), and the spoken texts were videotaped. Both text types were transcribed according to the minCHAT format and coded for, among other things, clauses and T-units.

The data are explored in a developmental perspective, with special focus on the interplay between speech and writing, as well as on the role of developing genre knowledge. This is also related to the writing process as revealed by keystroke-logging data.

This following studies are included in the thesis:

**A quantitative approach** This study includes quantitative analyses of the following so-called ‘production measures’: the number of word tokens, the number of clauses, words per clause (MLU), the number of T-units, clauses per T-units and words per T-units. The findings and interpretations concern variation due to age, genre and modality as well as effects of gender and of order (i.e. does it matter whether a person produced the spoken or written text first?).

**An exploration of keystroke measures** This study deals only with written texts and focuses on some of the data generated by the keystroke-logging program. Production measures such as words per minute and events per second are explored. A developmental perspective is taken on the use of certain keys on the keyboard, which is related to the amount of writing. The importance of genre is also discussed.

**Lexical measures** This study analyses two measures which are commonly used in studies of language development: lexical diversity and lexical density. The corpus is investigated not only to identify any differences in lexical measures depending on age, genre and modality, but also to determine how writing and speaking influence each other. Finally, the two lexical measures are contrasted with each other and it is discussed when it may be appropriate to use one of them rather than the other.

**Global pause patterns** This study investigates the pausing during written text production. It describes the global pause patterns and their dynamic variation as the writing unfolds. The results are related both to development and to genre.

When interpreting the results, I draw on findings from a wide range of research, including studies of language acquisition and development; the development of writing; genre differences in general, and in speech and writing in particular; differences between speech and writing; the grammar of speech; theories of writing, including working memory and cognitive costs; studies of writing research with keystroke logging, including pause time studies; lexicon studies; and frequency studies of language

corpora. There is both an upside and a downside to taking such a broad view. The advantage is that it brings together perspectives from different fields in new ways. The disadvantage is that I have not been able to go very deep into any of the fields in many areas where I have been forced to make a selection, and leave some books and articles unread. Even so, I hope that I have managed to cover the major, the most relevant, and – most of the time – the most recent studies in the overall field.

I consider myself as a psycholinguist with both a cognitive and a developmental perspective on the writing process, but first and foremost I see myself as a writing researcher, who is very interested in the interplay between speech and writing that every language user in our part of the world has to handle every day.

It should also be noted that large part of the work on this thesis has consisted in creating a methodology for analysing texts written in a keystroke-logging program, such as ScriptLog (see Section 7.2). This has been very explorative work, enabling many ways of performing analyses to be tried out. In fact, many of them have been left out of the thesis, some because of a lack of time to complete the study, and others because of methodological shortcomings.

### 1.3.1 Research questions

The aim of this thesis is to investigate the development of writing during school ages, with the “end point” being adults with several years of university education. Although the main focus is on written language, it is studied by reference to the interplay of writing and speech during development. A further subject is the role of genre in the development of written and spoken language.

More specifically, I will shed light on writing development, by relating it to the following issues:

1. The role of speech in the development of writing.
2. The effect of genre knowledge on the text-production process (independently of modality).
3. The interplay between speech and writing during the development of writing.
4. The cognitive costs of producing texts.
5. The importance and perspective of planning in speech and writing.

## 1.4 Outline of the thesis

### 1.4.1 Background

The thesis will start by giving a background, which is generally applicable to all the studies presented here. The background chapters are to some extent free-standing, and can be read in any order, although the chapters about Learning to write and Models of writing are probably best understood if read in the order in which they are presented here.

To facilitate an overview, I have divided the wide field of research that I discuss into four areas, each dealt with in a separate chapter:

**Speaking vs. writing** An overview of the differences between speech and writing, and some relatively new findings about the grammar of speech.

**Learning to write** Theories and findings from studies of the development of writing.

**Models of writing** Some proposed models of writing, and an overview of the research field of pause-time studies in writing.

**Genres** A discussion of the definition of ‘genre’, as well as the characteristics of the two genres studied in this thesis: narrative and expository.

Apart from the overview in the Background Part, relevant background theory is also presented in connection with the separate studies in the results chapters below. This has been done in order to facilitate reading of the result chapters.

### 1.4.2 Method

The background chapters are followed by a Method Part with two chapters. The first of them gives detailed information about data collection, transcription and coding decisions. The second chapter presents keystroke-logging programs in general, and ScriptLog in particular.

### 1.4.3 Results and conclusion

The four results chapters deal with the studies presented in Section 1.3 above: a quantitative approach to various production measures; an exploration of keystroke measures; an investigation of the lexical measures of lexical density and lexical diversity; and global pause patterns. The studies within each chapter, and the results of those studies, build on each other. It is, however, my intention that the results chapters should be possible to read in any order, which is why I frequently provide cross-references between the chapters.

The results chapters are followed by a concluding chapter where results from all studies are used to shed light on the general development of speech and writing in two genres.

### 1.4.4 Appendix

After the concluding chapter, an extensive Appendix follows. Through the years I have frequently been asked to share the experimental design and the elicitation material. Therefore I have decided to include large parts of this material in the thesis. Further, the Appendix also includes examples of various outputs from keystroke logging. The material included is referred to in the text.

## Part II

# Theoretical Background

# Chapter 2

## Speaking versus writing

### 2.1 Introduction

Even Aristotle claimed that speech was the main object of study for those interested in language (cf. Norrby, 2004; Chafe and Tannen, 1987; Chafe, 1994), and the founders of modern linguistics, for example Saussure and Bloomfield (Saussure, 1983; Bloomfield, 1933), agreed with him. Chafe (1992) even argues that speech has been overemphasized by the linguistic tradition, as represented by Boas, Sapir and Bloomfield (c.f. Sapir, 1921; Bloomfield, 1933). In spite of this, linguistic research has mainly consisted of the study of written language, in one way or another. There are many reasons for this; one is that until very recently writing was the only means by which spoken language could be recorded. However, one consequence of this is that once a spoken utterance has been written down, it is no longer speech. We have the lexical, grammatical and morphological aspects, but prosodic, phonological and sometimes even semantic and pragmatic details of an utterance are lost, unless they are somehow noted in the transcript (e.g., the Indian linguist Panini (c. 400 BC) and his predecessors developed ways of noting prosodic features, although Panini's grammar was not put into writing until centuries later (Robins, 1997; Itkonen, 1991)). Chafe (1992) further reflects that Sapir and Bloomfield do not seem to have identified any differences between speech and writing, leading them to the conclusion that all writing was simply good examples of speaking. This thought is not very far from equating writing with speech, which in turn leads to the thought that the things not included in writing (like pauses, repetition and hesitation) can – and maybe even should – be omitted in speech. This view is unconsciously demonstrated by almost all literate persons even today; we embrace the belief that written language is the true form of language, while speech is an incomplete way of expressing our thoughts (cf. the idea of the “ideal delivery” in speech, described by Clark and Clark, 1977). Possibly, this view is learnt (more or less implicitly) when we are taught to write, since this is the first time we encounter a visible form of language. When, in learning to write, we encounter linguistic elements that we previously have never noticed (e.g. word endings spelled differently from how we pronounce them, such as *talked* instead of *talkt*), we tend to believe that the written form is the “true form” rather than vice versa or than thinking that both are correct, but in different ways.

It is the Bloomfield tradition of claiming to study speech (but doing so through writing) that is what Linell (1982) criticizes and what he refers to as “the written-language bias in linguistics”. He suggests that instead of pretending to study speech while we are actually studying writing, we should in fact study speech. However, Wengelin (2002) claims that the linguistic study has in fact focused on speech for too long. It is time to study writing in its own right, not merely as a means of representing speech. Chafe (1994) advocates what may be a third view: “to regard speaking and writing as each having its own validity” (Chafe, 1994, p. 45).

### 2.1.1 Contents of this chapter

In this chapter I will discuss speech and writing in different ways. I will start with an overview of the differences between speech and writing, and conclude with a presentation of the fascinating new insights into spoken-language grammar that have been revealed in recent decades by research in the talk-in-interaction field (i.e. the field of discourse analysis and conversational analysis). It may seem unbalanced to give spoken language this much space, but the area is still very new and the findings are far from familiar or integrated in every linguist’s view of language. Moreover, writing will also be in focus in the coming chapter about theories of writing and writing development.

This chapter mainly deals with contrastive studies of speech and writing. The developmental and genre aspects of such studies are discussed in Chapter 3 (about development) and Chapter 11 (about genre).

## 2.2 Speech and writing

As a teacher, I sometimes lecture about the differences between speech and writing. When I begin by asking the audience, *What is the main difference between speaking and writing?* one of the first answers (and sometimes the only one) is usually that when you speak, you don’t need to bother about punctuation or spelling. When that aspect has been mentioned the lecture room usually gets silent for a while, and nobody can think of any other major differences.

I find it characteristic that most people think first and foremost of spelling and punctuation when they think about the differences between speech and writing. It is also significant that even when they continue to discuss the topic, most of them take writing as the starting point for the discussion, and treat speech as if it were second-best or something we have to settle for because we do not always have a pen and paper with us. Below I will present the differences between speech and writing that are relevant for the discussion in this thesis. Since a majority of all writers began their life as language users as speaking toddlers, I will change the perspective and present the differences from the point of view of how writing differs from speaking.

So, here is my answer to the question *What is the difference between speaking and writing?*



### 2.2.1 Sender and receiver

The prototypical speaking situation is the conversation (cf. Chafe, 1992), and the main linguistic activity we take part in is dialogical (cf. Linell, 1998). Language acquisition takes place through interaction with other people (cf. e.g. the work of Vygotsky). In the communicative situation, there is a sender and a receiver. In a conversation, the sender is the speaker and the listener is the receiver; with written text, the writer is the sender and the reader is the receiver. Of course, it is possible that the reader and the writer are the same person, but at different times. However, I am not sure that we should assign both roles of speaker and listener to the same person, unless we talk about recorded speech that the former speaker is listening to. The speaker is of course monitoring, or overhearing her own speech, but the question is whether this can be described as *listening* or not merely equivalent with the writer's monitoring of the emerging text that is being written. The writer can, in contrast, return to her text even years later, and then be the reader of this text.

When we are speaking, the receiver of the message is normally present. There are exceptions, such as telephone conversations, but also voice mail, video lectures, podcasts and other recorded messages. When we take part in a (normal) spoken conversation, we perceive the message during the same time as it is being composed. This way of receiving the message is the default. When we are reading we subconsciously have the thought that this is also the case for the written message. However, most of the things we read are *not* composed in the same order, and definitely not at the same speed, as we read it. On the contrary, the writer may have spent an enormous amount of time editing the message before it reaches us, and as readers we can take all the time we need to read and re-read parts that we like or do not understand. We can even skip parts of a written text.

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Today, research has shown very clearly that speech is produced in collaboration with the listener (c.f. Clark, 1996; Norrby, 2004). But the listener is not the only facilitating factor. The context also plays a major role. Writing has been claimed to be less autonomous, or less decontextualized, than speech. This is another way of saying that most of the time, writing needs to contain more specific information about the situation. In speech, the sender may use pronouns and gestures to indicate what she means, but in writing, she will have to be semantically more specific by using nouns and descriptions of location. The writer will have to be more explicit, and foresee what information the reader will need to understand the message.

Non-verbal communication is an important feature of speaking. Chafe (1992) says that the prosody of speech is to some extent reflected in punctuation. In modern media and on the internet, the use of **emoticons** (Hård af Segerstad, 2002) is another way of addressing the written message's lack of what Wengelin (2002) calls "the multi-dimensional and simultaneous aspects of speech". Non-verbal communication goes two ways: the sender can use it to express herself, and she can also use the receiver's physical reactions to tell whether she has got her message across. Irony or kindness in speech may be mistaken for criticism or anger if not accompanied by a smile or a wink. Irony or anger, kindness or criticism are of course possible to express in writing. But it takes longer to find the right words if the writer is consciously trying to avoid hurting the reader. The fact that the written word lasts, and the fact that no smile accompanies writing, may lead to misunderstandings. Emoticons, or smileys, can thus smooth out written communication in situations when it is necessary to write fast (e.g. an internet chat) and/or when there is limited space (e.g. a text message). In fact, the use of emoticons is an excellent example of how speech is – after all – primary to humans and how we struggle to find the way to express in writing what we can easily convey when speaking.

But we should get back to the risk of interruption. Skilled speakers have developed ways to keep the floor, for instance by using **filled pauses**. Such pauses can be filled with words, such as repetition or "empty phrases" (e.g. expressions like "so to speak"), or just phonetically prolonged ('eeh'). The general rules, or grammar, of conversation (see Norrby, 2004) are understood by both sender and listener, and they are acquired in parallel with other aspects of linguistic development. For instance, it makes most sense for a speaker to pause *after* a conjunction such as 'and' or 'that' than before it, because this location of the pause will indicate to the listener that there is more information to come, and so the polite or curious receiver/listener will wait for her turn. More about the underlying rules of spoken grammar is found in Section 2.3.

### 2.2.2 The visible language: the product

The written language is visible. This leads to many possibilities. First it can be saved, unlike the transient spoken signal (unless the latter is audio- or video-recorded, of course). The written message can also be edited (which is also possible, but more complicated, to do with recorded spoken material). In an ordinary conversation, we can correct ourselves, but any change we want to make to something we have said has to be made when the error has already been made. The listener has most certainly already heard what we said.

Listeners are however used to this process of "editing on-line". In fact, normal re-editing by speakers is what we expect from a conversation, and we only notice it if it gets very disturbing. The "interrupted" speech also gives the listener the opportunity to think and to follow the thought of the speaker. In fact, it can be much harder to understand someone who reads aloud (or has memorized text), for example at a lecture, than someone who speaks freely. The reason is that repetition and hesitation are in fact cornerstones of spoken language and have a function both for the speaker and the listener. They give the speaker time to plan content and

linguistic expression, and they give the listener time to perceive and integrate the message (cf. Allwood et al., 1992).

The fact that the written word is visible makes it more concrete, which may be one reason why people in general pay more attention to what and how they write than to what they say and how they speak. The written word also has a higher legal status as evidence, for instance in court as well as in documents such as contracts, receipts, medical journals and diaries.

Compared with speaking, writing is a visible, edited and, at best, flawless product. In fact, at school we are encouraged to edit our written texts so that they will be error-free when we present them to the reader. Because we only see edited written products, we get the notion that this is what “language” is like, and should be like. The encouragement to edit our writing installs in us the notion that language should be edited before we present it to the receiver. Further, we start to feel that writing is the “real” language while speaking is an imperfect product, not always language in its own right (cf. Chafe, 1994). Nobody would like to “write as they speak”, although most people would strive to “speak as they write”, not realizing that both ways would be a failure, since speaking and writing are so different modes of communication.

The value of making corrections in the written language (concerning spelling, semantic and stylistic differences, thematic and content changes, and so on), is taught at school, while the child is learning how to write. This means that (many) written products, in contrast to spoken products, are “corrected” and “complete” when they reach their reader. This is another factor that influences thinking about written language: since we are able to correct the written text, and since it therefore seems like a better product, we are quicker to reject spoken language as incorrect (on the other hand, a written text that is not corrected, and that contains a lot of spelling errors and inconsistencies, may be seen as an even worse product than a bad spoken product; this is another result of the expectations we have of a written text).

Some spoken language is more similar to that used in typical written texts, for instance the formal spoken language used in public debates, academic lectures and formal speeches (Biber, 1988). The reason why they are similar to written language is of course that they are often first composed in a written form and then – at least as regards content – learned by heart before they are presented. The tradition behind this kind of speeches reaches back to classical antiquity, when the rhetorical style required a written approach. This way of speaking is typical of certain groups in society, and it is a skill that is encouraged by higher education.

On the other hand, some kinds of written language can be seen as more similar to typical spoken language than others. Writing a letter to a friend, for example, is different from writing a course paper. The topic may influence your writing; not only the style you choose, but also the layout, the editing, and the way of presenting your content. It is thus possible to conclude that you will choose a different writing style to tell a personal story about something that has happened to you than to talk about a current general political problem (Einarsson, 1987).

It is ironic that writing is seen as the model language, when in reality it is comparably handicapped. All the non-verbal communicative elements present in

the speaking situation are missing in the written context. With only punctuation and lexical choices at hand, the writer is forced to be much more precise in her expression – for better and for worse. This, and the possibility to edit, enhances the expansion of the lexicon. The use of synonyms, hyponyms and hyperonyms makes writing more accurate. The use of noun phrases instead of pronouns makes the written text more lexically dense.

As children learn how to write, they become aware of linguistic patterns that they had not encountered or noticed before. They may be morphological endings which are visible in writing but silent in speech, the fact that phonologically identical words are not spelled the same, or the intricacies and possibilities of punctuation. In my data I have more than one example of 10-year-olds using a lot of spaces instead of full stops to indicate a “pause” between sentences (cf. e.g. Example 34 on page 164). This could be one way of illustrating that punctuation in writing to some extent is the prosody of writing (Chafe, 1992).

Editing calls for an iterative writing process. Experienced writers use this possibility to a much larger extent than younger and less skilled writers, who take a linear perspective (much like in speech) to their writing. This means that a good text from an experienced writer is seldom written linearly from the first word to the last, but that this is much more often the case with texts from young and inexperienced writers.

When we learn to write, we have to learn how to represent spoken language graphically. In an alphabetic writing system this includes two elements: phoneme-grapheme translation and knowledge about sentence construction and punctuation (c.f. Torrance, 2007).

We are used to looking at written language. But we are not used to looking at spoken language. Spoken language is not meant to be looked at, but to be listened to. Many features of speech look strange, absurd or completely erroneous when we see them written down, because they do not look like anything we are used to seeing in written language. It is hard (and sometimes impossible) to understand a written transcript of spoken language without prosodic cues.

### 2.2.3 Time: the process

The temporal aspect is a very important factor when we discuss differences between speech and writing. Speaking happens very fast and requires much less energy to produce. This difference is especially salient when we are learning to write. Forming the first letters takes time, and compared with speaking it takes eons only to write your name (cf. Gentner, 1983). Writing thus generally takes longer than speaking. By contrast, there is a higher degree of spontaneity in speaking, while writing gives – and requires – more time for thinking (Dahlstedt, 1982). Chafe (1992) describes spoken language as “shaped by constraints derived from the activation and deactivation of ideas” (Chafe, 1992, p. 23). Since writing is not produced under the same pressure, we can assume writing to have other properties. While Chafe sees conversation as the prototype of spoken language, there is no equivalent prototype for written language.

It is characteristic of written language that it is usually produced in a different time and place than where the reader is. This means that the written text has to be more decontextualized than the spoken text, and that simple anaphoric reference must be replaced with noun phrases (in a conversation, the speaker may say, for example: “As I’m sitting here...”, but a writer has to write something like: “Sitting in front of my computer in my office at the university...” if she wants to refer to the same situation). The child learning to write needs to realize the importance of giving the reader sufficient information. This may be more difficult than it seems, because the writer has no way of knowing what information the reader needs unless she puts herself in the place of the reader. In a conversation, we are normally able to see the listener and to use feedback and questions from the listener to determine whether any information needs to be added.

The time aspect has several consequences. One is that the writer will have time to formulate her message without interruptions. Among other things, this is about finding the right word, which is one reason why it is more common to have higher lexical density in writing (cf. Ure and Ellis, 1977; Halliday, 1985). Another consequence is that the writer has to be more exact in her descriptions, since the reader does not share the same perspective. In writing, she will also have time to read through the product (although not all writers use this advantage) and to edit the text (although even fewer writers do that). In all, this means that even a very quickly written message takes longer to produce than a spoken one.

As a consequence, the writer has time to think during the actual production of letters (whether handwritten or typed) to a larger extent than when speaking. This calls for different pause patterns, which is also recognized. Pauses during writing are more frequently located between sentences, while they often occur after a conjunction in speech (e.g. Matsubashi, 1981; Chanquoy et al., 1996; Van Waes and Schellens, 2003).

In speech, with a receiver present, there is always the risk of losing the speaking turn, which puts extra pressure on the sender not only to say what she wants to say as quickly as possible, but also to develop strategies for keeping the floor when in need of a planning pause. This is not necessary in writing, because no-one will interrupt you. This leads to less repetition in writing – there is simply no need for the writer to do this, neither for her own benefit (planning), nor for the benefit of the reader (understanding), since the reader can re-read difficult or tricky parts of the text as many times as necessary. This is also one reason why less use is made in writing of “small” words or fillers.

In writing it is not necessary to repeat oneself beyond a certain extent. Doing so does not fill the purpose it does in speech. In fact, most people are encouraged (when learning to write) not to repeat themselves, or to decrease the amount of repetition to a minimum.

## 2.2.4 Learning to write

There are several differences between written and spoken language that a child must learn to cope with when she learns to write. How the child deals with these differences is – with most certainty – associated with age, schooling, practice and

cognitive development. One can therefore presume that younger children in general have a more 'spokenlike' written language than older children and that university students, who have been exposed to written language for many years, especially texts written in an academic style, have a more 'writtenlike' written language than the younger age groups (Einarsson, 1987).

Learning how to write a "good" text is learning to put oneself in another time and place. It takes a certain degree of cognitive development to understand that the writer has to put herself in the place of the reader, and then to do so successfully (Dahlstedt, 1982; Strömqvist, 1996; Biber, 1988).

The situation where children learn how to read and write is normally much more formal than the one where they learned how to talk. Children may in fact start to look upon words as items. A good part of traditional teaching on how to write concerns how to write properly - how to spell, and so on. Therefore it is easy to understand the thought - which many people have - that written language is the correct norm and that spoken language should be corrected to fit the pattern of the written language (Einarsson, 1987; Biber, 1988).

## 2.3 The grammar of speaking

The past few decades have brought a whole new, exciting perspective on spoken-language communication. Several studies have shown how systematic the grammar of spoken language actually is. Overviews are found in Norrby (2004), Anward and Nordberg (2005) and Miller and Weinert (1998). Linell (2009) also provides some important perspectives on this issue. It would be extremely interesting to describe this field in greater detail, but here I will only be able to provide an overview that will help in interpreting the data in my later analysis. I warmly recommend the books mentioned above. The field is sometimes called **discourse analysis** and sometimes **conversational analysis**. Instead of dissecting the differences between these two terms, I will use the more neutral term **talk-in-interaction** when I refer to this research field.

Traditionally, the spoken language has been considered to be ugly or less important compared with the standardized written language (Norrby, 2004; Chafe, 1994). Given the traditional linguistic ambition of describing language(s) as a system of rules (c.f. Saussure, 1983; Chomsky, 1957), less focus has been put on the users of a language than on the language rules themselves.

That conversation is "the fundamental site for language use" (Clark, 1996, p. 318), is declared by many linguists (cf. Chafe, 1992). Clark (1996) stresses that although conversations are made up of utterances, they are more than the sum of their parts. One reason is that the speaker can change her ongoing message depending on the reactions of the receiver. Unlike in writing, interactivity is an important component of conversation (Goodwin, 1995). The frequent repetitions in speech are not redundant, but instead serve to ensure that speakers pay close attention to one another and also obtain a shared sense of how they interpret the topic of conversation (Coates, 1995).

Activities of study deemed interesting by researchers in the talk-in-interaction field include counting the number of words produced per minute and determining

whether there are individual differences in speaking rate. Another research question is, How long is an utterance, and how much overlap is there between utterances by different speakers in a normal conversation? The answer to this question will depend on socio-cultural factors such as gender, race, education level, society and status. For instance, the conversations with the most words per minutes are found between teenage girls and between women in their fifties, who produce around 260 words per minute Norrby (2004). More normal rates would be 220 words/minute for children between the ages of 11 and 16 while the average for adults is 210 words/minute. The length of turns, which is measured in seconds, is also interesting. A conversation with a short average turn length indicates frequent turnshifts and a more dialogical style. Some recent investigations of spoken grammar have studied the importance of certain structures and specific phrases in conversation (c.f. Ottesjö, 2005; Nilsson, 2005). Norén introduces the concept of *apokoinou*, i.e. prosodically cohesive and syntactically partially coherent utterances where the speaker appears to change her syntactic strategy midway (Norén, 2005; Linell, 2009). Apokoinou utterances exhibit the dynamic features of speech, but it is not totally settled whether or not they contain a set of conventionalized grammatical constructions. However, apokoinou is one example of conversational practices where the speaker's orientation toward the other listener is salient, as is the temporal aspect of the social interaction (Linell, 2009).

### 2.3.1 The dialogic perspective

One of the most influential persons in the Swedish talk-in-interaction field is Per Linell. In his recent book *Rethinking Language, Mind, and World Dialogically* he summarizes, comments upon and adds to the past few decades' research on interactive spoken language in Sweden. Apart from advocating his own dialogical view on everything, the book presents much of the research in the field – research that had previously mainly been published in Swedish.

Linell (2009) emphasizes the view, presented in Lindström (2005), that grammatical constructions in speech originate from conversational practices that have been internalized by the speakers. The examples he gives are of frequent micro-situations, or local communicative situations. After a certain number of repetitions and a certain amount of time, those practices will have become routinized and conventionalized for the participants. I would like to add that this is of course not valid for spoken language only: written-language conventions are also a result of the repetition of numerous instances of a certain pattern that has been accepted, re-used and grammaticalized. Within the talk-in-interaction field over the past decade, several conversational practices have been defined. They can be characterized in sequential, functional and formal terms.

The assumption underlying the dialogical grammar presented by Linell (2009) is that the user's grammar perception has its origin in her own experience of using language (Linell explicitly exemplifies with the talking situation, but this should also hold true for writing). The implication is, however, that grammar studies must by consequence be "user-based".

Clark (1996) describes (just like Norrby (2004)) how the structure of a conversation can be seen as consisting of adjacency pairs (questions and answers, for instance). These should make up the goals and plans for the speaker and listener. However, people generally do not know in advance what they will do during a conversation, and this is because they do not know what their partner in the conversation will do. Clark calls conversations purposive but unplanned.

A conversation could be anything from informal chatting about “nothing” to well-prepared, formalized lectures, work interviews or a debate on television. We hardly notice the way a conversation is organized, as long as it works well without interruption or misunderstandings. That conversations normally work so well can be seen as proof for the existence of universal rules for how to talk to each other. There are cultural differences, but there are no cultures allowing everyone to speak at the same time or having a turn-taking system which always gives the turn to the person who speaks the loudest. An important step in a child’s linguistic development is to understand how to speak to other people. Learning new words and grammatical structures is not enough. Interactional conversational research is interested in how participants jointly create a coherent discourse. What communicative goals and relations are there between the participants? How does the power balance between the participants influence the conversation (Norrby, 2004)?

How influential and important the past few years’ descriptions of spoken-language grammar is can be illustrated by the fact that the major new descriptive grammar of Swedish included sections about spoken-language structure and grammar, thus acknowledging not only that this grammar differs from that of written Swedish but also that it is a grammar in its own right (Teleman et al., 1999). In the “short version” of the grammar, i.e. the more prescriptive one intended for use in schools (Hultman, 2003), however, the spoken perspective is less prominent, which is criticized by Anward (2004). To summarize, there is a grammar of spoken Swedish. This grammar has much in common with the grammar of written Swedish but in part these two grammars possess different structures (Lindström, 2005).

### 2.3.2 Description of the grammar of speech

Norrby (2004) gives an introduction to the interdisciplinary area of talk-in-interaction. My overview in this section is based on the first chapters of her book *Samtalsanalys* (2004). This is a very heterogeneous field, with important branches like sociolinguistics, anthropology, philosophy, sociopsychology and sociology. What they all have in common is that they study linguistic interaction. The basis for this research field is face-to-face human interaction. As (Goodwin, 1995, p. 131) puts it: “Coherence within conversation is a pervasive, temporally unfolding task”.

One of the starting points of this research field One of the starting points of this research field is Tannen (1984), where the author describes a two-hour dinner conversation between friends. This piece of work is cited by most researchers in the field. Tannen’s point of departure for her analysis is a functional one: she wants to study how an utterance is used in a specific context and to draw conclusions from that about the function of the utterance. Her main interest is to describe the here-and-now-function of the utterance.



Although there are cultural and individual differences, the most fundamental rules of turn-taking are present in all spoken contexts. These rules are acquired in parallel with the child's spoken-language development. Talk-in-interaction views turn-taking in everyday conversation as primary to that of a more formal discourse (e.g. interviews and lectures). Turn taking can be signalled in many different ways, both from the speaker and the listener. One way is for the listener to use non-verbal signals, such as gazes or leaning forward, but the speaker can, for instance, avoid eye contact with the listener, in order to keep the floor. The speaker can also useBy using intonation and temporal cues (such as speaking more slowly), the speaker can to signal that she is ready to change turns. . A place where a speaker switch can take place (defined in a process-oriented way) is referred to in talk-in-interaction as a TCU (*turn-constructural unit*) (cf. Sacks et al., 1974) (a TCU does not necessarily mean that there will be a new speaker, merely that the speaker invited the listener to talk). A place where the turn can be handed over is called a TRP (*transition relevance place*). The turn can change in different ways: (a) the speaker may point to the next spaker, for instance by asking a question, giving a gaze, or using a name or pronoun; (b) the next speaker may nominate herself; and (c) the same speaker may continue her turn.

Depending on where in the conversation a pause occurs, it is referred to by different terms in talk-in-interaction. There are lapses, gaps and pauses. With a lapse there is a risk that the conversation will end. With a gap there is a possibility for a new speaker to take the floor. Pauses, finally, are resting points for the speaker. They can consist of short micropauses (most of the time less than 0.5 s) when the speaker looks for a word or of pauses occurring at a TRP where the current speaker again takes the floor. There could also be a pause when the new speaker hesitates to start her turn.

The conversational turns can be combined in several ways, but we can also encounter overlap in the conversation. Overlap at a TRP normally means that one participant knows the rules of conversation, and knows that it is her turn to speak, and anticipates the turn-shift with a premature start of the utterance. Overlap during a turn can also be supportive, which would signal an active listener.

### 2.3.3 An example of spoken expository

I will exemplify Norrby's description of spoken-language grammar by an example from the data analysed in this thesis. Example 1 comes from an expository monologue by a female adult university student. For a complete key to the transcription, I refer to Section 6.8; for now it is enough to understand that # symbolizes a pause of unspecified length and [/] symbolizes retracing without correction. The English translation is intended to capture the meaning rather than being an actual word-by-word translation. For the purpose of discussion, I have put numbers in the English translation close to constructions that I use as examples in the discussion following the transcription. 'SBJ' ('Subject') indicates the participant's speaker lines and 'INV' denotes the experimenter's speaker lines.

- (1) SBJ: i stort sett så vill ja [: jag] ju påstå.

*SBJ: basically I'd like to claim*

SBJ: att [/] # att problemen i samhället i stort reflekteras i skolan alltså [: alltså].

SBJ: **(1) that** [/] # *that problems in society at large are reflected in school so to say.*

SBJ: så att man [/] man ska kanske inte börja å [: att] söka efter [/] efter eh@fp grunden till problemen just i skolmiljön.

SBJ: *so that you [/] you should maybe not start to look for [/] for eh@fp the cause of the problems in the actual school environment*

INV: nä.

INV: *no*

SBJ: utan i stället se i samhället i stort.

SBJ: *but instead look at society at large.*

SBJ: om [/] om man säger [: säger] till exempel.

SBJ: *if [/] if you say for example*

SBJ: att eh@fp # en hög arbetslös och # en osäker hemmiljö osäkra samhällsförhållanden # leder ju till en hopplöshet inom skolan.

SBJ: **(2) that eh@fp # high unemployment (3) and # (4) an uncertain home environment uncertain conditions in society # lead to hoplessness at schools**

INV: m.

INV: *m*

SBJ: där [/] # där de [: det] e [: är] svårt.

SBJ: **(5) where** [/] # *where it is difficult*

SBJ: å [: att] sporra eleverna <till å [: att]> [/] till å [: att] verkligen # läsa [/] # läsa.

SBJ: *to stimulate the pupils to [/] to (6) really # read [/] # read*

SBJ: så ögonen blöder.

SBJ: *until their eyes bleed*

SBJ: för att # dom [: de] vet.

SBJ: **(7) because** # *they know*

SBJ: att på grund av # hög samhällssegregering eller hög arbetslöshet att dom [: de] har kanske inte så stor chans å [: att] få nåt [: något] jobb ändå.

SBJ: **(8) that because of** # *high segregation in society or high unemployment that they may not have such a big chance of getting a job anyway*

SBJ: å [: och] alla minst ett bra jobb <som dom [: de]> [/] som dom [: de] kanske vill ha.

SBJ: *and least of all a job <that they> [/] <that they> maybe want.*

SBJ: # <så de [: det] e [: är]> [/] de [: det] e [: är] där främst.

SBJ: **(9) #** *<so it is> so it is primarily there*

SBJ: som problemen ligger.

SBJ: *the problems are.*

[wu19mDES]

First, look at where the pauses (#) occur. In the cases of (1, 2, 3, 5, 7 and 8) we find pauses immediately after the initial conjunction, indicating that the speaker will say something more. In the case of (4), we find the pause with a preceding noun phrase, indicating that the listener can expect for instance a verb or a relative clause.

This is of course a very clever way of locating pauses, since it signals to the listener that there is more to come. It is (normally) not done consciously, and it is a feature of spoken language that speakers learn as they develop their language proficiency. To both listeners and speakers, this is a natural place to pause. Pause (9) is interesting, since it may indicate a possible TRP, but since this was a monologue, produced in an experimental setting, there is no one there to take the floor. The investigator (INV) makes two short, supportive utterances, almost overlaps in the conversation.

One may also look at the instances of repetition, or in this case the special case of retracing the same word(s), indicated by [/] in the transcripts. This is often done in combination with a hesitation sound (indicated here by *eh@fp*). These occurrences may indicate planning, since both are a way of keeping the turn by using filled pauses.

## 2.4 Summary of chapter

This chapter has outlined the differences between speaking and writing. The main differences have been identified as the written product being visible and taking longer to produce, and that there is normally a listener present when you speak. All these factors influence both the performance and the product.

Further, a description of spoken-language grammar shows that there are specific rules applying to speech that both speakers and listeners follow in order to construct a conversation – the most typical spoken situation. These rules are acquired during language acquisition, and are so implicit that we notice them only if they are broken.

# Chapter 3

## Aspects on learning to write

### 3.1 Introduction

This thesis presents developmental written data produced by children from age 10 and upwards. By the age of 10, the child already possesses all (major) syntactic structures, and it is generally thought that the main linguistic development from this point consists in lexicon growth. However (as is shown by Scott, 1988), the 10-year-old child does not yet master the whole complexity of language.

This chapter will only briefly touch upon the issue of reading and early writing development, before I move on to a brief overview of some of the literature on the development of writing. There are several books with collections of articles describing various linguistic phenomena during the development of language (e.g. Nippold, 1988; Barrett, 1999a), sometimes with special focus on writing (e.g. Nystrand, 1982; Verhoeven, 1994a; Pontecorvo, 1997; Tolchinsky, 2001; Berman, 2004). There are also handbooks of writing development (e.g. MacArthur et al., 2006; Beard et al., 2009). Apart from this, numerous articles in this field have been published in various journals, and a number of related theses and monographs have dealt with the subject of linguistic development in general, and in speech and writing more specifically. As Beard et al. (2009) point out, a joint perspective from a linguistic, psychological and sociocultural view is hard to find, although that is one that I would welcome. I will certainly not be able to present all perspectives here, nor to do justice to all studies. Instead, the overview below will serve the purpose of presenting a background to the interpretation of the data later in this thesis.

### 3.2 Reading development

Reading is included in all the proposed models of writing, for instance the Van Wijk (1999) model of written production, which is inspired by the Levelt (1989) model of spoken-language production, and Hayes and Flower's (1980) model, where monitoring of the text produced so far is an important component of the writing process. However, the opportunities that have arisen in recent years to link keystroke logging with eye-tracking equipment and thereby investigate what and when people read while producing their own text have shown just how much there is still to learn about the reading factor during writing (Wengelin et al., 2009b). Reading

not only occurs during pauses in writing but can also take place concurrently with writing. In addition, some kind of monitoring of the text obviously takes place in writers who are “skilled typists”, i.e. able to look at the computer screen while touch-typing on the keyboard, as well as in all those writing by hand (Johansson et al., 2008). This shows that there remain many more aspects to investigate before the importance of reading during writing can be fully understood, and even more until the developmental process of reading can be fully described.

Historically, reading has been more studied than writing (cf. e.g. the overview in Liberg, 1990). Lundberg (1993) presents an overview of the teaching of reading in Scandinavia, and Söderberg (1993) describes literacy development during the pre-school years.

Reading is described by Scollon (1998) as a kind of social interaction. This view is also taken by Liberg (1990), who sketches a U-shaped development curve for the pre-school child’s reading acquisition (cf. Strauss, 1982). She places a sociointeractionistic perspective on reading development, concluding that the teaching of both reading and writing should be seen from a functional perspective, where the child’s feeling for the purpose of writing is crucial for successful acquisition. She further emphasizes the importance of giving the child ample opportunities to explore language in both reading and writing, in many different settings and genres. In this way, the children will learn to use written language for interaction.

### 3.3 Early writing development

This thesis deals with writing at a stage when it has already been established, but even so it might be useful to give a quick overview of the earliest stages of writing development. Several schemes for early writing development have been presented (an overview is given by Dahlgren et al., 1999). Ferreiro and Teberosky (1979) take a linguistic perspective, starting with the child’s drawing/writing of nouns. Further on, the child realizes that verbs can also be written. In the next step, a whole sentence is written as one segment, without gaps between the words. Later on, the nouns are separated, but not the verbs. After this, everything can be written down except articles, which are not considered to be real words; and finally, the child notes articles as well, and a fundamental understanding is established.

A writing schedule focusing on social aspects is created by Eriksen-Hagtvet (1988). The child starts to “write” when there is a communicative need for it (cf. Liberg, 1990). At the first stage, the child uses imitative scribbling, which is then followed by play-writing as a creative activity. After this, the child may move on to conventional letters following each other, but without meaning. Then the child starts drawing the spoken language, and after that she moves on to explorative writing, where she will use the only letters she knows to write the message. And finally the child reaches the conventional writing stage.

In the schedule of Luria (1983), the child starts by imitating the writing of adults, producing something that may look like waves or lines. At this early stage writing is not a tool and does not function as a support for memory. In the following stage, the message has a functional meaning, but no form. Then follows a stage where the characters have no specific meaning but rather represent the length and form

of the utterance and possess no conventional meaning. After this, some marks in the texts start to reflect the content of the utterances. Writing can then be used to support memory. The child can “write” and “read”. Finally, the child develops pictograms which must not be mistaken for drawings, and this leads to the final stage of symbolic writing.

## 3.4 Becoming a proficient writer

Berman and Slobin (1994) define the process of becoming a proficient speaker as learning to use linguistic forms appropriately from at least three points of view: (1) the structural one (concerning morphosyntactic features of the native language), (2) the rhetorical one (concerning how texts are typically constructed in the native language), and (3) the discursive one (suited to the task) (Berman and Slobin, 1994, p. 597-598). According to Berman and Slobin, fully integrated knowledge of all three aspects is required to become a proficient speaker. In addition, the speaker must be able to build a fully updated representation of the listener’s understanding of the speech. This view on how to become a proficient speaker is also highly applicable to the gradual process of becoming a proficient writer.

### 3.4.1 The linguistic perspective

The acquisition of literacy is a “complex cultural and psychological process deeply affecting the transformation of societies and the development of individuals” (Verhoeven, 1994b, p. 12). Literacy in a society is generally acknowledged to enhance economic expansion, although the lack of literacy in an individual would not necessarily be seen as a problem in a non-literate society. However, in the Western industrialized societies, literacy is without doubt fundamental for the individual’s opportunities to take part in society. It is from this perspective that the notion of ‘functional literacy’ is important. To be functionally literate is to possess reading and writing skills that enable you to cope with the demands of everyday life. As a consequence, the level of the literacy demands will depend on the society. As Verhoeven (1994b) shows, socioeconomic background is an important factor for reading and writing skills throughout the world.

As Barrett (1999b) puts it, language acquisition is an immensely complicated task, an extended process lasting from infancy into early adolescence and beyond. Myhill (2008) summarizes a review of text-linguistic articles by saying that there are few systematic explorations of the linguistic characteristics of children’s writing. Further, only limited attempts have been made to describe its development.

Kress (1982) points out, that when children learn to write, their syntactic ability in speech is not mirrored in their written production. This is explained by the necessity of simultaneously attending to so many tasks. By exemplifying with texts in speech and writing, Kress asks the question why an 8-year-old writer do not use the same range of syntactic forms in writing as she obviously masters in speech. The reason would be that when the child writes a story (in contrast to giving a spoken account) the cognitive load will increase by effort of keeping all information in mind.

This will make the child use syntactic, semantical and lexical structures that come most readily to mind.

Scott (1988) probably gives the best overview of linguistic (or, more specifically, syntactic) development between the ages of 9 and 19. She underlines that during this period of development, changes appear very gradually. However, sentences (defined as T-units) grow by approximately one word per year, and the rate of change is even higher in written texts than in spoken ones. As regards some structures, it is not even clear when they first enter the language; for example, we do not know when teenagers start to use nonfinite verbs in subordinate clauses in English. Scott further argues that although it is possible to lay out a developmental schedule for syntactic structures in the pre-school age, this is a much more difficult task for older children. Nevertheless there is a difference between younger children and adolescents, which shows that it is not true as is often claimed that children have “mastered syntax by the age of five”. (Scott, 1988, p. 49). Syntactic structure is greatly affected by language context. One example is that teenagers rarely use the passive voice in conversations with friends but can nevertheless do so frequently in written reports of science experiments. Scott further stresses the importance of establishing the benchmark adult level for comparisons, emphasizing that this level should be “realistic rather than idealistic”. It should also be acknowledged that there is not one but several adult standards: it is important to remember that both adults and children employ various competence levels.- This should be interpreted as the competent language user being able to adopt style and linguistic features to the genre.

When language develops, many syntactical structures will function in more than one way. Scott (1988) exemplifies with ‘because’, which functions in a semantic context of admonition for the pre-schooler but has a function of logical justification for the teenager. Scott reports from an English perspective, and since language-specific morphological factors play a role here it is not possible to transfer her results to any other language, but even so they can give a hint on the general trend. Thus, apart from T-unit length growing by one word per year, clause length increases from five words per clause in fourth grade to eight words per clause in eighth grade. It was also evident that clause length increased when students wrote for a more remote audience rather than for a more intimate one. When Scott looks at developmental studies of subordination (e.g. the number of clauses per T-unit), she finds that the third-graders use a subordinated clause in about 20% of their T-units in speech, while the twelfth-graders have subordination in about 65% of their written T-units. The growth of the subordination index (i.e. the ratio of the number of total clauses to the total number of T-units) shows a development with several plateau periods, with a general leveling-off by eighth grade.

One important factor of language development is the acquisition of different types of genres and their integration into your linguistic repertoire. But the important thing is not just learning new ways of expression, but also learning when which of them is appropriate. The teenager *not* using the passive voice talking to her friends actually shows as much linguistic awareness as she does when she *does* use it in her science reports. As adults, we hopefully have a wide range of possible ways to

express ourselves. To investigate language development and linguistic competence it is therefore not sufficient to look at one area, one genre or one context alone.

A report from the Spencer Project (within the framework of which the data in this thesis were collected) investigates the development of the measures of word length (in number of word tokens per text), mean length of utterance (i.e.. MLU) (see Chapter 8) and lexical diversity (see Chapter 10.5) in a developmental corpus consisting of spoken and written texts in seven languages (Berman and Verhoeven, 2002). The conclusions drawn are that these measures develop with age and that this development happens stepwise. Thus, this study reports few differences between 9-10-year-olds and 12-13-year-olds, but then a large step to the next group of 16-17-year-olds. The conclusion is that text length, clause length and lexical variety measure text construction on a global level, and that they are important factors in the development of skills in speech and writing.

### 3.4.2 The cognitive perspective

What does it mean to become a proficient writer? Torrance (2007) describes the cognitive perspective of writing development, where the speaker learning to write must develop the skills to represent language in a way other than in speech (i.e. express language by visual means instead of auditory ones) and become able to communicate without having a listener present. Writing development is dependent both on instruction/teaching and on practice.

Bereiter and Scardamalia (1987) distinguish two strategies that a writer may adopt in her writing. One is the **Knowledge-Telling Strategy** and the other is the **Knowledge-Transforming Strategy**. The former strategy is generally used by unskilled (i.e. often young) writers. A writer following this strategy will translate knowledge units in the order in which they are retrieved, without devoting much time to organizing content. This is an economical strategy but it does not create coherence at a global text level. The latter strategy is used by experienced writers. It includes knowledge-telling but supplements it with the possibility of global planning, which leads to an ability to plan and (re)organize the text.

Bereiter (1980) suggests that writing development does not mean that every writer must follow a fixed schedule when learning to write. Nevertheless, writing development can be divided into discrete stages, some of which are more or less naturally ordered. Further, there might be a gradual development from unskilled to skilled writers. Young writers are mainly occupied with the low-level schemes (such as putting words onto paper). Until this process is sufficiently automatized, limited cognitive capacity is available for other, more complex processes. A mature writer is characterized as being able to divide her attention among several ongoing tasks, such as planning on a global level both before and during text writing as well as planning on the local level, for instance when it comes to connecting two sentences.

Kellogg (2008) describes the development of writing as a progression through three stages. It will take at least 20 years (of maturation, instruction and training) to pass through these stages. His starting point is the knowledge-telling model of Bereiter and Scardamalia (1987). **Stage 1: Knowledge-Telling** is the beginner's stage, where the writer simply tells what she knows. **In Stage 2, Knowledge-**



**Transforming**, the writer transforms what she knows “for the author’s benefit”, while in Kellogg’s innovative **Stage 3, Knowledge-Crafting**, the writer also include the reader’s perspective in the text composition. Only adults aiming to become skilled professional writers reach the third stage, which is described in Kellogg (2006) (cf. also Scardamalia and Bereiter, 1991). In sum, Kellogg (2008) describes writing development as a continuum where improvement can be achieved by practising both basic writing processes, such as planning, language generation and reviewing, and the mental representations that must be generated and held in working memory. This means that a child can be good and more advanced as a well-known, often practised task (e.g. writing a narrative text) compared with other types of tasks. Torrance and Galbraith (2006) exemplify by stating that a child can be rather proficient at a handwriting task of producing a narrative, but the cognitive burden will increase if the child has to type a persuasive text.

In the knowledge-telling stage, the writer (often a child) may have rich ideas of her own conceptions, but she is only partially able to represent this in writing. This ability gradually increases with age, practice and schooling. A 12-year-old (according to Kellogg) may think about the future reader, yet be unable to keep that perspective in working memory. A writer must understand what the text says before she can imagine how the text would be understood by another reader.

In the knowledge-transforming stage, the writer can interact with the text, since the text representation is “stable enough to maintain in working memory” (Kellogg, 2008, p. 5). It is not integrated with the interaction of working memory until the knowledge-crafting stage. Kellogg wants to underline that working memory is under heavy strain not only from the basic process of writing but also from the “maintenance and use of the three distinct representations underlying the composition of expert writers” (p. 5). When the writer at this stage is reviewing/reading the text, this gives rise to new ideas, more text and additional planning. At this stage, writing can entail that knowledge is stored in long-term memory (cf. the somewhat different view presented in the knowledge-constitution model in Galbraith (1999, 2009), claiming that writer’s can discover things through writing, and not merely generate ideas from the long-term memory). According to Kellogg, it is clear that the writer can maintain and use representations of both the author and the text once the transition to the knowledge-transforming stage has been made.

In the knowledge-crafting stage, the writer is able to juggle, on the one hand, the processes of planning, sentence generation and reviewing and, on the other hand, contents and alternative ways of saying the same thing. Kellogg proposes that there may be a difference between the author’s intentions and ideas of the texts and the interpretations that an imagined reader would arrive at (cf. the notion of speech act and illocutionary acts discussed by Austin (1962) and Searle (1969)). Only at the knowledge-crafting stage is the writer able to fully access the three representations of author, text and reader in working memory.

Kellogg summarizes by stating that it is clear that even young children take the reader into account during text composition, but it is a difference between being aware of a fictional reader during writing and reading (a recently) finished text from another person’s perspective.

Writing development is not complete until (sometimes years) after the university level. A professional writer is also “preoccupied with what the text says in relation to what the writer already knows” (Kellogg, 2008, p. 9). When Kellogg argues that the progression from knowledge-telling to knowledge-crafting is determined by training from the school years into adulthood, he bases this on other studies of expertise, showing that it takes at least 10 years to develop expertise at something (e.g. music, typewriting, chess) (Ericsson et al., 1993, 2006).

McCutchen (2000) claims that more fluent text production (as can be demonstrated by automatized typing) allows the writer to move beyond the knowledge-telling strategy and frees up more cognitive capacity for other things. However, this view leads to a paradox, since it is a fact that less skilled (or poor) writers may write more fluently than experienced ones. The same phenomenon is described by Scardamalia and Bereiter (1991) when they discuss the notion of being an expert writer, showing that the expert writer sets higher goals (i.e. has the reader in focus) than the non-expert. This may be one explanation why writing seems to be more effortful for skilled writers (as demonstrated by more revision, more reading, longer texts, longer time on task, etc.). McCutchen (2006) observes that whereas the younger children have text generation as their primary goal, the more skilled writers apply constraints of genre, audience, style and topic, which complicates their task. In this way, the expert writer does not necessarily make her task less effortful, but she will produce a text of higher quality. McCutchen concludes by saying that without explicit tuition that demonstrates to the child how to focus and manage her resources while writing, the child may be stuck with the knowledge-telling strategy just in order to handle the cognitive demands on working memory.

### 3.5 Studies of writing during the school years

Many studies, quantitative and/or longitudinal as well as cross-sectional, have studied writing in schools. While the large scale investigation of Hultman and Westman (1977) can be said to be the starting point for this research branch of research in Sweden, other more recent theses have rather focused on certain aspects of the texts (e.g. Nyström (2000, 2001a,b) studies coherence in different genres in written texts by high-school students), certain aspects of writing (e.g. Ledin (2001) studies how children put full stops in their composition) or writing in a particular setting (e.g. Geijerstam (2006) studies text written in the subject of natural science, how writing is used when children learn natural science, both as a way of looking at writing per se and to see how writing can be used as a learning instrument and how it can be used as a means of learning other things).

Östlund-Stjärnegårdh (2001) has investigated the assessment of texts from the national test in Swedish (taken in twelfth grade). She observes that many of the texts would not pass an independent (other than the teacher) assessor. She also reports that it is difficult to assess the narrative texts. Östlund-Stjärnegårdh's article is also interesting in that it gives an overview of the Swedish school system.

Ledin (2001) describes how two groups of children (aged 8 and 12) use full stops to mark out sentences. He distinguishes two basic sentence functions in the children's compositions: one topical function and one schematic function. In the

topical function, the sentence is organized around a specific theme, and the full stop marks the ending of the coherence unit. For a narrative, this means that the sentence consists of a minimal narrative and that the next sentence will often correspond to the beginning of a new narrative. The children struggle with creating coherence between sentences, but some of the youngest children in his data may actually not have that problem because each of their sentences consists of one theme or narrative in itself. In the narrative texts, the episode can be told in a single sentence, and in the expository texts one sentence consists of one example. In the dialogic text, there is one speaker utterance per sentence. This textual function of the sentence as a unit is one explanation of the phenomenon of comma splice (linking syntactical sentences with commas rather than major delimiters), and the use of conjunctions is also influenced by this. The older children in Ledin's study use their sentences in a schematic way; as a result each sentence contains less material, which entails an increase in the use of conjunctions.

A study of high-school writing has been performed by Nyström (Nyström, 2000, 2001a,b). She investigates the cohesion of expository texts by high school students by looking at their use of references. She gives an interesting genre perspective on the topic by concluding that the existence of many referent-identity-connections in a text is a sign of narrative sections in expository discourse, explaining this by stating that this is one way for a writer to master an otherwise unknown genre. In this way, reference-cohesion can be used to shed light on one of the classical problems of writing development: how students learn to master expository writing.

Strömqvist (1996) suggests that in the early phase of writing acquisition, a writer can be expected to generalize her knowledge from spoken language into the new domain. Strömqvist presents a developmental study of how children (9, 12 and 15 years old) and adults speak and write about a picture-based story (the *Frog Story*) and some of the same persons performing a written-composition task (with the preset headline "I was never so afraid"). All participants told the Frog Story in both speech and writing, and the experiment was balanced for order so that half of the subject started with the writing task and half with the spoken task. The writing tasks were performed in ScriptLog, a keystroke-logging program (see Section 7.2).

Strömqvist studies the spoken texts from the Frog Story and discovers an over-representation of left dislocation (i.e. first presenting the main noun or the topic of the conversation and then commenting on the topic, e.g. "the dog, he's tearing down the beehive here" (Strömqvist, 1996, p. 21)) in the spoken texts that were produced first. Left dislocations do not occur at all either in the written texts or in the spoken texts preceded by a writing task. This is thus an example of the influence of writing on speaking (cf. Slobin, 1996).

In the presentation of the results from the written texts from the composition task, Strömqvist investigates the pauses and concludes that, compared with speaking, the written texts contain more frequent word-internal pauses. He reflects that if you make a word-internal pause in speaking, this would make the perception and understanding of the word more difficult. If you stop to pause in the middle of a word in speech, you would repeat the word again. Since the on-line constraints of speaking are not present in writing, word-internal pausing is possible with no need to repeat the whole word.

Along with other researchers, Strömqvist observes that, from a developmental perspective, the stylistic differences between speech and writing do not occur just because the children start to write and encode linguistic messages in writing. Instead, the development is slow and takes a long time (Strömqvist, 1996).

Myhill and Jones (2007) applied the method of focused observation of students from grades 9 and 11 (ages 14 and 16) when they wrote compositions in the natural setting of the classroom. This was followed by interviews where the students were asked about choices they made during their text composition. Their results show that most students claimed that they did not revise at all during writing. They interpret this as a cognitive strategy to reduce the demands on working memory during writing. Some of the students even seemed aware of this. However, Myhill and Jones question the reliability of the students' self-report on this matter, since evidently most students did revise during writing (although the amount of revising differed). They therefore conclude that although students may report using a macro-strategy of writing down thoughts first and not revising, most of them do perform micro-level revisions during writing. The student interviews show metacognitive awareness of the writing processes, although many of the students are still mostly concerned with "better ways of saying things".

