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Written Language Development in Adolescents

Pause patterns and syntax in the writing process
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Abstract

In this study pause patterns during writing were investigated and compared in a developmental perspective. The material consisted of keystroke logging recordings of the writing process of 30 expository texts written by 30 persons from the age groups 13-year-olds, 15-year-olds and 17-year-olds. A total number of 3080, all pauses longer than two seconds, were identified and categorized, according to the syntactic context in which they occur as initial, medial or final pauses at paragraph, clause, phrase and word boundaries. The additional categories paragraph initial and editing pauses were used, a total number of eleven different categories.

The results showed that the 17-year-olds spent significantly more pause time in the production of phrases than the younger age groups. Other results pointed in the same direction and the interpretation of this result is in line with cognitive views of written language production where processes that are more demanding manifest themselves as pauses. It is also in line with developmental models that point out that one important trait of language development in adolescence is expanding noun and other phrases.

KEYWORDS: writing development, keystroke logging, writing processes, pauses in writing, syntax in writing development

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1 Introduction

The aim of this study is to explore adolescent writing development by investigating pauses during the production of a written text. For a long time influential linguists considered language development to be basically completed by the age of four or five (Scott 1988). Consequently, research on adolescents has been quite rare. However, during the last two decades or so, quite some effort has been made to elucidate the fact that there is more than just a superficial difference between an efficient text crafted by a professional writer and an essay written by a young schoolchild or even a college student. Also, assuming that pauses in writing as well as in speech to some extent disclose the cognitive processes behind text production, such as what tasks are cognitively more exhausting and what tasks are executed with less effort, researchers have started to engage in this line of investigation. Besides, the design of keystroke logging software like ScriptLog has immensely facilitated inquiries into the writing process in all its real-time detail without interfering unnecessarily with it. In this study, pauses during the writing of an expository text by a group of adolescents; 13-, 15- and 17-year-olds, are categorized and studied according to the syntactic context in which they occur. Since pause studies make up quite a new field of research, especially in a developmental context, my study is an explorative one. I start out with a review of descriptions of writing development and models of language production and of earlier research, then go on to introduce my research questions, hypotheses and the method used before I present and discuss the results of this study.

2 Background

In this section I bring to the fore some important aspects of writing development and written language production as well as some current viewpoints on cognitive development and the constraints of working memory. I also make an overview of early and recent studies into pauses and other details of the writing process and their methodology.

2.1 What is writing development past learning to read and write?

As mentioned in the introduction, the prevalent description of language development has to a great extent been limited to preschool and early school ages. I try to make some amends in this section by concentrating on descriptions of language growth in adolescence.

2.1.1 Descriptions of later language development

As late as in 2009 Debra Myhill made a review over research on written language development and went so far as to say that “research, which focuses on secondary writers and their linguistic development is virtually nonexistent” (Myhill 2009:405). However, the studies that had been made, according to Myhill, suggested that there are at least two important points to consider: The first one is evidence of an increasing syntactic complexity (for example longer clauses and sentences, increased use of subordination, decreased use of personal pronouns, more complex noun phrases and more frequent use of passives) as well as of a greater lexical diversity and density. (Lexical diversity measures vocabulary variation – how many different words are used in a text, whereas lexical density is the proportion of content words in a text. Both lexical diversity and density can be calculated in several different ways.) An increase in both of these lexical measures depends to a high degree on the expansion of phrases, especially the noun phrases. Myhill’s second point had to do with the effective use of the linguistic tools to achieve rhetorical and stylistic goals and to integrate reader perspective. That is: to have a bigger toolbox available, to be able to choose the most effective tools and, not least, to be able to refrain from using the ineffective ones, in consideration of the communicative situation and goal. She mentioned for example that Massey (2006) reported an increased use of simple sentences with growing age.

Ronald Kellogg took a slightly different view when describing the development of writing ability in three stages: knowledge-telling, knowledge-transforming and knowledge-crafting (Kellogg 2008). He started out with a comparison of speech acquisition and learning to write a good text. Kellogg’s main point in this comparison was that writing, in contrast to speaking, has a lot in common with learning to master another cognitively complex and culturally acquired art like chess or a playing a musical instrument. Learning to write at the stage of knowledge-crafting takes at least two decades of “maturation, instruction and training” (Kellogg 2008:3). He referred to Bereiter and Scardamalia who famously introduced the two first stages knowledge-telling and knowledge-transforming in 1987. The different stages were defined as different ways of managing (or not managing) the material in the text: in knowledge-telling the author really only discharges of what she knows, in knowledge-transforming she transforms the knowledge for her own benefit and learns while writing. Not unless she trains to become a skilled writer does she reach the third stage which can be described as mastering the craft of designing the text for the benefit of the reader.

In her doctoral thesis, investigating spoken and written text production from a developmental and genre perspective, Victoria Johansson found an indication of a developmental step somewhere between the ages of 13 and 17 (Johansson 2009). 13-year-olds did not seem to differ from 10-year-olds, and 17-year-olds not from university students. Describing developmental patterns with the help of a number of text production measures, this result was obvious when it came to text length (number of words, clauses and T-units). However, when she compared other measures like words per clause and words per T-unit (approximately equivalent to words per sentence) 13-year-olds had higher values than 10-year-olds. Also, looking closer at the writing process with the help of keystroke logging she found that 13-year-olds edited significantly more. Johansson analyzed pauses, too, but their distribution during the writing session rather than their location, syntactic or otherwise, and mainly in a genre perspective.

2.1.2 The role of syntax in later language development

So what does the “increasing syntactic complexity” referred to by Myhill (2009) in the preceding section really look like? Cheryl M. Scott is one of the scholars that highlights the fact that syntax is of great importance when it comes to later language development (Scott 1988). In her chapter “Spoken and written syntax” on the nine-through-nineteen age range, she argued that the opinion that children are syntactically full-fledged already at the age of four or five is an ill-informed one. The fact is, Scott claimed, that a lot of significant progress takes place during the years from nine to nineteen, and that it is only because acquisition criteria used for preschoolers are too coarse and directed at the wrong targets that this has not been generally acknowledged. To capture later language development, you need to know that at this later stage it is not so much about *the acquisition* of specific structures but more about adapting the usage, and the frequency of usage, of certain structures to a greater variety of contexts. These contexts include new channels (writing besides speaking), and genres; where a chronological disposition as opposed to a non-chronological one and a personal relationship sender – receiver as opposed to an impersonal one, affect syntax substantially. Language development is also to be able to use the same structures in a wider range of functions, for example hypothetically or more abstractly (Scott 1988).

So what measures can be used to capture syntactic growth at a later stage? Increase in T-unit length is steady through ages but Scott thinks that the increase is too slow, and also that it is overrun by the influence of discourse context, for it to be thoroughly reliable. The increase in clause length as comparison is relevant because clauses get longer by different operations (for

example noun or verb phrase expansion) than does sentence length, which to a high degree increases by more frequent use of subordination. Clause length, however, is greatly influenced by capability and sense of audience. Besides, neither longer clauses nor longer T-units equal syntactic maturity or qualitatively better texts. Subordination index (the number of main and subordinate clauses per T-unit) is another frequently used measure, but according to Scott opinions have been divided as to what exact structures to include among the subordinate clauses. An indirect problem with the subordination index is that it has been allowed to overshadow the more complex picture of syntactic development that includes several other important characteristics. These traits include noun and verb phrase expansion, usage of the expanded noun phrase in new grammatical roles (other than as post-verbal elements), as well as adding discourse-structuring devices like adverbial connectives to the repertoire (Scott 1988). Scott cited one researcher (Loban 1963) who “contended that syntactic development during the school years is concentrated at the phrase level rather than at the clause level” (Scott 1988:68), even though she wanted to modify this statement due to scarcity of data on how development and discourse type influence use and frequency of different subordinate clause types. Another interesting parameter of late syntactic development is the ability to control information structure in sentences via word order (to present new information at the end of sentences rather than at the beginning).

2.2 A cognitive perspective on later language development

2.2.1 Models of language production

An influential model of written language production was created by Flower and Hayes in 1980. In this model three components of the writing process were distinguished: planning, translating (formulating or, in the terminology of Fayol (1999), below, “graphic transcription”) and reviewing, functions which recur on each other throughout the writing process. The introduction of the element of planning into their model of the writing process was highly motivating for pause studies. The model was further developed in 1996 and specified the planning process into process planning and text planning, the latter consisting of conceptual and language planning. Later, the term ‘planning’ was also replaced by the wider ‘reflection’. According to Kristyan Spelman Miller (2006a) who gave a historical overview of theory and research on temporal aspects of language production, theorists will agree on this description or one very like it, even if the terminology differs some. Hayes’ and Flower’s

model also had an impact on the well-known Levelt theory of speech production (Levelt 1989).

Learning to produce an efficient text is to a great extent to learn how to manage the fact that text composition is a multi-complex task that consists of coordinating a number of sub-processes competing for limited attention and working-memory resources. The sub-processes were described by Michel Fayol as: “ [...] both lower-level processes such as graphic transcription, lexical access and syntactic frame construction, and higher-level processes such as elaborating ideas and conceptual relations, thematic processing, maintaining coherence and cohesion and respecting text-type constraint processes” (Fayol 1999:14). He reported of a number of studies, some of them his own, that confirmed for example how lower-level processes like graphic transcription are cognitively a lot less costly for adults compared to children due to the fact that it becomes highly automated with practice. The automating also improves the ability to carry out other tasks concurrently. But not only do inefficient lower-level processes impair performance on higher-level ones – the opposite is true, too. The experience of how students learning a foreign language are perfectly able to produce the correct inflections when this task is explicitly given but not so in a free composition assignment, is well-known to every language teacher. Higher-level processes, however, can only partially be automated by practice and familiarity for example with story schemas and good topic knowledge, according to Fayol. Also adults, but not children, have demonstrated the ability to slow down the speed of production and make pauses longer to adapt to harder or concurrent tasks like revising and planning ahead. What children (in Fayol’s case 8-year-olds) did is that they alternated between the different processes, switching their attention to one thing at the time: planning, formulating and transcribing step by step. According to Fayol this corresponds to the knowledge-telling strategy of Scardamalia and Bereiter, briefly summarized in section 2.1.1 above.