### 3.5.1 Writing in new media

Writing is used in its own right as a form of communication everywhere in our society today. Karlsson (2006) shows in her book *En arbetsdag i skriftsamhället* what a working day in the "writing society" can be like: The lorry driver is guided by written instructions to where he is to load his cargo and also has to present a written report by the end of the day. The girl at the shop counter is required to read and write in order to be able to sell. The nurse at the hospital must write down the date and time when she changed the patient's bandage or check by reading the case records that the right medication has been given.

As is pointed out by Britt-Louise Gunnarsson in the introduction to Gunnarsson and Karlsson (2007), the boundaries between speech and writing and between picture and text are not very clear in the new kinds of texts we find today. Anna-Malin Karlsson is one researcher who has been looking at text in conjunction with the situation in which it is used. The relevance of this perspective is especially clear when it comes to hypertext and intertextuality in texts on the internet, where the visual aspects are crucial to both the reader and the writer Karlsson (2001). Karlsson (2007) reflects that a broader definition of "text" could move the focus from the actual text to the situation around it (links, pictures, etc.). Today, reading newspapers (and similar texts) on the internet is part of almost everyone's everyday reading. The multimodality that Karlsson describes is an important feature of this, and although the focus of this thesis is the writer's perspective, the texts we encounter as a reader influence how we write. Thus, it is interesting to have studies describing how the reader reacts to newspaper reading on the internet (c.f. Holmqvist et al., 2004a; Holšánová, 2007)

Others have investigated how writing is used in new media such as e-mail, text messaging, internet chats and other internet communities. For instance, Hård af

Segerstad (2002) shows how in the new media, the limitations of time, space, non-verbal cues and reading effort give rise to creativity that promotes new ways to communicate: abbreviations, emoticons and new word forms. Bellander (2006) describes the communicative situation of young people today. Although many of them use internet chatting as a way of communicating, Bellander sees this rather as a complement to telephone calls, e-mail messages and MSN. She also concludes that short memo writing may be replaced by, on the one hand, notes in the mobile phone and, on the other, quick oral communication (it is easy to call and ask for the entry code to a building or a password when everybody constantly has their mobile phone with them). I think it is clear that many children and young adults today write much more than their peers of one or two generations ago, although they may not always engage in the traditional letter-writing or note-taking typical of the older generations, but rather in an interactive, instantly rewarding internet debate, with chats, blogs, video logs, MSN, texting, etc.

The text material of the present thesis was collected in 1998-1999, when the influence of internet's instant messaging, blogs, social media and mobile phones with texting and constant accessibility was less prominent than today. I dare say that the use, accessibility and necessity of written media during an ordinary day has undergone an unprecedented increase during the past decade. In that sense the results in this thesis to some extent reflect "the good old days".

## 3.6 Summary of chapter

This thesis deals with the development of writing once the fundamental knowledge is established, i.e. the youngest age group included in the present study is the 10-year-olds. Several studies show that the linguistic development (concerning e.g. both syntactic structures, ability to set and meet rhetoric goals, and genre knowledge) develop substantially also after this age. In a cognitive perspective, the more experienced writer is able to include perspectives of text and reader into the task of writing.

Studies of writing in new media (computer, sms, chat, blogs etc.) also show that writing is used in a variety of activities in today's society. This both changes how we look upon the written medium, but also how and when writing is used. Good writing skills are more important than ever before.

# Chapter 4

## Models of writing

### 4.1 Introduction

Since the beginning of the 1980s, several writing models have been proposed with the aim of explaining the complexity and “major cognitive challenge” of writing (p. 389 Kellogg, 2008). This chapter will present a brief overview of the most influential models and of how their main components or theories have been addressed and investigated over the past three decades. There will not be room to deal in depth with all the theories here, so it may be important to remember that the models propose “different but complementary aspects of verbal production”, as it is expressed in the book *Through the Models of Writing*, which provides an excellent overview of the writing models (Alamargot and Chanquoy, 2001, p. 20).

The first writing models presented here all share the feature of being recursive, while the last one is a connectionist model (Dell et al., 1997). Alamargot and Chanquoy (2001) comment that since only input and output representations can be evaluated in a connectionist model, it is more complicated for the researcher to investigate the writing processes using such a model.

In this chapter I briefly describe the most influential models of writing. I also include a short review of some studies concerning one of the issues most often addressed: working memory. There are many more aspects of writing processes (Hayes and Flower, 1980) that are not reported here; for instance, very little is said about the reviewing process, including reading, editing and models of revision. Some further aspects of the field are described in Chapter 9 (about transition) and Chapter 11 (about pausing). Also, note that the model of Bereiter and Scardamalia (1987), i.e. the knowledge-transforming model, is described in Section 3.4.2, as is the knowledge-crafting model of Kellogg (2008).

### 4.2 Models of writing

In the seminal model of Hayes & Flower from 1980, three fundamental processes of text production are suggested: **planning**, **translating** and **reviewing**. These processes should not be seen as sequential elements but rather as iteratively performed actions carried out throughout text composition (Hayes and Flower, 1980; Flower and Hayes, 1980).

The concept of planning embraces the formulation of goals and the generation and organizing of ideas to achieve those goals. The translating process consists of transcription and text generation. Thus, this is the process whereby the ideas from the planning phase are given linguistic form and put onto paper or screen. Finally, the reviewing process comprises reading and editing of the text already written text. The three processes are governed by a fourth process: **monitoring**, which functions as a regulator of the recursiveness of the writing process.

The model was revised by Hayes (1996). In the new version, the model also contains components of the cognitive processes involved in the writing processes, such as text interpretation, reflection and text production. Further, the new model discusses motivation components, such as goals, cost/benefit estimates and long-term memory, including factors such as task schemas, linguistic knowledge and knowledge about topic, audience and genre. Both the physical environment (e.g. the text produced so far), the composing medium (e.g. computer or handwriting) and the social environment (e.g. the audience or the writer's collaborators) are included in the new model. The importance of working memory for managing all these processes is also discussed.

### 4.2.1 The Levelt's speaking production model

The model of Hayes and Flower affected several other linguistic models. One example is Levelt's speaking model (Levelt, 1983, 1989), which provided the means for a theoretical comparison between speech and writing (Alamargot and Chanquoy, 2001). According to Levelt (1983), the process of speech production consists of five components:

**Message construction**, where the intended content is generated.

**Formulating**, where phonetic strings are generated.

**Articulating**, where the phonetic plan, or "internal speech", is converted using motor programs and the message is executed.

**Parsing**, which is the sum of the producer's ability to understand spoken language, including the ability to parse inner speech.

**(Self) monitoring**, which, first, compares parsed aspects of inner and outer speech and, second, detects speech errors, etc., as well as prosodic aspects of speech.

In Levelt's (1989) model, the pre-linguistic phase of planning is seen as the most important phase. This is called **the conceptualizer** and the linguistic process of formulating the message is called **the formulator**, which includes lexical choices and syntactic ordering.

The general criticism of the Levelt model focuses on its failure to take into account the fact that the expressive means may influence both content choice and expression (cf. the knowledge constitution model of Galbraith, 1999, 2009).

### 4.2.2 The Van Wijk model of writing

The Levelt model has inspired Van Wijk (1999) to propose a similar model for written language. Van Wijk (1999) also integrates the theories of Bereiter and Scardamalia about knowledge-telling and knowledge-transforming into the model. One key aspect that is emphasized is that writing expertise depends on both low-level processes (like memory retrieval) and high-level processes (like the overall goals).

## 4.3 Working memory

The notion of **working memory** has played a big role in many of the theories of writing. Kellogg's model from 1996, based on Baddeley's model of the working memory, is the most-used model (Baddeley, 1986; Kellogg, 1996). Working memory is described by Baddeley as a temporary storing and processing system. Working memory plays a key role in most cognitive tasks and is said to be composed of three major components: **the central executive** and the two slave systems it controls, namely **the phonological-articulatory loop** and the **visuo-spatial sketchpad**.

The function of the central executive is to allocate attentional resources. This includes the management of some activities and the inhibition of others. The function of the phonological-articulatory loop is to store acoustic and verbal information, while the visuo-spatial sketchpad stores visual and spatial information.

Torrance and Galbraith (2006) describe the two main schools when it comes to explaining the limitations to the mind's capacity to process information. The first of the two complementary explanations is the dual-task interference, which is based on the observation that when a person performs two tasks at the same time, the performance of one or both tasks will typically be reduced. The second explanation is that there are limits to our ability to keep information in mind. If there is too much information, short-term memory will not be able to keep it all active, which means that performance will be impaired.

Torrance and Galbraith (2006) describe the two main schools in explaining the limitations in the mind's capacity to process information. The two complementary explanations are first the dual-task interference, which has observed that when a person performs two tasks at the same time, the performance in one or both tasks typically will be reduced. The second explanation is based on research investigating the short-term memory. This research area explores the mechanisms at work when the writer concurrently must keep different kinds of information available in the working memory. There seem to be limits in our ability to keep information in conscious awareness, and the performance will be decreased, when the short-term memory is not able to handle it all.

### 4.3.1 Studies addressing the issue of working memory

Working memory has played a crucial role in explaining large part of the difficulties that a writer experiences when juggling the constraints of writing. Many studies investigate or discuss how a reduction in one constraint (e.g. low-level processes like typing or handwriting) can improve the performance of high-level processes (like



planning and revising). For instance, Kellogg (1988) proposes two ways of easing the writer's cognitive burden. First, the outline strategy, where the processes of generating ideas and organizing content precede the writing phase. Second, the strategy of the rough draft, where the translating process is facilitated by the fact that there is no need to worry about formulation or about the appropriateness of expressions (also cf. Kellogg, 1990).

Around the age of 10, children without learning disabilities typically seem to have developed sufficient writing fluency, which will reduce demands on their working memory when they are writing (e.g. Bereiter and Scardamalia, 1987).

Several studies have compared children's (free) writing with dictation tasks, finding that the texts in the writing tasks are in general shorter (Bereiter and Scardamalia, 1987). Other studies have first divided the translating process proposed by Hayes and Flower (1980) into subprocesses. Two of the processes, transcription and text generation have, for instance, been further divided by Berninger et al. (1994), who describes the transcription process as comprising spelling and handwriting, while text generation (according to Berninger et al., 1994) is the mental production of a linguistic message. By using this terminology, Berninger et al. (1997) suggest that by improving handwriting fluency, children also improve their fluency of text generation.

McCutchen (2006) claims that transcription will never be so automatic that it requires no cognitive resources at all. She has explored above all the translation process of Hayes and Flower's model. In several studies she addresses the importance of working memory for the generating of text. In McCutchen (2006) she discusses how the most important processes for text production, namely transcription and text generation, compete for the cognitive resources of the writer's mind.

McCutchen (1994) compares the writer to a switchboard operator having to divide her attention between several ongoing activities. Less experienced writers will have difficulties carrying out this demanding task. These conclusions were drawn after an study where McCutchen used a verbal protocol to investigate the writing process of two professional journalists at work. Although they wrote about their respective expert areas, she was struck by the time and effort behind translating the plans and knowledge into sentences. She explains this by claiming that their translation process consisted not so much in generating sentences as in producing sentences that corresponded to the rhetorical goals of the newspaper columns they were writing. During their composition, they switched their attention between reviewing and planning and translation, and she emphasizes that the iterativity of the process was salient. She contrasts this with children's writing, where for instance the sentences of second-graders were only vaguely related to each other. Sixth-graders, by contrast, managed to create coherence in their texts. This, according to McCutchen, is evidence that these writers are able to keep several constraints in mind during the writing process. One conclusion drawn is that good writing is the result of the translation process being carried out concurrently with the planning and reviewing processes. This leads to the view that the better coordination there is between these processes, the better - or easier - writing will be.

Piolat et al. (2004) investigate the revision process. During the revision of spelling, syntactic or coherence errors in a text, the writer's working-memory ca-

capacity was examined by means of secondary auditory probe tasks. No differences in cognitive effort were found depending on the kind of errors that was corrected. First, the authors show that reading to identify problems is more effortful than reading to understand a text. Second, they argue that checking their own text is an effortful process for the writers, and that when this difficult process is taking place, the writers will simply increase the duration of the activity. This means that when faced with a difficult task, the writers will simply take longer to finish it in order to reach the same results.

Bourdin and Fayol (1994) made three assumptions about working-memory capacity in writing: the first was that this capacity is limited, the second that each component of writing entails a cognitive load, and the third that any increase in the amount of attention devoted to one component will decrease the amount of resources available to other components. To test this, they overloaded the lower-level components by asking adults to write in capital letters. This increased the load from transcribing the written text and consequently led to a decrease in memory performance in that higher-level components suffered.

Fayol (1999) describes a study by Zesiger (1995), who studied young children's graphic transcription and found that this develops from a slow, irregular and highly controlled process to a fast, regular and mainly automatic process in adults. The consequence of this is that the adults are not impaired in their management of higher-order activities in writing. Fayol argues that in order to reach the goal of composing good texts, writers will have to find ways to manage the difficult situation of having different processes competing for cognitive resources. If the skills of typing, spelling, grammatical choices (e.g. agreement) and the like are improved, this will increase cognitive room for higher-level activities such as global text planning (cf. McCutchen, 1994).

Fayol (1999) proposes that the coordination of writing processes can be achieved in two ways. One is to automatize processes and the other is to adapt the writing rhythm to the problems that arise. An example of the second strategy is shown in Chanquoy et al. (1990), who report that the adults slowed down their rhythm of low-level motor processes (e.g. transcription) to accommodate high-level processing demands. This means that they write more slowly when the cognitive demands increase. Compared with children, they had longer pre-writing pauses and between-clause pauses, which would be an indication of more costly higher-level processes taking place. At the same time, their within-clause writing rate slowed down, which in turn could be an indication of an increase in working-memory load. The more constantly slower writing rate for younger children (showed e.g. by Wengelin, 2006)) would thus suggest that they are constantly occupied with lower-level activities, thus having less capacity left to engage in processes on a higher level.

Olive and Kellogg (2002) built on for example Fayol (1999) when they designed an experiment where children and adults composed texts while their reaction time was measured during handwriting while composing, pausing while composing and handwriting while copying. The results show that the children's handwriting requires an equally large effort regardless of whether they are copying or composing. The authors interpreted this to indicate that the children were unable to activate high-level writing processes together with motor execution and thus had to suspend

the transcription of text in order to think about what to write. They call this a *serial strategy*. The adults, on the other hand, use a *parallel strategy*, where they are able to execute the motor activity of transcription at the same time as they are engaged in high-level writing processes. This is shown by the fact that handwriting is more demanding when they compose text than when they copy it. However, when the adults were asked to write in capitals (cf. the experiments of Bourdin and Fayol, 1994), they also adopted a serial strategy, which is explained by the fact that the low-level motor execution of forming the capital letters demanded too much cognitive power and thus excluded simultaneous engagement in high-level processes.

According to Torrance and Galbraith (2006), competition for cognitive resources must decrease in order for writing development to progress. There are broadly three ways to achieve this. The first is to automatize (to as large an extent as possible) the low-level skills of writing, particularly transcription. The second is to develop skills that help you maximize your memory resources. One way of doing this would be to identify relevant information, in order to be able to focus on the task. For instance, Ransdell et al. (2001) advocates excellent bilingual skills as one factor that enhances the suppression of irrelevant information. Another example could be the report by Myhill and Jones (2007) that children claimed not to revise during text composition, as a strategy to reduce the cognitive load. The third way includes different strategies of pre-planning, for instance note-taking and draft-making, which will reduce the influence of the planning process on text generation.

## 4.4 The knowledge constitution model

The knowledge-transforming model of Bereiter and Scardamalia (1987) is an important extension of Hayes and Flower's (1980) model, specifically addressing the process of idea generation (Galbraith, 2009). The primary constituents of the model are described in Section 3.4.2 (on page 25).

According to Galbraith (2009), the knowledge-telling model accounts for writers who ask themselves questions like "What do I know about this?" or "Does this sentence correspond to the idea I want to express?", while the knowledge-transforming model embraces writers who ask themselves a question like "If I want to achieve this, then what is the first step I need to take?" (p. 55). When a writer shifts from one focus to another, this will thus have a great impact on text production. However, Galbraith (2009) claims that the model of Bereiter and Scardamalia (1987) does not fully describe the whole process of text generating. One aspect that is not accounted for is how new content is formulated during writing.

Galbraith (1999, 2009) has presented the knowledge constitution model as a way of explaining how writers who obviously can be classified as knowledge-tellers do generate new, coherently organized ideas during writing. Bereiter and Scardamalia (1987) argued that idea-generating consisted inof retrieving information from memory, and did not take into account the fact that the new, unfolding text and/or the writing process in itself could develop the writer's understanding of the topic. The model of knowledge constitution builds on the connectionist models of e.g. McClelland et al. (1995) and others. In this model, Galbraith is able to show why a writers are able to "find out what they think by seeing what they say" (Galbraith,

2009, p. 61). This is done by activating a network of constituents in the semantic memory every time a writer sits down to fulfill the goals of a specific topic and task. The best constituents in the semantic memory will be selected to form an utterance, which is much in analogy with the knowledge-transforming model of Bereiter and Scardamalia (1987). The difference is that the content in Galbraith's model is synthesized, which is the key to why new content created by the writer is not merely content generating from memory. Galbraith writes that "in this model, progressive refinement of thought is achieved in the text itself, and involves successive dispositional responses to emerging propositions rather than a progressive redefinition of rhetorical constraints." (Galbraith, 2009, p. 62).

While the model of Bereiter and Scardamalia (1987) accounts for the progress of writing development, by contrasting linear writers following a knowledge-telling strategy with skilled writers following a knowledge-transforming strategy which is characterized by achieving global rhetorical goals, Galbraith (1999, 2009) offers another explanation of why writers do not always behave according to this model. By claiming that the writers in fact do not retrieve content from memory, but rather from pieces linked together in a semantic network, he is able to explain why some writers learn things they "did not know" through writing. In this sense, writing becomes a knowledge-constituting process.

## 4.5 Summary of chapter

In this chapter, a brief overview is given of the most influential model of writing, the model of Hayes and Flower (1980). The investigation of the three processes of planning, translation and reviewing, as well as their sub-processes, has dominated writing research in the past three decades. The complementary model of the knowledge-telling and knowledge-transforming processes during writing (Bereiter and Scardamalia, 1987), as well as the model of working memory (Baddeley, 1986; Kellogg, 1996), have also influenced thinking and studies. While these models are recursive models of the processes of content generation and text production, Galbraith (1999, 2009) presents a connectionist model to explain the fact that some writers seem to create new knowledge through writing.

All in all, these theories provide the underpinning for large part of the explanations proposed in this thesis.

# Chapter 5

## Genres

### 5.1 Introduction

This thesis focuses on spoken and written texts produced in two genres: the narrative genre and the expository genre. The texts and the process behind the construction of them will be compared in different ways, and I will discuss how the characteristics of each genre affect the writing process. To do this, it is necessary first to give a background of what is generally meant by ‘narrative genre’ and ‘expository genre’.

In the present chapter I will first look at the definition of ‘genre’, and especially at how the narrative and expository genres have been defined. I will further look into some theories about the complexity of genres, which will serve as a framework later on when I discuss the constraints of genre in relation to language production. Finally, I will present an overview of other studies that have focused on genre and genre differences in speech and writing.

### 5.2 Definition of ‘genre’

The notion of ‘genre’ comes from literary studies. In linguistics, there are several more or less synonymical expressions relating to this notion, and it is not always easy to distinguish among them. Some scholars (cf. Ledin, 1996) make a distinction between *genre* and *text type*, while others prefer to use the term *discourse* (cf. Longacre, 1983).

In the study of literature, the traditional core genres have been poetry, drama and prose. These genres may then be further divided into subgenres; for instance, drama can be divided into tragedy and comedy. Various factors can be used to determine genre: content (e.g. crime, love story), form (e.g. epistolary novel), style (e.g. humoristic, realistic, naturalistic), target audience (e.g. children, adults, people working at hospitals), background of the writer (e.g. working-class novel), purpose (e.g. entertainment, propaganda), etc. These are all examples of a rhetorical definition, which sees genre as a way to categorize texts (Donovan and Smolkin, 2006).

The *social tradition*, introduced by the work of Bakhtin (1986), defines genre in another way. For instance, Labov would say that it is the social setting of a specific text (written or spoken) that determines its genre. The definition of ‘narrative genre’

according to Labov and Waletzky (1967) quoted in Section 5.3 above is an example of this kind of definition.

A third way of defining a genre is what Donovan and Smolkin (2006) call the *cognitive-psychological or empirical tradition*, which is used by Bereiter and Scardamalia (1987) and others. When Coirier et al. (1999) describe argumentative texts as distinct from other types of texts, they are part of this tradition.

### 5.2.1 Genre and text type

Ledin (1996) makes a distinction between *genre* and *text type*: "A genre classification is based upon prototypic distinctions about the referent, while a text type is a definition of a scientific categorization, based upon analytic models of e.g. literary or text-linguistic type" (Ledin, 1996, p. 12). 'Genre' is thus defined by reference to a prototype while 'text types' can be specified by means of a set of properties. According to Ledin, it is obvious that the narrative text type can be used for various social functions – to argue, entertain, inform, and so on. It is also obvious that a text belonging to a certain genre may contain one or more text types and that a certain text type may be found in different genres. Ledin exemplifies this with the journalistic genres, where it is likely that the descriptive text type will occur in all genres. It is further possible to relate genres to the dominant text type. On this reasoning, news reporting will typically be narrative, while letters to the editor will typically be argumentative. Another aspect of this is that a genre is often identified with its dominant text type.

Ledin argues that a text classification using linguistically internal parameters should be separated from a genre classification based on socio-cultural grounds, which is why he uses the term 'text type' for the discourse categories proposed by Longacre (1983) (see below).

Svensson (1993) writes that each text type or genre is constituted by a combination of linguistic and textual features with no constant proportions. Because of historical circumstances, there may develop conventions that cause the proportion of features in a given 'text type' to be similar from one text to the other, but it remains possible at all times to break those conventions when producing a text.

There are several text-type typologies in the field of linguistics. Werlich (1983) lists five text types: descriptive, narrative, expository, argumentative and instructive. Biber (1988) uses a vast number of factors to categorize genres and subgenres in the English language, for instance making a distinction (although a small one) between personal telephone conversations and business telephone conversations as well as between scientific academic prose and financial press reportage. Although I think most people will agree with Biber that there exist fine but distinctive differences between, for example, different types of conversations, Werlich's list is intuitively more useful and more manageable.

Longacre (1983) uses the term 'discourse' in his analysis of both dialogical and monological texts. I will here be concerned with his views on monological texts. Longacre finds that there are differences among monological discourses. In some cases the differences are obvious (such as between a fairy tale and a political speech),

and sometimes several discourses are used in for example a novel. We should also bear in mind that there are similarities between discourses, for example between a short story and a fairy tale. He calls for a classification that distinguishes among more (semantic) structures, that relates more to the overall purpose of the discourse and to surface structures, and, finally, that deals with formal characteristics. In many ways he shares Biber's views on the taxonomy of genres. Longacre further discusses the four text types of narrative, procedural, behavioural and expository based on two parameters: agent orientation and contingent temporal succession. The various text types are to be found at different intersections of these parameters. On this theory, the narrative text type is characterized by a present agent and a contingent temporal succession — or, in other words, by having a main character and a chronological (and temporal) progression. These properties are manifested by certain linguistic characteristics, such as the use of dynamic verbs and first- and third-person pronouns. The expository text type would be described as having logical, topical linkage, with themes rather than participants. Chronological linkage would be non-characteristic of expository discourse. From this, we understand that the narrative and expository genres are each other's opposites in Longacre's scheme.

Biber (1988) presents a huge-scale contrastive study of genres in speech and writing where he applies factor analysis to three large corpora (comprising some 960 000 words in all). The outcome of the analyses is that texts are plotted according to genre in a six-dimensional model. Biber shows both that there are no clear differences between spoken and written texts (as certain written texts have characteristics which are also to be found for spoken texts) and that several (different) genres could be associated with the same entities. Thus the borders between modalities and genres are not as clear-cut as we tend to think. Biber claims that the important contribution of his study is to form a typology based on linguistic features that may function as a definition of different text types (or 'genres', which is the word he uses).

## 5.3 The narrative and expository genres

### 5.3.1 The narrative genre

The **narrative genre** is defined as a story with “a series of logically and chronologically related events that are caused or experienced by actors” (Bal, 1985, p. 5). Labov and Waletzky (1967) further describe a narrative as typically having a beginning, a conflict and a resolution. The narrative events are organized in a sequential way, with a common theme holding them together. Thus, the typical structure of a Western-world narrative can be described as follows: The narrative starts with an exposition or setting, which provides temporal and spatial information, and introduces the actors and the setting. The next step is the initial event of the plot, which is followed by one or more event-based episodes where the protagonist attempts to resolve problems or to reach a goal. The narrative ends with a resolution, often extended with a coda, where the chain of events can be related to the present time in which the story is told (Labov, 1972; Berman, 1999; Labov and Waletzky, 1967; Tolchinsky et al., 2002).

A specific type of narrative is the personal narrative, which is the focus of study in this thesis. Labov (1972) describes the personal narrative as “one method of recapitulating past experience by matching a verbal sequences of clauses to the sequence of events which (it is inferred) actually occurred” (Labov, 1972, p. 359-360).

The typical structure of a narrative is already known to preschoolers, although younger children have difficulties in giving an overall structure to their stories (Karmiloff-Smith, 1981). At the age of nine (in fourth grade), children have access to the schemas of a well-formed personal narrative (Berman, 1999; Berman and Slobin, 1994; Nordqvist, 2001; Strömqvist, 1996). This is thus a genre that is mastered – in both speech and writing – at an early age.

### 5.3.2 The expository genre

An **expository text** must (just like a narrative) be hierarchically structured around a beginning, a middle and an end. But where the narrative text follows the chronological and temporal order of events, the expository text may contain conclusions and generalizations drawn from an example (which may form a small narrative in itself) (Berman and Verhoeven, 2002; Tolchinsky et al., 2002). Further, an expository text is most often characterized by its informative and explicatory purpose (Gayraud, 2000, p. 94-06). Lacking a chronological structure, the expository is instead built up by (logically) linked arguments or themes (Longacre, 1983). The construction of an expository calls for a higher cognitive development, particularly concerning monological text production (as is the case for the texts in the present thesis) (Scinto, 1986; Katzenberger, 1999). This leads to a large difference between experienced and inexperienced writers (Berman and Verhoeven, 2002).

The expository genre is mainly introduced and taught at school. Berman (1999) specifically associates the expository text with academic language, pointing out that this discourse is encouraged in schooling on higher levels. The expository discourse is thus associated with a high level of literacy (Berman, 1999; Goutsos, 1996; Pellegrini and Galda, 1998).

### 5.3.3 Narrative and expository: a comparison

“Canonical narrative organization may be manifested even in personal-experience accounts which are not particularly interesting in content, or complicated in episodic structure. But in expository texts, discourse organization and discourse content are intertwined, and the structuring of a piece of expository discussion depends not only on how the flow of information is organized, but also on the propositional content of the information it conveys.” (Berman and Verhoeven, 2002, p. 19).

The lack of a constraining structure (cf. Longacre, 1983) in the expository text is emphasized by Tolchinsky et al. (1999). They further claim that the narrative elements of the protagonist and the chronology of events (with an opening and a closing) facilitate story-telling. Unlike in the narrative discourse, the protagonist of the expository text is a topic rather than a person (cf. Havelock, 1986). Further,



there is less need for expository writing in everyday life, since such texts usually occur in more restricted environments, such as the academic sphere. More often than in other environments, children are exposed to expository discourse at school. That is also where children are specifically taught and asked to produce expository texts.

The ability to take a global perspective on the text in order to produce a persuasive and generalizing text (i.e. an expository text) is emphasized as a prerequisite by Matsushashi (1981), who contrasts this kind of writing with linearly ordered narrative-like descriptions. On this basis, she assumes that it is more difficult to produce a generalizing and persuasive text (i.e. a type of expository discourse) than a narrative-like text.

The narrative structure is already well known to preschool children (cf. Berman and Slobin, 1994; Nordqvist, 2001)). The expository genre, on the contrary, is something that is learnt later in life, and perhaps even learnt through the written medium (for example by reading other expository texts and writing school reports), since it is seldom used in spoken conversations. A pre-literate child will thus rarely or never have experienced the expository genre. Consequently, a 10-year-old will have encountered expository discourse (for example in school textbooks or in newspapers) but may not be very familiar with producing it herself. The linguistic structures used by writers to communicate their thoughts and ideas differ between the narrative and expository genres (van Hell et al., 2008). This may in itself indicate that different processes are at work when the texts in those genres are produced.

## 5.4 Genre in a developmental perspective

Donovan and Smolkin (2006) give an overview of children's understanding of genre as related to writing development. They claim that children's pretend readings, dictations and readings aloud of early writing attempts show that children know about genres before they start to use them themselves. Torrance (1996) emphasizes that appropriate genre knowledge is an essential component in writing expertise. With knowledge of the genre in question, a writer will produce a certain discourse with more ease. This should be valid for both younger and older writers.

Donovan and Smolkin (2006) observe that two genres, story-telling and informational texts, are the ones most commonly encountered at school. After going through the literature on genre studies and writing development, they conclude that children need to be exposed to a variety of genres from an early age on, to enhance their understanding and use of genres. On the other hand, they point out that more research is needed for us to understand whether certain ages are especially propitious for exposure to certain genres.

## 5.5 Other studies where genre matters

Genre is a component in many studies of writing, although the texts in question are not necessarily contrasted with texts belonging to other genres. For instance, Dellerman et al. (1996) look at argumentative texts, Chafe collects narratives from

“different people talking about the same thing” (Chafe, 1980, p. xii) using the *Pearl Story*, Berman and Slobin (1994) look at narrative structures in several languages using the *Frog Story*, and Nordqvist (2001) and Wengelin (2002) do the same thing in Swedish, although they also include other genres in their analyses. Geijerstam (2006) studies genres used to write about science at school.

Svensson (2001) is one of several researchers dealing with a genre referred to in Swedish as ‘sakprosa’. He translates this into English as *non-literary prose* and claims that this seems to be a Scandinavian phenomenon, but I would say that this genre has so much in common with a general notion of ‘expository’ that some other studies of sakprosa deserve to be listed here as well, for example Englund and Ledin (2003); Hellspong and Ledin (1997) and other publications within the project *Svensk sakprosa* (Svensson et al., 1996; Lagerholm, 1996; Svensson, 1993). Other relevant research deals with the debate article as a text type produced by students (Östlund-Stjärnegårdh, 1997) and with essay writing at school (Nyström, 2000).

Langer (1985) investigated to what extent children in grades 3, 6, and 9 differentiated between the genres of story and report. She shows that children structure their stories and reports differently from early on and that they have strong notions of the characteristics of each genre. She also showed, using several measures, that both genres grow in complexity with increasing age and that the students’ control of the genre-related structures improves.

Few studies compare genres in different modalities. One exception is Einarsson (1987), who compares expository material (although the texts in his study may be classified as informational texts, debate and essays, they all belong in the expository area). Another example is Wengelin (2002), who compares spoken and written picture-elicited narratives, personal narratives, route descriptions, letters to the editor and job applications. Somewhat similar genres (and data) are in focus in Strömquist and Ahlsén (1998).

Comparison between genres, from a developmental perspective as well, is performed by Gayraud (2000). She investigates the French part of the Spencer Study (see Section 6.2), but instead of only looking at narrative and expository texts she also makes comparisons with argumentative texts. The Spencer Study has generated several studies of genre in different modalities, such as Ravid and Berman (2006), on how information density varies in spoken and written narratives in English and Hebrew.

Johansson et al. (2008) compare picture description with expository texts. Andriessen and Coirier (1999) devote a whole book to the production and foundation of argumentative texts. Piolat et al. (1999) investigate the development of argumentative schemas, concluding that text writing is acquired over a long period of time. Before the age of 12-13, children mainly write texts including arguments for their own point of view, finding it difficult to integrate and coordinate counterarguments in their texts. Coirier (1996) has shown that it is possible for children as young as this to implement other perspectives in their text, if they are given some encouragement. Piolat et al. want to explain why many previous researchers have found that elaborate argumentative texts are produced much later. One explanation could be that young writers are incapable of fitting enough information into an argumenta-

tive schema. When there is too much information for them to handle using such schemas, they will instead rely on other textual properties to organize the text.

## 5.6 Summary on the characteristics of the narrative and expository genres

A narrative text is characterized by a linear pattern where one event follows the next according to a temporal and logical structure. When telling a personal (e.g. self-experienced) narrative, a series of events are activated in the mind of the narrator/actor/writer/speaker. These events once occurred in a specific order, and although it is possible to tell the story with a different time structure (e.g. starting in the middle of an exciting event), it appears reasonable that under the constraint of limited time most writers would choose the canonical, well-known way of telling a story. This means that, once the initial setting of the narrative has been established, the writing is facilitated by the fact that the writer can rely on the temporal structure of the events narrated.

An expository text, on the other hand, is structured quite differently. Although it may contain arguments, or logically related ideas, the expository text has no natural chronological or temporal structure. It is quite possible for the writer to start with any argument; there is no logical beginning – or end – to the text. Even if the writer wants to make a special point (or to argue something) in his text, there is no canonical order in which the ideas ought to be presented (cf. Goutsos, 1996). The writer/speaker is in fact faced with a demanding task when it comes to planning and organizing the text. This ought to be true even if the writer/speaker is well acquainted with the expository genre.

In this thesis, the narrative and expository genres are manifested in speech and in writing. I will use the term **text** when I talk about the discourses, independently of modality. The composite genres of spoken and written narrative texts, and spoken and written expository texts will be referred to using the term **text type**. The term ‘genre’ is restricted to the notion of the narrative or expository genre, in both modalities. This thesis thus comprises the study of four text types: spoken narrative texts, written narrative texts, spoken expository texts and written expository texts.

**Part III**  
**Methodology**

# Chapter 6

## Method

### 6.1 Introduction

The studies presented in this thesis are all based on the same set of data, although the data have been coded and analysed in different ways depending on the purpose. This methodology chapter provides general information about the data collection, valid for all studies presented later in the thesis. When it is called for, I also discuss the reasons for a certain methodological choice. The data have been collected within the framework of the Spencer Project (see Section 6.2), but I have been involved in the methodological discussions from the beginning. I have also carried out the data collection, the coding and the analysis myself.

This chapter further presents the Spencer Project (the framework in which the data collection was carried out), and it presents the transcription conventions and the coding of the material. Chapter 7 presents a detailed description of the computer tool, the keystroke-logging program ScriptLog, used to collect the written texts in the corpus. The methods or coding conventions used for a particular analysis are described in connection with each study in Part IV.

Since many methodological decisions depend on each other, I have frequently used cross-references between sections in this chapter.

### 6.2 The Spencer Project

The analyses in this thesis are based on data collected within the **Spencer Project**. The full name of the project is *Developing literacy in different contexts and in different languages*, and it was funded by a grant from the Spencer Foundation in Chicago to Ruth Berman, who also functioned as the main project coordinator.

The project's overall goal was to understand how schoolchildren of different ages, in different countries and with different languages construct monologic texts in different genres (here narrative and expository) and modalities. Data were collected in seven languages (and countries) by project teams with one coordinator in each: Dutch (Ludo Verhoeven), (American) English (Judy Reilly), French (Harriet Jisa), Hebrew (Dorit Ravid), Icelandic (Hrafnhildur Ragnarsdóttir), Spanish (Liliana Tolchinsky) and Swedish (Sven Strömqvist). The project ran between 1998 and 2001.

The youngest children in the Spencer Study were 9-10 years of age, which is the same age as the oldest children in the Berman and Slobin (1994) study of oral narratives. One of the assumption behind the Spencer Study was that the development of literacy continues throughout the school years, and perhaps also during the university years. The project wanted to analyse linguistic form in relation to discourse functions as well as the role of lexicon in the development of morpho-syntactic structures and the ability to produce text (Berman and Verhoeven, 2002).

The project resulted in many publications, including two special issues of *Written Language and Literacy* (Written Language and Literacy, 2002a,b). In the first issue, Berman and Verhoeven describe the aims, the data collection and overall decisions about transcription and coding. Their article also presents general results from the whole project (Berman and Verhoeven, 2002).

The methodological description below of participant recruitment, experimental settings, transcription and coding decisions relates to the Swedish subset of the Spencer data. In the few cases where the Swedish data collection or coding differ from the main Spencer data, this is explicitly noted.

## 6.3 Participants

### 6.3.1 Age

The Spencer Project aimed at studying the development of literacy through the school and university years. This was done with a cross-sectional design that included children from grade school (around 9-10 years), junior high school (around 12-13 years) and high school (16-17 years) as well as adult university students, 20-30 years old, who had written at least one formal academic paper.

The ages were chosen after considering an interaction between years of schooling and chronological age (Berman and Verhoeven, 2002). The age at which children normally first go to school differed widely between the countries in the Spencer Study, from around 3 or 4 to 7 in Sweden<sup>1</sup>. For a more elaborate description of the school systems in the countries included in the Spencer Project I refer to the schooling reports in Aisenman (1999), especially the report on the Swedish school system (Strömquist and Strömquist, 1999). For reasons of comparability, the children in the Spencer Project should have received approximately the same amount of teaching before taking part in the experiment. Therefore the Swedish participants were selected at the top end of each age range.

Table 6.1 shows the four age groups in the Swedish data and the number of participants in each group.

### 6.3.2 Participant recruitment

Each age group consists of 20 participants, and each participant produced four texts. For the subsequent linguistic and thematic analysis of the texts, we wanted

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<sup>1</sup>Since 1997 the practice has changed and most Swedish children today start school when they are 6 years old. However, all Swedish children participating in this study started school in the year when they turned 7.

Table 6.1: Number of Swedish participants in each age group, with information on the age range for each group, as well as mean and median ages. The transcription-code letters indicate the specific age-group code used for the transcriptions. Age is given in the format years;months

Age group	Transcription Code	Number	Age Range	Mean Age	Median Age	Grade
10-year-olds	g (grade school)	n=20	10:2-11:2	10;9	10;9	4
13-year-olds	j (junior high school)	n=20	13:2-14:1	13;8	13;8	7
17-year-olds	h (high school)	n=20	16:11-18:3	17;6	17;6	11 <sup>a</sup>
University students	u (humanities)	n=19 <sup>b</sup>	23:11-43:7	30;7	30;3	University
	s (science)					

<sup>a</sup>Some students were recorded at the beginning of their twelfth year.

<sup>b</sup>Unfortunately, one participant in the adult group had to be excluded so late in the recording process that it was impossible to replace him with someone else.

complete and comparable texts. For reasons of comparability, a complete data set of four texts was also needed from each participant in the study. This meant that some participants had to be replaced by others owing to technical problems (failure of equipment) during the recording (video camera, computer or tape recorder) or, in one or two cases, when we found out during the experiment that a participant was bilingual. A very late decision was to exclude one of the male adults from the investigation. After transcribing his very long spoken narrative, which was more than four times longer than any of the other participants', and which did not at all have the structure of a narrative, we decided to exclude him. We were never able to fill the gap, and thus the adult group contains only 19 participants.

The age groups were balanced for gender, 10 boys/men and 10 girls/women. Further, half the adult group was recruited among students majoring in the humanities and social sciences (students of linguistics, journalism and literary studies were excluded; the participants studied e.g. economics, education and sociology), and the other half of the group was recruited from students in the exact and natural sciences (e.g. students of medicine, mathematics, technology and engineering).

### 6.3.3 Socio-economic background

The Spencer Project aimed to keep the socio-economic background as constant as possible within the project. Below is a discussion of some important factors that restricted the choices made in the recruitment of participants:

**Influence of teaching** The influence of teaching methods (above all as regards reading, writing and oral presentation) is probably very strong in a study like this. The teacher's emphasis on specific aspects of the writing process and the

student's familiarity with certain genres will have an impact on results in the short term. For this reason we wanted – if possible – to recruit the children in the study from the same class, or at least from the same school.

**Monolingual background** To minimize influences in the text production from other languages, we aimed at recruiting children with a monolingual Swedish background. We defined monolingual as having two monolingual Swedish parents and not having spent a lengthy time abroad (using another language, e.g. by participating in education abroad). Because of the requirement of a monolingual background, it was impossible to delimit recruitment to a single class or even (for the older age groups) a single school. In the urban environment where recruitment took place, many children have one or two parents with a mother tongue other than Swedish, even in very “monolingual” middle-class areas which are not normally considered to have a high proportion of immigrants. Thus, for the 10- and 13-year-olds we selected two schools where there was acknowledged to be a large proportion of children with Swedish as their mother tongue, but we were still not able to find 20 children in the same class who qualified as monolingual.

**Proceeding to higher education** The cross-sectional design of the study was a faster alternative than following a group of students throughout their school years, from grade school to university. But this meant that we had to find other ways to ensure that we would increase our chances of recruiting children who were likely to proceed to higher education. We know from other studies that children whose parents have participated in higher education are likely to do so themselves. For instance, the PIRLS report from 2001 shows that children's scores on reading tests correlate with their parents' educational level (Skolverket, 2003). Given the cross-sectional design of this developmental study, we were interested in selecting schools with a high likelihood for the students to proceed to university. We therefore asked questions about the parents' professions in the questionnaire. The university students, obviously, qualified by being highly educated.

**Computer literacy** We wanted to collect the Swedish data by means of keystroke logging with the software ScriptLog (see further information in Section 7.2). Therefore an important factor was to investigate the ability to write on a keyboard, not only for the younger age groups but also for the adults. Experience with writing on a computer was therefore a factor in the recruitment of the Swedish participants.

In 1997, when we started to pilot for the experiments, computers had long been present in Swedish schools, and university students were expected (if not required) to hand in papers produced on a computer. Previous minor and major research studies on writing carried out with ScriptLog (e.g. Strömqvist, 1996; Strömqvist and Ahlsén, 1998; Johansson, 1994) had shown no problems for university or high-school students to compose texts using a computer. Additional piloting during 1998 showed that data collection with a computer worked fine for 10-year-old fourth-graders, but less well for 9-year-old third-



graders. This was one of the reasons for the choice of recruiting fourth-graders instead of third-graders for the Swedish experiment.

In conclusion, the Swedish school children's computer literacy was estimated to be high enough to carry out the experiment using computers for the writing task for all age groups.

**Reading and writing difficulties** The participants were not screened for reading and/or writing ability. Instead we trusted the teachers of each class to select children who were considered to have no reading or writing difficulties. Although a screening procedure may be preferable, we have no reason to believe that any of the participants in fact suffered from such difficulties. The adults were trusted to judge for themselves that they had no reading and writing difficulties.

### 6.3.4 Recruitment

To recruit the school-children, we mainly contacted teachers and/or principals at a number of schools in and around Göteborg. We asked them to help us to select children from their classes who met the above criteria and were willing to participate in our experiment. They were explicitly asked not necessarily to pick the top students of the class.

The students' Swedish teachers were further asked to fill in a questionnaire to rate, on a four-grade scale, each student's (a) reading comprehension, (b) ability to express him- or herself in writing and (c) ability to express him- or herself in speaking (cf. Appendix, page 184).

**10-year-olds and 13-year-olds** The two youngest age groups were recruited through direct contacts with two schools in Göteborg. There are no true monolingual areas in Sweden's large cities. Therefore much effort was put into finding schools with many children with a monolingual Swedish background. In the end we were able to limit our selection to three classes of 10-year-olds and two classes of 13-year-olds, all from the same school. This means that a total of five teachers were involved in teaching and selecting the children included in the study.

The recordings took place approximately in the middle of the fourth and seventh grade, respectively.

**17-year-olds** To recruit this group, we made personal contact with teachers and/or principals at several schools. The majority of the 17-year-olds were enrolled in two study programmes at the same high school, which is known for having a high percentage of pupils proceeding to higher education. A minority of the 17-year-olds were recruited from other high schools.

The main part of the recordings took place by the end of the eleventh grade.

**Adult university students** We required of the university students that they should have studied for at least three years at university level and that they

Table 6.2: Breakdown of participants by number and gender in relation to experimental order

Order	A		B		C		D	
Gender	F	M	F	M	F	M	F	M
Participant number	01-03	04-05	06-08	09-10	11-12	13-15	16-17	18-20

should have produced at least one major academic paper, equivalent to a BA thesis.

For several reasons, the group of adult university students is the most heterogeneous of the groups as regards background and age. Some of the students were recruited through an electronic mailing list including all PhD students at the University of Göteborg, and the rest were recruited through personal contacts (mostly friends of friends). They knew from the beginning that we investigated writing, and since they volunteered to participate for a very modest compensation, they were very motivated to participate in the experiment. Therefore they may not be completely representative of university students in general.

The adult group was divided into students from the humanities and social sciences (students of languages, linguistics, literature and journalism were excluded), and exact and natural sciences. Since humanities students can write their major papers any time after their first year<sup>2</sup>, it was rather easy to find humanities students who met the criteria of having studied for three years and having written a major paper and who were still enrolled at the university. Science students, however, posed a problem since they typically write their major paper during their last (most often fourth) year of study, after which they leave the university (unless they enroll as PhD students). Therefore, the science students were more likely than the humanities students to have a job outside the university. A large part of the adult group were PhD students and thus had a long education behind them.

Each adult participant was asked to grade him- or herself on a four-grade scale concerning (a) reading comprehension, (b) ability to express him- or herself in writing and (c) ability to express him- or herself in speaking.

### 6.3.5 Gender

The participants were balanced for gender, and as far as possible gender was also considered when the participants were divided into the four orders (see Table 6.2).

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<sup>2</sup>During the third semester of studying a single subject, it is customary to write a “C paper” (equivalent to a BA thesis). It is thus not unusual for a student to take the same subject during her first three semesters, writing a C paper during the third one, and then go on studying other subjects at the university for a few more semesters.

## 6.4 Procedure

The data-collection procedure was the same for all age groups. Overall, all data collection within the Spencer Project used the same procedure; any differences are described below.

I will first give an outline of the experimental procedure before discussing specific details:

1. The participant was welcomed to the Department of Linguistics at the University of Göteborg.
2. The participant watched the short elicitation film (see Section 6.4.3.1 on page 56).
3. SESSION I: The participant produced the first two texts, one in speech and one in writing.
4. Break with refreshments.
5. SESSION II: The participant produced the next two texts, one in speech and one in writing.
6. The participant orally answered a literacy questionnaire administered by the experimenter; this interview was audio-taped.
7. A concluding written form: the participants in the adult group filled in a written form about their reading and writing abilities; the younger groups' teachers provided the same information by letter to the researcher.

Below I will give detailed descriptions of all the steps in the experiment, but first I will discuss the experimental orders and the text types.

### 6.4.1 Orders

Each age group was divided into four subgroups: A, B, C and D; and each of these subgroups followed a different experimental order when producing the texts. This division made it possible to study both modality and genre effects, i.e. differences between participants who produced their spoken texts first (Orders A and C) and those who produced their written texts first (Orders B and D), and between participants who produced their narrative texts first (Orders A and B) and those who produced their expository texts first (Orders C and D). Table 6.3 defines the four subgroups with different orders of text production.

Note that we never mixed genres during a session. The two narrative texts and the two expository texts, respectively, were always produced during the same session, and the two sessions were always separated by a pause. It would have been possible to mix text types in other ways (e.g. NS EW ES NW, or NW EW NS ES), but I chose not to do so because the subgroups would have become too small. The experiment was thus not perfectly balanced for order.

Table 6.5 on page 63 shows the gender distribution of the four experimental orders.

Table 6.3: Experimental orders A, B, C, and D. NS = Narrative Spoken, NW = Narrative Written, ES = Expository Spoken, EW = Expository Written

Order	Session I		Pause	Session II	
	Text 1	Text 2		Text 3	Text 4
A (n=20)	NS	NW	Pause	ES	EW
B (n=20)	NW	NS	Pause	EW	ES
C (n=19)	ES	EW	Pause	NS	NW
D (n=20)	EW	ES	Pause	NW	NS

## 6.4.2 The text types – genres and modalities

One of the aims of the Spencer Project was to study how age and schooling influenced and enhanced language production in different genres and modalities. Therefore the experimental design included the production of texts in both speech and writing, as well as in two different genres: narrative and expository. The elicitation procedure aimed at producing monologues that could be categorized as belonging to either of those two genres. The study design with texts in both speech and writing resulted in four *text types*: **narrative spoken texts** (NS), **narrative written texts** (NW), **expository spoken texts** (ES) and **expository written texts** (EW) (Berman and Verhoeven, 2002). Thus each participant produced four texts in total.

Below is a description of the elicitation procedure used for the four texts. It was imperative that the instructions were identical for all age groups, although the narrative instructions in the Swedish part of the project differed from those used for the other languages.

### 6.4.2.1 The narrative texts

The study aimed at eliciting a narrative based on personal experience. For this purpose, a wordless video was used. The video depicted various examples of conflicts during a school day (for a more detailed overview of the video, see Section 6.4.3.1). The procedure for eliciting the narrative in the major Spencer Project was to show participants the video and then ask them to “tell and write a story about an incident of interpersonal conflict that they had experienced”.

When we piloted this elicitation question in the Swedish setting, it resulted in very poor personal narratives where the lack of any description of a specific, personal experience or situation was salient. The samples produced contained no narrative structures, only general statements or descriptions of a general situation similar to something that was shown in the film. Two examples of the poor narratives produced in the pilot study are found in Example 2 (a *complete(!)* written narrative by a 9-year-old girl) and in Example 3 (from a spoken narrative by a 12-year-old boy). (A key to the transcription standards is found in Section 6.8.)

- (2) SBJ: jag har varit med om såna problem.  
*SBJ: I've experienced such problems*  
 SBJ: det var inte roligt.  
*SBJ: It was not fun*

[the complete written narrative text produced by a 9-year-old girl in the pilot]

- (3) SBJ: de börja väl me  
*I guess it usually starts with*  
 SBJ: att man blir förbannad på varandra å ovänner  
*you getting angry with each other and become enemies*  
 SBJ: ha ursäkta mej  
*well excuse me*  
 SBJ: jaa sen så brukar ja ja oftast säga förlåt  
*well then I I usually say I'm sorry*  
 SBJ: å de va inte meningen  
*and I didn't mean to*  
 SBJ: att ja skulle bråka me dej  
*fight with you*  
 SBJ: å ha å så blir vi vänner igen  
*and well then we become friends again.*

[the complete spoken narrative text produced by a 12-year-old boy in the pilot]

As you can see, there is no narrative structure in these two examples. Further, they are not personal, and nor do they describe a specific situation or a specific sequence of events; rather, they give a very detached description of a general situation. The same pattern is found in the pilot texts produced by adults.

We believe that the origin of this difference might be a general fear of conflicts: no-one wants to be the bully, nor the bullied person. Therefore we could not elicit personal narratives, merely general statements, by using this wording. Since we wanted texts with a narrative structure that we could analyse, we modified the Swedish elicitation question (based on good results from a previous study of speech and writing in adults by Johansson (1994)). The question we used was: *Tell me about one time when you rescued somebody or were rescued by somebody from a predicament.* The new wording was also successfully piloted in speech in a group of fifth-graders (n=29).

This reworking of the elicitation question did not prevent us from using the video as a starting point for the experiment, and it allowed (although not explicitly so) the participants to find inspiration for their narratives in the film, if they wanted to, but it also allowed them to recount an entirely different event at their own discretion. Further, it also allowed the narrator to be the “hero” who saved a friend, instead of just having to choose between being the victim or the perpetrator.

The elicitation question could also, just as the wording for the major Spencer Project, be used independently of whether the participant was asked to perform the oral or the written task.

#### 6.4.2.2 The expository texts

The expository genre was much discussed before starting the main data collection in the Spencer Project (Berman and Verhoeven, 2002). While a narrative would

basically be a narrative independently of modality, this is not so for the expository text. The oral expository should be in the form of a talk given in class, while the written one should be a composition or an essay. Therefore the elicitation question differed between modalities.

The topic of the expository was to discuss (in a speech or in an essay/paper) the problems the participants had seen in the video, perhaps also suggesting some solutions. The participants were explicitly asked not to describe the video (cf. the wording in Section 6.4.3). In Swedish we used the word ‘föredrag’ for the speech, and the word ‘uppsats’ for the essay.

### 6.4.3 Instruction

Another complication with the elicitation is that we wanted to use the same wording and instructions for all participants, regardless of age. Before the task started, the participants always had time to ask questions if they felt that anything about the instructions was unclear. They were also explicitly invited to think before they spoke/wrote. The full wording (in Swedish and in English translation) is found on page 189 in the Appendix.

The wordings of the elicitation texts used for the Swedish tasks were thus:

**Narrative texts:** *Jag skulle vilja att du berättar om ett tillfälle antingen där du räddade någon ur en knipa, eller där någon räddade dig ur en knipa. Berätta inte vad du såg i videon, utan något du själv har varit med om. Det behöver inte ha utspelat sig i skolan. Du får gärna tänka efter innan du börjar.*

(‘I would like you to tell about one time either when you rescued somebody from a predicament, or when somebody rescued you from a predicament. Don’t tell what you saw in the video but instead something you have experienced yourself. It doesn’t have to have taken place in a school setting. You may take some time to think before you start.’)

**Expository texts:** *Du såg nyss en video som visade människor som hade hamnat i olika slags svårigheter, människor som hade problem av olika slag. Nu är vi intresserade av vad folk tänker om såna händelser. Vi samlar in uppsatser/föredrag om det här ämnet, så jag skulle vilja att du skriver en uppsats/håller ett föredrag där du diskuterar sådana situationer som människorna i filmen hade hamnat i. Vad har du att säga om det här?! (Beskriv inte filmen, utan diskutera allmänt). Tänk gärna efter innan du börjar skriva. .*

(‘You just watched a video/Before the pause you watched a video showing people in different kinds of troubles, people who had problems of different kinds. Now we are interested in what people think about such events. We collect essays/speeches about this topic, so I would like to ask you to write an essay/give a speech where you discuss the kind of situations that the people in the film got into. What do you have to say about this? (Don’t describe the film but discuss in general terms.) You may take some time to think before you start.’)

#### 6.4.3.1 The elicitation film

Since seven countries and languages were represented in the Spencer Project, we needed a non-verbal elicitation instrument for the texts that we wanted the participants to produce. The solution was a video film produced specially for the project, showing typical scenes from a school day. The film contains no dialogue, but it is accompanied by music and contains certain sound illustrations such as a school bell and a ringing mobile phone.

The film comprises eight scenes which illustrate ethical problems such as cheating, fighting, stealing and bullying. There is no narrative structure linking the different scenes.

The children in the film are in their early teens; the idea was that participants in all age groups should be able to somehow relate to or identify themselves with the children in the movie. For the youngest age group, grade-school children aged 9 or 10, the children in the film would be a few years older; the junior-high students would be almost exactly the same age as the video children; the high-school students would just have passed that age period, but should still be able to recognize similar problems in their everyday lives; and, finally, the adults would either react on behalf of their own children's school situation or remember similar incidents from their own school days (or even abstract the situations so far as to apply them to their present situation as university students or to their workplaces).

A detailed scene-by-scene description of the film is given on page 187 in the Appendix.

#### 6.4.4 Data-collection procedures

Description/schedules of the data-collection procedure are found on page 189 in the Appendix. The detailed description below refers to a person belonging to Order A (see Table 6.3). The same procedure was followed with some variations in all seven Spencer countries (see Berman and Verhoeven (2002) for further descriptions). The main difference in the Swedish data collection was that all participants came to the lab for the whole experiment (in most countries, the children's texts were collected in a classroom) and that the written texts were produced on a computer in all four age groups (computers were also used to collect some of the written data for the American and Icelandic data subsets, and the Dutch subset was collected using an electronic writing tablet).

#### 6.4.5 Time and place

The main data collection took place at the Department of Linguistics at the University of Göteborg from October 1998 to November 1999. The 10-year-olds were recorded in March 1999 and the 13-year-olds in February 1999. A few 17-year-olds were recorded in June 1999 while most of them were recorded in October-November 1999. The adult university students were recorded from October 1998 to November 1999.

All recordings were made at the university lab, and consequently all participants came to the department. Some participants (mainly younger ones) came in small groups, but all participants carried out their tasks individually.

After a word of welcome, the participants were briefly introduced to the aim of the project, which was presented as comparing how people in different countries write and speak. After the experimental sessions we welcomed more questions about the investigation, but we did not tell the participants beforehand that the word processor they would use could record everything they wrote (more information about the options available in keystroke-logging programs is provided in Chapter 7).

### 6.4.6 The experiment

The outline below describes a participant following Order A (cf. Table 6.3).

The participant was first shown the three-minute elicitation video and then asked to perform the first task: the narrative spoken task. This was done in the studio, with the experimenter present as a listener. The session was video-recorded, and a technician was always present to ensure the best possible sound quality. Some time at the beginning of each spoken session was spent on small talk with the participant to make her more comfortable with the recording situation.

This was followed by the narrative written task, which was carried out on a computer. The participant was always left alone in the room while writing; it was thus a truly monologic task. ScriptLog, the keystroke-logging program (see Chapter 7), had already been started on the computer and the participant was told that she would be using a very simple word processor without copy and paste functions. She was not allowed to make any handwritten notes beforehand but was encouraged to think before starting to write if she wanted to.

The participant was informed that she could write for 30 minutes and that the experimenter would let her know when there were 5 minutes left, so that she could finish her text. If the participant was done before this, she could come out of the room.

The experimenter always administered the technical aspects of the experiment by pressing the start button on the computer in order to start the recording of the keystroke-logging program ScriptLog (cf. Section 7.2.2 on page 73) after presenting the elicitation question, and the experimenter was also always the one to stop the keystroke-logging program, either after being called by the participant or having checked in on the participant to inform her that the time was up.

Since we were more concerned with having complete texts to analyse (i.e. texts with a beginning and an end), the participants were always given the opportunity to finish their text, although that sometimes meant exceeding 30 minutes. A discussion about the implications of this decision is found in Sections 8.10 and 9.4.1. The mean writing times for each group are shown in Table 9.1 on page 117.

After a break with refreshments, the second session followed, where the participant first gave the speech (spoken expository) and then wrote the essay (written expository). Since the Swedish expository task but not (necessarily) the previous narrative task linked back to the film, the experimenter explicitly pointed out (in or-



ders such as Order A where the expositorys were produced after the narratives) that in this part of the experiment, the participant should take the film as her starting point, even though she should not describe it (cf. Section 6.4.3).

**The literacy questionnaire** After producing the last text, the participants were interviewed (following a questionnaire) about how often, and for what purpose, they used computers, books, newspapers, magazines and encyclopaedias. They were also asked about their writing habits (did they write much in their free time – diaries, letters, e-mails, fiction?). The audio-taped interview was performed by the experimenter. The Swedish version of the questionnaire can be seen on page 185 in the Appendix.

The analysis of the literacy questionnaire has not been included in this thesis.

**Paper form** Finally, the adults were asked to fill in a paper form to provide information about their high-school studies, about their educational and linguistic background and about how they would rate their current text-comprehension skills and their written and spoken proficiency. For the school-children, equivalent information was provided by their (Swedish) teachers. The Swedish version of the paper forms (for the children) can be seen on page 184 in the Appendix.

## 6.5 Summary of data

Data were collected from four age groups (10-year-olds, 13-year-olds, 17-year-olds and adults) with 20 participants in each group<sup>3</sup>. Each person produced four texts: Narrative Spoken (NS), Narrative Written (NW), Expository Spoken (ES) and Expository Written (EW). In total, this Swedish corpus contains 316 texts. A summary of all the texts is given in Table 6.4

Table 6.4: Number of texts from each age group, broken down by text type

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Narrative Spoken	20	20	20	19	79
Narrative Written	20	20	20	19	79
Expository Spoken	20	20	20	19	79
Expository Written	20	20	20	19	79
Total	80	80	80	76	316

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<sup>3</sup>19 persons in the adult group.

## 6.6 Transcription

All data were transcribed according to the minCHAT format (MacWhinney, 2000), the transcription guidelines adopted for the Spencer Project (Assayag et al., 1999) and the special modification to this standard made for the Swedish data (Johansson, 2000b). Thus the written texts were also transcribed according to the CHAT conventions, in order to enable analyses using the CLAN programs (MacWhinney, 2000). The CHAT conventions have been developed for spoken language (and, in particular, the language of small children), but they worked relatively well also for the written data, where for instance codes normally used to denote speech errors could be used for spelling errors. The latest version of the CLAN manual is electronic (MacWhinney, 2009a), as is the description of the CLAN programs used to analyse the transcriptions (MacWhinney, 2009b).

In the overview of the Spencer Project, two major transcription versions are described. The first is the **Replica** or **“Mirror” version**, which is a representation that is as close as possible to what the participant actually produced, including pauses, hesitations, repetitions, spelling errors, repairs, etc. The second transcription version is a **Standardized** or **“Stripped” version**, which is corrected in some cases and contains standardized linguistic forms (Berman and Verhoeven, 2002).

The transcription examples presented in this thesis are *almost* mirror versions. Since I do not discuss spelling errors (except in the context of linear writing, in Chapter 7 and above all in Chapter 9) or compare morphology between speech and writing, I have decided to strip the transcriptions of the related information in the interest of readability. Although I thus do not represent the authentic spoken forms (as they are described in Section 6.6.4) in the transcripts in this book, they are still coded for in the data, and alternative written and spoken form are easy to access for further analysis. However, indications of hesitation such as pauses, replacements, corrections, etc., are always reported.

Below I will present a general guide to the transcripts and discuss some of the choices we made for the Swedish part of the Spencer Project.

### 6.6.1 The transcription header

On page 190 in the Appendix there is an example of a complete transcribed text. Each transcription contains a header designed according to the CHAT conventions, containing information about the persons participating in the session (i.e. always the participant and the experimenter (myself) for the spoken texts, and the participant only for the written texts); information about the participant (i.e. code, age, gender, level of education (grade), age group, order); information about the text (i.e. modality, genre); information about the experiment (i.e. date, location); information about the transcriber, coder and reliability checker; and, finally, the unique file name (cf. 6.8.2).

### 6.6.2 The transcription body

The body of each transcription contains the monologic account by the participant, with comments or feedback from the investigator. We always used the same speaker

code *SBJ* (for ‘Subject’) for the participant, and the experimenter (who was always the same person) was denoted by *INV* (for ‘Investigator’). Each speaker line thus begins with the three-letter code identifying the speaker.

The text is divided into clauses (see more in Section 6.7.3), containing one finite verb each. Each clause ends with a major delimiter, most often a full stop (indicating a statement) but sometimes a question mark (for questions or question intonation) or an exclamation mark (for exclamations) (cf. Section 6.8.2).

### 6.6.3 Transcription with replacement

In the written texts we corrected spelling errors, typos and other unconventional ways of writing by using a replacement command with brackets. This means that the word(s) needing to be changed will automatically be replaced by the word form within brackets when we use the CLAN programs for analyses.

An example of how this is done is found in Example 4, a written narrative text by a 13-year-old boy.

- (4) *SBJ*: en gång när jag var sex år.  
*SBJ*: once when I was six years old  
*SBJ*: var jag och min familj på malljorka [: Mallorca].  
*SBJ*: I and my family were on madjorka [: Majorca]  
*SBJ*: jag kunde inte simma.  
*SBJ*: I couldn't swim  
*SBJ*: men var ändå [: ändå] vid <swimming poolen> [: swimmingpoolen].  
*SBJ*: but was anyway [: anyway] by the <swimming pool> [: swimmingpool]  
*SBJ*: för där fanns en grund avdelning [: avdelning].  
*SBJ*: because there was a shallow part [: part]  
*SBJ*: när jag gick förbi den djupa avdelningen [: avledningen].  
*SBJ*: when I was walking past the deep part [: part]  
*SBJ*: så kom en annan kille.  
*SBJ*: another guy came  
*SBJ*: och åutte [: putte] i mig.  
*SBJ*: and oused [: pushed] me  
[wj20mDNW]

The misspelling of the island *Majorca* is corrected. So are the misspellings of *ändå* (‘anyway’), *swimming poolen* (‘the swimmingpool’) (which must be written as a closed compound according to Swedish spelling standards) and *avdelning* (‘part’). The typo in *putte* (‘pushed’) is also corrected. Note that when you want to replace several words, such as in (the Swedish misspelling) ‘swimming pool’, the minCHAT conventions require that these words are surrounded by angular brackets.

For words that can be spelled in several ways, a correct spelling was sometimes replaced by the more common form, for reasons of comparability. In Example 5 below, the participant wrote *skall* (‘will’), which has been replaced with the more common form *ska*. In Example 6, the word *mobbing* (‘bullying’) has been replaced

with the form *mobbning*<sup>4</sup>. It should be made clear, however, that with this kind of coding it is always possible to choose which form to include in the analysis search: the one inside the brackets, or the one outside. In the analyses in this thesis, we use the words within brackets to facilitate comparisons between speech and writing of specific word types or lemmas.

- (5) SBJ: allt skall [: ska] ju ändå göras i sista minuten.  
*SBJ: everything will be done in the last minute anyway*  
 [wu04fANW]
- (6) SBJ: ja det jag tar mobbing [: mobbning] då.  
*SBJ: yes I will choose bullying then.*  
 SBJ: för det är lättast # att prata om.  
*SBJ: because it is easiest to talk about*  
 [wh06fBES]

#### 6.6.4 Transcription of alternative spoken and written forms

In the transcription of the Spencer material, the aim was to use a “broad phonemic transcription, detailed enough to allow for morphological analysis, but not necessarily for phonological or even morphophonological analysis” (Berman and Verhoeven, 2002, p. 10). For the Swedish spoken text, a modified written orthography was used (inspired by Nivre, 1996, 1999b,a). This meant that by and large we followed the rules of Swedish standard orthography, but with slight modifications designed to render characteristics of spoken language. For example, when there is an alternative way of pronouncing a word, different from the standard one, we reported the form that was actually used (in speech). Swedish has a number of words that are, sometimes almost without exceptions, pronounced in a (phonematically) different way from how they are written.

One example is *sån* instead of *sådan* (‘such’), and other examples are personal pronouns: *ja* instead of *jag* (‘I’), *dom* (wr: *de* (‘they’) or *dem* (‘them’)), the reflexive pronouns *mej dej sej* (wr: *mig dig sig* (‘me’, ‘you’, ‘him’/‘her’)), and the possessive pronouns *vårat, erat* (wr: *vårt, ert* (‘our(s)’, ‘your(s)’)). All these words have one variant which is used in formal writing and another variant which can be used in informal writing (such as a letter, e-mail message or text message to a friend). In speech, the variant which is informal in writing is almost always used

We also decided to consider the pronunciation of other, very common, (function) words when transcribing. This meant that we write *de* (wr: *det*, (‘it’/‘there’/‘that’/‘this’)), *me* (wr: *med* (‘with’)), *a* (*ja* (‘yes’), *va* (wr: *var* (‘where’/‘was’/‘were’)), *va* (wr: *vad*; (‘what’)), *å* (wr: *och* (‘and’)), *å* (wr: *att* (‘that’/‘general subjunction’)). Further, we took care to transcribe the preterite of verbs belonging to the first conjugation without the preterite morpheme if this (as

<sup>4</sup>Bullying is a common theme in the data because related scenes were included in the elicitation video, and the word ‘mobbing’ is thus frequent. In the material, the form ‘mobbing’ is actually more common than the form ‘mobbning’, which is the one recommended by Swedish dictionaries. However, for practical reasons I have chosen to let all the instances be represented by the form ‘mobbning’.

is often, but not always, the case) was omitted (e.g., *kasta* (wr: *kastade* ('threw')) or *tala* (wr: *talade* ('spoke'))).

In short, this means that we tried to transcribe the words in the way they were pronounced, to facilitate future investigation of the spoken language in the corpus. But to enable comparisons with the written data, we coded these spoken forms with the same replacement code as we did for spelling errors. This can be seen as a form of **lemmatization**. An illustration of this is found in the transcription Example 7 below. It should be pointed out that we took care to transcribe the actual word form, e.g. if the speaker used the written-like form, this was of course transcribed.

When not otherwise specified, it is always the standard form of the word that is counted, but with very little effort (only a small change in the CLAN commands) we also have access to the spoken forms of the words.

This way of coding the data is supported by the transcription standard used by the Gothenburg Spoken Language Corpora (Allwood, 1998, 1999; Nivre, 1999a,b), and it also facilitates comparisons between the spoken language in our experimental, monologic texts and that large corpus of spoken Swedish (as is done in Johansson, 1999).

- (7) SBJ: a [: ja] då slog han till mej [: mig] på kinden.  
*yes then he hit me on the cheek*  
 SBJ: så ja [: jag] fick de [: det] där lilla fina äret.  
*SBJ: so I got that little nice scar*  
 SBJ: å [: och] så höll de [: det] på så.  
*SBJ: and so it went on*  
 SBJ: ända tills vi kasta [: kastade] ut han [: honom] ur vårt [: vårt] kaprum.  
*SBJ: until we threw him out of our cloakroom*  
 [wg15mCNS]

## 6.7 Data analysis

The data were coded and analysed in several ways. Some of the analyses were carried out across the whole Spencer Project, in which case they are presented here, while others were specific to the Swedish corpus. When called for, some information about coding and analyses will be presented in connection with the results in the coming chapters (e.g. coding for lexical diversity and density in Chapter 10).

### 6.7.1 Statistical analysis

In the following chapters I will use statistical analysis to explore the data in various ways. When not otherwise specified, mixed analyses of variance were carried out to explore the effects of the following five factors:

**Age** The four age groups are: 10-year-olds, 13-year-olds, 17-year-olds and university students. This is a between-subjects factor.

Table 6.5: Distribution of participants by number and gender across experimental orders and age groups

Order	A		B		C		D	
Gender	f	m	f	m	f	m	f	m
Participant number	01-03	04-05	06-08	09-10	11-12	13-15	16-17	18-20
10-year-olds	3	2	3	2	2	3	2	3
13-year-olds	3	2	3	2	2	3	2	3
17-year-olds	3	2	3	2	2	3	2	3
Adults	3	2	3	1	2	3	2	3
Total gender	12	8	12	7	8	12	8	12
Total order	20		19		20		20	

**Genre** The two genres are: narrative and expository. This is a within-subjects factor.

**Modality** The two modalities are: speech and writing. This is a within-subjects factor.

**Order** The four orders (in which participants carried out the experimental tasks) are: A, B, C and D (cf. Table 6.3). This is a between-subjects factor.

**Gender** The two genders are male and female. This is a between-subjects factor.

Significant interactions were followed up by an analysis of simple main effects. Measures of effect size (ES) are partial  $\eta^2$ , and are also reported for significant effects. Post hoc comparisons were made according to Tukey's HSD procedure.

For most measures spoken and written data are compared, but certain measures (e.g. concerning writing time and the number and types of keystrokes in Chapter 9, and pausing in Chapter 11) concern only data from keystroke logging and are thus carried out on the written texts only.

### 6.7.1.1 A note on the gender factor

The original design of the developmental study reported in this thesis did not concern itself with gender differences. Nevertheless, the age groups were balanced for gender. However, since we also balanced for order effects (see Section 6.4.1), this meant that the order cells for each age group contained only 2 or 3 persons of each sex (cf. Table 6.5). This means that there is an insufficient statistical foundation on which to analyse the (few) gender differences found in the material. For this reason, I have decided to mention gender differences whenever they occur in my data but discuss them only in Section 12.7 in the general conclusions of the thesis.

### 6.7.2 Words

I will be examining the number of word tokens in Chapter 8 and lexical measures such as lexical density and diversity in Chapter 10. It is therefore appropriate to discuss briefly how words have been transcribed and counted.

In Section 6.6.4 I discuss the choice of a parallel coding or transcription for some words that have two (or sometimes more) variants. Another question is what should be counted as a word. In general, the Spencer approach has been to define a word as a string of letters surrounded by spaces, i.e. a graphical word (Berman and Verhoeven, 2002). In addition to this, every language in the project would have to define its own rules on what to count as a word, according to the customs within each language community. For example, compounds were counted as single words in Swedish, Dutch and Icelandic (since this is the common orthographic representation of such words), but treated as two (or more) words in English and Hebrew (unless highly lexicalized). Below, I describe the choices made in the Swedish transcriptions.

CHAT provides the option of coding for compounds by using a plus sign between the lexical morphemes, such as ‘school+yard’. However, Swedish is a very productive language when it comes to compounds. Not only are there thousands of words in the lexicon that are the result of compounding, but compounding is also an active process to create words for any language user (cf. e.g. Mellenius, 1997). We have used the option of the ‘+’ in some other cases, i.e. phrases such as *klass+4a* (‘school class 4a’) and *granne+b* (‘neighbour b’) as well as certain numerical expressions such as *elva+och+trettio* (‘eleven-thirty’).

Swedish also has a few common expressions that may be written as one or several words, such as *över huvud taget* (‘on the whole’) and *i alla fall* (‘anyway’). These have consistently been transcribed as multiple words.

Finally, it has to be said that it is not easy to compare word-based measures between languages (cf. the discussion about lexical measures in Strömquist et al., 2002). What is one word in one language (e.g. English: ‘anyway’) may be three words in another (Swedish: ‘i alla fall’). What is historically two words (e.g. English ‘to-morrow’) may be written and perceived as one word today. The morphology of each language is crucial here. As another example, it can be noted that Swedish has a more bound morphology than English, such that ‘the book’ in English is ‘boken’ in Swedish. Nobody would perceive or count that as two words (although there are two morphemes, ‘-en’ being the definitiveness suffix), but I believe that ‘the book’ is generally counted as two words in English. Further, Swedish words do not mark the verb for person. Thus, there is no distinction between *jag äter* (‘I eat’) and *hon äter* (‘she eats’). English will here have to use two forms of ‘eat’ where Swedish will use only one. This is just to illustrate how much inherent morphology matters for the word count, and to explain that what is appropriate to code for in one language (such as compounds) may be obsolete or ridiculous to code for in another language (unless you have a specific interest in making a cross-linguistic comparison of a certain phenomenon). To really compare the number of “words” used across languages, we will have to lemmatize the transcriptions, such that, for example, the verb ‘eat’ will be represented as a single word (lemma) (neutralizing morphological variation with respect to for example tense, number, gender, mode and case). Such a coding approach, however, would go beyond the purposes of the present study.

To summarize, there are two main points to bear in mind when investigating word numbers. The first is to be consistent with your choices within the transcription of a specific corpus, and to note and report the choices you make; and the second is to

be careful when comparing “numbers of words” between languages, since the idea of what a word is may vary.

### 6.7.3 Clauses

All texts (both spoken and written) were coded into *clauses* as defined in Berman and Slobin (1994):

For our purposes, a clause was any unit containing a unified prediction, whether in the form of a verb or adjective. The verb might be finite or unfinite, e.g., the following were all considered a single clause in English: *running through the woods; taken by surprise; (in order) to help his friends; was angry*. Modal and aspectual verbs were counted together with their main verbs; that is, the following constitute single clauses: *want to climb the tree; goes to look; started running*. (Berman and Slobin, 1994, p. 26)

However, in the coding of the Swedish data, we were stricter in requiring that each clause must contain a finite verb. One reason is that Swedish lacks the aspectual contrast that for example English has. Sentences like *running through the woods* and *taken by surprise* would be expressed with finite verbs in Swedish (e.g. *medan [han] sprang genom skogen* and *(trots att) hon blev överraskad*). Another reason is that one characteristic of more elaborate Swedish discourse is infinitive clauses, many of which are “reduced main clauses”. If we had taken a coding decision to the effect that these would be separate clauses, we would have missed the opportunity to study the progression of longer clauses in more experienced writers. Finally, modal and aspectual verbs were also coded together in the Swedish data. For the modal verbs this is not controversial, since they combine with the infinitive of other verbs (e.g. *hon vill klättra i trädet* (‘she wants to climb in the tree’); *han går för att titta* (‘he goes to look’); *hon började springa* (‘she began to run’)). However, Swedish sometimes expresses the progressive aspect (for which there is no specific verb form like in English) by a pair of verbs such as *håller på och talar* (‘goes on and talks’, i.e. ‘is talking’) and *sitter och läser* (‘sits and reads’, i.e. ‘is reading’). Verb pairs such as these were coded in the same clause.

Although the main rule was to include a finite verb in every clause, exceptions were made for titles and codas. Exclamations, utterances and the like were also normally coded as a separate clause. In other cases, a clause could lack a finite verb if it was obvious that it could not be connected to a previous or following clause. One example is found in Example 8, from the written narrative by a male university student. The third clause lacks a finite verb:

- (8) SBJ: allt gick mycket bra.  
*SBJ: everything went very well*  
 SBJ: tills jag var nästan hemma.  
*SBJ: until I was almost at home*  
 SBJ: då slaaaaddddd [!] rakt ner i diket.  
*SBJ: then a sliiiiiiiide right into the ditch*



SBJ: och det var inte vilket dike som helst utan ett så kallat kronrike.

*SBJ: and that was not any ditch, but a so-called crown ditch*<sup>5</sup>

[wu20mDNW]

Swedish, like many other languages, has **center-embedded clauses** where clauses are nested. In the transcriptions these were noted with the code [+ CE] at the end of the line. The clause was then repeated on a subordinate tier, named %ces, following the main tier. An example of the coding of a center-embedded clause is shown in Example 9.

(9) SBJ: utan att det nästan tror jag i samtliga fall. [+ CE]

*SBJ: but that it almost I think in all cases*

%ces: tror jag.

%ces: I think

[wu18fDES]

In the clause count in this thesis (see Sections 8.4, 8.6 and 8.8), center-embedded clauses are counted individually; when I refer to the total number of clauses, this is then the sum of clauses and center-embedded clauses.

#### 6.7.4 T-units

The Spencer Project wanted to code the texts for units longer than the clause. Several studies of speech have struggled with the question of how to code spoken language. The notion of ‘sentence’ is mostly not appropriate for speech; for comparisons with writing another unit of analysis is needed.

A Swedish suggestion is the **macro-syntagm**. This is a syntactic unit consisting of a sequence of segments, internally connected by a web of syntactic relations and externally defined such that relations do not exist between adjacent segments (Loman and Jörgensen, 1971, p. 9). A macro-syntagm is further defined as a phonetic unit: “the stretch of material spoken with a single intonation” according to Hockett (in Loman and Jörgensen, 1971). However, these authors mainly use a definition based on syntactic criteria, where for instance prosodic criteria are secondary and only complementary.

A macro-syntagm is the largest possible sequence of words, considering the syntactic relations of the constituents. Thus, the constituents of a macro-syntagm are part of a system of syntactic relations (co-ordination, as well as super-ordination and sub-ordination) (Loman and Jörgensen, 1971). In short, macro-syntagms have been used for segmenting and analysing spoken language, above all in Swedish and other Scandinavian spoken-language data.

Another way of analysing spoken texts is proposed by Johansson (1995), who presents the **Text Encoding Initiative** (TEI). But although both the macro-syntagm and the TEI offer ways to analyse and compare spoken language, what the Spencer Project needed was a tool or a unit to compare speech with writing.

The **T-unit** (from *Terminal unit*) is defined by Hunt (1970) as “One main clause plus any subordinate clause or non-clausal structure that is attached to or embedded in it”. Thus, a T-unit is merely a syntactic unit, although, when applied to

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<sup>5</sup>An extra deep and wide ditch.

Table 6.6: Key to the CHAT transcriptions

*	every speaker line is introduced by a star, followed by a three-letter code, indicating the speaker. The code is unique for each speaker in the transcript, but in this project we used the code *SBJ for all the Subjects, and *INV for the Investigator. This facilitated later analysis. (In the transcription examples the star (*) in front of the three-letter code has been excluded.)
%	starts a dependent tier, containing comments or coding relating to the preceding speaker tier, e.g. %ces, indicating a center-embedded clause on the previous line.
#	pause of unspecified length.
[]	square brackets denote a clarification of some kind. In our case we have mainly used it for correcting misspelled words in writing and to translate (for comparative reasons) a spoken word form into its written equivalent. This means that the form that is generally included in the analysis is the form within square brackets. Example: <i>ja [ː jag]</i> ('I').
[?]	denotes that the transcriber is uncertain of the previous word or utterance. If the uncertainty covers more than one word, all the words are enclosed in angle brackets. Example: < <i>hunden som</i> > [?] ('the dog that').
[!]	denotes that the previous word(s) are emphasized. Example: <i>jag såg henne [!]</i> ('I saw her [!]', where 'henne' is emphasized).
+	denotes a word boundary, e.g. in compounds. For more information, see Section 6.7.2 about the transcription of words.
?	a question mark at the end of an utterance indicates question intonation
!	an exclamation mark at the end of an utterance indicates a stressed utterance, an imperative clause or an interjection.
xxx	unintelligible speech.
<word(s)>[/]	retracing without correction. Example: <i>han [/] han säger</i> ('he [/] he says') and < <i>han som</i> > [/] <i>han som är där</i> '<he who> [/] he who is there'
<word(s)>[//]	retracing with correction Example: ' <i>han [//] hon säger</i> ' ('he [//] she says')
<word(s)>[///]	retracing with reformulation. Example: < <i>han säger att</i> > [///] <i>jag tycker att man kan säga att</i> ('<he says that> [///] I think you can say that')
+...	<i>trailing off</i>

spoken language, intonation and thematic criteria might also be used for purposes of delimitation. The T-unit has been used as a unit of analysis in studies since the 1960s (cf. e.g. O'Donnell et al., 1967; Scott, 1988). Part of the Spencer material is analysed into T-units (Berman and Verhoeven, 2002; Tolchinsky et al., 2002).

However, the Spencer Project could not agree on using T-units throughout the whole material. Some languages chose instead, or in addition, to use **Longer units**, L-units. These were first described in Cahana-Amitay et al. (1999) and Katzenberger (1999). An L-unit typically spans more than one clause and includes text-internal packaging such as juxtaposed clauses which are thematically linked and units which are distinctly demarcated in terms of their discourse function and/or place in the

Table 6.7: A key to the transcription codes

Position	Code	Explanation
1	w	<b>Language</b> The first character indicates the language. <b>w</b> = Swedish.
2	g j h u/s	<b>Age group</b> The second character indicates the age group <b>g</b> = grade school; fourth-graders; 10-year-olds <b>j</b> = junior high school; seventh-graders; 13-year-olds <b>h</b> = high school; eleventh-graders; 17-year-olds <b>u</b> = university students; <b>humanities</b> ; adults <b>s</b> = university students; <b>science</b> ; adults
3-4	01-20	<b>Participant number</b> The third and fourth characters indicate the participant's unique number (between 01 and 20). The numbering restarts within each age group.
5	f m	<b>Gender</b> The fifth character indicates the participant's gender. <b>f</b> = female <b>m</b> = male
6	A B C D	<b>Order</b> The sixth character indicates the order in which the participant performed the experimental tasks (see Section 6.4.1).
7	E N	<b>Genre</b> The seventh character indicates the genre. <b>E</b> = Expository <b>N</b> = Narrative
8	S W	<b>Modality</b> The eighth character indicates the modality. <b>S</b> = Speaking <b>W</b> = Writing

text. Berman and Verhoeven (2002) report a high level of inter-judge agreement on coding and believe that the L-unit (unlike the intonational unit proposed by Chafe (e.g., Chafe, 1994)) can be used to compare both speech and writing.

## 6.8 Transcription guidelines

To facilitate the reading of the transcripts presented in this thesis, the parallel codings (cf. Section 6.6.4) for speech and writing have been excluded (unless they are necessary to illustrate the point of the discussion).

### 6.8.1 Translation of the transcripts

This thesis is written in English, and it is therefore necessary to translate the original Swedish examples. Whenever possible I have adopted a way of mainly capturing the meaning of the content, rather than producing an idiomatic or verbatim translation. However, the main principle is that every line of the English translation should capture the meaning of the equivalent Swedish utterance. Thus, every Swedish clause is followed by a line with the English translation in italics.

For examples from the output texts from ScriptLog, I instead give the English translation after the whole Swedish text.

All proper names in the transcripts are anonymized. However, I have kept some place names, as it is already known that the participants in this study came from

Göteborg and the surrounding area. Some other minor details have also been modified in order to protect the participants' integrity.

### 6.8.2 A key to the transcription codes

To facilitate transcription and analyses, each file was assigned a unique code consisting of eight characters. Throughout this thesis, these codes are used when text examples from the data are quoted, to enable easy tracking of the origin of a quotation.

The codes are built up as explained in Table 6.7 (cf. Table 6.1). Thus, the code *wh07fAEW* denotes a Swedish 17-year-old girl's written expository and *ws12mCNS* denotes a spoken narrative by a Swedish male university student of a scientific subject.

# Chapter 7

## Keystroke logging

### 7.1 Introduction

To collect the Swedish writing data we used a keystroke-logging program called *ScriptLog* (Strömqvist and Karlsson, 2001; Strömqvist and Malmsten, 1998). This program looks like a (simple) word processor, but is able to record the writer's activities during writing. This allows the researcher to analyse the dynamic writing process (such as planning, revising, pausing) afterwards, as opposed to only examining the static product that is the final text. Researchers using keystroke logging to study writing often focus on the cognitive processes underlying text production (cf. the description in Lindgren, 2005).

The general introduction of computers into nearly every school, workplace and home (in the Western world) has made it easy to use keystroke-logging programs to study writing. Not only has access to computers made it possible to record the writing process, but the spread of computer literacy even at a young age has opened up for the study of writing on computers in very young age groups (the youngest children in the Swedish data set here are 10 years old).

#### 7.1.1 Methods to study writing in real time

In recent decades, several other methods preceded keystroke logging in the real-time study of writing. Wengelin et al. (2009b) divide the methods into two types: (1) self-report measures such as **thinking-aloud protocols**, where the writer talks aloud during the writing session, reporting what she is currently doing and planning to do (Hayes and Flower, 1980; van den Bergh and Rijlaarsdam, 2007) or categorizes her own behaviours in response to randomized probes (e.g. Torrance et al., 2007); and (2) observations and recordings of writing (e.g. Myhill and Jones, 2007). Studies using the first type of method have been criticized for their reactivity and those using the second for not providing enough information about the processes (compared with what can be obtained through self-reporting). On the other hand, studies using the second type of methods are supposed to be less contaminated by the data-collection process.

Before computers could be used to record the writing process, researchers had to rely on thinking-aloud protocols or **retrospectives**, where the writer, after finishing

writing her text, goes through it with the researcher and accounts for her thoughts and considerations during the text-production process. While thinking-aloud protocols have the disadvantage of disturbing the writing process in that the writer must focus not only on what to write but also on what to say about what is being written (and not), thus adding cognitive effort to the task, they have the advantage of providing some insights into the writer's thoughts. The criticism levelled against thinking aloud-protocols concerns the completeness of the protocols and the extent to which the subject may (un)consciously report what she thinks that the experimenter wants to hear. It is also a controversial question how much the continual reporting interferes with the text that is being written (Spelman Miller and Sullivan, 2006; Sullivan and Lindgren, 2006).

While Greene and Higgins (1994) argue that retrospectives have the advantage of allowing writers to explain their thoughts directly, thus avoiding interference with their attention to the task, Levy and Ransdell (1996) advocate a more cautious approach. Because of the writer's memory constraints, retrospectives can be considered to have validity problems.

A third method to analyse writing is to **video-record a writing session** (e.g. used in combination with keystroke logging by Matsushashi, 1981; Wengelin, 2002). Compared with keystroke logging, however, accuracy is much lower and the analysis work is more time-consuming. There are also studies combining thinking-aloud protocols with keystroke logging (e.g. Stevenson et al., 2006))

Although **keystroke logging** solves many of the problems associated with other methods, the writer's inexperience with the keyboard is often an issue as lack of keyboard skills could entail that keyboard writing does not reflect the normal writing process. Today, that objection is almost obsolete, since adult students often write almost everything except very short texts on a keyboard. However, at the time when the data for this thesis were collected, it was less common for children in the younger age groups (10-year-olds and 13-year-olds in this case) to write long texts on a keyboard in a school setting. Lindgren (2005) argues that if a writer is well acquainted with typing on a computer, keyboard logging is both a non-intrusive and a non-reactive way of capturing the writer's actions.

However, although keystroke logging gives insights into the writing process, it only yields information about the surface: the progression of the text, recursivity, editing and pausing; it does not reveal what caused the pause, etc.: did the writer perhaps pause to do some planning? Indeed, a substantial amount of planning should still take place *simultaneously with* writing, and here we obtain even less information. Keystroke logging further does not reveal the writer's thoughts and intentions during writing.

### 7.1.2 Keystroke-logging programs

In recent decades, several keystroke-logging programs have been used in the field of writing research. Features common to all of them are that they present temporal information such as data on pauses (e.g. how long the pauses are and where they occur), and to a varying degree information about editing (e.g. what was deleted, what was added, and when). Further, all keystrokes made during a writing session

are recorded such that they can be replayed and analysed afterwards. The way these characteristics of the text-production process are represented can vary across programs.

On the surface, the keystroke-logging programs can look like simple word processors, although some of them (like Inputlog, see Leijten and Van Waes, 2006) actually operate beneath a word processor (such as Microsoft Word), and they can also be combined with speech recognition (Leijten, 2007). Some of the many programs used for writing research in recent decades include S-notation, J-Edit and Trace-it (Kollberg, 1998; Severinson-Eklundh and Kollberg, 1996, 2002; Lindgren, 2005), Inputlog (Leijten, 2007), Translog (Jakobsen, 2006) and ScriptLog (Strömquist and Malmsten, 1998; Strömquist and Karlsson, 2001). A further refinement of the method was to combine keystroke logging with eye tracking to investigate eye movements and reading patterns during writing. ScriptLog has been adapted to use this combined method (see e.g. Holmqvist et al., 2004b; Andersson et al., 2006; Wengelin et al., 2009b), but new programs, designed from the start to meet the specific need to detect automatically what a writer is looking at when writing, have also been developed, such as EyeWrite (Simpson and Torrance, 2007; Wengelin et al., 2009b). The writing tool Eye & Pen has specialized in handwriting (on an electronic writing tablet) combined with eyetracking (Alamargot et al., 2006), opening up for more systematic comparisons between keyboard writing and handwriting.

Overviews of the history of keystroke logging are found in Spelman Miller and Sullivan (2006) and in Sullivan and Lindgren (2006).

### 7.1.3 Writing research using ScriptLog

It is beyond the scope of this thesis to provide an overview of all the findings from keystroke logging, but two of the most recent books in the series *Studies in writing* (Series Editor Gert Rijlaarsdam) contain several chapters on this topic (Sullivan and Lindgren, 2006; Van Waes et al., 2006), as does the special issue of *The Journal of Reading and Writing* (Reading and Writing, 2009).

For example, the program used to record written data for this thesis, ScriptLog, has been used in a wide variety of research areas: an overall approach to the pause patterns of written composition (Strömquist, 1996); contrastive studies of speech and writing in a developmental perspective (Nordqvist, 2001), and in texts spoken and written by persons with various functional impairments (Wengelin, 2002; Strömquist and Ahlsén, 1998); an investigation of what kind of grammar errors Swedish school children do (using the same data as in this thesis) (Sofkova Hashemi, 2003); an investigation of pauses in “pre-fabricated phrases” in second-language learners of English (Wiktorsson, 2003); the close examination of micro-pauses in second-language learners of French (Gunnarsson, 2006); the examination of writing to dictation of non-words (Uppstad, 2005); and the study of the influence of typing skill on pause-execution cycles (Alves et al., 2007).

## 7.2 ScriptLog – A description

Below I will describe the keystroke-logging program ScriptLog in some detail. If not otherwise specified, the description of ScriptLog here refers to the Mac version ScriptLog Pro1.04. This version has not been further developed after 1998 (Strömqvist and Malmsten, 1998); instead, a more elaborate ScriptLog version has been adapted to the PC/Windows environment (Strömqvist and Karlsson, 2001). Older ScriptLog files produced in the Mac Pro version can be converted so that some of the features of the PC version can be used for analyses. The analyses in this thesis are mainly performed on output files from the Mac version, but for instance the pause analysis in Chapter 11 is made in the PC version after conversion of the Mac files.

Since most output files exist and are similar in both the Mac and PC versions, it is possible to use ScriptLog files from the PC version to carry out analyses similar to those described here. In the description of the Mac files below, I will therefore mention when the files exist in some other form in the more recent and updated PC version of ScriptLog.

Apart from generating output files, ScriptLog also provides the option to replay the writing session on the screen, from beginning to end (the PC version can also replay selected segments of the output). The output files were developed to provide the researcher with materials to enable methods other than the very time-consuming one of analysing the replayed session in real time.

### 7.2.1 A note on pauses

A big question when you study the writing process using keystroke-logging programs is what should count as a pause. This is a tricky issue which cannot be easily answered; I will discuss it in more depth in Chapter 11.

### 7.2.2 The ScriptLog set-up

Various kinds of writing experiment can be designed in ScriptLog. For example, the screen can be divided into a writing area and a stimulus area where prompts such as a picture or a sentence are shown, either during the whole writing session or only during a certain pre-set time. The program also allows the use of audio-files for elicitation purposes (for instance for a spelling test). The writing time and the writing area can be limited in various ways. The participants may be allowed to click themselves forwards through a series of pictures, or new pictures can be shown automatically at a certain interval.

The Mac version of ScriptLog looks like a stripped-down version of a word processor, rather similar to the Notepad program on a PC but with even fewer functions (for example, no possibility of bolding or italicizing the text or changing fonts or sizes; in our experiment, we even disabled the copy-and-paste function). The set-up we used was as simple as possible: only a “blank sheet of paper” (the **editor window**) on the screen. The participants were told that they would be using a simple word processor to perform their written tasks (writing a narrative or an expository text) (see Section 6.4.6, page 57). Apart from the open editor window, a start and



stop button was displayed in the upper right corner of the screen. The experiment leader clicked on this to start and end the recording.

### 7.2.3 ScriptLog file types

In the following, the most important output data files from ScriptLog are described. The description is limited to the file types that are most relevant for the present study. A more exhaustive description of the files can be found in the manuals of the Mac and/or the PC version (Strömquist and Malmsten, 1998; Strömquist and Karlsson, 2001).

The various file types described below are illustrated with examples from an expository text written by a 17-year-old girl [wh07fBEW]. Full texts are in most cases found in the Appendix (beginning on page 193). English translations are restricted to the TXT file, and to some extent the linear file. The translations are intended to capture the meaning of the text; literal translations are given only when called for.

#### 7.2.3.1 BIN file

After every completed ScriptLog session, a *BIN file* is created. This file contains all the information about the writing session. In the Mac version of ScriptLog it is not possible to open the BIN file to see what it looks like. The BIN file is used for extracting most of the other analysis files mentioned below<sup>1</sup>.

#### 7.2.3.2 TXT file/Final text

The TXT file or *text file* is a representation of how the writer intended the text to look in its completed state. Therefore the text file is also referred to as the *final text*. Several of the analyses performed in this thesis are based on TXT files, for instance all frequency counts of word tokens and types, clauses and T-units in Chapter 8. Example 10 show an example of the beginning of a final text from an expository text by a 17-year-old girl. An English translation is found in Example 11.

- (10) The beginning of the final text from an expository text by a 17-year-old girl

[wh07fBEW]

Att människor har problem är ingenting ovanligt och de problem jag såg i filmen var inte så annorlunda.  
Att vara utanför och inte få vara med sina klasskamrater är inget nytt problem, man kanske är annorlunda på något vis och blir därför utesluten ur gemenskapen. I låg och mellanstadiet hände detta ofta med olika personer, även i högstadiet vet jag att det förekom. När man är så liten som man faktiskt vardå, är man ganska osäker på sig själv, och man vet inte alltid hur man ska hantera olika situationer.

<sup>1</sup>In the PC version, the BIN file serves the same purposes but can also be opened in any text editor.

- (11) The beginning of the final text from an expository text by a 17-year-old girl.  
English translation of Example 10  
[wh07fBEW]

*People having problems is nothing unusual and the problems I saw in the film were not so different.*

*Being excluded and not being allowed to be with your classmates is not a new problem, you may be different in some way and therefore excluded from the community. In elementary school this often happened to different persons, in high school too I know that it occurred. When you are as small as you actuallywerethen, you are pretty uncertain of yourself, and you do not always know how to handle various situations.*

### 7.2.3.3 LIN file

The LIN file or *linear file* is a linear representation of the writing process. This file contains everything that was written during the session. It thus also includes text that was deleted as well as operations such as pressing delete, pressing the arrow keys (left, right, up and down) and moving the mouse. The linear files can be used to follow the writing process step by step, as an alternative to watching the ScriptLog replay. These two methods can be combined: study of the LIN file may identify interesting sections to play back, and something identified during a playback session may be the subject of a special study.

It is optional to include pause information in the linear file. The Mac version has default pause criteria of 2 seconds and 5 seconds, as well as a linear file with no pauses. Anything not representing pure text (i.e. anything other than characters and spaces visible on the screen and also found in the text file) is placed in angular brackets.

The codes to be found in linear files are explained below:

<START>, <END> These codes indicate the beginning and end of the writing session. The <END> code can also occur in the middle of the linear text, for example in experiments where writers produce a picture-elicited text and are asked to move forward to the next picture by means of a mouse click.

<DELETE> This indicates that the writer has pressed the delete key or the backspace key<sup>2</sup>. If the delete key is pressed several times in a row, the number of times is indicated with a number; two presses in a row are represented by <DELETE2> and twenty-four consecutive presses by <DELETE24>.

<RIGHT4> Use of the arrow keys is indicated by <RIGHT>, <LEFT>, <UP> and <DOWN>. Consecutive pressing of one of the arrow keys is represented by a number after the arrow indication such as <RIGHT4>.

<CR> This indicates a carriage return (i.e. a pressing of the enter key).

---

<sup>2</sup>The PC version of ScriptLog distinguishes between use of the delete key (erasing what is in front of the cursor) and use of the backspace key (erasing what is behind the cursor). The reason why this was not included in the Mac version is that the keyboard did not have a delete key.

<MOUSE ,170> This indicates a mouse click. The number after the comma indicates the position to which the writer moves the mouse. Position '0' is always the first character written on the screen. Note that depending on whether text is being deleted, inserted or moved during the writing session, the position of a letter relative to the starting point can vary.

<13.03> This indicates a pause of 13.3 seconds. The length of a pauses is indicated in seconds<sup>3</sup>.

Example 12 show an extract of the beginning of a linear text from an expository text by a 17-year-old girl. Pauses longer than 2 seconds are included.

(12) An Extract from the linear text from an expository text by a 17-year-old girl

[wh07fBEW]

```
<START><13.03>att mä<DELETE6>Att männis<DELETE>kor har problem,
<DELETE2> är ingenting ovanligt och de proble jag <3.93><LEFT5>m
<RIGHT2><LEFT2><DELETE><2.23><RIGHT4> såg i filmen
varinge<DELETE4> inte så annorlunda<7.30>. <12.73>att
in<DELETE6><CR>Att vara utanför och iny<DELETE>te få vara
<2.68>med sina kal<DELETE2>s<DELETE>lasskamrater är
ingetnyttproblem, <5.05><MOUSE ,170>
```

The file begins with <START>, which indicates that the experimental leader started the ScriptLog recording. After this, the writer paused for 13.03 seconds before she started to write *att mä* ('that peo[ple]'). This is followed by a deletion of 6 characters, i.e. everything written so far, probably to replace the first letter 'a' with a capital letter. Then the writer rewrites the words she had already written (with a capital 'a'), stops in the middle of the word *människor* ('people') to delete an erroneous 'l' and insert a correct 'k', and she finishes the phrase with a comma and a space. She immediately deletes this and continues writing *är ingenting ovanligt och de proble jag* ('is nothing unusual and the proble I'). She then probably detects that an 'm' is missing from 'problem' and uses the left arrow key to go back in the text and insert it, together with a space. After this she moves 2 steps forward using the right arrow key. She immediately goes two steps backwards, using the left arrow key, and then deletes the erroneous space. Then she pauses for 2.23 seconds and moves forward using the arrow key 4 times.

From this linear file we can conclude (at least) two things. The first is that a great deal of deletions, insertions and moving around in the text takes place that is impossible to detect only by looking at the final file. If we are interested in the process *behind* writing, we will have to analyse real-time data (for example as represented in the linear file or by the playback in ScriptLog), not the final product. If we do not do this, we will miss important insights into what the writing process really is. The second, and equally important, thing is that this – very typical – example from a linear file shows that writing is a more iterative process

<sup>3</sup>The PC version also offers the option of showing the time in minutes.

Table 7.1: Output from the ScriptLog LOG file. The first column shows the time (in s); the second column shows the type of event; the third and fourth columns show the cursor position before and after the keypress; and the fifth column shows what was shown on the screen, or (within angular brackets) what event took place

time	type	from	to	key
0.00	10	2	0	<START>
13.03	7	0	0	a
13.18	7	1	1	t
13.33	7	2	2	t
13.45	7	3	3	
13.81	7	4	4	m
14.43	7	5	5	ä
15.08	5	6	6	<DELETE>
15.26	5	5	5	<DELETE>
15.43	5	4	4	<DELETE>
15.61	5	3	3	<DELETE>
15.80	5	2	2	<DELETE>
16.08	5	1	1	<DELETE>
16.81	7	0	0	A
17.31	7	1	1	t
17.46	7	2	2	t
17.63	7	3	3	
17.90	7	4	4	m
18.30	7	5	5	ä
18.63	7	6	6	n
18.78	7	7	7	n
19.01	7	8	8	i
19.38	7	9	9	s
19.85	7	10	10	l
20.21	5	11	11	<DELETE>
20.63	7	10	10	k
20.90	7	11	11	o
21.31	7	12	12	r

than speaking. Two letters, words, phrases or sentences that are adjacent in the final text may not have been produced consecutively. The process that the writer goes through when writing a text thus differs (in many cases) significantly from the process of the reader.

#### 7.2.3.4 LOG file

A LOG file consists of columns with numbers and letters. Each keystroke or event is represented by a single line in the LOG file. This means that the LOG file is the largest of the files extracted from the BIN file. It is also not very easy to read for the human eye, although it can aid in clarifying information from the playback or the linear file. LOG files are thus normally not used directly but rather as input for other analyses that can extract and provide further information. Examples include calculating the distance between a deletion and the last character (the outcome of that analysis is an EDD file, a type not described in detail here), extracting the

Table 7.2: Output from the ScriptLog STA file. Edited tokens gives the total number of characters in the final edited text; Linear tokens gives the total number of keystrokes during text production; Time gives the total writing time (in seconds); Pausetime gives the pausetime as calculated using a given pre-set pause criterion (here 2 seconds); Median pausetime gives the median duration of inactivity between two events on the keyboard or mouse

Total	
Edited tokens:	3349
Linear tokens:	4086
Time:	2194.13
Pausetime (200):	703.35
Median pausetime:	0.30

strings that have been deleted (represented by a DEL file, which is described in detail below) and finding certain strings of characters in the linear text.

Table 7.1 shows an example of the beginning of a LOG file. The first column shows the time (in seconds) when a keypress or an event occurred. The second column shows the type of key or event. For instance, ‘7’ indicates a letter and ‘5’ indicates <DELETE>. The third and fourth columns show the cursor positions before and after the key was pressed down. When a letter is produced, the position number increases; when <DELETE> has been pressed, it decreases. And the fifth column explicitly identifies the key pressed. Thus, if we “translate” the LOG file, it tells us that at 0 seconds the writing session starts. When 13.03 s have passed, the first key (the letter ‘a’) is pressed, and at 13.18 s the second key (the letter ‘t’) is pressed, etc.

### 7.2.3.5 STA file

The STA file or statistics file summarizes basic statistics relating to certain production measures. Table 7.2 shows what the information from the STA file looks like. **Edited tokens** is the total number of characters in the final edited version of the text (i.e. the TXT file). Characters are defined as all units visible on the screen, i.e. letters, signs representing a word (e.g. % and ℘), spaces between words, and major and minor delimiters (e.g. ;,.,!?). **Linear tokens** is the total number of keystrokes in the text, thus including characters that have been deleted as well as presses on the backspace and arrow keys. **Time** gives the total writing time (in seconds), including pauses. **Pausetime** is calculated using the previously decided pause criterion (here 2 seconds). It is thus possible to produce several versions of the STA file depending on the pre-set pause criterion used. **Median pausetime**, finally, gives the median time of inactivity between two events on the keyboard or mouse. This is a rough proxy for the writer’s keyboard or typing skills.

In the PC version of ScriptLog, the STA file has been further developed. The differences are described in greater detail in Chapter 9.

Table 7.3: Output from the ScriptLog PTD file. The first column shows the time elapsed during a writing session (in seconds) before a certain pause occurred. The second column shows the pause length

0.00	13.03
45.00	3.93
54.16	2.23
77.80	7.30
85.28	12.73
113.46	2.68

### 7.2.3.6 PTD file

The PTD file or **pause-time data** file can be used to explore the distribution of pauses. The Mac version offers a choice to include pauses longer than 2 or 5 seconds. In the PC version it is easier to set the pause time according to your own criterion.

The PC version further provides an option called **Partial analysis** which offers the possibility of dividing the text into segments of equal length in minutes and seconds and then measuring pause time or pause length in each segment. This possibility is used for the investigation in Chapter 11.

An example of the output from a PTD file is found in Table 7.3. The output consists of two columns. The first column shows the point in time (in seconds) when a certain pause took place, and the second column shows the length of the pause starting at the indicated time. In the example in Table 7.3 (taken from the same example text used for the TXT, LIN, and LOG files above) we see that at 0.00 seconds (i.e. the beginning of the writing session), a pause of 13.03 s occurred. Then, 45.00 s into the writing session, a second pause of 3.93 s occurred, and 54.16 s after the start of the writing session there was a pause of 2.23 s, etc.

### 7.2.3.7 DEL file

The *DEL file* is extracted from the LOG file with the help of an auxiliary program working in the Unix environment. The program is called **Eddlista2** and provides the researcher with an output indicating everything that has been deleted in the text. The program was written by Åsa Wengelin; further examples of how the DEL file can be used are found in Wengelin (2002). Basically, the program goes through every occurrence of <DELETE> in the LOG file and produces an output file listing the strings that have been erased<sup>4</sup>.

An example of an output file is found in Table 7.4. The output consists of four columns. Each line represents one deletion string, i.e. something that was deleted by one or more consecutive presses on backspace (or delete) without any other keystroke interfering with the action of deletion. The first column gives an accumulative index (starting with 0) of the deletions. The second column shows the number of deleted characters. The third column shows the distance between the last written character

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<sup>4</sup>The function of Eddlista2 is now implemented in the PC version of ScriptLog, under the name *Deletion list - data*.

Table 7.4: Output from the ScriptLog DEL file. Each line illustrates one string of deletions. The first column shows an accumulative index of the deletions; the second column shows how many characters were deleted; the third column shows how far from the current position of the cursor the deletion was made; and the fourth column shows the deleted string.

0	6	0	att mä
1	1	0	l
2	2	0	,
3	1	0	
4	4	0	inge
5	6	0	att in
6	1	0	y
7	2	0	al
8	1	0	[7]s
9	1	0	u
10	18	0	är anno[9]rlunda och
11	1	0	
12	6	0	och de
13	4	0	, i
14	1	0	w
15	1	-11	[14]é

and the deletion; a zero indicates that the writer deleted the character that was written immediately before (i.e. the writer did not use the arrow keys or the mouse to move away from the character just written). In the example in Table 7.4, on line 1, the writer has deleted 6 characters: *a t t /space/ m ä*. A negative number (e.g. ‘-11’ in the example) indicates that the writer has moved back (e.g. by using the arrow keys) before deleting the string. This column thus gives an indication of how dynamic the writer is when editing. Many zeros may be a symptom of a linear editing style, where typos and spelling errors are immediately detected and corrected, while higher numbers (positive or negative) would imply that the writer moves (and reads) backwards and forwards in the text. The fourth column shows the deleted string, i.e. one or more letters, spaces, carriage returns or delimiters. The bracketed numbers sometimes occurring in the fourth column, e.g. ‘[7]’, indicate that the deletion constitutes a subdeletion of another deletion, in this case of the deletion with the index number 7.