2.2.2 The role of working memory in the development of writing expertise

It has been emphasized by several scholars that working memory, the cognitive focus of present attention, plays an important role in the writing process. Deborah McCutchen sketched a model of how writing expertise is developed on the bases of “fluent language generation processes” and stable knowledge of and familiarity with the conventions of different genres as well as with the subject-matter (McCutchen 2000:13). At the core of her model she placed long-term working memory, LT-WM, a notion introduced by Ericsson and Kintsch in 1995. LT-WM, she said, are the structures of retrieval that makes it possible for the

skilled writer to rapidly access knowledge stored in long-term memory “within the limits of a constrained working memory” (McCutchen 2000:15). Because there is a competition for capacity and processing in working memory, the writer relies on sTable and well practiced knowledge. But not until lower-level processes like transcription, or in Flower’s and Hayes’ model, translation, and spelling, are fluent, can the writer start to build efficient links to the appropriate knowledge in long-term memory. In her own research (McCutchen et al 1994) the results also suggested that only the writers with automated basic processes were able to access knowledge about narratives in LT-WM.

Ronald Kellogg (2008, briefly treated in section 2.1.1 above) also described how the limited capacity of working memory constrains development, and he, too, referred to the concept of the long-term working memory. The writing process does make heavy demands on executive attention, as was witnessed, he told us, by studies where response time to a secondary task was found to be considerably slower when the informant is simultaneously writing compared to when she is performing other cognitive tasks. Apart from planning, formulating and reviewing, a writer needs to juggle different representations of the text (author, text and reader representations) and house interaction between these. All three representations must exist in a sTable form before use can be made of them in planning and reviewing. Kellogg referred to McCutchen (2000) about the ability that is developed by skilled writers to quickly and efficiently link to writing-relevant knowledge in long-term memory. Increased executive control (briefly: the processes that allow for goal-directed action), an effect of the development of the growing brain, notably between the ages of ten and twenty, together with the capacity for abstract thought and the automating of basic writing skills like spelling and handwriting (or typing), go hand in hand with biological maturation in young writers growing up (Kellogg 2008, referring to Kuhn 2006). With experience and training domain-specific knowledge becomes sTable and familiar, so that it can be retrieved rapidly from long-term memory.

2.3 Pause studies

In this section I give an overview of pause studies, their history and relevance. I also report of some important and interesting studies that were made in this area and discuss the pause criterion.

2.3.1 Relevance and history of pause studies

Research in temporal aspects of language production originated with psycho-linguistic studies of speech, and for a long time was also limited to spoken language. The notion that pause studies – location, number and duration of pauses – are relevant is based on the assumption that pauses give indirect but measurable evidence of the demanding cognitive processes such as planning, behind language production. Kristyan Spelman Miller gave a historical overview of theory and research in this area, concentrating on pause studies (Spelman Miller 2006a). It is vital, she stated, to be aware of the indirect nature of the evidence – at this point we cannot establish with certainty what the language producer is actually doing when pausing. Nor is the concept of planning unambiguous as such since in practice it is hard to separate for example pauses for “planning backwards” or revision, reflection and re-reading from “planning ahead”. However, a tentative division of pauses into initial and final, or the equivalent (before and after the language unit chosen), was made for example by Van Waes and Schellens (2002) and also suggested by Åsa Wengelin (2006:112). A corresponding division into the sub-categories *final* and *initial* pauses was made in the present study. Some interesting progress was made on the point of reading during writing (Johansson et al 2008, briefly summarized in section 2.3.5 below). However, it remains a fact that studies established that pausing does not occur randomly, but that there is a strong correspondence between pausing and most obviously grammatical or hierarchical structure (e.g. Goldman-Eisler 1972 in Spelman Miller 2006a). Pauses tend to occur more often, and have a longer duration, at higher levels like paragraph, sentence or clause boundaries than for example within clauses or in word boundaries and it is probable that more than one kind of planning occur at these same points (Spelman Miller 2006a:27).

2.3.2 What is a pause?

The concept of the *pause* – silence during speaking, inactivity during writing – has established itself as a basic in temporal studies of language production during the past forty years or so. Even so, not a lot of discussion had been going on about how to actually define a pause, Åsa Wengelin wrote in “Examining Pausing in Writing: Theory, Methods and Empirical Data” (2006). The most common way to define a pause in speech, according to Wengelin, is every silence of more than 200 milliseconds. When it comes to writing, “[i]ntuitively, a pause is a transition time between two keystrokes, which is longer than what can be expected for the time needed to merely find the next key” (Wengelin 2006:111). In extant research a pause criterion of two seconds had been employed in many cases (including Chanquoy et al 1996,

Spelman Miller 2006b and Wengelin 2002). In other cases one second and even four seconds had been the chosen lower limits (Matsuhashi 1981). One reason for choosing the two-second criterion for the present study would be pragmatic, then, for the sake of comparability between studies. But the two-second-criterion is reasonable also because it “is about twice as long as a ‘normal transition’ even for the slowest writer. A normal transition time was defined as *the median transition time between lower-case letters within words* for each writer” (Wengelin 2006:111). Wengelin reported the values for maximum normal transition times from two different corpora as being 1.083 by a 10-year-old and 0.796 by an adult dyslectic writer. Ideally, an individual pause criterion is needed since transition times vary from individual to individual, something that is obvious from Wengelin’s data in the chapter mentioned.

2.3.3 A seminal pause study

One of the earliest studies of pausing during writing was Ann Matsuhashi’s doctoral dissertation in 1979. Assuming, as researchers of speech had done before her, that pause patterns can reveal something about the cognitive planning processes in language production, she compared pause duration at eight linguistic levels in three discourse types (Matsuhashi 1981). Her informants were four skilled high school students and the (hand-)writing sessions were videotaped and timed for length of pauses before the chosen units. She used a pause criterion of one second or longer except for content words where she used a four-second-criterion.

When it came to syntax – one of the eight linguistic units – average pause length prior to clausal or non-clausal items were measured and compared. Another of the units analyzed was the “abstraction level” of a T-unit in the discourse, inferring the hierarchal position of every T-unit in relation to the one preceding it: superordinate (concluding or moving on to a new subject), coordinate (conjoining, giving more detail or contradicting the latest T-unit), or subordinate (for example explaining or defining the previous T-unit). The results showed that the T-units with a higher abstraction level needed longer planning time than less abstract or subordinate T-units. Other results from this study were that pauses before T-units that start new paragraphs were considerably longer than those before any T-unit, indicating that the opening of a new paragraph is an important opportunity for decision-making. Even though the T-unit boundary frequently was the location of a pause, it was also common for pauses to occur within it, for example before some content words, or before or after function words that indicate the structure of the next clause, like a subordinate conjunction. Matsuhashi

interpreted this as lexical decisions in these cases occurring later in the production process than the decision of what structure to use. It is interesting at this point to note that Goldman-Eisler in 1972, in the context of spoken language production studies, associated lexical and conceptual decision-making with voluntary and creative processes as opposed to syntactic organization which she associated with more automated processes (Spelman Miller 2006a).

Matsuhashi also reported of a strong tendency that generalizing text types (like for example the expository texts in the present study) and persuading text types required more pause time than reporting ones. She attributed this to the fact that the linear organisation of reporting texts does not require the same amount of global planning.

2.3.4 Outcomes of some later pause studies

Spelman Miller listed several more recent studies (Chanquoy 1990, 1996, Phinney and Khouri 1993, Schilperoord 1996) that all agreed on the fundamental fact that increased pause duration correlates with hierarchically higher syntactic units so that the pauses associated with the paragraph, the sentence and the clause are longer than the ones associated with the phrase and the word (Spelman Miller 2006a).

Åsa Wengelin investigated (spoken and) written text production in adults with reading and writing difficulties in contrast to one deaf control group and one hearing control group without these difficulties (Wengelin 2002). She found that the group with reading and writing difficulties made significantly more pauses, especially word internal pauses, and that they spent a lot of effort on spelling. As a contrast, the hearing control group made a lot of typos or misspellings, too, but corrected them immediately and obviously without having to pause word-internally. The preoccupation with spelling for the group with reading and writing difficulties entailed a lower lexical density and diversity, a written language closer to spoken language than the controls.

Luuk van Waes and Peter Jan Schellens compared pause and revision data to investigate differences in the text production process by experienced writers using pen and paper with the same writers using a word processor (van Waes and Schellens 2002, based on data from 1991). They made a distinction between “pauses followed by the formulation of new text [...] and those followed by the revision of existing text” as well as linguistic location; location at sentence or paragraph boundaries or within sentences were distinguished (van Waes and Schellens 2002:837). Their results showed that in computer mode, writers paused more often, but that the pauses made when using pen and paper were longer. Besides, they found that

writers tended to revise more within the sentences when using a computer than when writing with a pen and paper, 78% and 60% respectively. The longest pauses (in both modes) were made at paragraph boundaries, the next longest at sentence boundaries and the shortest within the sentence.

Spelman Miller (2006b) demanded more refined pause location categories than the ones researchers had used up to that point, especially on the word level. She wanted, for one thing, to make it possible to distinguish better between relevant word classes. She also added a discourse-oriented location category called the framing device to her framework. But most of all she wanted to draw our attention to the fact that so far pause researchers had not sufficiently considered the constantly changing status of the language in the on-line writing process that is the focus of the studies. Her own contribution was a set of categories based on the concept of Potential Completion Points. The location of the pause in her system was characterized according to what (possibly) completed structural unit (character, word, phrase, clause and sentence) precedes the pause. For a more detailed description of these levels of pause location see Spelman Miller 2006b:133. She used the Potential Completion Points in a contrastive pause study of L1 and L2-speakers (native speakers and learners of a second language). In her study she found for example longer pauses as well as more frequent pausing among L2-speakers.

To summarise, the most important common denominator of the studies I have outlined above, from Matsuhashi to Spelman Miller, was that pauses at hierarchically higher syntactic levels like paragraph or clause boundaries had a longer duration than pauses at lower levels like phrase and word boundaries, or pauses within words. Moreover, paragraphs and word boundaries were more predictive of pausing than the word-internal location. In addition different genres required different amounts of pausing; generalizing and persuading texts more than reports or narratives. Besides, more frequent and longer pauses were made by younger writers or less skilled ones like L2-speakers, and more frequent pauses, especially word-internally, were made by writers with reading and writing difficulties.

2.3.5 A report about what is pause time can be used for

Roger Johansson, Victoria Johansson, Åsa Wengelin and Kenneth Holmqvist compared how much time was spent reading during writing for four different groups of writers: university students and 15-year-olds with and without reading and writing difficulties (Johansson et al 2008). In this study, the researchers combined data from keystroke-logging (ScriptLog) and

eye-tracking during writing. The subjects carried out two different writing tasks; one expository task and one description of a picture, both about 30 minutes long. One of the most important findings of this study was that the university students *without* reading and writing difficulties spent nearly twice as much time reading their own texts while writing compared to the 15-year-olds *with* those difficulties and independently of genre (Johansson et al 2008:54). However, when only the two groups without difficulties were compared, genre differences were significant and the reading proportion was higher in the expository text than in the picture description. University students and 15-year-olds without reading and writing difficulties spent about 9 and 8% of their time reading respectively. Johansson et al interpreted their results, that reading during writing increased with development and skill (university students without difficulties considered both more skilled and developed than the other groups), as indicating that reading during writing is closely related to high-level cognitive processes like global planning.

3 Research questions and hypotheses

In her doctoral thesis (2009) Victoria Johansson found a quantitative leap in writing development when 13- and 17-year-olds were compared, especially concerning text length and writing time. I wanted to explore whether this leap was reflected in the pause patterns – the syntactic location and duration of pauses during the writing process – of the same writers. I also included a corresponding group of 15-year-olds to be able to investigate where they situated themselves in comparison. Did they write more like the 13-year-olds or more like the 17-year-olds? Had they already initiated or even passed the leap and in what respects?

My hypothesis was that the three age groups would differ concerning the location and duration of pauses during the writing process. I also expected the proportion of the different pause categories to diverge. Earlier research had shown that adult and skilled writers read more during writing than young and inexperienced writers (Johansson et al 2008). Therefore, I expected the 17-year-olds in my study to spend more pause time at paragraph and clause boundaries than the younger age groups. Young and inexperienced writers had been shown to spend more effort on lower-level processes like transcription and spelling proportionally to effort spent at higher levels like clause, paragraph and text-global planning. I therefore expected the 13-year-olds to spend proportionally more pause time at word level and less at the other levels compared to the 17-year-olds. Whether the 15-year-olds would place themselves in between the other two age groups, and whether they would do it on all points

was more of an open question. Development sometimes suffers setbacks and even if a lot of things happen during these ages, there are only two years between the groups. However, I expected the 17-year-olds to spend more pause time in phrase contexts giving testimony to Scott's (1988) description that noun and verb phrase expansion is an important part of writing development.

4 Method

4.1 Participants and data

Data consists of 30 written expository texts, produced by 30 participants. The participants were 30 persons, distributed equally on each of the three age groups 13, 15 and 17 years old. The groups were balanced for gender with five females and five males in each. Instructions were to write an expository text discussing possible reasons and solutions to the problems of cheating and bullying, and the writing process was recorded with the keystroke logging software ScriptLog. Participants were introduced to the topic by watching a short film without a dialogue.

The texts by the 13-year-olds and the 17-year-olds were collected within the Swedish subset of the Spencer Project (*Developing Literacy in Different Contexts and Different Languages*) reported in Berman and Verhoeven 2002. I was given access to the material by my supervisor, Victoria Johansson, who wrote her doctoral thesis on these same texts (Johansson 2009). Even though the material originally included ten more participants in each group, these were excluded in this study. This was to evade impact on the writing process by the fact that they had produced a spoken expository text on the same topic prior to the written text. The participants were monolinguals without reading and writing difficulties. For more details and a discussion about computer literacy and other important factors in participant recruitment see Johansson (2009:47-51).

The ten texts written by 15-year-olds were collected for the study "Reading during writing" (Johansson et al 2008, briefly summarized in section 2.3.5) and were chosen on the same grounds out of a total of 29. The expository writing task was identical to the one within the Spencer Project.

4.2 Keystroke logging

In the keystroke logging program ScriptLog (Strömqvist and Malmsten 1998, Strömqvist and Karlsson 2001) every event in the writing session is recorded, including pauses; their duration and in what “micro-contexts” they occur, and revisions; what deletions and additions are made and at what point of time during the session they occur. This makes it possible to study the dynamics of the process of text production as opposed to the fait accompli of the final product. It is possible to replay the whole writing session, and also to get a linear output file, a printed representation of every keyboard event of the process in the order in which it happened.

Example 1 below is a small sample, from an expository by a 17-year-old boy, of an authentic linear file from the present study. The translation is tentative, made with the aim to capture what happens in the writing process and the overall meaning rather than being a word-by-word translation. Apart from all the keystrokes that result in characters and spaces you see the initial Carriage Return to start a new paragraph: <CR>, then, that after writing the word ‘odödliga’ (*immortal*) the writer had second thoughts and deleted it: <DELETE8>. After that he made a pause with the duration of 4.40 seconds: <4.40>, where possibly he pondered other options, then decided that ‘odödliga’ was the best after all and wrote the same word once more. Then after a couple of more words he discovered that he had left three spaces instead of one after the comma, moved five steps to the left: <LEFT5> and deleted the two spaces: <DELETE2> then back again: <RIGHT5>. A new pause further on: <2.45> was probably used to think of what other examples besides ‘vårt moderna samhälle’ (*our modern society*) could be given, then the writer decided one was enough, and so deleted ‘och alla’ (*and every*) <DELETE9>. Example 2 shows the corresponding final text, where in addition further edits had been made at other points later on in the session (‘odödliga’ was replaced by ‘eviga’ (*eternal*), ‘alla samhällen’ replaced ‘vårt moderna samhälle’:

(1)<CR>Dessa odödliga<DELETE8><4.40>odödliga fundament, varpå<LEFT5><DELETE2><RIGHT5> vårt moderna samhälle och alla <2.45><DELETE9>vilar på. (wh09m, 17 years)

<CR>These immortal <DELETE8><4.40>immortal fundaments, whereupon<LEFT9><DELETE2><RIGHT9> our modern society and every <2.45><DELETE9>rest.

(2) Dessa eviga värden, eller fundament, varpå alla samhällen vilar. (wh09m, 17 years)

These eternal values, or fundaments, whereupon every society rests.

Other output files like the statistics file provide information on the number of edited and linear tokens as well as total time and total pause time above a chosen pause criterion. For examples of a full-length linear file including all pauses longer than two seconds, the kind of file on which this study was based, see Appendix 1. Appendix 2 is the result of the same writing process represented as the fulllength final text. This writing session was executed by a thirteen-year-old male participant (wj10mBEW200). For more detailed information about ScriptLog I refer to “What Keystroke Logging can Reveal about Writing” (Strömqvist et al 2006).

4.3 Procedure

Every pause longer than 2 seconds in the linear files of each of the 30 writing sessions were identified and categorized (see Appendix 1 for an example of a linear file). All of these pauses, a total number of 3080, were categorized according to their syntactic context: clauses, phrases and words. Every pause was also labelled initial, internal or final according to where in relation to the clause, phrase or word it occurred. Additional categories were text and paragraph initial and revision pauses (all categories will be explained thoroughly in section 4.4). Total writing time, total pause time, pause time in proportion to writing time, and number of words were calculated for each individual writing session. Median transition time within words (a measure for keyboard skill and writing speed) in the Spencer project data (the 13- year-olds and 17-year-olds in this study) was investigated by Wengelin (2006) and no major differences were found, so there is no reason to believe that differences in typing speed have affected the results. The total time for each of the different pause categories was calculated along with mean duration for each of them, and also for each of the participants. Furthermore, proportional time for each of the categories to total pausing time was computed. The statistical calculations of significant differences between the age groups were made by my supervisor, Victoria Johansson. We used a univariate ANOVA with Tukeys Post Hoc test (if we found a main effect), and we also carried out a correlation test.

4.4 Pause categories

Below I will present the different pause categories, according to syntactic location, that were used in this study. Following Kristyan Spelman Miller’s concept of Potential Completion Points, it is what happens before the pause that determines the categorization. What (possibly) completed structural unit (word, phrase or clause) precedes the pause at that point? However, because of the ever changing character of language production online, what happens after the

pause is also of interest. Consequently, a description of the language unit after every pause was also made. The category of *the paragraph initial pause* I owe to Ann Matsuhashi (1981). The categories include text overall pauses (*the text initial pause* and *the paragraph initial pause*), pauses in a clause context (*clause initial/ final/ internal*), pauses in a phrase context (*phrase initial, final, internal*) and pauses in a word context (*word initial/ final/ internal*). The distinction between a *clause, phrase* or *word final* pause and an *initial* pause is that the initial pause occurs immediately *before* the structure in question, without a space. Finally, the categories *editing* (or revision) *pauses* and *other pauses* are accounted for.

4.4.1 Text overall pauses

Earlier studies have looked into *text initial* and *text final* pauses and results have showed significant differences between experienced and inexperienced writers (Wengelin 2006, Strömquist et al 2006). Due to differences in the experimental settings (eyemovement tracking for the 15-year-olds) I exclude all text initial and final pauses from this study.

The paragraph initial pause is made after a carriage return (<CR> or <RETURN>). Since many non-expert or developing writers tend to start every new sentence on a new line a check was made with the final edited text to see to what extent writers really used paragraphs. Matsuhashi (1981), who was basically interested in comparing pause duration in different contexts, found that pauses before T-units initiating paragraphs were longer than the ones before all other T-units.