### 7.3 Summary on keystroke logging

This chapter presents the research method of keystroke logging, exemplified by the program ScriptLog, which was used to record written data for this thesis. Keystroke logging is a technique for recording writing in real-time that is a successor to other methods, e.g. thinking-aloud protocols and retrospectives. A keystroke-logging program typically records what a writer is doing and allows the researcher to analyse the dynamic writing process underlying the final text. Researchers who use keystroke logging are often interested in the cognitive processes behind text production, such

as planning, revising and pausing. Most keystroke-logging programs generate a vast amount of data – analysis files that the researcher uses to investigate movements, editing and pauses during text writing. This chapter presents some of the most common types of analysis files (occurring in both ScriptLog and other programs): the final text, the linear text and the LOG file; and some files that are more specific to ScriptLog: the statistics file, the file with pause-time data and the deletions file.





**Part IV**  
**Results**

# Chapter 8

## Text length – a quantitative approach

### 8.1 Introduction

In this chapter, the data are explored according to certain **production measures**: number of word tokens, number of clauses and number of T-units; and **ratios**: words per clause, words per T-unit and clauses per T-unit. The purpose is on the one hand to investigate the differences between age groups in how they perform in different genres and modalities, and on the other to see how these measures interact, and what that can reveal about the demands of language production.

It is natural to assume that there will be a correlation between, for instance, the number of word tokens and the number of clauses in a text. Nevertheless, it is interesting to see that although there may be a general trend for texts by older writers to be longer, the production may differ depending on modality and genre. This is one purpose of exploring so many measures.

Wolfe-Quintero et al. (1998) carried out a literature study to investigate what they call **fluency measures** used in second-language and foreign-language development. Although they do not deal with first-language acquisition, their conclusions as regards which measures are most reliable for describing development are important. They state that words per T-unit, words per clause and words per error-free T-unit are fluency measures that are consistently linear. Measures of grammatical complexity that were also linear included clauses per T-unit and dependent clauses per clause. They also mention measures of lexical complexity; such measures are discussed in Chapter 10 of this thesis, which deals with lexical density and diversity. They finally conclude that they have found no study comparing all these measures for one population of learners.

Scott (1988) is a literature study comprising a range of studies that have investigated spoken and/or written texts by persons between 9 and 19 years of age using quantitative data. The results from Scott will be presented in connection with the measures below, but Scott also raises the question of whether data of this kind should be used in a normative sense. She advocates the use of the data to provide quantitative evidence of a child's abilities in relation to different text types. I agree with her view and would like to underline that the results here are merely a way to

compare the age groups' performances in the different text types, and to contrast quantitative data from speech and writing, from expository and narrative, and from the four age groups. The purpose is not to set a standard for what is typical of a specific age group, and the results should only be used with caution in that way.

Scott (1988) further points out that you have to be cautious not to equal syntactic complexity in sentences (in speech or writing) with syntactic maturity. Thus, for instance, a long T-unit (measured in number of clauses) is not necessarily a sign of better language production. A better view (if you want to investigate syntactic maturity), according to Crowhurst (1979), is to look at the syntactic resources that can be used in discourse according to particular discourse demands. I interpret this to mean that able, experienced language users adapt their language (here: syntactic structures) to the purpose and properties of a certain text type. This means that with increased knowledge and experience of different types of genres, and with more practice using the genres, the user will become better at producing sentences (or T-units) that are more appropriate for the genre. As an example, written expository texts typically include many T-units with many subordinated clauses, while a spoken narrative text includes more coordinated main clauses. Data from Scott (1988) support this view.

The report on quantitative measures from the international part of the Spencer Project only covered comparisons of text length in the number of word tokens and the mean length of utterances (e.g. number of words per clause) (Berman and Verhoeven, 2002).

## 8.2 Method

The measures in this chapter have all been extracted using CLAN analyses of the transcribed CHAT files, coded for T-units (MacWhinney, 2009b). The measures were obtained in the following way:

**Number of word tokens** was calculated by the CLAN program *freq*.

**Number of clauses** was extracted from results from the CLAN program *mlu*.

**Number of words per clause** was calculated by the CLAN program *mlu*.

**Number of T-units** was extracted by a combination of the CLAN programs *mlu* and *freq*.

For the comparisons in this chapter, the final versions of the written texts are used (cf. Section 7.2.3.2 on page 74), and thus not the linear texts, which contain everything that was written during text production. The linear texts are instead explored in Chapter 9. For the spoken texts, on the other hand, word repetitions, false starts and unintelligible speech were excluded from the count of the number of word tokens. Although it would have been interesting to investigate and compare the process versions of both modalities, there are several complications in doing so.

Indeed, you could argue that it would be more “fair” to compare the linear text files from writing with the spoken texts (which are inherently linear). If we do so,

we will truly compare the real-time production in both modalities. However, the issue of word counting in written linear texts can be very problematic. Let us take the example of a person starting to write a word, then erasing it (without finishing it) and instead writing something else. Should that half-written word be included in the count? Well, we could argue that it has its equivalent in false starts in spoken discourse. But what if a writer deletes one or more words (or a whole paragraph) – how should that be counted? Or if a writer deletes half a word, and rewrites it into something else – should that be counted as one or two words? Or if a writer cuts out a piece of text and pastes it into another part of the text? In summary, the possibilities of editing provided by (keyboard) writing make it complicated to count the number of words in the linear text. The same problem with counting occurs for the measures of clauses (a writer may for example erase a clause or make changes such that a main clause becomes subordinated to an adjacent clause) and T-units. And how should we deal with the correction of spelling mistakes and other editing operations that are not performed in immediate connection with the execution of a specific item?

Apart from all these objections, I believe that important insights into the different conditions and constraints of speaking and writing could in fact be gained from carrying out such comparisons, regardless of all the complicated taxonomic choices that would have to be made. Nevertheless, this will not be done in this thesis, because apart from the problematic question of how to systematize editing in writing, the second argument for using final texts is comparability with previous studies of quantitative data from speech and writing.

### 8.2.1 Statistical analysis

For the statistical analyses in this chapter I have used Anovas with modality and genre as within-subject factors and gender, order and age as between-subject factors. Significant interaction effects were followed up by analyses of simple main effects. Post hoc comparisons of significant main effects were carried out according to Tukey's HSD procedure. Effect size (ES) is partial  $\eta^2$  (cf. Section 6.7.1) Any gender differences are reported here but will be addressed in more general terms in the concluding chapter of the thesis (cf. Section 6.7.1.1 on page 63).

## 8.3 Text length in number of word tokens

The number of word tokens has been a common way of looking at production for the purpose of comparing text length, and it has also been an important measure for calculating fluency measures (i.e. the number of words per minute, etc.) (cf. e.g. Wolfe-Quintero et al., 1998). The more words produced per a certain time unit (in writing most often words per minute, and in speech syllables per second), the better fluency. Fluency would then be a measure of the ease with which the language producer can perform – where the most units in the shortest time is the best.

The Spencer Project measured text length as the number of words per text. Berman and Verhoeven (2002) distinguish a salient developmental trend for all text types, reporting the largest gap between the group of junior-high (in the Swedish

Table 8.1: Mean length of text in number of word tokens, broken down by genre, modality and age

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Narrative	124.15	141.50	445.10	450.24	288.22
Expository	151.45	206.18	576.15	613.74	384.01
Spoken	158.67	144.73	520.93	613.32	356.20
Written	116.93	202.95	500.32	450.66	316.03
Total	137.80	173.84	510.63	531.99	336.11

data: 13-year-olds) and high-school students (in the Swedish data: 17-year-olds). They also find language differences, with French and Hebrew having smaller age differences than the other languages. No significant gender differences were reported. The narrative texts are longer than the expositives, but no modality effects are reported, and not even an interaction of genre and modality. The study concludes that developing genre is more complicated than performing a task in two modalities.

### 8.3.1 Results from analyses of the number of word tokens

Text length in number of word tokens is a measure of the total number of words. Word repetitions are excluded, as well as false starts in speech. In the written texts, only the final versions are compared. Table 8.1 presents an overview of the mean number of tokens in each age group, each genre and each modality. Figure 8.1 illustrates the mean number of word tokens for each text type.

The statistical analyses showed many interactions and effects. To begin with, there was one significant four-way interaction: modality, gender, order and age ( $F(9, 47) = 2.188, p = 0.040, ES = 0.295$ ), and post hoc analysis showed that it consisted in the 17-year-old girls in Order D producing more word tokens than the boys. There was also a difference for the adults' spoken texts in that the women in Order B had more words than the men and that the men in Order C had more words than the women. In the written texts by the adults, the men had more words than the women in Order A. I will not explain these differences further, referring instead to the general analysis of gender in the conclusion of the thesis (Section 12.7).

Further, there were three significant three-way interactions: modality, order and age ( $F(9, 47) = 2.555, p = 0.018, ES = 0.329$ ), modality, genre and age ( $F(3, 47) = 3.536, p = 0.022, ES = 0.184$ ) and modality, genre and gender ( $F(9, 47) = 4.248, p = 0.002, ES = 0.083$ ). The modality-genre-gender effect will not be explored further, since it is included in the four-way interaction mentioned above.

**Post hoc analyses of the modality, order and age effects** revealed that the spoken texts by the 17-year-olds in Order B had more word tokens than the written texts. The same thing was true for the spoken texts by the university students in Order B and D.

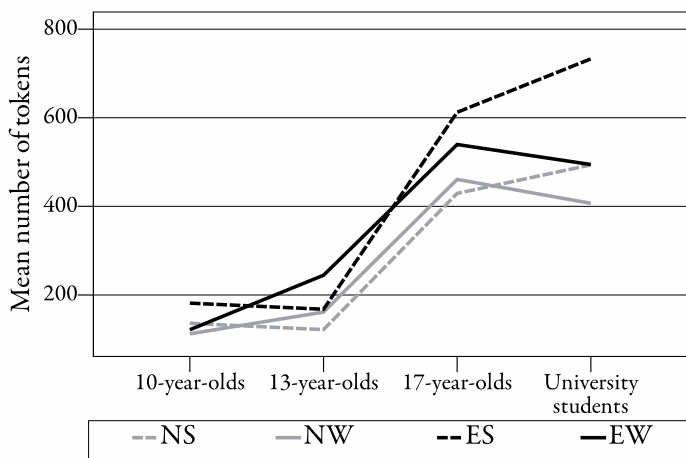


Figure 8.1: Mean number of word tokens in each text type, broken down by age

**Post hoc analyses of the modality, genre and age effects** show that the expository texts by the 13-year-olds have more words than the narrative texts. For the 17-year-olds and the university students the expository texts in both modalities have more word tokens than the narrative ones.

The statistical analyses further show four significant two-way interactions: genre and age ( $F(3, 47) = 3.144, p = 0.034, ES = 0.167$ ), modality and order ( $F(3, 47) = 8.737, p = 0.000, ES = 0.358$ ), modality and age ( $F(3, 47) = 7.625, p = 0.000, ES = 0.327$ ) and modality and genre ( $F(1, 47) = 10.496, p = 0.002, ES = 0.183$ ). Since these effects are all included in the three-way interactions above, no post hoc analyses have been carried out for them.

Finally, there was a main effect of modality ( $F(1, 47) = 7.043, p = 0.011, ES = 0.130$ ) in that the spoken texts had more word tokens than the written texts, a main effect of genre ( $F(1, 47) = 30.561, p = 0.000, ES = 0.394$ ) in that the expository texts had more word tokens than the narrative texts, and finally a main effect of age ( $F(3, 47) = 47.881, p = 0.000, ES = 0.753$ ). Post hoc analysis shows no differences between the 10-year-olds and the 13-year-olds, and no differences between the 17-year-olds and the university students, but a significant difference between the two youngest and the two oldest age groups.

### 8.3.2 Discussion of the number of word tokens

Just like in the results from the cross-linguistic Spencer data, the main developmental step occurred between the 13-year-olds and the 17-year-olds. The capability for text generation seems to increase immensely between these ages. In contrast to the analysis of the huge Spencer corpus, we here find both modality and genre differences. The two oldest age groups produced more words in their spoken texts, and all groups except the 10-year-olds had more words in their expository texts.

The order interaction showed that it was the speakers who had produced written texts first who had more words in their spoken texts (i.e. the participants in Order B for the 17-year-olds, and the participants in Orders B and D for the university students). This could be an indication that writing enhances spoken performance and that the adults are especially helped by this.

That the expository texts are generally longer may be a consequence of the genre characteristics. While a narrative is finished when the last episode has been told (maybe with an extension in the form of a coda), the logical, non-chronological arguments of the expositives can be, and are, more easily expanded. It may also be more difficult for the language user to judge when the expository text is finished.

## 8.4 Text length in number of clauses

The number of clauses is another measure of text length. In many ways it is equivalent to the number of word tokens. This measure will later be used for the calculation of words per clause and clauses per T-unit. However, when we consider this measure, we must also remember how a clause was defined. As was described in Section 6.7.3 on page 65, the division of the texts into clauses depended on the finite verb. Since we defined a clause as having one finite verb, this means that clause length will increase if, or when, a producer uses a nonfinite construction instead of using subordination (or coordination) to expand a clause.

A T-unit like in Example 13 (from a written expository by a 10-year-old girl) would be counted as one clause if we rewrote the second clause as an infinitive phrase, as in the hypothetical Example 14. An authentic example is found in Example 15 from a written expository by a 17-year-old girl, where the infinitive phrase in the first clause makes the clause longer.

- (13) SBJ: hon kan nog ändra på det  
*SBJ: she could probably change it*  
 SBJ: om hon slutar att ta saker.  
*SBJ: if she stopped stealing things*  
 [wg02fAEW]
- (14) SBJ: hon kan nog ändra på det genom att sluta ta saker  
*SBJ: she could probably change it by stopping stealing things*  
 [hypothetical example]
- (15) SBJ: och självklart är det irriterande att skriva ett prov och känna.  
*SBJ: and of course it is irritating to write a test and feel*  
 SBJ: att alla inte gör det på samma villkor.  
*SBJ: that not everyone is doing it under the same conditions*  
 [wh16fDEW]

If the sentence in Example 15 did not have any infinitive clauses, it might have looked like the hypothetical Example 16.

- (16) SBJ: och självklart är det irriterande.  
*SBJ: and of course it is irritating*



Table 8.2: Mean length of text in number of clauses broken down by genre, modality and age

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Narrative	19.77	24.00	68.30	67.76	44.67
Expository	24.40	33.52	86.88	83.84	56.82
Spoken	23.35	22.90	78.77	86.63	52.49
Written	20.82	34.63	76.40	64.97	49.01
Total	22.09	28.76	77.59	75.80	50.75

SBJ: om man skriver ett prov.

*SBJ: if you write a test*

SBJ: och känner.

*SBJ: and feel*

SBJ: att alla inte gör det på samma villkor.

*SBJ: that not everyone is doing it under the same conditions*

[hypothetical example]

These examples are intended to illustrate what clauses can look like. With the Swedish solution of strictly assigning only one finite verb per clause, the clause length measured in number of words per clause will provide a fruitful guide to the development of clauses. However, this also means that the developmental trend in the number of clauses may fall or level out as language users start to include more and more nonfinite constructions in their texts.

### 8.4.1 Results from analyses of the number of clauses

In this analysis, center-embedded clauses are counted as separate clauses. Table 8.2 presents an overview of the mean number of clauses in each age group, each genre and each modality. Figure 8.2 illustrates the mean number of clauses for each text type.

In the analysis of the number of clauses, there was one significant three-way interaction: modality, age and order ( $F(9, 47) = 2.353, p = 0.028, ES = 0.311$ ). Further, there were three significant two-way interactions: modality and order ( $F(3, 47) = 8.906, p = 0.000, ES = 0.362$ ), modality and age ( $F(3, 47) = 7.715, p = 0.000, ES = 0.330$ ) and modality and genre ( $F(1, 47) = 4.595, p = 0.037, ES = 0.089$ ). Finally, there was a main effect of genre ( $F(1, 47) = 16.624, p = 0.000, ES = 0.261$ ); and one main effect of age ( $F(3, 47) = 44.319, p = 0.000, ES = 0.739$ ).

Post hoc analysis of the modality and genre interaction shows that the expository spoken texts have more clauses than the narrative spoken texts, and that the written expository texts have more clauses than the written narrative texts. Further analysis of the genre effect shows that the expository texts have more clauses than the narrative ones. Although there is no main effect, the trend is that spoken texts have more clauses than the written ones.

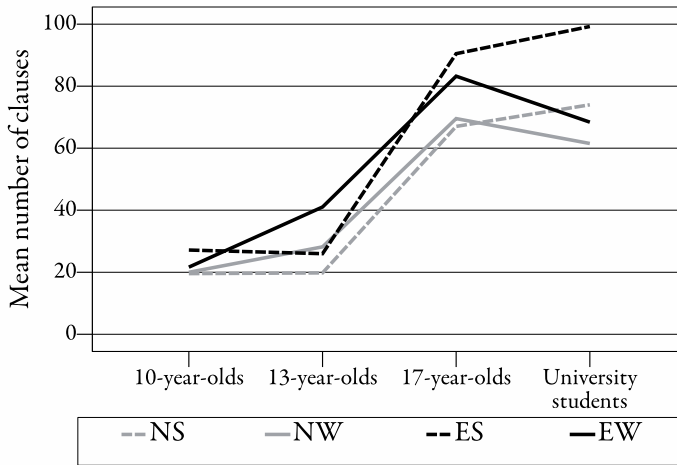


Figure 8.2: Mean number of clauses in each text type, broken down by age

Analyses of the modality-and-age effect revealed that in the spoken texts there were no differences between 10-year-olds and 13-year-olds, though both these groups differ significantly from the 17-year-olds and the university students. The same pattern is found for the written texts, where 10-year-olds and 13-year-olds produce the same number of clauses, which is significantly fewer than the 17-year-olds and the university students.

**Post hoc analysis of the modality, order and age effect** Post hoc analyses of the order effects in the *spoken texts* reveal the following:

**In Order A**, the 10-year-olds and the 13-year-olds group together and differ from the 17-year-olds. The university students do not differ from any group.

**In Order B**, the 10-year-olds and the 13-year-olds group together and differ from the 17-year-olds. The university students do not differ from any other group. Very similar to Order A.

**In Order C**, the 10-year-olds differ from the university students, while the 13-year-olds differ from the 17-year-olds and the university students.

**In Order D**, the 10-year-olds and the 13-year-olds group together and differ from the 17-year-olds and the university students, who also group together.

Post hoc analyses of the order effects in the *written texts* reveal the following:

**In Order A**, we find the same dichotomy as always: 10-year-olds and 13-year-olds vs. 17-year-olds and university students.

**In Order B**, the 10-year-olds and the 13-year-olds both differ from the 17-year-olds. The university students do not differ from any group.

**In Order C**, the 10-year-olds and the 13-year-olds group together and differ from the 17-year-olds and the university students, who also group together.

**In Order D**, the 10-year-olds differ from the 17-year-olds and the university students, while the 13-year-olds differ only from the 17-year-olds.

## 8.4.2 Discussion of the number of clauses

When looking at Figure 8.2, we indeed find the predicted downward trend in the number of clauses in the adult group. We already know from the number of word tokens that the adults produce more word tokens, mainly in the written narrative, but since this is not reflected in the number of clauses, this can be interpreted as an indication that the adults have more infinitive constructions as well as expanded noun, verb and adverbial phrases that increase clause length but reduce the number of clauses. We will find out more about this after analysing the number of words per clause in the next section. Interestingly, the adults have the smallest number of clauses in the expository written texts; this may be an indication that this text type contains more infinitive constructions.

We see that the expository texts have more clauses than the narratives, indicating a greater need for subordination in expository discourse. One reason is that the producer is giving her opinion about things, which tends to create one clause with *jag tycker* or *jag tror* ('I think'), and then a second (or more) clause stating the opinion. Another reason is that the genre (and this specific elicitation question) calls for many sentences including cause and consequence, or "if – then" clauses. The written expository text by a 13-year-old girl in Example 17 illustrates both of these things.

(17) SBJ: *jag tycker*.

*SBJ: I think*

SBJ: *att om man har svårigheter för att skriva eller något annat.*

*SBJ: that if you have difficulties in writing or something else*

SBJ: *ska man visa det.*

*SBJ: you should show it*

SBJ: *så man inte känner sig ensam om det.*

*SBJ: so you do not feel alone in it*

[wj11fCEW]

The genre effect is more profound in the spoken texts, which can be seen as a sign of the speakers having more difficulty in, for example, producing nonfinite constructions (which would decrease the number of clauses) under stronger time pressure.

The general picture, however, is that no differences are found between the two youngest age groups, or between the two oldest. There are more clauses in speaking (although, as Figure 8.2 tells us, this does not hold true in absolute numbers for the 13-year-olds) and in expository texts.

All in all, the 13-year-olds pose a problem here, since they break the general pattern. Although only indications, it seems as if this group may be struggling with adjusting to a genre that they have not yet mastered.

## 8.5 Text length in number of T-units

In Section 6.7.4 I discuss the choice of the T-unit as the unit of analysis on the “sentence” level. Hunt (1970) defines a T-unit as “One main clause plus any subordinate clause or non-clausal structure that is attached to or embedded in it”. As Scott (1988) points out, the T-unit can in this case be interchanged with the notion of a sentence. Scott further observes that in more advanced syntactic productions, elliptic expressions and utterances such as *yes* are common. Their lack of clausal structure will pose problems when we analyse and compare both spoken and written texts. Loban (1976) therefore proposed the *C-unit* (Communication unit) for spoken texts, which would then count an expression such as *Yes, please* as a *C-unit*. In fact, we have treated the division of the data into syntactic units just as if we were counting *C-units*, and not *T-units*. This means that occasional elliptic units will have been counted as *T-units* in the analysis below.

Wolfe-Quintero et al. (1998) report a study by Yau (without giving any further reference) that found strong correlations between words per T-unit and complex nominal phrases per clause. Their conclusion was that one major reason for the longer T-units is the complexity of the nominals. Here it is appropriate to comment that this can differ between languages, depending on morphology.

### 8.5.1 Results from analyses of the number of T-units

Table 8.3 presents an overview of the mean number of T-units in each age group, each genre and each modality. Figure 8.3 illustrates the mean number of T-units for each text type.

Statistical analyses showed one four-way interaction of modality, gender, order and age ( $F(9, 47) = 2.197, p = 0.039, ES = 0.296$ ) and one three-way interaction of modality, order and age ( $F(9, 47) = 2.848, p = 0.009, ES = 0.353$ ). There were also two two-way interactions: of modality and order ( $F(3, 47) = 10.189, p = 0.000, ES = 0.394$ ) and of modality and age ( $F(3, 47) = 6.844, p = 0.001,$

Table 8.3: Mean length of text in number of T-units broken down by genre, modality and age

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Narrative	13.93	14.23	40.07	37.03	26.18
Expository	12.78	16.25	41.70	38.89	27.26
Spoken	15.03	12.68	42.75	43.71	28.35
Written	11.68	17.80	39.03	32.21	25.09
Total	13.35	15.24	40.89	37.96	26.72

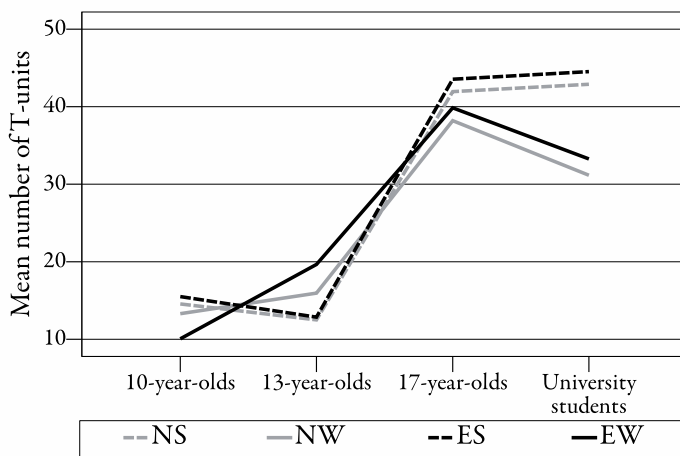


Figure 8.3: Mean number of T-units in each text type, broken down by age

$ES = 0.304$ ), and one main effect of modality ( $F(1, 47) = 6.543$ ,  $p = 0.014$ ,  $ES = 0.122$ ), and another main effect of age ( $F(3, 47) = 40.621$ ,  $p = 0.000$ ,  $ES = 0.722$ ).

Further analysis revealed no differences between the 10-year-olds and the 13-year-olds in the spoken texts, but both groups differed from the 17-year-olds and the university students. In the written texts, all age groups differed from each other, meaning that we finally found a measure discriminating fully between the ages and providing a developmental pattern.

**Further analysis of the effect of age, modality, gender and order** Post hoc analyses of the order effects in the *spoken texts* reveal the following:

**In Order A**, there were no differences found.

**In Order B**, the 10-year-old and 13-year-old girls group together and differ from the other grouping of 17-year-old girls and female university students. The male 13-year-olds further differ from the male 17-year-olds.

**In Order C**, there is a significant effect between the male university students and the 10-year-old and 13-year-old boys.

**In Order D**, the female 10-year-olds differ from the female 17-year-olds and university students. The 13-year-old girls differ only from the female university students. There are no differences between 17-year-olds and university students. The male university students differ from the males in all the other age groups.

Post hoc analyses of the order effects in the *written texts* reveal the following:

**In Order A**, the 17-year-old girls differ from all the other age groups. The male university students also differ from all the other age groups.

**In Order B**, the 10-year-old girls differ from the 17-year-olds and the university students. The male 17-year-olds differ from the 10-year-old and 13-year-old boys.

**In Order C**, there is a difference between the female 17-year-olds and the 10-year-old and 13-year-old girls. The 10-year-old boys differ from 17-year-olds and university students, and the male university students further differ from the 13-year-olds.

**In Order D**, the 17-year-old girls differ from the 10-year-olds. The 17-year-old boys differ from the 10-year-olds and the 13-year-olds, and the male university students also differ from the 10-year-olds.

### 8.5.2 Discussion of T-unit results

The general tendency is that the expository texts have more T-units and that the spoken texts have more T-units. Closer analyses of the interactions of modality and age, and the main effect of modality, show that modality is the most important factor for producing many T-units. The spoken texts have more T-units, which is an indication that spoken texts are longer; it is easier to produce much in speech. That the spoken texts have more T-units is an indication that subordination is more common in writing; in a comparison between texts with the same number of clauses, texts with a higher proportion of subordinated clauses would have a smaller number of T-units.

In speech we find the same developmental pattern as we have seen displayed for the number of word tokens and for the number of clauses: no differences between 10-year-olds and 13-year-olds on the one hand, and no differences between 17-year-olds and university students on the other. However, in writing there is a steady developmental trend, showing significant differences between all age groups. Interestingly, the 17-year-olds produce the most T-units. Producing many T-units, however, is not necessarily a good developmental sign. In one sense, the 17-year-olds' top position indicates that they are fluent enough to produce much text in a short time. On the other hand, their significantly higher number of T-units in writing, compared with the university students, indicates a less complex syntax.

Whether or not the non-existent difference in speech between the two oldest age groups in fact means that they produce as many T-units but that there remains a difference in syntactic complexity will be revealed when we look at the measure of clauses per T-unit.

## 8.6 Number of word tokens per clause (MLU)

The measure of *mean length of utterance (MLU)* is used as a measure of syntactic development (cf. Scott, 1988) and has been frequently used in the study of early

child-language development, although it has also been criticized on both methodological and conceptual grounds (cf. e.g. Bates et al., 1995; Snow, 1995). Miller and Klee (1995) even suggest that MLU may measure lexical skills rather than syntactic ones.

MLU is calculated by dividing the number of morphemes by the number of clauses in a text (Brown, 1973). This ratio provides information about the average length of a clause. Since a T-unit can be composed of more than one clause, counting the number of morphemes per clause is not the same thing as measuring morphemes per T-unit. Clause length increases with more complex noun phrases, infinitive constructions and adverbial attributes. However, when the language producer uses for example a relative clause to expand a noun phrase, clause length will not increase since what is added constitutes a clause in itself (cf. Section 6.7.3 on page 65 about clauses and center-embedded clauses). Instead the number of clauses in the text will increase.

MLU as mean length of utterances in morphemes was originally proposed by Brown, replacing the old method of measuring utterance length in the number of words. The underlying assumption for using MLU is that children follow the same development in their language acquisition. This view has been criticized lately, as is summarized for example by Lanza (1997). However useful the MLU measure may be for describing an individual child's development (argued by e.g. Peters, 1983), it should be used with care when comparing data from different languages. (Dromi and Berman (1982) even criticize it for being too "English-oriented".) A recent study by Parker and Brorson (2005) that compares English-speaking three-year-olds is able to show that there are no differences between the two methods of measuring MLU in, on the one hand, morphemes per utterance (as was proposed by Brown (1973)) and, on the other hand, words per utterance. In the present study we therefore use words per clause (which is less burdensome since it does not require morphological coding of the corpus).

Hunt (1970) reports an increase in clause length from around five words per clause in the fourth grade to eight words per clause in the twelfth grade. Scott (1988) also recapitulates findings from Rubin (1982) showing that clause length varied with the writer's sense of audience. When the students wrote for a more remote/distant/unknown audience, the clauses were longer than in texts they wrote for a more intimate/well-known audience. This could perhaps be compared with the different approaches of addressing the audience while producing a typical expository or narrative text: the imagined audience for the expository may be perceived as more remote.

The international Spencer Project compared MLU measures across the texts from the seven languages included in the project. Berman and Verhoeven (2002) report a significant developmental trend, although smaller in the individual text types. This suggests that there is an increase in the children's syntactic construction throughout the school years. The observed language differences were that there were fewer age differences in Hebrew and in French. The Swedish and Icelandic data appeared to have higher MLU than the other languages, especially in the spoken texts. No gender differences were found. Further, there was a genre effect, where the expository texts had more words per clause. There was an interaction of genre and modality, but no

main modality effect. This indicates that modality differences are more important in expository texts than in narrative texts. The findings thus suggest that both genre and modality are important when we study the development of clause length.

### 8.6.1 Results from the MLU analyses

Table 8.4 presents an overview of the mean number of words per clause (MLU) in each age group, each genre and each modality. Figure 8.4 illustrates the mean number of words per clause for each text type.

Statistical analyses show several significant results. First, there are two two-way interactions: of modality and age ( $F(3, 47) = 10.092, p = 0.000, ES = 0.392$ ) and of genre and age ( $F(3, 47) = 4.375, p = 0.009, ES = 0.218$ ). There was also a significant main effect of modality ( $F(1, 47) = 22.251, p = 0.000, ES = 0.321$ ) in that the spoken texts have more word tokens than the written texts, and a significant main effect of age ( $F(3, 47) = 18.734, p = 0.000, ES = 0.545$ ). The age effect was further investigated and revealed no differences between the 10-year-olds and the 13-year-olds. 17-year-olds had higher MLU than any of the two younger groups, and the university students had more words per clause than any other group.

The post hoc analyses of modality and age showed that the 10-year-olds and the 13-year-olds had more words per clause in their spoken texts than in their written texts. No modality differences were found in the texts from the two oldest age groups. Further analysis of the genre-and-age interaction showed that the expository texts by the university students had more words per clause than their narrative texts.

### 8.6.2 Discussion of the MLU

Clause length can be increased in several ways. One way is by using infinitive structures, which are more characteristic of expository texts. Another way of increasing clause length is the use of more complex noun and verb phrases, as well as adverbial phrases. Some of these structures may be less common in speech – not impossible to use, but structures that would seem a bit odd in speech yet natural in writing.

The general differences confirm the developmental pattern reported by Hunt (1970) and identified in the cross-linguistic comparison of the Spencer data. It is worth emphasizing that here we find that the developmental trend goes beyond

Table 8.4: Mean length of text in number of tokens per clause, broken down by genre, modality and age

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Narrative	6.33	5.91	6.70	6.73	6.42
Expository	6.09	6.27	6.64	7.42	6.59
Spoken	6.71	6.30	6.57	7.13	6.67
Written	5.71	5.88	6.77	7.02	6.34
Total	6.21	6.09	6.67	7.07	6.50



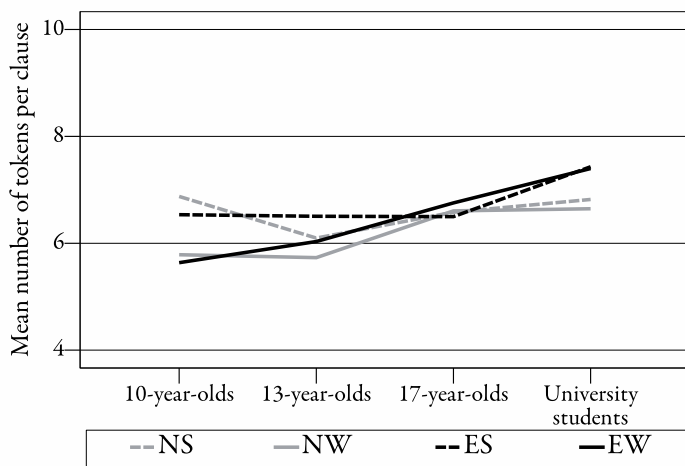


Figure 8.4: Mean number of word tokens per clause (MLU) in each text type, broken down by age

the 17-year-olds, with the university students having more words per clause than the other groups. It is also in the expository texts by the adults that we find the most words per clauses, which can be explained by their having more infinitive constructions or expanding noun and verb phrases.

In Example 18 we see one way of expanding the noun phrase, namely by adding a prepositional phrase (*i en av de norra förorterna i Göteborg* ('in one of the suburbs north of Göteborg')) to the noun. In speech, it would have seemed more natural to use a relative clause to describe the location of the youth recreation centre, which would then have resulted in a third clause rather than an expanded second clause, for example *en fritidsgård som låg i en av de norra förorterna i Göteborg* ('a youth recreation centre that was located in one of the suburbs north of Göteborg'); cf. the hypothetical Example 19. In fact, this same participant *did* spreads the information across two clauses in her spoken text, which is shown in Example 20. This indicates some explanations for the effect of longer clauses in writing (and in the adults' expository texts).

(18) SBJ: det var.

*SBJ: it was*

SBJ: då jag hade börjat att arbeta på en fritidsgård i en av de norra förorterna i Göteborg.

*SBJ: when I had started working at a youth recreation centre in one of the suburbs north of Göteborg.*

[wu13fCNW]

(19) SBJ: det var.

*SBJ: it was*

SBJ: då jag hade börjat att arbeta på en fritidsgård  
*SBJ: when I had started to work at a youth recreation centre*  
 SBJ: som låg i en av de norra förorterna i Göteborg.  
*SBJ: that was located in one of the suburbs north of Göteborg.*  
**[hypothetical example]**

- (20) SBJ: det var # åtta år sedan.  
*SBJ: it was eight years ago*  
 SBJ: när jag började jobba i Rannebergen.  
*SBJ: when I started working in Rannebergen [a suburb north of Göteborg].*  
**[wu13fCNS]**

## 8.7 Number of word tokens per T-unit

The number of word tokens per T-unit gives a rough indication of the number of words per sentence. T-units become longer by means of the same mechanisms that increase the length of clauses, namely the expansion of noun and verb phrases. But in addition, a T-unit will be longer if subordinated clauses are integrated into it. Here we will first concern ourselves with T-unit length calculated as the number of word tokens per T-unit, but in Section 8.8 we will look at the second way of lengthening the T-unit.

Scott (1988) discusses the problematic issue of T-unit length. It is salient from several studies that T-unit length increases as a function of age. However, the increase proceeds so slowly that statistical differences can be found only between age groups separated by two or more years. She further remarks that T-unit length can vary for the same individual depending on the text type. She recapitulates the findings from Crowhurst (1979), showing a difference of 3.11 words between the written narratives and argumentative texts of tenth-graders. Crowhurst further underlines that having longer T-units does not always mean better texts.

In a literature study, Scott (1988) summarizes the findings of several studies investigating the development of sentences (or words per T-unit) through adolescence. English data, produced by children from grades three to twelve, show a salient developmental trend. T-unit length increases from approximately 7.6 words independently of modality for third-graders to 11.7 words in speech for twelfth-

Table 8.5: Mean length of text in number of word tokens per T-units broken down by genre, modality and age

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Narrative	9.37	9.95	11.47	12.71	10.85
Expository	12.62	13.41	14.05	16.11	14.02
Spoken	10.94	11.79	12.22	14.38	12.30
Written	11.05	11.57	13.31	14.45	12.57
Total	11.00	11.68	12.76	14.41	12.44

graders and a little bit more (14.4) in writing. Hunt (1970) reports an increase in sentence length in written texts from 5.2 words in grade four to 11.5 in grade twelve. Loban (1976) distinguishes modality differences, where T-units were shorter in written than spoken texts until grade ten.

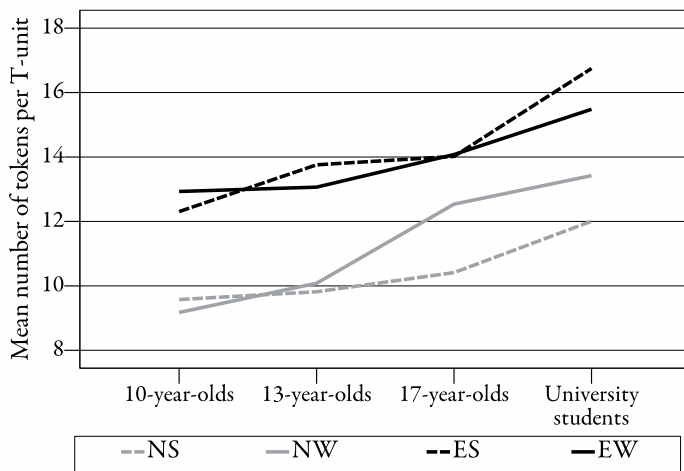


Figure 8.5: Mean number of word tokens per T-unit in each text type, broken down by age

### 8.7.1 Results from the analyses of the number of word tokens per T-unit

Statistical analyses of the number of word tokens per T-unit show one three-way interaction of modality, genre and age ( $F(3, 47) = 3.905, p = 0.014, ES = 0.200$ ). Post hoc analysis shows a genre and modality difference for all age groups. The expository texts always have more word tokens per T-unit than the narrative texts, something that is also clear from the graphs in Figure 8.5. Only the 17-year-olds and the university students have a modality difference in their narrative texts, where the written texts have more tokens than the spoken texts.

There was also a main effect of genre ( $F(1, 47) = 86.122, p = 0.000, ES = 0.647$ ) in that the expository texts have more tokens per T-unit, and a main effect of age ( $F(3, 47) = 10.556, p = 0.000, ES = 0.403$ ). The post hoc analysis shows no difference between the 10-year-olds and the 13-year-olds. Both groups differ from the university students, but the 17-year-olds differ only from the 10-year-olds.

### 8.7.2 Discussion of the number of word tokens per T-unit

The developmental trend reported by Hunt (1970) is replicated here, although the lack of differences between the 13-year-olds and the 17-year-olds shows that there is great variation in these groups. Since we have almost always seen salient differences between these age groups, the lack of them here indicates that there is evidence of some development in the 13-year-olds' texts.

Further, we have a striking genre difference, where all age groups have more words per sentence in their expository texts. This can only be an effect of the subordinate structures of the expository texts, which are especially salient in a task like this where the participants were asked to "discuss the problems in the film". This resulted in many "I think" in the texts, most prominently in the texts by the two youngest age groups. This proposition entailed more subordinate clauses, which in itself increased the number of words per T-unit.

## 8.8 Number of clauses per T-unit

Scott (1988) refers to the number of clauses per T-unit as the *degree of subordination*. This subordination index is thus a ratio of the total number of clauses in a text to the total number of T-units. As is mentioned in Section 8.7 above, one way of increasing T-unit length is by adding a subordinated clause. But the number of clauses per T-unit is also a measure of syntactic complexity. Thus, an increase in the number of clauses per T-unit would tie in with the notion that sentences become longer and more complex when clauses are added. But, as Scott (1988) points out, there are also other changes in syntactic structures that appear during the school ages, of which one is more complex noun and verb phrases.

The measure of clauses per T-unit has been problematic because of disagreement about what should be included as subordinate clauses. The main problem is posed by nonfinite structures, since Hunt (1970) only wanted to include clauses with finite verbs as subordinated items in the T-unit. We can remember that in this Swedish corpus, we applied the criterion of only one finite verb per clause, but we did count (occasional) elliptic structures such as *oj då* ('wow') as separate T-units if it was impossible to refer them to an adjacent clause.

Scott gives an overview of the literature where the subordination index has been used, indicating a mean value of 1.22 clauses per T-unit in third-graders' speech and a mean value of 1.73 for twelfth-graders' written texts.

### 8.8.1 Results from the analyses of the number of clauses per T-unit

Table 8.6 presents an overview of the mean number of clauses per T-unit in each age group, each genre and each modality. Figure 8.6 illustrates the mean number of clauses per T-unit for each text type.

Statistical analyses showed one three-way interaction of modality, order and gender ( $F(3,47) = 3.633$ ,  $p = 0.019$ ,  $ES = 0.188$ ). There were also two main

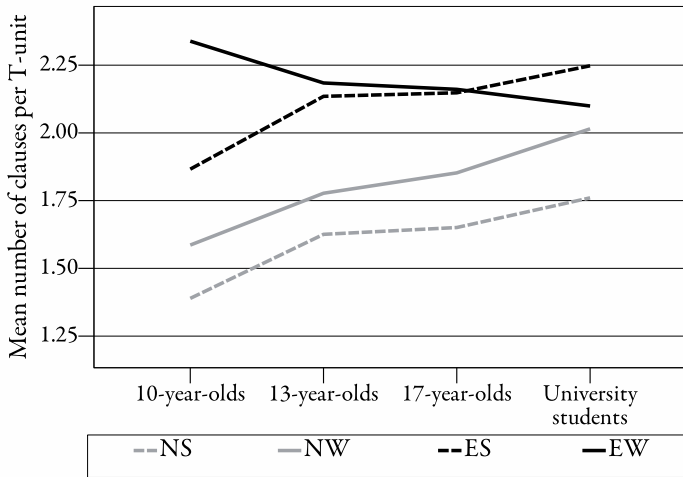


Figure 8.6: Mean number of clauses per T-unit in each text type, broken down by age

effects: of modality ( $F(1, 47) = 11.291, p = 0.002, ES = 0.194$ ) and of genre ( $F(1, 47) = 52.352, p = 0.000, ES = 0.527$ ).

Further analysis of the three-way interaction of modality, order and gender, revealed that there was a gender difference in Order A for the written texts, where the males produced more clauses per T-unit.

### 8.8.2 Discussion on the number of clauses per T-unit

The expository texts had more clauses per T-unit, which confirms the general expectation of more subordination in this genre. In addition, written texts had a higher subordination index than spoken ones, which was also expected, considering the more complex sentence structures used in writing.

Table 8.6: Mean length of text in number of clauses (incl. CE) per T-units, broken down by over genre, modality and age

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Narrative	1.49	1.70	1.75	1.89	1.70
Expository	2.10	2.16	2.15	2.17	2.15
Spoken	1.63	1.88	1.90	2.00	1.85
Written	1.96	1.98	2.00	2.06	2.00
Total	1.80	1.93	1.95	2.03	1.93

While Scott (1988) reports that a developmental trend has been identified in the literature for this subordination index, we did not find any age differences in this material, which was very surprising. To explain this lack of differences, we have to consult the data. We find that it is above all the 10-year-olds' narrative written texts that complicate the picture. In fact, there are only a few participants who have – for their age – extremely long T-units. Example 21 and Example 22 illustrate how a few of the 10-year-olds construct their T-units.

- (21) SBJ: ett annat ganska allvarligt problem är.  
*SBJ: another pretty serious problem is*  
 SBJ: att han som satt bredvid den där tjejen.  
*SBJ: that he who sat next to that girl*  
 SBJ: som visade sitt papper för honom.  
*SBJ: who showed her paper to him*  
 SBJ: han kollade ju inte ens.  
*SBJ: he didn't even look*  
 [wg04mAEW]
- (22) SBJ: att de bråkade.  
*SBJ: that they fought*  
 SBJ: kan bero på.  
*SBJ: could be because*  
 SBJ: att deras kompisar inte hjälpte dem med provet.  
*SBJ: their friends didn't help them with the test*  
 SBJ: och att dom de tycker.  
*SBJ: and that they think*  
 SBJ: att de är sämst.  
*SBJ: that they are the worst.*  
 [wg08fBEW]

From these examples we conclude that these T-units in fact consist of very unorthodox constructions, and that they are not typical of written language. We can compare with Example 23, where we find a long T-unit produced by a university student.

- (23) SBJ: brist på ärlighet kan till exempel innebära.  
*SBJ: lack of honesty could for instance mean*  
 SBJ: att man inte säger till.  
*SBJ: that you don't tell [the teacher]*  
 SBJ: när en kamrat skriver av ens svar under en skrivning.  
*SBJ: when a friend copies your answers during a test*  
 SBJ: medan oärlighet i samma situation skulle innebära.  
*SBJ: while dishonesty in the same situation would mean*  
 SBJ: att man avsiktligt försöker dölja.  
*SBJ: that you deliberately try to hide*  
 SBJ: att bänkgrannen skriver av ens skrivning.  
*SBJ: that the person next to you is copying your test paper*  
 SBJ: eller att man på direkt fråga av läraren förnekar att så har skett.

*SBJ: or that, on a direct question from the teacher, you deny that this has happened*

[ws17mDEW]

When we analyse the 10-year-olds' texts we find that their clauses are finite. They write, for example, *att dom bråkade* ('that they fought') instead of *att bråka* ('fighting'). That is one reason why they – unexpectedly – end up having many clauses per T-unit.

If we analyse the language in their T-units, we also find that they in fact constitute an example of what Strömquist (1996) describes as "left dislocation": you first introduce a person or a phenomenon and then make a comment on it, for example "The dog, he's tearing down the beehive here" (cf. Section 3.5 on page 28). This can be seen as a topic-comment construction. If we look at the 10-year-olds in the examples above, we find that they begin by presenting the problem, for example *ett annat ganska allvarligt problem är att han som satt bredvid den där tjejen som visade sitt papper för honom* ('another pretty serious problem is that he who sat next to that girl who showed her paper to him'), and then they say something about it, for example *han kollade ju inte ens* ('he didn't even look'). In fact, we have a center-embedded left dislocation within this example: *den där tjejen* ('that girl') which is commented on by *som visade sitt papper för honom* ('who showed her paper to him'). Strömquist found that left dislocation was prominent in spoken texts by 15-year-olds who began with the spoken modality but that the spoken texts of 15-year-olds who had first told their stories in writing did not use this construction at all.

I would like to interpret the 10-year-olds' use of left dislocation along the same line as Strömquist: they are using the same strategies they use for speaking when they produce their written texts. This reminds us that having longer T-units does not necessarily mean writing (or speaking) better (cf. Scott, 1988).

It may be worth pointing out that the strategy of left dislocation is not restricted to the 10-year-olds. Example 24 from a spoken expository text by an adult shows the same phenomenon. What is typical of the 10-year-olds is that their not yet fully developed skill at creating nonfinite constructions leads to more clauses per T-unit when they use clauses to create left dislocation.

(24) SBJ: # om man nu # tar mobbningsscenerna då.

*SBJ: if we take the bullying scenes then*

SBJ: att dom [/ /] # där dom de liksom # inte hälsar på någon och så där va.

*SBJ: that they where they kind of do not greet anyone and so on*

[ws16fDES]

## 8.9 Discussion and conclusion

When we look at and compare all these various measures of text length we obtain a very complex picture. I am sure that it is possible to interpret these results in many ways, but in this section I will summarize some general findings and discuss them.

### 8.9.1 Summary of the age, modality and genre differences

**Word tokens** The general trend is that expository texts are longer and that spoken texts are longer. 10-year-olds and 13-year-olds group together, as do 17-year-olds and university students.

**Clauses** The general trend is that the expository texts have more clauses, independently of modality. The spoken texts also have more clauses than the written ones. On a general level, the age differences consist in the 10-year-olds and 13-year-olds differing from the 17-year-olds and the university students.

**T-units** The general trend is that spoken texts have more T-units. No genre differences are found. In speech, the 10-year-olds and 13-year-olds grouped together, differing from the 17-year-olds and the university students. In writing there was a developmental trend in that all age groups differed from each other, but the 17-year-olds produced the most T-units.

**Number of word tokens per clause (MLU)** There is a general developmental trend from the 10-year-olds and the 13-year-olds to the 17-year-olds and finally the university students. The spoken texts have a higher MLU than the written texts, and the adults' expository texts have a higher MLU.

**Number of word tokens per T-unit** Apart from a salient genre difference, where the expository texts have more words per T-unit, we find a developmental trend from 10-year-olds to university students, although there are no differences between the middle groups of 13-year-olds and 17-year-olds.

**Number of clauses per T-unit** There is a general trend that the written texts have more clauses than the spoken ones. There is no developmental trend in speech; in writing, however, the adults produce more clauses per T-units than any other group.

### 8.9.2 Discussion of the developmental pattern

For the production measures, i.e the number of tokens, clauses and T-units, the salient developmental difference is to be found between the two youngest age groups on the one hand and the two oldest age groups on the other. Thus, the main developmental step seems to take place somewhere in junior high school, which is consistent with the findings from the large Spencer Project, reported in Berman and Verhoeven (2002).

It may be surprising that there are so few differences between 13-year-olds and 10-year-olds when we consider these measures. I would like to interpret this to mean that the 13-year-olds are struggling with other constraints than producing text while they are writing. One constraint may be punctuation: the marking-out of paragraphs and sentences. These constraints will lead to a higher cognitive effort and leave less time for producing longer texts.

Another interpretation is that the 13-year-olds are very linear in their language production, both in speech and in writing. They may be much faster than the 10-year-olds in telling their stories or in giving their opinions, but less likely to



devote time to editing and changing their texts once they are “finished”. Such an approach would lead to short and quickly produced texts which would reveal no surface differences compared with those of the 10-year-olds. Analyses of writing time, pausing time and editing patterns may shed more light on this question. Thus, the analyses in the coming chapters will hopefully be able to confirm some of these thoughts.

The other question is why we find so few differences between the 17-year-olds and the university students. There are no differences in the number of tokens or clauses, which would then mean that 17-year-olds can produce as much text than the adults. However, the 17-year-olds produce even more sentences (i.e. T-units) in writing. While this could be simply that they produce the longest written texts, the university students are in fact able to produce more word per clause (i.e. higher MLU) than the 17-year-olds, particularly in the expository texts.

### 8.9.3 Further analysis of length measures and content

Explanations frequently proposed by me in this chapter include the effect of various syntactic structures (e.g. more nonfinite constructions in the adults’ production and more subordination in expository texts). However, I have not systematically carried out any study of the connection between, for example, subordination and the number of clauses or the number of clauses per T-unit. I think one important further investigation in this field would aim to link the findings in this chapter with syntactic and grammatical descriptions of the texts in the data.

While I have not been able to perform a large-scale such investigation, I would like to give some insights into this field by reporting one small result from another study, which was intended for this thesis but which in the end was excluded owing to time constraints. It is part of a frequency study, investigating the most common words in each text type. From this study it became clear that expository texts contained more nonfinite clauses, as indicated by the very frequent use of the infinitive marker *att* (‘to’), and also that they used more subordination (for example indicated by the more frequent use of the general subordinating conjunction *att* (‘that’) (an prosodic investigation of a subset of these *atts* is also found in Johansson et al. (2001))<sup>1</sup>.

Table 8.7 shows an overview of the distribution of ‘att’ in the different modalities and genres from the frequency study. The two functions of ‘att’ (infinitive marker vs. subordinator) were disambiguated in half the texts in the corpus (i.e. 128 texts), equally selected from each age group and text type. In total, 1599 occurrences of ‘att’ were included in the study (of a total of 3655 occurrences in all texts in the corpus). The results show that ‘att’ the subordinating conjunction is more common than ‘att’ the infinitive marker. This is in line with natural expectations since ‘att’ the subordinator is used from very early ages in expressions such as *jag tror att*, *jag tycker att* (‘I think that’) or *jag vill att (du kommer)* (‘I want that (you should come)’).

Since only a sample of the data material has been disambiguated as between the subordinator and the infinitive-marker function, there would be too few texts

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<sup>1</sup>By incident, the infinitive marker *att* and the general subordinator *att* are homonyms in (written) Swedish.

in each cell if we broke down the text types by age group. However, there is a clear tendency that a higher proportion of 'att' as an infinitive marker is found in the written texts, and in the expository texts.

From this analysis, we can also note that the infinitive marker is more common in writing than in speech, indicating that there are more infinitive clauses in writing. We further find that the subordinator is more common in speech, which may not necessarily be proof of more subordination in speech than writing, but merely a consequence of speakers using the most frequent conjunction (which is thus the easiest one to access lexically) when speaking. On the other hand, the infinitive marker is more common in writing, implying that more infinitive structures are used there.

We find that both 'att' words are much more common in expository discourse, showing that both infinitive clauses and subordination are more common features in this genre. This will help us in interpreting the results from the length measures presented in this chapter. It is no wonder that the expository texts have more clauses independently of modality. They have more clauses because there is more subordination in the T-units. This is also why these texts have more words per T-unit.

The age differences are also interesting. The overall view tells us that it is above all the two oldest age groups who use 'att', although it is common for all age groups. Two things are especially worth noticing. One is that the adults use comparatively very few infinitive markers in narrative texts, indicating that this group – being masters of this genre – sees infinitive constructions as a less appropriate feature for narratives. The other thing is that the adults use many more infinitive markers in speech than the other groups, indicating that they have integrated the use of infinitive constructions in speech to a higher degree.

#### 8.9.4 On order differences

On the one hand, we have discovered that the order in which the texts were produced matters more than we may have thought from the start. The general order difference we have found is between Order A and Order D. The participants in Order A started by producing their narrative spoken task, went on to their narrative written text, and then continued with expository spoken and written. Order D carried out the experiment in exactly the reverse order, i.e. expository written, expository spoken, narrative written and narrative spoken. These order differences may in fact reveal influences depending on both modality and genre.