4.4.2 Pauses in a clause context

In the present study *the clause* is the highest syntactic level and no difference was made between main clause and subordinate clause. This means that, contrary to Spelman Miller, for example, I have not distinguished between sentence boundaries and clause boundaries, and contrary to Matsuhashi, I have not distinguished between T-units and clauses. The reason is that for the purpose of the present study, because of the developmental aspect of the clause described in section 2.1.2, that clauses get longer by phrase expansion, it is more interesting to distinguish between phrase and clause. Furthermore, clauses here are syntactic clauses and not graphic clauses, since it is not always, and especially not with young or inexperienced writers, that a clause boundary corresponds to a delimiter (full stop, question mark, comma etcetera).

The pauses at clause level consist of *the clause final pause* which occurs either immediately following a clause (without a space) or after a delimiter finishing a clause, and *the clause initial pause* which is immediately preceding a new clause (without a space). Please note,

however, that pauses occurring *after* coordinators like *och* ('and'), *men* ('but') and *eller* ('or') or subordinators like *för att* ('in order to'), *om* ('if'), *därför att* ('because') or *eftersom* ('since') are analyzed as *clause internal pauses* (even though the succeeding element is analyzed as a clause). To distinguish the clause internal pause from the clause initial is to make it possible to find out the extent to which, in Matsuhashi's (1981:128) words "writers occasionally pause after the function word in a clause or a phrase, indicating that they have not completed all of the semantic or lexical planning", occasions where a choice of a syntactic frame for the next clause seems to have been made before its actual content.

Several researchers have found that pause duration increases with the text unit level or that the sentence boundary context is a more likely location of pauses than the word boundary, or, even less likely, contexts within a word (Wengelin 2006:117, Wengelin 2002). To compare pauses around clause boundaries to those in other contexts in a developmental perspective is therefore potentially very rewarding.

The distinction between a clause final and a clause initial pause is relevant because it could make it possible to spot the differences between time spent in backward-editing of a clause and the forward-planning of a new one. However, even though Åsa Wengelin (2006:112) points out this probability, so far there is no way of knowing to what extent this is so.

In the examples below we find clause initial, clause final and clause internal pauses (in bold). Since all examples are authentic they sometimes include spelling mistakes and/or typos. I have made a tentative translation of these, too (see for example number 4 where Swedish 'kunna' (*know*), mistakenly spelt 'kuna', was translated into 'now'). Example (3) features both a clause initial (2.55) and a clause final (9.50) and on top of that a paragraph initial pause (3.16). In example (4) there is a clause internal pause after the function word *att* (2.76) and a clause initial one (2.28). There are two more clause internal pauses in the following examples (6.936, 5.61), both of them with the duration of around five seconds or more:

(3) Om jag ser några mobba en tjej/kille så kan inte jag gå fram till dom som mobbar **<2.55>**och säga till dom för då är jag rädd att jag skall bli mobbad**<9.50>**.<CR>**<3.16>** (wj06f, 13 years)

*If I see some people bullying a girl/guy then I can't walk up to those who are bullying **<2.55>**and tell them off because then I'm scared that I'm going to be bullied**<9.50>**.<CR>**<3.16>***

(4) När man fuskar sp<DELETE>om dom djorde <LEFT6> <DELETE> g<2.13><RIGHT5> i filmen kan det bero på att <2.76>dom som fuskar_kan inte <2.28>det som dom skulle <3.15>kuna_(wj19m, 13 years)

When you cheat lo<DELETE>ike they ded <LEFT3> <DELETE> i<2.13><RIGHT2> in the film it could be because <2.76>those who cheat_don't know <2.28>the things they ought to <3.15>now_

(5) det <BACKSPACE2> sku<4.272>ller<BACKSPACE>t <BACKSPACE2> tänka för sig själv att det ni<BACKSPACE2>inte är så må<BACKSPACE>ycket pengar och att <6.936>den persin<BACKSPACE2>onen får skulla sig själv. (hc13me, 15 years)

it <BACKSPACE2> sh<4.272>oulde<BACKSPACE>t <BACKSPACE2> think to himself that it in<BACKSPACE2>isn't a lot i<BACKSPACE>of money and that <6.936>that persin<BACKSPACE2>on must bleme herself.

(6) jag tror att <5.61>detgäller<LEFT6> <RIGHT7><DELETE15> det <6.48>gäller att vara ute i tid. (wh10m, 17 years)

I think that <5.61>it'sabout<LEFT5> <RIGHT7><DELETE14> it <6.48>is about being in good time.

4.4.3 Pauses in a phrase context

The next syntactic unit for pause location in my analysis is the phrase. As Åsa Wengelin (2006:118) writes, failing to distinguish phrase boundaries is one of the shortcomings of the automatic micro-context analysis that can be made in ScriptLog. A manual analysis of the pauses around phrase boundaries should therefore contribute with new and interesting data. *The phrase final pause* immediately follows a noun, verb, prepositional or other phrase. Clause adverbials, too, are analyzed as phrases. The verb phrase is here referred to in its extended meaning, where a subjective predicative is seen as part of the verb phrase (Josefsson 2001:100). *The phrase initial pause* immediately precedes, without a space, a phrase of the above definition.

However, a pause within the subjective predicative (consisting of for example an adjective phrase) is also analyzed as a phrase internal pause. *The phrase internal pause*, consequently, can be located between the preposition and the main word in a prepositional phrase (example 7: 4.023 seconds). The categorization of a pause in this location is an instance where I have chosen to differ from Spelman Miller, since I do not find her label of Character Completion Point, the equivalent of my word internal pause, justifiable here. Other possible locations for a phrase internal pause are between the copula verb and the subjective predicative (example 8: 3.45 seconds) or a pause between the determiner and the noun (example 9: 2.58 seconds). In

example 9, there are also two phrase initial pauses (3.13 and 2.28). In example 8 there are two phrase initial (2.50 and 11.56) and one of each of the other two kinds of pauses connected with the phrase (2.61 phrase final and 3.45 phrase internal). Example 10 shows a phrase internal pause (2.450), located between the determiner and the noun. All pauses in a phrase context below are in bold.

(7) och osanna rykten om **<4.023>**människor (hc04fe, 15 years)

*and untrue rumours about **<4.023>**people*

(8) Men i bland kan det vara så att **<2.50>**dom**<2.61>** **<11.56>**vill vara**<3.45>**coola
(wj10m, 13 years)

*But some times it can be that **<2.50>**they**<2.61>** **<11.56>**want to be**<3.45>**cool*

(9) så gör det mig **<3.13>**nästan **<2.28>**till en **<2.58>**medbrottsling. (wj06f, 13 years)

*then it nearly **<3.13>**makes me **<2.28>**an **<2.58>**accomplice.*

(10) Den första **<2.450>**scenen i filmen utspelade sej<BACKSPACE2>ig i ett
kls<BACKSPACE>assrum under ett prov et<BACKSPACE>ller läxföröhr<BACKSPACE>ör
(hc17me, 15 years)

*The first **<2.450>**scene in the film was <BACKSPACE4>took place in a
cls<BACKSPACE>assroom during an exam ot<BACKSPACE>r a test on homework<BACKSPACE>rk*

4.4.4 Pauses in a word context

The word final pause and the word initial pause immediately succeed and precede a word respectively. Most of the pauses classified as word final or word initial can be found in editing contexts where you can only see the isolated word amidst a number of cursor movements, deletions and other edits. In these cases there is no possibility of saying anything about the context surrounding it, like whether it is a phrase or part of a phrase. This is the case in examples 11 to 13 below (word final or initial pause in bold).

(11) **><2.21>**hejsan<DELETE6><CR><CR><CR><2.05>Hejsan hur mår
fu<2.01><DELETE2>du<DELETE20> (wj06f, 13 years)

***><2.21>**hi<DELETE2><CR><CR><CR><2.05>Hi how are yu<2.01><DELETE2>you<DELETE15>*

(12) RETURN2><BACKSPACE><UP><RIGHT5><LEFT2>tycker**<3.221>**<RIGHT32><2.530> (hc17me,
15 years)

*RETURN2><BACKSPACE><UP><RIGHT5><LEFT2>think**<3.221>**<RIGHT32><2.530>*

(13) ><MOUSE ,2084, 2085> lätt**<2.00>** <38.33><MOUSE ,1287>, (wh06f, 17 years)

><MOUSE ,2084, 2085> easy<2.00> <38.33><MOUSE ,1287>,

Apart from being located in the middle of a word, in this analysis *the word internal pause* can also be located between an auxiliary and a main verb within a verb phrase (see examples 14; 3.15, and 15; 3.11 below). I chose this classification in line with Spelman Miller's categories (2006:134). Another possibility would be to categorize such a pause as phrase internal.

Earlier research has shown that younger, unskilled writers as well as those with reading and writing difficulties pause significantly more often in word internal positions than adult, skilled writers do (Wengelin 2002). This is explained as a preoccupation with lower-level processes like spelling and the act of putting words onto paper. See example 16; 2.91 and 2.11. However, the word internal pause now and then seems to reflect something else, maybe the planning of the whole clause, like in example 17 (5.063).

(14) När man fuskar sp<DELETE>om dom djorde <LEFT6> <DELETE> g<2.13><RIGHT5> i filmen kan det bero på att <2.76>dom som fuskar kan inte <2.28>det som dom skulle <3.15>kuna (wj19m, 13 years)

When you cheat lo<DELETE>ike they ded <LEFT3> <DELETE> i<2.13><RIGHT2> in the film it could be because <2.76>those who cheat_don't know <2.28>the things they ought to <3.15>now_

(15) Förmodligen har de någon go<DELETE>ång <3.11>bidragit till att (wh08f, 17 years)

Probably they have at sime to<DELETE>ime <3.11>contributed to

(16) som på skolfotot när <5.05>tj<2.91>ejern««<DELETE3><2.11>na <6.73>lutar sig utanför (wj17f, 13 years)

like in the school photo when <5.05>gr<2.91>the gr««<DELETE3><2.11>irls <6.73>lean away

(17) H<5.063>ur kan man motvek<BACKSPACE>rka mobbning (hc15me, 15 years)

H<5.063>ow can you obsr<BACKSPACE>truct bullying (hc15me, 15 years)

4.4.5 Editing pauses

Some examples of *editing pauses* occur when the writer discovers a spelling mistake made in a word written earlier and goes back to correct it (example 18; 3.90). Others occur when the writer decides to express her/himself differently, for example by removing words or phrases or adding them, like in example 19 (11.40) or when writers move back and forth in the text but decides not to change anything (20; 5.282 and 2.065).

(18) de proble jag <3.93><LEFT5>m <RIGHT2><LEFT2><DELETE><2.23><RIGHT4> såg i
filmen (wh07f, 17 years)

the problem I <3.93><LEFT3>ms <RIGHT2><LEFT2><DELETE><2.23><RIGHT4> saw in the film

(19) tror att dom e<DELETE>äe<2.13><DELETE>r <3.60>coola<10.90> för att<2.11> do
<DELETE>m<39.15><DELETE3><11.40><DELETE9>.<CR><CR><5.70>MOBBNING (wj19m, 13 years)

*think that they r<DELETE>arr<2.13><DELETE>e <3.60>cool<10.90> because<2.11> thr
<DELETE>ey<39.15><DELETE4><11.40><DELETE9>.<CR><CR><5.70>BULLYING*

(20) Just dessa små saker<LEFT4><UP><5.282><LEFT18><DOWN><2.065><RIGHT20> (hc02fe,
15 years)

Exactly these little things<LEFT4><UP><5.282><LEFT18><DOWN><2.065><RIGHT20>

4.4.6 Other pauses

The category *other pauses* consists solely of four examples of pauses made when reeling off a long list of numbers, in itself a kind of rest from the act of writing.

5 Results

In total 3080 pauses were coded. I present the results firstly with the goal to give an overview of how much time the informants spent writing and pausing and of how many words they produced. Secondly I present Figures on the number of tokens remaining in the final text compared to the total number of tokens written during the whole writing process and what these Figures tell us about editing activity in the different age groups. Lastly I report average pause time in different contexts and how the total pause time was distributed in the different syntactic contexts.

5.1 Time spent writing and pausing and outcome in number of words

Starting out by looking at the 13-year-olds we find that the individual variation was great (Table 5.1). The mean time spent writing was close to 25 minutes (1472 seconds), but figures ranged from 459 to 2350 seconds. The corresponding figures on time spent pausing were 832 seconds (mean), with a minimum of 216 and a maximum of 1706 seconds. The mean proportional time spent pausing was 53% with a minimum of 25% and a maximum of 76%. The result was a text with the mean number of words of 233, ranging from 72 to 484. When taking a closer look at one example, 06f, it was demonstrated clearly that the writing process with the next longest writing time and the longest and highest proportion of pausing time did not result in the longest text, but in a text of 163 words, far below the mean of 233 words.

Table 5.1: Total writing and pause time in seconds, percentage pause time of total writing time and number of words for each one of the writing sessions by 13-year-olds. Mean, minimum and maximum times are also given.

Informant	total writing time	total pause time	pause time, percentage of total	no of words
13 years				
06f	2237	1706	76%	163
07f	867	216	25%	220
08f	1313	722	55%	313
09m	459	216	47%	100
10m	1443	815	57%	142
16f	1618	723	45%	267
17f	1826	917	50%	484
18m	1368	998	73%	72
19m	1238	513	41%	288
20m	2350	1493	64%	281
Mean	1472	832	53%	233
Minimum	459	216	25%	72
Maximum	2350	1706	76%	484

Moving on to the results of the 15-year-olds (Table 5.2), the mean time spent writing was very close to that of the 13-year-olds (1496 seconds compared to 1472), but variation in minimum and maximum, even if substantial, was not as great as for the younger age group. Here the range was 808 seconds to 2017, and the corresponding figures for the 13-year-olds were 459 to 2350 seconds. However, with the 15-year-olds, variation in proportional pause time was even greater, ranging from 15% to 94% with a means of 50% (13-year-olds 53%). 01fe produced the third longest text, 526 words, a number which was 41% above mean, in the second shortest writing time of the 15-year-olds, the shortest pause time and the lowest proportional pause time in all texts, irrespective of age.

Table 5.2: Total writing and pause time in seconds, percentage pause time of total writing time and number of words for each one of the writing sessions by 15-year-olds. Mean, minimum and maximum times are also given.

informant	total writing time	total pause time	pause time, percentage of total	no of words
15 years				
01fe	812	120	15%	526
02fe	1799	758	42%	410
03fe	808	758	94%	310
04fe	1674	758	45%	545
05fe	1519	758	50%	616
13me	1718	812	47%	312
14me	1884	1146	61%	219
15me	1619	752	46%	230
16me	1108	376	34%	316
17me	2017	1227	61%	245
Mean	1496	746	50%	373
Minimum	808	120	15%	219
Maximum	2017	1227	94%	616

A clear difference in writing time appeared in the Figures for the 17-year-olds (Table 5.3). They wrote for a significantly longer time ($F(2,29)=10,754$, $p < 0.000$). Their mean total writing time was 2282 seconds (38 minutes) as compared to 1496 and 1472 for 15-year-olds and 13-year-olds respectively. The difference between 13- and 15-year-olds, as seen above, was very small. The percentage pause time of total time is a little lower in the 17-year-olds, 41 % of the total writing time as compared to 53% for the 13-year-olds and 50 % for the 15-year-olds but this difference was not statistically significant. The individual variation in the 17-year-olds at all points; writing time, pause time, proportional pause time and number of words, was much smaller. There was a significant difference for age in the number of words, where the 17-year-olds differed from the 13-year-olds ($F(2,29) = 6.908$, $p < 0.001$) whereas 13- and 15-year-olds did not differ from each other and neither did 15- and 17-year-olds.

Table 5.3: Total writing and pause time in seconds, percentage pause time of total writing time and number of words for each one of the writing sessions by 13-year-olds. Mean, minimum and maximum times are also given.

informant	total writing time	total pause time	pause time, percentage of total	no of words
17 years				
06f	2277	954	42%	410
07f	2194	703	32%	593
08f	2120	799	38%	487
09m	2465	941	38%	518
10m	2628	941	36%	664
16f	2162	695	32%	578
17f	2174	853	39%	463
18m	2246	1006	45%	451
19m	1812	859	47%	426
20m	2744	1553	57%	337
Mean	2282	930	41%	493
Minimum	1812	703	32%	337
Maximum	2744	1553	57%	664

5.2 Number of linear and final tokens, edited tokens

“Linear tokens” - the total number of tokens written, including the ones deleted during some stage of the writing process, were compared to “final tokens”, the number of tokens that remained in the final text after editing. The differential between these two gives us an understanding of how great part of what was written was actually edited.

In Table 5.4 the means of linear tokens, final tokens and edited tokens as well as edited tokens in percent of linear tokens are shown for each age group.

Table 5.4: Linear, final, edited tokens and edited tokens in percent of linear tokens. Means as well as minimum and maximum for edited tokens in percent of linear tokens for each age group.

	linear tokens	final tokens	edited tokens	edited tokens in percent of linear tokens	minimum	maximum
13-year-olds	1811	1228	583	35%	14%	62%
15-year-olds	2269	1972	297	14%	0,5%	35%
17-year-olds	4506	2875	1631	35%	18%	49%

In Figure 5.1 it is possible to see how these measures were distributed on all three age groups. There was a significant effect of age on all three measures. Firstly, for the number of linear tokens ($F(2,29) = 27.637, p < 0.000$). Post hoc tests revealed that the 17-year-olds differ from the other two age groups, but there is no difference between the 13- and the 15-year-olds. Secondly, for tokens in final text ($F(2,29) = 15.260, p < 0.000$), and post hoc tests showed that in this respect there are significant differences between all three groups. The 13-year-olds have the lowest number, the 15-year-olds place themselves second and the 17-year-olds have the highest number of tokens in final text. Finally, for the percentage of edited tokens (edited tokens/ linear tokens): ($F(2,29) = 8.742, p < 0.001$). Post hoc tests revealed that the 15-year-olds delete significantly less than any of the other two age groups.

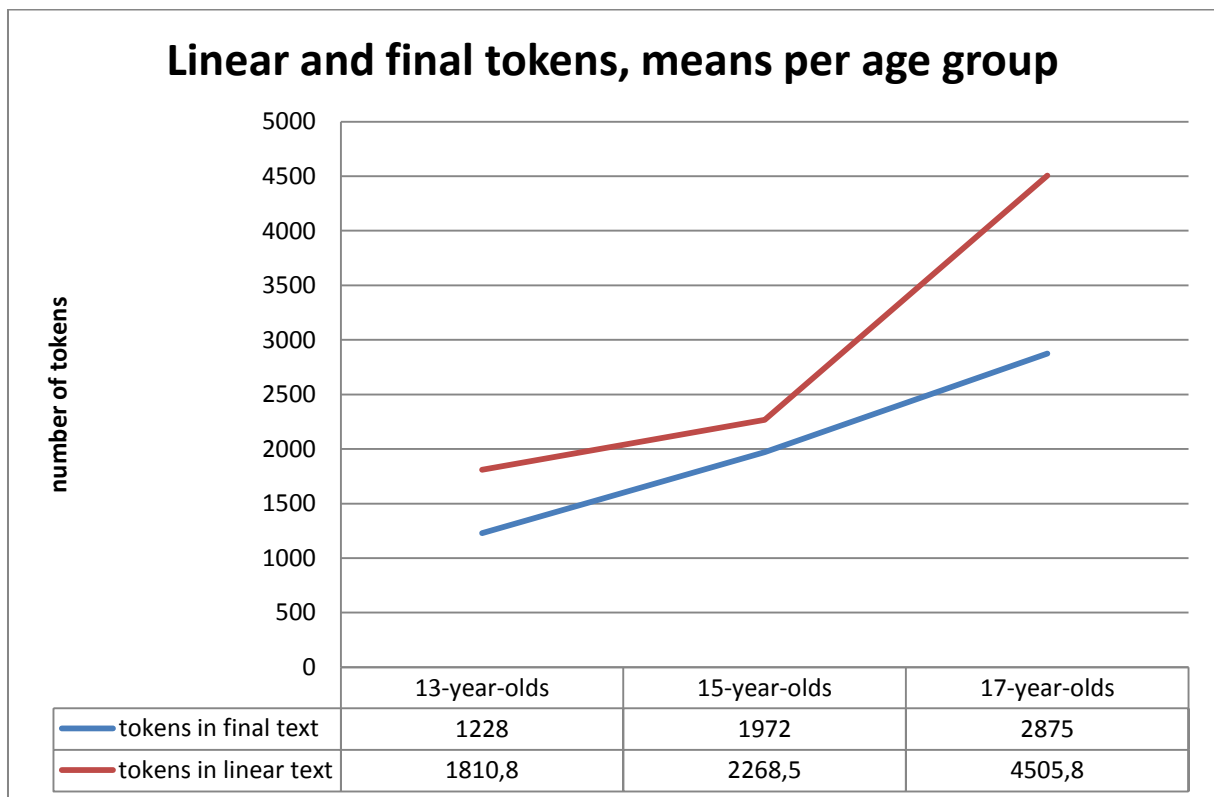


Figure 5.1: The total number of tokens in the linear and the final text, means for the three age groups. The differential between the two can be read as edited tokens.