The general tendency is that the spoken texts in Order D contain more tokens and that the written texts in Order A contain more. Thus, what we see is an effect of modality. Looking at Table 8.7, we see how text length in word tokens is distributed across the orders and text types. From this picture it is evident that the Order D texts are the longest ES and NS. Since the tendency is not at all as prominent for the texts produced in Order B, I would like to interpret the long spoken texts in Order D as an effect of starting with the production of written expository. The long texts in Order D can thus be seen as evidence that you are aided in composing spoken texts by having thought about how to express your thoughts beforehand.

Table 8.7: Distribution of *att* broken down by age, modality, genre and text types. The result is based on disambiguation of 1599 out of 3655 occurrences of *att* (i.e., the occurrences of *att* in a sample of 128 texts out of the total 316 texts in the Swedish Spencer corpus). The first three columns of the table display exact numbers while the last column displays the percentage of *att* which represents the infinitive-marker function

Sample of texts	Infinitive marker	Subordinate conjunction	Total	% Infinitive marker
Overall distribution by age group (128 texts in total)				
All texts	546	1035	1581	35
10-year-olds	40	109	149	27
13-year-olds	59	141	200	30
17-year-olds	174	333	507	34
Adults	273	452	725	38
All narrative texts (64 texts in total)				
All narrative texts	166	393	559	30
10-year-olds	15	48	63	24
13-year-olds	14	28	42	33
17-year-olds	52	113	165	32
Adults	85	204	289	29
All expository texts (64 texts in total)				
All expository texts	380	642	1022	37
10-year-olds	25	61	86	29
13-year-olds	45	113	158	28
17-year-olds	122	220	342	36
Adults	188	248	436	43
All spoken texts (64 texts in total)				
All spoken texts	278	640	948	29
10-year-olds	19	60	79	24
13-year-olds	14	69	83	17
17-year-olds	55	166	221	25
Adults	190	375	565	34
All written texts (64 texts in total)				
All written texts	341	453	794	43
10-year-olds	21	49	70	30
13-year-olds	45	72	117	39
17-year-olds	119	167	286	42
Adults	156	165	321	49
Distribution across text types (32 texts in each text type)				
Narrative spoken	42	203	245	17
Narrative written	124	190	314	39
Expository spoken	163	379	542	30
Expository written	217	263	480	45

And for that purpose writing is a better modality, because it gives you more time to think and formulate your thoughts. Since the writer lacks the possibility of using the sender as a collaborator to create the message (an opportunity that the speaker may take advantage of in most cases), she has to be more explicit, more lexically dense, when creating an unambiguous written message. This applies not only on the level of lexical choice but also on a structural level. In creating the written message, the writer will have constructed linguistic expressions that subsequently help her under the heavier time strain of speaking. It is, in fact, more economical for the speaker to re-use more written-like expressions (e.g. syntactic structures, less frequent words) that she has previously used in writing when she performs the spoken task, instead of looking for more spoken-like ways to express herself (cf. Kress, 1982).

I would therefore claim that the modality factor is more important than the genre factor for how you are aided in your language production. However, it seems – from looking at Order D – that the more elaborate expository genre, with features such as longer noun and verb phrases and more subordination, will spill over on the production of the following text. This is salient when we compare text length in number of word tokens between Orders D and B (see Table 8.7). Thus it seems as if genre also has an impact, although less strong, on performance. This could perhaps be interpreted to mean that the participants who first encountered the (written) expository task approached the whole experiment in a somewhat different way, such that the written expository text “set the standard” for the other texts they were asked to produce. The influence of the expository genre may also entail that the syntactic structures and other features of the expository genre have already been activated in the mind of the sender, meaning that it is in fact easier to continue using these structures in the narrative genre.

This would also be an example of the notion of “writing counts for more”: the second, oral, task is seen as less important than the written task, and therefore many participants in Orders B and D (those where the participants started with writing and continued in speech) show a general tendency to account for what they just wrote rather than producing an independent spoken text.

Examples of referring to what they previously wrote (or did not write) are found for several of the participants, indicating that the spoken text is seen as a mere report of what was written rather than as an independent text. The corresponding case of referring to the previously spoken text is never found in the written texts (i.e. nobody wrote, for example, “As was mentioned in the speech earlier”), and thus this type of expression is limited to participants in Orders B and D. Below are two examples of this; Example 25 is from a spoken expository by an adult man in Order D, and Example 26 is from a spoken expository by a 13-year-old girl in Order B.

- (25) SBJ: eh@fp ja # jag har nämligen skrivit den här # eh@fb lilla texten.  
*SBJ: eh well I have you see written this little text*  
 SBJ: som en [/ /] det vad ska man säga # en liten # pamflett mot oärlighet  
 eller brist på ärlighet och framför allt diskussion om på vad.  
*SBJ: as a it what should you say a little pamphlet against dishonesty or lack  
 of honesty and above all the discusson about on what*  
 SBJ: som är brist på ärlighet.

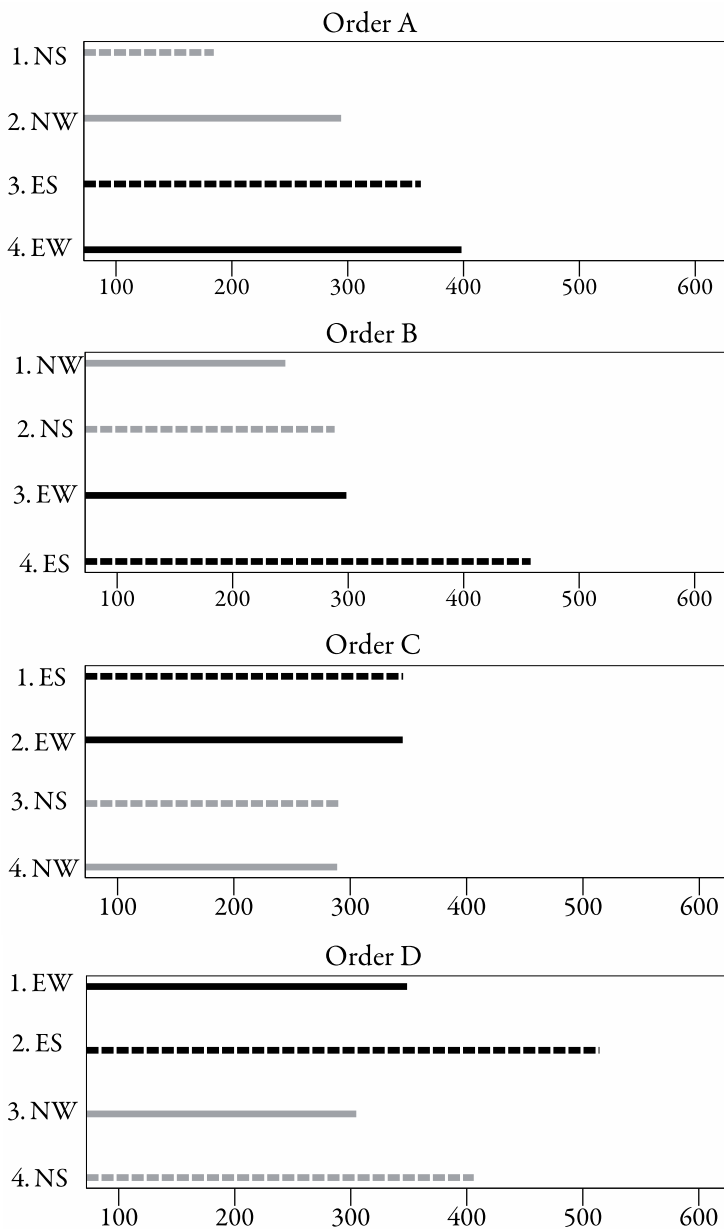


Figure 8.7: Mean number of tokens, broken down by order and text type. For each order, the text types are listed in the order in which they were produced in the experiment

*SBJ: is lack of honesty*

*SBJ: och vad som är oärlighet.*

*SBJ: and what is dishonesty*

*INV: m.*

*INV: mhm*

*SBJ: eh@fp och då tyckte jag.*

*SBJ: and then I thought*

*SBJ: att [/] att <oärlighet in(te)> [///] det är liksom lite mer aktivt [!].*

*SBJ: that dishonesty not it is kind of more active*

*SBJ: än vad # ärli(ghet) [//] eller vad brist på ärlighet är.*

*SBJ: than what hone... than what lack of honesty is*

[ws17mDES]

- (26) *SBJ: eh@fp # jag skrev ju om det där med den där fusklappen och så om fuskandet.*

*SBJ: eh I wrote about that with the crib and about the cheating*

[a part of the transcription is omitted]

*SBJ: sen sedan skrev jag inget mer om det.*

*SBJ: then I wrote nothing more about that*

*SBJ: jo jag skrev också om att.*

*SBJ: yes I also wrote about that*

*SBJ: det här med att frysa ut någon.*

*SBJ: this thing about excluding someone*

[wj07fBES]

One thing that should also be discussed in connection with the order factor is whether or not the participants showed a tendency to be tired toward the end of the experiment. In other words, was the last of the four texts in general shorter than the others? We do indeed find no such findings.

## 8.10 What about writing time?

Finally, I will address the issue of the texts' unequal length in time. As was described in Section 6.4.6 (page 57), the participants were informed that they could write for 30 minutes. When 5 minutes remained, they would be told, so that they would have time to finalize their text. If the participants were finished before the time was up, they were to tell the experiment leader. An experimental setting like this allowed for differences in writing time between the participants, as we can see in Section 9.4. In Section 9.4.1 the problematic issue of different length of writing time is discussed.

Of course the length of the writing time influences how many word tokens, clauses, etc., can be produced, and it also influences a measure of syntactic complexity such as the number of clauses per T-unit. The difference in writing time may very well be one explanation why the participants of different age groups perform differently on the length measures that have been discussed in this chapter. However, when we took the decision to let the writers – and speakers (!) – decide themselves when they were finished we may have built in an element of judgment in

the experimental design. The writers could themselves judge how much time (and effort) was needed for the task at hand.

If we had not chosen to do it in this way, we would have had to set the standards according to the shortest text produced (which is a little bit shorter than four minutes, as Table 9.1 on page 117 shows), and that would not have done justice to most of the texts in the corpus.

Thus, one could say that the producers' ability to decide when their text of a specific type is finished is actually part of the task. The 17-year-olds' ability to compete with the adults on certain production measures may in fact be something they pay for by spending a longer time on writing, as the analysis in Chapter 9 may reveal.

# Chapter 9

## Text length in keystrokes

### 9.1 Introduction

All the written texts that are analysed in this thesis were produced on a computer. One of the most important differences between typewriting and handwriting is that the former can be described as consisting of discrete keystroke events separated by intervals of keyboard inactivity, while the latter is a continuous action. This makes it much easier to define and detect correct performances in typing than in handwriting (Gentner, 1983).

In this chapter, however, I will not concern myself much with “correct performances in typing” but instead explore some of the measures that are available from the output files of the keystroke-logging program ScriptLog (see Section 7.2). There will thus be no comparisons with the spoken data in this chapter. I will first contrast the exploration of the production measures in Chapter 8 with an investigation of the production measures in the process data, i.e. the writing time, the number of written characters, and the number of keyboard and mouse events during a writing session. Finally, I will address the question of editing patterns by looking at keyboard events for moving and deletion. The question is whether a study of the linear texts will reveal other patterns of development and genre than the investigations of the final product reported in Chapter 8.

### 9.2 Computer writing

When Hayes and Flower (1980) included the notion of ‘translating’ in their model of writing, they meant the translation of ideas, or domain knowledge, into language. McCutchen et al. (1994) interpret translation as the “process by which words actually come to appear on the page”. However, this may not only involve the actual production of letters, as is shown in Alves et al. (2008), where the writers in a dual-task experiment report a good deal of translation (in the sense of ‘producing text’) during pauses as well.

McCutchen (1994) considered “translating *necessary*, but not *sufficient*, for optimal writing”. This means that without the process of translating the ideas into actual words and putting them on paper (or on screen), there would be no writing at all. But to create a good text, planning and revising are also needed.



Few writing studies specifically address the issue of typing and discuss the various keys on the keyboard and the opportunities they create for the writer. In recent years, however, a few studies in this field have appeared. One of them, conducted by Grabowski (2008), highlights the differences between writing on a computer and on a typewriter. The first difference is related to the fact that many written texts today are actually composed on the computer, and as a result the computer is not only an “electronic typewriter” but an important instrument that a skilled computer writer can use in creative ways to compose and edit texts. This means that writers typing on the computer keyboard are not just copying text but planning while typing. As a consequence, writing on a computer can be used as a means to investigate high-level processes such as planning and editing during text writing.

Second, the computer writer has so many more options than the typist. The computer offers possibilities to go back in the text, to change, delete and insert new text, and to move text around. One important difference is that mistyping in computer writing is much less serious than in typewriting. In fact, as has been pointed out, fluent correction skills can compensate for limited typing precision (Grabowski, 2008, p. 28). Taken together, this means that the computer has become a powerful tool for text composition – unlike the typewriter, which was often merely a tool for neatly copying text (a task often carried out by a professional typist); the more time-consuming, high-level processes of planning, editing and formulation were already finished (Grabowski, 2008). It can be added that it is of course not impossible to imagine some writers also composing their texts directly on the typewriter.

The study by Grabowski is a first attempt to systematically describe existing strategies in computer writing, using factor analysis to investigate a wide range of keyboard variables across several writing tasks. The aim is to discover underlying patterns of typing strategies. This is carried out by letting 23 university students perform three writing tasks in ScriptLog: copying from memory (a well-known nursery rhyme), copying from text (a text on paper) and text generating from memory (a route description). The investigation includes measures such as the total number of keystrokes, the number of deleted characters, the time spent on the task and transition times between keypresses. Taxonomically, the author divides the keyboard events into three categories, which coincide with the categories used in this chapter: (a) characters, (b) deletions and (c) cursor movements. The main difference is that Grabowski do not include mouse movements in his experiment.

Grabowski (2008) reports several findings. Across the tasks, typing speed turned out to be the most stable characteristic of a keyboard user (cf. comparable results in Usoof and Lindgren, 2008). He is further able to show that even in the copying-from-memory task there are inter-individual differences to be found in the number of deletions and cursor movements, indicating variation in writers’ keyboard efficiency (measured as the ratio between the number of characters in the final text and the total number of keystrokes (or **events**, as they are called in this thesis). Another finding is that fast typing seems to co-occur with much deleting, which may indicate that fast typing increases the probability of mistyping and consequently leads to an increase in deletion of typos. Writers may also have different strategies, ranging from immediate correction of spelling errors to editing and correcting only at the end of the writing task.

Spelman Miller (2006a) summarizes the pause findings from several keystroke studies by describing pauses as mainly located at “discoursally significant junctures” (p. 132). These junctures are found between linguistic units that may have a discourse role in introducing, maintaining and developing topic in the discourse produced. Her description is confirmed by several other studies. One is an article by Nottbusch et al. (2007), who investigate the production of written sentences and start from the assumption that since processing limitations require the production of words and sentences to be split into smaller linguistic units, this increase in the writer’s cognitive load will determine time patterns in writing. One conclusion is that major syntactic units will have more initial pauses. The results were confirmed in Nottbusch (2009), where it is shown that it is more cognitively effortful to plan before the start of a sentence with a subordinated structure than before a sentence with two syntactically equal noun phrases. The two studies confirm that syntactic structures influence the pattern of inscription and of pausing during writing.

Alves et al. (2008) investigated 99 writers divided into slow and fast typists (after Alves et al. (2007)), who first performed a dictation test and then wrote a picture-elicited narrative. The distribution of the writing processes of Planning, Producing Text, Typing, Revising and Other during writing was investigated by means of Kellogg’s technique and a dual task with Interference Reaction Times. The results show that slow typists had slower reaction times on the dictation test, indicating that the cognitive demands are higher during typing for this group. This would confirm the suggestion in McCutchen (2000) that automatized typing skills would free up more working memory for other tasks. However, independently of typing speed, pausing was higher for all writers, which suggests that high-level processes are present concurrently with writing. Other results show that revising is more demanding than planning and translation (i.e. writing down text). Alves et al. further report that the group of slow typists produce fewer words per minute than the fast typists, and consequently also shorter texts, but that syntactic complexity (measured in T-units) was not reduced. One conclusion drawn from the study was that, in the narratives, revising was the most demanding process while translation and planning were equally effortful. It was further found that differences in typing skills may impact on text writing but that these differences did not affect the strategic activation of planning, translation and revising or the time devoted to these processes. Language formulation is more likely to occur concurrently with motor execution (i.e. typing), while conceptual planning and revising rather tend to suspend typing.

Van Waes and Schellens (2003) carried out a comparative study of university students composing texts on computers versus with pen and paper. Several results were reported. One is that computer writers paused 70% more often than pen-and-paper writers, which would suggest that using a word processor may result in a more fragmented writing process. Of all pauses, 45-50% were revision pauses. The location of the pauses tended to be within sentences in the texts by the computer writers, while pen-and-paper writers paused twice as often at sentence and paragraph boundaries. The pen-and-paper writers also paused for almost twice as long as, but less frequently than, the computer writers. Almost half of the total time spent on pausing in the pen-and-paper mode took place at paragraph boundaries. The authors conclude that there are at least three areas where computer writers and

pen-and-paper writers differ: the level at which revisions are made; the way the revisions are distributed across the writing process; and the degree of fragmentation of the writing process.

As regards the level of revisions, they found that computer writers tended to revise more at the level of individual letters, often as a result of “mechanical considerations” (Van Waes and Schellens, 2003, p. 848). These revisions often serve the same purpose as the revisions made at the word level or above in the texts by the pen-and-paper writers. While pen-and-paper writers tended to revise in a systematical way, working from beginning to the end, the computer writers showed a tendency to revise throughout the writing process, but dealing with smaller units at a time. This is explained by reference to “word-processing comfort”, i.e. the fact that the writers are aware that they can change their text at any time during the writing session without leaving any traces in the text. This would then make it possible for them to try out – by writing down – different wordings before settling for one of them. By contrast, those writing by hand paused for longer, predominantly at sentence and paragraph boundaries, which would indicate that they tend to plan their sentences mentally and only write them down when they have finished planning.

I would like to propose another explanation besides that of word-processing comfort. Since computer writing is quicker (for a reasonably skilled typist) than handwriting, and since the computer text is easy to erase or edit, the computer writer can relieve her working memory of thoughts and linguistic constructions before she may have formulated the whole sentence in her mind. By doing so she will free up more working memory that can be used to finish the sentence. I claim that it is very economical for the writer to use the means at hand to get rid of some of the strain of text composition so as to free up more power to formulate and plan for the next thing that she is going to say.

Van Waes and Schellens claim that the relative lack of planning at the beginning and throughout the computer-writing session affects the rest of the writing process and leads to a higher degree of recursion. In the computer mode, longer pauses were much more evenly distributed throughout the writing process compared with the handwriting mode. One interpretation is that when writing on the computer, planning is spread more evenly across the writing process as a whole.

Taken together, these recent studies indicate that there are interesting further explorations to be carried out in the area of computer writing. They also show that there is a connection between the level of cognitive effort and the type of text production. This effort is of course easier to measure in typing than in handwriting. In addition, as Grabowski (2008) shows, computer writing offers many more editing opportunities than handwriting. In this chapter I will explore the written texts in my data and exploit some of the opportunities provided by keystroke logging.

### 9.3 Statistics

I have extracted information from several ScriptLog files (see under the various measures for more information). The statistical analyses were carried out using Anovas with genre as the within-subject factor and gender, order and age as between-

Table 9.1: Writing time in minutes and seconds, broken down by genre and age. Means, standard deviation, median, maximum and minimum time are displayed

Descriptive statistics	10-year-olds	13-year-olds	17-year-olds	University students	Total
<b>The written narrative texts</b>					
Mean	17 min 44 s	16 min 15 s	34 min 12.8 s	24 min 49 s	23 min 16 s
St.dev.	9 min 35 s	8 min 35 s	8 min 36	8 min 37 s	11 min 26 s
Median	17 min 1 s	18 min 10 s	36 min 34 s	23 min 32 s	23 min 3 s
Minimum	5 min 47 s	3 min 42 s	14 min 57 s	9 min 57 s	3 min 42 s
Maximum	44 min 55 s	28 min 53 s	50 min 6 s	51 min 56 s	51 min 56 s
<b>The written expository texts</b>					
Mean	19 min 4 s	22 min 27 s	40 min 9 s	33 min 9 s	28 min 39 s
St.dev.	6 min 12 s	8 min 7 s	6 min 8 s	8 min 43	11 min 9 s
Median	18 min 31 s	23 min 24 s	40 min 26 s	32 min 26 s	29 min 19 s
Minimum	5 min 37 s	5 min 20 s	29 min 12 s	13 min 42 s	5 min 20 s
Maximum	30 min 56 s	36 min 10 s	54 min 20 s	53 min 23 s	54 min 20 s
<b>All written texts</b>					
Total	18 min 24 s	19 min 26 s	37 min 11 s	28 min 59 s	25 min 58 s
St.dev.	8 min 0 s	8 min 47 s	7 min 58 s	9 min 59 s	11 min 32 s
Median	17 min 29 s	21 min 54 s	36 min 59 s	29 min 31 s	24 min 34 s
Minimum	5 min 37 s	3 min 42 s	14 min 57 s	9 min 57 s	3 min 42 s
Maximum	44 min 55 s	36 min 10 s	54 min 20 s	53 min 23 s	54 min 20 s

subject factors. Significant interaction effects were followed up by analyses of simple main effects. Post hoc comparisons of significant main effects were carried out according to Tukey's HSD procedure. Effect size (ES) is partial  $\eta^2$  (cf. Section 6.7.1). Contingent gender differences found are reported here but will be addressed in more general terms in the concluding chapter of the thesis (cf. Section 6.7.1.1 on page 63).

Owing to a defective LOG file, one of the adults had to be excluded from most analyses in this chapter. The adult group thus consists of 18 participants, while the other age groups contain 20 participants each.

## 9.4 Writing time

Table 9.1 shows various variables relating to writing time (in minutes and seconds) for each age group, and Figure 9.1 illustrates the age and genre differences.

Statistical analyses showed a main effect of genre ( $F(1,47) = 23.402$ ,  $p = 0.000$ ,  $ES = 0.332$ ), where more time was spent on writing the expository texts for all age groups. There was also a main effect of age ( $F(3,47) = 29.125$ ,  $p = 0.000$ ,  $ES = 0.650$ ). Post hoc analysis of the age effect revealed no differences between the 10-year-olds and the 13-year-olds, but both groups differed from the two oldest age groups. Further, the 17-year-olds differed from all the others by writing longer time; this was true for both genres.

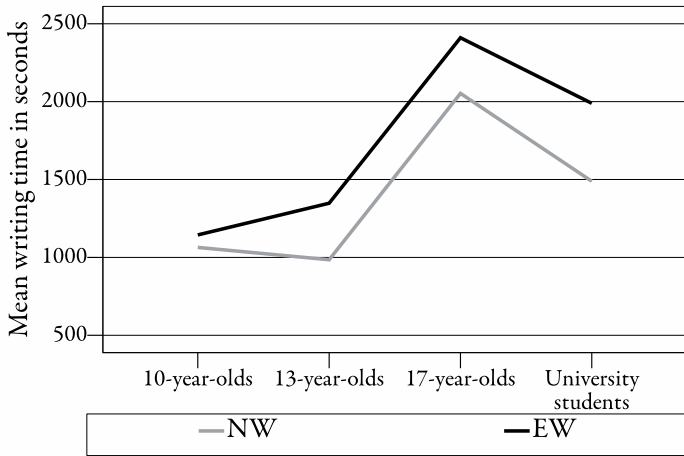


Figure 9.1: Mean writing time in seconds, broken down by age and genre

#### 9.4.1 Discussion of the writing-time results

The clear difference between the genres shows that more time was needed to write expository texts; this was true for all age groups. This could be explained by the expository task being more cognitively demanding. This task first required that the writer thought about the events in the film, second that she made a general analysis of the topic (e.g. bullying or stealing), third that she generalized a behaviour from this, fourth that she suggested why the behaviour occurred, and fifth that she proposed a way of changing the behaviour. During all of this, the writer also had to consider the issue of linguistic formulation or translation (cf. Kellogg, 2006), at the same time as trying to create coherence in the text and to meet her global rhetorical goals. An expository text consists of arguments with no inherent temporal order, although the writer may be helped by following the order in which the events were presented in the video.

The narrative would be less cognitively demanding. The writer was asked to tell about one time when she was saved (or saved someone) from a predicament. Once she had identified such an occasion, she would have been helped in her writing by the temporal structure of the event, as the text unfolded. Perhaps she had also told the story several times before (the content of the narratives suggests that many of the stories have been told to friends and family). When a writer had identified the topic of the narrative, it would often have been self-evident to her which propositions would follow upon each other, and this would ease the cognitive burden of planning.

We also find a clear age difference. The 10-year-olds and 13-year-olds show (as usual) no differences. The 17-year-olds write for longer than anyone else. We know that they compare relatively well in writing with the university students: when we look at many other measures (i.e. number of tokens) there are hardly any differences between these two age groups. But when we analyse writing time, we do see a very

significant difference in how much time they devote to the task. The 17-year-olds thus manage to be “as good” as the university students by spending more time on the task. Perhaps you could say that they have not yet automatized and internalized many of the processes (from keyboard use to syntactic structures, spelling, genre knowledge, etc.) that the adults are more experienced with. They simply have to assign more time in order to deal cognitively with the task as well as the adults do.

### 9.4.2 Correlations between writing time and number of word tokens

To investigate the connection between the text-production measures and writing time, the correlation between the number of word tokens and writing time was calculated. A significant correlation was found for the 10-year-olds’ written expository texts ( $r = 0.541$ ,  $p = 0.014$ ). No other age groups showed any significant correlations for the expository task. For the narrative tasks, however, all age groups except the university students showed a correlation between number of word tokens and writing time: 10-year-olds ( $r = 0.830$ ,  $p = 0.000$ ), 13-year-olds ( $r = 0.581$ ,  $p = 0.007$ ) and 17-year-olds ( $r = 0.741$ ,  $p = 0.000$ ).

One interpretation is that the more linear the writing is, the higher the correlation becomes. That is, in a writing session with little pausing and editing, where a writer more or less starts with the first word and ends with the last one, there will be a strong correlation between writing time and the number of word tokens. And conversely, with more deletions, editing and pausing there will be less or no correlation between the time spent on writing and the number of words produced. This finding can be interpreted to mean that all age groups except the 10-year-olds edit their expository texts to a large degree. In the narrative texts, all of the three youngest age groups show a linear pattern, which may be because the text type is familiar and so requires less editing and planning, and also because the narrative task promotes a more linear way of writing than the expository task. The adults may use more of their writing time for pausing, for instance to plan, read and edit. If the adults also delete more from their texts, this will not only take time but also lead to there being fewer words in the final text. However, we can equal the adults with the expert writers who will set different rhetorical goals also for the “simple narrative task” and therefore devote time to making a narrative text better (cf. Scardamalia and Bereiter, 1991; McCutchen, 2000; Kellogg, 2008). The 10-year-olds’ expository texts may further present a linear way of writing and their texts do in fact contain very little editing. All in all, this is something that can explain the high correlation between their writing time and the number of word tokens in their texts. They simply apply the knowledge-telling strategy of “do and be done with it” (Scardamalia and Bereiter, 1991), even to the expository task. Whether this is due to ignorance of the genre or to limited cognitive development is difficult to say.

As we have seen from transcription examples (e.g. Examples 21 and 22 on page 103), the 10-year-olds seem to have a local way of addressing the subject in the expository texts: they refer to different scenes and problems in the elicitation film and comment on them individually instead of presenting a general overview

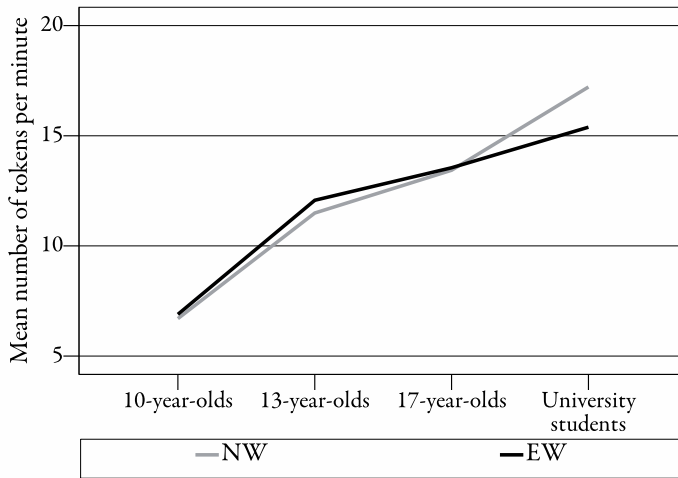


Figure 9.2: WPM: Mean number of words per minute, calculated as number of word tokens divided by writing time in minutes

and analysis of the topic “discuss the problems you have just seen in the film” (cf. Section 6.4.2.2 on page 54).

## 9.5 Production measures

### 9.5.1 Words per minute

One traditional way of measuring writing speed, and thus writing proficiency, is *words per minute* (WPM) (cf. e.g. Gentner, 1983). But as is shown (e.g. by Nottbusch et al., 2007; Nottbusch, 2009; Grabowski, 2008), there are other factors besides mere keyboard proficiency that influence the writing of free text, as opposed to the traditional use of this measure, which has been to rate typing skills. In a typical investigation of how many words per minute a typist can produce, people have been asked to copy texts. However, when we investigate the measure here, it will rather be a production measure, showing how much a person produced within a certain time. Thus, here the measure will reflect the cognitive demands of the writing task rather than the actual keyboard skills.

However, one or two words should be said about the typing speeds of the participants. As is discussed in Section 6.3.3, we took care to recruit persons with computer skills, and special concern was devoted to the youngest age group. Based on results from piloting we settled on 10-year-olds as the youngest age group to include in this experiment because we noticed that 9-year-olds had so poor skills at

computer writing that we judged their writing performance to be heavily influenced by this<sup>1</sup>.

No systematic comparison of typing skills is carried out in this thesis. One method that has been proposed to investigate typing skills is the median transition time between two consecutive keystrokes within a word (see e.g. Strömquist et al., 2006; Wengelin, 2006). The reasoning behind this measure is that the likeliness of pauses caused by high-level processes is considered to be very low between letters within a word (unless the writer has reading or writing difficulties). Wengelin (2006) has used the same data as in this thesis to investigate the median transition time within words. She reports a major difference between the 10-year-olds and the other age groups. Individual variation is also highest in the 10-year-old group, indicating that there are huge differences between the members of this group. However, if we look at the actual median time, the 10-year-olds' median time is a little less than 0.6 seconds while that of the 13-year-olds is around 0.3 seconds and those of the 17-year-olds and the university students are closer to 0.2 seconds. Taken together, this indicates that although there are some major age differences, above all between the 10-year-olds and the other groups, all groups should be considered to have sufficient keyboard skills to be able to perform the task. This, however, does not mean that the relative lack of keyboard proficiency does not influence the 10-year-olds' writing. We will return to that issue later.

In this study, WPM was calculated by dividing the total number of word tokens (as reported in Table 8.1) by the writing time (in minutes); see Table 9.1. Table 9.2 shows WPM means and Figure 9.2 illustrates the distribution of means across ages and genres. Statistical analyses of the measure show a significant two-way interaction of genre and gender ( $F(1, 71) = 7.799, p = 0.007, ES = 0.099$ ), and also a significant main effect of age ( $F(3, 71) = 17.670, p = 0.000, ES = 0.429$ ).

Further investigations of the interaction between genre and gender revealed that while the female participants had no significant difference between the genres, the male writers produced fewer words per minute in expository discourse than in narrative discourse. It is difficult to interpret this gender difference. More pausing in the expository task for the males may indicate a general tendency to plan more or to delete more text (since only words in the final texts are included here). It could thus mean, for instance, that the males produce more typos, and correct them, or that they find a stronger need for planning in an expository task. If the last explanation is correct, we do not know whether this indicates that the females are ahead of the males in development or behind them. Since we have very few other gender differences pointing in either direction, we should be careful with the interpretation here, but keep in mind that these differences could be seen as a possible starting point for further investigation.

Post hoc analysis of the age effect showed a difference between the 10-year-olds and the 13-year-olds. However, there is no significant difference between the 13- and 17-year-olds, only between the 13-year-olds and the university students. These results suggest a developmental trend from the 10-year-olds to the university

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<sup>1</sup>It is quite possible that today's 9-year-olds would perform much better in a similar test; the use of computers has increased greatly both at home and in pre-schools since 1997, when this piloting took place.



students. One reason why the 10-year-olds do not differ from the two oldest age groups may be a high level of variation in typing skills within the group (as is reported in Wengelin, 2006). However, the general developmental trend is that the writers produce more words per minute the older they are.

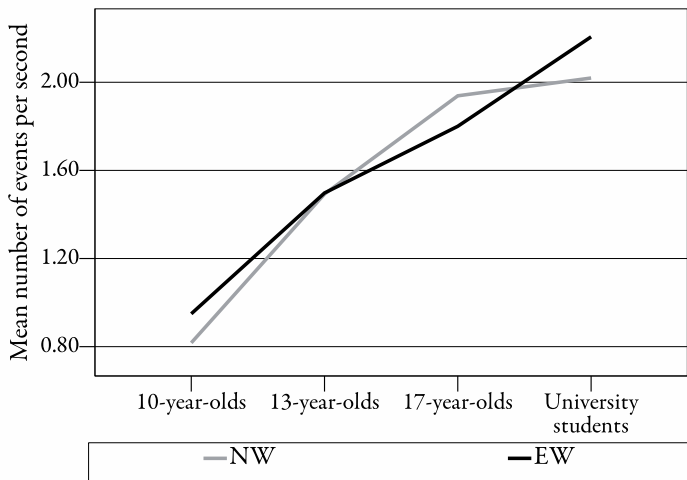


Figure 9.3: Total number of events divided by writing time (in seconds)

### 9.5.2 Total number of events divided by writing time (in seconds)

Another way of measuring text production would be to see how many *events* were produced during the writing time. I will address the issue of events more in Section 9.7, but in short an event can be described as any action a writer performs on the keyboard or with the mouse during a writing session. Keyboard activity includes all keystrokes, regardless of whether they resulted in a visible letter or merely consisted in pressing the delete or arrow keys.

In the previous measure of WPM, we divided the result from the final product (i.e. words) with the writing time, but if we divide the number of events by the writing time, we will instead look at the linear production.

Table 9.2 displays the mean number of events divided by writing time, and Figure 9.3 shows means across age and genre. There is a significant two-way interaction of order and genre ( $F(3, 47) = 4.525, p = 0.007, ES = 0.224$ ). Further investigation of the order effect showed a genre difference in Order A, where the expository texts had more events per writing time than the narrative ones. There is also an age effect ( $F(3, 47) = 17.991, p = 0.000, ES = 0.535$ ). Post hoc analysis showed that it consisted in the 10-year-olds producing fewer events per writing time

than any other age group and in the 13-year-olds producing fewer events than the university students.

We find a salient developmental pattern in that production, measured as number of events, increases with age. It is above all the 10-year-olds who differ from the other groups; one explanation can be that they simply type much more slowly (cf. Wengelin, 2006). Another interpretation of the result may be that the expression “do it and be done with it” (Scardamalia and Bereiter, 1991, p. 176) is applicable to the 10-year-olds to a larger extent. This means that they devote very little time to editing (or even reading) once they have said what they want to say. Indeed, this may illustrate an influence from speech, where there is no possibility to go back and change anything (although rephrasing and clarification are possible). An example of this linearity, and how it can be expressed in speech and writing, is found in the narrative texts by a 10-year-old girl in the data. Example 27 shows the written text (in this case produced before the spoken one), and we can see how the writer adds the information that her best friend Cecilie comes from Norway (perhaps this addition is caused by the unorthodox spelling of a name that would more commonly be spelled ‘Cecilia’ in Swedish). In writing it would have been possible to go back in the text and rewrite the first sentence, maybe into something like *I and my Norwegian friend Cecilie*. Instead, the writer keeps the spoken habit of providing information in a linear way. We can compare with Example 28, which shows that she keeps almost exactly the same way of telling the event in speech. (These text examples are investigated at length in Strömquist et al. (2006), p. 48-51, and in Strömquist (2009), p. 70-73.)

- (27) SBJ: jag och min bästis Cecilie hon kommer från Norge var på en klätterställning.  
*SBJ: I and my best friend Cecilie she comes from Norway we were on a climbing frame*  
 [wg16fDNW]
- (28) SBJ: det var så här en gång efter skolan så jag och min bästis Cecilie.  
*SBJ: it was like this once after school then I and my best friend Cecilie*  
 SBJ: hon kommer från Norge då.  
*SBJ: she's from Norway you see*  
 SBJ: vi var på en klätterställning.  
*SBJ: we were on a climbing frame*  
 [wg16fDEW]

Finally, we could mention that, on average, the 10-year-olds did not use the full 30 minutes they had at their disposal (as we know from the mean writing time shown in Table 9.1). It would, in theory, have been possible for this group to compensate for their slower writing speed by devoting more time to writing their texts.

The order effect, revealing that the participants in Order A have more events in their expository texts than in their narrative ones, may indicate an influence of genre. For this group, the written expository text was the last text that they produced. This text was preceded by, first, the spoken and the written narratives, and then the spoken expository. You could think that these participants were not prepared for such a demanding text type by the end of the experiment. Or, to

Table 9.2: Production measures in writing: mean number of events in the linear texts divided by writing time (in seconds); and WPM or number of word tokens in the final texts divided by writing time (in minutes). Each measure is broken down by genre and age

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Number of events in the linear texts divided by writing time (in seconds)					
Narrative	.8172	1.4925	1.9383	2.0193	1.5611
Expository	0.9490	1.4972	1.7999	2.2059	1.6055
WPM: Number of word tokens in the final texts divided by writing time (in minutes)					
Narrative	6.70	11.49	13.43	17.21	12.15
Expository	6.89	12.07	13.55	15.39	11.93

put it in another way: for the participants who produced their expository texts first, starting with this demanding task may have helped them, or may have set the standards of editing, etc., that they would continue to use when producing their written narrative text.

## 9.6 The issue of comparing texts of unequal length

When we look at the mean writing times in Table 9.1, we find that the range between the participant who wrote for the shortest time (a 13-year-old, whose narrative text was written in 3 minutes and 42 seconds) and the one who spent the longest time writing (a 17-year-old who wrote an expository text in 54 minutes and 20 seconds) is very wide. We also see that the standard deviations for each text type and age group are very high. This raises the question of whether the texts really are comparable.

First, there is of course a point in designing an experiment where all subjects write for exactly the same amount of time. In ScriptLog it would have been possible to time the writing sessions so that the session automatically ended after a certain time (say, 30 minutes). This would have excluded writing times longer than 30 minutes. But it would not have prevented that 13-year-old from writing for only 3:42 minutes! Even with a maximum time we would not have obtained texts of comparable length. There is of course the option of taking the shortest text in the sample as a starting point and then only analysing the first 3:42 minutes of all the other texts. However, in doing so, we would overlook the facts that all writers knew that they had 30 minutes at their disposal and that we must expect at least some of the more experienced writers to have adjusted and planned their writing accordingly. Only looking at the first part of the text would not do justice to the composing and editing patterns of the longer texts. In fact, we would only investigate the whole real-time process of writing in the shortest text, missing out on other interesting factors that may have occurred more than 3:42 minutes after the beginning in the other texts.

If you were indeed to investigate texts written during exactly the same amount of time, you would have to force all writers in the experiment to write for the stipulated time and not make any premature stops. In this case, where we also wanted to compare texts between modalities, a strict time criterion could have forced us to set a minimum time for performing the spoken tasks as well. Although we might not have had to use the same time criterion for speech and writing, a minimum time of five minutes (or even 3.42 min) would be a very long time for giving a speech for the youngest groups – and, for telling a spoken narrative, even for the older groups.

Second, in the overall Spencer Project we were interested in having complete texts, i.e. finished texts, where the writer had time to round off the task. The reason was that we wanted narrative and expository texts to analyse, and we wanted them to have a beginning and an end, which we would not always have had if the writer had been forced to hand in her composition before she had really finished it.

Finally, by allowing a writer to finish her texts we let herself decide how much time she needed to finish the task, i.e. how demanding she found the task of producing a certain text type. By doing so, we will in fact have included a notion of writer's satisfaction in the experimental setup. In this way, the amount of time the writer (or speaker) devoted to the task would therefore in itself be part of the participant's judgment of how much time a certain genre required. This is the main reason why it is important and interesting to compare not only the time devoted to each text type but also the texts produced during the unequally long periods that the writers used for their text production.

## 9.7 Events during keyboard writing

When the average reader encounters a text, in most cases she has very little idea of the work behind the final text. Even a very short and simple text could be the result of a very long process, but since the written product most often lacks traces of the editing process, it is not evident what parts were more difficult to produce. In speech, the listener perceives the speech in the same linear order as it is produced, but for a written text, the writer may have produced the words (or letters) in any order.

Having access to the real-time process of text production creates an opportunity to investigate the choices made and difficulties encountered during text production. For instance, by looking at the linear file from ScriptLog (see Section 7.2 of an elaborate description on linear files), we can easily follow the writer's actions during text composition, for instance to find out whether there have been any deletions in the text or where any pauses occurred.

People sometimes talk about “linear writers”, corresponding to writers following the knowledge-telling strategy presented by Bereiter and Scardamalia (1987). The 10-year-olds in this study can be categorized by this term, but even if they (as we will see below) edit less than the older age groups, their texts also show an editing pattern where they both delete spelling errors or typos as soon as they occur and insert missing words when they find it necessary. Thus the final product is not identical to the linear process behind it. This can be illustrated by an example from an expository by a 10-year-old girl. The text in Example 29 shows the final text, i.e.

the text the writer intended to be read, followed by a translation, and then follows the linear text, illustrating the process behind the same piece of text. The linear text includes pauses longer than 5 seconds.

- (29) Jag tycker att läraren **borde** ringt hem till fräldrarna<sup>2</sup> & om det har varit bråk mellan dom förut så vet dom ju vad dom ska säga till barnet (eleven).

*I think the teacher **should have** called home to the parents and if there has been a fight between them before they know what they should say to the child (the pupil).*

[wg12fCEW]

Jag tycker att läraren<6.76> ringt hem till  
frälda<DELETE>rarna och<DELETE> om det har  
varit bråk n<DELETE>mellan dom förut  
så vet dom ju <18.90>vad dom ska  
säja<27.48><LEFT100> <RIGHT>borde <RIGHT30>  
<RIGHT69><8.45> till barnet (eleven)<12.55>.

If we look at the final text, we find the sentence *Jag tycker att läraren **borde** ringt hem till fräldrarna* ('I think the teacher **should have** called home to the parents'). However, if we trace this back to the linear file, the word *borde* ('should (have)') is missing at that point in the linear production. Instead the writer finishes the whole sentence, followed by a pause of 27.48 s, where a good assumption is that she reads through what she has written. After this pause she moves 100 steps to the left, thus moving backward in the text by pressing the left arrow key 100 consecutive times. Then she probably realizes that she has moved one step too far, and uses the right arrow key to move one step to the right. Here, she inserts the word *borde*, to make the sentence complete. After this she uses the right arrow keys (with an interruption to insert a space) to go back to the end of the sentence, and finishes it with a prepositional phrase (*till barnet (eleven)* ('to the child (the pupil)'). Apart from the insertion of the auxiliary verb *borde*, the writer performs several minor deletions by immediately correcting spelling errors or typos. The longer pauses (6.76 s, 18.9 s, 27.48 s, 8.45 s and 12.55 s) further indicate that the production of this short text is more laborious than it may seem on the surface.

Example 29 above also shows that during keyboard writing, most writers use keys other than those resulting in visible characters on the screen, i.e. keys representing letters, numerals and logographs, the space bar and the return (enter) key. Use of the space bar and the return key will move the cursor forward and downward, respectively. In addition to those keys, the typist also has access to the backspace and/or delete keys to delete text. When the text is finished, there will be no visible traces of those deletions (whereas in the case of handwriting it often is possible to detect that something has been erased). In addition, as the example above illustrates, it is possible to move around in the text with the arrow keys in order to

<sup>2</sup>The spelling *fräldarna* is erroneous (correct spelling: *föräldrarna*). However, since the first syllable is unstressed, the spelling is phonematically correct. The writer might have considered this the correct spelling.

find the right place to erase or insert a letter, word or phrase. The arrow keys can also (in most computer software) be used together with the shift key to highlight text, and the text can then be deleted or moved (cut-and-pasted)<sup>3</sup>. Finally, use of the mouse makes it possible to move around in the text, and the mouse is for some people the tool of first choice for highlighting text.

### 9.7.1 Categorizing events

Below, any action carried out by the writer during text production on the computer will be called an **event**. An event can thus consist of using a key to produce a letter, numeral, punctuation mark or logograph, using a key to make a space or begin a new line, using the arrow keys to move around in the text, using the delete or backspace key to erase a previously written letter, a space or a line break, or clicking the mouse. The number of events during a writing session can be seen as a measure of how effortful the writing was, just as another production measure, such as the number of word tokens (cf. Section 8.3).

The events can be divided into subgroups (cf. Grabowski, 2008, who uses the three categories of characters, deletions and cursor movements; mouse events are not included in his study):

**Characters** All keystrokes that result in a visible sign: letters, numerals, punctuation marks and logographs (e.g., “%”, “&”) as well as blank spaces and line breaks (caused by the return key).

**Deletion events** All keys that remove/delete a previously written character: backspace and delete (delete and xedit).

**Moving events** All events that are used to move around in the text: the arrow keys (left, right, up, down), mouse clicks and mouse events used to move to a certain place in the text or to highlight parts of the text.

Below I will compare the total number of events in the texts to paint a picture of how general production characteristics differed between ages and genres. I will then compare the number of characters in the final texts. In this sense I am on the one hand looking at the linear, real-time processes, and on the other hand looking at the final texts.

One measure that of course would have been interesting to investigate further is the proportion of deleted characters, i.e. how many characters were written in the linear texts but not included in the final texts. In the new PC version of ScriptLog this measure is rather easy to extract from the STA files (i.e. subtracting the number of characters in the final text from the number of characters in the linear text). However, the written data I investigate here come from the older Mac files, and in spite of several attempts it has unfortunately proved difficult to obtain any reliable data on the proportion of deleted characters. Findings in Johansson (2000a) indicate that there were no age differences in the proportion of deleted tokens in the

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<sup>3</sup>It may be pointed out that the option of cut and paste was disabled during the production of the texts in this study.

Table 9.3: Mean number of events in the linear texts; mean number of characters in the final. Each measure is broken down by genre and age

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Number of events in the linear texts					
Narrative	844.3	1348.1	3985.8	2867.2	2253.7
Expository	1039.0	1837.4	4354.8	4265.6	2856.6
Total	941.6	1592.8	4170.3	3566.4	2555.6
Number of characters in the final texts					
Narrative	577.4	829.6	2515.7	2304.9	1547.4
Expository	630.3	1265.1	3003.5	2895.2	1936.5
Total	603.8	1047.3	2759.6	2600.1	1742.0

expository texts, but that there may be some in the narrative texts. However, the question of deletions is not totally overlooked here, since the issue will be addressed when I investigate the proportion of deletion events in Section 9.8.1.

### 9.7.2 Number of events in the linear text

The number of events can be calculated only in the linear text, since the final text contains only the results of keystrokes giving rise to visible signs. As Example 29 on page 126 shows, even behind the texts from the 10-year-olds there is more activity than simply the generation of characters. Thus, if we want to make a fair comparison of the effort behind each text we need to explore how the number of events varies between the age groups and genres.

The number of events in the linear texts was extracted from the number of lines in the LOG file. The means are shown in Table 9.3, and the age and genre differences are also illustrated in Figure 9.4. Statistical analyses show a significant three-way interaction of age, gender and order ( $F(9, 46) = 2.954, p = 0.007, ES = 0.366$ ). Analysis of the three-way interaction of age, gender and order reveals that the difference is found in Order A, where the 17-year-old girls produce more events than the boys and the male university students produce more events than their female peers. From this we can probably conclude that this interaction is a mere coincident.

In addition, there was a significant main effect of genre ( $F(1, 46) = 14.824, p = 0.000, ES = 0.244$ ) in that the expository texts contain more events, which would indicate that the expository task encourages more editing. The reason for this would be the more complicated syntactic structures induced by causal connectivity, argumental structures and logical organization, e.g. problem–solution, cause–effect, and comparison–contrast (cf. van Hell et al., 2008).

Finally, there is an age effect ( $F(3, 46) = 55.325, p = 0.000, ES = 0.783$ ). Post hoc analysis of this effect shows that there are no differences between the 10-year-olds and the 13-year-olds, and nor are there any differences between the 17-year-olds and the university students. However, there are significant differences between the two youngest and the two oldest age groups. This is a pattern we

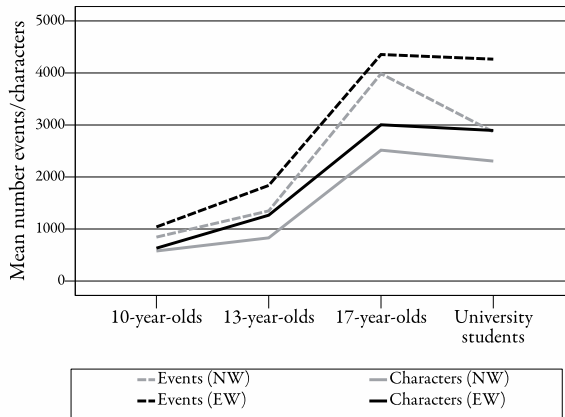


Figure 9.4: The upper, dashed, lines show the total number of events in the written texts, broken down by genre. The lower lines show the total number of characters in the final texts, broken down by genre. The number of characters in the final texts is included in the total number of events, but the number of events also comprises deleted characters as well as mouse movements and presses of arrow keys and delete and backspace keys

recognize from several of the measures in Chapter 8, for example the number of word tokens and the number of clauses. The number of events thus proves to follow the general developmental trend.

### 9.7.3 Number of characters in the final text

The number of characters in the final texts has been counted using the Microsoft Word tool *Word count*. This measure includes *only* the number of characters, i.e., visible characters like letters, numerals, punctuation marks and logographs (e.g. “%” and “&”) and “invisible” characters like spaces and line breaks. That is, deletion and moving events are excluded in this calculation.

The means are shown in Table 9.3, and the age and genre differences are illustrated in Figure 9.4. There is a significant main effect of genre ( $F(1, 47) = 15.932$ ,  $p = 0.000$ ,  $ES = 0.253$ ), consisting in the expository texts having more characters than the narrative texts. Further, there is a significant main effect of age ( $F(3, 47) = 66.632$ ,  $p = 0.000$ ,  $ES = 0.812$ ). Post hoc analysis shows no difference between 10-year-olds and the 13-year-olds, nor between the university students and the 17-year-olds. However, there are significant differences between the two oldest and the two youngest age groups.

That the expository texts should have more characters is consistent with the finding that this genre has more words and clauses (as is shown in Chapter 8). One explanation why expository texts should be longer may be their typically non-chronological



organization, with arguments built around descriptions and causal structures. This may in itself generate more text than the personal narrative, which relates what happened according to a temporal, often chronological structure, from beginning to end (in most cases providing minimal background information). Another angle of this explanation is that knowledge of the expository genre is less integrated and automatized by the writers, which makes this genre more difficult to “write”. Instead, many of the expository texts may be categorized as following the knowledge-telling strategy.

The age differences reveal no surprises. Again, we find the typical division between the two youngest and the two oldest age groups, which simply confirms that the main steps of writing development takes place somewhere between the ages of 13 and 17.

### 9.7.4 Correlation between the number of linear events and the number of characters in final texts

The correlation between the number of events in the linear texts and the number of characters in the final texts was investigated. Strong correlations were found for all age groups (10-year-olds:  $r = 0.870$ ,  $p = 0.000$ ; 13-year-olds:  $r = 0.796$ ,  $p = 0.000$ ; 17-year-olds:  $r = 0.771$ ,  $p = 0.000$ ; university students:  $r = 0.804$ ,  $p = 0.000$ ). This indicates that the proportion of deleted characters was evenly distributed across ages and genres, suggesting that the deletion of characters remains constant independently of age and genre. One explanation is that the vast majority of the deletions are due to typos or other spelling errors, which are (almost immediately) detected and corrected. The proportion of deletions would then be merely an effect of writing style, and not sensitive to genre – or age! The number of deletions caused by, for example, lexical and syntactical choices may be negligible in the texts, because of the limited time that the writers had at their disposal. It could be hypothesized that at least the oldest age groups would have carried out more editing and deletions on word and phrase level if they had had more time. This is confirmed by the study in Johansson (2000a), which shows a small increase in deletions of words and phrases in the group of university students. It would be interesting to investigate this further, for example by looking at writers who have more time for editing or by setting up an experiment which specifically elicited editing and/or deletion.

## 9.8 Types of event

To explore the events a little bit further, this section will investigate the use of the different types of deletion events and the moving events, i.e. the kinds of events that are *not* characters. Let us start with looking at a linear file again. Example 30 shows the linear text from the end of a narrative by a 17-year-old boy. He writes about a school play in elementary school where a girl, Catrin, who plays one of the main parts has accidentally peed in her pants. To help her in her predicament, the writer pours a pitcher of juice over her. Although the text extract is a bit difficult to follow, the main point is to illustrate the amount of deletion and moving events that the writer uses to move around, erase and insert words and phrases to enhance clarity.

The full text is found on page 193 in the Appendix. In this case, it makes little sense to show the equivalent final text, since this extract from the linear text illustrates the last editing phase of the writing session. In this example, the writer is moving around very much, changing parts of the texts already written. All the instances of <LEFT>, <RIGHT>, <UP>, <DOWN>, <MOUSE> and <DELETE> indicate an extensive editing phase.