5.3 Average pause duration for the different syntactic contexts

Mean pause duration for each of the specific syntactic contexts, for example phrase initial or word internal, was calculated for every informant. No statistically significant differences were found between the age groups. In Figure 5.2 you can see that the means for clause boundary pauses was longer than the means for phrase and word boundary pauses. The word initial context only occurred once in the 15-year-olds.

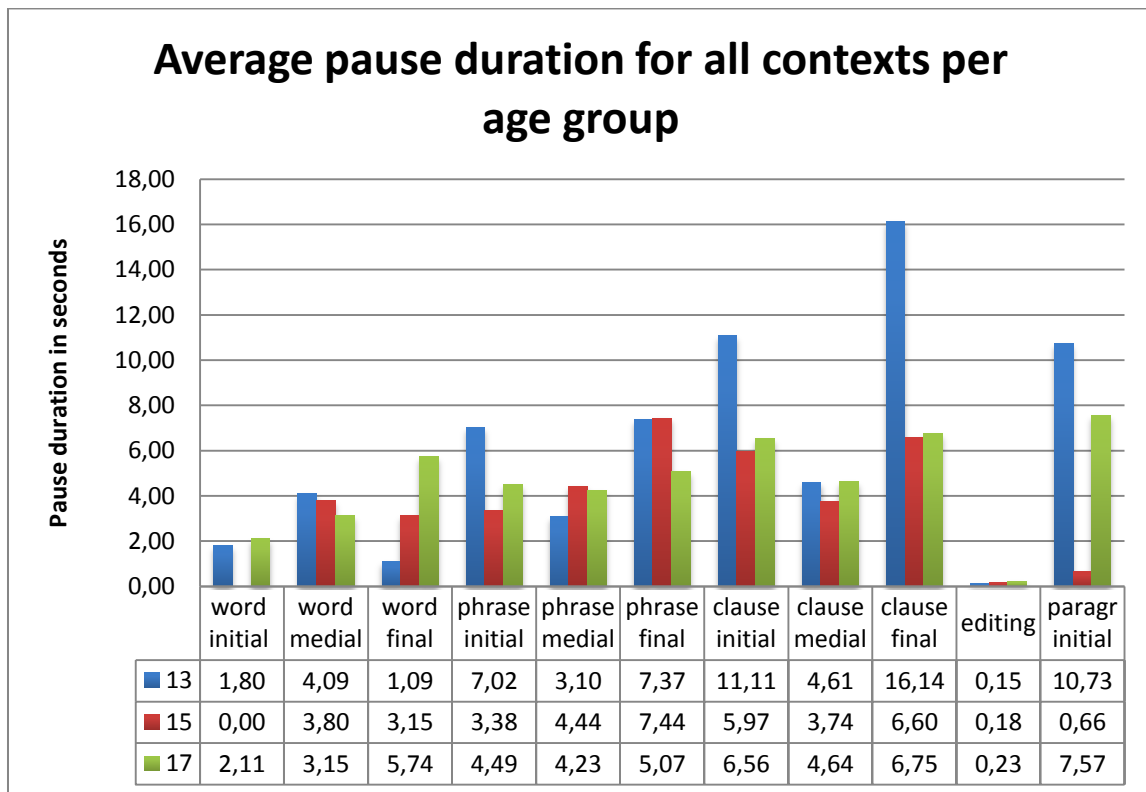


Figure 5.2: Average pause duration for all contexts per age group (total pause time for each context/ number of pauses in the same context).

5.4 Percentage of total pause time for the different contexts

This measure represents how great part of the total pause time a writer spent in the different contexts. To start with, I report the totals from the main categories word, phrase and clause boundaries and then go into some detail within those groups.

In Figure 5.3 the three main categories word, phrase and clause boundary pauses are represented as percentage of the total pause time for the three age groups. Clause boundary pauses taken together showed no statistically significant differences between the age groups. The same went for word boundary pauses. Phrase boundary pauses, however, show significant differences for age ($F(2,29)=5,765$, $p=0.008$). Post hoc tests of all age groups

showed that only the 17-year-olds differ significantly from the other two age groups. After that the contexts with significant age differences were studied in detail.

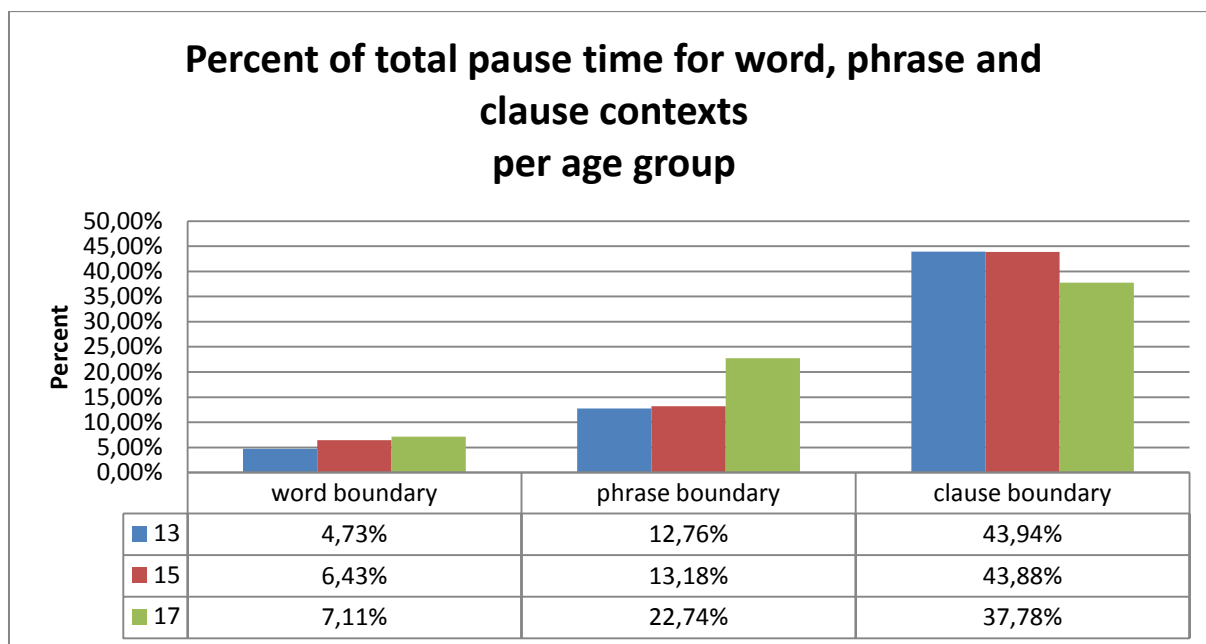


Figure 5.3: Percent of total pause time for word, phrase and clause contexts per age group.

5.4.1 Pause time spent in significant sub-contexts

Statistical calculations were made for the percentage of the total pause time made up by all the different sub-contexts, meaning that this gives a picture of how the writer distributed her pause time. Table 5.5 shows the means for each age group for the four contexts; phrase initial, phrase internal, word final and paragraph initial, which showed significant differences. The same numbers are graphically represented in Figure 5.4. Did the writer choose to (or need to) devote more time to certain contexts that were more difficult and therefore needed more attention?

Table 5.5: Percentage of total pause time for four significant sub-contexts.

age	phrase initial	phrase internal	word final	paragraph initial
13	5,49%	2,87%	0,31%	5,22%
15	3,22%	5,68%	1,02%	0,22%
17	8,49%	8,78%	3,06%	2,73%

For the *phrase-initial* pause time proportional to total pause time there was a significant difference in age ($F(2,29) = 6.567, p = .005$). 15-year-olds had the shortest proportional pause time before phrases and 17-year-olds the longest. 13-year-olds placed themselves in between, and they did not differ from any of the other groups.

Furthermore, time spent on *phrase-internal* pauses differed significantly between the age groups ($F(2,29) = 8.347, p = .02$). The 13-year-olds had a lower proportion than the 17-year-olds. 15-year-olds did not differ from any of the other groups.

In addition, when it comes to how great part of the pause time that consisted of *word-final* pause time, there was also a significant difference between the age groups ($F(2,29) = 5.026, p = .04$). Post hoc analyses showed that 13-year-olds and 17-year-olds differed, while 15-year-olds did not differ from any of the other groups. Thus, the 13-year-olds spent a significantly lower part of their pause time after words compared to the 17-year-olds.

For *paragraph-initial* pause time proportional to total pause time there was a significant difference in age ($F(2,29) = 6.993, p = .004$). Here, 13-year-olds had the greatest proportion of pause time, and 15-year-olds the lowest proportion. 17-year-olds did not differ from any of the other groups.

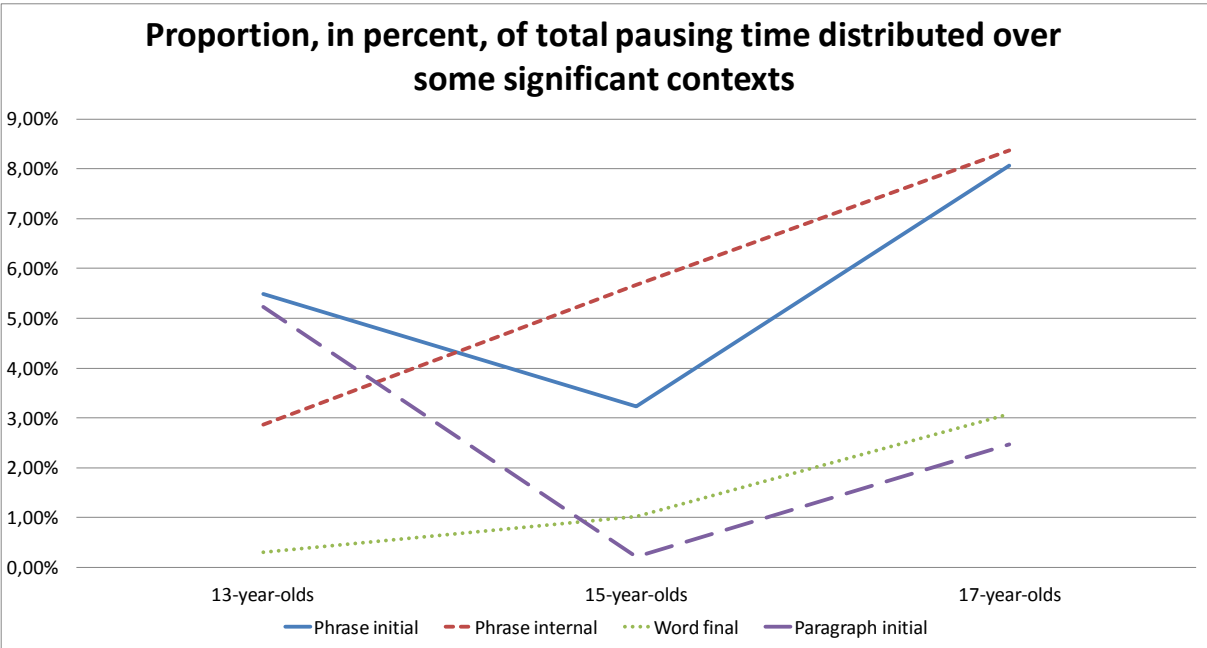


Figure 5.4: The proportion of total pausing time over phrase initial, phrase internal, word final and paragraph initial contexts.

5.5 Correlations

There was a strong correlation for all writers (among the 30) that those that spent proportionally (out of total pause time) longer time in clause boundary pauses also made longer clause boundary pauses. The 13-year-olds spent proportionally more time at clause level and had longer pauses at the same level. For 15-year-olds the picture was more complex,

but the same writers who spent proportionally more pause time at phrase and word boundaries also had longer phrase and word pauses. 17-year-olds who spent a longer time proportionally at clause level also had longer clause boundary pauses, and longer phrase boundary pauses. The 17-year-olds who had longer word level pauses also had a higher proportion of word level pauses. Summarized, 13-year-olds had a stronger correlation for clause level, 15-year-olds for time spent in pauses at phrase and word level and finally the 17-year-olds had the strongest correlation phrase time per pause and per total pause time but also for clause level though not as outspoken as the 13-year-olds.

6 Discussion

6.1 Time spent writing and pausing, outcome in number of words

The comparison of writing time shows that the 17-year-olds wrote for a decidedly longer time than the other two groups. As mentioned in section 2.1.1, writing time was one of the central aspects of a developmental leap that Victoria Johansson found signs of in her study (2009). Interestingly the 15-year-olds, who were not part of that study, in the present investigation placed themselves at the same level as the 13-year-olds, so in this respect they had not “taken the leap”.

Comparing the number of words produced, Johansson also showed a decisive difference between 13-year-olds and 17-year-olds and here we note that the 15-year-olds rank more or less in between. No leap had been taken, but development had been made, seemingly at a steady pace.

When Johansson looked at the mean proportion of total pause time to total writing time, she found that there were no differences between the ages, a result which is mainly confirmed here, even though the 17-year-olds seem to pause proportionally a little less than the other two groups. However, individual variation is so great among the 13-year-olds and even more so among the 15-year-olds so it would be too delicate to draw any conclusions from this difference. Johansson’s pause criterion was 5 seconds, and her calculations included the spoken texts, which ought to explain the differences between her Figures, around 30-35 % (Johansson 2009:169) and mine, 41-53 %. Johansson et al (2008) found that adults (university students) spent more time reading while writing, an effect which we cannot really see traces of here. Nevertheless, for the 15-year-olds eyemovement data exist, and it would be greatly interesting to take a closer look at them.

More complex syntax, greater lexical diversity and density, knowledge-transforming instead of knowledge-telling – all the characteristics of later writing development that Myhill (2009) and Kellogg (2008) highlighted – would not all of this take *more* time and effort and thus be reflected in proportionally longer pause time as you mature as a writer? On the other hand, reconnecting to cognitive models of writing development and working memory (Fayol 1999, McCutchen 2000, Kellogg 2008) we are reminded that lower-level-processes (transcription, spelling, lexical access, syntactic frame construction) even though initially laborious, become highly automated with practice and that this makes the writing process faster and also makes it possible for the writer to carry out other tasks simultaneously. This effect could possibly conceal the fact that fundamentally different processes motivate much the same amount of pausing at different ages.

6.2 Number of linear and final tokens, edited tokens

As could be expected (because we know from Johansson's research 2009 that they write longer texts, as long as university students, in fact), 17-year-olds wrote decidedly more, measured both in linear tokens and final tokens. However, though the three age groups placed themselves on a neat line when final tokens were concerned (1228, 1978 and 2805 respectively), there was a substantial difference in how many linear tokens they had originally written and subsequently edited. The 13-year-olds edited just above 32% of the linear tokens, the 15-year-olds only 13% and, finally, the 17-year-olds edited 36% of the linear tokens. It is of course unexpected that the 13-year-olds edit substantially more than the 15-year-olds, and that the differential to both of the other groups is so great for the 15-year-olds.

According to Kellogg (2008, section 2.1.1) the third stage of knowledge-crafting would not be possible to reach until at the earliest around 25 so it ought not to be relevant to the participants in the present study. What about the second stage, knowledge-transforming? Could it be that only the 17-year-olds have reached this stage in a stable way, and that this can be seen in how they devote their pause time and attention to edit extensively and so to transform their knowledge, to digest it? Consequently the resulting text is characterized by the greater detail and elaboration pointed out by Myhill (2009). Is this one of the most important ingredients in Johansson's (2009) developmental leap? It was not possible within the present study to compare for example how many of the edits were made locally, within the word, and how many were made at higher levels, or to compare pause time spent with linear and recursive editions respectively, but the proportion of editing pauses taken together did not show any significant differences between the age groups (see section 6.4 below).

But if the editing behaviour of the 17-year-olds is a sign of knowledge-transforming, what are the 13-year-olds so busy editing? One obvious reason is that they still concern themselves, to a higher extent, with spelling and typos due to less automated lower-level processes. According to Fayol (1999) linear writers (with little editing at other levels than the local word) are examples of the knowledge-telling strategy. In that case, the 15-year-olds, in their turn, might have automated the lower-level processes more without yet being able to elaborate or specify; transform, in the sense of knowledge-transforming.

6.3 Average pause length for a certain syntactic context

The results from the present study, that the mean duration of clause boundary pauses was longer than the means for phrase and word boundary pauses, corroborate the list of earlier research, starting with Matsuhashi in 1981, that has shown that pauses in a hierarchically higher context are longer than the ones lower in the hierarchy. It may seem self-evident now that this is so, but it has rarely been shown with developmental data.

The fact that the average pause durations for each of the syntactic contexts, calculated for every informant show no significant differences between age groups may be due to the fact that the individual variation is great. It could also be that pause durations in different contexts have a universal pattern, with no difference between the ages.

6.4 Pause time in a certain context in proportion to total pause time

Paragraph initial pause time in proportion to total pause time showed significant differences for age, but the fact is that the greatest difference here was that out of the ten 15-year-olds only one had any (two) pauses in this context. Among the 13-year-olds and 17-year-olds the paragraph initial pause occurred more often. Eight of ten 13- and 17-year-olds used paragraphs in their text structure, whereas only six of the 15-year-olds divided their texts into paragraphs at all. Those pauses that occurred in the same context, after <CR>, but turned out to be examples of the practice of moving to a new line for every new sentence are not counted as paragraph initial pauses but as clause initial.

Several results showed significant differences in proportional pause time and therefore effort spent at phrase boundaries. The 17-year-olds spent more time at this location. Especially the phrase-initial and the phrase-internal location attracted a lot of pausing. Possibly this is a sign of the fact that they produced longer phrases, and this entails a need for more planning and revision and consequently pausing before and while you produce them.

This result matched the intuitive observation that 13-year-olds and 15-year-olds were satisfied with finding *a* noun or *a* verb and did not question whether there was a better alternative. On the other hand, 17-year-olds certainly picked and chose, tried out different solutions, and expanded noun and verb phrases with additions, specifications and detailed description, in line with Myhill's 'elaboration'. Another intuitive observation was that 17-year-olds did not seem to spend pause time on the correction of spelling mistakes or typos, but corrected them "on the go".

It is interesting to note that when it comes to proportional pause time spent at the phrase level (Figure 5.3 above) as well as proportional phrase initial and paragraph initial pausing (Figure 5.4) results show clear signs of U-formed development where the 15-year-olds do not develop writing expertise in a linear way but actually deteriorate compared to the 13-year-olds. One explanation could be that the 15-year-olds have come as far as they can get with the knowledge-telling strategy, and feel quite satisfied with that. They are still not experienced and mature enough to have stored relevant expert writing knowledge in long-term memory, nor to be able to build the efficient retrieval structures in the brain that will give them easier access to this knowledge.