- (30) The written narrative by a 17-year-old boy.  
[wh14mCNW]

```
<5.46><UP><LEFT18><DOWN><UP3><DOWN><RIGHT><DOWN2><RIGHT11>
<DELETE><RIGHT3>den stora <RIGHT8><LEFT2>. Som planerat
<7.13>ko saf<DELETE4>m saften över k<DELETE>Catrin<12.05>
<XEDIT26><RIGHT><DOWN2> Nui<DELETE> kom <DELETE4><6.36>
<DELETE3><21.20><MOUSE ,417><DELETE5>extra
sr<DELETE>tarka<13.96><DOWN><LEFT15><DOWN><DELETE5>
<DOWN><9.73><DOWN><LEFT><RIGHT16> som, gav ifrån
su<DELETE>ig ett lätt skrik<6.93><MOUSE ,973>,<RIGHT5>
<DELETE><16.05><MOUSE ,1108><DELETE>
<RIGHT7><58.83>
```

```
<5.46><UP><LEFT18><DOWN><UP3><DOWN>
<RIGHT><DOWN2><RIGHT11><DELETE>
<RIGHT3>the big <RIGHT8><LEFT2>. As planned <7.13><ca
juice<DELETE4>me the juice over k<DELETE>Catrin<12.05>
<XEDIT26><RIGHT><DOWN2> Nowi<DELETE> came
<DELETE4><6.36><DELETE3><21.20><MOUSE ,417>
<DELETE5>extra sr<DELETE>trong<13.96><DOWN>
<LEFT15><DOWN><DELETE5><DOWN><9.73><DOWN>
<LEFT><RIGHT16> which, gave up<DELETE>
a small scream<6.93><MOUSE ,973>,<RIGHT5><DELETE>
<16.05><MOUSE ,1108><DELETE><RIGHT7><58.83>
```

From Example 30 it is salient that a great many actions apart from merely producing characters take place in this boy's writing. We can distinguish the extensive use of arrow keys, which is shown by <LEFT>, <RIGHT>, <UP>, and <DOWN> – sometimes followed by a number, indicating consecutive use of a key. We also find indications of deleting both backward and forward; in this case backward deleting is indicated by <DELETE> while forward deleting (i.e. deleting something placed in front of the cursor) is denoted by <XEDIT>. Finally, the mouse movements are also recorded.

In this section I will investigate to what extent the use of those types of events differs between age groups and genres. I will start by presenting the event types and their typical use, and their denotation in ScriptLog. The focus will be on the Macintosh version of ScriptLog, but whenever the denotation differs from the PC version this will be noted.

## Deletion events

**Delete: delete backward/backspace** The most common way of erasing something from the text is to place the cursor *to the right of* the string of letters you want to remove and then press the backspace key, which produces a backward deletion. Most often this is done immediately after typing the erroneous letter(s), and thus no specific “placing” of the cursor is necessary. The backspace key is very often used several times in a row. In the ScriptLog files, use of backspace is denoted as `<DELETE>`<sup>4</sup>. Consecutive presses on backspace are indicated by a number; for example, `<DELETE4>` means that the writer pressed backspace four times directly following each other.

**Xedit: delete forward** On many computers (but for instance *not* on most portable Mac iBooks) it is also possible to delete forward. This means that the cursor is placed *to the left of* the string to be deleted, and when the delete key is pressed, the text in front of the cursor is erased. While the backspace key is placed comfortably within reach in the top right corner of the normal keyboard, the delete key is typically placed further away to the right, close to – or on – the numeric keypad. Everybody uses the backspace key, but preferences for using the delete key are very individual. The fact that the delete key is located farther away from the normal keyboard and that it is not even available on all keyboards (for instance not on some laptops) makes it a special key.

Since all keyboard writers with some experience will be aware of the existence of the delete key, the xedit key is the one that has to be “discovered” to be included in the writer’s repertoire. Both the delete key and the delete forward key (here called ‘xedit’) are used to erase text, but xedit is the marked case. In the ScriptLog files, use of the key for deleting forward is denoted as `<XEDIT>`<sup>5</sup>. In the text below the key for deleting backwards will sometimes also be called ‘backspace’.

‘Delete’ and ‘XEDIT’ together make up the category **deletion events**.

## Moving events

**Mouse event** A quick and efficient way of moving to a specific point in the text is by using the mouse. The mouse can also be used to highlight a word by double clicking on it. A further function is performed by clicking, dragging and releasing the mouse, which can be used to highlight anything from two letters to a whole text. In the ScriptLog files, the mouse events are marked as `<MOUSE>`, followed by one or two numbers indicating the position to which the cursor is moved; one number indicates a single mouse click and two numbers indicates a highlighting.

**Left arrow** The arrow keys are used to move around in the text, for instance to go back one or more characters, often to delete or insert something. Some writers

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<sup>4</sup>The PC version of ScriptLog uses the term `<BACKSPACE>` for this action, while the term `<DELETE>` is reserved for forward deletion.

<sup>5</sup>In the PC version of ScriptLog, the denotation is `<DELETE>`.

use arrow keys to move backward or forward very long distances, while others limit their use to short distances. The left arrow key is used to move to the left in the text. In the ScriptLog files the left arrow key is marked as `<LEFT>`. Consecutive pressing is common, and indicated as, for example, `<LEFT14>` for 14 consecutive presses on the left arrow key.

**Right arrow** The right arrow key is used to move to the right in the text. Very often writers first use the left arrow to go back in the text to a word or phrase that they want to edit. After editing, they use the right arrow to move forward, back to where they came from. In the ScriptLog files the right arrow key is marked as `<RIGHT>`. Consecutive key-presses are indicated as, for example, `<RIGHT14>`.

**Up arrow** The up arrow is used to move upwards in the text, and it is especially often used in combination with the left and right arrow keys. In the ScriptLog files the up arrow key is marked as `<UP>`. Consecutive key-presses are indicated as, for example, `<UP14>`.

**Down arrow** is sometimes used to move back to the insertion point after the left arrow has been used to move backwards in the text. In the ScriptLog files the down arrow key is marked as `<DOWN>`. Consecutive key-presses are indicated as, for example, `<DOWN>`.

The categories of mouse, left, right, up and down together make up the category of **moving events**.

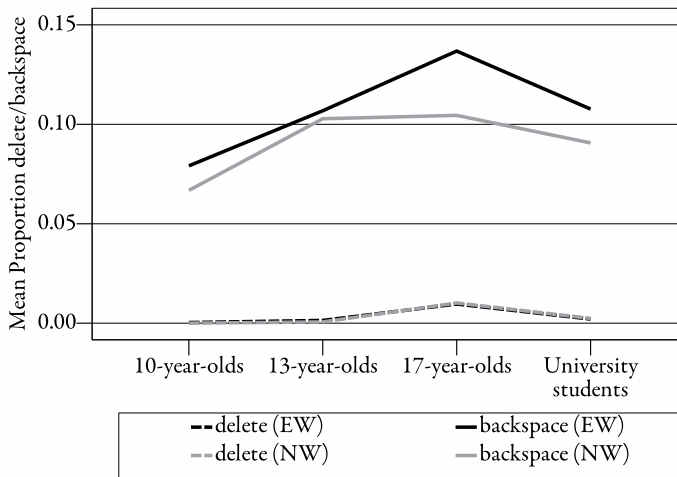


Figure 9.5: Proportion of deletion events in relation to the total number of events. The solid lines display the mean proportions of the use of the delete key and the dashed lines display the mean proportions of the use of the xedit key (delete forward)

### 9.8.1 Statistical analyses of the event types

The numbers of instances of the various event types were extracted from the LOG files. The the number of deletion events (e.g. <DELETE> and <XEDIT>) and the number of moving events (e.g. <MOUSE>, <LEFT>, <RIGHT>, <UP> and <DOWN>) were obtained, and then counted using the counting function in the program BBEdit.

There are two ways to calculate the event types. One way is to count every single key-press. For example, if a writer erases the word ‘house’ by pressing delete 5 consecutive times, this will be counted as 5 deletes. The second way is to think of this as one action of deletion, and count it as one use of delete. In the analyses below the first way of counting is used, and thus our example of erasing ‘house’ will be counted as 5 deletes.

In the following analyses, the proportion of each event type in relation to the total number of events has been used to investigate age and genre differences. Table 9.4 shows the mean number of each event type, as well as the proportions. It is worth noticing that some event types are very rare for certain age groups, such as <XEDIT> in the 10-year-old group. Also, even when an event type is represented in an age group, it is not necessarily the case that every individual writer in the group uses it. Such individual non-users exist among all age groups for <XEDIT>, <MOUSE>, <UP> and <DOWN>. In Table 9.4 and in the statistical analysis presented here, <UP> and <DOWN> arrows are always grouped together, as are <LEFT> and <RIGHT> arrows. This grouping was preceded by calculations for each arrow key individually, but since those analyses gave the same results they were not included here. The groups deletion events and moving events are also grouped together to further investigate the editing and deletion habits.

**Delete** Table 9.4 shows the proportion of deletion events to the total number of events, broken down by age group and genre. Figure 9.5 illustrates the same proportions, and also provides a comparison with the proportions of xedits. Statistical analyses show a main effect of age ( $F(3, 47) = 3.632$ ,  $p = 0.019$ ,  $ES = 0.188$ ), demonstrated in that the 17-year-olds had significantly more deletes in their texts than the 10-year-olds. There was also a tendency toward a main effect of genre ( $F(1, 47) = 3.816$ ,  $p = 0.057$ ,  $ES = 0.075$ ) in that the expository texts had more deletes than the narrative texts.

**Xedit** Table 9.4 shows the proportion of xedits in relation to the total number of events, broken down by age group and genre. Figure 9.5 illustrates the same proportions and also provides a comparison with the proportion of deletes. Statistical analyses reveal a main effect of age ( $F(3, 47) = 4.661$ ,  $p = 0.006$ ,  $ES = 0.229$ ). Post hoc analysis shows that the 17-year-olds use xedit significantly more than the 10-year-olds and the 13-year-olds. There was also a tendency for the 17-year-olds to use it more than the university students ( $p = 0.069$ ).

**Delete and xedit** Further analyses were performed on the sum of deletes and xedits (the mean numbers are not included in Table 9.4). The statistical analyses

Table 9.4: Mean number of event types: delete, xedit, mouse events and arrow keys, broken down by genre and age. Percentages of event types in relation to the total number of events in the texts

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Number of deletes					
Narrative	54.6	152.5	422.0	269.5	224.1
Expository	83.4	205.1	555.2	465.2	325.4
Total	69.0	178.8	488.6	367.3	274.8
Number of deletes per total number of events					
Narrative	0.0668	0.1028	0.1045	0.0906	0.0912
Expository	0.0791	0.1068	0.1368	0.1077	0.1076
Number of xedits (delete forward)					
Narrative	0.0	0.6	41.3	6.7	12.2
Expository	0.3	2.5	46.6	9.6	14.7
Total	0.1	1.5	48.8	8.2	13.5
Number of xedit (delete forward) per total number of events					
Narrative	0.0000	0.0006	0.0102	0.0024	0.0033
Expository	0.0003	0.0014	0.0096	0.0021	0.0034
Number of mouse events					
Narrative	7.8	6.2	24.4	29.2	16.7
Expository	4.2	10.7	27.3	39.3	20.1
Total	6.0	8.4	25.9	34.2	18.4
Number of mouse events per total number of events					
Narrative	0.0077	0.0037	0.0078	0.0112	0.0076
Expository	0.0059	0.0046	0.0070	0.0110	0.0071
Number of arrow keys (sum of left, right, up and down arrows)					
Narrative	140.8	183.1	518.6	159.6	251.6
Expository	233.8	164.9	528.2	258.8	296.9
Total	187.3	174.0	523.4	209.2	274.3
Number of arrow keys (sum of left, right, up and down arrows) per total number of events					
Narrative	0.1402	0.1260	0.1040	0.0617	0.1085
Expository	0.1926	0.0982	0.1173	0.0613	0.1181
Number of left and right arrow keys (sum of left and right arrows)					
Narrative	137.0	169.3	490.5	143.1	236.1
Expository	226.0	153.5	501.3	231.7	278.7
Total	181.5	161.4	495.9	187.4	257.4
Number of left and right arrow keys (sum of left and right arrows) per total number of events					
Narrative	0.1372	0.1150	0.989	0.0538	0.1018
Expository	0.1866	0.0918	0.1113	0.0555	0.1120
Number of up and down arrow keys (sum of up and down arrows)					
Narrative	3.75	13.9	28.0	16.5	15.5
Expository	7.8	11.45	26.9	27.2	18.2
Total	5.8	12.7	27.4	21.8	16.9
Number of up and down arrow keys (sum of up and down arrows) per total number of events					
Narrative	0.0029	0.0110	0.0051	0.0079	0.0067
Expository	0.0061	0.0064	0.0060	0.0058	0.0061

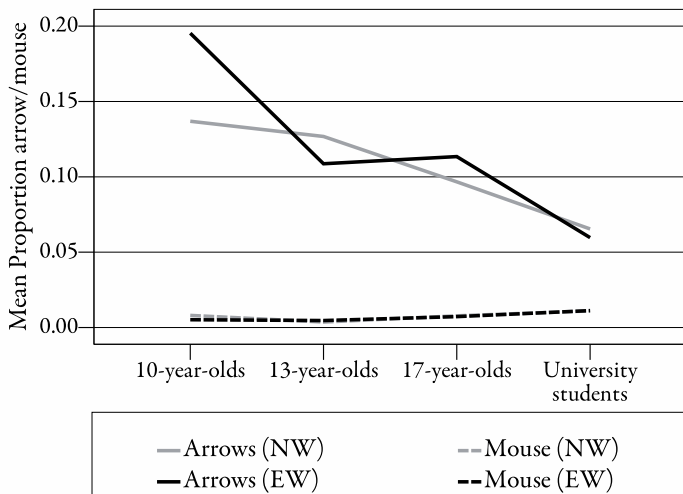


Figure 9.6: Proportion of moving events in relation to the total number of events. The solid lines show the mean proportions of arrow-key events and the dashed lines show the mean proportions of mouse events

show a main effect of age ( $F(3, 47) = 5.032, p = 0.004, ES = 0.243$ ), and post hoc analysis reveals that the 17-year-olds use delete and backspace more than the 10-year-olds. There is also a strong tendency toward a main effect of genre ( $F(1, 47) = 3.875, p = 0.055, ES = 0.076$ ) in that the expository texts have more deletes and xedits than the narrative texts

**Mouse events** Table 9.4 shows the mean proportion of mouse events in relation to the total number of events. Figure 9.6 illustrates the same proportions. Note that the same figure also includes a graphic representation of total arrow use. Statistical analyses show a four-way interaction of genre, age, gender and order ( $F(9, 47) = 2.120, p = 0.046, ES = 0.289$ ) and a main effect of gender ( $F(1, 47) = 5.887, p = 0.019, ES = 0.111$ ). Further analysis of the four-way interaction showed that it consisted in the 10-year-old girls having more mouse events in their expository texts in Order B than the boys, and that in the 10-year-old girls having more mouse events in their narrative texts in Order C. Finally, the university students showed gender differences in their expository texts in Orders A and C, where the men had more mouse events than the women. We can probably explain the differences observed here as an effect of the small number of representatives of each gender in the order cells (cf. Section 6.7.1.1).

**Arrow keys** After looking at the individual distribution of the usage of arrow keys, it was salient that while (almost) all writers used the left and right arrow keys,

far from all of them used the up and down keys. However, use of the up and down arrows went hand in hand. Therefore the statistical analyses below first present results for all arrow keys together and then results broken down into, on the one hand, the left and right arrows and, on the other hand, the up and down arrows.

Table 9.4 shows mean numbers for the use of all arrow keys as well as the proportion of arrow-key events in relation to all events during the writing session. In Figure 9.6 we find an illustration of the use of arrows. The statistical analysis shows a main effect of age ( $F(3, 47) = 3.472, p = 0.023, ES = 0.181$ ). Interestingly, the pattern shows that the use of arrow keys is most frequent in the youngest age group and decreases with age, although the only significant difference is between the 10-year-olds and the university students. The higher use of arrow keys in the youngest age group may be a sign of more local editing, where the arrow keys are preferred to the mouse as a tool for moving around in the text.

There is also a main effect of gender ( $F(1, 47) = 6.248, p = 0.016, ES = 0.117$ ), indicating that the female participants use arrow keys more.

Table 9.4 further shows mean numbers for the left and right arrows together as well as the proportions of left and right arrows in relation to the total number of events. These means are not graphically illustrated. Statistical analyses show a main effect of age ( $F(3, 47) = 4.057, p = 0.012, ES = 0.206$ ), thus indicating the same trends as for the analysis of the use of all arrows: the 10-year-olds use the left and right arrow keys more than the university students. There is further a significant main effect of gender ( $F(1, 47) = 6.245, p = 0.016, ES = 0.117$ ) in that the girls use the arrow keys more.

In Table 9.4 we also find mean numbers for the up and down arrows together as well as the proportions of up and down arrows in relation to the total number of events. These means are also not graphically illustrated. The statistical analysis shows a three-way interaction of genre, age and order ( $F(9, 47) = 2.701, p = 0.013, ES = 0.341$ ). Post hoc analysis shows that this is because the 13-year-olds use up and down arrow keys more in their narrative texts. This would suggest that the 13-year-olds have begun to edit in more distant parts of the texts than the 10-year-olds, thus moving up to previous lines to delete and edit before moving back down again. The difference in relation to the 17-year-olds and the university students may be that the older age groups use the mouse to move to previously written text. Taken together, this indicates more dynamic behaviour in the 13-year-old group.

### 9.8.2 Correlations between the proportions of event types

Correlations between the various event types were explored. The measures compared were the proportion of deletes, the proportion of xedits, the proportion of arrow keys and the proportion of mouse events.

**The narrative texts.** The 10-year-olds show a negative correlation between use of deletion events and use of the arrow keys ( $r = -0.526, p = 0.017$ ), showing that if you use the deletion keys often you use the arrow keys less. One explanation could be that the 10-year-olds move to one place with the arrow keys, and when they have done that they delete larger parts of the texts. It could also be a sign that they often



delete an erroneous letter immediately and that there is thus no need first to move somewhere with the arrow keys. Finally, it may indicate that they do not move around much to edit small parts of texts here and there. All three explanations can suggest a rather linear and local way of editing.

The 13-year-olds do not exhibit any correlations between these measures in the narrative texts. This is interesting, since it may suggest that members of this group use arrow keys a great deal but delete keys very little. Could it be a sign that they move far back in the text and delete very little?

In the texts by the 17-year-olds, there is a strong correlation between the number of deletes and the number of xedits ( $r = 0.876$ ,  $p = 0.000$ ), suggesting that the persons using delete use xedit as well. Further, there is a negative correlation between mouse events and arrow movements ( $r = 0.520$ ,  $p = 0.019$ ), indicating that if you use the arrow keys a lot you make fewer mouse clicks, and vice versa. Here it may be noticed that the mouse can be used to highlight large parts of the text and delete it all by means of a single press on the backspace key. This would not leave many traces of deletes in the data files.

The university students show a negative correlation between the number of arrows and the number of deletion events ( $r = -0.502$ ,  $p = 0.029$ ), indicating that if they move around much in the text with arrow keys they delete less, which may indicate that they go far back in the text to many places and delete few characters.

**The expository texts.** In the 10-year-olds' texts, there was a negative correlation between the proportion of arrows and the proportion of mouse events ( $r = -0.469$ ,  $p = 0.037$ ), indicating that if you do not use the mouse to move around in the text, you will use the arrow keys instead.

The 13-year-olds showed a negative correlation between the proportion of deletion events and that of mouse movements ( $r = -0.518$ ,  $p = 0.019$ ), indicating that if you make many mouse clicks you do not need to use consecutive presses on deletion keys as often. This suggests that mouse users are more likely to highlight a word or phrase with the mouse and then delete it with one press on the backspace or delete key, rather than move to the text they want to remove with the arrow keys and then delete it with consecutive backspaces. Further, the likelihood of using the left and right arrows was higher in those who used the up and down arrows ( $r = 0.628$ ,  $p = 0.003$ ).

The 17-year-olds showed a negative correlation between mouse events and the use of arrow keys ( $r = -0.096$ ,  $p = 0.006$ ), indicating that if you use the mouse, you use arrow keys less.

The university students also show a negative correlation between the use of arrow keys and the use of mouse events ( $r = -0.463$ ,  $p = 0.046$ ), indicating that an increase in either leads to a decrease in the other. One interpretation is that writers have different strategies: some are arrow-users, some are mouse-users.

As for correlations between mouse events and arrow keys, it may also be argued that if a writer must move back a long way in the text, it is certainly more economical to use the mouse to do so. The 10-year-olds may not move so far, since they either write short texts or edit only locally.

## 9.9 Discussion and conclusion

This chapter has explored some of the many options available to investigate the output files from a keystroke-logging program. The results are not entirely clear, but we can see a trend that, with increasing age, the writers produce longer texts in a relatively shorter time (as indicated not only by the WPM measure but also by the investigation of events per second). This is partly attributed to the fact that typing skill increases, but it is also an indication that more experienced writers have automatized not only typing but also the construction of sentences and the design of the global structure of the texts.

We have also discovered that the writers use a great many keys in addition to those used to produce characters. All writers delete to some extent, but the manner in which they do so may differ. We have some indications that the 10-year-olds are more local (they use deletions a great deal, but their use of deletion keys does not correlate with arrow-key movements), and that the editing patterns differ in other ways is clear from Figure 9.6, where we see the decrease in arrow-key use with age. The older age groups may use the mouse more to move around, or may actually delete more whole words or sentences in order to change their texts.

We have further seen that the 17-year-olds use most deletion events. If we compare with many of the measures in Chapter 8, such as the number of tokens or the number of T-units, where the 17-year-olds manage to perform just as well as the university students, the results in this chapter show that this equality of performance has its price in longer time on task (the 17-year-olds' average writing time is the longest of all age groups, as is shown in Figure 9.1, and they also have the largest number of events, as is shown in Figure 9.4). It is thus much more laborious for them to produce something that can compete with, for example, the level of lexical diversity exhibited by the adults' written texts, if we think about the results in Section 10.3.2.

Many of the choices as regards the use of the various editing keys may be individual, which confirms the reasoning in Grabowski (2008) that many people using the computer today have no formal training. Some people may not even know about the option of deleting forward (i.e. what is here called *xedit*). For instance, we may explain the fact that the 13-year-olds had no correlations between any events in their narrative texts by reference to the fact that the members of this group are in very different developmental stages in learning to use the keyboard. A pilot investigation of the 13-year-olds' texts shows that some of these children have developed an extensive editing phase at the end of their narrative texts, while other writers in this group are "finished" when they have written down the last episode of the narrative text. This shows that there is progress going on in that the 13-year-olds are moving from being strictly linear writers to taking advantage of the more recursive options of language production that writing provides.

The results in this chapter can only serve as a starting point for further investigation into how the events correlate with different writing strategies, and with different syntactic and semantic structures as well as a general sense of text quality. However, I believe that once these relations are more explored, the method of in-

investigating “quick” and easily obtainable measures like these may provide valuable insights into the laborious parts of text production.

# Chapter 10

## Lexical diversity and lexical density

### 10.1 Introduction

This study investigates lexical development in the corpus<sup>1</sup>. Literature about early lexical development (i.e. pre-school development) often uses the term *vocabulary development*. For example, a reader looking up ‘lexical development’ in the index of *The Handbook of Child Language* is referred to ‘vocabulary development’ (Fletcher and MacWhinney, 1995). The same term is used e.g. by Dromi (1999) in her overview of early lexical development, and the index of David Crystal’s *The Cambridge Encyclopedia of Language* refers to ‘vocabulary’ from the index entry ‘lexicon’ (Crystal (1997)).

This study will compare two measures that have often been used to describe later lexical development: *lexical diversity* and *lexical density*. I will explore the data using these two measures and also discuss whether they are interchangeable or whether we need both of them to describe lexical development in relation to both genre and modality.

Lexical diversity is a measure of lexical variation, i.e. a measure of how many *different* words are used in a text, while lexical density provides a measure of the proportion of lexical items (i.e. nouns, main verbs, adjectives and some adverbs) in a text. Both measures have the advantage of being both easy to operationalize and well suited to computer-assisted analysis of large text corpora. Further, both lexical diversity and lexical density have been shown to be significantly higher in writing than in speaking (cf. e.g. Ure, 1971; Halliday, 1985). From this it could conceivably be concluded that the two measures are interchangeable and that we will encounter a similar developmental pattern independently of which measure we use to describe lexical development.

However, it is theoretically possible for a text to have high lexical diversity (i.e. to contain many different word types) but low lexical density (i.e. to contain many pronouns and auxiliary verbs instead of nouns and lexical verbs), or, vice versa, low lexical diversity (i.e. the same words or phrases are repeated over and over) but

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<sup>1</sup>An earlier version of this chapter was published in Johansson (2008).

high lexical density (i.e. most of the words that are repeated are nouns, adjectives and verbs).

Lexical diversity is often used as an equivalent of *lexical richness* (e.g. Daller et al., 2003). However, Malvern et al. (2004) begin their book about lexical diversity with a discussion of the difference between lexical diversity and lexical richness, stating (along the lines of Read, 2000) that the measure of lexical diversity is only *one* part of the multidimensional feature of lexical richness. Other factors proposed by Read as elements of that feature are lexical sophistication, number of errors and lexical density (Read, 2000). I side with Read and Malvern et al.: neither lexical diversity nor lexical density is the one and only measure. However, both measures are easily accessible and easy to apply to corpora of different kinds. No doubt they also provide important insights into texts, and as long as they are not used as the only basis for a qualitative judgement of a text, they are very useful.

### 10.1.1 Aim of the study and outline of the chapter

This study focuses on developmental patterns in terms of the lexical measures of lexical diversity and lexical density. I will examine whether these lexical measures are sensitive to genre (narrative vs. expository) and modality (writing vs. speaking). Another goal is to investigate the extent of correlation between these two measures. The chapter will first give a theoretical background to the two measures, then account for statistical analyses, and finally present a conclusion.

## 10.2 Lexical diversity

The more varied the vocabulary manifested by a text, the higher its lexical diversity. For a text to be highly lexically diverse, the speaker or writer has to use many different words, with little repetition of the words already used. There are a number of different measures of lexical diversity, some of which are discussed below.

**The type-token ratio** The traditional measure of lexical diversity is the ratio of different words (types) to the total number of words (tokens), which is referred to as the type-token ratio or TTR (e.g. Lieven, 1978; Bates et al., 1988). One problem with the TTR measure is that text samples containing large numbers of tokens give lower values for TTR, and vice versa. This is because the number of word tokens will tend to increase faster than the number of word types (although both can increase infinitely) as it will often be necessary for the writer or speaker to re-use several function words in order to produce a sentence where one new (lexical) word appears<sup>2</sup>. The longer the text, the stronger the need will be to use a certain function word again. Thus, once a text has reached a certain length, the addition of a new sentence often means that the number of word types increases by, say, one or two, while the number of word tokens will increase by perhaps five or six. This implies that longer texts in general have a lower TTR value than shorter texts, which makes it especially complicated to use TTR in developmental comparisons,

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<sup>2</sup>Agglutinative languages with few free function words can show a different pattern.

for instance between age groups, where (as we have seen in Chapter 8) the number of word tokens increases with age. As is also shown in Chapter 8, the number of word tokens is higher in speech than in writing. Further support for that conclusion comes from Gayraud (2000), who compares TTR and the number of word tokens for the French part of the Spencer data and is able to show that although the number of word tokens increases substantially in the adult group, the TTR actually drops.

One consequence of this is that TTR can be used only to compare texts of equal length. In spite of this, TTR is still used for comparison of text production, for instance between children's texts or between various groups with language impairments.

A variant of the TTR measure is the *Index of Guiraud*<sup>3</sup>. This measure uses the square root of TTR instead. Other proposed variants include *Advanced TTR* and *Guiraud Advanced*, for instance used by Daller et al. (2003).

Vermeer (2000) discusses TTR and several other measures, and their use in both first- and second-language acquisition. She concludes her discussion by proposing that lexical richness can be more successfully measured on the basis of the degree of difficulty of the words included in a text as measured by their frequency in everyday life.

**Theoretical vocabulary** Several ways around the problem of TTR have been proposed and used. One is the measure of *theoretical vocabulary* (see e.g. Broeder et al. (1986)). The principle behind this measure is to pick a random number (e.g. 100) of consecutive words from a text and then calculate the number of word types in the sample. Theoretical vocabulary takes into account all possible ways of choosing 100 consecutive words from the text. This makes it possible to compare texts of different lengths; the only restriction is that the shortest text limits the maximum sample size.

Johansson (1999) uses theoretical vocabulary to compare spoken and written expository texts between a group of Swedish university students and a group of 12-year-olds. The program *Vocab* (Grönqvist, 1998, 2000) was used to calculate theoretical vocabulary and the results show that lexical diversity is higher in writing than in speech for both the adults and the 12-year-olds, and that the adults have a higher lexical diversity than the 12-year-olds. Wengelin (2002) uses *Vocab* to compare written texts in various genres from three populations: a group of adult controls, a group of congenitally deaf adults, and a group of adults with reading and writing difficulties. The control group had a higher diversity than the other groups. Some of the written texts also had spoken equivalents, and Wengelin was able to show that the control group had a greater difference between their spoken and written texts than the group with reading and writing difficulties. These findings thus confirm the general view that lexical diversity is sensitive to both modality and development.

**VocD** From the discussion of TTR above, we understand that we need a measure independent of sample size in order to be able to compare texts of different lengths.

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<sup>3</sup>The Guiraud who created the index must not be mixed up with Gayraud (2000) who studied parts of the French material from the Spencer project.

One such measure is the  $D$  measure proposed by Brian Richards and David Malvern (Richards and Malvern, 1997; Malvern et al., 2004; MacWhinney, 2000). The  $D$  measure is based on the predicted decline of the TTR as the sample size increases. This is then compared with empirical data from a text sample. Information from the whole text sample is used to calculate  $D$  (however, the minimum length of the text is 50 words). A higher value of  $D$  indicates a higher vocabulary diversity and thus a richer vocabulary. The  $D$  measure is implemented in the most recent versions of CLAN (MacWhinney, 2000), under the name of *VocD*. The *VocD* measure is described at length, with many examples and references to previous studies of lexical measures, in Malvern et al. (2004).

Although Malvern and Richards claim that *VocD* permits comparisons between texts of unequal length, not everybody is convinced that the text-length factor is completely eliminated by the use of *VocD*. In fact, the  $D$  measure has been criticized, for instance by Daller et al. (2003), who instead prefer the Guiraud index.

Further, the  $D$  measure is severely criticized by McCarthy and Jarvis (2007) for not being insensitive to text length. McCarthy and Jarvis (2007) compare  $D$  with 13 alternative methods of measuring lexical diversity, concluding that  $D$  (or *VocD*) performs better than most of them, but that there are better options. However, another conclusion is that the length of the texts that you want to compare should determine which measure you use, since some measures are more effective within certain length ranges. The analyses of McCarthy and Jarvis show that  $D$  is the second-best of all measures within the text-length range of 100-400 word tokens, which is also what is claimed in Malvern et al. (2004). The article ends by questioning “whether a single index has the capacity to encompass the construct of lexical diversity” (McCarthy and Jarvis, 2007, p. 483).

*VocD* has already been used to compare lexical diversity in the international Spencer data. Strömquist et al. (2002) compare the adults’ written and spoken texts, reporting large differences between speech and writing with writing having much higher lexical diversity. However, it was also concluded in this study that you should be careful when using this measure to compare data from different languages. The morphological structure of the languages concerned strongly influences the outcome of the comparison. Further, the finding of overall differences between the languages in the Spencer study includes an analysis of lexical diversity using *VocD*. Berman and Verhoeven (2002) identify a clear developmental pattern, with the major difference to be found between the junior-high students (i.e. 13-year-olds) and the high-school students (i.e. 17-year-olds). They conclude that schooling is important not only for overall text length and syntactic development (as is shown by the increase with age in the number of word tokens and in MLU) but also for lexical variation. They further report a language difference in that the French and Hebrew texts have relatively small differences between age groups. No gender differences are found. The differences between text types reported include a genre effect, showing that lexical diversity is greater in expository texts. There is also a significant interaction of genre and modality, but no main effects of modality. This demonstrates, according to Berman and Verhoeven, that genre is more important for the development of lexical diversity than modality.

### 10.2.1 Definition and calculation of lexical diversity in this study

To conclude, there are several ways of comparing lexical diversity between texts of different lengths. So far, VocD seems to be an accurate instrument to use, in spite of the criticism from McCarthy and Jarvis (2007). It may be worth noticing that, in general, the texts of the Spencer data fall in the length range of 100-400 words. In this range, according to McCarthy and Jarvis, the D measure is the second-best one (information about mean text lengths in number of word tokens is given in Table 8.1 on page 87). Consequently, the D measure will be used for the calculations and comparisons of lexical diversity below.

Lexical diversity was calculated using the D measure as implemented (as VocD) in the CLAN programs. Since it can only be calculated for texts longer than 50 words, a few texts which were shorter than that could not be analysed. These were ten in total, all found among the texts produced by 10-year-olds: three in narrative spoken, three in expository spoken, and four in narrative written.

## 10.3 Lexical density

Lexical density is the term most often used to describe the proportion of content words (nouns, verbs, adjectives, and often also adverbs) to the total number of words. A text with a high proportion of content words contains more information than a text with a high proportion of function words (prepositions, interjections, pronouns, conjunctions and numerals). Therefore, lexical density says something about *information packaging*.

Various measures of lexical density have been used. A popular one is to divide the number of nouns with the total number of tokens in the text, which is called *noun density*. Other options include verb or adjective or adverb types relative to all lexical words. Various options are described and discussed in Wolfe-Quintero et al. (1998).

One case where noun density has been used is Einarsson (1987). He investigates two large Swedish corpora of written texts (comprising about 175 000 words from various printed (expository) texts, with a selection of essays written by high-school students) and spoken texts (comprising 300 000 words from interview data, as well as debates and discussions). To compare lexical density in the two modalities, he calculates on the one hand the number of nouns per 100 words, and on the other hand the number of pronouns per 100 words. His conclusion is that the noun ratio is higher in writing than in speech and, vice versa, that the pronoun ratio is higher in speech. This confirms his hypothesis that writing is less context-bound than speech, and that greater use of nouns is therefore necessary in writing in order for the writer to convey her message. By contrast, pronoun use is greater in the spoken condition, where both speaker and listener can use pronouns to refer to objects in their shared surroundings (Einarsson, 1987). This study confirms that modality is important for how lexically dense a text is.

In introducing the concept of *lexical density*, Ure (1971) distinguishes between words with lexical properties and words without them. According to Ure, items that



do not have lexical properties can be described “purely in terms of grammar” (Ure, 1971, p. 445), meaning that such words (or items) possess a more grammatical-syntactic function than the lexical items. Lexical density is then defined as the total number of words with lexical properties divided by the total number of orthographic words. The result is a percentage for each text in the corpus. Ure finds that the large majority of the spoken texts have a lexical density of below 40%, while the vast majority of the written texts have a lexical density of 40% or higher. One remark to be made in relation to this is that these numbers ought to be highly language-dependent – a language with more bound morphology would probably have a higher proportion of lexical items.

In a later article, Ure defines lexical density as “the proportion of words carrying lexical values (members of open-ended sets) to the words with grammatical values (items representing terms in closed sets). Since *all* words have grammatical values, this is a part : whole relation” (Ure and Ellis, 1977, p. 207). Ure as well as Ure and Ellis correctly maintain that the matter of lexicality is important when discussing the concept of lexical density. Traditionally, nouns, verbs and adjectives are the three parts of speech or word classes considered to have lexical properties (although neither Ure (1971) nor Ure and Ellis (1977) explicitly state this). These parts of speech are often called *content words* or *open-class words* (because they are open to new members), while the more grammatical ones are called *closed-class words* (new prepositions and pronouns, for example, are rare).

The concept of lexical density is developed and further refined by Halliday (1985). He points out the importance of discriminating between lexical items and grammatical items. An ‘item’ may consist of more than one word. Thus, Halliday counts ‘turn up’ as one lexical item, while Ure (1971) counts this as one lexical item (‘turn’) and one grammatical item (‘up’). A lexical item is defined by Halliday as an item that “function[s] in lexical sets not grammatical systems: that is to say, they enter into open not closed contrasts” (Halliday, 1985, p. 63). The lexical item is part of an open set, which can be contrasted with a number of items in the world. A grammatical item, on the other hand, enters into a closed system, according to Halliday. A characteristic property of the grammatical system is that the (word) classes belonging to it have a fixed set of items and that it is (almost) impossible to add new members.

According to Halliday, child language gives evidence for the existence of two classes, one with lexical and one with grammatical items. At the beginning of their linguistic development, children often construct sentences where all grammatical items are missing, which would be once evidence of there being words of (at least) two categories. Halliday further emphasizes that there is a continuum from lexis to grammar, and that there are – and always will be – intermediate cases. For instance, he claims that English prepositions and certain classes of adverbs are on the borderline between the lexical and the grammatical. The adverbs that he gives as an example are the *modal adverbs*, such as ‘always’ and ‘perhaps’. The important thing when comparing, say, speech and writing is to be consistent in drawing the line between “lexical” adverbs and “grammatical” adverbs; exactly where the line is drawn matters less.

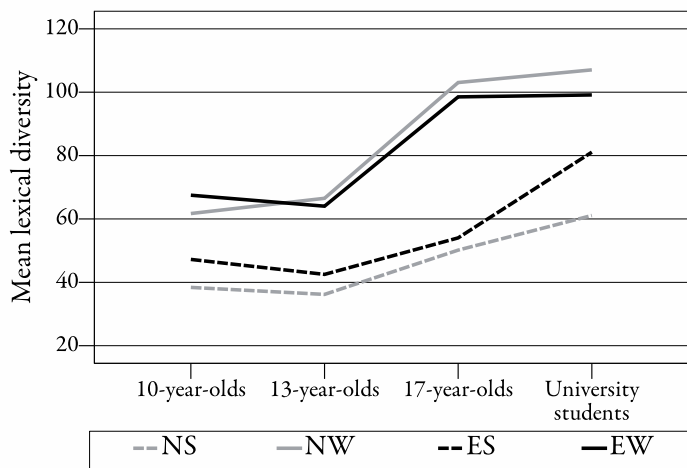


Figure 10.1: Lexical diversity broken down by age group and text type

The definition of lexical density given by Halliday is thus “the number of lexical items, as a proportion of the number of running words” (Halliday, 1985, p. 64). The difference between Halliday’s and Ure’s definitions of lexical density is that Halliday includes some adverbs in the class of lexical items.

Other variations on the theme of lexical density are in use today. For instance, Geijerstam (2006) uses two measures of lexical variation (or diversity): the number of nominal referents divided by the number of verbs, and the number of referential types per token.

### 10.3.1 Definition and calculation of lexical density in this study

This study follows Halliday’s definition of lexical density. Thus, the grammatical adverbs are included among the closed-class items, while non-grammaticalized adverbs (including all adverbs derived from adjectives) are counted as lexical items. Lexical density was calculated by dividing the number of lexical items by the total number of words in each text.

In this section I will present the results from the statistical analyses, and discuss the implications of each result.

For the statistical analyses I have used Anovas with modality and genre as within-subject factors, and gender, order and age as between-subject factors. Significant interaction effects were followed up by analyses of simple main effects. Post hoc comparisons were made according to Tukey’s HSD procedure. Effect size is partial  $\eta^2$ . Correlation coefficients were calculated to compare the two lexical measures.

Table 10.1: **Lexical diversity (VocD):** Means broken down by age group and text type

Text type	10-year-olds	13-year-olds	17-year-olds	University students
NS	38.39	36.1789	50.165	61.1105
NW	61.72	66.5158	103.065	107.0474
ES	47.23	42.5105	54.015	81.1053
EW	67.49	64.0316	98.54	99.1474

### 10.3.2 Lexical diversity: results and discussion

There is a clear trend for lexical diversity to increase with age and to be higher in the written condition. Table 10.1 shows the means for each age group and text type. In Figure 10.1 the same means are shown graphically. From the figure it is obvious that the difference between speech and writing is striking for all age groups, independently of text type.

When analysing lexical diversity, two significant four-way interactions were found: of modality, genre, age and gender ( $F(3, 41) = 3.291, p = 0.030, ES = 0.194$ ) and of modality, genre, age and order ( $F(9, 41) = 2.294, p = 0.034, ES = 0.335$ ). There was also a significant three-way interaction of modality, genre and age ( $F(3, 41) = 5.593, p = 0.003, ES = 0.290$ ), and two two-way interactions of modality and genre ( $F(1, 41) = 15.829, p = 0.000, ES = 0.279$ ) and of modality and age ( $F(3, 41) = 9.982, p = 0.000, ES = 0.422$ ). Finally, there were two main effects: of genre ( $F(1, 41) = 5.968, p = 0.019, ES = 0.127$ ) and of modality ( $F(1, 41) = 365.341, p = 0.000, ES = 0.899$ ).

**Gender differences** Exploration of the gender effect with pairwise comparisons as well as simple main effects looking at age, modality and genre, respectively, did not yield any significant values. For further discussion about gender differences, I refer to Section 12.7 of the final chapter.

**Order differences** Further investigation of the order effects for age show that they consist only in a difference between the university students' spoken expository texts. VocD means for each order in the adults' spoken expository texts are displayed in Table 10.2. From this we can see that the participants beginning with their expository texts (i.e. Orders C and D) have much higher lexical variation in their expository texts than the participants beginning with their narrative texts (i.e. Orders A and B). But could this also indicate that persons beginning with the narrative texts have a more relaxed way of approaching the expository tasks? However, it may be noted that when we investigate the order differences on the age level, the number of participants in each cell is really very small.

**Modality differences** The written texts always have higher lexical diversity than the spoken texts. This holds true for all age groups and genres, confirming all previous investigations of this measure. It is simply much easier to vary your linguistic

Table 10.2: Lexical diversity (VocD) Means for spoken expository texts, for the university students. Broken down by order

Order	University students
A	61.653
B	63.250
C	93.894
D	107.984

expression when you have more time to think about different ways of saying things. But a more important explanation is that the written condition actually requires more lexical diversity. When speaking you can use the word *this* and refer with a gesture to the table in front of you; this is completely impossible in writing if you want the notion of ‘table’ to get across to your reader. This need for linguistic clarification in writing thus fosters greater lexical diversity.

**Genre differences** For genre, there are some interesting effects. First, there are no differences between the genres in writing. Second, in their spoken texts, the 10-year-olds, the 13-year-olds and the adults all have significantly higher diversity in the expository texts than in the narrative ones, while the 17-year-olds’ spoken texts do not differ significantly between genres. I will address the issue of the 17-year-olds in the following paragraph, which deals with age differences.

However, it is interesting that genre differences show up mainly in speech and not in writing. It may be that the expository task stimulates a more varied lexicon, since the participants were invited to talk about the themes addressed in the film. The elicitation video may in that sense help the speaker by activating a more varied lexicon (although no words were used in the film). On the other hand, it may be that the narrative scheme of the personal story leads to greater use of (personal) pronouns, which would yield a lower lexical diversity.

**Developmental differences** We observe a strong developmental trend for this measure. However, the development differs between the text types. In writing, we find the now well-known division, with the 10-year-olds and 13-year-olds at one end of the scale and the 17-year-olds and the university students at the other. The huge development in lexical variation thus takes place somewhere between 13 and 17 years of age.

By contrast, the developmental trend looks different in speech. Development there is both more drawn-out and more stepwise in nature. In the spoken narrative texts there are, again, no differences between 10-year-olds and 13-year-olds, and both groups have lower lexical density than 17-year-olds. However, the university students show higher lexical variation than any other group. In the spoken expository texts, the 10-year-olds differ only from the university students, while the 13-year-olds differ from both the 17-year-olds and the university students.

This illustrates, again, that the conditions and constraints of spoken discourse make it difficult to use a varied vocabulary. It is easier to re-use the words that have already been used before than to come up with synonyms or other alternative ways of expressing the same thing (cf. Kress, 1982). While the 17-year-olds and the adults are equally good in writing, the 17-year-olds cannot compete with the university students in speech. One interpretation is that, because of their experience with reading and writing (in many genres), the adults have integrated knowledge about text construction on all levels into their linguistic knowledge. This makes them able to draw on skills acquired in writing when they speak. The process would be akin to the one described for writing by, for example, McCutchen (2000, 2006), where the idea is proposed that more fluent text-production processes will free up working-memory resources. This extra working-memory capacity is what allows the writer to engage in higher-level processes, i.e. planning and organizing.

Compared with the university students, the 17-year-olds have not yet internalized knowledge of how to structure a speech, how to organize the topic, and how to express themselves. They thus use their working memory to cope with the task of organizing their speech on a global level, and they do not have any free resources for lexical variation. However, the fact that they are struggling with the global outline of the text at the same time as they are planning what to say could be a sign that they are developing into “knowledge transformers” (cf. Bereiter and Scardamalia, 1987; Kellogg, 2008).

What happens in the spoken expository is that the speaker is asked to give a speech that should include her opinions of events in the film she just watched. This requires juggling both memory (what scenes were there in the film?), interpretation (how do I generalize about the themes in the film?), content (what should I say about that theme?) and structure (how should I organize that in my speech?). All in all, there is a lot to think about, and it is important for the speaker to gain as much time for thinking (and planning) as possible. During the elicitation of the spoken texts, all participants were encouraged to take their time to think before they started speaking, if they wanted to. The 17-year-olds seldom, if ever, used this opportunity. Instead they started talking at once, and they hardly stopped to think while giving their speech. Instead they sometimes planned aloud, a habit which reduces lexical diversity since it includes much repetition. (It will in fact also reduce lexical density, since the repetition of many function words reduced the proportion of content words.)

Example 31 below will illustrate the strategy most often followed by the 17-year-olds. It shows the beginning of a spoken expository, and the first clause already illustrates the typical way of introducing a topic in speech – putting it at the end of a clause (*ja det [/] jag tar mobbning då* (‘yes it I will take bullying then [as an example]’). This gives the speaker the most time to think. In combination with interjection and disfluency (retracing with correction), this first clause gives a relatively long time to think before the content word *mobbning* (‘bullying’) is mentioned. Further, the first four clauses are almost completely dedicated to discussing the fact that the topic of the speech is bullying, and this discussion will in turn supply more time for the speaker to think about what she wants to say about bullying. Also, note the frequent use of expressions that will help the speaker in planning: *i och för sig*

(approximately equivalent to ‘come to think of it’), *jag tror/tror jag* (‘I think’), *jag tycker inte* (‘I don’t think’), as well as the strategically located pauses, most often occurring after an introducing subjunction, such as *att* (‘that’) or *för att* (‘because’).

- (31) SBJ: ja det [/ /] jag tar mobbning då.  
*SBJ: yes it I will take bullying then*  
 SBJ: för det är lättast # att prata om.  
*SBJ: because it is easiest to talk about*  
 SBJ: # i och för sig # det är roligast med fusket.  
*SBJ: come to think of it it is most fun with the cheating*  
 SBJ: ja ja jag får ta lite mer # allt möjligt.  
*SBJ: yes yes I have to include some more all kinds of things*  
 SBJ: # okej eh@fp # mobbning i skolan är väldigt # vanligt.  
*SBJ: okay eh bullying at school is very common*  
 SBJ: och jag tror.  
*SBJ: and I think*  
 SBJ: att # de flesta jag känner har # eller är [/ /] nej < de är> [/ /] de flesta är inte mobbade.  
*SBJ: that most people I know have or is no they are most of them are not bullied*  
 SBJ: för att # när man kommer på gymnasiet.  
*SBJ: because when you come to high school*  
 SBJ: så # tror jag.  
*SBJ: then I think*  
 SBJ: man accepterar andra mer.  
*SBJ: you will accept others more*  
 SBJ: än vad man gör i högstadiet.  
*SBJ: than what you do in junior high school*  
 SBJ: # men jag tycker inte.  
*SBJ: but I don't think*  
 SBJ: det borde vara så.  
*SBJ: it should be that way*  
 SBJ: för att # det är inte # rätt.  
*SBJ: because it is not right*  
 [wh06fBES]

### 10.3.3 Lexical density: results and discussion

Table 10.3 presents means for lexical density broken down by age group and text type. Figure 10.2 gives a graphic overview of the same data. Just as for lexical diversity, the graph of lexical density shows a difference between the spoken and the written texts, independently of genre. We also find a trend for lexical density to increase with age.

When analysing lexical density, we find two two-way interactions of modality and age ( $F(3,47) = 3.205$ ,  $p = 0.032$ ,  $ES = 0.170$ ) and of genre and age ( $F(3,47) = 3.333$ ,  $p = 0.027$ ,  $ES = 0.175$ ). There are also three main effects: of modality ( $F(1,47) = 789.269$ ,  $p = 0.000$ ,  $ES = 0.944$ ), of age

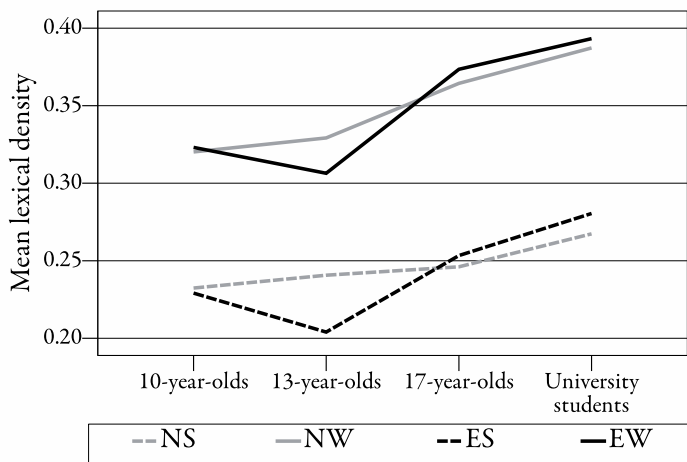


Figure 10.2: Lexical density broken down by age group and text type

( $F(3, 47) = 20.434, p = 0.000, ES = 0.566$ ) and of gender ( $F(1, 47) = 4.744, p = 0.034, ES = 0.092$ ).

**Gender differences** The gender difference consists in the female participants having lower lexical density than the males. It is difficult to interpret this result, and considering that the effect size is very small we can only speculate about what it means that the females have a higher proportion of function words. There is no other factor interacting with gender, which means that we cannot explain it simply by reference to, for example, a general tendency for women to be more social in speech. Perhaps one interpretation could be that the female participants are better at creating coherence by using pronouns and conjunctions, and maybe they also talk about things from a more personal perspective (with more instances of *I think*, etc.). We have to conclude that this would be an interesting starting point for further investigation and refer to the general discussion about gender in the conclusions in Section 12.7 on page 181.

**Modality differences** Like for lexical diversity, the modality effect is huge. Lexical density is extremely much higher in writing than in speech. This can be explained by reference to the different constraints on the two modalities. The mechanisms causing the increase of lexical diversity are much the same as those that explain the increase of lexical density in writing: the spoken condition facilitates the use of pronouns, since the speaker and listener share the same context. The time constraint of having to produce the message quickly in speech further prompts the use of easily accessible, highly frequent lexical items. In addition, the spoken condition calls for a variety of social expressions, which are beneficial not only to the speaker (buying

Table 10.3: **Lexical density:** Means broken down by age group and text type

	10-year-olds	13-year-olds	17-year-olds	University students
NS	0.23	0.241	0.2465	0.2668
NW	0.32	0.33	0.3635	0.3874
ES	0.23	0.204	0.253	0.2805
EW	0.32	0.307	0.3865	0.3942

her time to think and plan) but also to the listener, by helping to introduce the topic and giving time to process what the speaker has said. It is also worth noticing that in most cases it would be highly uneconomical to include many of the typical spoken expressions in writing, since they would only take time to write and fill no function in the text.

**Genre differences** There are not many genre differences for lexical density, but, as can be seen from the big dip for the expository texts in Figure 10.2, the 13-year-olds have greater density in narrative texts, independently of modality. I would suggest that this is a developmental indication of the 13-year-olds' struggle with the expository genre. One interpretation is that they are aware of what it is that they are required to do when told to give a speech or to write an essay, but that they are not (yet) capable of actually performing the task. Their texts are, indeed, not very lexically dense from an impressionistic perspective either. Example 32 is a *complete* spoken expository text by a 13-year-old boy. The boy is clearly struggling to create coherence. The text is almost incomprehensible if you have not seen the film and heard the elicitation question.

- (32) SBJ: ja att till exempel # när de ska ta sådana här skolfoton.  
*SBJ: yes that for example when they are going to take these kind of school photos*  
 SBJ: # och inte han får # komma med där.  
*SBJ: and he is not allowed to be part of it*  
 SBJ: # att eh@fp # ja det är ju inte så bra.  
*SBJ: that eh yes that is not too good*  
 SBJ: och eh@fp # läraren borde ju se det.  
*SBJ: and eh the teacher ought to see that*  
 SBJ: # så han kan ju prata med dem.  
*SBJ: so he can talk to them*  
 SBJ: och eh@fp # så att alla får vara med och # ja.  
*SBJ: and eh so that everybody can join and yes*  
 [wj14mCES]

**Developmental differences** When we look at the spoken texts, we can conclude that the proportion of content words is very stable, independently of age and genre. However, two things are interesting: there are no age differences in narrative spoken texts; and in the spoken expository, the university students differ from all the other



groups. Apart from this, there is also the dip for the 13-year-olds, which makes their texts significantly less lexically dense than the 17-year-olds' texts. The cause of this dip is discussed above, under genre differences, so here we should instead discuss the importance of the adults' higher density in their spoken expositories. One suggestion is that they are able to plan with less use of repetition and "empty expressions" to buy them time to think, which is the strategy employed by the 17-year-olds. This would then be something that they have acquired from their greater experience with written language – both as readers and as writers. If we compare Example 33, from a male university student's spoken expository, with Example 31, which is a spoken narrative by a 17-year-old girl, we find that the adult uses much less hesitation and repetition (which, to the extent that the words repeated are function words, will decrease the proportion of lexical items in the text) but uses lexical items more. (Also note that this is a person from Order C, who thus started with the spoken expository and has not been helped by a previous writing session on the same topic.)

- (33) SBJ: dagens ungdomar de har det inte lätt [!].  
*SBJ: the youth of today they don't have it easy*  
 SBJ: det finns många problem.  
*SBJ: there are many problems*  
 SBJ: och jag skulle vilja exemplifiera med några [!] som för mig [!] betyder mycket och sedan kunna avsluta det hela med # ansvarsfrågan [!].  
*SBJ: and I would like to exemplify with some that to me mean a lot and then be able to conclude it all with the question of responsibility.*  
 [ws11fCES]

In the written texts, we see a another picture. In the expository texts, we find the well-known pattern of differences between the two youngest groups and the two oldest. In the narrative texts, on the other hand, while the 10-year-olds differ from both the oldest groups, the 13-year-olds differ only from the university students. I would like to interpret this as indicative of development: the 13-year-olds have not yet developed far enough to differ from the 10-year-olds, but they have come far enough not to differ from the 17-year-olds. They are thus in some kind of a transitional state.

## 10.4 Comparison of the measures

Figure 10.4 displays the correlations between the two lexical measures. As we can see, the measures are in many ways highly correlated – but what does the correlation or lack thereof actually mean? If an age group manages both to produce a very dense text and to attain high lexical variation, there will be a correlation. On the other hand, we will also find a correlation for the age groups with little lexical variation and a high proportion of function words. Therefore we have to look at the previous results in order to interpret the correlations.

For the narrative written texts, we can conclude that both 17-year-olds and university students manage to produce both lexically dense and varied texts, while the 13-year-olds and the 10-year-olds have more dense than varied texts. This could

indicate a general tendency that variation in the lexicon requires more working-memory capacity than the use of lexical items. In the narrative spoken texts, this is even more salient. There are no correlations in any age group, and the texts seem to be more dense than diverse. Thus, to create a coherent text, the speakers need to provide enough information, which they do by using a certain amount of nouns and verbs. But the more severe constraints of the spoken condition make it more difficult to vary the nouns and verbs that they use, which leads to low diversity.

In the expository written texts, the lexical measures correlate for the texts produced by the 13-year-olds and the 17-year-olds, but this is not the case for the university students and the 10-year-olds. Both these groups seem to have a higher increase in density than in diversity. This would also indicate that, from a developmental perspective, you start using more content words before starting to vary your vocabulary. The first can be done by replacing pronouns with nouns (as may be the case for the 10-year-olds) or by adding more adverbs or adjectives (as may be the case for the university students). This is easier to do than to vary the lexicon (to exhibit a varied lexicon, in fact, the sender will usually need to use even more lexical items).

In the expository spoken texts, the measures are correlated for the three youngest age groups, but not for the university students. Instead the members of this group seem to increase their lexical diversity but produce lexically less dense texts. We already know that the adults have the most diverse expository texts, and we have suggested that this has to do with their being better at meeting the time constraints of planning what to say while the speaker is listening. They are relaxed in taking the time to think before they speak, instead of producing sentences that will force them to think while speaking. This, of course, will increase both measures.

## 10.5 Conclusion

This study has shown that although both lexical density and lexical diversity can be used to account for modality differences and developmental differences, a closer analysis where both measures are used on the same material reveals that they are not interchangeable and that one or the other measure (if it is impossible to use both) should be selected depending on what you want to find out.

For instance, lexical diversity is more sensitive to genres, which is also one of the conclusions drawn by Berman and Verhoeven (2002), who investigate the data from the international Spencer Study. Lexical diversity also exhibits some very complicated order effects, which may indicate influences exerted by one genre on another rather than modality influences.

From a developmental perspective, lexical diversity shows a more drawn-out trend in the spoken condition while the density measure seems to give more insights at least into narrative written texts. This suggests that lexical diversity is a better measure if the aim is to detect differences between age groups. These differences also indicate that there may be a developmental order between lexical density and lexical diversity, where the former will increase before the latter.

Two main explanations have been proposed in the discussion of the differences between groups in this study. One is the inherent differences between speaking and

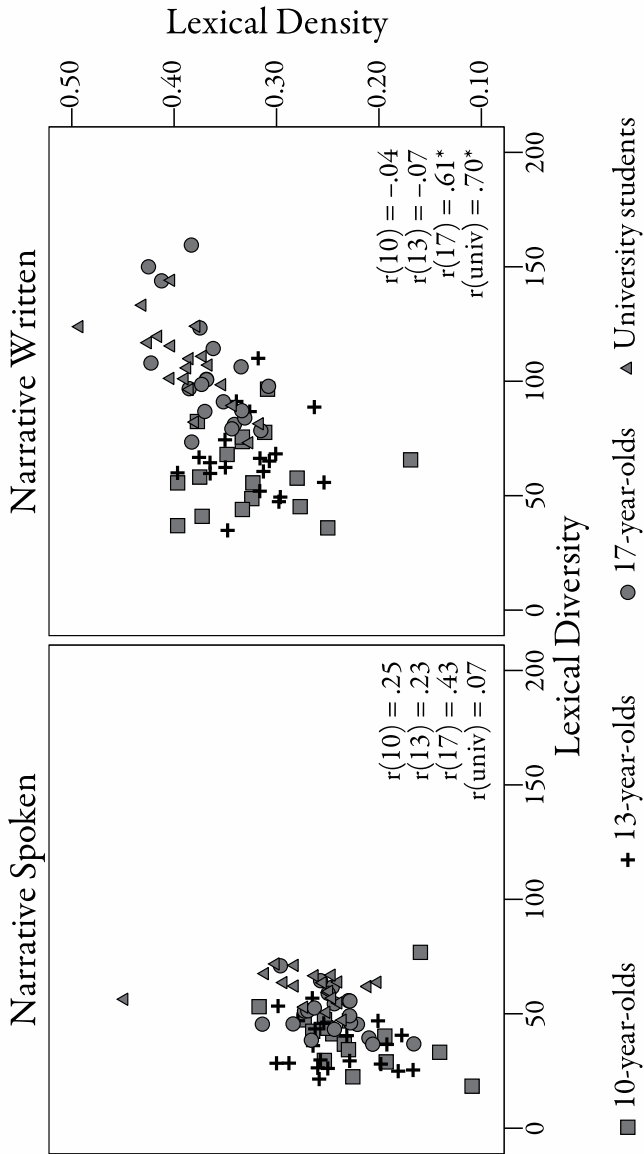


Figure 10.3: Correlation between lexical diversity and lexical density in the narrative texts, broken down by age group and text type. The correlation coefficients are displayed in the graphs, with a \* indicating that the coefficient is significant

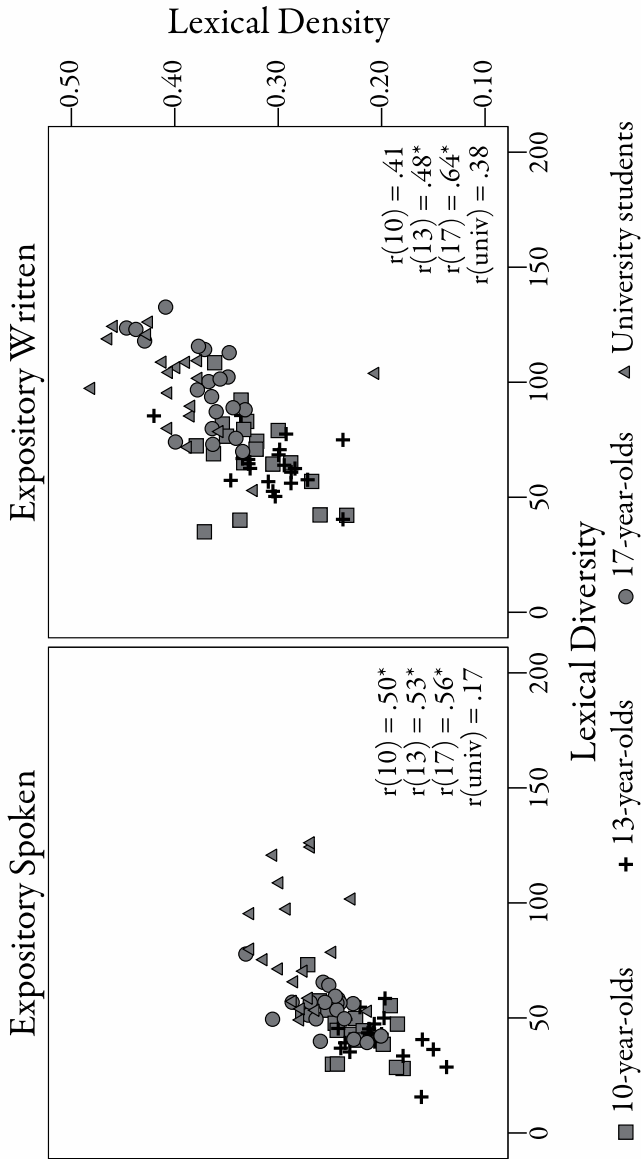


Figure 10.4: Correlation between lexical diversity and lexical density in the expository texts, broken down by age group and text type. The correlation coefficients are displayed in the graphs, with a \* indicating that the coefficient is significant

writing. Texts in the former modality are less dense because it is possible for the speaker and listener to create a common context, which will make it possible for the speaker to use pronouns instead of nouns, thus easing the burden of lexical retrieval. But the spoken condition also poses problems in that the speaker must constantly say something in order not to lose the floor. This creates a complicated task, where the speaker may produce “empty phrases” just to fill the silence while she is thinking.

This first explanation ties in nicely with the second, the one about working-memory capacity. With increased knowledge of genre and text type, more capacity can be used for higher-level processes such as global planning of the text, creating coherence, expanding content and varying the language. The 17-year-olds apparently have this cognitive capacity in writing, but in the more constrained spoken context their lack of experience leads to less ability to vary their language, compared with the university students. We can observe much the same trend for the 13-year-olds, in the text types where there are differences between them and the 10-year-olds.

# Chapter 11

## Global pause patterns

### 11.1 Introduction

Today's writing researchers would generally agree that pausing during language production may reveal something about the cognitive effort behind the production of a text. This was already proposed by Goldman-Eisler (1968), who studied pauses in speech. After the introduction of the planning process in Hayes and Flower's (1980) model, pause studies came to play an important role in the exploration of planning during text writing (cf. e.g. Matsuhashi (1981); Chanquoy et al. (1996) and the historical overview in Spelman Miller (2006b)).

Goldman-Eisler (1968) was one of the first to propose that pauses can reflect the amount of planning in language production. She used pauses to investigate planning in speech and was able to show that pausing in spontaneous speech varied with regard to both the pressure of social interaction and the difficulty of verbal tasks. She further found that there were individual differences in the length and distribution of pauses and that the situation type determined the length and distribution of pauses. Further, she found that pauses in spoken discussions never exceeded 3 seconds (in fact, in 99 % of cases they were shorter than 2 seconds) and, finally, that familiarity with the verbal material reduced both pause time and pause frequency (Goldman-Eisler, 1968, p. 15). When she investigated hesitation pauses, she concluded that the pauses were rarer (measured in the number of words uttered without a pause) when the speech was prepared, but even then it was uncommon to find as many as 10 consecutive words without a pause. There were also individual differences in how often people paused during speech.

Many (or even most) of the pause-time studies using keystroke logging or audio/video recordings, with or without thinking-aloud protocols, have focused on the distribution of pauses. That is, where do the writers feel a need to pause? The general findings suggest that pausing is most likely between paragraphs and less likely within words or between words within a syntactic unit (e.g. a noun phrase) (Nottbusch, 2009; Chanquoy et al., 1990, 1996; Van Waes and Schellens, 2003; Matsuhashi, 1981, 1982; van Hell et al., 2008; Strömquist, 1996; Holmqvist et al., 2004b, e.g.). This is consistent for writers without any disabilities who are producing texts in their first language, but differences compared with this pattern occur when we

look at writing in other groups (e.g. Wengelin (2002) finds more word-internal pausing in texts written by persons with reading and writing difficulties).

Alamargot and Chanquoy (2001) summarize the underlying assumption behind the analysis of pause duration during text writing in on-line studies by saying that longer pause durations indicate that the ongoing processes are more complex. Alves et al. (2007) describes the various functions of pauses that have been proposed in the literature. The most widespread interpretation is that pauses occur because of competition for limited processing capacity (proposed e.g. by Just and Carpenter, 1992). Another reason for pausing is that the execution of a motor skill like typing (i.e. a low-level process) competes with high-level processes like planning and revision (e.g. Pashler, 1993; McCutchen, 1994). And a third suggestion is that pauses occur because the outcome of the processing of one task conflicts with the processing required for another task (proposed by Navon and Miller, 1987). Torrance and Galbraith (2006), finally, propose that pauses may occur because of memory decay.

Several studies have addressed the issue of pausing and planning. I will here present a small selection, chosen because they are in one way or another relevant to comparisons with the current data, for example because they compare children and adults, contrast writing in different genres, or both.

Assuming that the cognitive planning processes during the production of written texts are reflected in pauses, Matsuhashi (1981) investigated pausing and planning in the writing of four skilled writers who produced texts of different types. She looked into pauses occurring in connection with various grammatical and syntactic units, concluding that the level of abstraction plays an important role for the writer's planning time. A writer typically needs more time to plan highly abstract sentences when producing a discourse with generalized writing, compared with a discourse type rather characterized by reporting. The conclusion is that writers think and plan differently depending on the type of discourse they produce. Matsuhashi (1982) used a video-recorded writing session immediately followed by a retrospective interview with one writer to discuss the pause pattern. She concludes that there is no correspondence between grammatical units and planning. Instead, planning correlates with psychological processes. Second, she claims that during long pauses, which can be spent gazing and/or re-reading, the writer is engaged in planning on both a global and a local level, and this planning is characterized by multiple decision-making.

Chanquoy et al. (1990) let groups of 8- and 10-year-olds and adults write down text endings to beginnings in narrative and descriptive genres. They concluded that the mean duration of pauses between propositions was longer in the descriptive than the narrative endings both for 10-year-olds and for adults, but not for 8-year-olds. Chanquoy et al. investigated pause duration at linguistic boundaries, i.e. pauses after grammatical and syntactic units such as paragraphs, sentences, clauses, phrases and words, in texts written by 10 adult university students. Their results showed that pause duration varied depending on the extent of the following unit. The longest pauses were connected with the highest syntactic units while the shortest pauses were found in connection with clauses and phrases as well as between or within words. They conclude that "the cost of the most important processing in

the unit production would be localized at the beginning of these units” (Chanquoy et al. (1996), p. 42).

van Hell et al. (2008) explicitly link expository text writing with the notion of knowledge-transforming in Bereiter and Scardamalia (1987). They let children (fourth-graders) and adults write complete texts, one narrative and one expository (following the Spencer design) and hypothesized that pause duration would vary as a function of syntactic location independently of the age group. However, they expected that overall pause duration would not vary between the genres in the children’s texts whereas the adults’ texts would have longer overall pause durations in the expository genre. They found that the mean pause duration was longer for fourth-graders than for adults, but there was no main effect of genre. When comparing the genres within each age group, the pauses in the adults’ expository texts were longer than in the narrative texts. No equivalent genre difference was found in the fourth-graders’ texts. The authors further report that both children and adults in their study, independently of genre, pause for significantly longer before clause-initial words than before clause-internal words.

### 11.1.1 The aim of this study

In this chapter, I will not be concerned with the actual location of individual pauses. Instead I will address the question of differences in pausing behaviour depending on the text type, or genre, that the writer is producing. This will be done by means of an investigation of the global pause patterns, i.e. the variation in pausing throughout a whole writing session. I expect genre-inherent characteristics to influence text production.

## 11.2 Genres in development

In the overview of genre and writing development in MacArthur et al. (2006), Donovan and Smolkin (2006) conclude that “early and continued experience with different genres provides a foundation of knowledge about those genres from which children draw when reading, writing and discussing different genres” (Donovan and Smolkin, 2006, p. 139). However, more research is needed to determine whether there are specific age spans within which children should preferably be exposed to certain genres. In fact, the same thought is proposed in Piolat et al. (1999), where it is concluded that the development of argumentative schemas is acquired over a long period of time. A study by Englert et al. (1988) looked at written-text production on micro- and macro-levels in three types of text structures, or genres, of which one was the expository, in texts written by third- and sixth-graders. The study found that writers become better with age in their ability to compose expository structure, as evidenced in the generation of superordinate and subordinate statements. The overall results suggest that text-structure knowledge depended on the children’s ability to structure and organize their texts. Fitzgerald and Teasley (1986) instructed fourth-graders in narrative structure and found that this had a positive effect on their story-writing, which also indicates that exposure to a specific genre will enhance the ability to perform in that genre.



Research from intervention studies of writing (e.g. summarized in Rijlaarsdam et al., 2008) also indicates that children are able to take in knowledge of what a good text is by making observations of various kinds (e.g. of readers thinking aloud while they are trying to comprehend a text written by the child, or by watching others solving tasks ) and then to apply some of this new knowledge to their own writing. These are all examples of how exposure to texts and strategies (of various kinds) helps you to learn more about a genre or about a specific way of producing text in a genre.

One conclusion drawn from all these studies is that genre knowledge is an important factor for performance in a specific genre. The adult's longer experience with reading, writing, listening and speaking in a variety of genres will have given her a larger repertoire enabling her to express herself in different situations. This would then suggest that pausing during writing would look different depending on the writer's experience with the genre.

### 11.3 What is a pause?

There are some problematic issues inherent in the study of pauses. One concerns the categorization of pauses into word-initial, phrase-initial and paragraph-initial ones and is addressed by Spelman Miller (2006a), who points out that it is important to refine the definition of word-level locations in pause studies, referring to many of the previous studies in the area. She exemplifies with the problem of how to classify a pause after a noun. That pause can be described as following a noun phrase, but what if the writer adds an apostrophe and an *s*, transforming the noun into a genitive? Then the pause was not phrase-final, after all. Spelman-Miller thus asks how we can account for the temporary status of a text being produced.

The other, more obvious, and perhaps more important, issue is what should be classified as a pause. As we know from the literature background in Chapter 9, pauses during computer writing do seem to reflect more cognitive effort and are not merely a result of writers having problems finding the right keys (e.g. Grabowski, 2008; Nottbusch et al., 2007; Nottbusch, 2009). However, the question of which pauses are due to low-level processes (e.g. problems finding the right key) and which are due to higher-level processes (e.g. planning, reading, revising) remains. (Not to mention the pauses that are the result of coffee drinking or of thoughts about text-external matters.) We thus need some means to define a pause.

Wengelin (2006) gives the most recent overview of how a pause in writing can be defined. According to her, most studies using pauses as a means to study cognitive processes stipulate a pause criterion that suits the aim of the study, and use the same criterion for all writers in the study. However, Wengelin likes to define the pause as a 'transition time between two keystrokes that is longer than what can be expected to be necessary for the time needed to merely find the next key' (Wengelin, 2006, p. 126). This means that each typist will need her own pause criterion, since a certain time between keypresses may well be a long pause for a fast typist but a (very) short pause for someone struggling to find the keys. The question is how to find out what is a normal pause time, or *transition time*, for a certain writer.

Since this question has not yet been resolved, the solution from Wengelin (2002) can be used. She argues (in line with, e.g., Jansen et al., 1996; Severinson-Eklundh and Kollberg, 1996) that the pause criterion should be set in a way that suits the aim of the research. One solution is to use ad hoc definitions. For instance, Strömquist defines the pause operationally as “keyboard inactivity longer than 5 seconds” (Strömquist, 1996, p. 27). Matsuhashi (1981) also uses an ad hoc stipulation when she decides to use a 4-second criterion as a cut-off point before content words, in order to include only longer pauses in her study. However, Matsuhashi’s 4-second criterion is a good match for the cut-off point between clauses, phrases and words on the one hand and paragraphs and sentences on the other as shown by Chanquoy et al. (1996). They analyse pauses in adult text writing and show that the mean pauses preceding syntactic units such as paragraphs and sentences are 17.3 s and 12.7 s, respectively, while the mean pauses preceding clauses, phrases and words are 2.8 s, 1.2 s, and 0.9 s, respectively. In a non-published pilot study investigating the context of all pauses longer than 5 seconds in the data in this thesis, a general observation was that very few pauses with the length of 3-5 seconds occurred in the data.

In this chapter, the concern is not only to exclude pauses mainly related to processes on the micro-level, but also to include pauses expected to reflect deeper cognitive processes during text writing. Therefore we have stipulated a pause criterion of 5 seconds, a criterion almost twice as high as the cut-off point in Chanquoy et al. (1996). With a criterion as high as that, it is more probable that the majority of the pauses examined will reflect the writer’s cognitive load.

## 11.4 Investigating pause patterns

One way for the researcher to explore data from a keystroke-logging program like ScriptLog is to look at the linear files, replay writing sessions and “get a feel” for what the data are like. How does a text grow on the screen? Where do people pause, and where do they edit, and what? (And why?) I think anyone who is interested in this field and has access to keystroke data should spend some time with this kind of examination, as a starting point for testing hypotheses and as a way to explore and get to know the data. When I engaged in this fascinating exploration, I found one striking thing, and that was how pause patterns seemed to vary depending on genres in my data sample, i.e. between narrative and expository texts. Since this was a finding on the global text level, I would like to exemplify with a whole text, and therefore this will be illustrated by texts from a 10-year-old boy. However, the pattern is found in many other texts, in all age groups. Let us start by looking at his narrative text in Example 34.

There are many interesting things to observe in this text. One is that the boy writes the whole text in capital letters. The other (although a little more unclear in the transcription here) is that he has a habit of pressing the space bar many times between words. A third thing is that he does not use punctuation, except for the last full stop (cf. Ledin, 2001). A fourth observation is that he is a very linear writer who corrects his writing (or spelling) errors immediately and does not make any final corrections in his texts, although the two pauses at the end lasting for 14.11

s and 44.50 s, respectively, may indicate that he reads through (parts of) the text. However, for the time being, this is not what I am interested in. Instead, I would like to discuss the pause pattern in this short text.

- (34) Linear representation of a written narrative text by a 10-year-old boy. Pauses longer than 5 seconds are indicated. (An English translation is found in Example 35.)  
[wg13mCNW]

```
<START><12.53>VI VAR <12.90> I<DELETE2> PÅ
ÅB<LEFT2>B<RIGHT3><DELETE>RÅSS<DELETE5>ORÅS <6.75>BAD HUS
<36.93>MIN KLASS KAMRAT <13.60>VILLE INTE HOPPA FRÅN
<6.18>HOPPTORNET <8.20>TVÅ <11.33>ANDRA KIÖÖ<DELETE2>LLAR
<6.38>SZS<DELETE2>A ATT HAN VAR FEG SOMM<DELETE>
INTEE<DELETE> HOPPADE JAG SA TILL <DELETE7>ATT HAN
BEHÖVDE <5.25><LEFT8>INTE <RIGHT8> HOPPA OM HAN INTE VILLE
<9.01> SEN GICK VI DÅR <6.65>IFRÅN<5.11> OCH
HAN HOPPADE INTE<14.11>.<44.50><CR><80.66>
```

- (35) English translation of the written narrative text by a 10-year-old boy in Example 34. Pauses longer than 5 seconds are indicated. The English is a little unconventional in places where I have found this necessary in order to ensure that it is comparable to the original Swedish text. Texts within square brackets are my additions to facilitate comprehension.  
[wg13mCNW]

```
<START>
<12.53>we were
<12.90> in<DELETE2> at åb<LEFT2>b<RIGHT3><DELETE>råss<DELETE5>orås
<6.75>bath house
<36.93>my class mate
<13.60>didn't want to jump from
<6.18>the diving tower
<8.20>two
<11.33>other guhh<DELETE2>ys
<6.38>szs<DELETE2>aid that he was a coward whoo<DELETE>
didn't<DELETE> jump I said to [them] <DELETE7>that he need
<5.25><LEFT8>didn't <RIGHT8> to jump if he didn't want to
<9.01> then we went away from
<6.65>there
<5.11> and he didn't jump
<14.11>.
<44.50><CR>
<80.66>
```

In Example 35, I have divided the text in Example 34 into lines based on the pauses. Each line begins with a pause, and I have taken the opportunity to translate

the text into English. The first thing that happened was that the experimenter pressed the *Start* button in ScriptLog. After this, the boy paused for 12.53 s before he started to write *vi var* ('we were'). This was followed by another pause of 12.9 s, before he wrote *i* ('in'), deleted this, and instead wrote *på* ('at'), after which follows the name of a Swedish town, *Borås*, which can indeed be tricky to spell as indicated by the many deletions and editing operation during the writing of this word.

If we analyse the pausing here, we find that almost all pauses are found at phrase or clause boundaries, exactly as we can expect from previous studies (see e.g. the overview in Spelman Miller, 2006b). Although I do not believe that you should in general assign too much importance to the interpretation of a single pause, I will discuss the exceptional pauses that are not found at phrase or clause boundaries in this short text. We find one exception in the phrase *två andra killar* ('two other guys'), with a long pause of 8.2 s before *två*, and another before *andra*, which may indicate that the writer is struggling with how to refer to the two villains of his story. Other outstanding patterns are the pause of 6.75 s in the middle of the proper name *Borås badhus* ('the bath house of Borås') and the pause of 6.65 s between *där ifrån* ('away from there') toward the end of the text. In both cases you could speculate whether the writer was thinking about alternative phrase endings, for example *vi var på Borås simhall* ('we were at the Borås Swimming Pool') and *vi gick iväg* ('we went away'). In the case of *Borås badhus*, you could also imagine that the writer is checking the final spelling of 'Borås', to judge whether it is correct or not.

- (36) Linear representation of a written expository text by a 10-year-old boy. Pauses longer than 5 seconds are indicated. (An English translation is found in Example 37)  
[wg13mCEW]

```
<START><24.93>_<DELETE>-<8.40><DELETE>det <LEFT3><DELETE>D<RIGHT3>
ringde <DELETE16><31.96>När en pratade med en <5.25>
<DELETE3>s kompis <34.15>utan att <14.55><DELETE56><9.63>
En kille ri<DELETE3>fuskade <5.41>när han ringde <15.51>.
när han hade pratatf<DELETE> <5.73>färdigt <9.85>fick
han inte ut det han hade fuskat med <6.38>.Han slängde
luren <CR>och <5.65>gick iväg.<CR><19.50> <21.95>
<DELETE3> det var fult gjort <7.13> <10.40>tycker
<6.31>jag .<CR> <9.63>Två <5.11>tjejer sitter på
en bänk en tredie <DELETE7>die ttttj<DELETE4>jej
kommer <17.56>. Dom två tjejerna som satt där
innan <18.38>reser sig och går.<13.78><CR><CR><8.96>
MER KOMMER JAG INTE I HÅG<LEFT4><XEDIT><RIGHT7>
<6.25><MOUSE ,45, 472>N<RIGHT14>
<DOWN6><32.36>
```

We further find that there are almost no pauses during the most dramatic part of the story, where the narrator tells about the interaction with the "bad guys". In fact, the only pause here is when the writer detects that he has forgotten to write *inte* ('didn't'), and moves back with the arrow keys to place *inte* in front of *behövde*

(‘need’). Finally, there are some long pauses at the end of the text, before the full stop (14.11 s) and after the full stop (44.50 s), which may indicate that the writer is reading through his text, before he presses the carriage-return key. The long final pause of 80.66 s is the time period during which he tells the experimenter that he has finished writing and the experimenter comes into the room to end the recording.

- (37) English translation of the written expository text by a 10-year-old boy in Example 36. Pauses longer than 5 seconds are indicated. The English translation is a little unconventional in places where I have found this necessary in order to ensure that it is comparable to the original Swedish text. Texts within square brackets are my additions to facilitate comprehension.

[wg13mCNW]

```

<START>
<24.93>_<DELETE>-
<8.40><DELETE>it <LEFT3><DELETE>D<RIGHT3> called <DELETE16>
<31.96>When one talked to one
<5.25><DELETE3>s buddy
<34.15>without
<14.55><DELETE56>
<9.63>A guy ca[lled]<DELETE3>cheated
<5.41>when he called
<15.51>. when he had talkedf<DELETE>
<5.73>finished
<9.85>he couldn't get out the thing he used for cheating
<6.38>.He threw the phone <CR>and
<5.65>went away.<CR>
<19.50>
<21.95><DELETE3> that was bad to do
<7.13>
<10.40>think
<6.31>I .<CR>
<9.63>Two
<5.11>girls are sitting on a bench a third <DELETE7>ird
ggi<DELETE4>irl comes
<17.56>. The two girls that sat there first
<18.38>raise and leav.
<13.78><CR><CR>
<8.96>I DON'T REMEMBER ANYMORE <LEFT4><XEDIT><RIGHT7>
<6.25><MOUSE ,45, 472>N<RIGHT14><DOWN6>
<32.36>

```

The expository text in Example 36 shows a different pause behaviour. It is obvious that the pauses in this case do occur in places other than between syntactic units. The text is divided into lines, each starting with a pause, and translated in Example 37. If we look at the pauses at the beginning of this text, we find some very long ones, in combination with a seemingly effortful text composition. On

the seventh line in Example 37, beginning with the pause of 14.55 s, we see that the writer also erases everything written so far (indicated by '<DELETE56>') and starts all over again. However, the writing is divided into many small text chunks in the following sentences as well. Compared with the narrative text in Example 35, there do not seem to be any phases during which the writer produces text with more ease. Instead, we find a constantly high cognitive load, indicated by pauses when the writer is trying to remember the scenes from the film (e.g. scene 5, on page 187 in the Appendix, when a boy gets angry with a broken phone booth), to describe the scene with the right words (*När en pratade med ens kompis utan att...* ('When one talked to one's buddy without...')) or *En kille fuskade när han ringde* ('One guy cheated when he called'), and to pass a moral judgment on this (*Det var fullt gjort* ('That was bad to do')).

I claim that this constant load is characteristic of the expository genre, where descriptions, opinions and judgements are required. This is also what fundamentally changes the pausing behaviour and what creates a different global pause distribution in the boy's two written tasks. I will illustrate the differences in pausing with two graphs. Figure 11.1 shows all pauses longer than 5 s in the narrative text in Example 34, in chronological order. The last pause is excluded from this graphic illustration. And Figure 11.2 shows all pauses longer than 5 s in the expository text in Example 36.

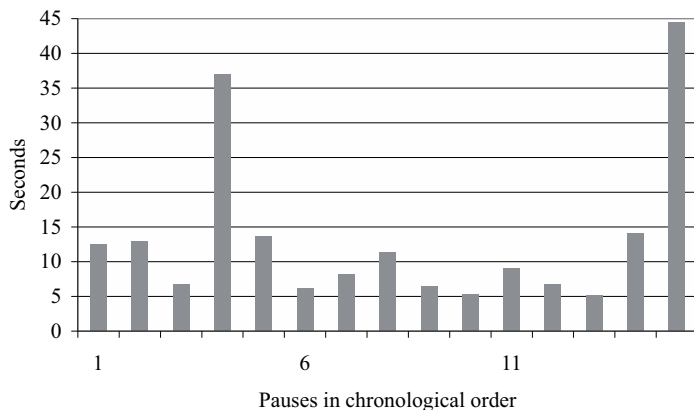


Figure 11.1: Pause distribution in the narrative text by a 10-year-old boy [wh13mCNW]. The pauses are presented in chronological order, excluding the very last pause. Only pauses longer than 5 s are shown. Note that the time elapsing between pauses may vary

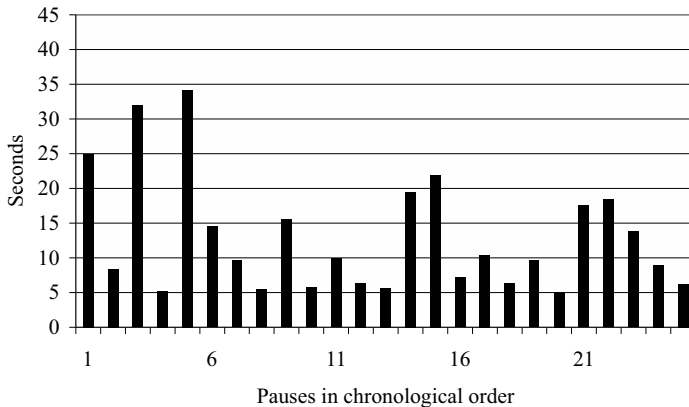


Figure 11.2: Pause distribution in the expository text by a 10-year-old boy [wh13mCEW]. The pauses are presented in chronological order, excluding the very last pause. Only pauses longer than 5 s are shown. Note that the time elapsing between pauses may vary

In Figure 11.2 we find the distribution of the pauses in the expository text by the same writer.

If we compare Table 11.1 showing the pause distribution in the narrative text with that of the expository text in Table 11.2, we will find some initial long pauses in the narrative text and also a long pause at the end of the text. In between there are several pauses lasting between 5 s and 12 s, most of them less than 10 s. In the display of pause length and distribution in the expository text in Figure 11.2, we instead find several pauses that are close to or longer than 15 s distributed throughout the whole writing session. In addition, there are particularly long pauses at the beginning of the text. Similar patterns are found when comparing the written texts in the two genres for many other participants.

## 11.5 Results

In this section I will present an investigation into the total pause time of each text, then describe how the texts were divided into segments, and finally explain how a comparison of pause time between segments was carried out. The methodology is presented in connection with each result.

Table 11.1: Mean proportion of pause time to total writing time in each text, broken down by age and genre. Pauses longer than 5 s included

Text type	10-year-olds	13-year-olds	17-year-olds	University students	Total
Narrative	0.38	0.35	0.30	0.29	0.33
Expository	0.36	0.36	0.29	0.32	0.33
Total	0.37	0.36	0.30	0.31	0.33

### 11.5.1 Statistical analysis

For the statistical analyses in this chapter I have used Anovas with genre as a within-subject factor and gender, order and age as between-subject factors. Significant interaction effects were followed up by analyses of simple main effects. Post hoc comparisons of significant main effects were carried out according to Tukey's HSD procedure. Effect size (ES) is partial  $\eta^2$  (cf. Section 6.7.1).

### 11.5.2 Proportion of pause time to total writing time

The obvious starting point for investigating global pause differences would be to compare the average time devoted to pausing in each writing session. This measure was obtained by dividing the pause time (including pauses longer than 5 s) by the total time spent on the task for each text. The last pause in each text was excluded.

Table 11.1 shows the mean proportion of pause time to total writing time in the texts, broken down by age and genre. Statistical analyses showed no genre differences. Nor were there any age differences. (There were also no gender or order effects.) This means that we found no differences regarding how much time the writers spent on pauses. Independently of age and genre, all writers paused for the same percentage of time during writing.

One explanation for this may be that the writer paused for equally long independently of the genre, but that there were differences in pause distribution that could not be detected when we considered the text as a whole.

### 11.5.3 Proportion of pause time in segments

Since no differences in pause behaviour were found either between the genres or between the age groups, I decided to try to investigate the pause differences in another way. To compare pause patterns between the written texts, we have to find a way to compensate for the varying duration of the writing session (cf. the discussion about comparing texts of unequal length in Section 9.6). To solve the problem, each text was divided into five equally long segments, i.e. each time segment consisted of exactly 20% of the writing time. This was done using the Pause Time Data file in ScriptLog (see Section 7.2.3.6 for a description) and the option of Partial Analysis, available in the PC version of Scriptlog (Strömquist and Karlsson, 2001). In settling on an ad hoc division of the writing time rather than basing the division on syntactic or rhetorical criteria, we made it possible to explore the dynamics of



Table 11.2: Mean proportions of pause time per total time in each segment, broken down by genre, segment and age. The first number in each cell is the proportion, the second is the standard deviation

Segment	10-year-olds	13-year-olds	17-year-olds	University students	Total
Expository texts					
SEG1	0.37 0.20	0.27 0.15	0.26 0.14	0.34 0.16	0.31 0.17
SEG2	0.35 0.20	0.32 0.20	0.25 0.13	0.25 0.12	0.29 0.17
SEG3	0.36 0.19	0.36 0.25	0.26 0.16	0.27 0.15	0.32 0.19
SEG4	0.36 0.17	0.40 0.23	0.31 0.15	0.32 0.17	0.35 0.18
SEG5	0.36 0.17	0.43 0.21	0.39 0.18	0.37 0.16	0.39 0.18
Narrative texts					
SEG1	0.34 0.22	0.33 0.26	0.30 0.17	0.30 0.18	0.32 0.21
SEG2	0.34 0.21	0.25 0.21	0.20 0.12	0.21 0.15	0.25 0.18
SEG3	0.29 0.15	0.33 0.21	0.20 0.13	0.23 0.18	0.27 0.17
SEG4	0.40 0.29	0.36 0.29	0.32 0.18	0.29 0.27	0.34 0.26
SEG5	0.46 0.27	0.45 0.29	0.48 0.23	0.44 0.27	0.46 0.26

pausing during text writing without considering linguistic cues. By counting the total pause time in each segment and then dividing it with the total time of the segment, we obtain a pause percentage time for each segment. These percentages makes it possible to compare the pause distribution on a global text level between different writers, independently of total writing time. It would also account for the variation in cognitive demands that the investigation of the pauses in the linear files had suggested.

Table 11.2 shows the mean proportion of pause time in all segments, for all age groups and genres. For each segment, the pause time (calculated as the sum of the duration of all pauses longer than 5 s in the segment) in relation to the total time of the segment was calculated. Table 11.2 shows the proportion of pause time in each segment, broken down by genre and age. The standard deviations for the percentages show rather high values but cannot be considered too high for the results to be valid.

The statistical analysis of the differences revealed a complicated pattern. There were both differences between the genres and differences between the segments, showing that there is indeed variation in pausing patterns between the two genres. However, it is worth noticing that there are no age differences. Thus, the differences in the global pause distribution during these writing sessions seem to apply to all writers, independently of age.

Figure 11.3 shows the pause-time distribution for all texts in the two genres. The statistical analyses showed a three-way interaction of genre, segment and order ( $F(12, 47) = 1.885$ ,  $p = 0.038$ ,  $ES = 0.107$ ). Post hoc analysis showed that the differences in segments occurred in Segment 1 and Segment 5. In Segment 1, the expository texts had a significantly smaller proportion of pause time in Orders B and D, and in Order C the expository texts had a larger proportion of pause time than the narrative texts. In Segment 5, the narrative had a larger proportion

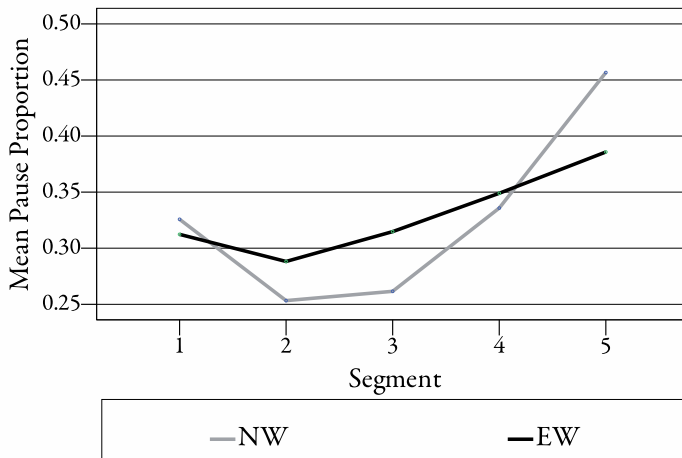


Figure 11.3: Pause time per segment in the written texts (pauses longer than 5 s included). The light grey line shows the distribution in the narrative texts while the black line shows that in the expository texts. The values refer to all age groups taken together

of pause time than the expository in Order B. This shows that the initial pausing during expository-text writing decreased when the writer had first performed the task orally (as is the case in Orders B and D, but not in C). The difference in Segment 5 is harder to explain.

Further, there was a two-way interaction of genre and segment ( $F(4, 47) = 3.832$ ,  $p = 0.005$ ,  $ES = 0.075$ ). Further investigation of this interaction showed that in Segment 3, the narrative texts had a smaller proportion of pause time than the expository texts; and that in Segment 5, the expository texts had a smaller proportion of pause time than the narratives. This is illustrated in Figure 11.3. One interpretation of the difference in Segment 3 is that, when writing the narrative texts, the temporal structure helped the writer to know what to write next, i.e. less planning was needed in the middle of the text writing. However, the non-temporal structure of the expository may call for constant planning. As regards Segment 5, the reduced pausing in the middle section of the narrative text may result in a more extensive editing phase toward the end of the writing session.

There was also a two-way interaction of segment and order ( $F(12, 47) = 2.381$ ,  $p = 0.007$ ,  $ES = 0.132$ ). Further investigation of this interaction showed that the participants in Order A had a significantly smaller proportion of pause time than those in Orders B and D. This may indicate that the writers in Order A needed less planning time because their written task was facilitated by the previous oral task. Having just performed the spoken narrative or expository text may help the writer

organize structure and content, thereby reducing pausing time. It is unclear why we do not find the same difference for Order C.

Finally, there is one main effect of segment ( $F(3,47) = 17.448, p = 0.000, ES = 0.271$ ). A closer look at this effect showed a complicated pattern. Segment 5 had significantly more pausing than Segments 1, 3 and 4. Further, Segment 1 had significantly more pausing than Segment 2. Segments 2 and 3 (apart from the other differences) had less pausing than Segment 4.

We are helped in the interpretation of this by looking at Figure 11.3. Initially, the writers have a long pausing time, probably in order to plan before they write. In the narrative task they will have to come up with a specific predicament to tell about, and in the expository genre they will have to recall the events in the film and preferably build some kind of general idea or theme about the content of the film. As was shown in the discussion of the order interactions above, the writers were helped in this if the oral task had preceded the written one. Further, as we look at the progression of the writing session, we find that Segments 2 and 3 have less pausing than Segment 4. This would indicate that once the writer has identified the topic for the text, writing proceeds with less need for pausing (suggesting that less planning and/or revision is needed). Toward the end of the writing session, however, there is again a need for reading and/or revision, as showed by an increase in pausing time.

## 11.6 Discussion and conclusion

As we can see from Figure 11.3, the curve for the narrative texts is much more U-shaped than that for the expository texts, indicating that the narrative texts had much pausing in the initial segment (where the writer may have engaged in much planning on what predicament to write about). Then the proportion of pause time decreases dramatically in Segments 2 and 3, where you could expect that the writer told the episodes of the narrative and that these episodes followed upon each other in chronological order; thus the writer was much helped by this when producing text, and there was less need for planning. As we saw from Example 35 this also seemed to be a writing phase with little editing. In Segments 4 and 5, the proportion of pause time increases, indicating long pauses for reading and editing.

The expository texts, on the other hand, show a flatter curve. In Segment 1 the pause time is somewhat higher, indicating an initial planning phase. But the pause proportion remains relatively high in Segments 2 and 3 as well. One explanation is that the writer is more constantly engaged in planning (and revision) activities during the production of the expository texts. One interpretation is that the structure of the expository, built on logical arguments, calls for constant pausing. This may also to some extent be because of the elicitation. The film showed several scenes, and it is clear from the texts that many of the participants treat the themes from the film one by one. The mere task of recalling may thus cause this kind of more constant pausing.

However, one interesting finding is the increasing pausing at the end of the writing sessions. The increase is steeper in the narrative texts, indicating both more reading and more editing (although we can of course not be sure what the writers

actually do). We could on the one hand imagine that the writers compensate for the low level of pausing in the middle of the writing session and engage more in editing by the end. This would be a good strategy, which could be interpreted as writers trying to find ways to ease the cognitive burden during text composition. In this case it would mean that you postpone editing and spelling correction until you have produced the more easily written part of the narrative core, i.e. the main event or predicament. Another way of interpreting the extensive pausing (and maybe editing) phase in the narrative is to contrast it with the expository task. It may be that in a more well-known genre such as the narrative, the writers are better able to edit. They may have a clearer global rhetorical goal, and because they want to achieve that goal they engage in more extensive editing.

The younger writers in particular may also feel that there is less need for editing on a global level in the expository texts, since their texts often lack a global structure: they simply report on each theme from the film individually but do not see these themes as part of a global plan. This would suggest a knowledge-telling strategy. Could it in fact be the case that writers follow the knowledge-telling strategy in some genres while they may have moved on to knowledge-transforming strategies in other genres?

There is also the question of why we do not find any age differences. Could this be explained by the notion of literacy expertise proposed by Scardamalia and Bereiter (1991) and developed by McCutchen (2000)? According to this explanation, more skilled writers would impose a more difficult task on themselves than less experienced writers. As you become better in a field and learn more about it, you simply try to do more difficult things there. This means that when a writer moves on to knowledge-transforming strategies, the task she will set herself is beyond the mere generation of new text and may therefore induce a higher cognitive load (and thus more pausing). The writer will use knowledge stored in long-term memory, which will interfere with the more low-level activity of text production.

Finally, we may conclude that the writers benefit from the temporal structure of the narrative once they have identified the topic of the story. However, the relatively fluent account of the unfolding events of the narrative is compensated for by a longer and more extensive editing phase at the end of the text. The expository texts give rise to more constant planning. It is not easy to tell whether this is because the writer has to retrieve information from long-time memory or experiences problems in recalling the scenes in the video, or because of the inherent logical, non-temporal structure of the expository. However, it seems that genre is a stronger factor than age when it comes to pause distribution during text writing.

There are several interesting further studies to be done in this area. For instance, it could be interesting to investigate the pause patterns of more genres, and of different subgenres of the narrative and expository ones that we have explored here (for example picture-elicited narratives, made-up narratives and text-elicited expositives).

# Chapter 12

## Conclusions

### 12.1 Introduction

Instead of merely using the cliché that the results from this thesis have raised far more questions than they have given answers, I would instead like to highlight those questions as the most important outcome of the studies presented here. They identify many areas where more research is needed. I will address a few of them at the end of this chapter.

The results shown here illustrate that the development of writing and speech is the product of complex and multidimensional processes. One main conclusion is that development in one area does not always go hand in hand with development in another area. A language user can be good at writing narratives, but this does not necessarily mean that her proficiency is as good when it comes to writing expositorys. And a person may perform well in the written expository task and yet have difficulties giving a speech on the same subject.

Another general observation is that development does not proceed in a steady, linear fashion, either in speech or in writing. Instead it appears to occur stepwise, and many results from the studies presented here suggest that a major step in both written and spoken production occurs between the ages of 13 and 17. There are many reasons to believe that this reflects a major cognitive development, not merely improvement of writing and speaking skills due to education.

In the following sections I will outline some conclusions about the development of writing and speech that can be drawn from the studies and results in this thesis. It may be appropriate to point out that this chapter is not a general summary of the preceding ones but rather an attempt to identify and discuss some general areas of interest.

### 12.2 Development of text types

If I were to sketch a developmental progression in genre knowledge as indicated by the data in this thesis, it would start with spoken narrative texts, followed by written narrative texts, written expository texts and finally spoken expository texts. In many ways this order follows the order in which children encounter and become

familiar with the different text types. We first encounter spoken narratives in everyday conversations. Then we come across written narratives with a very similar structure in picture books, and in the early story books and teaching materials at school. Written expository texts are found in school books and, perhaps even earlier, in short instructional and informational texts. But the spoken expository genre, and especially the very formalized form of speech, is encountered much later. Practice in that genre is also scarce, although the child or student can be used to listening to a teacher or a lecturer.

Writing is often described as an enormously complicated process (e.g. by Wengelin et al., 2009a; Negro and Chanquoy, 2005; Kellogg, 2006, 2008; Scardamalia and Bereiter, 1991). However, say, an essay really a more complex task than giving a speech? Is the latter not a problem-solving task every bit as much as the composition of an extended text?

The majority of the child's language production takes place in dialogue, in conversation, where the sender and receiver take turns at building up the text (cf. Linell, 2005, 2009; Chafe, 1994). And this, as Torrance et al. (2007) points out, provides opportunities to cue content to talk about, and to monitor what happens when language is produced. By contrast, most writing tasks lack such support.

The performance of a formal speech (without a preceding (written) preparation) requires the speaker to perform most of the same tasks as the writer, but *in addition* it is necessary for her to remember what she said at the beginning of her speech and to plan on a global level how the speech will end while simultaneously producing what she is saying right now. And this she must do without the help of a listener (as is the case in a normal spoken situation, where the text is built up in collaboration with one or more speakers) and under the constraint of not having visual access to the text (as she would in writing); and moreover she is subject to the requirement of producing a coherent text without much hesitation (as compared to writing, where she could take her time and hesitate for as long as she wanted). The question is indeed whether there are not in fact greater constraints to manage in this situation.

Now, what would facilitate a task like this is if the speaker had access to a ready-made structure that can be filled with content. This means that, for example, genre knowledge will aid the task immensely. This would be one explanation why the adults, when we evaluate performance using a range of measures, do better than any other group in the spoken expository task: they have more experience with this genre.

This can be contrasted with the text type of the spoken narrative. The findings for this genre demonstrate that there are genres that are acquired – maybe almost to perfection – at an early age. For instance, the 10-year-olds perform just as well as the adults in terms of measures such as the lexical density of the spoken narrative texts. This is also a genre which is well practised in everyday life. Most of us tell short personal narratives several times a day (about how I almost missed the bus, the history behind why I don't like oranges, what my sister and I did last weekend, how I managed to get the sheet of paper that was stuck out of the printer). We all know how to build a narrative, we know the structure, and we know how much background information is needed. Some of us even know how to produce a good punchline at the end, although this is not a necessary feature of a spoken narrative.

However, few of us give speeches every day. It is a very specialized form of speaking and we cannot expect young children to have much experience of it. We therefore cannot tell whether the children's poorer performance at the spoken expository task is a matter of general cognitive development or simply a lack of exposure and practice. Both factors may exert an influence here.

### 12.3 Easing the burden

For all language production we can distinguish tendencies and strategies to make expression as economical as possible. This can be observed on many linguistic levels. In speech it may mean assimilation and co-articulation between phonemes, in handwriting it may mean developing a more or less readable style of joined-up writing. In a conversation, the speaker is helped by the listener in creating the discourse, but the speaker also uses other methods to reduce the cognitive load while speaking. The grammar of speaking, described in Section 2.3, offers a wide variety of means to decrease the cognitive load: for example, strategically located pauses which buy the speaker time to plan the following clause or empty phrases that can be used as a resting point while the speaker is thinking about what to say next. All these are strategies that are learned concurrently with the acquisition of speech.

There are many ways to circumvent the cognitive demands of the language-production process. One way of easing the cognitive burden is by using acquired skills. These skills can be automatized keyboard writing, which will reduce the mental capacity occupied with mere motor execution while typing and so free up more working memory for higher-level processes. They can also consist in mastering the grammar of speech and being able to use "clever" hesitation phenomena in speech, such as pausing after a conjunction (indicating that there is more to come) or "resting" on empty phrases; all of these create more planning time for the speaker, who is subject to suffers from the constraints of spoken discourse. Another way to increase the cognitive capacity available for language production is to rely on knowledge stored in long-term memory, such as knowledge of genres or text types. Other skills that can be more or less automatized are punctuation and the use of syntactically subordinate clauses; the more experience a writer has in these things, the less effortful they are, and the more working memory is freed up for other things.

As regards our developmental data, I would suggest that the 10-year-olds reduce the effort of writing (meaning the execution of typing and the need to endure the much longer time it takes to write than to speak) by using strategies from speech. This includes telling the story or giving their opinion from the beginning to the end in a linear fashion (just as it would be done in speech). Thus, when they are faced with the more unfamiliar modality of writing, they rely on the familiar way of telling a story in speech, when they are faced with the more unfamiliar modality of writing. What will happen eventually is that they by practicing will turn them into become more and more experienced writers. They learn to master the keyboard, they get used to editing their message, they increase their knowledge of individual genres and they expand their genre repertoire. This will also have an effect on their spoken performance. Such interference between genres is most saliently illustrated

by the differences between 17-year-olds and university students in our data. For the measures that we have investigated here, the 17-year-olds are in many cases able to compete with the adults in writing, but they achieve this by writing for a longer time, thus confirming the results of Piolat et al. (2004) showing that writers will increase the duration of an activity when it is cognitively effortful. It is thus not entirely correct to say that the 17-year-olds perform as well as the adults. In the expository speech, the age difference is even more salient; the adults have a higher lexical density than the 17-year-olds, indicating that they are able to vary their linguistic expression in spite of the time constraint of the spoken condition.

There are even some instances of U-shaped development to be found among the results (cf. Strauss, 1982). One example is the 13-year-olds' lexical density in the expository texts (see Table 10.2 on page 152). In both speech and writing, the 13-year-olds produce much less lexically dense texts than the 10-year-olds, which I would interpret as the older children being so occupied with other newly acquired properties of the expository genre (e.g. organizing the global structure of the text, expressing their opinions, generating general ideas, and not merely describing the film; they are, as it were, in the process of moving from knowledge-telling to knowledge-transforming strategies) that they are unable to produce a wide variety of lexical items at the same time. The 13-year-olds' struggle to achieve the global rhetorical goals of the expository thus exerts a price in the form of reduced lexical density.

As is shown by for instance Kellogg (2006), McCutchen (2000, 2006) and Scardamalia and Bereiter (1991), decreasing the cognitive load does not necessarily mean that the writer (or speaker) will perform the task with greater ease. The reason for this paradox is that the skilled writer sets other rhetorical goals, including audience, style and topic. This complicates the task. McCutchen (2006) describes the result as "not necessarily an effortless writing process for the expert, but it is an effective one that yields high-quality text". Thus, we can conclude that when cognitive capacity expands, the new space available is used by the experienced writer to achieve new goals.

## 12.4 The adult standard

The development of linguistic skills continues long into adulthood, just like Kellogg (2008) suggests. Several findings in these studies indicate that the adults are able to benefit when they speak from strategies acquired in writing

Scott (1988) brings up the important issue of specifying what it is that we measure development against. When we compare developmental data, we often use the "adult level" as a benchmark. However, it is not unproblematic to specify what the adult level is. Scott underlines how important it is to have "a realistic (rather than idealistic) adult standard" (Scott, 1988, p. 52), and we must also appreciate that there are several adult standards. Adults, like children, demonstrate a wide range of competency levels. This is why it is important to investigate texts from many genres (and modalities) if we want to obtain a full picture of the competence of an age group or of a specific writer.



In fact, as is shown for instance by analysis of the spoken narrative texts in this thesis, in many ways a 10-year-old is just as competent as an adult in certain genres with which she has long experience. This illustrates that part of being a skilled language user consists in being able to adopt the right syntactic and linguistic features for the right genre. For example, telling a spoken narrative using very lexically dense subordinated sentences is very artistic (and indeed something that only an experienced speaker can do), but it is not very spontaneous and not well adapted to the normal audience. Skilled adults will therefore typically use the same genre characteristics that have already been well integrated by the 10-year-olds, rather than trying to speak like a high-brow novelist might write. To grasp the full competence of a language user we must thus include a variety of text types in our investigation.