Word-final pause location, the fourth context where significant differences in proportional pausing time was shown between the age groups, is found mainly in editing contexts. It is the 17-year olds who pause substantially more in this location. If the 17-year-olds have longer and more complex phrases, especially noun phrases, they would need to pause more often to go back to make word changes and add detail.

I would like here to reiterate example 1 (section 4.2), where a 17-year-old male writer exerted himself to find the appropriate words and more than one example to make clear his statement:

(1)<CR>Dessa odödliga<DELETE8><4.40>odödliga fundament, varpå<LEFT5><DELETE2><RIGHT5> vårt moderna samhälle och alla <2.45><DELETE9>vilar på. (wh09m, 17 years)

<CR>These immortal <DELETE8><4.40>immortal fundaments, whereupon<LEFT9><DELETE2><RIGHT9> our modern society and every <2.45><DELETE9>rest.

Compare this to example 3:

(3) Om jag ser några mobba en tjej/kille så kan inte jag gå fram till dom som mobbar <2.55>och säga till dom för då är jag rädd att jag skall bli mobbad<9.50>.<CR><3.16> (wj06f, 13 years)

If I see some people bullying a girl/guy then I can't walk up to those who are bullying <2.55>and tell them off because then I'm scared that I'm going to be bullied<9.50>.<CR><3.16>

The 13-year-old writer thrice used the word 'mobba', several one-word noun phrases consisting of pronouns, no expanded noun phrases and consequently did not need to pause in a phrase context but once before and once after a clause.

All three age groups have a lot of clause final pauses, but especially so the 13-year-olds. If the corresponding phrases written by 13-year-olds are shorter, the obvious example being noun phrases consisting of only one word, often a pronoun, it would be natural that they need shorter pauses in this location and that they pause more for planning and evaluation at clause boundaries. The older groups need to pause in other contexts too, because their clauses are longer.

Scott (1988) paid a lot of attention to the fact that clauses get longer with written language development and that clauses get longer not by coordination or subordination but by information-packaging structures like expanded noun and verb phrases and more infinitive phrases. In this light it seems natural that the writers should spend more time and effort expanding their phrases. In passing I observed that infinitive phrases hardly occur in 13-year-olds and not at all in 15-year-olds whereas 17-year-olds exhibit a substantial number. Correlations showed that those 15-year-olds who spent more time at word and phrase level also paused for a longer time in those contexts. This seems to suggest that some of them elaborate their phrases more, so to speak on their way to the knowledge-transforming stage. Something else that correlations showed was that some 17-year-olds also spent more time in clause boundaries. This might be an effect of more time spent reading than the younger age groups, as showed by Johansson et al (2008).

7 Conclusion and directions for future research

The results from the present study showed that the 17-year-olds spent considerably more time and effort in the production of phrases than the younger age groups. This was shown in the significantly higher proportion of pause time they spent in a phrase context. Other results that pointed in the same direction were the amount of word-final pausing and the extent to which they edited their texts. The interpretation of this result is in line with cognitive views of written language production where processes that are more demanding manifest themselves as

pauses. It is also in line with developmental models that point out that one important trait of language development in adolescence is expanding noun and other phrases. One of my research questions was whether it would be possible to see signs of a developmental leap according to Johansson (2009) taken by 17- but not by 13-year-olds, in the 15-year-olds. Some measures, notably text length and writing time show that 15-year-olds have not yet taken the leap while individuals in this group might be initiating it. Mainly, the leap is more likely to have taken place at 17, where several measures show more stability between individuals, than at 15.

The natural and greatly interesting follow-up to this study would be to compare data from this analysis with measures of the final texts like words per clause and phrase length. In Johansson (2009) 17-year-olds had more words per clause than any of the younger age groups. Where do the 15-year-olds place themselves in this respect, and do the 17-year-olds actually produce longer and more complex noun and verb phrases than the younger age groups? An investigation of lexical diversity and density, likewise, would be another way of broadening the analysis of written language development in these groups, and data from the 10-year-olds in the Spencer project could be analyzed for further comparison.

In my analysis, I have consistently made a difference between initial and final pause categories. It is impossible to say whether what is going on in the brain at these different points also fall into the categories reading and revising (“backward”) and planning (“forward”) respectively. But the material is there to take a closer look at. Moreover, for the 15-year-olds, eyemovement tracking data exist so that it is quite possible to compare how the final/initial categories agree with at least reading. “On the list” is also a closer investigation of editing behaviour and the proportions of linear and recursive edits.

Finally, I anticipate that a close look at the data for *clause internal* pausing would be very rewarding. Both Matsuhashi (1981) and Goldmann-Eisler (1972) (see section 2.3.2) made interesting points about the order and automaticity of syntactic and lexical decisions.

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Appendix 1 Linear file wj10mBEW200

<START><28.08>FUSKA P□
PRO<2.51>V<4.25><LEFT13> _____ <DELETE11><RIGHT13>.<CR><CR><DELETE>
<21.81>DOM SOM FUSKARP□ PROV KANSKE<3.33><LEFT14> <RIGHT14><3.46><MOUSE
,15, 44><5.60><MOUSE ,44><DELETE28><2.31>om som fuskar pE prov<4.23>
ochsEn t<LEFT><RIGHT><DELETE2>t<LEFT4><RIGHT><LEFT>
<RIGHT4><4.13>kanske inte kan <8.98>eller vill lšra sig<LEFT35>
<RIGHT36><3.38>
<8.46>telexmpel<3.08><LEFT7><DELETE>i<4.10><RIGHT7><DELETE8>ex.<6.73>do
m <2.55>kan ha det svErt i skolan<3.81> <2.30>eller
hemma<3.15>.<11.06><DELETE> deras mmmma och pappa kanske brEkar<4.08>
mycket<2.70><LEFT33><DELETE>a<RIGHT>m<RIGHT32><2.83>.<25.28>Men i bland
kan det vara sE att <2.50>dom<2.61> <11.56>vill vara<3.45>coola<LEFT5>
<RIGHT6><8.78><LEFT><RIGHT><DELETE15><4.48>tror att dom
e<DELETE>še<2.13><DELETE>r <3.60>coola<10.90> fšr att<2.11> do
<DELETE>m<39.15><DELETE3><11.40><DELETE9>.<CR><CR><5.70>MOBBNING<2.85>.
<CR><CR><DELETE>CXCXCXXCXXCXCXCxcxcxcxcxcxc<DELETE27><CR>ccc<DELETE4><2
1.56>dom som mobbar <3.26>šr
otast<LEFT4>f<RIGHT5><2.28>mp<DELETE>obbade<2.01><LEFT7> <RIGHT8>
<2.93>mobbdæ<LEFT><RIGHT><DELETE3>ade <2.18>sjšlva<2.93>
<LEFT6><UP><DOWN><LEFT><DOWN><UP><DOWN4><UP2><DOWN2><RIGHT25><2.95><RIG
HT7><DELETE8><RIGHT15><11.91> <2.05>eller ocksE
<17.61>att<2.48><DELETE3><2.38>tror<3.01> dom att det šr
<2.63>fš<2.10><DELETE>ršckt att<4.26> det šr <3.06><LEFT><DELETE7>
mobba<50.43> anrda<DELETE3>dra<8.55> <2.43>dom kan gšra det fšr att
komma med <2.35>ett <2.01>gšng ock<DELETE>h dE mEte man <2.06>bevisa
<2.01>att man šr tillršckligt<3.15>col<2.10><LEFT><2.00>o<LEFT3>
<LEFT26><UP><LEFT12><UP><DOWN><LEFT8><DELETE>D<RIGHT94><LEFT><3.28>.<2.
28><RIGHT4><DELETE3><2.01>Man<7.56><DOWN><LEFT><RIGHT4><LEFT><10.93>fšr
dom<10.40>.<CR><CR><10.45>KOMMA ISLAGSM□L<LEFT8>
<RIGHT8>.<CR><18.33>V<4.66>issa kommer i slagsmEl <2.45>fšr att
do<DELETE>m šr tykna eller <2.95>sE <2.41>vill man
brEka<3.61>.<3.71><LEFT36><RIGHT>o<RIGHT36><50.23>Det kan finnas
fšršldrar<5.48> som <2.95>slEer<2.10> och skriker Eet en hemma<4.08>
och<2.06>dE <LEFT3> <RIGHT2>kan man<13.33><LEFT7> <RIGHT8><4.80>slE
folk fšr att<5.71> <2.10>man hlet enkelt tror att <2.11>man skall gšra
sE<6.80>.<27.25><UP><LEFT3><UP7><RIGHT6><2.03><DELETE> fšr att dom inte
tršnar<14.50> pE<2.35>proven<2.06><LEFT6>
<RIGHT6>.<13.95><DOWN><20.81><DOWN2><11.25><RIGHT27><DOWN3><4.41><UP9><
DOWN3><RIGHT3><DOWN><UP><RIGHT10><13.31><RIGHT29><3.63><DOWN13><CR><CR>
<CR><CR><3.78>SLUT<3.08>!<RIGHT3> <CR><CR>
<DELETE6><4.48>AV:ANDREAS
<2.48>NILSSON<29.98><UP8><9.26><UP><RIGHT><UP><RIGHT><UP><RIGHT><UP><RI
GHT><UP><RIGHT2><UP2><RIGHT20><UP3><2.43><RIGHT18><UP><7.03>

Appendix 2 Final text wj10mBEW200

FUSKA PÅ PROV.

Dom som fuskar på prov och sånt kanske inte kan eller vill lära sig tex.dom kan ha det svårt i skolan eller hemma deras mamma och pappa kanske bråkar mycket.Men i bland kan det vara så att dom tror att dom är coola för att dom inte tränar på proven.

MOBBNING.

Dom som mobbar är oftast mobbade själva eller också tror dom att det är fräckt att mobba andra. Man kan göra det för att komma med ett gäng och då måste man bevisa att man är tillräckligt cool för dom.

KOMMA I SLAGSMÅL.

Vissa kommer i slagsmål för att dom är tykna eller så vill man bråka. Det kan finnas föräldrar som slår och skriker åt en hemma och då kan man slå folk för att man hlet enkelt tror att man skall göra så.

SLUT!

AV:ANDREAS NILSSON