In the data analysed for the studies in this thesis, we have used the adult group as a comparative end-point, representing the kind of “ideal performance” that the development of the younger age groups aims for. This, however, is not to say that the adults represent the best possible level for all the text types included in this investigation. I believe that there is still room for further development, as is described by Kellogg (2008) and by Scardamalia and Bereiter (1991). The adults here were also not recruited in their capacity as expert writers – in fact, quite the opposite, since we deliberately excluded such adults whom we knew, or could expect, to have studied writing *per se* during their university studies (i.e. we excluded students of journalism, modern languages, literature and linguistics). The adult group simply represents the literacy of adults who have a long education and thus find themselves at the other end of “schooling”, which was the word used in the original proposal for the Spencer grant. With this approach, we avoid the “idealistic adult standard” that Scott (1988) talks about: the adults in this data have performed exactly the same tasks as the children, and they do not represent some kind of idealistic adult expression but are a true example of adult performance.

## 12.5 Becoming a reader

I began this thesis with two quotes. The first is by J.D. Salinger and reads *If only you'd remember before ever you sit down to write that you've been a reader long before you were ever a writer*. This applies to the fictive author Buddy Glass and is an excerpt from his discussion with himself about what kind of text he should write and what topic he should write about. I have chosen this quote because it says very much about what it means to write, not only for an author like Buddy Glass or Salinger, or for the two journalists in McCutchen's (1994) example, whose rhetorical choices when writing their newspaper columns involve thinking about their audience, but also for anyone who wants to communicate a message in writing, not necessarily with artistic aspirations.

One thing a writer has to understand is that there is a reader who should understand what she is writing. This makes it necessary to provide enough information to make the text comprehensible. In speech, the listener can ask questions or look puzzled to elicit clarifications if something is unclear, or give positive feedback by smiling and nodding to encourage the speaker to continue. When writing, however,

the writer has to anticipate the questions and predict the extent of knowledge of her future reader. That this is done from early on is shown, for instance, in Example 38, which is a written narrative by a 10-year-old boy. The author here describes what a ‘fender’ is. It should be noticed that he provides no explanation of this notion in the spoken narrative, of which an extract is reproduced below as Example 39 (and which followed the written narrative in the experimental order). It is impossible to say whether this was due to the fact that the written texts “counts for more” and that he sensed that the explanation in writing sufficed, or that the listener signalled that she knew what a fender is. In the extract of the same piece of text from the linear file, Example 12.5, we find that in connection with writing the explanation about the fender, the boy makes some really long pauses (14.08 and 39.18 s) as well as performing some deletions and some editing, all in all indicating that this process of thinking about the reader is not so easy. Not only do you have to identify the problematic issues, but it may also take a lot of thought and planning to write (hopefully) sufficient explanations.

- (38) SBJ: när vi gick på båten.  
*SBJ: when we boarded the boat*  
 SBJ: skulle jag ta upp fendrarna.  
*SBJ: I had to pull up the fenders*  
 SBJ: de som sitter på båten på sidan.  
*SBJ: the ones sitting on the side of the boat*  
 SBJ: de som gör.  
*SBJ: those that make it*  
 SBJ: att man inte repar båten.  
*SBJ: impossible to scratch the boat*  
 SBJ: som ligger bredvid.  
*SBJ: lying next to it*  
 [wg10mBNW]

- (39) SBJ: när jag gick på båten.  
*SBJ: when I boarded the boat*  
 SBJ: sa morfar +” /.  
*SBJ: my grandfather said*  
 SBJ: +” kan du upp fendrarna Jonathan.  
*SBJ: can you pull up the fenders Jonathan*  
 SBJ: +” tar jag upp de andra.  
*SBJ: and I will take up the others*  
 [wg10mBNS]

- (40) Linear text from a 10-year-old boy’s written narrative. [wg10mBNW]

när vi gick på båten skulle jag ta upp fendrarna de som sitter <14.08>  
 på båten på sidan <39.18><DELETE>.D<DELETE2> de som jör <DELETE4>gör  
 att man inte repar båten som ligger bred v<DELETE2>vid

One important factor in becoming a “good” writer is learning to detach yourself from the subjective process of expressing your thoughts and becoming a reader. A

writer has to be her own critical eye and foresee the difficulties of a potential reader. This does not only involve explaining difficult terms or identifying characters, as in Example 27 on page 123 where the authors explains who ‘Cecilie’ is, but rather amounts to developing an idea of the global structure of the message and setting rhetorical goals: What is the best way to address this topic? How should I begin and how should I end in order to present my case in the best way to the reader? Between these extremes, there are the lexical choices and the use of syntactic structures to give emphasis to certain features. There is also the notion of information packaging – how lexically dense can I make my text without making it incomprehensible to the audience I address?

In this way, rhetorical goals and knowledge about the audience influence the whole writing process. A good writer has internalized an independent reader in her mind who detects problematic issues and alerts her if something is not good enough. If we, in Salinger’s words, remember that we were readers before we were writers, we will also know what kind of text we need to write.

In organizing our text on a global level, to meet the rhetorical goals we have set, the inherent properties of writing are immensely helpful. These properties allow us to read through the message, evaluate the content and structure, and rearrange them to our satisfaction. An experienced writer will take the opportunity to do so.

## 12.6 Becoming an editor

The other quotation in the beginning of the thesis is from Blaise Pascal and reads *I have made this [letter] longer, because I have not had the time to make it shorter*. This sentence comprise much wisdom. As the description of the knowledge-telling strategy suggests, it is often not very difficult to generate new text for the younger age groups. The problematic issue comes when the text should be formalized according to some specific form, genre, text type or rhetorical goal. We have seen from the results here that there is a salient difference between the 17-year-olds and the adults in how much they write – and for how long! We have already discussed that the 17-year-olds are able to compete with the adults only at the expense of extra time. The 17-year-olds have simply not had the time to write short! It can take immense effort to produce a short (written) message that is lexically dense or strikes the absolutely right tone.

The knowledge-telling strategy, where one statement in the text leads on to the next and where the writer can finish when the “story is told” or follow the motto of “think it, write it” (as it is put in McCutchen, 1994, p. 7), will lead to texts that are longer than those produced by someone who has only the rhetorical goal of the reader or the topic in focus, i.e. knowledge-transformers or even knowledge-crafters. A long text is not necessarily a better text. Here, too, I believe that we will encounter a U-shaped developmental pattern, where text length increases until a certain stage (perhaps apparent in some of the 17-year-olds) where editing of the message results in shorter but more dense texts and perhaps also a syntactically more complex message. However, with practice, we can also expect that an experienced writer could write short(er) right from the start.

## 12.7 Gender differences

In the literature about writing development, gender differences are frequently reported. They can be summarized as girls being good writers and boys being under-achievers (cf. Kanaris, 1999). In this thesis, some gender differences have been found, but they occurred only in interaction with order effects and therefore should rightfully be attributed to the small size of the cells in each order. Table 6.5 on page 63 shows that in some cells (e.g. Order B for the university students) there is only one male participant. Otherwise the number of persons of each gender per cell varies between 2 and 3 in every age group. This means that 1-2 persons' way of producing their texts could highly influence any gender effects identified in the statistical analysis. If we want to investigate gender differences in speech and writing more systematically, we will have to construct different experimental designs (for example abstain from varying the order of the text types) and have different (i.e. larger) participant groups.

Even so, the fact that (almost) no gender differences were found is worth a few words. The age groups *were* balanced for order; half of the participants are members of each sex. So why did we not find any of the frequently reported differences between the genders? One reason, I believe, is that we have excluded participants with reading and writing difficulties. Although the participants did not go through any screening process to make sure they had no such difficulties, we did ask the teachers who helped in recruiting the schoolchildren to choose pupils without such problems. We also stated that we did not particularly want the best children in the class. For the adult group, we made sure beforehand that they did not have any difficulties in reading or writing. By recruiting the participants in this way, we ruled out some of the “underachieving” boys right from the start, since they would most certainly qualify (in their teachers' opinion) as having reading and writing difficulties. Further, our decision to exclude the best students may also have excluded more girls than boys, on the assumption that girls were over-represented at the top of the classes.

The studies reporting gender differences typically include a population consisting of all children in a class, or a randomized sample from a certain age group. It could be argued that the Swedish part of the Spencer Corpus was too small to account for any systematic gender findings, but it is worth noting that the international Spencer Project, comparing corpora from seven languages, also did not find any gender differences (Berman and Verhoeven, 2002). (Although, of course, the researchers in the other countries selected their participants along the same lines as we did in Sweden.)

Even though gender differences in writing were not a main factor in the present thesis, this would be an interesting perspective to use in further research. Some of the studies (particularly in Chapter 9 and Chapter 11) would be interesting to extend to other populations, and then gender would be an important factor to include.

## 12.8 Further research

The results from this thesis point in many directions. Here are some areas of future research that I have identified; it should be emphasized that this is not an exhaustive list.

One issue, arising above all from the results of Chapter 11, concerns what actually happens during the pauses. Attempts to investigate this have been made by combining keystroke logging and eye tracking, which makes it possible to investigate gaze behaviour and even reading. Some results have come from the project *Reading during writing* (Johansson et al., 2008), showing that writers have different gaze behaviour depending on whether they look at the monitor or the keyboard. The results from this project further show that there remains a great deal of pause time that we are not yet able to account for: that is, what do the writers do when they pause from writing but do not read? Here there is a potential for many new interesting research fields.

There is also a need to investigate the content and quality of the texts in a more systematic way, to see how these factors interact with the length measures and lexical measures. Is a text necessarily better because it has higher lexical diversity? I deliberately abstain from addressing that issue here, reporting instead only on general developmental trends.

The comparisons between speech and writing that have been carried out here indicate that many interesting differences, but also similarities, are to be found between the modes of expression used in the two modalities. It would naturally be very interesting to see if a more systematic examination of real-time data on language production in both speech and writing would reveal more information about development in the two genres and about similarities and differences in how the linguistic message is produced.

Further, it would be helpful to expand this investigation to include other text types (i.e. other than narrative and expository in two modalities) and other types of writers. The adults in this study are indeed very skilled writers, with several years of university studies behind them. Nevertheless, they are not *professional* writers. Some pilot recordings of writers who are journalists and/or authors point to differences in writing behaviour that would be most intriguing to investigate further. Similarly, comparing the writing patterns of adults with less education would provide essential information about whether writing practice and longer schooling are the most important factors for writing skills, or if mere cognitive development contributes more. Further, adding a group of, say, 15-year-olds to examine the interesting gap between ages 13 and 17 would probably be very rewarding, as would comparing the writing and speaking skills of persons of various ages with special language impairments.

Last, but certainly not least, the next step is to use the results of this thesis as a starting point for detailed studies of the linguistic structures in the material presented here. In this thesis I have investigated how the ability of production improves. I have also looked at how the ability to use a varied lexicon depends on modality and genre. Further, I have investigated the use of various keystrokes, and pause patterns. All this reflects various aspects of language production. But all of

these measures are also rather top-down in nature, and although I present a number of examples from the large corpus, no systematic investigation of the morphological, syntactic, linguistic or rhetorical content has been carried out. Nor have the texts been scored according to text quality (in any way). This is of course a limitation inherent in the present investigation. Nevertheless, the results may function as a guide to areas that would be specially interesting to focus on in the future.

## 12.9 Concluding remarks

Writing a thesis that discusses the processes of writing is in many ways a strange meta-cognitive project that, on some level, constantly involves an evaluation of your own ongoing activity. One thing that has been part of my rhetorical plan is that I should return to the first image that I set forth in the Introduction: the skilled speakers in the radio show *På minuten*. Why are we – rightly – impressed by speeches that are delivered without hesitation, deviation or repetition? And what processes make it possible to perform such acts?

As has been shown here, hesitation and repetition are important features of the spoken message. In addition, they are almost inevitable when other cognitive constraints, such as having to stick to an unfamiliar topic (i.e. not deviating), having to produce speech under time pressure (i.e. not hesitating) and having to vary the linguistic message (i.e. not repeating), compete for the resources of working memory. One way to ease the burden is by relying on previously known strategies, for instance genre knowledge and various linguistic features. Many of these have been acquired through writing, although it should be emphasized that these structures are not necessarily learned through writing. Nevertheless, the ability to make a good speech is strongly enhanced by a good knowledge of linguistic structures that are predominantly found in written rather than spoken language.

Thus, it may only be after years of training that it is truly possible for the skilled speaker to actually follow Lewis Carroll's exhortation to the story-teller: *begin at the beginning and go on till you come to the end; then stop*.

# Appendix

## Teacher questionnaire

This questionnaire was distributed among the (Swedish) teachers of the school children in the experiment. The adult participants answered the same questions regarding their own abilities in connection with the experiment.

### Upplysningar om eleven

Elevens namn:

I vilket ämne/vilka ämnen undervisar du denna elev:

Är du också elevens klassföreståndare?

Hur länge har du undervisat denna elev?

Vad anser du om elevens färdigheter inom följande områden? Ringa in det alternativ du tycker passar bäst in på denna elev. Skalan är 1-4, där 1 är lägst och 4 är högst.

1) läsförståelse

1 2 3 4

2) förmåga att uttrycka sig i tal

1 2 3 4

3) förmåga att uttrycka sig i skrift

1 2 3 4

Tack för din medverkan!

## Literacy questionnaire

The questions were asked by the experiment leader, and the participants answered orally. The interview was audio-taped.

### 1. Datorer:

1. Har du en dator hemma?
2. Vad använder du datorn till? Spel? Läxor?
3. Har du tillgång till Internet hemma?
4. Har ni en dator i skolan? Hur många datorer finns det i ditt klassrum/har din klass tillgång till?
5. Vad använder du datorn i skolan till? Spel? Läxor?
6. Har du tillgång till Internet i skolan?
7. Använder du ofta Internet i skolan? Till vad?

### 2. Tidningar:

8. Brukar du läsa tidningar?
9. Vilka tidningar läser du? Brukar du läsa en morgontidning? Brukar du läsa en kvällstidning? Serietidningar? Motormagasin? Veckorevyn? Modemagasin?
10. *Barn*: Vilka andra tidningar har du hört talas om, men inte läst?
11. Varifrån får du tidningarna? Var läser du dem?
12. Varför läser du tidningar?

### 3. Böcker:

13. Läser du böcker?
14. Vad för slags böcker gillar du? Deckare, hästböcker, romaner, science fiction, historiska romaner, facklitteratur, biografier...
15. Vilka böcker har du läst på sista tiden? (Om fp inte har läst någon bok: Vilka böcker kommer du ihåg att du har läst?)
16. *Barn*: Vilka andra böcker har du hört talas om, men inte läst?
17. Var får du tag på böckerna du läser?
18. Varför läser du böcker?

### 4. Skriva:



19. Brukar du skriva mycket utanför skolan, förutom läxorna?/Brukar du skriva mycket förutom det du skriver för dina studier och ditt arbete?
20. Vad skriver du för något? Anteckningar, komihåglappar, brev, email, dikter, dagbok, noveller...
21. Varför skriver du? För/till vem skriver du?

#### 5. Referensmaterial:

22. Brukar du använda referensmaterial, t ex kartböcker, ordböcker?
23. Vilken slags referensmaterial använder du? Uppslagsböcker, ordböcker, kartböcker, Internet...
24. Varifrån får du referensmaterialet? Har du det hemma? Biblioteket? Skolbiblioteket?

#### 6. Andra aktiviteter:

25. Vad gör du på fritiden? Förutom läxor? Tränar, träffar kompisar, tittar på tv, hobbies?

#### 7. Språk:

26. Vilka språk (förutom svenska) studerar du i skolan? När började du studera det språket?/Vilka språk har du studerat, i skolan och sedan du slutat skolan? När började du studera språket? Hur länge studerade du språket?
27. Tycker du det är roligt att studera språk(et)?
28. Hur pass bra tycker du att du behärskar (kan) språket? I tal? I skrift?
29. Har du vistats utomlands någon länge tid? Använde du något annat språk än svenska under din utlandsvistelse? Vilket språk?
30. Använder du normalt något annat språk än svenska en vanlig dag? När träffar kompisar, släkt, familj? I skolan? På universitetet? I dina studier (förutom rena språkstudier)? Vilket språk?
31. *Vuxna:* Har du studerat språk på universitetet, eller sedan du lämnat gymnasieskolan? När började du studera det språket? Hur länge har du studerat språket?
32. *Vuxna:* Tycker du det är roligt att studera språk(et)?
33. *Vuxna:* Hur pass bra tycker du att du behärskar (kan) språket? I tal? I skrift?
34. *Vuxna:* Har du tillbringat någon längre tid utomlands i samband med dina universitetsstudier, eller i något annat sammanhang? Hur länge i så fall? Vilket/vilka språk kom du i kontakt med/använde då?

## The scenes in the elicitation movie

The Spencer elicitation movie is three minutes long and consists of eight scenes. Each scene illustrates an ethical problem: cheating, fighting, blaming someone else, excluding friends, stealing, damaging things on purpose or by accident. Each time a problem has been presented, the picture is frozen to highlight the problem. This is illustrated with a *Click!* below.

The film is speechless, but accompanied by rhythmic music.

**Scene 1** Cheating in the classroom. The scene shows a classroom with pupils sitting an exam. Their teacher walks around in the classroom. The first cheating situation shows a boy who has a crib in his pen bag. Together with his neighbour he copies the crib. *Click!* Another boy in the classroom is not writing but looking straight into the air, showing that he does not know the answers and that he does not care. The girl who is his neighbour offers him to look at her exam paper, but he refuses. *Click!* The third situation shows a girl who is desperately trying to look at her neighbour's exam paper, but the neighbour covers the paper and will not let her look at it. *Click!* The school bell rings, indicating that it is time for a break. The children leave the classroom.

**Scene 2** Fighting in the corridor. The scene shows a break in the corridor. Two boys start to quarrel, one of them pushes the other, and it develops into a fight. *Click!* The teacher notices the fight, intervenes to stop the fight, and grabs the arm of the boy who did not start the fight, as if blaming him for the incident and sending him to the headmaster. *Click!*

**Scene 3** Playing basketball. The scene shows a basketball court with four children playing basketball. They seem to be having a good time and to get along fine, when a fifth boy arrives. He greets the other players by giving each of them a "high five" but excludes one boy, who ends up standing with his hand untouched in the air. He is all of a sudden excluded from the others' play. *Click!*

**Scene 4** Stealing the one-hundred note. The scene shows a woman walking outdoors. Her mobile phone rings, and when she picks it up out of her purse she drops a one-hundred note on the ground. She does not notice it, but continues walking. However, a girl walking behind her notices the dropped note. She picks it up, looks in the direction of the woman who is walking away, hesitates, looks over her shoulder, and finally puts the note in her pocket, turns around and walks away. *Click!*

**Scene 5** The telephone. The scene shows a boy talking in a phone booth. He hangs up and tries to get his phone card back but to no avail. He hits the machine, but still no result. Finally, he leaves the phone hanging and walks away. *Click!*

**Scene 6** The drink. A girl runs out of the school building and keeps on running through a group of children, where by accident she causes a boy to drop his drink. She does not stop to ask how it went but continues running. *Click!*

**Scene 7** The girls on the bench. Two girls (A and B) are sitting on a bench, paging through a magazine. A third girl (C) approaches, and girl A on the bench pushes girl B to attract her attention to who is coming. Girl C raises her hand as if to say "Hello!", but the other girls do not respond. Instead they move over to one side of the bench, totally ignoring girl C, who also sits down on the bench. A few moments later, girl B whispers something to girl A, and they both stand up and leave. Girl C remains seated, disappointed, excluded and abandoned. *Click!*

**Scene 8** The class photo. All the children gather to take a class photo. Two children in the front row very reluctantly make room for a boy to sit. They demonstratively move away to show that they do not want to sit close to him. At the moment when the photo is taken, a girl behind this boy holds up two fingers (like horns) behind the boy's head. *Click!*

## The elicitation instruction for Order A

The Swedish elicitation instructions are presented below. The same instructions were used for all four age groups (10-year-olds, 13-year-olds, 17-year-olds and university students). The instructions presented here follows Order A, but with very small exceptions the same procedure was carried out in the other orders. (The difference being in which order the text types were elicited).

### Order A I: NS then NW II: ES then EW

**Allmän introduktion** Här på universitetet håller vi på med ett forskningsprojekt om hur folk talar och skriver, och vi samlar in material för det här. Vi kommer be dig att tala och skriva.

**Introduktion narrative** Nu kommer vi be dig att tala och skriva om situationer där folk har hamnat i en knipa. Först kommer du att få se en kort video, som ger några exempel. Visa videon.

**Narrative spoken** I videon såg du flera exempel på folk som hamnade i olika knipor. Vi samlar in historier om liknande händelser. Jag skulle vilja att du berättar om ett tillfälle antingen där du räddade någon ur en knipa, eller där någon räddade dig ur en knipa. Berätta inte vad du såg i videon, utan något du själv har varit med om. Det behöver inte ha utspelat sig i skolan. Du får gärna tänka efter innan du börjar.

**Narrative written** Nu skulle jag vilja att du skriver och berättar om samma händelse, det vill säga när du räddade någon, eller när någon räddade dig ur en knipa. Jag kommer att gå ut ur rummet. Tala om för mig när du är klar.

**Introduktion expository** (Investigator sits opposite the subject) Före pausen fick du se en video som visade människor som hade hamnat i olika slags svårigheter, människor som hade problem av olika slag. Nu är vi intresserade av vad folk tänker om såna händelser.

**Expository spoken** Vi samlar in föredrag om det här ämnet så jag skulle vilja att du diskuterar sådana situationer som människorna i filmen hade hamnat i. Vad har du att säga om det här? Tänk dig att du står inför klassen/en klass, och talar om ämnet. Du får gärna tänka efter innan du börjar tala.

**Expository written** Nu skulle jag vilja att du skriver en uppsats om samma ämne, det vill säga att du diskuterar sådana situationer som människorna i filmen råkade ut för. (Beskriv inte filmen, utan diskutera allmänt). Tänk gärna efter innan du börjar skriva. Jag kommer att gå ut ur rummet. Tala om för mig när du är klar.

## Text examples

### Transcription example from a 13-year-old girl

The translations below use an idiomatic rather than verbatim approach. However, Swedish word order is sometimes allowed to overrule that of English so that the translation can be made line by line. Most transcription conventions are excluded from the translations. However, repetitions of various kinds are included ([/], [//], [///]).

@Begin

@Participants: SBJ Subject, INV Investigator

@Filename: wj11fCES.cha

@Age of SBJ: 13;7.9

@Sex of SBJ: Female

@Language: Swedish

@Year of schooling: 7th

@Grade-level: 7th

@ID: 06.2.11.1.1.1.3

@Text Type: Expository spoken

@Order: C

@Session: I

@Transcriber: Victoria Johansson

\*SBJ: jo ja [: jag] tycker.

%tra: well, I think

\*SBJ: de [: det] här med när dom [: de] spelar basket.

%tra: this when they play basketball.

\*SBJ: att eh@fp dom [: de] höll på ge mej [: mig]

<give me five> ["] å [: och] de [: det].

%tra: that eh they were doing "give me five" and that

\*SBJ: å [: och] när inte han fick liksom göra de [: det].

%tra: and when he wasn't kind of allowed to do that

\*SBJ: då tycker ja [: jag].

%tra: then I think

\*SBJ: att de [: det] kan bero på.

%tra: that it could be because

\*SBJ: att han inte f(år) [?] [//] så bra självförtroende.

%tra: he doesn't get that much self-confidence

\*SBJ: å [: och] att eh@fp <en person> [//] man vill inte

va [: vara] me [: med] en person.

%tra: and that eh <a person> [//] you don't want to be

with a person

\*SBJ: som inte e [: är] nöjd me [: med] sej [: sig] själv.

%tra: who isn't satisfied with himself

\*SBJ: eller som tycker.

%tra: or who thinks  
 \*SBJ: de [: det] e [: är] tråkigt # hela tiden.  
 %tra: that it is boring all the time.  
 \*SBJ: som e [: är] lessen [: ledsen] å [: och] så.  
 %tra: who is sad and so on.  
 \*SBJ: så de [: det] kan ju bero på de [: det].  
 %tra: so it can be because of that.  
 \*SBJ: och eh@fp # de [: det] här me [: med] s(kriver) [?] [//]  
 när dom [: de] skriver lappar å [: och] sånt [: sådant].  
 %tra: and eh this with writing [//] when they write notes and so on  
 \*SBJ: <de [: det] e [: är] > [//] ja [: jag] tycker inte.  
 %tra: <it is> [//] I don't think  
 \*SBJ: de [: det] e [: är] så bra att +...  
 %tra: that it is so good that +...  
 \*SBJ: ja [: jag] tycker.  
 %tra: I think  
 \*SBJ: dom [: de] [//] lärarna ska göra.  
 %tra: they [//] the teachers should make  
 \*SBJ: så dom [: de] känner.  
 %tra: them feel  
 \*SBJ: att dom [: de] inte e [: är] ensamma om de [: det].  
 %tra: that they are not alone in this  
 \*SBJ: så dom [: de] # inte e [: är] så rädda för att visa.  
 %tra: so that they are not so afraid of showing  
 \*SBJ: att dom [: de] har [!] svårigheter.  
 %tra: that they have difficulties.  
 \*SBJ: för då kan ju ingen hjälpa dom [: dem] # så liksom.  
 %tra: because then nobody can help them kind of  
 \*SBJ: # å [: och] # a [: ja] # sen [: sedan] kommer  
 ja [: jag] inte ihåg riktigt.  
 %tra: and well yes then I don't quite remember  
 \*SBJ: va [: vad] de [: det] va [: var] mer.  
 %tra: what else it was  
 \*SBJ: men # de [: det] va [: var] typ så hela tiden.  
 %tra: but it was kind of like that the whole time  
 \*SBJ: så att dom [: de] måste visa.  
 %tra: so that they had to show  
 \*SBJ: att dom [: de] har de [: det].  
 %tra: that they have that  
 \*SBJ: så nån [: någon] kan hjälpa dom [: dem].  
 %tra: so somebody can help them  
 \*SBJ: måste söka hjälp å [: och] så.  
 %tra: have to ask for help and so  
 @End

## Example from a 17-year-old boy [wh14mCNW]

This is the complete linear text from Example 30 in Section 9.8.

<START>Vi sku<DELETE7>Jag gick itredje <DELETE17>När jag gick på  
laå<DELETE2>åga<DELETE>stadiet skulle hela j<DELETE>klassen spela  
Klas klättermus<7.63> infll<DELETE2>ör föräldrar och skola.  
Vi hade övat änge och alla kunde sina sågtexter utantill.<CR>Så kom  
då den stora dagen då vi skulle spela upp för skolan.<9.61><LEFT11>  
pjäsen <RIGHT4>heka<DELETE2>la <RIGHT7> Alla var väldigt nervös  
<DELETE9>gt bn<DELETE2>nervösa, men när det väl satte igång slappnade  
nästan alla <DELETE15>de i alla fal jag av.<CR>Men det gjorde inte  
stackars katrin<DELETE6>V<DELETE>Catrin som stog bagom disken i  
bageriet där räven skulle köpa sina salta peppea<DELETE2>ar<DELETE>  
rkakao<DELETE2>or. <6.03>Fr<20.48><DELETE2><CR>Catrin stod stel som  
en pinne<5.53> och när man tittade närmare insåg man att <DELETE6>  
<MOUSE ,469><DELETE3>jag<RIGHT23>jag vad som hade häm<DELETE>nt -  
Catrin hade kissat d<DELETE>ner sig.<XEDIT2> Jag insåg vilken  
sensation det skulle bli när skolans sötaste tjej kissat ner sig,  
m<DELETE><6.01><DELETE2>. Jag insåg dock att underhållningsvärdet på  
<DELETE2>för Catrin va<DELETE2>inte var fullt så stort. <CR>På  
disken hade vi di<DELETE>ukat fram pepparkakor och saft som sedan  
skulle användas<DELETE>s för den stora festen. Men för att rä'dda  
catrin från <DELETE13><LEFT4><DELETE><RIGHT3> Catrin från att bli  
utskrt <DELETE2>rattad <10.76>vällte jag omkull en av saftbägarna  
sp<DELETE>å att det kom på catrin<LEFT7><RIGHT><DELETE>C<RIGHT6>.  
<7.60><LEFT26>st<DELETE2>när de skulle användas <RIGHT30><UP><RIGHT>  
<DOWN><UP><DOWN><LEFT19><RIGHT11><LEFT2><RIGHT><LEFT6><DELETE34>så  
att det <RIGHT15> Hon blr<DELETE>e<DELETE>ev nu ännu blötarem  
<DELETE>, men det tror jag att hon <DELETE22> jag tot<DELETE2>ror  
aldrig hon uppskattat att någon spilt<LEFT>1<RIGHT><5.16><UP>  
<RIGHT14><DOWN><LEFT4><RIGHT4><LEFT2><DELETE><RIGHT> på henne så  
mycket sdom då.<UP6><LEFT19><RIGHT><DELETE5>o<DELETE>elever<RIGHT15>  
1<RIGHT27>n<RIGHT><DOWN><LEFT84>in<RIGHT58><DOWN><LEFT61><RIGHT46>  
<LEFT36><DOWN><LEFT7><RIGHT72><LEFT><RIGHT><LEFT64><DELETE5>förstod  
<DELETE>g<DELETE>d<RIGHT55><DOWN2><LEFT20><UP><RIGHT19><DELETE14>  
begränsat<DOWN><LEFT36><RIGHT78><DELETE><DOWN><UP>1<DOWN><LEFT69>  
<RIGHT14><MOUSE ,1000><LEFT><DELETE><DOWN><43.55><CR>Självf fick jag  
ta emot en ioc<DELETE3>och annan kommentar för min fi'<DELETE2>  
umlifhet,<LEFT4><DELETE>g<RIGHT4> men det var <DELETE81>ä.<5.18>  
<MOUSE ,892>när vi dukade fram inflö<DELETE>ör festen<LEFT><RIGHT>  
<5.46><UP><LEFT18><DOWN><UP3><DOWN><RIGHT>  
<DOWN2><RIGHT11><DELETE>  
<RIGHT3>den stora <RIGHT8><LEFT2>. Som planerat <7.13>ko  
saf<DELETE4>m saften över k<DELETE>Catrin<12.05><XEDIT26><RIGHT>  
<DOWN2> Nui<DELETE> kom <DELETE4><6.36><DELETE3><21.20><MOUSE ,417>  
<DELETE5>extra sr<DELETE>tarka<13.96><DOWN><LEFT15><DOWN><DELETE5>

```
<DOWN><9.73><DOWN><LEFT><RIGHT16> som, gav ifrånm su<DELETE>ig ett
lätt skrik<6.93><MOUSE ,973>,<RIGHT5><DELETE><16.05><MOUSE ,1108>
<DELETE><RIGHT7><58.83>
```

## Example of ScriptLog files

Below are presented example of various ScriptLog files, all extracted from the same writing session, i.e. a written expository text by a 17-year-old girl [wh07fBEW]. An explanation of the purpose and representations of the files are found in Section 7.2.3. A translation into English of the first part of the TXT file is also found there. All proper names have been anonymized.

### Example of a TXT file (i.e. the ‘final text’) from the written expository text by a 17-year-old girl [wh07fBEW]

Att människor har problem är ingenting ovanligt och de problem jag såg i filmen var inte så annorlunda.

Att vara utanför och inte få vara med sina klasskamrater är inget nytt problem, man kanske är annorlunda på något vis och blir därför utesluten ur gemenskapen. I låg och mellanstadiet hände detta ofta med olika personer, även i högstadiet vet jag att det förekom. När man är så liten som man faktiskt vardå, är man ganska osäker på sig själv, och man vet inte alltid hur man ska hantera olika situationer. Det kan krävas lite liverfarenhet, men inte mycket för att förstå hur ledsen någon kan bli om man stänger dem ute ur gemenskapen. Denna typen av problem tycker jag är den värsta typen som finns, att inte ha några vänner att prata, skratta och umgås med är det värsta som skulle kunna hända mig tror jag. Om man då är den som är utanför så får man ju försöka att förstå vad det är som gör att man blir utanför, varför man inte är fullt accepterad, man kanske kan göra någonting åt det, jag tror att man måste våga förändra sig själv, våga vara sig själv utan att bli missförstådd.

Jag såg även andra problem i filmen, vissa ungdomar satt och tjuvkikade på sina klasskamrater under provtiden, detta kan antingen bero på att man inte har läst inför provet eller att man helt enkelt har problem med att lära sig vissa saker, att inte läsa inför ett prov är onödigt men det händer alla att man inte gör det någon gång, men att strunta i det vid varje provtillfälle är dumt eftersom att man kommer att få nytta av kunskapen någon gång i framtiden. Om man är trött på skolan kan behöva ett uppehåll i några månader eller ett år, sedan kan man börja igen, med nya



krafter. Då kanske man behöver någon som kollar att man hela tiden gör det man ska göra. Man kan behöva någon som peppar en till att fortsätta vara flitig med skolarbetet. Om man har svårt att lkärasig kan man behöva hjälp vidsidan av den vanliga skolundervisningen, för att inte tappa all lust till skolarbete.

En flicka kom gåendes bakom en kvinna, kvinnan tappade en pengarsedel, flickan tar upp sedeln, tvekar ett ögonblick innan hon stoppar ner den i sin egen ficka. Detta ärett svarare problem, det beror ju förstås på hur mycket pengar det handlar om, om man ska behålla pengarna själv eller inte, smavetet och ens uppfostran säger en sak medan din hjärna säger en annan sak om jag exempel vishittarfemhundrasvenska kronor i skolan utan minstaaning om vem de tillhör, då går jag genast till vaktmästaren och lämnar in pengarna eftersom att jag förväntar mig att någon annan skulle göra det om jag tappade mina pengar. om jkag går på gatan och hittar femhundra kronor, då skulle jag inte gå till polisstationen och lämna in dem, då skulle jag nog behålla pengarna.

Det finns många andra probem i filmen, som pojkar som hamnar i slagsmål, lärare som upptäcker slagsmål och många andra saker, det är svårt att säga hur dessa sorters problem skall lösas. I många fall är man upprörd och arg, jag tror det är bra att försöka behärska sig eller vänta tills man har lugnat ner sig och försöka lösa problemet när man känner sig lite lugnare, då kan man nog lösa saker på ett bättre sätt. Det är ibland bra om man kan få pratamed någon man kan anförtro sig åt, någon man vet attman kan lita på, och då kan man fånågons goda råd om ens problem.

Maria Sandberg  
Den 8 oktober 1998

### Example of a LIN file from the written expository text by a 17-year-old girl [wh07fBEW]

```
<START>att mä<DELETE6>Att männis<DELETE>kor har problem,
<DELETE2> är ingenting ovanligt och de proble jag <LEFT5>m
<RIGHT2><LEFT2><DELETE><RIGHT4> såg i filmen varinge<DELETE4>
inte så annorlunda. att in<DELETE6><CR>Att vara utanför och
iny<DELETE>te få vara med sina kal<DELETE2>s<DELETE>lasskamrater
```

är inget nytt problem, <MOUSE ,170> <MOUSE ,175> <MOUSE ,186>  
 man är annou<DELETE>rlunda och <DELETE18>kanskeär annorlunda  
 <LEFT14> <RIGHT13> <DELETE>på något visoch de<DELETE6> och  
 blir därför utesluten ur gemenskapen, i <DELETE4>. I låg och  
 mw<DELETE>éllanstadiet<LEFT11><DELETE>e<RIGHT11> händedetta  
 ofta med olika peer<DELETE2>rsoner, <DELETE2>, <MOUSE ,294>  
 <MOUSE ,2522> <MOUSE ,328>även i högstadiet vet jag att det<LEFT3>  
 <RIGHT3> förekom. dett<DELETE4>Denna typen av problem tycker jag  
 är det<DELETE3> den värstatypen som finns, att inte ha några  
 vänner att prata <DELETE>, skratta och umgås med är  
 detväs<DELETE>rats<DELETE6> värstz <DELETE2>a som  
 skulle kunna hända mig trr jag. jag såg även andra problem i filmen,  
 vissa ungdomar satt ochh <DELETE2> tjuv <DELETE>kikade på sina  
 klasskams<DELETE>rater<MOUSE ,612> <MOUSE ,5423><DELETE>  
 J<MOUSE ,634> under provtimmer, detta kan antingen bero på att  
 man inte har läst inför provet eller att man helt enkelt hat<DELETE>r  
 problem med att lära sig vissa saker, att <DELETE> inte  
 pl<DELETE3>ö<DELETE>läsa inför ett prov ät<DELETE>r  
 onödigt men det händer alla att man intr<DELETE>e gör det  
 någon gång, men att strunta i det vid varje provtillfälle är dumt  
 eftersom<DELETE>m att<MOUSE ,904> <MOUSE ,918>  
 <MOUSE ,921> <MOUSE ,939> <MOUSE ,895> <MOUSE ,940>  
 man kommer rätt få nytta av kunskapen någon gp<DELETE>ång  
 <MOUSE ,952> <MOUSE ,951><DELETE><DOWN>i  
 framtiden,<DELETE>. man kan <DELETE8> Om man är trött på  
 skolan j<DELETE>kan behöva ett uppehåll några månader eller  
 ett år, sedan j<DELETE>kan man börja igen <DELETE>, med  
 nt<DELETE>ya krafter. <MOUSE ,1040> <MOUSE ,1053>  
 i<MOUSE ,1127> Då kanske man behöver någon som kollar att  
 man hela tiden gör det man ska <MOUSE ,3692> När man  
 å<DELETE>är så liten som man faktiskt<DELETE>kt vardå,  
 är man <DELETE4> man ganska osäker på sig själv, och man  
 vet inte alltid hur man ska hantera olika situationer, det  
 <DELETE4> <DELETE3>. Det kan krävas lite lite lib<DELETE>  
 vs<DELETE>erfarenhet, men inte mycket för att förstå hur  
 ledsen någon kan bli och<DELETE>m man stänger dem ute  
 ur gemenskapen.<MOUSE ,577> <DELETE><MOUSE ,684>  
 <MOUSE ,803>och<MOUSE ,810, 811> Om man <DELETE4>  
 man då är den som är utanför så <DELETE3>p<DELETE>å  
 får man ju försöka att förstå vad det är som gör att man  
 blir utanför, varför man inte är<DELETE3>är <LEFT3>  
 <RIGHT3>fullt accepterad<DELETE>d <DELETE>, man  
 kanske kan göra någonting åt det, jag tror att man måste våga  
 förändra sig själv, våga vara sig själv utan att bli  
 missförstådd<LEFT2>å<RIGHT2>. <MOUSE ,1242>  
 <MOUSE ,1266> <MOUSE ,1685> <MOUSE ,1696>

<DELETE><CR><DELETE2>v<MOUSE ,1720><DELETE>  
 <MOUSE ,1750>göra. Man kan behöva någon som peppe  
 <DELETE>ar en till att fö<DELETE>ortsätta vara flitig med  
 skolarbetet. Om man har svårt att lkärasig kan manbehöva hjälp  
 <MOUSE ,1876> <MOUSE ,1890>vidsidan av den vam<DELETE>nliga  
 skolundervids<DELETE2>sningen <DELETE>, föratt inte  
 a<DELETE>tappa all lust till ski<DELETE>olarbete. <CR><MOUSE ,19374>  
 <MOUSE ,1980>En flicka kom gåendesbakom en kvinna <DELETE>  
 <DELETE>,<LEFT16> <RIGHT16> kvinna tappar <DELETE2>de en  
 pengarsedel<MOUSE ,2025>n<MOUSE ,2049> o<DELETE2>, flickan  
 tarupp sedeln, tvekarett ögonblick innan hon stopparnerdeni sin  
 eh<DELETE>gen ficka.<MOUSE ,2114> <MOUSE ,2118> <MOUSE ,2110>  
 <DELETE><MOUSE ,2111> <MOUSE ,2062> <MOUSE ,2081>  
 <MOUSE ,2139> Detta ärett mersvårt <DELETE9>svårare  
 probö<DELETE>lem, det beror ju förstår<DELETE>s på hur  
 mycketpengardet handlar om <MOUSE ,2203> <MOUSE ,2210>  
 <MOUSE ,2226><DELETE>, om man ska behålla pengarna  
 själv ellerinte, smavete<DELETE>et säger en <DELETE11>t  
 och ens uppfostran sägeren sak medan din hjärnd<DELETE>a  
 sägeran<DELETE2> en anna sak om jag exempel  
 vishittarfemhundrasvenska kronor i skolan utan minsta  
 ning om vemde tillh<DELETE>hör<MOUSE ,2415, 2416>a  
 <MOUSE ,2427> <MOUSE ,24382>, då går jag genast till  
 vaktmästaren och lämna<DELETE>A<DELETE>arin dem  
 <DELETE7> in pengarn a<DELETE>a<DELETE2>a eftersom  
 att jag d<DELETE>förväntar mig ar<DELETE>tt alla  
 <DELETE5>någon annan skulle göra det o <DELETE>m jag  
 tappade mina pengar. <DELETE>om jkag går på gatan och  
 hittar femhun<DELETE>dra kronor <DELETE>, då  
 tr<DELETE2>skulle jag inte p<DELETE>gå till o<DELETE>  
 polisstaionen och lämna in dem då skulle jag nog beg  
 <DELETE>hålla <MOUSE ,2697>,<MOUSE ,2724>  
 pengarna.<MOUSE ,1006> <MOUSE ,1016>  
 <MOUSE ,19822><CR><MOUSE ,1089><CR><CR>  
 <MOUSE ,2740><CR><CR>Det finns många andra probem i  
 filmen , som pojlar <DELETE4>kar som hand<DELETE2>mnar  
 i slagsmål, <MOUSE ,2780, 2781><DELETE2>,<RIGHT34>  
 lärare som uptäcker slagsmål, <DELETE2> och många andra  
 saker <MOUSE ,2827>p<MOUSE ,2868>de<DELETE3>det ärsvårt  
 <LEFT6> <RIGHT6>attsäga <LEFT4> <DELETE><LEFT><DELETE>t  
 <RIGHT4> hur dessa sorters pe<DELETE>roble m<DELETE2>m  
 skall lösas. i m<DELETE3>I många fall är man upprördoch arg  
 <DELETE>, jag tror det är bra att försöka behärska sig eller vänta  
 tills man harlugnat b<DELETE>ner sig <MOUSE ,3034>  
 <MOUSE ,3051>och försöka lösa problemet m<DELETE>nå  
 <DELETE>är man kännersig <MOUSE ,2866>,<MOUSE ,2956>

<MOUSE ,3094> <MOUSE ,3099>lite lugnare, då t<DELETE>kan  
man nog lösa saker på ett bättre sätt. <MOUSE ,3150>  
<MOUSE ,3144> <MOUSE ,31582>Det är ibland bra om  
man kan få prqt<DELETE2>atamed någon man kan anförtro  
sig åt, någon man vet att man kan lita på, och s<DELETE>då  
kan man få någon <DELETE>s goda råd om ens pron<DELETE>blem.  
<CR><CR>Maria Sandbe<DELETE>rg<DELETE2>rg <CR>Den 8  
oktober 1998<MOUSE ,3341>

### Example of a LOG file from the written expository text by a 17-year-old girl [wh07fBEW]

The LOG file from even a very short text tend to be rather long. The LOG file of this girl is for instans 79 pages! Below is represented as far as the example from the linear file in Chapter 6.

```
time type from to key
0.00 10 2 0 <START>
13.03 7 0 0 a
13.18 7 1 1 t
13.33 7 2 2 t
13.45 7 3 3
13.81 7 4 4 m
14.43 7 5 5 ä
15.08 5 6 6 <DELETE>
15.26 5 5 5 <DELETE>
15.43 5 4 4 <DELETE>
15.61 5 3 3 <DELETE>
15.80 5 2 2 <DELETE>
16.08 5 1 1 <DELETE>
16.81 7 0 0 A
17.31 7 1 1 t
17.46 7 2 2 t
17.63 7 3 3
17.90 7 4 4 m
18.30 7 5 5 ä
18.63 7 6 6 n
18.78 7 7 7 n
19.01 7 8 8 i
19.38 7 9 9 s
19.85 7 10 10 l
20.21 5 11 11 <DELETE>
20.63 7 10 10 k
```

20.90 7 11 11 o  
21.31 7 12 12 r  
21.48 7 13 13  
21.83 7 14 14 h  
21.96 7 15 15 a  
22.18 7 16 16 r  
22.38 7 17 17  
22.86 7 18 18 p  
23.31 7 19 19 r  
23.70 7 20 20 o  
24.05 7 21 21 b  
24.53 7 22 22 l  
24.61 7 23 23 e  
24.98 7 24 24 m  
25.61 7 25 25 ,  
25.76 7 26 26  
26.26 5 27 27 <DELETE>  
26.48 5 26 26 <DELETE>  
27.36 7 25 25  
28.36 7 26 26 ä  
28.80 7 27 27 r  
28.96 7 28 28  
29.41 7 29 29 i  
29.68 7 30 30 n  
30.08 7 31 31 g  
30.25 7 32 32 e  
30.51 7 33 33 n  
30.83 7 34 34 t  
31.25 7 35 35 i  
31.65 7 36 36 n  
31.98 7 37 37 g  
32.16 7 38 38  
33.06 7 39 39 o  
33.56 7 40 40 v  
33.83 7 41 41 a  
34.01 7 42 42 n  
34.61 7 43 43 l  
34.86 7 44 44 i  
35.21 7 45 45 g  
35.43 7 46 46 t  
35.68 7 47 47  
36.85 7 48 48 o  
37.20 7 49 49 c  
37.45 7 50 50 h  
37.65 7 51 51  
37.86 7 52 52 d

37.95 7 53 53 e  
38.25 7 54 54  
39.56 7 55 55 p  
40.95 7 56 56 r  
41.45 7 57 57 o  
42.06 7 58 58 b  
42.66 7 59 59 l  
42.75 7 60 60 e  
43.48 7 61 61  
44.38 7 62 62 j  
44.61 7 63 63 a  
44.81 7 64 64 g  
45.00 7 65 65  
48.93 8 66 66 <LEFT>  
49.15 8 65 65 <LEFT>  
49.33 8 64 64 <LEFT>  
49.55 8 63 63 <LEFT>  
49.90 8 62 62 <LEFT>  
51.01 7 61 61 m  
51.15 7 62 62  
52.23 8 63 63 <RIGHT>  
52.43 8 64 64 <RIGHT>  
53.08 8 65 65 <LEFT>  
53.30 8 64 64 <LEFT>  
54.16 5 63 63 <DELETE>  
56.40 8 62 62 <RIGHT>  
56.60 8 63 63 <RIGHT>  
56.83 8 64 64 <RIGHT>  
57.01 8 65 65 <RIGHT>  
58.61 7 66 66  
59.51 7 67 67 s  
59.83 7 68 68 à  
60.33 7 69 69 g  
60.48 7 70 70  
60.73 7 71 71 i  
60.93 7 72 72  
61.48 7 73 73 f  
61.98 7 74 74 i  
62.41 7 75 75 l  
62.76 7 76 76 m  
63.03 7 77 77 e  
63.08 7 78 78 n  
63.26 7 79 79  
64.36 7 80 80 v  
64.55 7 81 81 a  
64.70 7 82 82 r

65.75 7 83 83 i  
 66.25 7 84 84 n  
 66.53 7 85 85 g  
 66.75 7 86 86 e  
 68.46 5 87 87 <DELETE>  
 68.68 5 86 86 <DELETE>  
 68.90 5 85 85 <DELETE>  
 69.20 5 84 84 <DELETE>  
 70.81 7 83 83  
 71.75 7 84 84 i  
 72.01 7 85 85 n  
 72.30 7 86 86 t  
 72.53 7 87 87 e  
 72.63 7 88 88  
 72.98 7 89 89 s  
 73.18 7 90 90 à  
 73.38 7 91 91  
 73.60 7 92 92 a  
 73.75 7 93 93 n  
 73.90 7 94 94 n  
 74.13 7 95 95 o  
 74.56 7 96 96 r  
 76.15 7 97 97 l  
 76.40 7 98 98 u  
 76.70 7 99 99 n  
 77.68 7 100 100 d  
 77.80 7 101 101 a  
 85.10 7 102 102 .

**Example of a PTD file from the written expository text by a 17-year-old girl [wh07fBEW]**

0.00 13.03  
 45.00 3.93  
 54.16 2.23  
 77.80 7.30  
 85.28 12.73  
 113.46 2.68  
 135.98 5.05  
 143.48 17.06  
 165.93 2.01  
 170.38 2.03  
 173.11 3.16

194.30 3.43  
198.55 5.20  
212.60 2.28  
244.63 3.43  
255.00 9.25  
279.65 2.91  
282.95 2.05  
285.16 4.96  
292.03 8.93  
302.10 3.55  
315.23 2.06  
317.58 7.90  
331.11 4.23  
335.63 10.33  
361.03 2.96  
394.18 4.81  
426.43 6.13  
446.51 3.18  
454.95 3.20  
458.15 4.58  
476.01 2.15  
479.06 5.85  
487.01 3.86  
493.20 3.91  
542.41 3.16  
618.73 3.91  
623.70 2.81  
630.16 2.28  
632.45 7.11  
639.95 2.78  
645.26 3.58  
665.93 3.46  
669.65 2.30  
673.36 2.51  
681.03 2.61  
733.76 4.40  
738.35 4.86  
747.70 6.60  
754.30 2.33  
778.95 9.05  
789.68 11.83  
821.51 2.48  
836.03 2.08  
845.15 2.31  
861.05 4.73  
873.75 2.45



923.23 5.78  
929.01 5.81  
935.16 2.13  
939.21 8.91  
948.75 3.81  
953.38 2.35  
965.73 2.98  
972.71 2.95  
1012.08 3.30  
1025.86 2.18  
1042.95 2.85  
1054.40 2.75  
1072.58 4.01  
1084.23 2.45  
1086.81 2.25  
1089.06 2.00  
1091.30 2.03  
1093.66 8.91  
1104.85 19.43  
1126.48 2.36  
1131.73 2.88  
1141.26 4.21  
1167.20 2.98  
1178.06 2.98  
1200.83 4.70  
1223.30 2.30  
1246.13 4.16  
1250.30 2.00  
1255.40 4.63  
1264.08 2.06  
1296.65 4.61  
1306.70 5.55  
1312.25 2.21  
1353.30 4.68  
1357.98 2.66  
1367.58 4.11  
1372.11 3.01  
1375.40 2.21  
1377.61 12.45  
1390.06 15.63  
1430.30 2.83  
1443.81 3.85  
1451.30 4.53  
1478.53 2.01  
1495.56 5.86  
1552.01 4.73

1569.35 3.10  
1582.43 4.28  
1638.03 2.76  
1658.31 3.10  
1694.18 6.16  
1701.41 2.20  
1708.08 7.01  
1717.11 8.16  
1725.28 2.78  
1728.86 7.31  
1737.18 3.96  
1742.30 13.31  
1788.70 4.38  
1801.78 24.16  
1838.26 4.90  
1849.91 7.53  
1859.58 8.58  
1903.80 4.80  
1923.03 2.13  
1958.38 5.66  
1981.25 2.78  
1984.98 8.51  
1994.43 4.85  
1999.56 6.76  
2015.33 4.23  
2024.78 4.11  
2037.86 2.40  
2040.50 2.31  
2043.01 2.26  
2046.66 2.60  
2050.58 2.46  
2059.10 3.68  
2108.73 2.46  
2123.98 2.55  
2133.26 3.31  
2137.45 2.31  
2145.80 2.95  
2149.15 44.98

**Example of a DEL file from the written expository text by a  
17-year-old girl [wh07fBEW]**

wh07fBEW.LOG

0 6 0 att mä  
1 1 0 l  
2 2 0 ,  
3 1 0  
4 4 0 inge  
5 6 0 att in  
6 1 0 y  
7 2 0 al  
8 1 0 [7]s  
9 1 0 u  
10 18 0 är anno[9]rlunda och  
11 1 0  
12 6 0 och de  
13 4 0 , i  
14 1 0 w  
15 1 -11 [14]é  
16 2 0 er  
17 2 0 ,  
18 4 0 dett  
19 3 0 det  
20 1 0  
21 1 0 s  
22 6 0 vä[21]rats  
23 2 0 z  
24 2 0 h  
25 1 0  
26 1 0 s  
27 1 -71 j  
28 1 0 t  
29 1 0  
30 3 0 plu  
31 1 0 [30]ö  
32 1 0 t  
33 1 0 r  
34 1 0 m  
35 1 0 p  
36 1 -2 r  
37 1 0 ,  
38 8 0 man kan  
39 1 0 j  
40 1 0 j  
41 1 0  
42 1 0 t  
43 1 0 å  
44 1 0 k  
45 4 0 men

46 4 0 det  
47 3 0 , [46]  
48 1 0 b  
49 1 0 s  
50 1 0 c  
51 1 0  
52  
53 4 0 amn  
54 3 0 så  
55 1 0 [54]p  
56 3 0 ar  
57 1 0 n  
58 1 0  
59 1 10 w  
60 2 0 v[59]<CR>  
61 1 25 m  
62 1 0 e  
63 1 0 ö  
64 1 0 m  
65 2 0 ds  
66 1 0  
67 1 0 a  
68 1 0 i  
69 1 0  
70 1 0 [69]  
71 2 0 r  
72 2 0 o  
73 1 0 h  
74 1 0  
75 9 0 mersvårt  
76 1 0 ö  
77 1 0 r  
78 1 15  
79 1 0 e  
80 11 0 t säger en  
81 1 0 d  
82 2 0 an  
83 1 0 h  
84  
85 1 0 A  
86 1 0 [85]A  
87 7 0 in dem  
88 1 0 a  
89 2 0 [88]a  
90 1 0 d  
91 1 0 r

92 5 0 alla  
93 1 0  
94 1 0  
95 1 0 r  
96 1 0  
97 2 0 tr  
98 1 0 p  
99 1 0 o  
100 1 0 g  
101 4 0 lar  
102 2 0 nd  
103 2 -35 ,  
104 2 0 ,  
105 3 0 de  
106 1 0  
107 1 -3 t  
108 1 0 e  
109 2 0 m  
110 3 0 i m  
111 1 0  
112 1 0 b  
113 1 0 m  
114 1 0 à  
115 1 0 t  
116 2 0 qt  
117 1 0 s  
118 1 0  
119 1 0 n  
120 1 0 e  
121 2 0 [120] 'n

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